UNIVERSITY OF GRANADA

DEPARTMENT OF TRANSLATION AND INTERPRETING

DOCTORAL THESIS

METAPHOR IN SPECIALISED LANGUAGE: AN ENGLISH-SPANISH COMPARATIVE STUDY IN MARINE BIOLOGY

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METAPHOR IN SPECIALISED LANGUAGE: AN ENGLISH-SPANISH COMPARATIVE STUDY IN MARINE BIOLOGY

Doctoral Thesis

Submitted by PhD candidate José Manuel Ureña Gómez-Moreno to the University of Granada to obtain the **Doctor Europaeus Mention**

Approved and signed	Approved and signed
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To my beloved parents, José Manuel and Sonsoles

"You need an 'as if' to look at the world. You need an 'as if' to explain the world".

Horace Romano Harré, philosopher and psychologist.

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0. INTRODUCTION

0.1. Presentation and Scope of the Study

It is now generally agreed that metaphor pervades the terminology of specialised language domains (Lakoff 1987; Nunberg 1995; Turner and Fauconnier 1995). Some decades ago, this statement would have been greeted with disbelief in scientific circles, since metaphorical expressions — and figurative language in general — were thought to have a marginal role in science. Ortony (1993: 1) writes that in the past scientific and technological knowledge was regarded as being precise and unambiguous. As a result, its linguistic description was considered to be devoid of metaphor. This is paradoxical, given the important body of research that focuses on scientific metaphor (e.g. Bono 2001; Boyd 1993; Collins and Gentner 1995; Emmeche and Hoffmeyer 1991; Hesse 1966, 1974, 1993; Knudsen 2003; Paton 1993, 1997; Paton et al. 1994; Stambuk 1998; Stengers 1989; Thagard 1992). These studies examine and highlight the role of metaphor both as a tool to generate and develop scientific theories and as a resource for specialised knowledge popularisation.

Because metaphor was initially regarded as being inexistent in scientific communication, research on metaphor in specialised knowledge domains only began in the last two decades. Now there is a general consensus of opinion that the study of terminological metaphor contributes to more effective communication between the groups of people with different knowledge levels. In short, terminological metaphor (TM) is pivotal in the treatment and diffusion of specialised information.

There is an extensive body of research which describes genre-specific metaphor on the basis of structural, functional, cognitive and contrastive criteria at all levels of language (terminological meaning, propositional meaning and pragmatic context). Research has been undertaken in domains such as computer science (Meyer, Zaluski and Mackintosh 1997; Meyer, Zaluski and Mackintosh 1998; Meyer 2001), coastal engineering (Faber and Márquez 2005), oncology (Tercedor Sánchez 1999 ab, 2000, 2004; Faber and Márquez 2004), economics (Cristofoli 1996; Cristofoli et al. 1998; Dyrberg 1996; Stage 1996), as well as politics and journalism (Musolff 2004; Moreno 2004, 2005).

When TM is studied from a contrastive approach, this is relevant to specialised translation. Metaphor is a powerful cognitive mechanism that triggers both lexical and textual creativity, and is a candidate for the elusive *tertium comparationis* in any model of translation. Other authors who have studied terminological metaphor are Tabakowska (1995b), Meyer and Foz (2001) in computer science; Boquera Matarredona (2005) in civil engineering; and Vandaele (2002) in citology. Vandaele (2002: 235) underscores the role of TM in specialised translation, where "enunciation in the target language is precisely related to the question of coherence of conceptual metaphors in both source and target languages".

This research study provides a contrastive analysis of TM in English and Spanish to show how metaphor is instrumental in conceptualisations in marine biology. Our results highlight the ways in which metaphor varies across languages.

According to Faber et al. (to appear): "terminology is a many-splendored thing with approaches that range from traditional approaches (Wüster 1968) to communicative approaches (Cabré 1999, 2000; Gaudin, 2003) to cognitive approaches (Temmerman, 2000, 2001; Faber et al. 2005, 2007)". This study adopts a cognitive-oriented perspective and is based on theoretical premises from Terminology and Cognitive Linguistics. Therefore, our work is within the field cognitive-oriented terminology.

Regarding Terminology, we explore different theoretical models to account for TM and also situate it in regards to data fields such as morphosyntactic structure and variants/synonyms. Regarding Cognitive Linguistics, we focus on theories of metaphor proposed within this framework, and use those principles that are relevant for our study. In this respect, the cognitive theories of metaphor and the experientialist view that they advocate can be used to analyse TM.

An experientialist account also leads to questions about the constraints imposed by cultural aspects of domain-specific metaphorical conceptualisation and provides solutions for such questions in an interlinguistic terminological framework. Cognitive-oriented general language studies take culture into account. As a matter of fact, cultural aspects of metaphor are a significant focus (cf. Kövecses 2002, 2005, 2006; Yu 2003, 2008). Nevertheless, Cognitive Linguistics has only marginally touched upon socio-cultural factors, giving preference to the theory of embodiment and universal cognitive primitives (Johnson 1987; Lakoff and Johnson 1980, 1999; Sweetser 1990).

Concerning terminological research, a similar scenario is depicted. Temmerman's Socio-cognitive Theory of Terminology (2000, 2001, 2006) explores the influence of socio-cultural factors affecting specialised metaphorisation and concept formation as a whole. Insofar as interlinguistic contrastive studies of terminology, Alexiev (2005:38) claims that “the choice of a TL conceptualisation strategy and the corresponding surface realisation depend both on cognitive and language- and culture-specific factors”. In a parallel way, our study highlights culture, and demonstrates that it is a determining factor prompting significant differences in the way specialised concepts are created in English and Spanish through metaphorisation.

Also relevant to our study is Temmerman’s (2002) view that terminologists and technical translators should be made sensitive to the impact of metaphorical reasoning on lexicalisation in scientific discourse. This is in consonance with Alexiev (2004: 208), who maintains that in this way translators “could learn to distinguish between language- and culture-specific and language- and culture-neutral metaphorical models thereby developing the skill of finding the best strategy for TM translation”

The linguistic and conceptual shift in Terminology has led to a more discourse-centred approach with a focus on how terms are used in texts (Temmerman and Kerremans 2003). The notion of *discourse* now has a prominent role, because it relates to concepts such as pragmatics, function, context, and communicative situation, which are crucial for modern lexicological and terminological research. As Roberts (1994-1995: 61) affirms, it is not enough to opt for one term or the other to achieve precise and effective communication, but it is also necessary to place the term in the appropriate specialised context.

Consequently, our research adopts a descriptive approach to terminology. The metaphorical terms analysed in our study were extracted from a corpus of real marine biology specialised texts. This signifies that the context in which these terms are embedded is what activates their semantic and pragmatic meaning and assigns them to a specific concept linked by sets of conceptual relations, depending on to the discourse and knowledge field under examination. Moreover, keeping in mind that meaning disambiguation has become more complex owing to the use of new metaphors that arise constantly (Cameron and Deignan 2006), context is an essential element both in general language and specialised language analysis.

0.2. Working hypotheses

This research study is based on the following assumptions:

- It was initially assumed that the domain of marine biology would contain a rich repository of terms coming from general language since metaphor is a phenomenon that underlies the process of terminologisation. One of our hypotheses was that the analysis of these terms in context would lend further support to findings regarding metaphor in other specialised fields (Faber and Márquez 2004, 2005 and Tercedor Sánchez 1999 ab, 2000, 2004 in oncology; Méndez Cendón 2001, 2002 in radiology; Meyer 2001 in computer science; Temmerman 2000, 2006 in genetics; Riabtseva 1992 in scientific disciplines as a whole). It was assumed that our results would show that experts tend to conceptualise complex realities by transforming general language lexical units into terms through metaphorisation.

§ A second basic assumption was that TM can be studied on the basis of conceptual, structural, functional and contrastive criteria (Alexiev 2005), and that this would also be true for the study of terminological metaphor in marine biology.

§ Conceptual criteria.

Alexiev (2005: 40) states that "conceptual aspects of TM involve the mechanism of metaphorisation, key conceptual themes underlying the metaphorical terms in a given terminology, motivation for metaphorical transfer and distinction between conventional (conceptual) and image (one-shot) metaphors". It was our hypothesis that the analysis of these aspects in metaphorical marine biology terms would give significant insights into the conceptual basis of such specialised expressions as well as into the ways that marine biology experts make and communicate science.

Metaphor has an important role in providing a framework for the structuring of scientific texts. Therefore, it should underlie the configuration and organisation of the domain of marine biology.

§ Structural criteria.

As stated by Nakagawa and Mori (2003: 201), "the majority of domain-specific terms are compound nouns, in other words, uninterrupted collocations". Our research assumed that many marine biology metaphorical terms would be more or less fixed multiword units. As a matter of fact, TM constitutes a never-ending source of lexical, *phraseological*, textual and pragmatic creativity (Tercedor 2004: 233).

Thus, very close attention was paid to specialised metaphorical phraseology.

Terminology nowadays has the goal of giving a descriptive and communicative account of how specialised concepts in a given subject field can be linguistically encoded by any grammatical class, including nouns, verbs, adjectives, adverbs and even prepositions (Pavel 1993, 1994). This claim has been examined in various lexicographic studies with a special focus on verbs and adjectives (cf. L'Homme 2002, 2003, 2006). Studies within the Communicative Theory of Terminology also highlight the role of non-substantive terminological units (cf. Cabré 1991; 2000ab, 2003, 2005).

Terminological variation exists because specialised concepts are not imbued in monolithic designations. Accordingly, terminological units are amenable to lexical, syntactic, dialectal, functional, discursive, interlinguistic, and cognitive variation (Tercedor Sánchez and Méndez Cendón 2000; Ménzdez Cendón 2002; Freixa 2006). We thus find solid reasons to hypothesise that marine biology metaphorical terms can undergo any of the aforementioned variation types, since "patterns of metaphor use are stabilities emerging from the dynamics and variability of discourse" (Cameron 2007: 120).

§ Functional criteria.

TM has two possible functions: (i) as a tool for specialised concept formation and knowledge domain organisation; (ii) as an exegetical or clarifying alternative to cryptic or semantically obscure terms (Boyd 1993). Our hypothesis was that in the field of marine biology there are metaphors having one of these two types of functions.

§ Contrastive criteria.

Because TM provides a framework for the structuring of scientific text content, it is an integral part of the intertextual correspondence, which is one of the basic elements of cross-linguistic studies and translation. By analysing the metaphorical terms used in a specialised domain in different languages, it is possible to gain access to the conceptual underpinnings of such metaphorical terms. Knowledge of these underpinnings entitles the researcher to draw interlinguistic comparative conclusions. On this basis, the standard configurations between any two languages (cf., for instance, Alexiev 2005; Deignan, Gabrys and Solska 1997; Al-Zoubi, Al-Ali and Hasnawi 2006) are the following:

- Same conceptual metaphor and equivalent linguistic expression
- Same conceptual metaphor but different linguistic expression
- Different conceptual metaphors used

This schema is presumably applicable to our English-Spanish comparative account of marine biology metaphors.

- An emergent body of studies shows how cognitivist theories dealing with issues pertaining to all levels of linguistic structure can account for the patterns found in natural language via corpus-based methodologies (cf. for instance Hoffmann 2006 for a study of prepositions in English relative clauses; Divjak and Gries 2008 for an analysis of near-synonyms in Russian; and Dziwirek and Lewandowska-Tomaszczyk 2008 for research covering a wide range of aspects of language use). The same is true for conceptual metaphor, which has received attention from linguists such as Charteris-Black (2004), Deignan (2005) and Stefanowitsch and Gries (2006). Concerning domains of expertise, Faber and Márquez (2004: 207) demonstrate that corpus data provide an empirical basis for research in TM in oncology, as does Caballero Rodríguez (2003ab, 2006) in the field of architecture. We also believe that this is true for marine biology metaphor as well.

0.3. Objectives

The goals pursued by this study were the following:

1. To provide evidence that metaphor is pervasive in the domain of marine biology as a means of terminological creation. This reinforces the claim that metaphor-induced terminologisation is a widespread phenomenon that occurs to some extent in all specialised knowledge fields.

2. To enrich the study of terminological metaphor by providing corpus-based analysis and concordance-derived data (Deignan 2005; Stefanowitsch and Gries 2006). This entails the analysis of corpus data or the occurrence of

terminological units *in vivo* (De Bessé et al. 1997; Dubuc and Lauriston 1997), i.e. real terms (Cabré 2000a) instead of *in vitro* terms (De Bessé et al. 1997; Dubuc and Lauriston 1997).

3. To shed light on contrastive aspects of terminological metaphor and formulate principles for conceptual metaphor description. This is necessary because cross-linguistic variation of metaphor is one of the areas in which knowledge is currently tentative or lacking, together with diachronic change (Stefanowitsch 2006: 9).

4. To demonstrate the existence of interlinguistic differences in terminological metaphorisation resulting from cognitive and cultural factors, which give rise to interlinguistic differences in the domain of marine biology.

5. To formulate a typology of conceptual metaphors applicable to terminological metaphor.

1. COGNITIVIST THEORIES OF METAPHOR

1.1. Introduction

> Metaphor […] breathes life into language and is central to the growth of both language and knowledge (Charteris-Black 2004: 3).

For many decades, metaphor has been a focus of interest for scholars in a wide variety of disciplines (Kimmel 2002: 24). For this reason, it is a point of intersection for linguistics, literary studies, philosophy and rhetoric, politics, anthropology, theology, psychology, and cognitive sciences, such as psychology and psycholinguistics. All of them address metaphor from their own unique perspective.

As regards linguistic studies of metaphor, studies can be divided into two groups: (i) those conducted up to the first decades of the 20th century; (ii) those carried out from the middle of the 20th century until today (Boquera Matarredona 2005: 26). The first group follows the premises of the classical school, rooted in Platonic philosophy and Aristotelian rhetoric. The second group is closely related to disciplines that were formerly thought to have no links to language (e.g. psychology) or simply did not exist (e.g. artificial intelligence, knowledge engineering). The interdisciplinary nature of these studies provided the foundation for modern and contemporary theoretical models of metaphor.

Within this context, cognitivism first emerged in the early 1980s. These studies had a significant impact on metaphor analysis. Unlike pre-cognitivist theses[1], these research studies contend that metaphorical processes are an integral part of thought processes. For example, Goldberg (1998b: 214) argues that one of the ways to extend the inherent meaning of concepts such as movement, change of state, change of possession, causativity, etc. is through general and systematic metaphors. Some authors even go so far as to suggest that all cognitive mechanisms, to a greater or lesser extent, are based on structures that are metaphorical in nature. This is the case of Minsky (1987: 299), who states that "no two things or mental states ever are identical, so every psychological

[1] For an overview of the pre-cognitivist models, i.e. semantic theses and pragmatic theses, see Boquera Matarredona (2005) and Alexiev (2005).

process must employ one means or another to induce the illusion of sameness. Every thought is to some degree a metaphor”. Along these lines, Sweetser (1990) writes that the conceptualisation of mental processes is necessarily couched in metaphor.

The theoretical framework that underlies cognitivist language studies is Cognitive Linguistics[2]. Within this framework, conceptual metaphor (cf. § 1.2.), along with metonymy, is explicitly recognised as central to a theory of knowledge (Ruiz de Mendoza 1997: 162). Accordingly, metaphor has been approached from a lexical perspective (Lakoff 1987; Tyler and Evans 2003; Evans 2004a), a grammatical perspective (Goldberg 1998b), and a pragmatic perspective[3] (Sperber and Wilson 1986; Fauconnier and Turner 2002). However, whatever the perspective, Cognitive Linguistics considers “meaning to be the central issue” (Lakoff 1987: 266).

The submodel within Cognitive Linguistics that provides full coverage of meaning is called Cognitive Semantics. As Talmy (2000: 4) explains, “research in cognitive semantics is research on conceptual content and its organization in language”. Research in Cognitive Semantics is based on the relationship between experience, the conceptual system, and the semantic structure encoded in language. This model of meaning was a reaction to the Aristotelian view of meaning as well as the premises of objectivist semantics[4].

Cognitive Semantics is the link between cognitivist studies in general language and specialised language or Terminology. Before discussing the theoretical models of terminological metaphor, we shall first describe the cognitivist metaphor theories in general language, since these are the theoretical principles that will be applied to our account of terminological metaphor in the field of marine biology.

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[2] See Taylor (1995), Ungerer and Schmid (1996) and Evans and Green (2006), *inter alia,* for detailed accounts of Cognitive Linguistics.

[3] The possibility of adopting all three perspectives for metaphor analysis rests on the Cognitive Linguistics’ Generalisation Commitment (cf. Lakoff 1991 [1990]), which defends an integrated view of all areas of language. Language is thereby conceived of as a whole whose parts are closely and indissolubly related, and thus form a *continuum.* Therefore, the division between lexis and grammar and between semantics and pragmatics is formal rather than real.

[4] See Lakoff and Johnson (1980) and Lakoff (1987) for an account of the differences between objectivist semantics and cognitivist semantics.

De Bustos (2000: 171) affirms that there are two cognitivist theories of metaphor: (i) Conceptual Metaphor Theory (Lakoff and Johnson 1980, 1999a; cf. Johnson 1987; Lakoff 1987, 1993); (ii) Relevance Theory (Sperber and Wilson 1986, 1987, 2004). In turn, Steen (2007: 48–49) identifies four approaches that "define metaphor as essentially a conceptual phenomenon, following the modern development of taking metaphor as a figure of thought":

§ the two-domain approach, i.e. Conceptual Metaphor Theory (Lakoff and Johnson 1980, 1999a; cf. Johnson 1987; Lakoff 1987, 1993);

§ the many-space approach, i.e. Blending Theory (Fauconnier and Turner 1996, 1998, 1999, 2002; Turner and Fauconnier 1995, 1999, 2000; cf. Fauconnier 1997);

§ the class-inclusion approach (Glucksberg 2001; Glucksberg, Brown, and McGlone 1993; Glucksberg and Keysar 1990, 1993; Glucksberg and McGlone 1999; Glucksberg, McGlone and Manfredi 1997; Keysar and Glucksberg 1992; Keysar et al 2000); and

§ the career of metaphor approach (Bowdle and Gentner 2005; Gentner and Bowdle 2001; Gentner, Bowdle et al 2001; Gentner and Rattermann 1991; Gentner and Wolff 1997; Wolff and Gentner 2000).

It is also necessary to mention Primary Metaphor Theory (Grady 1997ab, 1999; Grady 2005a; Grady and Johnson 2002). Although it has grown out of Conceptual Metaphor Theory and remains within this tradition, Primary Metaphor Theory constitutes a principled model, providing significant refinements to the experientialist base of the proposal of Lakoff and his co-workers.

In our domain-specific study, we largely relied on Conceptual Metaphor Theory to account for the theoretical basis of terminological metaphor. As a part of this theoretical basis, we also applied Primary Metaphor Theory and Blending Theory when it came to describing the cognitive underpinnings of metaphorical representation. Concerning the methodological procedure for metaphor identification within our corpus, we followed the assumptions posed by observational approaches to metaphor that have Conceptual Metaphor Theory as a reference.

We focused on the career of metaphor approach (cf. § 1.6.), which criticises Conceptual Metaphor Theory in the conceptual and cognitive dimensions of metaphor, but does not discredit Lakoff's claims altogether. In theory, we agree with this refinement of Conceptual Metaphor Theory. Nevertheless, because of the analyst-centrered approach adopted in our terminological study, we based our study on the premises of Conceptual Metaphor Theory (cf. § 1.6. for details).

Blending Theory was useful for the introspective study of marine biology metaphor, particularly for the analysis of the cognitive operations giving rise to an extensive number of metaphorical terms. Although Blending Theory primarily focuses on the exploration and description of single instances of verbal data (Steen 2007: 118), it will be shown (cf. § 4.2.3.1.1.2.) that it can also be of help when describing well-entrenched cases of metaphoric usage in specialised language.

For the purposes of our study, Relevance Theory was not considered because it is essentially a theory of Pragmatics, which is not pertinent to this phase of our research. The class-inclusion approach was not considered either because it exclusively deals with metaphor in usage. However, we found some claims of Class-Inclusion Theory useful, especially as regards the conceptual and psychological nature of metaphor as part of the marine biology discourse.

Thus, this research study combines Conceptual Metaphor Theory, Primary Metaphor Theory, and Blending Theory, and shows how all three models can be applied to the analysis of terminological metaphor.

1.2. Experientialism and Conceptual Metaphor Theory

The experientialist theory was first proposed by Lakoff and Johnson (1980), and further elaborated by Lakoff (1987) and Lakoff and Johnson (1999). The general claim of this theory is that human capacity to build complex models is contingent on basic physical experiences, which prompt conceptual representations. In a more detailed manner, Experientialism claims the following:

- Thought is largely based on imagery, i.e. metaphorical, metonymic and other figurative processes which transcend literal representation of reality.
- Conceptualisation is the result of our bodily experience. In a parallel way, concepts have an ecological structure. This signifies that they do not arise from simple manipulation of symbols, but rather that they arise from interaction with our surroundings.
- Experientialism and conceptual metaphor are constrained by cultural factors.

- We are psychologically prone to think in terms of basic-level concepts, as first proposed by Rosch (1978).
- There are two types of metaphors, namely image metaphors and conceptual-structural metaphors.

1.2.1. Metaphorical thought

Lakoff (1987) affirms that in our constant effort to make sense of our experience, we use imaginative mechanisms (i.e. metaphor, metonymy and mental imagery). There is presently a consensus of opinion that metaphor is indispensable for understanding the objects in the real world, structuring them according to multiple analogy patterns, and codifying them in the language system. Nevertheless, this view of metaphor had to overcome the barriers of objectivist semantics, which regarded metaphor as a figure of speech. In this sense, Lakoff and Johnson can be regarded as pioneering figures of Cognitive Linguistics and the fathers of Experientialism. Their seminal contributions (Johnson 1987; Lakoff 1987, 1990; Lakoff and Johnson 1980) transformed our view of metaphor, and showed that this phenomenon was not confined to the realms of speech and literature, but is an integral component of human reason and thought. It is present in all types of discourse. Lakoff and co-workers demonstrated that metaphor is pervasive in language and literally governs thought. In other words, metaphors are what we are governed by. Lakoff and Johnson (1980: 3) write:

> Metaphor is for most people a device of the poetic imagination and the rhetorical flourish — a matter of extraordinary rather than ordinary language. Moreover, metaphor is typically viewed as characteristic of language alone, a matter of words rather than thought or action. For this reason, most people think they can get along perfectly well without metaphor. We have found, on the contrary, that metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature [...]. The way we think, what we experience, and what we do every day is very much a matter of metaphor.

This is the essence of what is widely known as *conceptual metaphor*, whose theoretical premises were further developed in Conceptual Metaphor Theory (Lakoff 1993 [1992]).

Although the notion of *conceptual metaphor* lends itself to different interpretations (Kittay 1987; Stern 2000; Dirven and Pörings 2002), Conceptual Metaphor Theory (CMT) has become a model for many authors who aspire to build their own theories of metaphor. Such is the case of Turner (1991, 1996), Grady (1997a, 1999), Fauconnier

(Fauconnier 1999; Fauconnier and Turner 1998, 2002), and Ruiz de Mendoza (Ruiz de Mendoza and Mairal 2008).

According to Lakoff and Johnson (1980: 5), the mechamism underlying conceptual metaphor consists of "understanding and experiencing one kind of thing in terms of another". Lakoff and Johnson refer to each of these things as ***domains of experience***. The rationale of CMT is that people relate domains of experience by means of cross-domain mappings that give rise to conceptual metaphors. These are stable cognitive patterns that usually organise entire fields of knowledge. Therefore, CMT argues that people actually have conceptual metaphors in their minds, an assumption that is harshly criticised outside core cognitivist circles, especially by Class-Inclusion Theory (cf. § 1.6.), as well as by discourse analysts and applied linguists.

As it stands now in cognitivist studies, the notion of *domain* is vague and susceptible to multiple interpretations. In fact, a clear definition of the concept of domain is one of the challenges of Cognitive Semantics (Croft 1993: 339). For example, Langacker (1987: 147) considers domains to be "contexts for the characterisation of a semantic unit [...] mental experiences, representational spaces, concepts or conceptual complexes". According to Kimmel (2002: 26), "domains may be defined as coherent and permanent organizations of experience into arrays of clustered knowledge".

A more pragmatic stance is taken by Faber and Márquez (2004), who argue against *ad hoc* ways of specifying the notion of *domain*. Faber and Márquez (2004: 202) contend that in order to obtain a specific definition for *domain* we should adhere to Goldberg's (1998: 205) claim that the world is carved up into discretely classified event types. This event types have a semantic organisation, since syntax alone is not sufficient to account for semantic differentiation. Only when these event types are specified is it possible to make the most of metaphor, since "metaphoric extension is an important tool for linguistic creativity and knowledge representation" (Faber and Márquez *ibid.*: 204).

Because of its abstract nature, the notion of *domain* has been analysed from many different perspectives within Cognitive Linguistics. The four major proposals for mental representation are *frame* (Fillmore 1977, 1982; Fillmore and Atkins 1992), *mental space* (Fauconnier 1994 [1985], 1997), *cognitive domain* (Langacker 1987) and *idealised cognitive model* (Lakoff 1987). Although Lakoff does not offer an explicit definition for *ICM* (Idealised Cognitive Model), his explanations describe ICMs as conventional and prototypical conceptual representations resulting from a mental exercise whereby our brains conceive concepts as highly abstract constructs. These constructs emerge from the idealised generalisation of the entities in the world.

His much-quoted example of an ICM is that of *mother* (Lakoff 1987: 74ff.). The prototypical conceptual representation of *mother* is the birth mother, viz. a human female who gives birth to a baby. Yet, there are other less prototypical representations that are part of the concept of *mother* as well. A mother can also be (i) the woman in charge of nurturing and raising a child and who is his/her legal guardian, i.e. adoptive mother; (ii) the woman charged by the state to nurture the child but who is not the child's legal guardian, i.e. the foster mother; (iii) the wife of a child's father, i.e. marital mother; (iv) the woman contributing half of a child's genetic equipment, i.e. genetic mother; (v) the woman who is married to the child's father but who did not supply genetic material or give birth, i.e. the stepmother; (vi) the woman who gives birth to the child, but does not supply the genetic material, i.e. the surrogate mother; (vii) a child's closest female ancestor, i.e. the genealogical mother.

In the classification of ICMs established by Lakoff (1987: 68, 113–114), metaphor is regarded as a separate type of ICM, together with propositional models, metonymy and image schemas.

1.2.2. Embodiment and the ecological nature of metaphoric thought

Within Cognitive Semantics, the embodiment thesis was firstly presented by Lakoff and Johnson (1980) as a complement to Conceptual Metaphor Theory, and was further elaborated by Lakoff and Johnson (1999). In accordance with Experientialism, meaning is characterised "in terms of *embodiment*, i.e. in terms of our collective biological capacities and our physical and social experiences as beings functioning in our environment" (Lakoff 1987: 266). Embodiment has since become an essential part of conceptual metaphor research, and covers all of the basic aspects covered by Cognitive Linguistics.

Furthermore, embodiment forms an entire research paradigm which is not addressed by the language theory alone. In fact, empirical evidence gathered from research in disciplines such as cognitive science (e.g. Varela, Thompson, and Rosch 1991; Ziemke 2003) and cognitive neuroscience (e.g. Damasio 1994, 2000) shows that embodiment should be considered to concern Cognitive Linguistics in particular and language in general. In fact, embodiment can also account for general cognitive phenomena which occur in our brains (Varela, Thompson, and Rosch 1991).

Embodiment is a form of categorisation inherent to human reason insofar as it is "a reason inextricably tied to our bodies and the peculiarities of our brains" (Lakoff and Johnson 1999: 17). In other words, concepts are created in our minds through the projection of our bodily structure and sensory perception onto *realia*. Lakoff and Johnson (1999: 4) argue for an embodied mind, which means that the cognitive benchmark against which conceptualisation functions depends on the nature of our bodies: "reason is not disembodied [...] the very structure of reason itself comes from the details of our embodiment".

Moreover, embodied categorisation signifies that we interact with one another and with our environment, i.e. concepts arise as a result of our ecological nature. *Ecological* should be understood in terms of human ecology, namely, as "the branch of sociology that is concerned with the relationship between humans and their physical and social environments"[5]. According to Lakoff and Johnson (1980: 125), "concepts are not defined solely in terms of inherent properties; instead, they are defined primarily in terms of interactional properties". Interaction entails the involvement of our sensory-motor capacities to understand and shape reality.

In this regard, embodiment and interaction can be regarded as generic concepts understood as multi-modal phenomena. The term *multi-modal* is used similarly to Barsalou (1999), who argues that concepts — or *perceptual symbols* — are experienced as *multi-modal*. This means that they emerge because we receive information from different sensory-perceptual inputs. For instance, the concept *hammer* is based on characteristics such as shape, weight, and texture, and on sensory-motor patterns derived from our experience of using a hammer. In this sense, embodiment is fleshed out by different perceptual facets or sensory-motor experiences.

Lakoff and Johnson (1999: 91) establish a direct link between conceptual metaphor and embodied realism. They consider that conceptual metaphor also fleshes out embodied realism along with perceptual and motor inferences. One of the assumptions of CMT is the unidirectionality thesis. This thesis holds that metaphors map structure from a source domain to a target domain but not *vice versa*. In other words, the less clearly delineated concepts are understood in terms of the more clearly delineated ones, which are directly grounded in our bodies (Lakoff and Johnson 1980: 59). This implies

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[5] *The American Heritage® Dictionary of the English Language* [available on http://www.bartleby.com/61/].

that only the source concept is assumed to be directly tied to sensory-motor experience, in other words, it is embodied. This fact makes the source concept an indispensable support for the target concept, which is abstract in nature (Lakoff 1990). In this regard, Kövecses (2002: 20) writes that "target domains are abstract, diffuse and lack clear delineation, and as a result they 'cry out' for metaphorical conceptualisation". For example, the metaphor IDEAS ARE OBJECTS arises because the source concept ***object*** emerges from direct sensorial perception.

Since embodiment and conceptual metaphor are believed to be universal prompts for conceptualisation, it follows that there must be a significant array of metaphors shared by speakers across languages. This is one of the basic claims of our terminological study. However, there are also cross-linguistic differences motivated by cognitive aspects. These differences can also be ascertained in specialised discourse, as shall be seen in § 3.5. Moreover, cultural factors can also give rise to cross-linguistic differences in metaphorisation.

1.2.3. Cultural aspects of conceptual metaphor

One of the areas of disagreement in conceptual metaphor research is the role of culture. In principle, Experientialism approaches metaphor on the basis not only of conceptual and linguistic aspects, but also of cultural ones. At the inception of CMT, Lakoff and Johnson (1980: 57) overtly acknowledged the value of culture by stating that "it would be more correct to say that all experience is cultural through and through, that we experience our 'world' in such a way that our culture is already present in the very experience itself". Lakoff and Johnson (***ibid.***: 14) identify a direct link between our embodied conceptualisation system and the cultural value in what they call ***orientational metaphors***, which are not arbitrary, but "have a basis in our physical and cultural experience". The influence that cultural factors exert on our conceptualisation system is so strong that "it is hard to distinguish the physical from the cultural basis of a metaphor" (***ibid.***: 19).

There is a variety of research that deals with socio-cultural aspects, which give rise to cross-linguistic differences in the metaphorisation process (cf. e.g. Al-Zoubi et al. 2006 for a contrastive study of English and Arabic lexical units used in politics and religion; cf. Kövecses 2002, 2005 for a constrastive study of everyday English, Hungarian, Chinese and Spanish lexical units designating bodily states). Kövecses shows that even bodily states and physiological processes, which were presumably universally conceptualised by speakers across languages, are subject to socio-cultural contraints. Kövecses (2005: 70) argues that "there can be differences in the range of conceptual metaphors (or, more precisely, the range of source domains) that languages and cultures have available for the conceptualization of particular target domains".

One example is the concept of ***happiness***, which is conceptualised as a target domain for a wide range of source domains in Chinese and English. In fact, although both these languages share the conceptual metaphors HAPPINESS IS UP, HAPPINESS IS LIGHT, and HAPPINESS IS A FLUID IN A CONTAINER, the metaphor HAPPINESS IS FLOWERS IN THE HEART only exists in Chinese. The latter yields expressions such as *Ta xin-hua nu-fang* (flowers are blossoming wildly in his heart) and *Ta xin-li le kai le huna* (she is so happy that flowers are blooming in her heart).

Notwithstanding studies of this kind, the cultural aspects of metaphor are often neglected. Cognitive linguists have focused on the sensory grounding of thought and downplayed socio-cultural factors involved in conceptualisation and metaphorisation. As Kimmel (2002: 10) states, "major implications of cognitive linguistics still await a more extensive treatment. One of these arenas for development concerns the culture issue [...]".

Proof of this is Lakoff's current research programme: the Neural Theory of Language[6] (NTL). This project, which was set in motion by Lakoff and Johnson (1999), presents a three-level proposal to account for embodiment based on neural modelling and neurocomputing. NTL is currently being developed in a range of parallel research works (cf. Dodge and Lakoff 2005; Feldman 2006; Feldman and Narayanan 2004; Gallese and Lakoff 2005), and has increasingly been the subject of debate. In this regard, Rohrer (2006: 121) writes: "some cognitive linguists run the risk of advocating translating polysemy, syntax and grammatical construals into talk of neural models, neural circuits, axonal firings and parietal-hippocampal networks". Nevertheless, at the end of the day, the experientialist dimension of metaphor is the cornerstone of NTL. As Feldman (2006: xvi) points out: "we look further at the structure of conceptual systems and how they arise through metaphorical mappings from direct experience".

The tendency to consider cognitive processes simply in terms of physical and physiological size is currently losing ground in favour of culture-specificity and the triad body-mind-culture (cf. Dirven et al. 2008; Rohrer 2006; Sinha 2002; Zinken,

[6] See http://www.icsi.berkeley.edu/NTL.

Hellsten, and Nerlich 2003; Zlatev 2006, inter alia). In the field of cognitive anthropology, examples of metaphor-based, non-physical experiences giving rise to complex social domains have been documented as well (cf. Alverson 1991; Kimmel 2002; Quinn 1991; Palmer 1996). For instance, Quinn (1991) contends that culture should be given a more important role, since "metaphors, far from constituting understanding, are ordinarily selected to fit a preexisting and culturally shared model". She comes to this conclusion after analysing eight metaphorical categories associated with the concept of marriage, which are *sharedness*, *lastingness*, *mutual benefit*, *compatibility*, *difficulty*, e*ffort*, *success*/*failure* and *risk*. For Quinn, these categories, instead of being related to marriage, are rather inherent to this concept, and reflect cultural values and beliefs about it.

In sum, the experientalist view of the embodied mind is condensed in Gibbs' (1999: 155) affirmation that cognition is what happens when the body meets the world. Yet, it is also necessary to ask what happens when the world meets the body (Mey 2006: 46). In our opinion, conceptual metaphor analysis, whatever the knowledge field, is traceable to both sensory-motor inferences and cultural factors. This is also true for the domain of marine biology, as shown by our study. We provide empirical evidence that the cognitive and cultural dimensions of TM are equally important and dependent on each other.

1.2.4. Prototypes and basic-level categories

Prototype Theory is a radical departure from the traditional structuralist semantics, based on watertight categories defined in terms of binary features such as [+ human], [-female], [+ young], etc. Categorisation, as conceived by Prototype Theory, classifies concepts in terms of family resemblances The members of a conceptual category thus have unequal status, and consequently, the notion of *category* is a radial, graded one.

As defined by Rosch (1973), a prototype, also called a *cognitive reference point*, is a category member that is the most representative exemplar of the category. To determine this, Rosch asked 200 American college students to rank a set of items according to whether they were a good or bad example of the category *furniture*. The results showed that *chair* was the best exemplar or the most prototypical item of the category.

Prototype Theory also introduces the notion of *basic level* in categorisation. In consonance with Rosch (1978) and Berlin and Kay (1969), Experientialism posits that human beings have a number of basic-level concepts (Lakoff 1987; Lakoff and Johnson

1999). This is the level at which most of our knowledge is organised (Lakoff 1987: 46). As stated by Lakoff (*ibid.*: 269), “the basic level is an intermediate level; it is neither the highest nor the lowest level of conceptual organization”. A basic-level concept usually has the special cognitive status of being a best example because it has the highest degree of cue validity. According to Rosch (1977: 29), cue validity is the conditional probability that an entity belongs to a certain category, provided that this entity has some cue or attribute associated with such category. Precisely for this reason, basic-level concepts are full of informational content, and for this reason, constitute richly contoured mental representations. Examples of basic-level concepts are *bird*, *fish*, *fire* and *table*.

According to Lakoff (1987: 33), the reasons for categorising at this level are the following:

§ People name things more readily at that level.

§ Languages have simpler names for things at that level.

§ Categories at that level have greater cultural significance.

§ Things are remembered more readily at that level.

§ At that level, things are perceived holistically, as a single gestalt, while for identification at a lower level, specific details (called *distinctive features*) have to be picked out to distinguish, for example, among the kinds of oak.

As shall be seen in the methodology and the results sections, marine biology basic-level concepts also have a role in metaphor-induced terminological designation, and inherit the features mentioned above.

1.2.5. Image metaphors vs. structural-conceptual metaphors

Lakoff and Turner (Lakoff 1993 [1992]; Lakoff and Turner 1989) distinguish between image metaphors and conventional (structural-conceptual) metaphors. Image metaphors are conceptually simple, i.e. only one concept of the source domain maps onto the target domain. This single mapping results in one expression. Futhermore, image metaphors are based on a sense-perceived resemblance (what Caballero (2003b) calls *external similarities*) between a concrete entity and another entity, which may be concrete or abstract. In other words, image metaphors emerge from resemblance based on physical (shape and colour) features that are shared by two entities.

Lakoff and Turner (1989: 90) give Andre Breton's hourglass metaphor as an example of physical resemblance. The fact that a woman's waist is compared to an hourglass is grounded in perceptual resemblance of shape. Lakoff (1992: 418) describes this type of metaphor as the result of image-to-image mappings, and contends that image metaphors are mentally visualised:

> Instead of mapping the structure of one concept onto another, they (i.e. the image metaphors) map the internal structure of one conventional mental image onto the internal structure of another image.

According to Lakoff (1993) and Lakoff and Turner (1989), another characteristic of image metaphors is that they arise as fleeting comparisons which never become stable, and consequently, are not ultimately lexicalised in language. Thus, they encode novel or nonce expressions. "Image metaphors [...] are one-shot metaphors: they map only one image onto one other image" (Lakoff 1993: 229). This idea of fleetingness is also argued by Kövecses (2002: 38), who states that an image-to-image mapping is "of the *oneshot* kind that is generated by two images that are brought into correspondence by the superimposition of one image onto the other".

Lakoff (1993) states that the natural field of image metaphors is literature. For this reason, examples of image metaphors are frequently found in poetry (Lakoff 1993: 229). In contrast, conceptual metaphors emerge from the entire projection of one domain of experience onto another (domain-to-domain mapping). They involve the mapping of rich knowledge and rich inferential structure (Lakoff and Turner 1989: 91), which guarantees a significant array of cross-domain correspondences. These correspondences give rise to a more or less extensive number of linguistic expressions.

In addition, Lakoff and Turner affirm that conceptual metaphors are difficult or impossible to visualise. They are called *conventional* because they are well-entrenched metaphors that are frequently used in everyday language. One of the most recurrent examples of structural metaphor is LOVE IS A JOURNEY, which generates expressions such as: *Look how far we have come; We will have to go our separate ways;* and *It has been a long and bumpy road* (Lakoff and Johnson 1980: 44–45).

As shall be seen in the next section, Lakoff's account of image metaphor was refined by Grady. Furthermore, in our opinion, Lakoff's dichotomy *image metaphor-conceptual metaphor* suffers from a number of shortcomings that will be discussed in § 4.2.

1.3. Primary Metaphor Theory

Conceptual Metaphor Theory constitutes the launching pad for Grady's Primary Metaphor Theory (1997ab, 1999). Grady laid the foundations for his model of metaphor in his 1997 Ph.D. dissertation *Foundations of meaning: Primary metaphors and primary scenes*. Although inspired by Lakoff's proposals, Primary Metaphor Theory rose to prominence for passing judgement on CMT.

1.3.1. Primary metaphors vs. compound metaphors

Primary Metaphor Theory proposes two types of conceptual metaphor: primary metaphors and compound metaphors. Primary Metaphor Theory departs from Conceptual Metaphor Theory in that primary target concepts reflect not abstract but rather subjective responses to sensory perception and represent "judgements, assessments, evaluations and inferences" (Grady n.d.: 5/15). Therefore, Grady contends that these concepts are no less experiential than source concepts, since they are also directly tied to sensory-perceptual experience. It is subjectivity and not abstraction that pairs target concepts with source concepts in primary metaphors. In other words, though equally grounded in bodily experience, target concepts are mentally or subjectively experienced. This signifies that they are evaluative response content to the objective image content represented by source concepts, which emerge from external sensorimotor experience (Grady 1997a, 1999, 2005a).

The primary metaphor which Grady's theory is based on is QUANTITY IS VERTICAL ELEVATION[7]. The target concept ***quantity*** "lacks the kind of perceptual basis which characterises the source concept" (Grady n.d.: 5/14). Quantity needs to be measured via the external sensorimotor experience of verticality, which is fleshed out by the kinaesthetic process of piling things up. In this sense, Primary Metaphor Theory also needs to validate unidirectionality, but in terms of objective-to-subjective rather than concrete-to-abstract mappings.

Primary Metaphor Theory contributes another very important refinement to the experientialist basis of Conceptual Metaphor Theory. Grady (1997) argues that a core characteristic of primary metaphors is that they are couched in *experiential correlation*, which consists of establishing a strong conceptual link between two distinct events that

[7] See Grady (1997a) for an account of other primary metaphors, or Lakoff and Johnson (1999: 50–54), who also provide an inventory.

iteratively co-occur. Grady (n.d.: 5–31) contends that this phenomenon occurs by virtue of what he terms *primary scenes*, which are "recurrent patterns of experience, in which simple dimensions of perception are associated with simple dimensions of meaningful interpretation or response"[8].

Thus, experiential correlation usually gives rise to primary conceptual metaphors because after repeated co-occurences in our perceptual experience of the world, we come to conceive one event in terms of another. For instance, the metaphor CHANGE IS MOTION, which allows for the subjective judgment of experiencing a change of state, arises because physical entities in motion are perceived to cause changes in their environment. In this sense, passing an unsoiled, wet cloth over a dirty surface always renders it clean. Since experiential correlation results from the physical and physiological configuration of our bodies and their interaction with our environment, primary metaphors represent cross-linguistic universals.

Finally, primary metaphors rely upon ***simple*** concepts stemming from two distinct domains. As Grady (1997a: 100) puts it, primary metaphors "refer to simple aspects or dimensions of subjective experience, not confined to any particular, rich domain, but crosscutting these domains". Being simple in nature, primary metaphor concepts cannot be broken down further. Examples of such concepts are MOTION, ELEVATION and FORCE.

To describe compound metaphors, Grady (1997b) employs the conceptual metaphor THEORIES ARE BUILDINGS, originally presented by Lakoff and Johnson (1980). According to Grady, THEORIES ARE BUILDINGS cannot be regarded as an instance of primary metaphor, and therefore, qualifies as a compound metaphor because:

- It entails the participation of two entire complex domains which, owing to their complexity, can be broken down into component parts. For instance, BUILDINGS have WINDOWS, TENANTS and RENT.
- Not all the component parts of the source domain map onto the target domain. Grady (1997b) calls the occurrence of these mapping gaps *poverty of mapping*, and he gives the following examples (Grady 1997b: 270):

  This theory has French windows
  The tenants of her theory are behind in their rent

[8] In turn, primary scenes are constituted by *subscenes* (Grady 1997a).

In contrast, primary metaphor mappings leave no parts of the source concept and the target concept unpaired.

- § It lacks a clear experiential basis, i.e. the source domain and the target domain are not linked by experiential correlation. In this regard, Evans and Green (2006: 309) write that "we can hardly claim that theories and buildings are closely correlated with one another in our everyday experience of the world". This lack of experiential basis may be due to the highly structured nature of THEORIES ARE BUILDINGS, which, as Grady suggests, builds upon the primary metaphors PERSISTING IS REMAINING UPRIGHT and ORGANISATION IS PHYSICAL STRUCTURE.

1.3.2. Primary metaphors vs. resemblance metaphors

Grady applied the rationale of primary metaphor theory to other areas of Cognitive Linguistics such as conceptual integration (Grady 2005a) and embodiment, especially to image schemas (Grady 2005b: 45–50). However, it was first necessary to dissociate primary metaphors from what he calls *perceived resemblance metaphors*, which explicitly compare two entities by virtue of their perceived similarity in behaviour or physical (colour or shape) appearance.

Although both behaviour-based metaphors and metaphors based on physical properties constitute robust representatives of the ***is-a*** kind of metaphors, Grady (1999) focuses on behaviour-based metaphors, which he calls *resemblance metaphors.* Grady (*ibid*: 89) presents this type of metaphor and makes it clear that such type must be understood within the theoretical framework of cognitivism and not within truth-conditional objectivism:

> The metaphorical association between them [between the two entities compared] – involving projection in whichever direction – is most plausibly based on the perception of common aspects in their behaviour. I will call this proposition the 'resemblance hypothesis' in order to distinguish it from the similarity theory, and to highlight the role of our perceptions and representational schemas, as opposed to facts about the world.

The stereotypical example proposed is *Achilles is a lion*, previously presented by Lakoff and Turner (1989). Achilles *resembles* a lion because both man and animal seem to share a feature that, although perceived through our senses, is not physical, but it answers a comparison pattern based on behaviour, viz. bravery and courageousness when confronting enemies (Grady 1999: 92).

Grady (1999: 89) points out that behaviour-based metaphors are not the same as those arising from physical appearance, which correspond to Lakoff and Turner's notion of image metaphor: "'Achilles is a lion' is not an image metaphor, since it makes no claims about Achilles' physical form". However, Grady does not enter into further analysis of image metaphors, as though assuming Lakoff's view that this is an infrequent or literature-bound kind of metaphor. However, in section 4.2.3., we show that behaviour-based metaphors and image metaphors are really not so different, and are not two clearly differentiated categories.

In summary, Grady establishes two sets of metaphors: (i) correlation-based metaphors, including primary metaphors, and compound metaphors; and (ii) resemblance metaphors[9]. Although this dichotomy is right, our study shows a set of resemblance metaphors that make use of a particular type of correlation in experience to emerge (§ 4.2.4.4.). We also propose a refinement of the image metaphor/behaviour-based metaphor typology, which, in our view, is not as rigid as Grady argues (§ 4.2.3.).

1.4. Mental Spaces Theory and Blending Theory

Mental Spaces Theory (Fauconnier [1985] 1994, 1997) is a cognitive semantic approach to meaning construction and representation. Blending Theory (Fauconnier 1999; Fauconnier and Turner 1998, 2002) is rooted in Mental Spaces Theory. It is the most prominent cognitivist model inspired by Conceptual Metaphor Theory that accounts for the pragmatic dimension of conceptual metaphor, together with Relevance Theory.

1.4.1. Mental Spaces Theory

Mental Spaces Theory offers a plausible framework for bringing together the pragmatic and the cognitive aspects of meaning construction. It includes the following

[9] Grady (1999: 95) includes Lakoff and Turner's (1989) GENERIC-IS-SPECIFIC metaphors in the same class as resemblance metaphors insofar as both "do appear to be alternative ways of construing what is essentially the same conceptual relationship".

components: (i) mental spaces; (ii) mapping operations between these mental spaces; (iii) discourse context, which guides the mappings.

According to Fauconnier and Turner (2002: 102), mental spaces are "small conceptual packets constructed as we think and talk, for purposes of local understanding and action". In other words, mental spaces are temporary domains that are assembled as a result of ongoing discourse, where background knowledge fuses with on-line information. Once mental spaces are assembled, they give rise to meaning, which is thus conceived as a dynamic process. In this way, semantic meaning is constructed directly in context, and thus, cannot be dissociated from pragmatic meaning.

Mental spaces are internally structured by Idealized Cognitive Models and frames. All three structures can be integrated into a whole, where "referential structure is indicated by mental spaces, whereas conceptual structure is indicated by *Idealized Cognitive Models* (or ICMs) and *frames*, which structure the mental spaces" (Lakoff and Sweetser, foreword section x–xi in Fauconnier 1994).

Mental spaces have the following basic constituents: (i) space builders; (ii) the elements or entities; (iii) the properties and relations featuring the elements. Space builders are "linguistic units that either prompt for the construction of a new mental space or shift attention back and forth between previously constructed mental spaces" (Evans and Green 2006: 371). Examples of space builders are prepositional phrases and adverbs, to name a few.

What makes space builders interesting is that they invite the hearer to construct a scenario which may transcend the here and now. This means that the hearer may be required to think about reality in some other place, hypothetical or counterfactual situations, ideas and beliefs, etc. The elements inside mental spaces may be on-line entities arising during communication or pre-existing conceptual constructs. Elements are represented in language by noun phrases. Finally, the space builders within one mental space provide the mental scenario where the properties attributed to the elements and the relations held between such elements can exist.

The sentence *In the scene, bold Harry Potter is riding a unicorn*[10], the space builder *In the scene* sets up a mental space. The name *Harry Potter* and the noun *unicorn* introduce two elements — ***a*** and ***b*** — in this mental space, and the adjective ***bold***

[10] Adaptation of the example provided by Evans and Green (2006: 373-374) to describe building mental spaces.

assigns a property to element ***a***. ***Harry Potter*** recruits the frame relating to MAGICIANS and MAGIC, and ***unicorn*** prompts for the frame of MYTHICAL CREATURES. In turn, the verbal form ***is riding*** expresses a relation between ***a*** and ***b***, and recruits the RIDING frame. This frame brings with it the participant roles of RIDER and ENTITY RIDDEN. The RIDER role maps onto element ***a***, and the ENTITY RIDDEN role maps onto element ***b***. Figure 1 shows the mental space SCENE, represented by a circle, elements ***a*** and ***b*** linked inside the mental space, and the RIDING frame:

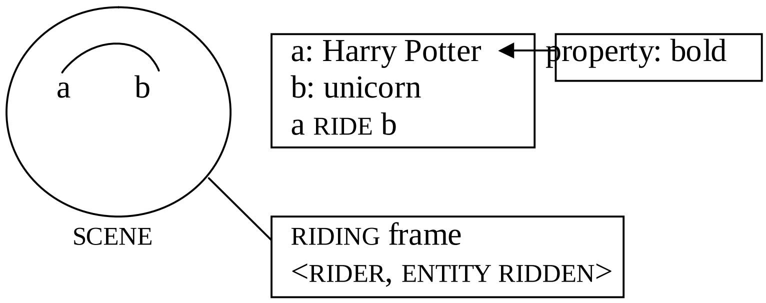

Figure 1. Mental space SCENE.

Once constructed, mental spaces are linked to one another in discourse, giving rise to "a network or lattice as more schemas are induced and links between the resulting spaces are created" (Evans and Green 2006: 374). The mental space which represents the starting point for any particular stage in discourse is called the *base*. This mental space lends the basic conceptual material so that further mental spaces can be constructed. Mental spaces can form chains because elements are propagated to neighbouring spaces. More precisely, by virtue of the Access Principle, "an expression that names or describes an element in one mental space can be used to access a counterpart of that element in another mental space" (Fauconnier 1997: 41). Counterparts, which are elements in different mental spaces having a related pragmatic function, are linked by means of connectors. Thus, connectors establish mappings between mental spaces on the basis of pragmatic funcion.

Evans and Green (2006: 376) use the following example: *James Bond is a top British spy. In the war, he was an officer in the Royal Navy*. The first sentence is the linguistic representation of one mental space, which is the base. The base is recruited by an implicit space builder which derives from our background knowledge that James Bond is a fictional character. So, the space builder could be *In the book*, *In the film*, etc. Element a1 is the counterpart of element a2, which pertains to the second mental space constructed in the second sentence. This second mental space is recruited by the space builder ***in the Royal Navy***. Both counterparts are linked by a co-referential or ***identity connector***, which is not represented by any linguistic expression. The reason is that this connector is a cross-space mapping operation that arises as an inferential operation in context.

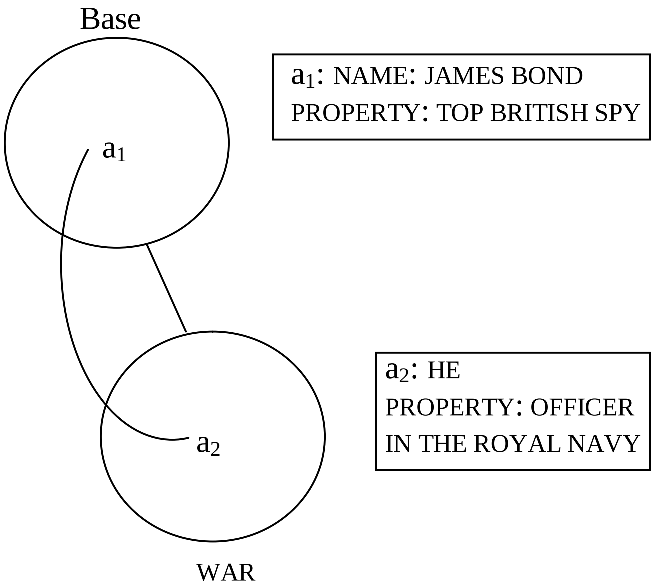

Figure 2. Link between two mental spaces, the base and its neighbouring space, by means of connectors.

Such cross-space mapping operations are the basis for the rationale of Blending Theory.

1.4.2. Blending Theory

Blending Theory is based on both Conceptual Metaphor Theory and Mental Spaces Theory. Blending Theory has a more direct relationship with Mental Spaces, to the extent that the former is usually considered an extension of the latter. The reasons are that Blending Theory inherits the mental space model and its concern with the dynamic aspects of meaning construction. In this regard, Turner and Fauconnier ([2000] 2002: 470) state:

> Contemporary accounts of metaphor and analogy have focused on structure-mapping from a source (or base) onto a target […] The work on conceptual blending has shown that in addition to such mappings, there are dynamic integration processes which build up new "blended" mental spaces. Such spaces develop emergent structure which is elaborated in the on-line construction of meaning and serves as an important locus of cognitive activity.

According to Fauconnier and Turner (2002), conceptual blending is a general, ubiquitous cognitive operation, and therefore, is central to human thought. The crucial assumption of Blending Theory is that “meaning construction typically involves integration of structure that gives rise to more than the sum of its parts” (Evans and Green 2006: 400). For this reason, Blending Theory is also known as *Theory of Conceptual Integration*. According to Mental Spaces Theory, counterpart connections are established between mental spaces. When such connections have been established by a projection, new projections take place from these spaces towards a *generic space*, which contains information abstract enough to be shared by the elements from the two or *input spaces*. Information in this third space typically consists of role templates. Each element from the input spaces finds its counterpart in the generic space following a mapping operation. Finally, there is a fourth mental space, the *blended space* or *blend*, where elements from the original or *input spaces* are merged and form a new scenario containing emergent or novel structure. The emergent structure contained in this fourth space is independent of the two input spaces, and accounts for the metaphorical meaning produced in language.

The three basic component processes giving rise to this emergent structure are (i) composition; (ii) completion; (iii) elaboration. Composition involves bringing together elements from separate inputs. Completion entails schema induction, i.e. the unconscious and effortless recruitment of background information. This process is called *completion* because we complete “elements in the blend by using existing integrated patterns as additional inputs” (Fauconnier and Turner 2002: 328). These patterns are background structure recruited in discourse. This entire *packet* of informational substrate is processed on-line. In other words, it is elaborated to give rise to a blend containing the inherited partial structure from each input space and unique conceptual structure.

An often cited example of blending is *That surgeon is a butcher*. As shown in Figure 3 (Grady, Oakley and Coulson 1999: 104), the composition includes the links of the elements from the different spaces through connectors, which give rise to a wide range of cross-space mappings. In this way, the mappings are established between the entities, *surgeon* and *butcher*, on the one hand, and *patient* (person) and *commodity* (animal), on the other. Other mappings exist between the instruments, *scalpel* and *cleaver*, and also between the locations, *operation room* and *abattoir*, etc. These mapping operations are enriched by the background knowledge that a surgeon's work involves repair and reconstruction and that a butcher's work involves dismembering.

The elaboration process gives rise to a blended space where a surgeon is assessed as a butcher. The emergent additional structure in the blend is the striking inferential idea of incompetence, which is associated with surgeons so that metaphorical meaning arises. It is striking because the background knowledge in reference to a surgeon's work is overidden in the blend by the emergent structure, which includes "the structure copied from the input spaces, together with the emergent structure relating to a surgeon who performs an operation using the skills of butchery and is therefore incompetent" (Evans and Green 2006: 405).

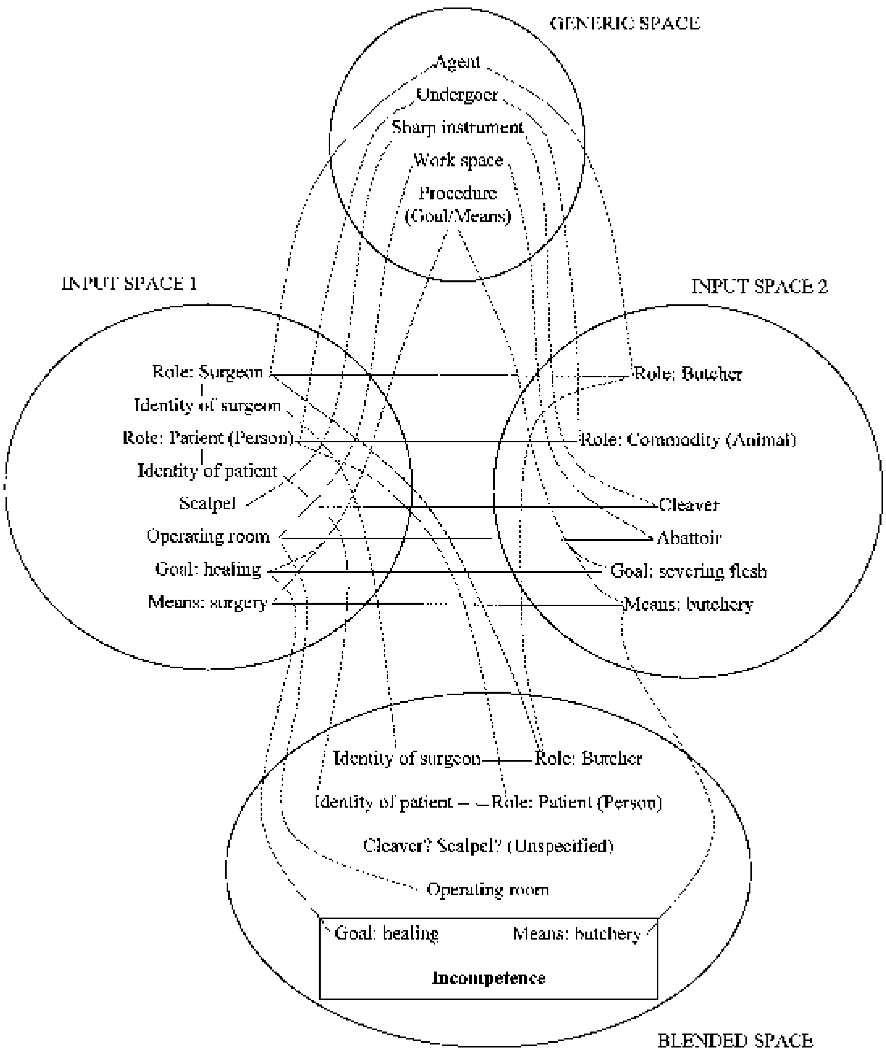

Figure 3. Blended space of the statement *That surgeon is a butcher.*

1.5. Class-Inclusion Theory

Glucksberg's Theory challenges the two-domain approach of CMT. As regards the conceptual dimension of metaphor, Class-Inclusion Theory argues for the interrelation between three *conceptual categories*, which are more specific structures than the domains proposed by Lakoff and Johnson, though more general than Fauconnier and Turner's even more specific mental spaces. The example most frequently used to describe the tenets of this theory is: *My job is a jail*. In this example, there are no cross-category mappings. Rather the source category passes its properties to the target category by means of a class inclusion process. In other words, Glucksberg's contention is that the basis of metaphor is class inclusion rather than mere similarity. There is an unnamed superordinate category which the source or vehicle concept (in this case, *jail*) depends on. This is in fact the typical exemplar of the superodinate category. The category substantiated by the target or topic concept (*job*) *inherits* the features of the superordinate, which is instantiated by *jail*. Thus, we are dealing with a cognitive network consisting of three conceptual structures that operate together to give rise to metaphorical meaning.

Moreover, Class-Inclusion Theory contends that though categories may be more or less general, as well as permanent or *ad hoc*, when the indirect use of such expressions becomes conventionalised, they are no longer metaphorical, since the interpretation process does not rely on novel or *ad hoc* meaning anymore. In fact, conventional metaphor just activates one category through the vehicle term, which is the superordinate concept capturing the metaphorical content that has become conventionalised as an independent category. It is thus retrieved from memory and no longer construed in an *ad hoc* fashion from the original source concept.

Therefore, for conventional metaphor to arise, all that is needed is an activated superordinate category. This leads to the assertions such as the following: (i) Class-Inclusion Theory basically conceives of metaphorisation as an *ad hoc* categorisation process; (ii) Class-Inclusion Theory does not stem from the assumption that people have conventionalised conceptual metaphors in their minds (as argued in Keysar et al. 2000)[11]. However, it is also true that they do not discard this possibility entirely, but

[11] This assertion is closer to Jackendoff's (1996, 2002) more radical view, which contends that particular linguistic structures may also be explained by other conceptual structures rather than by cross-domain mappings, which work via superordinate conceptual abstractions: "[…] Cognitive linguistics tends to

rather profess to be “agnostic” about it (Glucksberg and McGlone 1999: 1554–1555). Nevertheless, when all is said and done, even though the domains of discourse and conceptualisation are distinct and require independent theoretical elaboration and development, they must interact in some systematic, yet-to-be-understood fashion (Glucksberg and McGlone 1999: 1557).

These claims definitely have major implications for metaphor description in the area of linguistic formalisation. Glucksberg and co-workers focus on novel metaphor, establishing a clear line that separates this type of metaphor from conventionally metaphorical language. According to these authors, a novel metaphor involves a one form-meaning pairing in which one sense and a dual reference to one category and an *ad hoc* superordinate category are at work. A conventional metaphor entails a one form-pairing in which one sense and a single reference to a superordinate category are at work. Although these scholars concentrate on novel metaphor, they use constructed discourse contexts to examine it. These two aspects set Class-Inclusion Theory at a different level of research from our account of marine biology metaphor, since our study is limited to the description of conventionalised metaphors in usage, only ascertained in naturally running texts. Moreover, while Class-Inclusion Theory practitioners are inclined to use nominal metaphorical expressions, we also expect to find and analyse other types of lexical and grammatical formalisations, particularly verbs that are polysemous in nature.

As for the research area dealing with psychological processes and products, we agree with Glucksberg in that metaphors are not mentally processed and represented as such when they are conventionalised. In connection with this, we also believe in the instrumental role of the analysis of the symbolic dimension of language for behavioural research. In other words, a metaphorical mapping remains hypothetical as long as it has not appeared in the analysis of behavioural data of metaphor as a process and its product (Glucksberg and McGlone 1999: 1545). However, this claim needs testing in the form of manipulative experimental research with participants, involving reaction time studies, time-accuracy tradeoffs, and other experimental exercises.

This is a methodology which we plan to apply in future research. This analysis of marine biology metaphors (see § 3.5.) is based on the the interpretation of corpus data.

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view cross-field parallelisms as derivational, while I view them as parallel instantiations of a more abstract schema” (Jackendoff 1996: 116).

In this sense, as shall be seen, we take a similar approach to Career of Metaphor Theory, which extracts the conclusions based on the conceptual structure of linguistic data, since it regards them having an empirical status of their own.

It is precisely on the psycholinguistic side of metaphor that Glucksberg and collaborators have obtained more fruitful and enlightening results, providing principled evidence supporting their claims (cf. Glucksberg 2001 for a summary). Our study of marine biology metaphor has a somewhat wider scope, since it also addresses cross-linguistic and cultural aspects that condition specialised language metaphor in the symbolic area.

1.6. Career of Metaphor Theory

The proposal by Gentner and her colleagues is perhaps the most eclectic of all since it includes assumptions from the rest of models. Concerning the conceptual level, Career of Metaphor Theory does not reject the possibility that conceptual metaphors are valid entities, while at the same time, it takes on board the categorisation process of Class-Inclusion Theory. Cross-domain mappings and a concomitant process of comparison take place in novel metaphor. Therefore, only two conceptual structures are in order here. In contrast, conventional metaphor requires a three-concept network, where the topic concept is dependent on the subordinate and superordinate concepts of the basic categorisation process. This account states that whether metaphors are processed directly or indirectly and whether they operate at the level of individual concepts or entire conceptual domains depends on their degree of conventionality.

At the level of linguistic form, a form-meaning pairing is regarded as metaphorical if it involves (i) one sense and a *dual* reference to two concepts that are compared (novel metaphor); (ii) one sense and a single reference to a superordinate concept (conventional metaphor). Furthermore, Career of Metaphor Theory does not seem to be interested in variation in the sense of nominal or verbal metaphor (Steen 2007: 53), which is an important aspect for our purposes. Bowdle and Gentner (2005) argue that linguistic expressions can be seen as renderings of extended metaphorical mappings. In addition, though it is more controversial to affirm that they remain as metaphorical items stored in an individual's memory, "conventional base terms like *crossroads* retain a degree of polysemy, referring to both a literal concept and to an associated metaphoric category" (Bowdle and Gentner 2005: 213). In other words, Career of Metaphor Theory actually argues for the existence of metaphor in lexico-grammar for polysemous units, something that Class-Inclusion Theory takes issue with.

Nevertheless, not only is Career of Metaphor Theory comparable to Class-Inclusion Theory in that it studies metaphor in usage, but it also uses linguistic data for experimental purposes. For example, Bowdle and Gentner (2005) obtain their results based on three experiments, which draw on the very language that people use to make figurative assertions. As demonstrated in these experiments, Gentner and Bowdle postulate what has been explained in the previous paragraphs, i.e. a shift in mode of mapping from comparison to categorization as metaphors are conventionalized. Their work is supported by further experimental evidence contributed by Giora (2003). Evidence is found that linguistic processing rather than conceptual processing is brought to bear when we are presented with a conventionalised metaphorical expression. In this way, during lexical access, conventionally metaphorical units prompt for the activation of several senses, from which the metaphorical one is singled out as contextually relevant. Therefore, no cross-domain mappings are retrieved or even constructed at the cognitive level.

In our opinion, Genter's hypothesis is a valid framework, which can be applied to the comparison and categorization models of metaphor. Yet, the Career of Metaphor Theory is considerably more difficult to apply to practical cases. In this regard, we assume that metaphorical terms are entirely conventionalised units, and therefore, are no longer metaphorically conceived by experts. However, in our study of marine biology metaphorical terms, we will depart from the experts' perspective, and take the point of view of an analyst of language and thought, who seeks to describe the cognitive operations that underlie metaphorical expressions in specialised language. For this purpose, we consider Conceptual Metaphor Theory and Blending Theory to be the best approaches. Our description of the conceptual (cross-domain mappings) and psycholinguistic properties (mental representations) of marine biology metaphors in English and Spanish provides insights that prove the validity of these theories for terminology.

1.7. Comparing Blending Theory and Conceptual Metaphor Theory

This section compares Conceptual Metaphor Theory and Blending Theory. As previously mentioned, for practical purposes, our domain-specific study of metaphor is mostly based on Conceptual Metaphor Theory. The significance of Conceptual

Metaphor Theory and Blending Theory is highlighted in cognitivist circles to the detriment of Class-Inclusion Theory and Career of Metaphor Theory. For example, Steen (2007: 383–384) notes:

> The bulk of this book has focused on the two cognitive-linguistic theories by Lakoff and Johnson and by Fauconnier and Turner, because these have had more to say about a wide range of topics in grammar and usage; they have therefore had most academic impact in linguistics. It is also true that these cognitive linguists have expressed greater aspirations regarding the psychological sides of their models that their psychological competitors have done for the linguistic sides of their own models; the cognitive-linguistic models consequently set out to cover more of the entire field.

For this reason, it is interesting to compare these theoretical models. There are several ways in which Blending Theory differs from Conceptual Metaphor Theory, such as the following:

§ Blending Theory builds upon mental spaces, which are temporary on-line conceptual constructs emerging locally as discourse develops, giving rise to real-time inferential meaning. Since Blending Theory draws upon the dynamic nature of communication, this theory focuses on metaphors that are instances of "unusual or invented language" (Deignan 2005a: 166). For instance, the surgeon and butcher blend is a novel metaphor.

§ Blending Theory employs a minimum of four spaces, which are interconnected by mapping operations.

§ Blending Theory provides an account of emergent structure, which derives from the mappings between elements of the input spaces (and the background knowledge associated with these elements), but is definitely not the simple sum of all these elements.

§ Corresponding connections giving rise to blended spaces apply not only to metaphorical instances of meaning construction., but equally to non-metaphorical instances of meaning construction (Evans and Green 2006: 406). An example of non-metaphorical blending is the following counterfactual sentence. As Evans and Green (2006: 407) point out, Bill Clinton would not have been harmed by his relationship with Monica Lewinsky if he had been a French politican. Apart from the obvious correspondences, the background knowledge that we have of French and American political lives takes part in these mapping operations. This knowledge involves the fact that while in America having an extra-marital affair results in political harm, the same is not true in France. All of this conceptual material is projected into the blend, and inferential information is recruited that did not previously exist in either of the inputs that gives rise to it.

- § Metaphorical blends arise from the selective projection of structure from inputs to the blended space. Furthermore, blends enjoy backward projection, i.e. the structure in the blend can be projected back to the input spaces because these stay connected to the emergent blend. For instance, the CLINTON AS A FRENCH PRESIDENT blend exists because it remains connected to the input spaces of CLINTON and PRESIDENT.

In contrast, Conceptual Metaphor Theory differs from Blending Theory in the following assumptions:

- § Conceptual Metaphor Theory is based on domains, not on mental spaces. Domains are highly stable constructs stored in our long-term memory[12]. Grady, Oakley and Coulson (1999: 120) state that whereas Conceptual Metaphor Theory consists of stable knowledge structures represented in long-term memory, Blending Theory seeks to model the dynamic evolution of speakers' on-line representations.
- § Conceptual Metaphor Theory builds upon a two-domain topology of metaphorical mappings. As a consequence of the two-domain architecture, no inferential or emergent structure is derived.
- § Whereas Blending Theory posits general premises based on the study of the nature and specificities of a definite number of examples, Conceptual Metaphor Theory derives generalisations across an extensive range of metaphoric expressions.
- § The conceptual structure in Blending Theory, which takes part in the mapping operations stems from several inputs. In contrast, Conceptual Metaphor Theory

[12] Lakoff has traditionally been criticised because he dispenses with context and the pragmatic dimension of language. This criticism extends to the field of lexical semantics, where his proposal of ***radial categories*** (Lakoff 1987) is under fire.

argues for unidirectional cross-domain mapping operations. As a result, Conceptual Metaphor Theory does not consider backward projection.

According to Grady, Oakley and Coulson (1999: 120), because of these differences between Blending Theory and Conceptual Metaphor Theory, certain authors consider both these theories to be competing models that account for the same phenomena. However, as Grady, Oakley and Coulson (*ibid.*) argue, these theories are complementary because they tackle different aspects of metaphoric conceptualization, and because "the conventional conceptual pairings and one-way mappings studied within CMT are inputs to and constraints on the kinds of dynamic conceptual networks posited within BT".

The complementariness between Blending Theory and Conceptual Metaphor Theory is strengthened by various factors. The factor relevant to our study is that blends can be conventionalised by recurrent use[13]. An example of a conventionalised blend is that of the GRIM REAPER as the personification of DEATH. Regarding this capacity for conventionalisation, Grady, Oakley and Coulson (1999: 111) write:

> What started out (undoubtedly) as some individual's creative, on-line, conceptual achievement has become a shared, entrenched conceptualization, presumably because the blend proved successful for some purpose, therefore arose again and through repeated experience became conventional.

Compounding, a sub-type of blend within the blend type called formal blend, is especially amenable to conventionalisation. A formal blend involves "projection of specific lexical forms to the blended space and rely partly upon formal lexical or grammatical structure for their meaning" (Evans and Green 2006: 414–415). More specifically, compounding entails "the process of blending two (or more) free morphemes to give rise to a new word" (ibid.). An example of compounding is landyacht, a colloquial term which refers to the large, traditional, luxury sedans produced by American automobile manufacters from the 1950s to the 1990s. In marine biology we also expect to find compounds or multi-word metaphorical terms which are blends.

However, we believe that the two-domain approach will allow us to get insight into the way experts exploit conventional metaphor in English and Spanish. Moreover,

[13] See Grady, Oakley and Coulson (1999: 120 and ff.) for an overview of the other factors.

Conceptual Metaphor Theory is a valid option for our cross-linguistic, corpus-based study in specialised language, a claim that ties in with previous corpus work on usage, such as that by Charteris-Black (2004), Chilton (1996), Deignan (2005a), Koller (2004), and Őzçaşlikan (2003, 2004). Although in our study, we also applied premises from Blending Theory, this approach is best used to study novel or non-conventional metaphor. In this last regard, the two-domain theory is thought to be less applicable to metaphor in usage, and more concretely, to creative or novel metaphor. A more complex model is thus often necessary to account for certain aspects of this type of metaphor. Such a model, it is claimed, should be based on more than two domains, with various conceptual systems playing a role as potential inputs for metaphoric thought — as has been acknowledged even by Lakoff and Johnson (1999a: 47).

1.8. Observational Approaches to Metaphor: Corpus-Linguistic Studies

All of the theoretical models described above have traditionally shown a preference for studying metaphor through instropective methods, focusing on individual instances in isolated contexts. More often than not, introspective studies dispense with quantitative methods. In other words, they eschew observational patterns of thought. However, this methodology is being challaged by a growing body of cognitive-linguistic studies demonstrating that metaphorical verbal data can also be analysed quantitatively through observational patterns, both in the area of language and thought. Currently, observation in the semiotic approach to metaphor largely rests on corpus analysis. Scholars have now realised that a theory of thought is not sufficient to account for metaphor, and that corpus data interpreted from a linguistic perspective provides the complementary theory of communication required.

There are two corpus-based approaches: (i) the first approach uses the mainstream cognitive-semantic findings of Conceptual Metaphor Theory to test this model of thought and language in particular knowledge fields; (ii) the second approach uses Conceptual Metaphor Theory only as a starting point, but they go beyond it because it focuses on how speakers use language to create meaning, metaphor being one tool in this task" (Deignan 2005a: 123).

1.8.1. Mainstream cognitive-semantic approaches to metaphor

Although both Conceptual Metaphor Theory and Corpus Linguistics arose at the beginning of the 80s, they have not had much to say about each other until recently.

Fortunately, things seem to be changing now. The usefulness of naturally-occurring text corpora is even documented for cross-linguistic metaphor research pertaining to all levels of linguistic structure. Deignan, Gabrys and Solska (1997) and Deignan (2003) use corpora to show that certain metaphors fail or succeed and become conventional, depending on the importance that a speech community gives to specific domains.

Deignan (1995, 1999, 2005ab) provides further relevant examples of the convergence of both approaches. Based on a corpus, which is a cross-section of the Bank of English of 56 million words, Deignan (2005a) deductively uses CMT to obtain the specific relations of individual lexical units in a set of domains. Deignan (*ibid.*: 223) argues that since corpus-data are rarely inconsistent with CMT, this type of information can rectify flawed intuitions. Although Deignan's work is deductive in nature, she validates it against a corpus of texts, so that her conclusions are derived inductively.

In this respect, she draws on naturally occurring data to propose a corpus-based classification of metaphorically motivated linguistic expressions which mirror tighter categories than those suggested by CMT. This classification shows that the proposed systematicity of metaphorical mappings (Lakoff's (1990) Invariance Hypothesis) is not always correct. She argues for a more relevant role of target domains in prompting linguistic metaphors. As she puts it, "the corpus data showed that target domain words take on grammatical roles following the inherent domain structure, and that these do not necessarily echo their source domain grammatical roles" (Deignan 2005a: 221). For instance, the word ***dog*** can only be used as a verb when it bears metaphorical meaning, which is evidence of the influence that the target domain may have on the linguistic form of a metaphor.

Deignan also emphasises the importance of syntagmatic relations for metaphor identification and analysis, in the sense that "there are relatively few figurative expressions that appear in isolation; and that the majority form part of a lexical string" (Deignan 2005a: 218). For example, in the corpus analysed, the only figurative expression that is freely combining is the verbal sense of *rock*, meaning *destabilize*. Moreover, Deignan notes that in some citations *rock* is just freely combining from a lexical perspective, but not from a grammatical one, since it is usually post-modified by a prepositional phrase beginning with *of* (e.g. […] regarded in Washington as a rock of stability). As Tercedor (1999b, 2004) shows in the subfield of oncology, specialised language also contains terminological and non-terminological units with metaphorical meaning that are linguistically complex. As shall be seen, the same applies to the domain of marine biology.

In short, Deignan's work is an important contribution to the cognitive studies of metaphor obtained from corpus-linguistic analysis. In other words, it shows how useful it is to have a stronger consideration of naturally-occurring language for testing cognitivist claims. As shall be shown, this is basically what we have done in our study.

In the field of architecture, Caballero (2006) uses an inductive, corpus-based approach to metaphor that is in line with the assumptions of CMT. Caballero's work, which is discussed in § 2.2.3.3, provides theoretical assumptions that were useful for our study.

1.8.2. Discourse approaches to metaphor

Discourse approaches to metaphor research use CMT as a starting point, rather than as a testing ground for theory. Unlike cognitivist-semantic studies, which in their early stages concentrated on isolated and invented examples, discourse studies have always dealt with naturally-occurring texts — or by default, with data elicited from participants through structured interviews. They pay special attention to the pragmatic and rhetorical potentials of metaphor, thus underscoring the spontaneousness of individual language users in discourse. According to Deignan (2005a: 124), discourse-based research can be divided into two types. The first seeks to show "how metaphors are used to present a particular message or ideology, an aim broadly within the tradition of Critical Discourse Analysis" (Deignan *ibid.*). The second aims at "looking at how speakers use metaphor to develop shared understandings as a spoken discourse unfolds" (Deignan *ibid.*). Studies of both types analyse specific text types, such as political speeches, newspaper reports, etc. They are also in consonance with the CMT because metaphors are frequently used to communicate social and political ideas.

Drawing on poststructuralist discourse theory and critical linguistics, Critical Discourse Analysis focuses on how social relations, identity, knowledge and power are constructed through written and spoken texts in communities, schools and classrooms. Metaphor studies that explicitly or implicitly are related to Critical Discourse Analysis focus on topics such as gender and race (Koller 2004; Santa Ana 1999; Van Teeffelen 1994), economics and finance reporting (Charteris-Black 2000, 2004; Boers 1999, Semino 2001), as well as politics and government (Charteris-Black 2004; Semino and

Masci 1996; Wee 2001)[14]. Within the latter, the Gulf War has received treatment from a considerable number of linguists (e.g. Pancake 1993; Rohrer 1995; Sandikcioglu 2000; Voss et al. 1992).

From a cross-linguistic point of view, Charteris-Black and Musolff (2003) use a corpus made up of copies of the British *Financial Times* and its German sister publication to compare the metaphors used to talk about the Euro in English and German. They find that both languages share certain conceptual metaphors, especially thos pertaining to up-downward movement and health domains. In her cross-linguistic work dealing with the same subject, Semino (2002) uses a corpus to show that English and Italian differ in the speakers' attitude towards the topic, rather than in cultural aspects. Other linguists, who study the way in which metaphorical mappings differ across languages are Charteris-Black and Ennis (2001), Chun (2002), Chung et al. (2003ab) and Stefanowitsch (2004). In this respect, we examined the the rationale of marine biology metaphors in English and Spanish and compared them in terms of their similarities and differences.

Charteris-Black (2004) analyses metaphor in various discourse contexts, such as politics, sports and financial reporting, and religion. By drawing on corpus evidence, Charteris-Black succeeds in integrating corpus linguistics with Lakoffian cognitive semantics and Critical Discourse Analysis, which gives rise to what he calls *Critical Metaphor Analysis*, i.e. "a way of revealing underlying ideologies, attitudes and beliefs – and therefore constitutes a vital means of understanding more about the complex relationships between language, thought and social context" (Charteris-Black 2004: 42). Based on Lakoff's two-domain approach, Charteris-Black applies a deductive methodology to elicit a set of conceptual keys. These are abstract formulations encompassing conceptual metaphors, which in turn underlie metaphorical expressions. Thus, Charteris-Black's findings also support Lakoff's notion of inheritance hierarchy, according to which metaphors can be described by their position in a hierarchy. The higher the position of a metaphor on the scale, the more abstract it is. Figure 4 reflects the inheritance system of metaphors in each type of discourse analysed by Charteris-Black and the interrelation between them.

[14] For further (domain-specific) corpus-based studies of metaphor, see Stefanowitsch and Gries (2006).

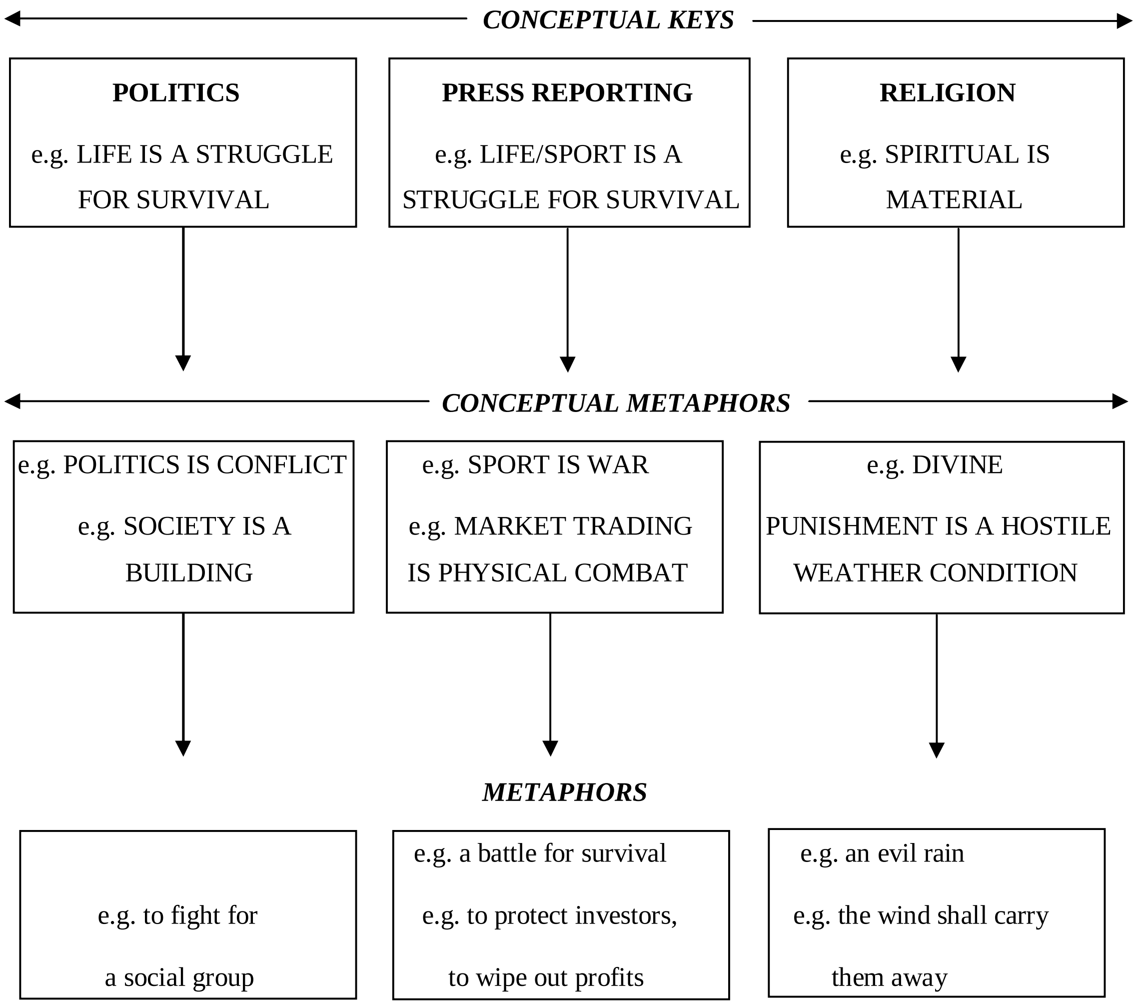

Figure 4. A hierarchical cognitive model of metaphor Charteris-Black (2004: 245).

Charteris-Black's (2004: 244) main claim is that "by analysing metaphors in a corpus it is possible to understand better the conceptual level of metaphor and how this relates to underlying ideology". Ideological assumptions and empowerment, as well as social tensions are not an issue that concerns us here. The following points are applicable to our cross-linguistic account of marine biology metaphor:

- Critical Metaphor Analysis draws on the inheritance hierarchy model, which is applicable to both conventional and novel metaphor. We also used the inheritance hierarchy model and conceptual keys to describe terminological, that is, conventional, metaphor.
- Critical Metaphor Analysis also includes the embodiment proposed by CMT, and claims that metaphorical thought is also grounded in social experience. For example, the struggle metaphor is based on physical contact in childhood or at war as well as on competition for workplace, participation in a recognisable

social group or in personal social relations. Our study also provides evidence that socio-cultural factors can also model specialised concepts through metaphor.

- Particularly interesting for our study is the methodology that Charteris-Black uses for metaphor identification within a corpus, based on metaphor keywords and candidate metaphors. This methodology will be extensively explained in § 3.5.

The second kind of discourse research is concerned with the use of metaphor as a hugely exploitable avenue towards the expression of meaning in interactive communicative situations. Recurrent topics are specialised genres such as health and education. A good example is the work by Cameron (2003) in classroom discourse. She concludes that while metaphor can facilitate understanding, it can also impede it (cf. Dirven and Verspoor 1998). Another finding is that the borderline between conventional and novel metaphors, far from being clear-cut, is often fuzzy in actual discourse, depending on the speakers' interpretations of specific metaphors.

For example, Cameron shows that sometimes children at school are presented with a conventional metaphor which they *feel* to be novel. This same fuzziness also exists in marine biology discourse, where experts sometimes disagree about the newness of particular linguistic expressions. Nevertheless, as Deignan (2005a: 40) notes, regarding concordance analysis, "the difficulty of deciding on cases of innovative metaphor arises only rarely, because innovative metaphors are infrequent". In our opinion, innovative metaphors are less frequent than terminological expressions, even in semi-specialised texts and popularisation texts.

Cortazzi and Jin (1999) show that metaphor helps teachers organise their understanding of learning and verbalise their assessments. Gwyn (1999) found that people suffering from chronic illness use both conventional and creative metaphor to understand and express their experience. Liebert (1997) implicitly supports the claim by Boyd (1993) that metaphor is often used in problem-solving talk about popular science. As already mentioned, this is of special interest to our study of marine biology metaphor as a tool for specialised knowledge popularisation.

As a summary, discourse approaches to metaphor research demonstrate the need for converging research methods and data from both a cognitive and pragmatic perspective. However, both perspectives are complementary. Whereas discourse approaches exclusively focus on corpora of spontaneously produced language, cognitivist approaches are gradually being adapted to new insights on metaphor description. These involve using corpora to explore both conventionalised and creative metaphors in different communicative contexts. Moreover, discourse studies address metaphor as a product, whilst cognitive studies also try to shed light on the psychological processes of metaphorical thinking.

2. METAPHOR IN TERMINOLOGY THEORIES

2.1. Metaphor in Science

This chapter provides an overview the evolution of metaphor in science and the treatment that it has been given by scientists and philosophers of science.

2.1.1. A shift in perspective

As Goschler (2007: 7) points out, "the question of how to deal with metaphors and analogies in scientific arguments and theories is probably as old as the philosophy of science itself". The tendency to consider metaphor as a dangerous error that diverges from scientific truth seems to have existed throughout the history of science. For instance, Aristotle argued for this idea in Ancient Greece, and so did Locke, father of Empirism, in the seventeenth century. Represented by scholars such as Ayer and Russell, Positivism — also known as *Logical Atomism* — is a philosophical school that advocated empiricism during the first half of the twentieth century. According to positivist philosophers, metaphor was a deceptive resource, which was believed to distort the content of scientific findings. From a linguistic perspective, it was regarded as an obstacle to communication.

In the sixties, experts in science, philosophy of science and epistemology begin to realise that "scientific progress not only depends on the hypothetic-deductive method, but also on the capability to create and infer" (Matarredona 2005: 129, translation). In other words, metaphor began to be recognised as a valuable instrument for specialised concept formation and denomination. Many studies have since been carried out that associate the epistemic status of scientific models with the role of metaphor in such models (cf. Boyd 1979, 1993; Hesse 1966, 1974, 1993; Kuhn 1967, 1979a, 1993, *inter alia*).

In fact, Hesse notes that whenever scientists talk shop they are employing a wealth of metaphors central to the conceptualisation and understanding of essential scientific ideas. Hesse's work is particularly relevant because it underscores the social function of the elaboration and understanding of metaphors. Arbib and Hesse (1986) consider metaphorical processes as one of the most important psychological tools to structure and broaden our knowledge of the world.

Kuhn's (1967) theory of scientific revolutions also supported this new view of metaphor. His model of scientific thinking rose to prominence for fostering a change in basic assumptions within the ruling theory of science. In other words, his model is an important contribution to the epistemological paradigm shifts in science, which he calls *scientific revolution*. Thanks in part to his claims, there is now general agreement among scientists and philosophers that metaphor pervades all forms of knowledge, and that it plays a prominent role in scientific thought.

Similarly, Brown (2003), in the field of chemistry, and Machamer (2000), in the history and philosophy of science, contend that metaphor is unavoidable in science. Keller (1995c, 1996) affirms that metaphors establish research pathways, and shows in the field of biology that metaphor brings our cultural values to scientific practice. They may even foster and help to develop research lines and certain experiments.

Weinrich (1995), a linguist closely linked to the world of science, argues that science can be created through metaphor, and that the assumption that scientists do not make use of metaphors is a myth. According to McCloskey (1964: 217), “science is a more orderly system of metaphors than occurs in poetry or in common speech”. In turn, Boyd (1993: 482) affirms that the function of metaphors “is a sort of *catachresis* — that is, they are used to introduce theoretical terminology where none previously existed”.

2.1.2. Types of metaphors in science

Although Kuhn (1967) regards metaphorical thought as a useful heuristic tool for the generation of ideas in science, he is at the same time aware that metaphor may also be a dangerous trap or obstacle, which despite initially leading to progress, later produces stagnation. Thus, it becomes clear that there are good and bad metaphors in science. The good ones are central to the creation of scientific theories and models, whereas the bad ones lead to confusion. Hesse (1974) writes that each scientific metaphor can be said to have both dispensable and indispensable implications. Dispensable implications are those that can be fairly disclaimed by theorists. When a scientific metaphor is valid, it is so clearly structured and specified that those using it know which parts of the metaphor are indispensable and which are not.

Boyd (1993) presents a typology of scientific metaphor that is now a standard reference because it also addresses the use of scientific metaphors in non-specialist discourses, an issue that has been largely neglected (Knudsen 2003: 1247). Boyd’s typology includes theory-constitutive metaphors, heuristic metaphors, and pedagogical or exegetical metaphors. Theory-constitutive metaphors are foundational to certain theoretical models and “an irreplaceable part of the linguistic machinery of scientific theory [...] metaphors which scientists use in expressing theoretical claims for which no adequate literal paraphrase is known” (Boyd 1993: 486). As examples, Boyd mentions terms from the field of computer science. For instance, thought is a type of information processing, the brain is a computer, and learning is an adaptative response of an auto-controlled machine.

Though not pre-theoretical, heuristic metaphors help develop theories and support scientific knowledge by solving or presenting new approaches to problems specific of each specialised discourse. They are used when it is difficult to express theoretical premises literally, or even when direct observation is not possible. The expression *information highway* to refer to the Internet is an instance of heuristic metaphor.

Theory-constitutive metaphors and heuristic metaphors are one of the mechanisms of thought used by experts to generate scientific ideas, and to construct hypotheses and theories. Both types of metaphor are reflected in Hoffman’s (1980: 416) statement that “metaphor is important in theorizing and can be a part of the theory”. Levinson (1995: 147) also highlights the role of metaphor in science as a constitutive element:

> Metaphor is not only central to poetry, and indeed to a very large proportion of ordinary language usage, but also to realms as diverse as the interpretation of dreams and the nature of models in scientific thought.

Once theory-constitutive metaphors and heuristic metaphors are tested and accepted, their lexicalisations take the form of terms or entrenched expressions in the lexicon of scientific thought. After a while, “the experienced scientist within the field no longer considers the metaphor to be truly metaphorical; rather it becomes an almost literal expression with specific reference, similar to any other scientific concept” (Knudsen 2003: 1248). Because of their transparent and self-explanatory nature, metaphorical terms are not only used to construct scientific models, but also to explain complex concepts to laymen. As Kugler et al. (1995: 60) point out, “terms are used by experts or technical writers to communicate the knowledge of the domain to other experts, novices and in some cases laypersons”. Meyer et al. (1997: 20) regard metaphorisation as a useful tool to bring scientific knowledge to commoners:

> This phenomenon is bound to become increasingly frequent and important. […] as we evolve into a “knowledge society”, more and more laypeople are required to understand and use technical terminology. Realizing this, the creators of technical

> terms may well increasingly prefer metaphorical terms for the conceptual clarity they provide to non-domain experts.

The knowledge society referred to by Meter et al. (1997) emerges from the general public's desire to find convincing and understandable answers that meet their basic needs. People are increasingly interested in scientific and technological issues, which help them solve their daily problems. For this reason, experts, who wish to provide clear explanations of complex processes, often find themselves not only employing metaphorical terms — which are usually conceptually clearer because of the images evoked —, but also improvising non-terminological metaphors, which have a clear pedagogical goal. Boyd calls these metaphors, *exegetical metaphors*, which, unlike theory-constitutive and heuristic metaphors, do not transmit new scientific thought. Boyd (1993: 359) describes exegetical metaphors as follows:

> There are, no doubt, a considerable variety of sorts of metaphors that play a role in science, and in theory change. Certain metaphors, which might be plausibly termed exegetical or pedagogical metaphors, play a role in the teaching and explication of theories which already admit of entirely adequate non-metaphorical (or at any rate less metaphorical) formulations. I have in mind, for example, talk about 'worm-holes' in general relativity, the description of the spatial localization ofbound electrons in terms ofan 'electron cloud', or the description of atoms as 'miniature solar systems'.

The explanatory function of metaphor has been studied in a wide range of knowledge domains, such as economics (White Hayes 1996), medicine (Salager-Meyer 1990), publicity (Cortés de los Ríos 2001), and science teaching (Bradford and Dana 1996; Ciapuscio 2001, 2004). Since exegetical metaphors have an illustrative role, Brünner and Gülich (2002) regard them as one of the mechanisms of illustration in the expert-layman interaction, along with *exemplification*, *scenes*, and *concretisation*. From a general perspective, Ortony (1979: 53) highlights the pedagogic potential of figurative language: "the great pedagogic value of figurative uses of language is to be found in their potential to transfer learning and understanding from what is known to what is less well-known and to do so in a very vivid manner".

Finally, the role of exegetical metaphors may go well beyond mere illustration. It may also extend to expressing feelings and connotations. Although the language of science tends to be impersonal, it may contain value judgements which connote demonstrations, criticism and agreement, with traces of hidden emotions, such as admiration, irony and even contempt (Kocourek 1991).

2.1.3. Integration of general language lexical units into specialised language

The previous section discussed metaphor in science, and explained that scientists and philosphers of science now acknowledge its importance for both constructing theories and explaining them to the general public. This section describes how metaphor is reflected in the language of science, more specifically, its linguistic form.

Metaphorical terms can either belong to a certain specialised knowledge domain (or an associated domain), or belong to general language. Regarding terms that belong to specialized domains, many of them do not initially appear to be metaphorical. Their meaning may seem cryptic because it stems from Greek or Latin. Such terms may belong to more than one knowledge field. Within marine biology, the following examples can be found:

- *Scyphozoa*/*escifozoo* (commonly known as *jellyfish*/*medusa*). This term comes from Greek *scyphozoa*, which can in turn be broken down into *skyphos* (top) and *zoon* (animal).
- *Cnidaria*. The root of this term is the Greek word *unid* (nettle).
- *Copepod*/copépodo. This term stems from New Latin *copepoda*, which comes from the Greek compound *kope* (oar) plus *pod* (foot).
- *Pyrosome*/*pirosoma*. This term comes from Greek *pyros* (fire) and *soma* (body).
- *Tunicate*/*tunicado*. This term originates from Latin *tunicatus* (tunic).

Although these scientific metaphorical terms are very numerous, there is a second type of metaphorical term which, apart from being very frequent, comes from general language. Experts tend to conceptualise complex realities by using general language lexical units. Such lexemes can become terms through metaphorisation (Faber and Márquez 2004; Tercedor Sánchez 1999ab, 2004). As Tercedor Sánchez (1999b: 41) points out, “it is worth analysing how concepts imported from general language progressively lose their original meaning to finally become a part of specialised domains through metaphoric extension” (translation). Faber and Márquez (2004: 214) argue that the metaphorical motivation of many terms is found in everyday concepts, in the analogy that experts establish between the entity to be designated and another closely related entity in our environment:

> Muchos términos especializados se han creado porque se ha percibido cierta similitud en cuanto a su forma, su tamaño, su actividad, etc. con respecto a un ente o aspecto determinado del contexto inmediato del hablante. Ello implica otro tipo de interpretación en el que la entidad se categoriza en términos de esa otra entidad más cotidiana.

In the same way as general language incorporates words from domains of expertise, these domains incorporate general language lexical units to their terminologies (Varantola 1986: 228; Goffin 1992: 432). Some authors call the first phenomenon ***banalisation***, and refer to the second as ***terminologisation*** (see for instance Cabré 1999a: 100).

Generally speaking, ***terminologisation*** is understood as occurring when a general language lexical unit takes on an additional meaning that provides such a lexical unit with a technical value and places it within a specific terminology. In terms of Cabré, terminologisation does not imply that a lexical unit passes from general language to specialised language, but that such a lexical unit simply adopts one of its possible meanings. It should be noted that for Cabré, lexical units belong neither to general language nor to specialised language. Rather, they fit into one sphere or the other, depending on the pragmatic features of discourse (Cabré 2007: 83). In this vein, Kocourek (1991: 180) states that a terminological sense is just another possible sense a word may acquire and that some senses can be considered exclusively from the perspective of a specialised domain, such as computing, medicine or law.

In turn, Gutiérrez Rodilla (1998: 144–145) states that terminologisation, which is an extraordinary source of polysemy, may occur in three ways:

§ By integrating a general language word into the terminology of a field of expertise. This is the case of the words *fork*/*horquilla*, which in genetics refers to a structure within a DNA molecule that looks like a fork/horquilla.

§ By incorporating a term from one field of expertise into another field of expertise. For instance, the terms *genetic map*/*mapa genético* exist as a consequence of the meaning extension of the original terms *geographic map*/*mapa geográfico*.

- By retrieving a general language or specialised language word that was out of use and incorporating it into a specialised knowledge field. Gutiérrez Rodilla (1998: 196) gives the words *palsy*/*perlesía* as an example.

These three kinds of terminologisation give rise to what are known as *sense neologisms*, i.e. elements of the system that take on a new meaning while keeping the same form (Gutiérrez Rodilla 1998: 144).

One prominent aspect of many general language lexical units that have undergone terminologisation (through metaphorisation) is their multidisciplinary nature (Meyer et al. 1998; Cabré 1999: 97). Authors such as Haensch et al. (1982), López Arroyo (2000: 82), and Méndez Cendón (2002: 32) call these units *subtechnical terms*. In contrast, other authors (e.g. Tebé 1999) refer to them as *semi-terms* or *semi-technical terms*. Méndez Cendón (2002: 24) states that “the study of subtechnical terms is very interesting, since they are words coming from general language that may be present in the discourse of all subfields of one same field” (our translation). For instance, Méndez Cendón (*ibid.*) writes that many terms from the domain of medicine “are all found scattered in the texts of the different specialities” (our translation). This is the case of *patient*, *disease*, *findings*, *evidence*, *test*, *study* and *examination*.

Banalisation, terminologisation, and multidisciplinarity are discussed by Ahmad et al. (1995: 10), who propose three types of meaning extension or adaption of a lexical unit to different areas:

- From specialised language to general language (banalisation). An example of this type is *parameter* (from mathematics to general language).
- From general language to specialised language, where metaphor has a salient role (terminologisation). An instance of this type is *mouse* (from general language to computer science).
- From the terminology of one specialised knowledge domain to another one (multidisciplinarity). This is the case of the term *virus*, whose meaning has been extended from microbiology to computer science through metaphor.

Because terminologisation through metaphor is a frequent phenomenon which pervades all knowledge domains, the corpus of marine biology texts that will be analysed in this research study was found to be a rich source of metaphorical terms stemming from general language.

2.2. Metaphor Studies in Terminology Theories

Before dealing with the theories that account for metaphor in Terminology, we will discuss how Boyd's classification of scientific metaphor has been addressed by terminologists.

2.2.1. Types of scientific metaphors in terminology

In Terminology, Boyd's (1993) three-level typology of scientific metaphor has been reduced to a two-level typology in which theory-constitutive metaphors and heuristic belong to one category, whereas exegetical/pedagogical metaphors belong to another. For instance, Temmerman (2000: 208) calls the first category *creative metaphors*, and refers to the second one as *didactic metaphors*. Furthermore, Temmerman (*ibid.*) contends that the analogical basis necessary for both these categories is provided by the Metaphorical Idealized Cognitive Models of Lakoff's experientialist semantics:

> It is possible to distinguish between the sub-m-ICMs which basically provide the analogy for creative metaphorisations (cognitive function) and the sub-m-ICMs which served for didactic metaphorisations (communicative function).

Knudsen (2003: 1259) also talks only about theory-constructive metaphors and pedagogical metaphors. She bridges the gap between both types by applying pragmatic and temporal criteria to the study of research articles and non-academic publications on genetics:

> The borderline between these two categories is more fuzzy than initially assumed. This is not to say that genuine theory-constructive or pedagogical metaphors do not exist in a pure form [...] The point is that any categorization of a metaphor has to rely on a pragmatic, diachronic analysis as well, because, as we have seen, theory-constructive metaphors can be used for pedagogical purposes, and [...] perhaps even the other way round.

Knudsen (2003: 1247) notes that depending on historical aspects, context and genre, the same metaphors are used both for creating science and explaining science: "metaphors should not be classified according to the individual expressions, but in relation to the developmental history of the specific metaphor, as well as such parameters or criteria as communicative purpose and genre".

According to Baran (2004), there are *terminological metaphors*, which are exclusively employed in communicative situations between experts, and *scientific-*

discourse metaphors, created by experts and used both by experts and laymen. Based on Assal (1994: 235–236), Baran (2004: 248) states that terminological metaphor "is essentially a way of thinking, which places this kind of metaphor in the domain of conceptualisation". Consequently, terminological metaphors also have a denominative function. In other words, they prompt for the creation of metaphorical terms, which are part of the terminologies of specialised knowledge fields.

This research study focuses on terminological metaphor. In other words, our study analyses well-entrenched metaphorical expressions that marine biology experts use in their discourse.

2.2.2. Communicative Theory of Terminology

The recognition by scientists that metaphor is a theory-constitutive tool in science took place at more or less the same time as the advent of modern Terminology, which was founded by Wüster. However, it took terminologists longer to accept that metaphor is a valid — and inevitable — source of specialised concept formation and denomination, and thus, it should be studied in Terminology.

Wüster's lectures at the *Institut für Sprachwissenschaft der Universität Wien* in 1972–74 gave rise to the General Theory of Terminology[15], whose premises were posthumously laid down by Felber (1979) in the work *Einführung in die allgemeine Terminologielehre und terminologische Lexikographie*. The General Theory of Terminology (GTT) was the first one to systematise and formalise the linguistic expressions of a domain of expertise. Being prescriptive in nature, the GTT postulates that the goal of Terminology is to achieve absolute univocity in the term-concept interaction by standardising names for concepts. This claim is known as the *Univocity Principle* or *Principle of Isomorphism*. Wüster's main objectives (*apud* Cabré 2003: 173) were:

§ To eliminate ambiguity from technical languages by means of standardization of terminology in order to make them efficient tools of communication;

§ To convince all users of technical languages of the benefits of standardized terminology;

[15] However, as Cabré (2003: 165) points out, "Wüster himself never spoke of a "Theorie"— the German word exists and is widely used — but always of "Lehre", which implies practical guidelines rather than a purely theoretical approach to a subject".

- To establish terminology as a discipline for all practical purposes and to give it the status of a science.

In accordance with Wüster, term standardisation is possible because concepts are considered to have perfectly delineated borderlines, and therefore, ambiguity should not exist. Not considering ambiguity entails that phenomena such as synonymy, terminological variation, polysemy and metaphor fall outside the scope of Terminology, since these phenomena are not consistent with the Univocity Principle and the denominative unambiguity of the GTT. As a matter of fact, Wüster's assumptions were in line with the positivist scholars of science theory and applied linguistics of the first half of the 20th century.

The Communicative Theory of Terminology (Cabré 1998c, 1999, 2000a, 2003) arose as a critical response to the reductionist and idealist tenets of the GTT. Cabré presents a more realistic view of Terminology, and proposes a descriptive — instead of prescriptive — approach to terms. The Communicative Theory of Terminology (CTT) studies how terms are actually used in communicative contexts. In other words, it describes terminological units in discourse, and analyses the discourse conditions that give rise to different types of texts. CTT is an ambitious enterprise since it endeavours to account for the complexity of specialised language units from a social, linguistic and cognitive point of view. Thus, it does not come as a surprise that the CTT is considered by some authors as the best alternative nowadays to the GTT, which is no longer valid to describe the nature of terms. For instance, Faber (2009: 114–115) states that

> CTT is probably the best candidate to replace the General Theory of Terminology as a viable, working theory of terminology. It has led to a valuable body of research on different aspects of Terminology such as conceptual relations, terminological variation, term extraction, and the application of different linguistic models to terminology. This has helped terminology as a field to get its act together, and begin to question GTT premises, which previously were not open to doubt.

Cabré (2003: 184) describes terms, which she calls ***terminological units***, as "sets of conditions" which result from, *inter alia*, the particular knowledge domain, their conceptual structure, meaning, lexical and syntactic structure and valence, as well as the communicative context (or pragmatics) of specialised discourse. Drawing on her ***Theory of the Doors***, Cabré (2003) states that terminological units are polyhedric structures, i.e. three-dimensional solid figures with a cognitive facet, a linguistic facet, and a sociocommunicative facet[16]. Each facet is a door giving access to a terminological unit. Using one door (or perspective) does not mean that the other two remain closed, but that they reside in the background, ready to be opened at any moment because all three doors are interconnected.

The CTT also departs from the GTT in that the CTT posits that a term is not subject to a denominative form, but can also be a verb, an adjective and even a preposition. Cabré (1999) argues that terms are classified in relation to form, function, meaning and origin. The function criterion refers to the role that terms play in discourse. From this standpoint "terms can be classified into various functional groups: nouns, adjectives, verbs, and adverbs (Cabré 1999: 87). The meaning criterion focuses on the class of concepts that terms designate and how these classes are expressed. According to this criterion, the following classes are identified (Cabré 1999: 87–88):

- Objects, expressed by nouns.
- Processes, operations and actions, expressed by verbs or nominalizations of verbs.
- Properties, states and qualities, expressed by adjectives.
- Relationships, expressed by adjectives, verbs, prepositions.

We thus studied metaphorical meaning in terms other than nouns in our marine biology corpus. However, in specialised language "the number of nouns is highly disproportionate in relation to the number of adjectives and verbs" (Cabré 1999: 87).

Function is a key notion in the CTT which contends that all language units are speech acts, thus being inconditionally linked to their function and the context of discourse. Unlike the GTT, the CTT accepts terminological variation, a tool to provide distinct communicative situations with the appropriate units. In this regard, Cabré (2003: 167) writes: "Wüster developed a theory about what terminology should be in order to ensure unambiguous plurilingual communication, and not about what terminology actually is in its great variety and plurality". The assumption that specialised concepts can be transmitted in different pragmatic frames through different linguistic units is known as the ***Principle of Variation***. Cabré (1998c: 63) states that this

[16] This is a parallel proposal to Budin's (1996) notion of *polyfunctionality*.

Principle applies to all terminological units, although it is subject to different degrees according to each communicative situation:

> Este principio es universal para las unidades terminológicas, si bien admite diferentes grados según las condiciones de la situación comunicativa. El grado máximo de variación de la terminología lo cumplirían los términos de las áreas más banalizadas del saber y los que se utilizarían en el discurso de registro comunicativo de divulgación de la ciencia y de la técnica; el grado mínimo de la variación sería propio de la terminología normalizada por comisiones de expertos; el grado intermedio, la terminología usada en la comunicación natural entre especialistas.

In this regard, Cabré (1999a: 122, 140) also affirms that synonymy depends quantitatively on the specialisation level of discourse.

Not only is Cabré (1993: 213) aware that terminological univocity is not always possible, but also that terms are likely to undergo polysemy and synonymy, which derive from denominative variation:

> En teoría los términos, a diferencia de las palabras del léxico común, son unidades unívocas (la relación entre forma y concepto es única) y monorreferenciales (un término solo designa un objeto). Teoría y realidad, sin embargo, no siempre corres parejas, y la terminología no es una excepción a este principio. En efecto, si analizamos la relación entre la forma y el contenido de un lexema (especializado o no), observamos que la correspondencia entre ambas partes no suele ser unívoca sino múltiple. Así, una forma puede ser portadora de varios significados (polisemia), y un concepto puede ser denominado de varias formas (sinonimia).

Since Cabré recognises the frequent incidence of terminological variation — especially in the form of synonymy and polysemy —, she leaves the door open for figurative language, where metaphor has a prominent role. As previously explained, metaphor is present in all communicative contexts as a source of specialised concept formation. Moreover, once the existence of variants and synonyms is recognised in specialised language, we will search the marine biology corpus for any possible cases of terminological synonymy.

Proof of the concern of the CTT about metaphor in specialised discourse is the work carried out by Vidal and Cabré (2004) in the subfield of genetics (human genome), where they analyse the combinations verb-noun in Spanish that bear metaphorical meaning. According to Vidal and Cabré (2004: 395), "the main feature of metaphorical combinations is that one of the constituents, the verb, undergoes a process of extension or semantic specialisation that is metaphoric in nature” (translation).

Vidal and Cabré (*ibid.*) argue that genetics includes mainly three metaphorical fields that codify many prototypical concepts in this knowledge domain, namely, war (e.g. Se ataca a los invasores/Invaders are attacked, Se recluta a las tropas invasoras/Defensive troops are recruited), agriculture (Una célula o un virus se cultivan/A cell or virus is cultivated, Los cultivos crecen, se transplantan y se siembran/Cultures grow, are transplanted and sown), and linguistic information (Las moléculas, las proteínas y los ácidos se codifican, se copian, se traducen, se transcriben, etc./Molecules, proteins, and acids are codified, copied, translated, transcribed, etc.).

Vidal and Cabré (2004: 400) come to the conclusion that it is the use of verbs in a certain specialised discourse that provides them with a specialised meaning and activates a range of specific arguments that form combinations with such verbs. Thus, two points proposed by the CTT are confirmed: (i) the importance of the communicative context is a key aspect to trigger the metaphorical specialised meaning of polysemic verbs; (ii) lexical units are abstract entities (neither words nor terms) which acquire either a general or a specialised meaning depending on the communicative context.

Although the CTT is considered to be the best candidate theory to replace the GTT, it is not without its shortcomings. According to Faber (2009: 115), CTT presents three major shortcomings:

> […] the CTT [Communicative Terminology Theory] avoids opting for any specific linguistic model. The relation of the CTT with Linguistics is more in the nature of a light flirtation with various models than a monogamous relationship with any one in particular. […]
>
> Its view of conceptual semantics is also in need of clarification. Although in a very general way the CTT bases its semantics on conceptual representation, it is more than a little vague when it comes to explaining how such representations are created, what they look like, and what constraints they would have. […]
>
> Another area in need of clarification in the CTT is semantic meaning […] the CTT seems to be avoiding the question of what specialized meaning is, and what its components are. The only clue given is when Cabré (2003:190) states that terminological meaning consists of a specific “selection of semantic features

according to the conditions of every speech act", which seems to implicitly say that she is in favor of some type of semantic decomposition.

2.2.3. Cognitive-based accounts of terminology

Over the last decade, linguistic theory is undergoing a cognitive shift (Evans and Green 2006). Like the CTT, cognitive-based terminology proposals analyse terms in co(n)text and discourse. However, they incorporate principles of Cognitive Linguistics and Psychology into their theories of category structure and concept description and representation. Relevant proposals for the present research work are Socio-cognitive Theory (Temmerman 1997, 2000, 2006), Alexiev's (2004, 2005) experientialist approach to metaphor, Caballero's (2003ab, 2006) account of metaphor in architecture, and Frame-based terminology (Faber et al. 2005, 2006, 2007)

2.2.3.1. Socio-Cognitive Theory of Terminology

The Socio-cognitive Theory (Temmerman 1997, 2000, 2006) exploits the cognitive potential of terminology and domain-specific terminological variation in the form of verbal, situational and cognitive contexts in a wide range of communicative environments (Temmerman et al. 2005). Socio-cognitive Theory holds the following five premises (Temmerman 2000: 223):

- § Socio-cognitive Theory is based on *units of understanding* which generally have prototype structure.
- § Understanding constitutes a structured event. A unit of understanding has intracategorial and intercategorial structure, and it functions in cognitive models.
- § Optimal terminological definition structure varies, depending on the level and type of specialisation of sender and receiver in communicative contexts, and ultimately, on the type of unit of understanding.
- § Synonymy and polysemy frequently occur in specialised discourse. They are functional in the progress of understanding, and therefore, must be included in any realistic terminological analysis.
- § Categories, concepts, and terms are constantly evolving. Thus, they should be studied from a diachronic perspective. In this sense, cognitive models (e.g. ICMs) play an important role in the development of new ideas.

Temmerman's terminological model is based on the empirical analysis of categorisation processes in corpora of scientific publications on life sciences. Temmerman employs a wide range of communicative contexts to show that many categories are prototypical, thus discarding the General Theory of Terminology's claim that concepts are exclusively organised in terms of IS_A and PART_OF conceptual relations. She further asserts that category boundaries are not clear-cut but fuzzy. This fact guarantees a flexible and diversified process of categorisation, which is pragmatically attested in texts, and confirms that prototypical categories can be structured in different ways (Temmerman 2000: 150).

Furthermore, Temmerman calls specialised concepts *units of understanding* to underscore the dynamic, diachronic and polysemic nature that features most of these concepts. In this way, she manages to dissociate the traditional assumption of a concept as being monosemic and synchronic. Indeed, Socio-cognitive Theory is maybe the first model of Terminology to seriously address the historical or diachronic dimension of terms, which can be traced through the evolution of units of understanding. These evolve at the same time as discoveries and scientific advances, which are in turn influenced by the socio-cultural environment. This phenomenon is known as *sociocultural situatedness* (Temmerman 2006).

Like the CTT, Socio-cognitive Theory argues for the interdisciplinarity of terms, and thus rejects the GTT's assumption that a term should only belong to one knowledge field. By highlighting the interdisciplinarity of terms, as well as the flexible and variable nature of categories, Temmerman is vindicating the existence of polysemy and synonymy in specialised language. Polysemy and synonymy are characterised by their functionality in a scenario of change and scientific evolution (Temmerman 2000: 154):

> The reasons for polysemy in some categories of the life sciences show that functional advantage is a dynamic and ongoing process, which is linked to progress of understanting. Progress of understanding forces words into flexible adaptation. The flexible adaptability if a lexeme is restricted by the structural stability of conflicting frames of understanding.

Apart from the prototypical structure of categories, Socio-cognitive Theory integrates two other major insights from Cognitive Semantics, more concretely from Lakoff's cognitivist account of language. These insights are Experientialism/ embodiment and conceptual metaphor. As concerns Experientialism and embodiment, Temmerman (1997) argues that much of what we understand arises from our sensorimotor experience:

> Much of what we know and understand about the world is embodied, is the result of our sensory perception. It should be added that the other part is the result of our reasoning, which is interactive with the input via sensory perception, and via the transfer of other language users' ideas which we take in via discourse (written and spoken) for which language is the medium.

This idea is the extension of Lakoff's (Lakoff 1987; Lakoff and Johnson 1999) claim of *embodied realism* (see § 1.2.2.) in Terminology and specialised discourse. As envisaged by the experientialist view of Cognitive Linguistics (Lakoff 1987; Lakoff and Johnson 1980, 1999), metaphor is a natural cognitive mechanism which organises thought and which emerges from the configuration of our bodies and their interaction with our environment. Consequently, it is hardly a coincidence that metaphor pervades all types of knowledge, including both everyday activities and areas of expertise. This conception of metaphor began to have an impact on terminology theory with the advent of Socio-cognitive Theory. The fact that embodiment and conceptual metaphor are strongly interrelated (Lakoff and Johnson 1999: 91) is also underlined in our study regarding marine biology metaphorical terms.

Socio-cognitive Theory pays special attention to conceptual metaphor in the fields of genetics and biotechnology (cf. Temmerman 2000, 2006). Much along the lines of Boyd (1993) in Philosophy of science, Temmerman argues that metaphorical thinking is a salient type of thought in science which is essential for scientific advance:

> Life specialists understand by means of metaphorical domains and that these metaphorical domains have left their traces in language as lexeme metaphors (Temmerman 2000: 180).

> The creative forces of linguistic reasoning are part and parcel of the creative mechanisms applied (consciously or not) when attempting the advancement of science. Metaphorical modelling can be seen as one of these creative mechanisms (Temmerman 2006: 330).

Through a historical, diachronic, semantic and discourse analytic linguistic analysis of the polysemous term *splicing* in its new usage in terminology, Temmerman (2006) illustrates the role of metaphor as a functional tool to fulfil our need for linguistic economy and create scientific terms. Temmerman also shows that the metaphorical mechanism behind lexicalisation, which may be consciously or unconsciously used, exerts a critical influence on category configuration in specialised knowledge domains. She traces the evolution of *splicing* by showing the phases of meaning extension of this word through metaphor. These phases include, on the one hand, the literal meanings in the fields of sailing, carpentry and metalwork, and on the other hand, the metaphorical meanings in the fields of film editing, as well as molecular biology and genetic engineering. The diachronic schematic representation below (Figure 5) shows how metaphor provides *splicing* with an interdisciplinary nature and how it exploits the diachronic, prototypical, and figurative dimensions of meaning.

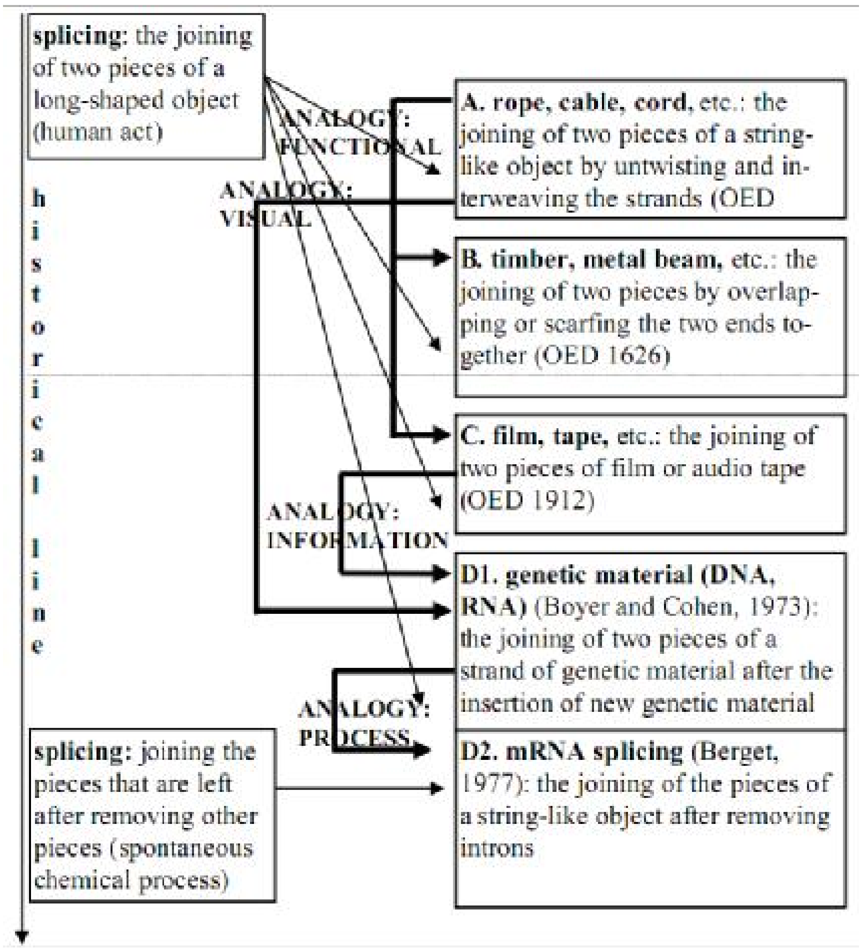

Figure 5. The meaning extension of *splicing* (Temmerman 2006: 343).

Although Socio-cognitive Theory presents an innovative perspective, it also has shortcomings. What makes socio-cognitive terminology different from other theories is its emphasis on conceptual organization from the standpoint of cognitive linguistics approaches. In effect, the most relevant shortcoming of this theory is its effort to integrate the category representation model proposed by Cognitive Semantics into terminology theory.

As previously explained, this model is based on the prototypicality of conceptual categories — as proposed by Rosch's (1978) Prototype Theory —, which are conceived of as idealised cognitive models (ICMs) — as proposed by Lakoff (1987). Prototypes and ICMs have three major disadvantages: (i) they are totally unconstrained; (ii) they are based on an open-ended inventory of conceptual relations; (iii) the resulting ICM and/or prototypical category seems to be largely based on the intuition of the modeller. This intuitive, introspective model does not say anything about the inner structure of categories, the type of information they contain, and the system of interrelated nodes they represent, which makes systematic conceptual representation an impossible enterprise. Metaphorical ICMs (m-ICMs) inherit the arbitrary nature of non-metaphorical ICMs. Logically enough, specialised m-ICMs studied by Temmerman (2000) in life sciences present this disadvantage as well.

Socio-cognitive Theory also inherits the same shortcomings of Cognitive Semantics as concerns lexical meaning representation. Cognitive Semantics proposes representation models based on semantic networks. According to Geeraerts (1995), there are three major models in Cognitive Semantics, namely, Langacker's (1987, 1991) schematic network, Lakoff's (1987) radial category network, and the overlapping set model proposed by Geeraerts himself (1989[17]). All three models take on board the prototypicality of conceptual categories and the mechanisms of meaning extension (polysemy, metaphor and metonymy). Nevertheless, none of them specifies the nature of prototypical configuration, or offers convincing criteria to specify such a nature. Temmerman (1998) applies Geeraerts' model to describe how the diachronic changes undergone by certain conceptual categories give rise to cases of terminological polysemy[18].

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[17] Other lexical meaning representation models, based either on polysemy or on semantic decomposition, are the following: (i) Jackendoff's (1990, 1992) lexical-conceptual structure; (ii) meta-entry or semantic information structure proposed by Pustejovsky's (1991, 1995) generative lexicon model; (iii) Fillmore and Atkins' (Fillmore 1976, 1977, 1982, 1985; Fillmore and Atkins 1992) frames; (iv) definitional entries proposed by Faber and Mairal's (1999) Lexical-Functional model; (v) Victorri's (1994, 1996) semantic space.

[18] Apart from Temmerman (1998), whose proposal is based on Geeraerts' model of overlapping sets, there are other authors who apply some of the lexical representation models to specialised language. For

More recently, Socio-cognitive Theory has adopted ontologies as its system of conceptual representation in an attempt to eliminate the arbitrariness and introspection-based methodology of Cognitive Linguistics. Combining terminology, ontology, and terminography has resulted in what is known as *termontography*. This is a hybrid approach which integrates the methodologies and theoretical premises of these three branches to account for knowledge representation in specialised languages (cf. Temmerman and Kerremans 2003; Kerremans, Temmerman and Zhao 2005).

2.2.3.2. An experientialist-terminological approach to metaphor in mining and civil engineering

Alexiev (2004, 2005) studied terminological metaphor in Mining, Geology, Civil Engineering, and Architecture. Alexiev presents an approach that builds upon the combination of two theoretical models, namely, Lakoff's Experientialism and Concept Theory of Terminology. This combination requires "filtering out only those elements of experientialism that are compatible with basic principles of terminological analysis" (Alexiev 2005: 36). According to Alexiev (2005), the Concept Theory of Terminology results from contributions by a wide range of terminologists from diverse theoretical backgrounds, such as Dahlberg (1992), Felber (1979, 1984), Sager (Johnson y Sager 1980; Sager 1990; Sager y Kageura 1994-1995), Gilreath (1993a), Cabré (2000, 2006), de Bessé et al. (1997), Budin (2001), and L'Homme (L'Homme, Heid y Sager 2003). This theory focuses on concept construction and formation through the definition of *concept*, which is modelled in consonance with (i) a mentalistic view, which involves definitions of *concept* containing "mental construct" or "unit of thought" as its genus (cf. Felber 1984: 103); (ii) an epistemological view, which involves definitions containing "knowledge item/unit" as its genus (cf. Dahlberg 1992; Gilreath 1993a; Johnson and Sager 1980; Sager 1994); (iii) a cognitive view, which is concerned with defining concepts as "constructs of human cognition processes" (Sager 1990: 22).

Alexiev's combined approach to terminological metaphor deals with the following issues (Alexiev 2005: 154):

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instance, Zawada and Swanepoel (1994) also use Geeraert's model, Thomsen (1997) relies on Pustejovsky's model, and Condamines (1993) takes Fillmore's frames as a reference point.

- The structuring of a model for TM [Terminological Metaphor] creation;
- The structuring of a model for CA [Contrastive Analysis] of SL [Source Language] metaphorical terms and their TL [Target Language] equivalents;
- The determination of CA procedures with recognizing the cultural specificity of TM;
- The determination of criteria for assessing the functional appropriateness of TM translation equivalents;
- The applicability of the research findings in terminography.

Alexiev carries out an interlinguistic contrastive analysis of metaphorical terms in Bulgarian, English, and Spanish with a view to filling a gap in the area of contrastive studies dedicated to metaphorical terms and their possible translation equivalents (Alexiev 2005: 43).

It should be underlined that translators translate concepts, units of thought, and not terms or linguistic expressions. Thus, they must know the place of each concept in the overall conceptual network underlying a knowledge domain, and the relations holding between concepts in this network. In this way, it is easier for translators (or any language user) to match specialized knowledge units with their correspondences in other languages.

For his contrastive analysis, and with the help of a subject specialist, Alexiev (2005: 55–56) first developed a general conceptual classification scheme of material entity categories in the specialised domain of mining, including conceptual features of these material entities, which are candidates for metaphorical transfer. He identifies two general level categories:

- NATURAL PHYSICAL ENTITIES. This category includes SURFACE LANDFORMS (with the features encoded by shape, location and size), UNDERGROUND FORMATIONS (with the features encoded by shape, spatial position, and size) and SUBSTANCES (ROCKS and MINERALS, with the features encoded by composition, properties and use).
- ARTEFACTS. This category comprises MINING STRUCTURES/PARTS OF MINING STRUCTURES (with the features encoded by shape, spatial position, and purpose) and MINING MACHINES AND DEVICES/PARTS OF MINING MACHINES AND DEVICES (with the features encoded by size; weight; parts, i.e. position and connection; operation; and function).

Alexiev (*ibid.*: 36) argues that the study of constrastive aspects of terminological metaphor to improve translation strategies of this phenomenon must be supported by structural, functional, and conceptual aspects since they help “solve the problem of the discrepancy between the theoretical inferences and the practical results of corpus analyses”. In the case that the target language metaphor is not the same as that of the source language in the sense of containing in its conceptual structure a different interactional metaphoric characteristic, Alexiev (*ibid.*: 89) proposes the three classical strategies for referent conceptualisation through metaphor: (i) preserved metaphorical conceptualisation; (ii) substituted metaphorical conceptualisation; (iii) lost metaphorical conceptualisation.

Alexiev explores the structural, functional, conceptual, and contrastive aspects of a number of metaphorical terms extracted from three corpora of terminological units. One of the objectives of his combined approach is to improve terminographical practice in the field of multilingual translation-oriented terminography, and thus bring about a higher degree of concept and term harmonisation (Alexiev 2005: 161). The first corpus, which he calls a ***representational corpus***, is monolingual, and comprises a list of 52 terms in English and their definitions excerpted from several specialised dictionaries. According to Alexiev 2005: 37, this corpus proves the applicability of the combined terminological-experiential approach to TM despite the difficulties in identifying the source domains on which the metaphorical terms in a given subject field are based. The second corpus is trilingual, and includes 22 English mining terms and their definitions, plus their Spanish and Bulgarian equivalents. Alexiev refers to this as the ***exemplary corpus***, because it serves to exemplify the importance of linguistic and conceptual factors involved in terminological metaphor translation strategies. The third corpus is a Bulgarian-English glossary containing 1308 metaphorical terms that designate material entities from Mining, Geology, Civil Engineering and Architecture. This glossary aims at improving the quality of specialised dictionary presentation by contributing terminographic strategies, particularly as regards the presentation of entries (e.g. rearrangement of items, substitution of long descriptive equivalents by more suitable equivalents, cultural substitutes, superordinates, etc.). Alexiev (2005: 38) writes that this glossary may also be regarded as a separate data base which can be used in future terminological, translation and didactic projects.

In our view, although all of these corpora are all well-structured, they are not text corpora but rather inventories of terms. As a result, they cannot be regarded as content-rich because they do not include running text from which chunks of real linguistic information (i.e. terms in context) can be obtained.

Regarding the structural aspects of terminological metaphor from a contrastive standpoint, Alexiev takes Meyer's et al. (1997) structural typology as a reference. This typology includes fully metaphorical terms (i.e. metaphorical terms with all components being metaphorical) and partly metaphorical terms (i.e. metaphorical terms with just some components being metaphorical). As for fully metaphorical terms, Alexiev further subdivides them into simple metaphor terms (e.g. *garland*) and juxtaposed metaphorical terms (e.g. *horsetail vein*). Concerning partly metaphorical terms, Alexiev establishes a structural-semantic differentiation between identifying metaphor and characterising metaphor. The former takes the form of *non-metaphorical determiner + metaphorical nucleus* (e.g. *ore pocket*), while the latter takes the form of *metaphorical determiner + non-metaphorical nucleus* (e.g. *rib pillar*).

This is a perfectly assumable classification that seems to be consistent with the standard criteria of classification of terminological nominal structures. In our research of marine biology metaphorical terms, we also analyse the components of complex nominal forms to establish comparative patterns between the way English-language and Spanish-language experts use or do not use metaphor to designate specialised concepts.

Based on principles proposed by Sager (1990: 105–113), Alexiev (2005: 118ff.) establishes three criteria for the assessment of the functional appropriateness of interlinguistic equivalents from a semasiological perspective:

- § Informativity, which includes three types of information that can be obtained from the term form (Alexiev 2005: 157):
  - (i) necessary information (its potential to reflect genus, species and relational concept characteristics);
  - (ii) correct information (its potential to designate a characteristic of a special concept by its immanently fixed meaning in general language);
  - (iii) precise information in case of identity/equivalence between the semantic values of term meaning and term designation.
- § Economy of expression, which refers to conciseness of terms.
- § Internationality, which refers to *classical internationalisms* (i.e. terms composed of Greek or Latin word components), any type of borrowings, and *conceptual internationalisms* (i.e. loan translations/calques and similes).

In our opinion, the first two criteria do not provide translators with relevant terminological information. However, the third criterion may be useful to indicate the association between a semantically cryptic Greek or Latin term and its metaphorical alternative stemming from general language, and to identify possible borrowings. However, these data are obtained basically from the form of metaphorical terms and not from their function. As a matter of fact, the function of terminological metaphor is to help in developing scientific theories by establishing analogies so that scientists understand complex concepts and construe their arguments.

According to Alexiev (2005: 40), most authors consider the conceptual aspects of TM to involve the mechanism of metaphorisation, key conceptual themes underlying the metaphorical terms in a given terminology, motivation for metaphorical transfer and distinction between conventional (conceptual) and image (one-shot) metaphors.

What makes these aspects relevant for our study is that they can be used as parameters for an inter-linguistic comparison of marine biology metaphorical terms in English and Spanish. As for the mechanisms of metaphorisation, Alexiev (2005: 66) adopts a cognitive-experientilist view of metaphorisation. However, at the same time, he proposes a new interpretation of this type of metaphorisation in specialised language:

> We suggest that within the context of TM a special referent (SR) can be interpreted as an unnamed, i.e. unfixed SRC [Special Referent Concept], resulting from partial conceptualisation of an entity which has the capacity of being further conceptualised metaphorically.

Alexiev uses the formula

> GRC (General Referent Concept) ⇒ SR (Special Referent) > SRMC (Special Referent Metaphorical Concept)

where the sign ⇒ denotes *mapping onto* and the sign > denotes *results in* to explain that the specialised concept must firstly be understood as an intermediate stage concept before becoming an entirely formed metaphorical concept by virtue of an interactional metaphoric characteristic as its structuring element.

Insofar as the traditional distinction between conventional (conceptual) and image metaphors, Alexiev does not assume Lakoff's (1993) concept *image metaphor* for a terminological analysis. His argument is the following (Alexiev 2004: 203):

> The very concept 'image TM' is inapplicable to a terminological analysis. It also is at variance with a basic assumption of 'metaphorically structured ***concepts'*** in experientialism (Lakoff and Johnson, 1980; our emphasis)". We are aware of the fact that what Lakoff probably has in mind when speaking of 'image (one-shot) metaphor' is something like a snapshot [...] Nevertheless, in view of observing the terminological principle of 'precision of expression' we deem it necessary to replace the term 'image metaphor' with the term 'non-conventional metaphor'. Thus we recognise two main types of TM: (a) *conventional TM* and (b) *non-conventional TM*.

Alexiev thus argues that by using the term *image metaphor,* Lakoff seems not to regard these metaphors as concepts, which should not be the case. Alexiev concludes that since Lakoff views them as images or mental snapshots, these metaphors cannot be considered concepts from a terminological standpoint. As shown in § 4.2.3., this is not the case for marine biology image metaphors, which are specialised *concepts* as well as *images*.

Alexiev (2005: 69–70) identifies six conventional/conceptual metaphors in his mining corpus which make explicit the most recursive conceptual themes in metaphor in this knowledge field. The conventional metaphors specified by Alexiev are the following:

- MINING MACHINES AND DEVICES/PARTS OF MINING MACHINES AND DEVICES ARE LIVING CREATURES/PARTS OF LIVING CREATURES (e.g. *automatic spider, beetle, bull bit, crab locomotive*);
- SURFACE LANDFORMS ARE LIVING CREATURES/PARTS OF LIVING CREATURES (e.g. *arm, crest, foot, valley head*);
- UNDERGROUND FORMATIONS ARE LIVING CREATURES/PARTS OF LIVING CREATURES (*belly, horse, horsetail vein, neck, orebody*);
- SUBSTANCES (ROCKS AND MINERALS) ARE LIVING CREATURES/PARTS OF LIVING CREATURES (*beetle stone, kidney ore, peacock ore*);
- MINING STRUCTURES ARE LIVING CREATURES/PARTS OF LIVING CREATURES (*dogleg, face, rib pillar, sole*); and
- PARTS OF MINING STRUCTURES ARE PARTS OF BUILDINGS (*roof, floor, wall*).

However, Alexiev (2005: 70) considers that the domain-to-domain mapping operation involved in this type of metaphors is not fully reliable since this differentiation depends on the level of generality at which they are determined. The high degree of subjectivity in specifying the scope of the respective source domains is part of the debate on whether valid insights into cognitive matters can be obtained through one's intuitions or introspections.

In our opinion, perceptions of this kind are valid as long as they are based on corpus-based data. Yet, the CMT particularly and Cognitive Linguistics as a whole are open to criticism for exclusively relying on linguistic analyses for conceptual metaphor identification. This methodology is not sufficient in itself for the specification of conceptual metaphors. As Gibbs and Perlman (2006: 212) point out, psychologists and psycholinguists voice concern about the lack of explicit criteria for identifying conceptual metaphors from a systematic analysis of conventional expressions. For this reason, the structural-conceptual metaphors specified in our study were verified against the data extracted from a large corpus of marine biology texts.

As regards motivation for metaphorical transfer, Alexiev (2005: 42) writes that there are typologies including complex motivating factors, such as the one proposed by Čitkina (1988: 46), which, besides similarity of form and function, includes similarity of purpose, process, quantitative characteristics, origin, appearance, interrelation of components and contiguity of concepts. Nevertheless, Alexiev (*ibid.*) considers that some of these criteria seem to be somewhat fuzzy, obscuring the boundary between metaphor and metonymy. For this reason, he opts for the three basic motivation types, namely, form, function, and position, apart from a mixed-type motivation. Concerning the latter, he gives the example of *gathering arm loader*, in which "the motivation for transferring the name of a body part to designate a part of a loading machine can be both form (i.e. shaped like an arm) and function (functioning as an arm)" (Alexiev 2005: 43).

Logically, we based our study on these four types of motivation since, as Alexiev argues, they occur frequently in terminological metaphor. We also provide evidence of another type metaphorical motivation, namely, material, which has hardly been considered in studies of terminological metaphor. Yet, it was also necessary to consider metonymy or contiguity of concepts as possible motivating aspects operating together with metaphor. Our introspective analysis in the field of marine biology revealed that this was also true of metaphorical terms in this knowledge domain.

Alexiev defends the role of cultural and linguistic factors in the creation of specialised concepts, which directly affects translation strategies. Alexiev (2005: 156) points out that the TM cognitive-experiential type is not a determining factor in choosing the TL conceptualisation strategy and the respective surface realisation since "the choice of a target language conceptualisation strategy and a translation technique accordingly are determined not only by cognitive, but also by language- and culture-specific factors" (Alexiev 2005: 36). A frequent language factor is the pursuit of economy of expression, which is at work, for instance, in the English-Bulgarian pair ***duckbill-*** *човка* ***(bill)***. Culture-experiential parameters which determine the choice of the designation — and thereby, the general concept to be exploited in the terminological metaphorisation process — are the following (Alexiev *ibid.*: 108–115):

- § The angle of special referent perception, which is based on the terminological metaphor designator's experience of the particular culture, and is contingent on the classification methodology adopted in the respective scientific/technological subculture (i.e. the subject field of the particular linguistic community);
- § The degree of cultural typicality of the general concept which the metaphorical concept arises from. The more prototypical a referent is in a linguistic community, or the more frequent it is experienced the more chances for such a referent to take part in metaphorisation processes.
- § Availability of a fixed general referent concept to become a *broad* (i.e. polysemous) special referent concept. The resultant predication can be spelled out as *a special referent resembling a gerenal referent concept in form/function/position (or combination or particular types of these)*. Thus, the polysemous nature of certain lexical units makes explicit cultural differences that are reflected in the linguistic expressions of (specialised) concepts.
- § The level of specificity of special referent perception, i.e. the source language culture perceives the same special referent at a higher or lower level of generality that the target language culture.

In our view, culture-specific metaphors should be differentiated from metaphors with a high degree of cultural typicality. Culture-specific metaphors are only found in a specific linguistic community. If we interpret the examples given by Alexiev, an example of culture-specific metaphor in the field of mining is *гърне* (Bulgarian term for *earthenware pot*), which is the traditional pot for cooking the national Bulgarian bean stew dish. An example of a higher degree of cultural typicality in a language is the term *martinete* (the Spanish equivalent for *beetle*), whose literal meaning is *small kingfisher*. *Martinetes* are prominent aquatic birds in Spain. The action of lifting the mining tool designated as *martinete* is compared to this bird's beak diving to catch fish. The analysis of our corpus determines whether there are cases of culture-specific metaphors in the marine biology discourse.

As earlier highlighted, there is sufficient general language research that supports that culture can shape thought and prompt cross-linguistic differences in metaphorisation patterns. In other words, people exhibit a culturalised embodied behaviour, since the model of thought and the way of structuring *realia* in a specific community of speakers is not dissociated from their linguistic manifestation, and therefore, from metaphorical patterns of thought. Based on Alexiev's claims that certain mining metaphorical terms are culturally constrained, our study also provided evidence for this in the field of marine biology.

2.2.3.3. Figurative language in built space

Another interesting study of metaphor in specialised language is that by Caballero Rodríguez (2006). Caballero gives an account of the linguistic metaphors used by architects to assess design solutions in building reviews, and the conceptual mappings that underlie such linguistic metaphors. The perspective adopted offers a view of figurative language that frames its use in real communicative situations involving specific participants, clear rhetorical aims, and straightfoward textual artefacts. It is remarkable that Caballero combines a genre approach to texts with a cognitive approach to metaphor. This combined study underlines the linguistic and textual aspects of metaphor as an instrument of both cognition and communication.

The theoretical assumptions of this research work are twofold. First, a situated description of how metaphor is used in a particular genre provides insight into its rhetorical potential. Caballero (2006: 71) writes:

> [...] The figurative language found in texts reveals a conventional mode of thinking as well as the purposeful use of language to achieve rhetorical goals in discourse interactions. In this respect, both conventional and innovative metaphorical expressions may provide useful information about the ways people think and interact in their discourse world.

Some of the rhetorical functions of metaphor in architectural discourse are to make evaluative assessments of buildings through manipulation and hedging, highlight architects' combinatory skills to create their architectural products, and describe how such organisation may be visually perceived and/or imagined in an aesthetic — and even striking — manner. As a matter of fact, the visual aspects of architectural design are especially addressed with a direct link to image metaphors, as mentioned below.

The rhetorical functions of metaphor are thus an important aspect, and concern the domain of marine biology as well, particularly as a figurative linguistic tool used by experts to explain specialised concepts to laymen. In our English-Spanish constrastive study, we will not look into the pedagogical role of metaphor since we will only be dealing with specialised texts. We have carried out an analysis concerning the cognitive processes that occur in experts' minds to create specialised concepts through metaphor. One of our near future research studies involves a psycholinguistic analysis of the linguistic expressions that experts construct to refer to such concepts, and assess their pedagogic value because they are highly imagistic.

The second outstanding contribution made by this study is to provide a principled account of image metaphor, a type of metaphor that has been shown to be particularly abundant in architecture. The weight given to visual metaphors in architectural discourse is a vindication of the cognitive importance of a class of metaphor often regarded as marginal and fleeting in cognitive linguistics. Moreover, Caballero (2006: 79–80) states that just like there are clear cases of image metaphors and clear cases of metaphors concerned with the abstract properties of built artefacts, there are also figurative occurrences that are less easy to classify as conceptual or image metaphors. These are conceptual metaphors tinted with imagistic overtones, as shown by examples (1) and (2):

(1) Cognitive linguistics is not of course the same as *cognitive grammar*, which *represents just one of the numerous strands in this loosely woven fabric*.

(2) Constructed from indigenous eucalyptus hardwoods, *this element has*, as Andresen says, "*a warp and weft as if woven from the trees*".

This finding is also relevant to our study because we have found in our corpus instances of marine biology metaphors that encapsulate both imagistic and more complex or abstract structure.

Another aspect worth mentioning is the inductive methodology used by Caballero to construct conceptual metaphors, such as ARCHITECTURE IS LANGUAGE and ARCHITECTURE IS MUSIC. These are formulations constructed retrospectively from the analysis of empirical data. Our approach to marine biology metaphor was initially inductive because we first examined an extensive body of linguistic forms in order to discover general or encompassing metaphors. However, it then became a deductive study because we semi-automatically identified further linguistic forms by relying on the source and target domains of such general metaphors. Our study demonstrates that this is a workable research methodology which contributes to solid theory formation.

Still another point that brings our research work close to Caballero's is that, although of interest to discourse analysts and genre researchers, Caballero's study fits into the approach that exploits a particular knowledge field as a testing ground for the tenets of CMT. As mentioned in § 1.8., this purely cognitive-linguistic approach departs from discourse approaches to metaphor, which use CMT only as a starting point to make claims about beliefs, power, social relations, and cultural values.

3. METHODOLOGY

3.1. Approaches to and Stages for Metaphor Identification and Processing

There are different ways of understanding, identifying, and analysing metaphor. As seen in § 1, this is also true in Cognitive Linguistics, where metaphor is studied from distinct approaches or theories. At the same time, metaphor is a complex phenomenon that occurs at different levels of language and cognition. According to Steen (2007), such levels or areas of investigation should rely on their own methodologies and techniques, while at the same be closely related. Table 1 shows these areas, each of them raising a self-contained question (Q_x) that must be answered for metaphor identification.

		Metaphor in grammar	**Metaphor in usage**
Approached as symbolic structure	*Approached as language*	Q_1 When does a conventionalized linguistic form-meaning pairing count as metaphorical?	Q_2 When does any linguistic form-meaning pairing in text and talk count as metaphorical?
	Approached as thought	Q_3 When does a conceptual structure related to a conventionalized linguistic form count as metaphorical?	Q_4 When does a conceptual structure related to any linguistic form in text and talk count as metaphorical?
Approached as behavior, whether process or product	*Approached as language*	Q_5 When does the storing, acquisition or even loss of a conventionalized linguistic form-meaning pairing count as metaphorical?	Q_6 When does the production or reception in text or talk of any linguistic form-meaning pairing count as metaphorical?

		Metaphor in grammar	**Metaphor in usage**
Approached as behavior, whether process or product	*Approached as thought*	Q_7 When does the storing, acquisition, or even loss of a conceptual structure related to a conventionalized linguistic form count as metaphorical?	Q_8 When does the production or reception in text or talk of a conceptual structure related to any linguistic form count as metaphorical?

Table 1. Areas of research for cognitive-linguistic approaches to metaphor in language (Steen 2007: 14)

According to Steen (2007), in all approaches and areas of investigation there are five stages of metaphor identification and processing. In chronological order, these stages are conceptualisation, operationalisation, data collection, data analysis, and interpretation. These five stages can also be applied to the identification of terminological metaphor, and for this reason we used them to carry out and to present our study. Accordingly, conceptualisation corresponds to our introduction (state of the art of the theoretical models of metaphor and choice of one or more of them). Operationalisation and data collection corresponds to the methodology section. Data analysis refers to the presentation of the results obtained. Interpretation corresponds to the discussion of our results.

Deciding which area(s) of metaphor research suit(s) our terminological endeavor was an essential step that had to be taken before engaging in these stages. In this respect, one of Steen's (2007: 21) major caveats is that converging evidence of *phenomenological pluralism* (addressing metaphor from a conceptual, linguistic or behavioural perspective) and *methodological pluralism* (different ways of data collection and analysis), is problematic, and has not as been achieved.

The map presented at the beginning of this chapter is based on the three main contrasts in cognitive-linguistic research, i.e. grammar vs. usage, language vs. thought, and symbol vs. behaviour. Concerning the first contrast, Steen (2007: 6) writes that "it is possible and useful to keep the study of conventional metaphor in grammar and usage apart as two distinct if related areas of cognitive-linguistic research, in order to map the field of metaphor studies".

In section 3.3.1, we provide a set of criteria to guarantee that the metaphorical expressions analysed are really terms that are totally conventionalised units from the marine biology domain. To find terms, we had to pay attention to "specific meanings of specific expressions by specific individuals in specific contexts" (Steen 2007: 37). As expected, our study ultimately found evidence of terminological metaphor at the morphological-phraseological level (e.g. *milkfish, fireworm, evolutionary arms race*), as well as at the lexical level (including grammatical categories such as verbs and simple nouns e.g. *attack, colonise, siphon*).

The second contrastive pair is language vs. thought. Lakoff and Johnson (1980) initially pointed out that not only do we often talk metaphorically but we also *think* metaphorically. As previously mentioned, conceptual metaphors are cognitive or mental units that create and organize thought by understanding one concept in terms of another, while linguistic metaphors are the formal realizations of conceptual metaphors. Evidence is provided in our marine biology corpus that linguistic metaphors are the result of complex conceptual metaphors that organise specialised thought.

As Steen (2007: 8) points out, cross-linguistic research has greatly profited from this distinction, as evidenced by cognitive-linguistic studies by Deignan, Gabrys and Solska (1997), and by Kövecses (2005). They all propose possible configurations or schemas for the metaphorical structures between any two languages (see § 3.3.4.). There are also cross-linguistic studies in specialised language, as is the case of Alexiev's work (§ 2.2.3.2.). Studies of this kind served as guidelines for our work, since one of its aims was to specify and compare the metaphorical schemas of the domain of marine biology in English and Spanish.

For cross-linguistic descriptive adequacy, it is often useful to specify which of these two areas — the linguistic or the conceptual — was tackled. However, it is also possible to focus on both (Steen 2007: 9), as was the case in our study. In this regard, we found that one aspect that impinged on both linguistic and conceptual factors was culture. In our opinion, cultural factors influence the linguistic and conceptual structure of specialised knowledge units in the domain of marine biology. In fact, cultural factors were the source of interlinguistic differences between English and Spanish in this field. Evidently, this is of great relevance in translation.

The third contrastive pair, symbol vs. behaviour, refers to the difference between the symbol-based approach, which focuses on words, and other constructions, or their related conceptual structures (Steen 2007: 395–396), and the behaviour-based approach, which deals with people and their behaviour, not signs (*ibid.*: 16) — more concretely, with psychological models of metaphorical representation in language users' minds. As for grammar, it "may either be described as symbolic structure capturing the conventionalized part of language as a sign system; or it may be studied as the mental representation and processing which captures the entrenched part of language as a cognitive capacity of individual people" (Steen 2007: 11).

The symbol-based approach corresponds to metaphor as a conventionalised semiotic phenomenon (pertaining to Q_1 and Q_3 in Table 1), whereas the behaviour-based approach refers to conventionalized metaphor as behaviour (pertaining to Q_5 y Q_7). The same contrast applies to usage (Q_2 and Q_4 for a semiotic approach, and Q_6 and Q_8 for a behaviour-based approach).

Cognitive linguists have traditionally been more concerned with the symbolic dimension of metaphor. Although our study is generally more concerned with the symbolic dimension, we have included a section on those psycholinguistic processes associated with the mental images that underlie certain marine biology metaphorical concepts.

3.2. Conceptualisation

The conceptualisation stage specifies the theoretical framework(s) which any study of metaphor is based upon. As mentioned in § 1.1, for the purposes of our domain-specific study, we largely relied on Conceptual Metaphor Theory though we also used assumptions by Primary Metaphor Theory and Blending Theory to describe the cognitive underpinnings of the metaphorical representation.

3.3. Operationalisation

Once specified which theoretical model(s) we followed in our study, our next step was to adopt operational criteria for the identification of metaphors and for the definition of metaphorical meaning. These criteria are not single monolithic entities, but rather can be regarded as "partial criteria that have to be applied in a logically ordered series of smaller decisions" (Steen 2007: 384–385). These decisions or criteria are specified below.

3.3.1. Criteria for deciding what counts as a term

A critical question that had to be answered was when a lexical unit or expression should be regarded as a term. It was essential to operationalise the terminological status of metaphorical expressions because we were dealing with units that have a specific, conventionalised meaning withing the field of marine biology. We thus brought three criteria to bear:

- § Consultation of on- and off-line resources. Adopting an authoritative source as a concrete norm of reference when deciding whether a particular (metaphorical) meaning is conventionalised provides for an independent reflection of what counts as the meanings of words for a particular group of users (Steen 2007: 97). The fact that the lexical units analysed in our study occurred in academic publications written by experts to other experts was an almost unmistakeable signal that they were really terms. Still, we consulted the on-line biology databases *Integrated Taxonomic Information System* (ITIS)[19] and *SeaLifeBase*®[20] to obtain authoritative information about marine organisms. A linguistic item will doubtlessly be a term if it has its own or shared entry in a specialised marine biology glossary or is registered in a checklist or nomenclature. The multiword unit *softcoral pipefish* is given as an example. Its entry in the *SeaLifeBase* database provides the following information:

  a) Taxonomic name: *Siokunichthys breviceps*, Smith 1963.
  b) Synonymous common name: —.
  c) Size / Weight / Age: Max. Length 15.0 cm SL male /unsexed.
  d) Environment: Reef-associated; marine.
  e) Climate / Range: Tropical.
  f) Distribution: Western Indian Ocean: Mozambique. Western Pacific: Indonesia, the Philippines, and Queensland, Australia.
  g) Short description: Uniform light cream for the type material of West Indian Ocean species; the west Pacific form has a banded pattern.

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[19] ITIS website is http://www.itis.gov/.

[20] *SeaLifeBase* website is http://www.sealifebase.org/.

h) Biology: Caught by surface dip-nets from coral rubbles and coral heads from 0 to 21.9 m. Ovoviviparous (Ref. 205). The male carries the eggs in a brood pouch which is found under the tail (Ref. 205).
i) Threat to humans: Harmless.

- Expert consultation and validation. Specialists in this field can be of great help in deciding whether a linguistic item is a term. In our case, we were fortunate to be assisted by lecturer Luis Sánchez Tocino, a marine biology expert at the Department of Animal Biology and Ecology from the University of Granada. This criterion was particularly useful to validate the terminological status of non-resemblance metaphor units since they are not included in the aforementioned databases. The reason for this is that these terms do not designate specific species of sea organisms associated with specific taxonomic designations (e.g. *brain coral*, scientific name *Goniastrea aspera*), but refer to more general types of marine organisms (e.g. *intrusive species*) and to the processes and actions (linguistically rendered by verbs) carried out by them (e.g. *colonise*).
- Frequency of occurrence. A very positive aspect about modern user dictionaries and glossaries is that they are increasingly based on corpus work, which allows conventionalisation to be measured in terms of frequencies of use across hundred of millions of words (Deignan 2005a). Nevertheless, the fact that an expression is frequent or conventionalised does not necessarily mean that it can be regarded as a term in a particular specialised knowledge domain. Therefore, corpus frequencies can only be used as a rough — and on no account conclusive — guide. However, a linguistic expression is a better term candidate if it frequently appears in specialised texts. The annotation of our corpus enabled us to obtain quantitative data, including the frequency of occurrence of the metaphorical terms that were tagged.

These three aspects are in fact regarded as an efficient framework for terminological description. For instance, Bourigaut and Slodzian (1999: 29–30) argue that such a framework should include the information extracted from texts through corpus analysis, the consultation of dictionaries, reference books, and terminological databases as well as expert validation.

3.3.2. Criteria for deciding what counts as metaphorical

Irrespective of the type of discourse, metaphor identification is often understated in current research, particularly in approaches following the experientialist cognitive tradition (Caballero 2006: 65). In fact, decisions are often taken based on intuition and random inference. To avoid this tendency in our study, we first bore in mind that the question of what is metaphorical can be approached from several perspectives (Steen 2007).

At the levels of thought (Q_3 and Q_4 on Table 1) and behaviour (Q_7 and Q_8), and as far as terminological (i.e. conventionalised) units is concerned, we are not alone in suggesting that, once metaphorical thinking is conventionalised in grammar, it is no longer metaphorically processed either as cross-domain mappings (at the conceptual level in the symbolic research area) or as mental images that merge (at the psychological level in the behavioural research area). This claim is endorsed by supporters of Class-inclusion Theory and by discourse analysts such as Cameron (2003: 66–67) and Charteris-Black and Ennis (2001). In this regard, Steen (2007: 94) notes:

> Technical or register specific terms with a metaphorical origin may be seen as direct terms within the context of their technical uses because their basic meanings are never used anymore, or at least no within that register [...]

Steen goes on to affirm that this view, which applies both to the symbolic and the behavioural analysis of metaphor, "may reflect the experience of the specialists in a particular register, who in their day-to-day practice may fail to recognize that their technical terms have a metaphorical basis". Thus, what is perceived as metaphorical by one group of speakers may not be perceived as metaphorical by another.

In this respect, in our opinion, the conceptual and psychological reality of specialised metaphoric thought is contingent on the type of user of these metaphors and the discourse context. On this basis, the metaphorical mental processes and products (proto)typically take place in the minds of (i) experts who give a novel name to new marine biology organisms and activities; (ii) experts when proposing a metaphorical alternative to a cryptic term that ends up becoming a terminological unit; (iii) laymen who have access to the names of such organisms and activities for the first time. In the rest of cases, it is dubious that such processes and products come about.

Low (1999b) argues that criteria for metaphor identification can be adopted from either an analyst-centered approach (cf. Drew and Holt 1995, 1998; Cortazzi and Jin

1999) or a user-centred approach (cf. Steen 1994; Cameron 1999b; Low 1999a). In our study, we adopted the perspective of the analyst, a layman who addresses metaphorical candidates without considering the perspective of the users (in our case, marine biology experts). The reason why we adopted the analyst's viewpoint is that marine biology experts may not be aware that the cognitive representations that underlie terms such as ***starfish*** and ***harmful algal bloom*** are of a metaphorical nature. From the analyst's perspective, metaphorical terms are given the status of novel entities whose figurative basis is to be explored.

Concerning the linguistic approach within the symbolic area, we first established a set of lexical and grammatical keywords as well as other discourse markers to set the scope of analysis of potentially metaphorical lexical units extracted from our corpus (see § 3.5.1. and 3.5.2.). These keywords and markers turned out to be good pointers to metaphorical expressions. However, there were terms that needed testing. For this reason, we devised a number of criteria for the two types of metaphor studied in this research work: resemblance metaphors and non-resemblance metaphors. The first criterion involves identifying the motivation for metaphorical transfer of the terms found in the corpus by applying a three-step procedure similar to that followed by the Pragglejaz Group (2007). This procedure tests the alleged metaphorical meaning of a lexical unit in a particular context against its non-metaphorical meaning in other contexts. The steps taken are the following:

1. To determine whether the metaphor candidate has a more basic contemporary meaning in contexts other than the domain-specific one.
2. To compare the basic meaning of the metaphor candidate with the meaning that it acquires in the specialised context.
3. To determine if the comparison of both meanings gives rise to semantic tension between them and if such semantic tension leads to referential incongruity (Caballero 2006, Kittay 1987) — or what Charteris-Black (2004) calls *domain shift*. If that is the case, then this is regarded as indicative of an instance of terminological metaphor.

As previously mentioned, this study relied on authentic data, and searched standardized observational patterns in a corpus. However, when it came to determining the figurative meaning of specialised language units, it was convenient to adopt a dictionary as a concrete norm of reference in order to have an independent reflection of what counted as the meanings of words for a particular group of users (Steen 2007: 97). Evidently, we were dealing with conventionalised expressions, and this meant that they had to be included in dictionaries or other types of reference book.

The reference sources used in this study for the English terms were the general dictionary *American Heritage® Dictionary of the English Language*, the specialised *Atlas of Marine Invertebrate Larvae*, the field guide *Sharks of the World – An Annotated and Illustrated Catalogue of Shark Species Known to Date* (volumes 1 and 2), *Encyclopedia of Marine Mammals* and the on-line marine biology database *SeaLifeBase.* For the Spanish terms, the resources consulted were the general language dictionary *Diccionario de la Real Academia Española®* and the specialised field catalogues *Guía de Identificación de los Peces Marinos de Europa y del Mediterráneo*, *Guía Submarina de Invertebrados no Artrópodos*, and *Diccionario Etimológico de Malacología*.

The term *sea scorpion* is given as an example of resemblance metaphor. The *American Heritage Dictionary of the English Language* defines *scorpion* as follows:

> Any of various arachnids of the order Scorpionida, of warm dry regions, having a segmented body and **an erectile tail tipped with a venomous sting**.

The *SealifeBase* defines *sea scorpion* as follows:

> (Member of the) family Scorpaenidae. Body compressed; head usually with ridges and spines […] Dorsal, anal, and **pelvic spines can bear venom gland**.

This description reflects the referential incongruity of this term, and thus underlines the metaphorical motivation. *Sea scorpion* was classified as a behaviour-based metaphor since the sea scorpion’s dorsal, anal, and pelvic spines have a venom gland, and thus cause the same effect as a scorpion’s sting.

The Pragglejaz Group’s method can also be applied to *escorpión marino*, the Spanish equivalent of *sea scorpion*. First of all, we determined the basic meaning (description) of *escorpión*, which, according to the *Diccionario de la Real Academia Española*, is the following:

> Arácnido con tráqueas en forma de bolsas y abdomen que se prolonga en una cola formada por seis segmentos y terminada en **un aguijón curvo y venenoso**.

We then compared the basic meaning of *escorpión* with the meaning of the multiword unit *escorpión marino*, which is provided in the *Guía de Identificación de los Peces Marinos de Europa y del Mediterráneo*. The meaning of *escorpión marino* is:

> (Miembreo de la familia) Cottidae. Cabeza con espinas y aristas óseas bien visibles en la nuca [...] **Las espinas de la cabeza pueden ser venenosas durante el período de reproducción**.

Thus, the specialised meaning of *escorpión marino* contrasts with the basic meaning of *escorpión* on account of semantic tension or referential incongruity. Therefore, the term *escorpión marino* is metaphorical.

It should be noted that, although their figurative nature was to be attested, the combination of lexical units making up multiword expressions such as these were good pointers to referential incongruity since they are clear examples of what is known as *incongruous collocation* (Caballero 2006: 68). Incongruous collocation entails the co-occurrence of two or more words whose basic meanings would be incompatible in discourse units other than that where such words co-occur.

In those cases in which the definition of a term or the description of the marine organism included no clear indicators of the possible motivation for metaphorical transfer, it was analysed in either of these two ways:

§ By exploring the linguistic context of the term in the academic article(s) in search of an explicit or implicit explanation. This was done in Wordsmith Tools with the *View Text* option in *Concord*. This function displays maximised co-text of 400 words for single concordance lines. Context (1) is an example of explicit explanation.

> (1) The bioluminescent pelagic squaloid shark, *Isistius brasiliensis* (Figure 1), has acquired the common name of '**cookie-cutter shark**' because of its very unusual feeding style, that apparently involves **extracting cookie-shaped plugs of flesh** from fast swimming, larger predators. (*Environmental Biology of Fishes* 53(3), 1998, pp. 267–273).

Curiously enough, the description of this shark on the database *SeaLifeBase* (context (2)) incidentally revealed the metaphorical motivation of *tollo/tiburón cigarro* [cigarette shark], the Spanish terminological equivalent of *cookie-cutter shark*. The dark collar of this shark resembles the tip of a cigarette (see Figure 37). Also, its thin, elongated body is compared to the shape of a cigar.

(2) The cookiecutter shark *Isistius brasiliensis* is distinctive for the prominent dark **collar** marking around its throat […] it has a characteristic **small cigar-shaped body** with two small close-set spineless dorsal fins far posterior on back, no anal fin, huge, triangular-cusped teeth without blades, short, bulbous snout and a unique suctorial lips (*SeaLifeBase*: short description of the cookie-cutter shark (*Isistius bralisiensis*, Quoy and Gaimard 1824))

Contexts (3) and (4) are examples of the implicit explanation for the metaphorical motivation of the term *fat innkeeper worm*.

(3) *Urechis caupo* (the **fat innkeeper worm**) is an echiuran which **inhabits a U-shaped burrow** in both intertidal and subtidal mudflats at three major population sites on the northern coast of California. (*Marine Biology* 113, 1992, pp. 613–623).

(4) **Several commensals dwell** within the tubes of *U. caupo*, including a small goby *Clevelandia ios*, the pinnotherid crabs *Scleroplax granulata* and *Pinnixa franciscana*, a polynoid polychaete *Hesperonöe adventor* and a small clam *Cryptomya californica* (Rice, 1980). (*Marine Biology*, 78, 1989, pp. 275–284)

Corpus data also helped to discover the non-metaphorical nature of intriguing terms. For instance, the term *mosquito fish* may mislead the reader into thinking that this animal looks and/or behaves like a mosquito. Context (5) implicitly specifies that this fish is called so simply because mosquitoes are part of its diet:

(5) Eastern **mosquitofish** *Gambusia holbrooki* Girard and western **mosquitofish** *Gambusia Gambusia affnis* (Baird & Girard) have been artificially propagated throughout the world to **fight mosquito-borne**

diseases through predation on mosquito larvae (Courtenay & Meffe, 1989). (*Journal of Fish Biology* 61(6) , 2002, pp. 1560–1585)

- By asking marine biology expert Luis Sánchez Tocino, who helped us disambiguate specific expressions. We contrasted our intuitions as linguists on particular uses of figurative language with his scientific knowledge.

- By examining images of the marine organisms. Many pictures are available in the electronic database consulted, in the journal articles that we compiled, and on the Google image search engine. Figure 6 shows a shamefaced crab (*Calappa granulata*) extracted from the database *SeaLifeBase*. The dark reddish patches on this crab's shell, which resemble the red face of a person who feels ashamed, reveal why this animal receives its name.

Figure 6. Shamefaced crab (*Calappa granulata*) (SeaLifeBase).

In sum, we tested the metaphorical nature of marine biology terms against four types of evidence: dictionary and encyclopedic information, contextual data extracted from the corpus, expert validation, and visual evidence from an online marine biology database.

3.3.3. Criteria for establishing types of metaphorical terms

Operational criteria involve, first of all, pinning down our units of analysis, since, as Steen (2007: 82) notes,

> Language and its cognitive processing and products display metaphorical meaning at many levels of organization, in both grammar and usage. For instance, linguistic forms which may express a cross-domain mapping may be pitched at the level of morphemes, lexical items, phrases, clauses, or sentences.

The analysis of data extracted from the marine biology corpus was instrumental in the specification of the types of metaphorical formalisations with specialised meaning in this knowledge field. The range of metaphor instances analysed in our study included simple and complex lexical items. It was not surprising to find many metaphorical multiword units in our corpus since, according to Deignan (2005a: 219), “syntagmatic relations may be more significant for metaphorical meanings of words than for literal ones, that is, metaphorical language tends to be more fixed than literal”.

As previously shown, the criteria to establish a typology of general language metaphor in cognitivist studies converge with those established by research on terminological metaphor (cf. Alexiev 2005; Caballero 2006). In accordance, image metaphors and resemblance metaphors are grounded in comparison entailing physical or behavioural patterns whereas conceptual-structural metaphor emerge from a more abstract and complex kind of comparison. This typology is used in the methodology section, together with the traditional motivations for metaphorical transfer suggested for image and resemblance metaphors (shape, colour, size, and behaviour). However, they are all refined in the results section. For practical purposes, in the methodology section we use the terms ***resemblance metaphors*** to refer to image and resemblance metaphors and ***non-resemblance metaphors*** to refer to conceptual-structural metaphors.

3.3.4. Criteria for carrying out a cross-linguistic analysis of metaphorical terms

In our research work the operational criteria adopted were also cross-linguistic. Thus, we did not limit ourselves to identifying and describing the linguistic renderings of marine biology metaphor and the conceptual structures underlying them, but also analysed similarities and differences between linguistic designations in English and Spanish. When comparing these linguistic designations, cross-linguistic differences emerge at the conceptual level, which can in turn be constrained by cultural factors. Therefore, apart from the linguistic and conceptual specifics of each domain of expertise, it is necessary to bear in mind the socio-cultural particulars that characterise the speech community associated to such domain. As previously remarked, culture has a direct bearing on the concepual and linguistic renderings, and thus, it can give rise to cross-linguistic differences:

> As characteristics of cultures change, so can the metaphor and its linguistic expression. In it, the cognitive and the cultural are fused into a single conceptual

> complex. In this sense, what we call conceptual metaphors are just as much cultural entities as they are cognitive ones" (Kövecses 2005: 160).

To identify formal, conceptual and cultural differences between marine biology metaphorical expressions in English and Spanish, we took into account four questions proposed by Kövecses (2005: 133):

- Is the word form in question the ***same*** or ***different*** in the two languages?
- Is the literal meaning of that word form the ***same*** or ***different*** in the two languages?
- Is the figurative meaning of that word form the ***same*** or ***different*** in the two languages?
- Is the conceptual metaphor underlying the word with that particular literal and figurative meaning the ***same*** or ***different*** in the two languages?

Insofar as the translation of metaphor, there is a consensus of opinion that a Cognitivist account of cross-linguistic metaphoric patterns is conducive to three general translation strategies: (i) the same metaphorical conceptualisation in the source as in the target language (ii) different metaphorical conceptualisations in the source and target languages (iii) metaphorical conceptualisation in the source language, but none in the target language. By the same token, in an English-Arabic constrative study, Al-Zoubi, Al-Ali and Hasnawi (2006) distinguish three types of metaphors, corresponding to the three models of cognitive mappings that they have established for metaphor translation:

- metaphors generated by the same cognitive mapping and with an identical or similar lexicalisation;
- metaphors generated by the same cognitive mapping, but with different lexicalisations;
- metaphors generated by different cognitive mappings, and thereby, with different lexicalisations.

Generally speaking, Deignan, Gabrys and Solska (1997) propose the following possible configurations between any two languages:

- Same conceptual metaphor and equivalent linguistic expression
- Same conceptual metaphor but different linguistic expression
- Different conceptual metaphors used
- Words and expressions with similar literal meanings but different metaphorical meanings

In our analysis of marine biology metaphor, we took into account all these patterns in order to create our own schema, which was elaborated after comparing marine biology metaphor terms in English and Spanish.

The term pair *bramble shark* and *tiburón de clavos* [nail shark] is given as an example of how we tested the metaphorical nature of the terms found in the corpus and how they were analysed to determine whether they were based on the same conceptual metaphor or on different ones. *Bramble shark* and *tiburón de clavos* occurred in the English and Spanish texts, respectively, together with their corresponding scientific designation *Echinorhinus brucus*. We asked ourselves the questions proposed by Kövecses (2005) for a cross-linguistic study of metaphor:

1. Is the word form in question the *same* or *different* in the two languages?

   The answer is *different*.

2. Is the literal meaning of that word form the *same* or *different* in the two languages?

   The answer is *different.*

We applied the Pragglejaz Group method to verify the metaphorical nature of these terminological units, and identified their motivations for metaphorical transfer. In both cases, the contrast between the basic meanings of *bramble* and *clavo* on the one hand, and the meanings of the terms *bramble shark* and *tiburón de clavos* on the other indicated the semantic tension/referential incongruity. In addition, the descriptions of this animal revealed the metaphorical motivation in each language:

> Basic meaning of *bramble*: A prickly shrub or bush (*The American Heritage® Dictionary of the English Language*).
>
> Basic meaning of *clavo*: Pieza metálica, larga y delgada, con cabeza y punta, que sirve para introducirla en alguna parte, o para asegurar una cosa (*Diccionario de la Real Academia Española*).
>
> Meaning (and description) of *bramble shark*: A rare, large, sluggish, deepwater shark, scientific name *Echinorhinus brucus*, found on continental and insular shelves and upper slopes. The bramble shark has **thorn-like denticles on body** which are very large (single denticles up to about 15mm in basal diameter in adults), sparse irregularly distributed […] (*SeaLifeBase*).

Meaning (and description) of *tiburón de clavos*: este tiburón, *Echinorhinus brucus* (Bonnaterre, 1788), presenta un **cuerpo grueso, con dentículos dérmicos de diversos tamaños [bulky body, with dermal denticals in different sizes]**, poco numerosos e irregularmente repartidos, dejando grandes espacios desnudos entre ellos (*Guía de los Tiburones de las Aguas Ibéricas, Atlántico Nororiental y Mediterráneo*).

We then asked ourselves the third question:

3. Is the figurative meaning of the word forms the same or different in the two languages?

   The answer is *different*.

4. Is the conceptual metaphor underlying the word with that particular literal and figurative meaning the *same* or *different* in the two languages?

   The answer is *different*.

3.4. Data collection

As stated by Steen (2007: 107), there are three methods of data collection: introspection, observation, and manipulation. Introspection implies observing one's own behaviour. Observation entails analysing the behaviour of other people in natural situations. Manipulation entails observing other people who are instructed to produce a particular language or thought behaviour.

Manifestations of metaphor come in three fundamentally different kinds: verbal data, non-verbal data, and metadata (Steen 2007: 104). Non-verbal data include pausing, reading times, eye movement, gestures, and facial expression. Researchers working on nonverbal data are usually psycholinguists who show a preference for manipulation methods. Metadata involve reflecting upon performance, its means, and its cognitive processes and products. Metadata are mainly collected by means of introspective and manipulative methods. Finally, verbal data, which include spoken or written language, can be analysed by all three methods (introspection, observation and manipulation). It is a type of data used by linguists from all schools of thought to approach metaphor both as a linguistic and a conceptual phenomenon. Cognitive linguists are not the exception.

Since they typically study metaphorical verbal data within the semiotic area, much of their reseach relies heavily on introspection and observation.

On this basis, our account of metaphor in marine biology firstly describes metaphorical language and thought as observed in natural settings (§ 3.5. and 4.1.), and secondly, as imagined in introspection (§ 4.2). Importantly, in both the empirical (observational) and the introspective approaches, we analysed metaphorical terms that were extracted from running texts.

In fact, this section presents the criteria used to select and compile a corpus of marine biology texts in English and Spanish. The application of a corpus is sanctioned by the spirit of the first approach to marine biology metaphor, an approach which is observational in nature. In fact, it presents a contrastive cross-linguistic analysis of the metaphorical units of the discourse of marine biology in English and Spanish. Thus, we approach metaphor as envisaged in the symbolic area of research. Our analysis compares the formalisations of specialised concepts in both languages, which entails a linguistic approach to metaphor, and the conceptual mappings underlying such expressions, which calls for a thought-based approach to metaphor. In our inter-linguistic study we make predictions and find evidence of the nature of conventionalised terminological metaphor. We chose not to focus on either entirely novel metaphors or improvised metaphors that arise from well-entrenched metaphor systems in the discourse of marine biology. The analysis of these metaphors is left for future research. Marine biology terminological metaphors are thus addressed from the perspective of Conceptual Metaphor Theory, combining it with assumptions held by observational approaches to metaphor

This corpus was also used for the second productive part of our research work, which deals with the psycholinguistic rationale of metaphorical terms, because we considered it necessary to examine instances extracted from real texts. Thus, although approached introspectively, the terms analysed in § 4.2. were extracted as real discourse units from our marine biology corpus. This research tackles terminological metaphor both as language (because we study how mental images are evoked through linguistic access) and thought (because we consider the complexities of cross-domain mappings).

3.4.1. Corpus selection and composition

The methodology section proposes a systematic way of finding resemblance metaphor terms, i.e. well-entrenched linguistic units with specialised meaning. These terms were extracted from a corpus of specialised texts in order to ensure authentic, naturally occurring data. According to Charteris-Black (2004: 19), corpus evidence helps the user to detect cases of inactive conventional metaphors and compensate for the arbitrariness of dictionaries.

Corpora of small-scale studies of metaphor are generally compiled by the researchers themselves. This was also the case for this study though our corpus is somewhat larger than average (4,550,190 tokens) because we wished to obtain results as objective and representative as possible. Our corpus, which was manually annotated to obtain comparative statistical data (see details in § 3.5.1.2.1., § 3.5.1.2.2., and § 3.5.2.2.), was composed of research articles in academic journals on marine biology. The Journal Citation Reports (JCR) website[21] was found to be useful for the classification and quality evaluation of the journal articles. The following factors were considered:

- Citation index of the journal
- Subject of the journals
- Topic of the articles (only English-language articles)
- Availability of complete on-line articles
- Date of publication

The Web provides quick and easy access to electronic texts, which can subsequently be compiled and processed with corpus analysis software programmes. These articles were converted into plain text *.txt* for their processing in Wordsmith Tools®, a lexical analysis programme.

The JCR is an on-line service which provides a ranking of the most cited journals published by over 3,000 publishers worldwide. Journals are ranked according to a citation index defined by the website itself. Apart from the citation index criterion, the English-language journals used were chosen, based on the prestige and reputation of the companies that publish them. With the exception of *Ciencias Marinas,* all of the journals used are published either by Springer, Blackwell or Elsevier. *Ciencias Marinas* is a Mexican bilingual journal that publishes English and Spanish research papers in all areas of marine science. This was useful to identify interlinguistic term pairs though the number of articles chosen from this journal was limited to avoid computing possible

[21] http://www.scimagojr.com/index.php.

literal translations of English terms into Spanish. Another criterion for selecting articles was their subject matter, which was as diverse as possible in order to guarantee a more varied set of metaphorical terms. The bibliographic references of the articles were compiled as well because they also contained terminological data. Finally, all articles selected were published between 1989 and 2010.

Table 2 lists the English-language journals used in this study[22].

English-language journal	JCR Citation Index	Number of articles	Number of tokens
Fish and Shellfish Immunology	0.183	34	276,929
Coral Reefs	0.127	46	365,173
Marine Biology	0.104	62	356,736
Helgoland Marine Research	0.082	22	172,441
Journal of Fish Biology	0.074	28	196,570
Environmental Biology of Fishes	0.068	31	373,249
Marine Ecology	0.063	30	235,477
Fish Physiology and Biochemistry	0.054	27	188,960
Ciencias Marinas	0.041	11	74,792
		Total: 291	**Total**: 2,240,327

Table 2. English-language journals.

Unfortunately, this classification could not be applied to the Spanish-language journals because of their low JCR ranking. Only three journals appeared on the list (see Table 3), and all had poor rankings. Although the rest of the journals in the Spanish corpus were not on the JCR ranking list, they were considered to be quality publications. The journal *Boletín del Instituto Español de Oceanografía* is published by

[22] JCR index consulted on 15 June 2010.

the Spanish Ministry of Science and Innovation. The other journals are published either on the *SciELO* (*Scientific Electronic Library Online*) or *Redalyc* (*Red de Revistas Científicas de América Latina, el Caribe, España y Portugal*) websites. These websites follow a number of strict norms, guidelines, and selection criteria that guarantee the quality of the scientific journal articles that they host[23].

Table 3 lists the Spanish-language journals used in this study.

Spanish-language journal	JCR Citation Index	Number of articles	Number of tokens
Ciencias Marinas	0.041	11	74,792
Revista de Biología Marina y Oceanografía	0.032	57	450,335
Boletín del Instituto Español de Oceanografía	0.028	64	609,998
Investigaciones Marinas	—	56	449,506
Revista de Biología Tropical	—	33	252,069
Boletín de Investigaciones Marinas y Costeras	—	56	473,163
		Total: 277	**Total**: 2,309,863

Table 3. Spanish-language journals.

3.5. Corpus processing and data analysis

After collecting the metaphorical data from the corpus, the next step was to apply a methodology to identify, process, and analyse the metaphorical units from our marine

[23] The *SciELO* website's criteria for journal evaluation and selection can be accessed at http://www.scielo.org/php/level.php?lang=es&component=44&item=2.

biology corpus. We exploited the corpus to explore the following dimensions of metaphor:

- § The symbolic dimension, where we examined metaphorical terms in English and Spanish to find cross-linguistic commonalities and similarities induced by conceptual and linguistic factors, as well as by cultural factors, which eventually constrain the other two. This examination implied identifying motivations for metaphorical transfer, discovering the cognitive mappings instantiated in the linguistic expressions, and specifying metaphorical formulations. This study draws on an observational procedure, combining qualitative research into linguistic and conceptual aspects, and quantitative analysis based on corpus-linguistic data (mainly frequency analysis and concordancing). Frequencies of metaphorical expressions help draw inferences about the productivity and incidence of metaphorical formulations. The results obtained from the analysis of the symbolic aspect of metaphor are presented in § 4.1.
- § The behavioural dimension, where we looked into the psychological underpinnings of mental imagery giving rise to metaphorical thought (this study is described in § 4.2.). Although this is a qualitative introspection-based study, all of the metaphorical terms analysed were extracted from the corpus to ensure the analysis of exclusively authentic data.

  Extensive use of the introspective procedure in Cognitive Linguistics has been greatly criticised since accounting for psycholinguistic processes and products is most reliable through experimental data analysis in observational or manipulative contexts. In our study, however, we introspectively analysed metaphorical verbal data as cognitive processes and results. Although we are aware of the shortcomings and limitations of the introspective approach, we believe that it yields insightful results within cognitive-linguistic studies of terminological metaphor[24]. At any rate, as shall be seen, some of our claims actually draw on psycholinguistic experimental research based on observation or manipulation. Moreover, although the study of metaphor as a process and result is an exercise of self-analysis, we have performed a metadata analysis insofar as conclusions are reached "in the form of judgments about conceptual issues [...]

[24] In this sense, our study is innovative, since psycholinguists have mostly focused on metaphor processing and comprehension in relatively neutral discourse contexts (Steen 2007: 353).

being off-line reflections on people’s own knowledge” (Steen *ibid.*: 387). In this case, it is marine biology experts’ knowledge that is analysed.

We first explored the corpus to look into the symbolic side of marine biology terminological metaphor. The introspective account and its results are described in § 4.2. This account uses the metaphorical terms extracted from the marine biology corpus as units of analysis.

There is a range of corpus-based studies underlying the role that metaphor plays in particular genres and discourses from a monolingual perspective (e.g. Charteris-Black 2004 in politics, press reporting, and religion) as well as a cross-linguistic perspective (e.g. Boers and Demecheleer 1997 in economic discourse; Charteris-Black and Musolff 2003, and Semino 2002 in financial reporting; Musolff 2004 in politics). Although these studies deal with specific subject fields, none of them focuses on scientific domains. Our study is innovative because it analyses terminological metaphor in a naturally-occurring corpus of texts from a cross-linguistic perspective, and applies a systematic and time-efficient method of identifying metaphorical terms in corpora. Earlier corpus-based studies of terminological metaphor (e.g. Alexiev 2005; Caballero 2006) do not propose a method of this nature, and some of them do not even analyse metaphorical terms in discourse, but rather isolated instances extracted from specialised dictionaries and glossaries (e.g. Alexiev 2005).

Regardless of the theoretical approach, discourse type, objectives, and number of languages examined, corpus research on metaphor invariably begins with linguistic expressions (Koller 2006: 241). This entails the application of a method to search the corpus for instances of metaphoric usage. This is not an easy task. Since metaphorical mappings are not straightforwardly associated with particular word forms, they cannot be retrieved automatically without difficulty (Stefanowitsch 2006: 1–2). Stefanowitsch (2006: 2–4) speaks of five strategies for extracting linguistic expressions manifesting conceptual mappings from corpora: (i) manual searching; (ii) searching for source domain vocabulary; (iii) searching for target domain vocabulary; (iv) searching for sentences containing lexical items from both the source domain and the target domain; and (v) searching for metaphors based on ‘markers of metaphor’. Strategies (i), (ii), (iii), and (v) were used to ascertain terminological metaphors in the marine biology corpus. Strategy (iv) was not applied since the results obtained with the rest of strategies were sufficiently conclusive. Moreover, strategy (iv) requires exhaustive lists of source and target domain vocabulary as well as corpora that are annotated for clause and/or sentence boundaries (Stefanowitsch 2006: 4).

For clarity of exposition of the strategies used for metaphorical term identification and retrieval, in what follows in the methodology section the analysis of marine biology metaphorical terms is divided into two main subsections. The first one deals with resemblance metaphors (based on physical appearance and/or behavioural patterns) and the second accounts for non-resemblance metaphors (based on abstract aspects that do not involve either physical appearance or behaviour). As shall be seen, the specifics of each type of metaphor call for different strategies to guarantee the optimal identification and retrieval of metaphoric terms.

Finally, an aclaration is in order before presenting the methodology itself. Tognini-Bonelli (2001) distinguishes between corpus-based and corpus-driven studies. Corpus-based research starts with existing paradigms and checks them against a corpus, while corpus-driven research begins with a clean slate or *tabula rasa*, that is, with no assumptions about what will be obtained from the corpus, to elicit new rules and categories from it. Our account of marine biology metaphorical terms can be considered to be a corpus-based study since we first extracted initial lists of words from the bilingual corpus that were part of complex terminological items from the bilingual corpus, and analysed them. Constitutive elements of these items became keywords, serving as semantic and grammatical patterns to ascertain candidate metaphorical terms.

3.5.1. Identification and retrieval of marine biology resemblance metaphors

A great number of the metaphorical terms found in our corpus are instances of resemblance metaphors, i.e. metaphors that arise from the physical or behavioural comparison between the source domain and the target domain.

Concerning their role in science, it is shown that these terms are *creative metaphor* (Temmerman 2000: 208), in other words, they fall into the heuristic type of Body's classification. The reason for this is that although they are not indispensible to make science, each term presents a striking conceptual perspective that helps marine biology experts to conceptualise the entity designated, and facilitates mental retrieval.

As previously highlighted, searching a corpus for instances of metaphorical usage is not an easy task since metaphorical mappings are not straightforwardly associated with particular word forms. For this reason, the vast majority of corpus-based research on metaphor cannot rely on annotated corpora (Stefanowitsch 2006: 2). This body of research draws on manual searching and on the four abovementioned semi-automatic strategies suggested for detecting metaphorical expressions in a corpus: (i) searching for source domain vocabulary; (ii) searching for target domain vocabulary; (iii) searching for sentences containing lexical items from both the source domain and the target domain; and (iv) searching for markers of metaphor. These four strategies yield interesting results, but they have seldom been combined in one research study. Consequently, new metaphorical patterns are often not detected.

As a way to solve this problem, this research study describes a method of finding metaphorical terms in a corpus of English and Spanish research articles on marine biology. In the first phase, the corpus was searched for target domain keywords. The great potential of this strategy has been documented by various researchers (cf. Tissari 2003; Stefanowitsch 2004, 2006; Koivisto-Alanko and Tissari, 2006), but never applied to scientific texts. Secondly, a search was made for a set of lexical markers that are typical of scientific discourse. Thanks to these markers, it was possible to find metaphorical terms that could not be retrieved by means of pre-defined target domain keywords. Besides being quicker and more effective than manual searching, the combination of both these search strategies was found to successfully retrieve metaphors, also providing interlinguistic information regarding terminological metaphor. A tagging system was also applied that further exploited such lexical markers, and helped to identify other metaphorical terms.

The advantages of manually tagging a corpus have been verified in many studies on a wide range of discourse types (e.g. Koller 2006 in business media; Sardinha 2008 in banking; Semino 2006 in prose fiction, newspaper news reporting, and biography and autobiography; Wallington, Bardnen, Buchlovsky, Fellows and Glasbey 2003, in medicine). Our tagging system was effective since it provided a quantitative account of metaphor in English and Spanish. This has valuable implications for metaphor theory because only a few studies have ever provided numerical data regarding the use of metaphor in language (Sardinha 2008: 127). Such results are also conducive to establishing a standard of comparison for cross-linguistic research on terminological metaphor. This standard is relevant because cross-linguistic variation of metaphor is one of the areas in which knowledge is currently tentative or lacking (Stefanowitsch 2006: 9).

Firstly, a preliminary, qualitative approach was carried out to find key inferences regarding metaphor in marine biology. Secondly, a quantitative analysis was performed with a view to reinforcing, and if possible, refining these inferences statistically. For this purpose, the marine biology corpus was manually annotated using a tagset that complies with the standards of conciseness, perspicuity, and analysability (Leech 1997b: 25–26). The annotated corpus was then processed with Wordsmith Tools to obtain comparative statistical data concerning the absolute frequencies of metaphor occurrences as well as the interlinguistic metaphorical term pairs that had been extracted.

Apart from the abovementioned strategies for semi-automatic retrieval, we also relied on manual searching to search for a particular type of resemblance metaphor. Genuinely manual search has satisfactorily been carried out in several studies (e.g. Semino and Masci 1996; Jäkel 1995, 1997). Jäkel (1997: 145ff) even provides a justification of this method as compared to corpus-based methods. In this respect, manual searching also turned out to be a valid strategy for finding metaphorical terms in the marine biology corpus.

3.5.1.1. Qualitative analysis

This section shows the effectiveness of the two strategies used by providing illustrative examples extracted from the marine biology corpus.

3.5.1.1.1. Extracting resemblance metaphors by means of target domain keywords

Given the significant size of the marine biology corpus, it was necessary to first search for keywords in the target domain. This strategy generally yields good results when a large body of representative and relatively monothematic texts is available (Stefanowitsch 2006: 3). It is also effective because most domain-specific terms are compound nouns, in other words, uninterrupted collocations (Nakagawa and Mori 2003: 201). This is interesting because searching for target domain lexis involves searching for complex metaphorical expressions in which at least one source domain item is required for the whole lexical unit to be regarded as metaphorical. For instance, the target domain word *fish* needs to occur with *clown* to form the metaphorical term *clownfish*.

As a starting point, frequency was taken as the main factor defining salience (Geeraerts 1997: 44; Koivisto-Alanko 2000: 47–48; Koivisto-Alanko and Tissari 2006: 194). In our view, the most frequent lexical words in a corpus are domain-relevant units indicative of large semantic classes that are a breeding ground for metaphorical thought. For this reason, the *Wordlist* function in Wordsmith Tools was used to obtain the frequency of the words in each sub-corpus. This is a crucial step because “no theory of metaphor can foresee which word forms will be used more often metaphorically” (Sardinha 2008: 128). Table 4 shows that some of the most frequent lexical words in the English corpus are nouns.

Lexical word	Frequency (number of hits)	Frequency (%)
Species	8,823	0.39
Fish	7,601	0.34
Sea	5,026	0.22
Organism	4,532	0.20
Water	4,209	0.18
Data	3,587	0.16
Cells	2,993	0.13

Table 4. Recurrent lexical words in the English corpus.

Table 5 shows some the most frequent lexical words extracted from the Spanish corpus. Among them are *agua* [water], *pez* [fish], and *mar* [sea]. This is hardly surprising since all these words are the linguistic designations of basic concepts in the domain of marine biology.

Lexical word (English translation)	Frequency (number of hits)	Frequency (%)
Especies (species [plural form])	8,317	0.36
Pez (fish)	7,209	0.31
Organismo (organism)	4,379	0.19
Agua (water)	3,874	0.16
Mar (sea)	3,298	0.14
Figura (figure)	3,094	0.13

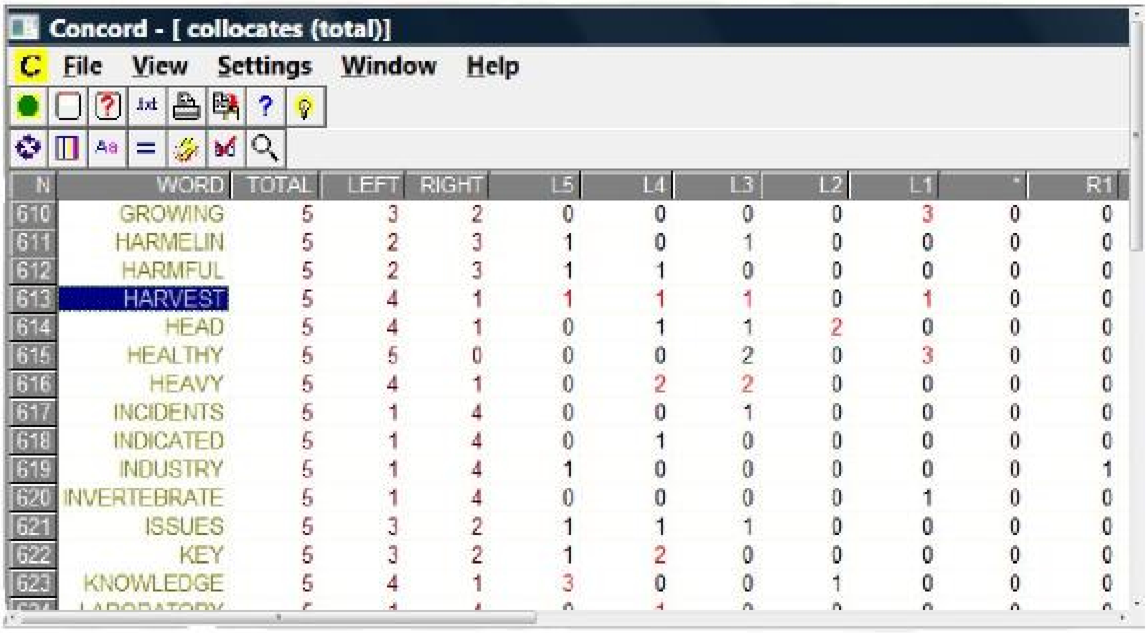
Estudio (study)	2,924	0.12
Crecimiento (growth)	2,827	0.12

Table 5. Recurrent lexical words in the Spanish corpus.

Concordancing tools are the most usual way of studying a corpus for linguistic purposes (Deignan 2005a: 78). Accordingly, concordances were generated for the keyword pairs "water/*agua*", "fish* / *pez*/*peces*[25], and "sea/*mar*" by using the *Concord* function in Wordsmith Tools. The default option of this programme for the collocational horizons of the node (five words on the left and five words on the right of the node) was maintained. Once concordances were obtained, it was necessary to filter out obvious non-metaphorical occurrences, since the frequency of the keywords in the corpus generated a lot of noise.

For enhanced data discrimination and candidate identification, the *Show collocates* function in Wordsmith Tools was used. This function yielded a list of collocates for each keyword in English and Spanish. This list includes the number of occurrences of collocates in each of the five positions on the left and right of the node. Figure 7 shows an English-language sample list of collocates, where *harvest* is highlighted. This collocate was regarded as a component of the potentially metaphorical term *harvest fish* because it occurred in the first position to the left of the node *fish* (L1), and does not originally belong to the field of marine biology, but rather to agriculture.

[25] Wordsmith Tools allows to append an asterisk (*) to (truncated) words to search for longer units.



N	WORD	TOTAL	LEFT	RIGHT	L5	L4	L3	L2	L1	*	R1
610	GROWING	5	3	2	0	0	0	0	3	0	0
611	HARMELIN	5	2	3	1	0	1	0	0	0	0
612	HARMFUL	5	2	3	1	1	0	0	0	0	0
613	HARVEST	5	4	1	1	1	1	0	1	0	0
614	HEAD	5	4	1	0	1	1	2	0	0	0
615	HEALTHY	5	5	0	0	0	2	0	3	0	0
616	HEAVY	5	4	1	0	2	2	0	0	0	0
617	INCIDENTS	5	1	4	0	0	1	0	0	0	0
618	INDICATED	5	1	4	0	1	0	0	0	0	0
619	INDUSTRY	5	1	4	1	0	0	0	0	0	1
620	INVERTEBRATE	5	1	4	0	0	0	0	1	0	0
621	ISSUES	5	3	2	1	1	1	0	0	0	0
622	KEY	5	3	2	1	2	0	0	0	0	0
623	KNOWLEDGE	5	4	1	3	0	0	1	0	0	0

Figure 7. List of collocates of *fish* where *harvest* is highlighted.

Based on previous knowledge of the English terminology in the field, we also concordanced the form **fish*, since complex terms can be written as separate words (multi-word items) or as compounds without spaces (see concordance pairs (1) and (2) below). Although not so frequent, we also took into account the Spanish word *marino* (i.e. coming from or living in the sea).

The *Clusters* option (with the default settings *Words in cluster*: 3 and *Horizons*: 5L-5R) was also useful for semi-automatic data discrimination and metaphor candidate identification. For example, whereas Spanish-language clusters such as *desde el mar* [from the sea] and *mar filtrada a* [sea filtered to] were discarded, the prepositional phrase *de mar* [from the sea] was found to be a frequent component of potentially metaphorical complex terms. A good example is *pepinos de mar* [sea cucumbers] in Figure 8. The *Clusters* function also indicates the number of occurrences of each cluster. This is very useful since frequency of occurrence usually provides evidence of the extent to which a linguistic metaphor has become conventional in a language. As can be seen, *pepinos de mar* occurred 16 times in the Spanish sub-corpus. The clusters *de mar que* [from the sea which] and *de mar se* [from the sea], also with 16 hits each, were also potential pointers to metaphor candidates.

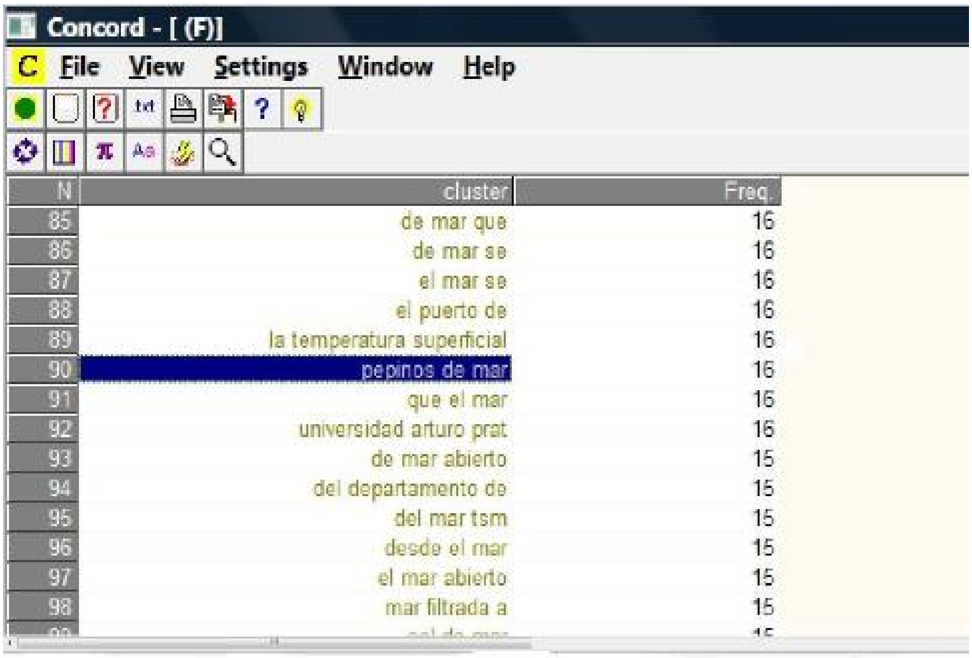


Figure 8. List of clusters where *pepinos de mar* is highlighted.

Many English and Spanish resemblance metaphor terms were extracted from the corpus by these procedures. From a qualitative perspective, the concordance lines in both languages showed that the metaphorical terms in one sub-corpus had the same linguistic formalisation as metaphorical terms in the other sub-corpus (literal translation equivalents), which could well indicate that both languages share conceptual metaphors to designate the same specialised concepts. For this reason, they are regarded as *exact pairs*. Extended concordance pairs in (1) and (2) are given as examples:

(1) Significantly lower fungal growth rates on extracts of *G. cf. mariae* than *G. ventalina* support the hypothesis that *G. cf. mariae* is more chemically resistant to aspergillosis. When comparing **sea fan** disease across different regions of the Yucatan, we detected significantly higher prevalence in *G. ventalina* near Akumal than further north near Cozumel and Puerto Morelos. (*Marine Biology*, 149(6), 2006, pp. 1355–1364)

Aunque en Colombia, se han llevado a cabo evaluaciones de la estructura de la comunidad de gorgonáceos en varias localidades (Botero, 1987; Sánchez, 1995 y 1999; Sánchez *et al.*, 1997), no existe información reciente sobre el estado y el desarrollo de las poblaciones del **abanico de mar** 15 años después de la mortalidad masiva. (*Boletín de Investigaciones Marinas y Costeras*, 35(1), 2006, pp. 77–90)

(2) Numerically and in biomass, the **lanternfish** is the dominant fish in the vast pelagic region of the Southern Ocean bounded on the north by the Antarctic Convergence and in the south by the Antarctic continental shelf. (*Marine Biology*, 133(1), 1999, pp. 145–158)

El método numérico determinó que la presa más representativa fue el **pez linterna** *Benthosema panamense* (38,0%; n=305), seguido por el scianido *Larimus argenteus* (31,3%; n=252), *Sardinops sagax* (9,2%; n=74) y *Merluccius gayi* (9,2%; n=74) (Tabla 1). (*Revista de Biología Marina y Oceanografía*, 42(1), 2007, pp. 59–69)

The coral *sea fan* receives its names because its flat, circled shape resembles that of a fan. The behaviour of the lanternfish is compared to the functioning of a lantern because of the photophore, a light-producing organ used by the lanternfish as both a defence and a mating strategy.

Even though target vocabulary retrieval shows great potential for metaphor candidate identification, it is not without its shortcomings. In fact, it is often criticised for capturing only subsets of metaphor occurrences since it only considers high-frequency lexical words. However, to avoid solely drawing on high-frequency words, we concordanced basic-level names, such as crab*/*cangrejo**, shark*/*tiburón**, and dolphin*/*delfín**. The advantages of this procedure have been highlighted in several studies (cf. Tissari 2003; Stefanowitsch 2004, 2006; Koivisto-Alanko and Tissari 2000, 2006), but had not been previously documented in scientific discourse. Stefanowitsch (2006) calls it *metaphorical pattern analysis*. A metaphorical pattern is “a multi-word expression from a given source domain (SD) into which one more specific lexical item from a given target domain (TD) have been inserted” (Stefanowitsch 2006: 66).

Many collocates of these entity names revealed potentially metaphorical complex terms designating types of crab, shark, and dolphin as shown in (3).

(3) Off Patagonian coasts, Argentina, the **dusky dolphin** is one of the most common small cetaceans. (*Marine Biology*, 152(1), 2007, pp. 165–177)

The dusky dolphin’s back is dark brown/black, a colour similar to that of dusk (the darker stage of twilight). Exact pairs were also found, as extended concordances in (4) and (5) show.

(4) Abstract Ninety four scalloped **hammerhead sharks**, *Sphyrna lewini* (53 females and 41 males) ranging in size from 121 to 321 cm total length (TL), were collected from surface gillnetters operating off northeastern Brazil and throughout the southwestern equatorial Atlantic Ocean between January and December 1996. (*Environmental Biology of Fishes*, 61, 2001, pp. 151–159)

2004 Nota científica Presencia del **tiburón martillo** *Sphyrna zygaena* (Carchariniformes: Sphyrnidae) y nuevo registro del tiburón espinudo *Echinorhinus cookei* (Squaliformes: Squalidae) en San Francisco, Chile central (*Investigaciones Marinas*, 32(2), 2004, pp. 141–144)

(5) The **silky shark**, *Carcharhinus falciformis*, and scalloped **hammerhead**, *Sphyrna lewini*, represent >80% of the shark by-catch of the winter **swordfish**/tuna longline fishery of the northwestern Gulf of Mexico. (*Environmental Biology of Fishes*, 19(3), 1989, pp. 161–173)

Los juveniles y adultos prereproductivos del **tiburón sedoso**, *C. falciformis*, fueron los más abundantes en las capturas de la unidad pelágica y tiburonera, por lo tanto sostienen la pesquería durante la mayor parte del año. (*Revista de Biología Marina y Oceanografía*, 42(3), 2007, pp. 403–413)

The metaphorical motivation of *hammerhead shark/tiburón martillo* is evident since the head of this shark is has the same shape as a hammer. The silky shark is called so because of its extremely soft skin, which is compared to silk.

The analysis of these concordances resulted in the extraction of units from a variety of source domains. Since these units were indirectly signalled by target domain items, they were not used to find complex metaphorical candidates designating marine organisms. The terms from the land animal domain were found to be particularly salient in both languages, and exact pairs were even identified, such as (6) and (7):

(6) These species represent the most abundant scraping and excavating **parrotfish** species on inshore reefs. Grazing scars of each species were marked, measured and observed for seven consecutive days. (*Marine Biology*, 156(4), 2009, pp. 771–777)

Dentro de la familia Scaridae (**peces loro**), *Sparisoma radians* fue vista solamente en las estaciones SP. (*Boletín de Investigaciones Marinas y Costeras*, 37(1), 2008, pp. 111–127)

(7) The pea crab *Dissodactylus crinitichelis*, the **spider crab** *Epialtus brasiliensis* and a suite of xanthoids undertook considerable releasing activity in both periods. (*Marine Biology*, 151(5), 2007, pp. 1989–2002)

M. gregaria es una especie característica de las comunidades de fondos blandos, y junto al **cangrejo araña**, *Eurypodius latreillei*, son los decápodos mas importantes de la comunidad bentónica del golfo. (*Revista de Biología Marina y Oceanografía*, 42(3), 2007, pp. 221–229)

Parrotfish/*peces loro* are thus named for their dentition, which includes numerous teeth tightly arranged on the external surface of the jaw bones. The teeth form a parrot-like beak with which these fishes rasp algae from coral and other rocky substrates. Spider crabs/*cangrejos araña* resemble spiders because of their extremely long legs.

3.5.1.1.2. Extracting resemblance metaphors by means of lexical markers

The lexical markers used in our study were the following: (a) taxonomic designations[26]; (b) scientists' names; (c) the lexical phrases *known as* and *conocido/a como*.

3.5.1.1.2.1. Taxonomic designations

The concordances and collocates showed taxonomic names (particularly species names) to be extremely productive lexical markers for metaphorical terms in English and Spanish. Taxonomic names (species names) were then collected from the co-texts of the previously extracted metaphorical, and from the checklists in the academic journal articles in the corpus. Taxonomic designations are used by experts to guarantee referential accuracy. However, as shall be seen, synonymy is a quite common in specialised discourse.

[26] The taxonomic designation of a species is the Latin name in binomial nomenclature used by the scientific community to classify such a species into a specific taxon. The first and the second constituents of the binomial refer to the genus and the specific name, respectively. Both constituents must be written in italics (e.g. *Dicentrarchus labrax*).

Many English and Spanish metaphorical terms co-occurring with their corresponding taxonomic designations were found. These were generally names of sea organisms (especially fish and invertebrates). Apart from a desire for referential precision, another reason for this type of co-occurrence is that taxonomic designations strengthen the terminological status of their common names. The taxonomic designations associated with a metaphorical term in one language were concordanced in the sub-corpus of the other language to establish comparative interlinguistic patterns. This strategy permitted the identification of exact pairs, as shown by the extended concordances in (8):

(8) In order to study this enzyme in elasmobranchs, partial cDNA clones of 3β-HSD were isolated from steroidogenic tissue of the blacktip shark (*Carcharhinus limbatus*), **southern stingray** (*Dasyatis americana*), and the **spiny dogfish shark** (*Squalus acanthias*). The deduced amino acid sequences of the elasmobranchs were 40-44% identical to mammalian 3 β-HSD sequences, and approximately 50% identical to the **rainbow trout** (*Oncorhynchus mykiss*) form. (*Fish Physiology and Biochemistry*, 19(4), 1998, pp. 293–304)

Entre las especies de mayor valor económico de los Andes venezolanos, se encuentran la **trucha arcoiris** (*Oncorhynchus mykiss*), introducida en 1935 (Ginés et al. 1952) (*Revista de Biología Tropical*, 46(3), 1998, pp. 775-782)

The term *rainbow* trout was detected in the corpus by examining the co-text of *spiny dogfish shark*, which was in turn identified by retrieving expressions containing the basic-level keywords *fish* and *shark*. The metaphorical motivation of *rainbow trout* and its exact equivalent, *trucha arcoiris*, is colour since this fish has brightly colored longitudinal bands on each side of its body, similar to those in a rainbow.

As shown in the English text of concordance (8), the distributional behaviour of linguistic metaphors facilitated the identification of further metaphorical terms, which occurred in close proximity to the lexical marker *Oncorhynchus mykiss*. Metaphor distribution across texts has been assessed by various discourse researchers (e.g. Martin 2006 and Cameron 2007). They found that linguistic metaphors are not evenly distributed, but rather occur in clusters in discourse (Cameron 2007: 121). Also, the occurrence of a given metaphor increases the chances for this metaphor to be used again in the subsequent discourse (Martin 2006). Still another example supporting this claim is given in (9) and (10).

(9) A small assemblage of reef fishes that included the **cherubfish**, *Centropyge argi*, **sunshine chromis**, *Chromis insolata*, **greenblotch parrotfish**, *Sparisoma atomarium*, **yellowcheek** wrasse, *Halichoeres cyanocephalus*, **sargassum triggerfish**, *Xanthichthys ringens*, and the **longsnout butterflyfish**, *Chaetodon aculeatus* was most abundant or only present from stations deeper than 30 m, and thus appear to be indicator species of mesophotic habitats. (*Coral Reefs*, 29, 2010, 277–288)

(10) Se describen tres anomalías: el pico de guadaña en el chinchilín, *Quiscalus niger* (Boddaert) (Passeriformes: Emberizidae), un patrón de color de corona en el **isabelita medioluto [little Isabel in half-mourning**], *Holacanthus tricolor* (Bloch) (Perciformes: Pomacanthidae), y un patrón de color de doble mancha en el **vaca blanca [white cow]**, *Hypoplectrus unicolor* (Walbaum) (Perciformes: Pomacanthidae). (*Revista de Biología Tropical*, 54(3), 2006, pp. 161–169)

Among the abovementioned terms are interesting metaphors, such as *sunshine chromis* and *isabelita medioluto*. The metaphorical motivation of *sunshine chromis* involves the comparison of the bright-yellow colour of the back of this fish and the bright sun beams. Although approximately half of the body of the fish *isabelita medioluto* [little Isabel in half-mourning], is yellow, the other half is black, hence the name.

The repetition of one metaphor throughout a discourse unit can also be traced visually with the dispersion plot function in Wordsmith Tools, which graphically represents the distribution of a specific lexical item in a text. Figure 9 shows the spread of the term *hermit crab* (ascertained by concordancing the keyword *crab**) in each of the ten corpus articles where it occurred. This crab receives its name because it lives by itself inside its shell. This behaviour is compared to that of a hermit, who is a recluse and lives withdrawn from society in a solitary retreat.

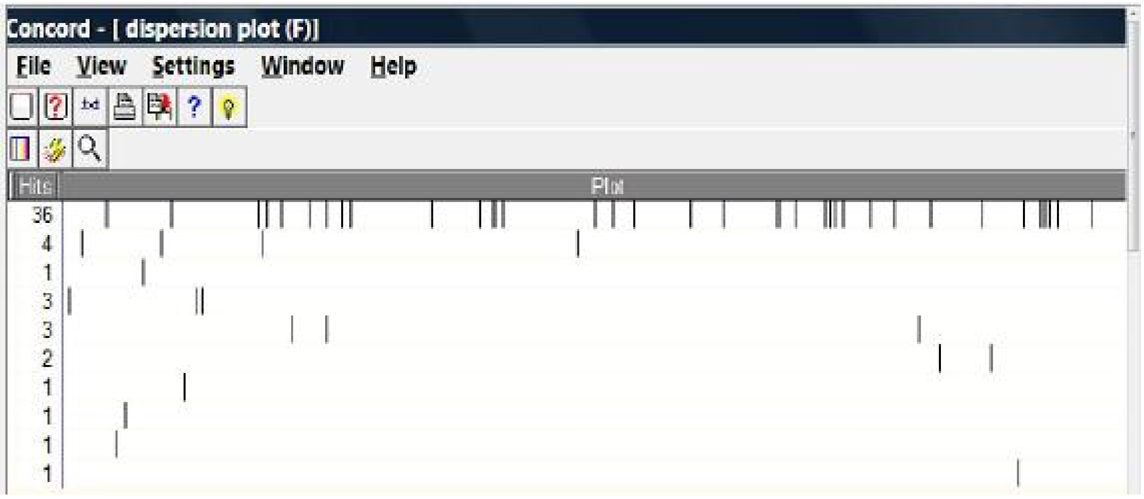


Figure 9. Dispersion plot of the term *hermit crab*.

The first article in the corpus (*Local, regional and global patterns of resource use in ecology: hermit crabs and gastropod shells as an example*) focused on this animal, which explains the 36 occurrences of *hermit crab*. The other articles had 1–4 occurrences.

However, a number of concordances also revealed a tendency to use metaphorical names only at the beginning of the articles, and rely on taxonomic names thereafter. This supports the existence of what Partington (2006, p. 268) calls *genre-specific metaphor*, which refers to the particular behaviour of metaphor in different genres or discourse types. Figure 5 shows two extended concordances of the term *sea lettuce* (a type of alga that resembles a lettuce in shape and colour), where the authors either clearly state (Figure 10, concordance 2) or imply (Figure 10, concordance 1) that the name *Ulva* (*lactuca*) will be used in the remainder of their articles.

Figure 10. Extended concordances of *sea lettuce*.

The analysis of taxonomic designations also revealed a curious type of interlinguistic term pair. Though based on the same conceptual metaphor, in these pairs one term focuses on a more or less specific/generic aspect of the source conceptual domain than the other term does. This phenomenon has been described in general language studies. Kövecses (2005: 154), for instance, calls it *degree of specificity*. We will call these metaphorical term pairs *partial pairs*. Concordances (11) and (12) are given as an example.

(11) The myotomal fibres of the pectoral fins of **white croaker** (*Micropogonias furnieri*) have been studied using histochemical techniques and transmission electron microscopy (TEM). (*Fish Physiology and Biochemistry*, 35(3), pp. 317–323)

(12) El objetivo del presente trabajo es realizar un análisis osteológico descriptivo y comparativo que permita la identificación, a través de los elementos óseos, de las principales especies de peces presentes en Mar Chiquita: la saraca (*Brevoortia aurea*), la lisa (*Mugil platanus*), el pejerrey de mar (*Odontesthes argentinensis*), la **corvina rubia** (*Micropogonias furnieri*), la corvina negra (*Pogonias cromis*), el lenguado de fango (*Paralichthys orbignyanus*), la anchoa de banco (*Pomatomus saltatrix*), la pescadilla de red (*Cynoscion guatucupa*) y la burriqueta (*Menticirrhus americanus*). (*Revista de Biología Marina y Oceanografía*, 43(2), 2008, pp. 355–380)

Croaker and *corvina* [raven-like] are a partial pair. *Croaker* is a generic concept that refers to the land animals that produce a specific sound (ravens and other animals, such as frogs), and this aspect is mapped onto the target conceptual domain FISH. In contrast, *corvina* straightforwardly refers to the particular type of bird that produces that sound, which is a raven. This aspect is likewise mapped onto the target domain FISH. Both *croaker* and *corvina* belong to the source conceptual domain LAND ANIMALS THAT PRODUCE A CROAKING SOUND, but there is a clear differentiation in specification.

The presence of exact pairs in the corpus opened the door to the possible existence of two other types of interlinguistic term pairs: (i) those whose constituents were based on different metaphors; (ii) those in which only one constituent was metaphorical. Type (i) term pairs were regarded as *separate pairs*, and type (ii) as *unbalanced pairs*. These pairs were significant in themselves because of the scarcity of studies addressing cross-linguistic variation of metaphor, especially in specialised language. However, it was impossible to attest the existence of separate pairs at this stage of our study since, as the quantitative analysis later revealed, this type did not occur as frequently as exact pairs. In contrast, we came across an unbalanced pair by concordancing taxonomic designations, as shown in (13).

(13) We determined age and growth, size at maturity, and fecundity for **cownose rays**, *Rhinoptera bonasus*, collected from the northern Gulf of Mexico. (*Environmental Biology of Fishes*, 73(3), 2005, pp. 321–331)

Otros autores describieron la estructura de los folículos del ovario en *Urolophus jamaicensis* y *Dasyatis americana*, basada en la descripción de los tipos de células y tejidos que componen el trofonemata para estas especies, encontrando marcadas diferencias con otras como *Rhinoptera bonasus* y *Myliobatis* sp. Los hábitos reproductivos para *R. percellens* han sido mencionados sólo de manera descriptiva. (*Revista de Biología Marina y Oceanografía*, 43(3), 2008, pp. 469–481)

The cownose ray has a broad head with wide-set eyes, and a pair of creased lobes on its subrostral fin. This causes it to resemble a cow's nose and head.

3.5.1.1.2.2. Scientists' surnames

The analysis of taxonomic designations revealed that they usually co-occurred with the surnames of the scientists who first described the species. The surnames of two of the most prominent taxonomers, Carl Linnaeus and Georges Cuvier, were concordanced to search for any possible designations that could only be found in the body of the text because they were not included on the checklists consulted. Figure 6 highlights the metaphoric term *bib*, which occurred close to the lexical marker *Linnaeus*. The metaphorical motivation of this term is shape because it designates a fish whose lower jaw has a barbel, similar to a baby's bib. Figure 11 also reveals the metaphorical term *boarfish* (concordances 53 and 55), thus named because of its projecting snout and bright red colouring.

37	les escleractA-neos Diploria labyrinthiformis (Linnaeus 1758) y Montastraea annularis (
38	marine clam species, Venerupis decussata (Linnaeus, 1758) and Venerupis pullastra (
39	editerranean sea, whereas Zostera marina Linnaeus, 1758 and Zostera noltii Horneman
40	d metallothionein genes from Sparus aurata Linnaeus, 1758 and Liza aurata (Risso, 18
41	s miliaris (Gmelin), and Echinus esculentus Linnaeus to conspecifics were tested in a c
42	s miliaris (Gmelin), and Echinus esculentus Linnaeus. We tested the hypothesis that es
43	eneral numerical increases in Aurelia aurita (Linnaeus, 1758) over much of the study ar
44	n and fecundity of the bib Trisopterus luscus (Linnaeus, 1758) (Pistes, Gadidae) in the c
45	e reproduction of the bib Trisopterus luscus (Linnaeus, 1758) off the coast of Asturias (
46	oalgae, including Enteromorpha compressa (Linnaeus) Greville, E. linza (Linnaeus) J.
47	graphical locations of syntypes. The text of Linnaeus is based on specimens from his
48	read or cosmopolitan species. Aurelia aurita (Linnaeus) has been considered a good exa
49	trachus puntactus (Bloch, 1792), D. labrax (Linnaeus, 1758), Sparus aurata (Linnaeus,
50	laris (Schmidt, 1862) and Spongia officinalis (Linnaeus, 1759) and from the alga Dictyot
51	st species The clams Venerupis decussata (Linnaeus, 1758) and Venerupis pullastra (
52	cryptic species of Ostreidae, Ostrea edulis (Linnaeus, 1758) 380 and Ostreola stentin
53	Another species, the boarfish Capros aper (Linnaeus 1758), is common in North Atlan
54	Predator species, such as Mumena helena Linnaeus, 1758 and the genus &t.Gnephrlu
55	Another species, the boarfish Capros aper (Linnaeus 1758), caugth along the Portugue

Figure 11. Concordances of *Linnaeus* where *bib* is highlighted.

Concordance (44) in Figure 11 is significant because it provides evidence of the existence of single-word metaphorical terms in marine biology. Consequently, it also shows the relevance of taxonomic designations as good lexical markers of the different linguistic manifestations of resemblance metaphor.

3.5.1.1.2.3. Known as and conocido/a como

The English phrase *known as* and its Spanish equivalent *conocido/a como* were concordanced. As lexical markers, they signalled the presence of a number of metaphorical terms in both languages. They were particularly useful as indications of metaphorical terms co-occurring with taxonomic designations that were not included in the checklists, and those metaphorical terms that did not contain any of the basic-level keywords (fish, *pez*, etc.). However, these markers turned out to be less decisive than taxonomic designations and basic-level keywords, as shown in (14–16).

(14) In Europe, *Ostrea edulis*, the European flat oyster, and *Ostreola stentina*, also known as the Provence oyster or **dwarf oyster**, are both present along the European and African, Atlantic and Mediterranean, coasts. (*Marine Biology*, 150(1), 2006, pp. 103–110)

(15) Los ejemplares de Pomacentridae capturados en diferentes oportunidades en la costa de Valdivia (ca. 39º48'S) (Fig. 1), suman seis ejemplares, que al ser analizados taxonómicamente con claves especializadas y comparándolos

con otros de colecciones de peces del Instituto de Zoología de la Universidad Austral de Chile, resultaron ser inequívocamente pertenecientes a *C. crusma* (Valenciennes, 1833), comúnmente conocida como "**castañeta**" [**castanet**] (Fig. 2) (*Investigaciones Marinas*, 33(1), 2005, pp. 101–107)

(16) Esta laguna es muy importante por su gran diversidad faunística, incluyendo al "fósil viviente" *Limulus polyphemus* L. (Arthropoda), conocido como **cacerolita de mar [little sea saucepan]**, especie endémica de las Penínsulas de Yucatán y Florida (Gómez 1993). (*Revista de Biología Tropical*, 46(3), 1998, p.p. 487–492)

The dwarf oyster is compared to a dwarf because of its small size. *Castañeta* [castanet] is a roundish fish that resembles a castanet, a round percussion musical instrument that is very common in Spain. Round shape is also the metaphorical motivation for the chelicerate *cacerolita de mar* [little sea saucepan], which resembles a small saucepan.

The lexical markers *known as* and *conocido/a como* provided resemblance metaphor forms that differed from the terms previously found, i.e. terms designating sea organisms. These new terminological forms were nouns designating body parts of sea organisms, not the organisms themselves. A much less numerous set of body part metaphors were identified by means of *known as* and *conocido/a como*. Since they are not associated with any taxonomic designations, their semi-automatic retrieval clearly entails a strategy that does not exclusively draw on the previously lexical markers[27]. Although manual searching was a satisfactory procedure to find further cases (see § 3.5.1.1.3.), a possible strategy to apply in future research would be to establish a set of keywords from source domains productive in this knowledge field and search for them in the corpus. Concordances (17) and (18) show two occurrences of body part metaphor terms found in the English and Spanish corpora by concordancing *known as* and *conocido/a como*.

[27] We came across a considerable number of resemblance metaphors designating body parts of marine organisms while exploring the co-text of taxonomic designations and the basic-level keywords (e.g. *pico de guadaña* [scythe tip] and *corona* [crown] in concordance 8). However, this is obviously not a (semi-)automatic procedure.

(17) *Hippolyte obliquimanus* showed sexual dimorphism in the third pereopod, absence of **coupling hooks** (also known as *cincinnuli*) in the first pleopod, and no reduction of the appendix masculina in the largest males. (*Marine Biology*, 154, 2008, pp. 127–135)

(18) En larvas de ostra Japonesa (*Crassostrea gigas*) se ha investigado principalmente la enfermedad viral que afecta al **velo [veil]**, conocida como OVVD (Elston y Wilkinson, 1985) la que produce elevadas mortalidades en criaderos. (*Investigaciones Marinas*, 27, 1999, pp. 111–114)

Finally, *known as* and *conocido/a como* showed some cases of synonymy involving metaphorical common names in English and Spanish[28]. We were already aware of the existence of synonymy in marine biology because some entries in the databases consulted included synonymous common names of the main terms. For instance, the entry of *tiburón galano* [adorned shark], *Negaprion brevirostris*, in *SeaLifeBase* shows that this shark can also be called *tiburón limón* [lemon shark]. However, we always sought to find occurrences of terminological variation in running texts. Concordances (19) and (20) show two examples of synonymy extracted from our corpus by means of the markers *known as* and *conocido/a como*:

(19) Modern stomatopods (also known as **mantis shrimps**) are placed in 7 superfamilies with over 450 species that occur mostly in coral reef environments. (*Marine Biology*, 150(2), 2006, pp. 213–220).

(20) Con este propósito se ha escogido a *Fissurella crassa*, conocida como "lapa de sol" [**sun limpet**] en el norte de Chile (Bretos 1978) o "**lapa ocho**" [**eight limpet**] en la zona central y sur del país (*Revista de Biología Marina y Oceanografía*, 33(2), 1998, pp. 223–239).

The term *mantis shrimp* is striking because it has a double metaphorical motivation. The term does not designate either a terrestrial praying mantis or a shrimp, but rather a type of sea crustacean that shares several features with both these animals. It resembles a mantis in behaviour (aggressive and solitary) and in physical appearance (big, round

[28] Synonymy does not concern morphosyntactic variation of terms. Cases of this variation were also identified in the English sub-corpus (e.g. sea-fan/sea fan, clownfish/clown fish).

eyes). It is also similar to a shrimp because it has an elongated body with multiple short legs. As for the term *lapa ocho,* it refers to a limpet whose shape is more ellipsoid than normal, and which resembles the number *eight*. The term *lapa de sol* is not metaphorical. It refers to the fact that this limpet usually clings onto rock clefts where it is easily reached by the sunlight.

One of the advantages of relying on corpus evidence is that "it shows instances of performance rather than competence" (Koller 2006: 239). A signal of the performative condition of a corpus of specialised data is precisely the presence of terminological synonyms and variants, phenomena which have been documented, for instance, in medical texts (cf. Tercedor and Méndez 2000). Thus, these two instances of synonymy could well point to further cases of terminological variation, as was finally the case in our study.

3.5.1.1.3. Extracting resemblance metaphors by means of manual searching

As previously argued, manual searching turned out to be a rather productive strategy to find instances of body part metaphor terms both in English and Spanish. At this stage, the bilingual journal *Ciencias Marinas* was of great help to determine how each language conceptualises body parts of marine organisms metaphorically. Many of the interlinguistic term pairs identified were exact pairs, as contexts (6) and (7) show.

(6) Age and growth of the annular seabream *Diplodus annularis* off the Canary Islands (Central-east Atlantic) were studied. The length range of fish was between 82 and 209 mm in total length. Otoliths showed clear **growth rings**. Two **rings**, one opaque and one translucent, were laid down each year on the otoliths.

(7) Se determinó la edad y el crecimiento del raspallón *Diplodus annularis* de las islas Canarias. Los **anillos de crecimiento** anuales se observaron con claridad en los otolitos. Cada año se formaron dos **anillos**, uno de crecimiento rápido y otro de crecimiento lento. (*Ciencias Marinas*, 28(1), 2002, pp. 1–11)

As with partial term pairs featuring marine organisms, the corpus also contained partial term pairs featuring body parts of marine organisms. Many articles compiled from the monolingual Spanish-language journals consulted, such as *Investigaciones Marinas*, included one abstract in Spanish and one abstract in English as well as captions of figures in both languages. This enabled us to find a considerable number of interlinguistic pairs featuring body part metaphors, including partial pairs. A case in point is given in contexts (8) and (9).

(8) The ovary of this species […] has an unusually well developed system of **hemolymphatic vessels** within the **muscular wall** and extensions of it.

(9) Tanto en la **pared muscular** como en las extensiones se observaron numerosos **vasos hemolinfáticos**.

(*Investigaciones Marinas*, 28, 2000, pp. 175–194)

Contexts (8) and (9) include an example of exact pair, that is, *muscular wall*/*pared muscular*, and an example of partial pair, which is *hemolymphatic vessel*/*vasos linfáticos*. This is a partial pair because the concept *vessel* is more generic than *vaso* [glass] though both belong to the source conceptual domain RECIPIENTS FOR LIQUID, which initially caused the conceptual metaphor to emerge.

We also came across some separate term pairs and unbalanced term pairs by scrutinising bilingual abstracts. Contexts (10) and (11) include the separate pair *gill rakers*/*branquiespinas* as well as the exact pair *arch*/*arco*. It should be noted that in those case where a metaphorical word forms a part of a complex terminological unit, such as *gill raker* and *branchial arch*/*arco branquial*, the whole unit was marked bold to help situate the metaphorical words conceptually. This was done for all types of terminological metaphor in this research study.

(10) A single shoal of northern anchovy (*Engraulis mordax*) was captured and sampled in Baja California, Mexico. The fish were sized, weighed and the first **branchial arch** of the left side was used for counting the number of **gill rakers**.

(11) Un cardumen de anchoveta (*Engraulis mordax*) fue capturado y muestreado en Baja California, México. Se midieron y pesaron los peces, y se contó el número de **branquiespinas [branchial spines]** de su primer **arco branquial** izquierdo.

(*Ciencias Marinas*, 21(3), 1995, pp. 281–293)

Contexts (12) and (13) show an instance of unbalanced pair in which only the English term is metaphorical.

(12) The egg showed spiral segmentation, followed by gastrulation through epiboly, the formation of a non-typical trochophore and veliger larva. The embryos fed on the egg yolk. **Nurse eggs** were not observed.

(13) Los huevos tuvieron segmentación espiral seguida de una gastrulación por epibolia con la formación de larvas trocóforas no típicas, y veliger. Los embriones se alimentaron del vitelio contenido en el huevo. No se observó la presencia de **huevos nutritivos [nutritional eggs]**.

(*Ciencias Marinas*, 30(2), 2004, pp.297–310)

All of the instances of body part metaphors shown so far emerge from comparison in shape (physical appearance). *Nurse egg* is an example of a body part metaphor that is not based on physical appearance but rather on function/behaviour. A nurse egg is an egg that is used by embryos as an additional food resource. For this reason, it is compared with a nurse because both are meant to guarantee the survival of individuals.

A case of unbalanced pair in which only the Spanish term is metaphorical is given in contexts (14) and (15).

(14) Males with zero **tooth dentine layers** have skulls slightly smaller than those of females but they grow faster.

(15) Los machos con cero **bandas de dentina [dentine bands]** presentan cráneos ligeramente menores que los de las hembras pero se desarrollan más rápido. (*Ciencias Marinas*, 26(1), 2000, pp. 145–176)

Figures 12, 13, and 14 were extracted from an article of the journal *Investigaciones Marinas* (34(1), 2006, pp. 43–62). Figure 14 shows the corresponding bilingual captions of Figures (12) and (13).

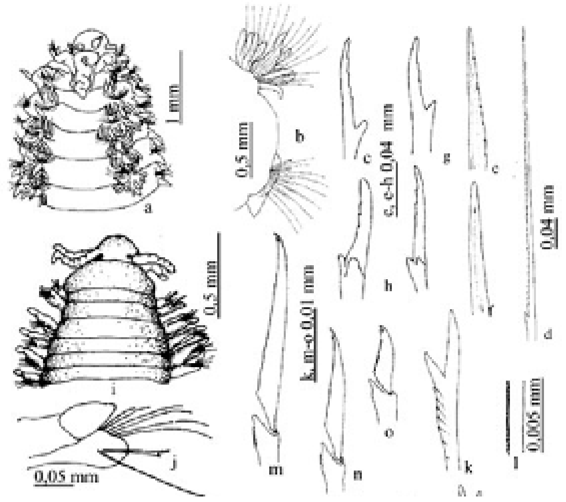


Figure 12. Body parts of *Pareurythoe chilensis* (I).

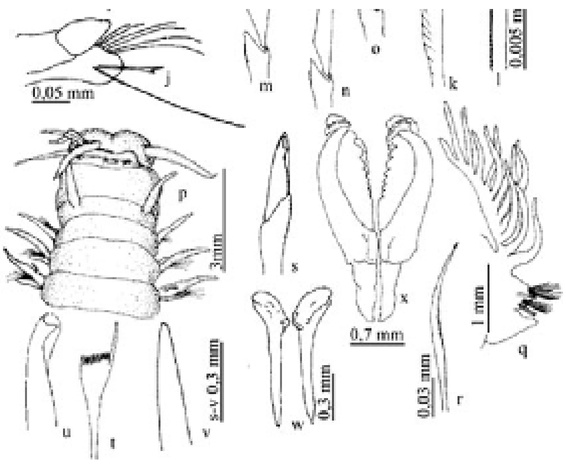


Figure 13. Body parts of *Pareurythoe chilensis* (II)**.**

Figura 1. *Pareurythoe chilensis*: a) extremo anterior, en vista dorsal, b) parápodo medio, c-d) notosetas furcadas, e-f) notosetas arponadas, g) neuroseta furcada, h) neurosetas aciculares; *Schistomeringos longicornis*: i) extremo anterior, en vista dorsal, j) parápodo medio, k) seta furcada, l) detalle de la seta capilar con margen serrado, m-o) setas compuestas; *Eunice* cf. *pennata*: p) extremo anterior, en vista dorsal, q) parápodo medio, r) seta superior, s) seta compuesta, t) seta pectinada, u) gancho subacicular, v) acícula, w) mandíbulas, x) complejo maxilar.
Figure 1. *Pareurythoe chilensis*: a) anterior end in dorsal view, b) middle parapodium, c-d) spurred notosetae, e-f) harpoon notosetae, g) spurred neuroseta, h) acicular neurosetae; *Schistomeringos longicornis*: i) middle parapodium, k) forked seta, l) detail of the capillary seta with serrated edge, m-o) compound setae; *Eunice* cf. *pennata*: p) anterior end in dorsal view, q) middle parapodium, r) superior seta, s) compound seta, t) comb seta, u) subacicular seta, v) aciculum, w) mandibles, x) jaws.

Figure 14. Captions of images in Figures 12 and 13.

Table 6 lists the types of term pairs found in Figure (14).

Exact pairs				
English terms		Harpoon notosetae	Serrated edge	Comb seta
Spanish terms		Notosetas arponadas	Margen serrado	Seta pectinada
Unbalanced pairs				
Only the English term is metaphorical	**English**	Spurred notosetae	Spurred neuroseta	Forked seta
	Spanish	Notosetas furcadas	Neuroseta furcada	Seta furcada
Only the Spanish term is metaphorical	**English**	Subacicular seta		
	Spanish	Gancho subacicular [subacicular hook][29]		

Table 6. Exact pairs and unbalanced term pairs extracted from Figure 14.

To attest the metaphorical nature of body part metaphor terms and determine their motivation for metaphorical transfer, we consulted the glossaries of technical terms in the field guides *Encyclopedia of Marine Mammals*, *Sharks of the World – An Annotated and Illustrated Catalogue of Shark Species Known to Date* (volumes 1 and 2), *Guía Submarina de Invertebrados no Artrópodos*, and *Diccionario Etimológico de Malacología*. These glossaries include definitions of the terms and descriptions of their corresponding specialised concepts, which also provided us with their metaphorical motivation. Entries 1 and 2 are given as examples.

[29] This is an accidental unbalanced pair since the metaphorical term *hook*, the literal translation equivalent of *gancho*, exists in the English marine biology terminology (e.g. *coupling hook* in Table 15). In this case, the writers preferred to use the non-figurative term *seta* in the English text, whereas they decided on *gancho* to emphasise the hook-like shape of this body structure in the Spanish text. However, they also used *seta* in the Spanish text, as in *seta superior* (superior seta).

(1) Nasal curtain

> Anterior **nasal flaps that are expanded medially and posteriorly and have fused with each other**. Nasal curtains are found in some carcharhinoid sharks and in many batoids. (*Sharks of the World – An Annotated and Illustrated Catalogue of Shark Species Known to Date*, volume 2, p. 23)

(2) Penacho branquial [branquial tuft]

> En poliquetos, **estructura a manera de plumero [tuft-like structure]** resultado de la modificación de apéndices del segmento preoral o prostomio, implicada en la respiración y alimentación. (*Guía Submarina de Invertebrados no Artrópodos*)

The drawings and pictures that some articles include (e.g. Figures 12 and 13) were also of great help. In any case, as can be seen, body part metaphors are highly imagistic, which facilitated to determine their motivation.

3.5.1.2. Corpus annotation and quantitative analysis

Corpus annotation has been shown to yield optimal results concerning different aspects of metaphor description. Manual tagging is the most frequent type of corpus formatting. For instance, Semino (2006) annotates her corpus to describe a specific kind of metaphorical speech act annotation, whereas Sardinha (2008) annotates his corpus to compute the probabilities of each candidate word form being a vehicle metaphor.

Recent research relies on artificial intelligence, which offers automatic semantic field annotation tools, such as *UCREL Semantic Annotation System* (Koller, Hardie, Rayson and Semino 2008), and metaphor extraction systems that exploit the codification of pre-defined semantic relations between units in lexical databases, as is the case of *CorMet* (Mason 2004).

Although convincing results have been obtained, the approaches of these studies are not suitable for our research of marine biology resemblance metaphors. First of all, the procedure used in projects such as *CorMet* is only valid for verbs[30], whereas the study of marine biology metaphors focuses on nouns. Secondly, in our view, semantic domain tagging by the *UCREL Semantic Annotation System* (USAS) could not be used in our study for various reasons. As previously shown, many of the marine biology resemblance metaphors are linguistically rendered by compound terms with neither spaces nor hyphens. These terms are generally made up of one word belonging to the source domain LAND ORGANISMS and one belonging to the target domain SEA ORGANISMS (e.g. *wolffish*). The only semantic domains offered by the USAS for this type of metaphorical pattern are much too general (i.e. *Life and living things*, *Living creatures: animals*, and *plants*). Consequently, potential source domain units would be hard to identify since both the target and the source have the same semantic tag in this classification. The same applies to compound terms whose source and target units belong to the domain of marine biology (e.g. *whale shark*) and aquatic life in general (*crocodile fish*). Finally, it is not clear how the USAS could be systematically exploited to reflect cross-linguistic differences of resemblance metaphors, something which is guaranteed by our tag set.

For the retrieval of non-resemblance metaphor terms, we relied on the traditional source and target domain keyword strategies, which yielded fruitful results, as shall be seen. Thus, the suitability of the two aforementioned metaphor retrieval methods to marine biology non-resemblance metaphors is still to be determined. For this reason, it is our intention to work on this issue as a near future research line.

Our corpus was also manually annotated by using a tagging system that yielded quantitative results, which were both reliable and revealing for marine biology resemblance metaphor — and as shall be seen in §, non-resemblance metaphor. This type of analysis supplements the qualitative analysis, and provides statistical data regarding the use of metaphor in language, something that is generally not done in metaphor studies (Sardinha 2008: 127). As shall be seen, the annotation system involves a tagset that meets the three criteria proposed by Leech (1997b: 25–26) for tag labels, which are: (i) conciseness (short tags better than long ones); (ii) perspicuity (tags must be as readable as possible); (iii) and analysability (it should be possible to decompose

[30] *CorMet* identifies metaphors by finding systematic differences in *selectional preferences* between domains. A selectional preference is “a verb’s predilection for a particular type of argument in a particular role” (Mason 2004: 23).

tags into their logical parts). The corpus was tagged and processed with Wordsmith Tools in order to obtain the absolute frequencies of metaphor occurrences and the number of English-Spanish term pairs in the corpus.

3.5.1.2.1. Annotation of resemblance metaphor terms designating sea organisms

This section describes the annotation system applied to sea organism resemblance metaphor terms to firstly obtain their absolute frequencies, and secondly, obtain comparative information about the English-Spanish term pairs found in the corpus.

3.5.1.2.1.1. Tagging to obtain absolute frequencies

As a starting point, the concordance lines of the basic-level keywords “fish/*pez* (*peces*)”, “sea/*de mar*”, “crab*/*cangrejo*”, “shark/*tiburón*”, and “dolphin/*delfín*, as well as the lexical markers *known as* and *conocido/a como* that contained no metaphorical terms were manually tagged. Clean lists were then obtained by means of the *Zap* function in Wordsmith Tools, which filtered out the marked concordance lines. The metaphorical terms of the remaining concordance lines were marked with the tag *METAPH* in their corresponding .txt files in each sub-corpus. Those co-occurring with their taxonomic designations were tagged *METAPH TAXO*, and were subsequently concordanced (e.g. Figure (16)). It should be noted that these and the rest of tags, which will appear further below, were inserted on the right of the metaphorical terms. The symbol **<** was used to signal the beginning of the metaphorical units on their left.

Given that many academic journal articles in both languages contained checklists of the species being described, these checklists helped to retrieve further resemblance metaphor terms in English and Spanish and statistically refined the cross-linguistic account. Not surprisingly, most checklists in research articles dispense with common names as a way to avoid ambiguity. A case in point is Figure 15, which shows a checklist extracted from an article of the Spanish-language journal *Boletín de Investigaciones Marinas y Costeras* (37(1), 2008, pp. 111–127).

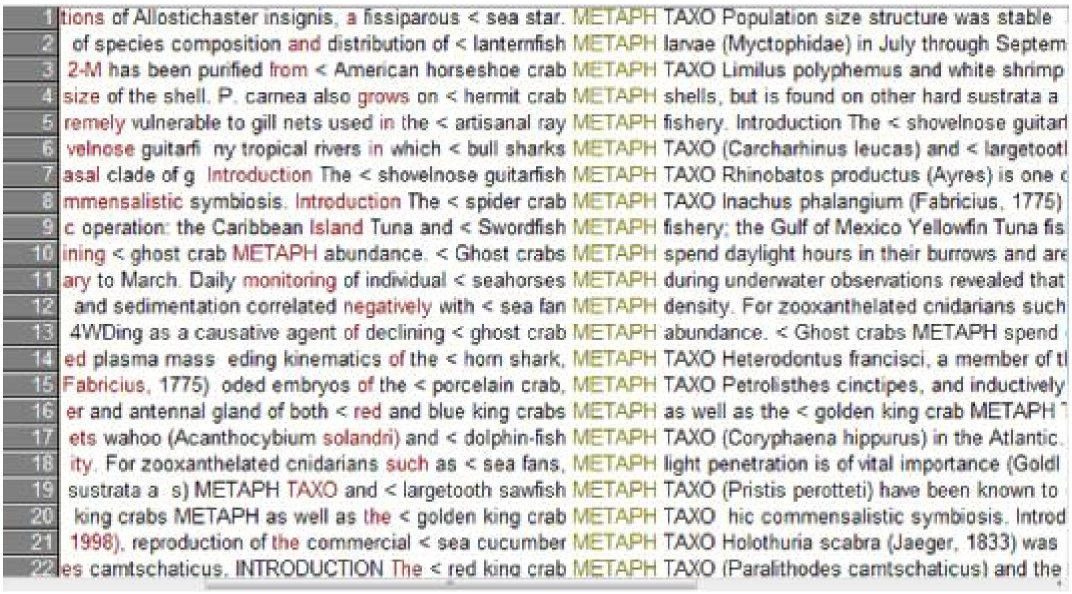
Tabla 3. Listado de las 30 especies con mayores frecuencias de observación (FO) y abundancias relativas (AR) promedio de estaciones sin protección y del PNNT. En negrita se resaltan las especies que sólo alcanzaron este estado en una de las zonas.

Especie	Sin Protección		Especie	PNNT	
	FO	AR		FO	AR
Acanthurus bahianus	100	5.52	*Acanthurus bahianus*	100	4.94
Bodianus rufus	100	3.05	*Bodianus rufus*	100	3.75
Chromis multilineata	100	7.00	*Elacatinus illecebrosus*	100	3.75
Haemulon flavolineatum	100	4.05	*Haemulon flavolineatum*	100	5.19
Myripristis jacobus	100	7.39	*Haemulon plumierii*	100	3.31
Sparisoma viride	100	3.09	*Sparisoma viride*	97	3.94
Cephalopholis cruentata	98	2.50	*Canthigaster rostrata*	94	2.94
Chaetodon sedentarius	98	3.02	*Lutjanus mahogoni*	94	3.28
Halichoeres garnoti	98	3.30	*Myripristis jacobus*	94	5.00
Pseudupeneus maculatus	98	3.48	*Sparisoma aurofrenatum*	94	4.47
Sparisoma aurofrenatum	98	5.27	*Gnatholepis thompsoni*	92	4.03
Chromis cyanea	95	6.02	*Halichoeres garnoti*	92	2.86
Elacatinus illecebrosus	95	2.98	*Mulloidichthys martinicus*	92	4.47
Thalassoma bifasciatum	95	6.93	*Thalassoma bifasciatum*	92	5.78
Acanthurus coeruleus	93	3.09	*Acanthurus coeruleus*	89	3.75
Gnatholepis thompsoni	93	4.48	*Chaetodon capistratus*	89	2.58
Mulloidichthys martinicus	93	4.64	*Chromis cyanea*	89	4.97
Stegastes partitus	93	8.20	*Chromis multilineata*	89	6.22
Canthigaster rostrata	91	3.02	*Haemulon chrysargyreum*	89	4.25
Holacanthus tricolor	91	2.07	*Pseudupeneus maculatus*	89	2.47
Serranus tigrinus	91	2.57	*Scarus iseri*	89	2.28
Chaetodon capistratus	89	2.61	*Serranus tigrinus*	89	2.11
Chaetodon ocellatus	86	2.32	*Stegastes partitus*	89	7.72
Chromis insolata	86	4.75	*Cephalopholis cruentata*	86	2.44
Coryphopterus personatus	84	6.23	*Abudefduf saxatilis*	83	3.39
Lactophrys triqueter	84	1.73	*Microspathodon chrysurus*	83	3.78
Haemulon chrysargyreum	82	3.27	*Elacatinus saucrus*	78	2.58
Abudefduf saxatilis	80	3.07	*Stegastes adustus*	78	3.83
Aulostomus maculatus	73	1.30	*Acanthurus chirurgus*	75	3.22
Hypoplectrus puella	70	1.18	*Holacanthus tricolor*	72	1.58

Figure 15. Checklist of taxonomic designations of marine organisms that includes no (metaphorical) common names.

More often than not, the checklists included all of the taxonomic designations quoted in the text body of their corresponding articles. Those taxonomic designations from the checklists that were not previously detected were concordanced and cleaned to search for metaphorical terms containing neither of the previously mentioned basic-level keywords (e.g. staghorn coral, *camarón café*). These concordances were tagged *METAPH TAXO.*

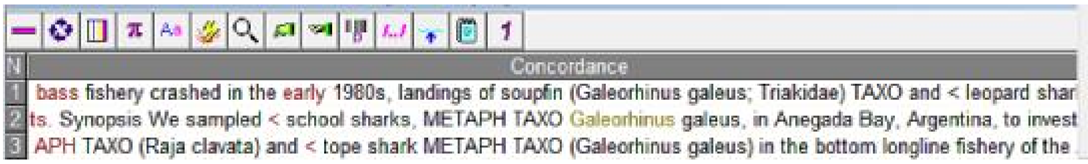
The annotation process revealed cases in which taxonomic designations co-occurred with common names. However, they were not figurative in nature. These terms were tagged *TAXO* (see examples further below). The concordances of *Linnaeus* and *Cuvier* were of help to find further taxonomic designations co-occurring with metaphorical terms. They were tagged *METAPH TAXO*.



N	Concordance
1	tions of Allostichaster insignis, a fissiparous < sea star. METAPH TAXO Population size structure was stable
2	of species composition and distribution of < lanternfish METAPH larvae (Myctophidae) in July through Septem
3	2-M has been purified from < American horseshoe crab METAPH TAXO Limilus polyphemus and white shrimp
4	size of the shell. P. carnea also grows on < hermit crab METAPH shells, but is found on other hard sustrata a
5	remely vulnerable to gill nets used in the < artisanal ray METAPH fishery. Introduction The < shovelnose guitarl
6	velnose guitarfi ny tropical rivers in which < bull sharks METAPH TAXO (Carcharhinus leucas) and < largetootl
7	asal clade of g Introduction The < shovelnose guitarfish METAPH TAXO Rhinobatos productus (Ayres) is one c
8	mmensalistic symbiosis. Introduction The < spider crab METAPH TAXO Inachus phalangium (Fabricius, 1775)
9	c operation: the Caribbean Island Tuna and < Swordfish METAPH fishery; the Gulf of Mexico Yellowfin Tuna fis
10	ining < ghost crab METAPH abundance. < Ghost crabs METAPH spend daylight hours in their burrows and are
11	ary to March. Daily monitoring of individual < seahorses METAPH during underwater observations revealed that
12	and sedimentation correlated negatively with < sea fan METAPH density. For zooxanthelated cnidarians such
13	4WDing as a causative agent of declining < ghost crab METAPH abundance. < Ghost crabs METAPH spend
14	ed plasma mass eding kinematics of the < horn shark, METAPH TAXO Heterodontus francisci, a member of tl
15	Fabricius, 1775) oded embryos of the < porcelain crab, METAPH TAXO Petrolisthes cinctipes, and inductively
16	er and antennal gland of both < red and blue king crabs METAPH as well as the < golden king crab METAPH T
17	ets wahoo (Acanthocybium solandri) and < dolphin-fish METAPH TAXO (Coryphaena hippurus) in the Atlantic.
18	ity. For zooxanthelated cnidarians such as < sea fans, METAPH light penetration is of vital importance (Goldl
19	sustrata a s) METAPH TAXO and < largetooth sawfish METAPH TAXO (Pristis perotteti) have been known to
20	king crabs METAPH as well as the < golden king crab METAPH TAXO hic commensalistic symbiosis. Introd
21	1998), reproduction of the commercial < sea cucumber METAPH TAXO Holothuria scabra (Jaeger, 1833) was
22	es camtschaticus. INTRODUCTION The < red king crab METAPH TAXO (Paralithodes camtschaticus) and the

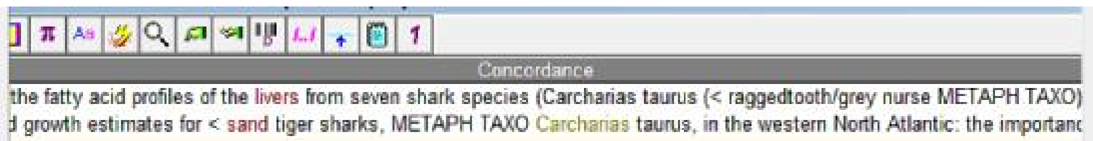
Figure 16. Extended concordance lines of *METAPH* from the English corpus.

Not only did the markers *known as* and *conocido/a como* help to find instances of terminological variation, but they also revealed other cases in the annotation process while checking the taxonomic designations against the different articles where they occurred (listed by Wordsmith Tools) and by examining their co-text. Those variants that were metaphorical were tagged *METAPH TAXO*, and those with a literal meaning, *TAXO*. Figures 17 and 18 show some of the cases of synonymy found in the English corpus (apart from *cloud sponges*/ *sponge gardens* and *Provence oyster*/*dwarf oyster*).



N	Concordance
1	bass fishery crashed in the early 1980s, landings of soupfin (Galeorhinus galeus; Triakidae) TAXO and < leopard shar
2	ts. Synopsis We sampled < school sharks, METAPH TAXO Galeorhinus galeus, in Anegada Bay, Argentina, to invest
3	APH TAXO (Raja clavata) and < tope shark METAPH TAXO (Galeorhinus galeus) in the bottom longline fishery of the

Figure 17. Common name variants of *Galeorhinus galeus*.



Concordance
the fatty acid profiles of the livers from seven shark species (Carcharias taurus (< raggedtooth/grey nurse METAPH TAXO)
d growth estimates for < sand tiger sharks, METAPH TAXO Carcharias taurus, in the western North Atlantic: the importanc

Figure 18. Common name variants of *Carcharias Taurus*.

Figures 19–22 show some of the cases of synonymy found in the Spanish corpus (apart from *lapa de sol*/*lapa ocho*). Concordance lines were *zapped* to bring the synonyms together.

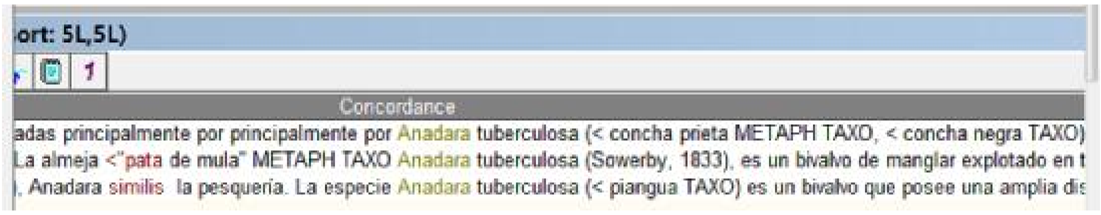


Figure 19. Common name variants of *Anadara tuberculosa*.

[Concha prieta ~ tight conch]

[Concha negra ~ black conch]

[Piangua ~ no literal translation into English]

[Pata de mula ~ mule's leg]

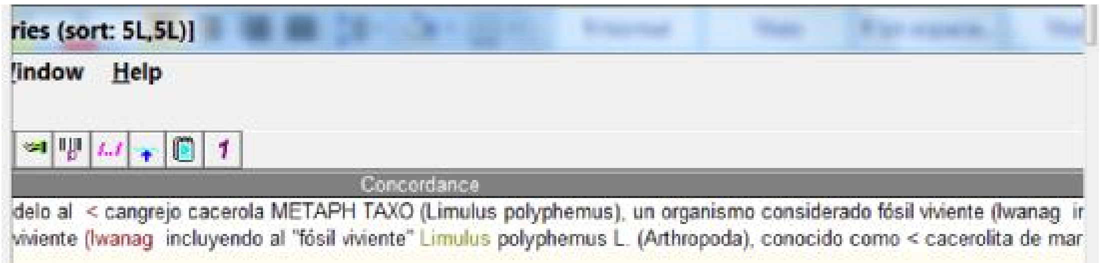


Figure 20. Common name variants of *Limulus polyphemus*.

[Cangrejo cacerola ~ saucepan crab]

[Cacerolita de mar ~ little sea saucepan]

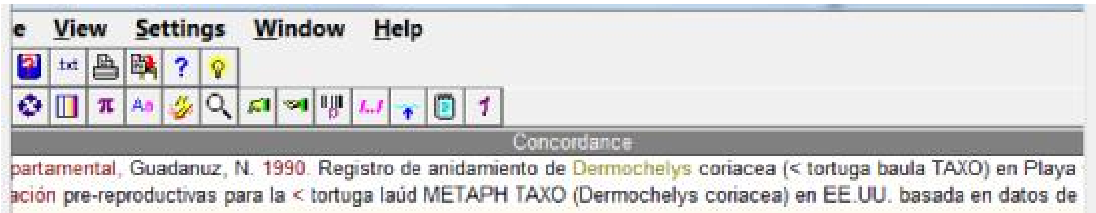


Figure 21. Common name variants of *Dermochelys coriacea*.

[Tortuga baula ~ no literal translation into English]

[Tortuga laúd ~ lute turtle]

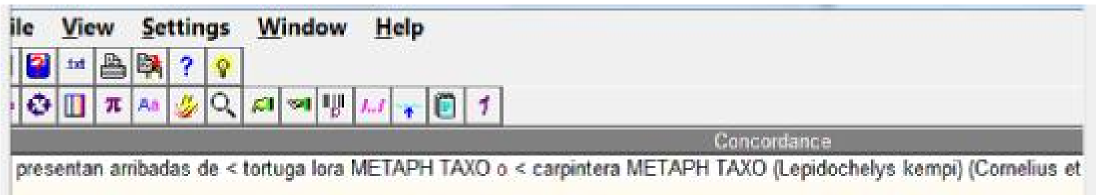


Figure 22. Common name variants of *Lepidochelys kempi*.

[tortuga lora ~ female parrot turtle]

[tortuga carpintera ~ carpenter turtle]

Once all occurrences of resemblance metaphor terms were tagged in English and Spanish (including both repeated units and hapaxes[31]), they were computed. The absolute frequency of individual items was then calculated for each language. The results and the discussion of these results are provided in the results section (§ 4.1.1.).

3.5.1.2.1.2. Tagging to obtain interlinguistic term pairs

Comparable English-Spanish results from quantitative data were obtained by the following procedure. Concerning exact pairs, since the taxonomic designations are the same in both languages, a separate corpus was created that included the English and Spanish texts, and preserved the tags used so far. This was done with a view to finding exact pairs more easily. The tag *METAPH TAXO* was concordanced, focusing on those terms that contained neither of the basic-level keywords. Exact pairs were identified by searching for every taxonomic designation across the concordance lines with the *search* function, and comparing interlinguistic strings. Whenever an exact pair was identified, the tag *METAPH TAXO EXA* was added to both interlinguistic equivalents.

The same procedure was used to find term pairs containing one of the basic-level keywords (i.e. “fish*/ *pez*/*peces*”, etc.). A search was made in the corpus of the other language for a literal translation for each basic-level metaphorical term with no taxonomic designation. This procedure had already been tentatively carried out with some terms during the qualitative analysis to check for exact pairs. When there was a hit, the tag *METAPH EXA* was added to the English term. Subsequently, the concordance entries of *METAPH EXA* and *METAPH TAXO EXA* were added up. Since

[31] A hapax is a lexical item that occurs only once in a whole unit of analysis (in this case, the marine biology corpus).

it was a question of computing term pairs rather than tokens, the figure obtained was divided by two to calculate the number of pairs. The results of this analysis are provided and discussed in the results section (§ 4.1.1.).

The tagging process showed that there were only two instances of partial pair in the corpus, which were *croaker-corvina* and *triggerfish-pez ballesta*. The first one was already previously described in this study. The second one is explained in § 4.1.1.

The analysis of the co-text of the taxonomic designations not only generated exact pairs, but also separate and unbalanced pairs, which were tagged *METAPH TAXO SEP* and (*METAPH*) *TAXO UNB*, respectively. Each tag was then concordanced separately for computing. The tagging process thus confirmed the existence of separate pairs in the corpus. Figure 23 shows two of the entries of the separate term pairs found.

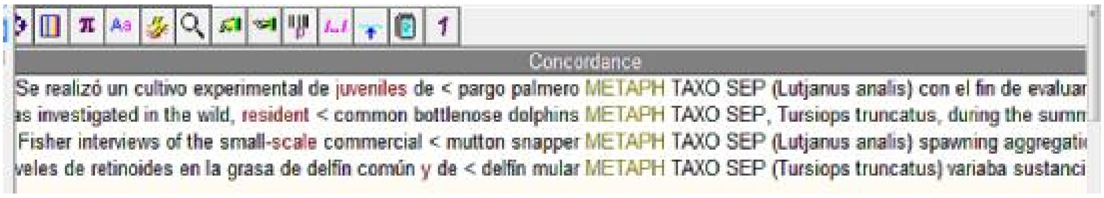


Figure 23. Concordance lines showing instances of separate pairs.

As the concordances show, the species *Lutjanus analis* is named *mutton snapper* in English, whereas in Spanish it is named *pargo palmero* [palm fish]. The species *Tursiops truncatus* is called *bottlenose dolphin* in English, whereas in Spanish its name is *delfín mular* [mule dolphin].

All of the separate term pairs found in our corpus will be provided in tables in the results section.

The identification of unbalanced pairs in the corpus showed two sub-types of pairs:

- those in which only the English term is metaphorical (as previously shown in concordance (13));
- those in which only the Spanish term is metaphorical.

For calculation purposes, the metaphorical terms of the pairs were tagged *METAPH TAXO UNB*, and the non-metaphorical ones, *TAXO UNB*. Furthermore, in both sub-types, the non-metaphorical constituent either had a common name or only the taxonomic designation was used. To retrieve all unbalanced pairs, the tag *TAXO UNB* was concordanced. Figure (24) shows two examples of interlinguistic pairs found in the corpus in which the non-metaphorical constituents have a common name associated to their taxonomic designations.

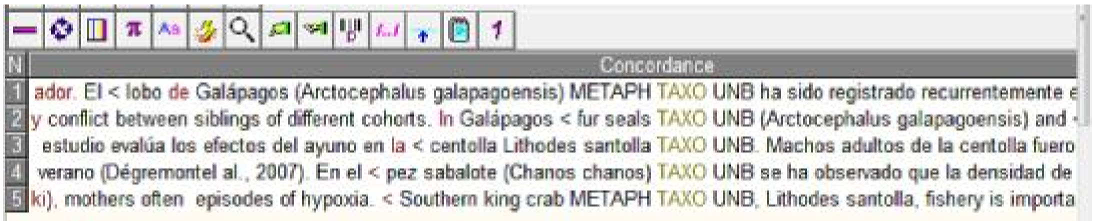


Figure 24. Interlinguistic term pairs in which the non-metaphorical constituents have a common name associated to their taxonomic designations.

Concordances (1) and (2) in Figure 24 show that *Arctocenphalus galapagoensis* is metaphorically referred to as *lobo fino* [slender wolf] in Spanish, whereas in English it has a literal name, which is *fur seal*. In contrast, concordances (3) and (5) reveal that the species *Lithodes santolla* has a metaphorical term in English, *king crab*, but it is literally referred to as *centolla* in Spanish.

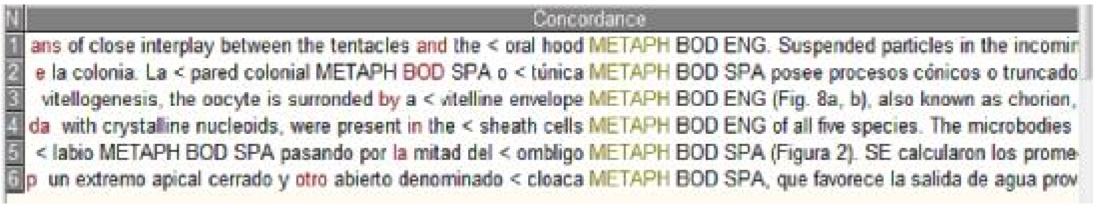
Figure 25 shows some of the pairs found in the corpus in which a taxonomic designation co-occurred with a metaphorical term in the English texts, whereas the same taxonomic designation did not occur with any common name on *all* occasions that it appeared in the Spanish texts. As the annotation revealed, no instances were found where the situation was the other way around. It should be noted that the fact that a taxonomic designation does not occur with a common name in this corpus does not necessarily mean that experts use a common name for such taxonomic designation in other texts.

Figure 25. Instances of term pairs in which the metaphorical constituents co-occurred with their corresponding taxonomic designations.

Concordances (2) and (6) in Figure 25 show that English-language experts use the metaphorical term *fan mussel* to refer to the species *Pinna nobilis*, whereas there is no (metaphorical) common name associated to this taxonomic designation in Spanish. The same applies to *Aurelia aurita*, which is metaphorically referred to as *moon jelly* in English (concordance (3)), but is not associated with a (metaphorical) common name in Spanish (concordance (1)).

3.5.1.2.2. Annotation of resemblance metaphor terms designating body parts of sea organisms

For the annotation of body part resemblance metaphor terms, we first read through the monolingual journal articles. Each of the English terms that featured a body part metaphor was tagged *METAPH BOD ENG* and each Spanish term, *METAPH BOD SPA*. Figure 26 shows some of these terms tagged in the corpus and identified by Wordsmith Tools. Figure 26 contains corpus text lines in English and Spanish because we continued to work on the joint corpus, which included texts in both languages.



N	Concordance
1	ans of close interplay between the tentacles and the < oral hood METAPH BOD ENG. Suspended particles in the incomin
2	e la colonia. La < pared colonial METAPH BOD SPA o < túnica METAPH BOD SPA posee procesos cónicos o truncado
3	vitellogenesis, the oocyte is surronded by a < vitelline envelope METAPH BOD ENG (Fig. 8a, b), also known as chorion,
4	da with crystalline nucleoids, were present in the < sheath cells METAPH BOD ENG of all five species. The microbodies
5	< labio METAPH BOD SPA pasando por la mitad del < ombligo METAPH BOD SPA (Figura 2). SE calcularon los prome
6	p un extremo apical cerrado y otro abierto denominado < cloaca METAPH BOD SPA, que favorece la salida de agua prov

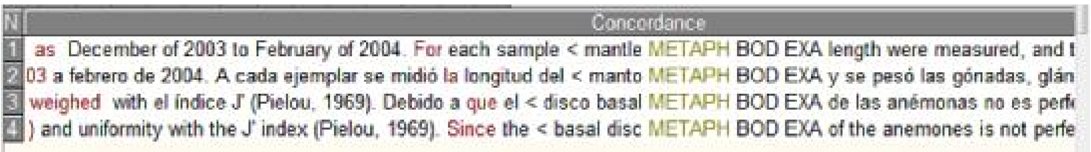
Figure 26. Instances of English and Spanish resemblance metaphor terms designating body part of sea organisms.

As shown by concordance (3) in Figure 26, the term *vitalline envelope* is synonymous with *chorion*, which co-occurs with the lexical marker *known as*. The Spanish term *pared colonial* [colonial wall] in concordance (2) is synonymous with *tunica* [tunic]. The English metaphorical terms *sheath cells*, *vitelline envelope*, and *oral hood* as well as the Spanish metaphorical terms *pared colonial*, its synonym *tunica* [tunic], *labio* [lip], and *ombligo*[32] [navel] are grounded in a comparison in shape (physical appearance). As context (16) shows, the Spanish metaphorical term *cloaca* [cloaca] is based on a comparison in behaviour between organs. Context (16) is an example of corpus data that implicitly explain a term's metaphorical motivation. *Cloaca* designates the open tip of *Pyrosoma atlanticum* (a type of colonial tunicate), which is compared with a bird's cloaca because this structure causes the water coming from the colony's walls to go out.

[32] *Labio* and *ombligo* are two organs of the gastropod mollusc *Cittarium pica*.

(16) la colonia es tubular, similar a un dedo de la mano, con un extremo apical cerrado y otro abierto denominado **cloaca, que favorece la salida de agua proveniente de los blastozooides que conforman las paredes de la colonia** (*Investigaciones Marinas*, 32(2), 2004, pp. 133–136)

We were able to easily identify interlinguistic pairs while reading articles in the Spanish-language journals that contained abstracts and figure captions in English and Spanish. The same strategy was followed for the terms of the articles of the bilingual journal *Ciencias Marinas*. In all these cases, exact pairs were tagged *METAPH BOD EXA*. Figure 27 shows concordance lines including instances of exact term pairs.

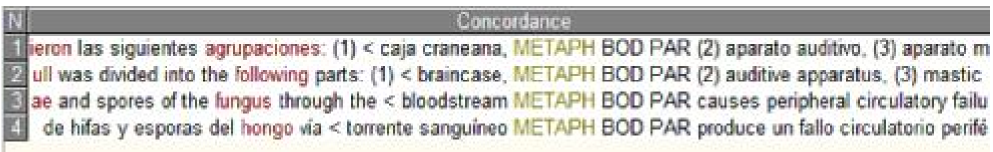


N	Concordance
1	as December of 2003 to February of 2004. For each sample < mantle METAPH BOD EXA length were measured, and t
2	03 a febrero de 2004. A cada ejemplar se midió la longitud del < manto METAPH BOD EXA y se pesó las gónadas, glán
3	weighed with el índice J' (Pielou, 1969). Debido a que el < disco basal METAPH BOD EXA de las anémonas no es perf
4	) and uniformity with the J' index (Pielou, 1969). Since the < basal disc METAPH BOD EXA of the anemones is not perfe

Figure 27. Instances of exact term pairs designating body parts of sea organisms.

Basal disc and *disco basal* designate the portion of the stalk of an anemone attached to the substrate, and receives this name because it is round in shape. *Mantle* and *manto* refer to the protective layer of epidermis in molluscs that secretes a substance forming the shell. The metaphorical motivation is shape because this layer spreads like a mantle but also function because it is used to cover and protect.

In the annotation process partial pairs were also ascertained. They were tagged *METAPH BOD PAR*. Figure 28 includes examples of this type of term pair.



N	Concordance
1	ieron las siguientes agrupaciones: (1) < caja craneana, METAPH BOD PAR (2) aparato auditivo, (3) aparato m
2	ull was divided into the following parts: (1) < braincase, METAPH BOD PAR (2) auditive apparatus, (3) mastic
3	ae and spores of the fungus through the < bloodstream METAPH BOD PAR causes peripheral circulatory failu
4	de hifas y esporas del hongo vía < torrente sanguíneo METAPH BOD PAR produce un fallo circulatorio perifé

Figure 28. Instances of partial term pairs designating body parts of sea organisms.

Bloodstream and *torrente sanguíneo* [blood torrent] are a partial pair because *torrent* is a specific type of *stream*, specifically “a turbulent, swift-flowing stream”[33]. The metaphorical motivation of this pair is behaviour (both water and blood flow) and shape

[33] All definitions given here were extracted from *The American Heritage® Dictionary of the English Language*.

(both water and blood flow within an elongated structure). As regards the pair ***braincase-caja craneana*** [cranial box], a case is "a container, a receptacle", and therefore, is a generic concept, whereas a box is a more specific concept because it is "a container typically constructed with four sides perpendicular to the base and often having a lid or cover". This pair is based on a comparison in shape.

Separate pairs were also found in the annotation process and were tagged *METAPH BOD SEP*. Figure 29 shows concordance lines containing two examples of this type of pair.

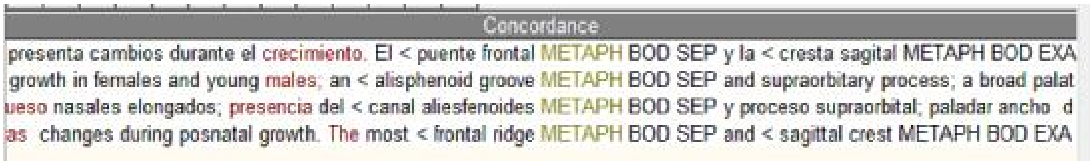


Figure 29. Instances of separate term pairs designating body parts of sea organisms.

The terms *frontal ridge* and *puente frontal* [frontal bridge] refer to a structure in the head of sea lions (a type of seal) and other mammals that links two other anatomical points. These terms are a separate pair because they are grounded in different conceptual metaphors. *Frontal ridge* is a metaphor that emerges from the comparison in shape between an actual ridge and the anatomical structure, since both are elongated structures presenting a rugged surface. In contrast, *puente frontal* is a metaphor that arises from a double comparison between an actual bridge and the anatomical structure. First of all, there is a comparison in shape since both are elongated structures. Secondly, there is a comparison in function since both structures are meant to link two points.

Concerning the separate pair *alisphenoid groove-canal aliesfenoides* [alisphenoid canal], *alisphenoid groove* is a metaphor that emerges from a comparison in shape between an actual groove and the anatomical structure, which is an orifice in the alisphenoid bone which the trigeminus, the fifth cranial nerve in mammals, passes through. In contrast, *canal aliesfenoides* is a metaphor based on a double comparison: (i) in shape (both an actual canal and the anatomical structure are elongated openings); (ii) in function (both structures are meant to let something pass through).

The results section (§ 4.1.1.2.) provides the total number of body part metaphor terms found in each language, their absolute frequencies, as well as the number of exact pairs, partial pairs, separate pairs and unbalanced pairs.

3.5.2. Identification and retrieval of marine biology non-resemblance metaphors

We have so far addressed what are traditionally known as *image metaphors* (Lakoff 1993) and *behaviour-based metaphors* (Grady 1999), which emerge from resemblance in physical appearance and behaviour, respectively. In scrutinising the co-text of resemblance metaphor terms and of taxonomic designations in our corpus of English and Spanish texts, we came across a different type of metaphorical expressions, many of which were not based on resemblance but rather on more abstract patterns of comparison. Those based on resemblance featured more complex behavioural patterns than the patterns exhibited by resemblance metaphors. A case in point is the metaphorical term *architecture* in concordance (21), which is in turn a clear example that a significant number of metaphorical terms can co-occur in a short discourse unit.

(21) **Clonal architecture** in an **intertidal bed** of the **dwarf eelgrass** *Zostera noltii* in the Northern Wadden Sea: persistence through extreme physical perturbation and the importance of a **seed bank**. (*Marine Biology*, 156(10), 2009, pp. 2139–2148)

Non-resemblance metaphor terms are instances of what is traditionally known as *structural-conceptual metaphors* (Lakoff 1993). In this study, we will call them *non-resemblance metaphors* because we consider it to be a more appropriate term (§ 4.2. for an explanation).

We applied two strategies to retrieve further non-resemblance metaphor expressions from the marine biology text corpus: searching for source domain keywords and searching for target domain keywords.

3.5.2.1. Qualitative analysis

As with resemblance metaphors, we first performed a qualitative analysis that yielded rich, inferential information about non-resemblance metaphors. This information will be statistically accounted for in the quantitative analysis section.

3.5.2.1.1. Finding non-resemblance metaphors by means of source domain keywords

Invasion biology is a subdiscipline of conservation biology that is concerned with strategies to maintain biodiversity. The language of this subdiscipline has been shown to be fraught with metaphorical expressions, mostly featuring three elements: fears of invasion, competition, and militarism (cf. Larson 2008). As shall be seen, concordancing lexical units associated with these concepts was of great help to find non-resemblance metaphors in the marine biology corpus.

The concepts of invasion, militarism, and competition were robust candidates for forming part of a productive conceptual metaphor system. In fact, these terms seemed to be instances of one of the most recurrent source domains, namely WAR. This was hardly a coincidence since it is a fact that such concepts inevitably pervade almost any dimensions of life. They are aspects inherent to all living beings as an instinct for survival. WAR as a source for cross-domain mappings has been documented in a wide range of knowledge fields, such as business reporting (Koller 2006), medicine (Faber and Márquez 2005; Tercedor 2004), political and social conflicts (Semino 2006), and everyday arguments in general (Lakoff and Johnson 1980). On this basis, we thought that marine biology would not be an exception.

The incidence of the domain of WAR in our corpus was first tested by identifying lexical units of this field in the co-text of the resemblance metaphor terms and of the keywords and markers previously used to retrieve them. Concordance (22) shows an example of a non-resemblance metaphor belonging to the subdomain of militarism in the co-text of the concordanced taxonomic designation *Robsonella fontaniana* in the Spanish corpus.

(22) Este trabajo tiene como objetivo describir la alimentación natural y determinar las preferencias alimenticias en condiciones experimentales del pulpo *Robsonella fontaniana*, poniendo a prueba la hipótesis de que los pulpos presentan una **estrategia [strategy] de forrajeo** oportunista debido a su amplio nicho trófico (dieta generalizada). (*Revista de Biología Marina y Oceanografía*, 44(2), 2009, pp. 277–283)

Concordance (23) includes a non-resemblance WAR metaphor term, which was extracted from the English corpus by analysing the co-text of the keyword *marine*.

(23) Intracellular defence mechanisms act to minimize potential damage by agents having penetrated the first **line of defence**. The different marine mollusc species used feature very similar trends between polluted and reference sites in all measured parameters. (*Helgoland Marine Research*, 57(3–4), 2003, pp. 157–165)

Importantly, the corpus data revealed that non-resemblance metaphors can be rendered not only by nouns (e.g. concordances (22) and (23)), but also by adjectives (e.g. concordance (24)) and verbs (e.g. concordance (25)). In contrast, resemblance metaphors are most times rendered by nouns. The taxonomic designation *Etheostoma nigrum* in concordance (24) showed the occurrence of the resemblance metaphor term *johnny darter*, and its co-text contains the adjectival non-resemblance metaphor terms *nest-guarding* and *intruding*. The taxonomic designation *Acipenser gueldenstaedtii* in concordance (25) signalled the presence of the metaphorical verb *equip*.

(24) Aggression by **nest-guarding male** johnny darters, *Etheostoma nigrum*, against **intruding crayfish** was investigated in laboratoy experiments and field observations. (*Environmental Biology of Fishes*, 24(4), 1989, pp. 301–306)

(25) The covering of the eggs in Russian sturgeon *Acipenser gueldenstaedtii* consists of three envelopes (the vitelline envelope, chorion and extrachorion) and is **equipped with** multiple micropyles. (*Journal of Fish Biology*, 76(3), 2010, pp. 694–706)

The metaphorical term *intrusiones* (intrusions) in concordance 26 was identified in the Spanish subcorpus by searching the co-text of the taxonomic designation *Rhincalanus nasutus*.

(26) En la zona de Concepción, también se ha señalado la asociación entre el copépodo *Rhincalanus nasutus* y la CMO, donde ocurren **intrusiones** de esta especie oceánica favorecidas por advección costera del AESS, durante épocas de surgencia y alta productividad fitoplanctónica (Castro et al., 1993). (*Investigaciones Marinas*, 32(1), 2004, pp. 19–32)

The metaphorical terms of this kind extracted up to this point from the corpus led us to infer the existence of the encompassing metaphor LIFE/SURVIVAL IS WAR in the marine biology discourse. We then searched the corpus for further representative vocabulary of the source domain of WAR in Wordsmith Tools (e.g. *arm*/*arma*, *enemy*/*enemigo*, *invade*/*invadir*, *raid/incursión*, etc.). This vocabulary successfully guided us into topic exploitation both in English and Spanish, and ratified the existence of the metaphor LIFE/SURVIVAL IS WAR. Concordances (27) and (28) are given as examples.

(27) Similar to vertebrates (Li et al. 2008), therefore, whelks appear capable of developing associative networks between environmental stimuli and risk, at least when risk cues derive from an **enemy** having a shared evolutionary history (i.e., *N. lamellosa* whelks have coexisted with *C. productus* crabs—the predator in this study—for millennia, but they do not respond to concentrated doses of other less known predators, such as *Carcinus maenas* green crabs, a recent **invasive species** with which *N. Lamellose* has had limited interaction; Edgell and Neufeld 2008). (*Marine Biology*, 157(1), 2010, pp. 215–219)

(28) This is not influenced by the proximity of parasitic males. We observed, however, that females leave SBM nests if disturbed by the **raid** of parasitic males, thereby interrupting oviposition, and do not always return to the nest. (*Environmental Biology of Fishes*, 70(1), 2004, pp. 23–30)

Concordances (29) to (30) are given as examples in Spanish.

(29) Tres ejemplares de *Coryphaenoides subserrulatus* Makushok, 1976, capturados entre el archipiélago de Juan Fernández y la costa central de Chile, confirman la existencia de esta especie en el Pacífico sur oriental, situación dudosa hasta antes de la realización de este estudio. Además, se indica por primera vez que esta especie **invade [invades]** levemente la placa de Nazca en su sector oriental. (*Investigaciones Marinas*, 31(2), 2003, pp. 95–99)

(30) En el presente trabajo se analiza la **incursión [incursion, raid]** de 25 especies de moluscos y 15 de crustáceos tropicales, registrados entre los años 1972 y 2003, tiempo en el cual ocurrieron cinco eventos El Niño (EN). (*Revista Peruana de Biología*[34], 11(2), 2004, pp. 213–218)

[34] *Revista Peruana de Biología* does not belong to the set of journals consulted for this study. However, we came across one of its articles during the compilation process since this journal is also hosted by the *SciELO* database. This article includes the term *incursión*, an interesting example to illustrate the claim made in this section of the study.

Finding the Spanish term *incursión* prompted us to concordance its literal English translation equivalent, *incursion*, to check for its existence in marine biology. We obtained instances of it in the corpus, as in concordance (31), which meant that *raid* and *incursion* were terminological synonyms.

(31) In 1995/1996 the Commonwealth Scientific and Industrial Research Organization (CSIRO) Centre for Research on Introduced Marine Pests (CRIMP) undertook an intensive evaluation of the region with the aims of developing a comprehensive species list of native and introduced biota and contrasting previous bay-wide assessments with a current field survey in order to detect new **incursions** and discern alterations to native communities. (*Marine Biology*, 144(1), 2004, pp. 183–202)

Words stemming from the same root were another way of retrieving further metaphors. This was the case for *recruit** in English (concordances (32–34)) and *recluta** in Spanish (concordances (35) and (36)). This strategy shows corpus analysis' potential to reveal the use of metaphorical expressions across word classes.

(32) This study quantifies the contributions of **larval recruitment** and **post-recruit** (juvenile and adult) **immigration** to net increases in population size for 150 species of fishes found on ten isolated coral patches or 'bommies' (108–267 m^2) within a typical reef of the Great Barrier Reef system. (*Coral Reefs*, 16(3), 1997, pp. 139–149)

(33) The domination of a small isolated patch of habitable substratum by a sponge is most unusual, given that they are regarded as relatively poor **recruiters**. (*Marine Biology*, 126(1), 1996, pp. 27–33)

(34) Both genes **were recruited** early and displayed similar steadily decreasing patterns from fertilization until hatching. (*Fish Physiology and Biochemistry*, 32(3), 2006, pp. 249–253)

(35) Se propone además que los modelos de producción por **recluta [recruiter]** incluyan explícitamente algún término que defina la "productividad de turnover", y se desarrolla un modelo concreto en el que los **reclutamientos [recruits]** sean proporcionales a la fecundidad del stock. (*Boletín del Instituto Español de Oceanografía*, 10, 1992, pp. 99–104)

(36) En julio el grupo de juveniles **se ha reclutado [has been recruited]** en su totalidad a la población adulta, caracterizándose por ser pocos individuos con una baja biomasa y tallas grandes. (*Revista de Biología Tropical*, 46(2), 1998, pp. 257–266)

We also used the Concord function in *Wordsmith Tools* to find multiword expressions. For instance, we inserted *compet** in the Concord search engine, and afterwards used the *Clusters* option. Concordances (37) and (38) show two interesting metaphorical multiword terms retrieved by using this strategy.

(37) Werner EE, Gilliam JF (1984) The ontogenetic niche and species interactions in size-structured populations. Annu Rev Ecol Syst S15:393–425 Zaret TM, Rand AS (1971) Competition in tropical stream fishes: support for the **competitive exclusion principle**. Ecology (*Marine Biology*, 157(3), 2010, pp. 565–574)

(38) La búsqueda, el aislamiento y la caracterización de cepas nativas de biopelículas productoras de substancias inhibitorias contra otros géneros del mismo hábitat, podrían ser consideradas como una alternativa para biocontrolar la densidad bacteriana mediante el **principio de exclusión competitiva [competitive exclusion principle]** (Williams & Vicker 1986, McCarthy *et al*. 1994) y/o producción de substancias antibióticas (Jorquera *et al*. 1999). (*Revista de Biología Marina y Oceanografía*, 40(2), 2005, pp. 117–125)

The concepts *war* and *competition* are strongly linked both in everyday life and in the field of marine biology. This fact is evidenced by concordance (39).

(39) Thus, *F. vesiculosus* invariably **wins competitive battles** with *Ascophyllum* when both are at the germling stage. It is also noteworthy that *F. vesiculosus* experiences more severe intraspecific than interspecific **competition** because it is more difficult to **out-compete** its peers, which have the same morphology, and intrinsic growth rate and require exactly the same resources from the environment. (*Marine Biology*, 147(2), 2005, pp. 525-532)

The presence of the abovementioned terms is on no account coincidental. Many of them are so well-entrenched that they no longer seem metaphorical. We also searched for source domain units that were presumably perceived as more metaphorical in the marine biology discourse, such as *target*, *tactic*, *launch*, *cohort*, *weapon*, *gun* and *sneak*. Concordances (40–41) show a number of examples extracted from the English subcorpus. Further terms will be given in the results section.

(40) In all aggregations, scars occurred most often on the caudal fin, which may result from the fin being the body part closest to the surface when boats pass over, or they may provide a large **target** for predator attack. (*Journal of Fish Biology*, 72(6), 2008, pp. 1488–1503)

(41) LB males employ two mating **tactics**. Either they **guard** the female or they attempt **sneak-matings** with guarded females. The tactics seem to obey a pure conditional **strategy** where relative size is the important criterion. (*Environmental Biology of Fishes*, 26(3), 1989, pp. 159–176)

Concordance (41) provides evidence of how experts exploit an encompassing metaphor — in this case, LIFE/SURVIVAL IS WAR — in one discourse unit. This accumulation of related metaphorical expressions in the same text is hardly surprising. In fact, it has been shown that genre-specific texts typically feature complex metaphorical chains, which convey the underlying conceptual map of a particular discourse (Koller 2003: 243). Such accumulation of related metaphors was also ascertained for resemblance metaphors (see, for example, concordances (9) and (10)). Further cases of clustering of conceptually linked metaphorical terms are provided in the results section.

Concordance (40) shows that the term *target* can be used to designate a multicelullar organism (a fish, in this case). However, it can designate smaller sea structures as well, such as cells, as shown in concordance (42). This concordance also includes the metaphorical term *machinery*, which is related to terms belonging to the source domain WAR, such as *weapon* and *arm*.

(42) Chemokines exert their biological activities by interacting with specific chemokine receptors on the cell surface of their **target cells** to activate a complex network of intracellular signaling **machinery** that controls cell migration, growth, differentiation and death (Thelen 2001). (*Fish Physiology and Biochemistry*, 35(3), pp. 489–499)

The same search was performed in the Spanish subcorpus. This search also yielded many terms, as shown by concordances (43) and (44).

(43) Se realizarán estudios paralelos de variabilidad genética de las **poblaciones diana** que determinen si se trata de una población homogénea o si por el contrario se trata de una sucesión de “genoespecies” con similar aspecto morfológico que se suceden a lo largo del ciclo anual. (*Instituto Español de Oceanografía*, reseña sobre el Proyecto de Investigación *Interacciones físico-biológicas en poblaciones de Dinophysis en las costas de Galicia*, 2006)

(44) A partir de las evidencias de terreno y de laboratorio mostradas en este estudio, se plantea que el pulpo *R. fontaniana* presenta una conducta de caza selectiva, una dieta especializada representada por un nicho trófico restringido y la **táctica de caza** característica de un maximizador de energía (ver Jaksic & Marone 2007, Tabla 4.1), la cual no debería ser distinta de otras especies de pulpos. (*Revista de Biología Marina y Oceanografía*, 44(2), 2009, pp. 277–283)

When the word *gun* was concordanced, the results showed that this word was a constituent of two terminological units, *gene gun* and *shotgun sequence*. However, neither of them directly referred to the biology of sea organisms, but rather to high performance gene and molecular techniques applied by marine genetists to test fish immunisation procedures (gene gun) and track the genome structure of sea organisms (shortgun sequence). Concordance (45) shows an instance of the phrase *gene gun* as well as of *particle bombardment*, another WAR metaphor term which was detected because it occurred in close proximity to *gene gun*. Concordance (46) includes an example of the unit *shortgun-sequence*.

(45) The relative efficacy of various routes of immunisation with pIHNVw-G was evaluated using 1·8 g rainbow trout fry vaccinated via intramuscular injection, scarification of the skin, intraperitoneal injection, intrabuccal administration, **cutaneous particle bombardment** using a **gene gun**, or immersion in water containing DNA vaccine-coated beads. (*Fish and Shellfish Immunology*, 10(8), 2000, pp. 711–723)

(46) In contrast, no TCC gene has been identified from cyclostome lamprey using **whole-genome shotgun-sequence analysis** and liver EST analysis. (*Fish and Shellfish Immunology*, 27(6), 2009, pp. 768–772)

When we concordanced the word *pistola*, the literal Spanish equivalent of *gun*, we did not retrieve any non-resemblance metaphor terms. However, we did find an example of a resemblance metaphor. Concordance (47) contains this resemblance metaphor term, *camarón pistola* [gun/pistol shrimp], which is thus called because it produces a loud sound made by an extremely rapid closure of its larger claw.

(47) *Alpheus puapeba* Christoffersen, 1979
Nombre común: **camarón pistola**. **[gun/pistol shrimp]**
Distribución: Desde Espíritu Santo, Brasil (20º27'S), litorales de las provincias de Buenos Aires y Chubut, hasta el sector norte del golfo (cercanía de I. Leones). (*Revista de Biología Marina y Oceanografía*, 40(1), 2005, pp. 7–21)

We tried concordancing the word *shotgun* in the Spanish subcorpus, and a number of occurrences were retrieved. In all of them, *shotgun* co-occurred with the word *secuencia* [sequence] o *secuenciación* [sequencing]. Therefore, *secuencia shotgun* [shotgun sequence] and *secuenciación por shotgun* [shotgun sequencing] are terms that Spanish-language marine experts have borrowed from English. Concordance (48) includes an occurrence of *secuenciación por shotgun*.

(48) Recientemente, novedosas técnicas moleculares de alto rendimiento han permitido identificar y caracterizar varias proteínas estructurales de WSSV. Estas incluyen la **secuenciación por** "**shotgun**" **[shotgun sequencing]** y marcadores isobáricos para cuantificación absoluta y relativa (iTRAQ). (*Revista de Biología Marina y Oceanografía*, 44(1), 2009, pp. 1–11)

Something similar occurred in the case of the military terms *deploy* and *deployment*, which frequently appeared in the English subcorpus. The occurrence *deployed* in concordance (49) was retrieved by means of the keyword *marine*. As this concordance shows, in most of the hits obtained in the corpus, *deploy* did not refer to the biology of marine organisms but to the technological devices that biologists employ to study the behaviour and morphology of such organisms.

(49) The early marine migration of 55 Atlantic salmon post-smolts tagged with acoustic transmitters was automatically monitored using 13 to 25 km long arrays of receivers **deployed** inside the Bay of Fundy, a coastal system on the east coast of Canada. (*Journal of Fish Biology*, 66(2), 2005, pp. 485–498)

Fewer cases were found in which *deploy*/*deployment* referred to the biology of a sea organism (behavioural patterns, morphological/physiological traits). An example is given in concordance (50).

(50) A rapid **thread-deployment strategy**, shown by post-larvae which are brought into suspension, may prolong each drifting excursion and thus further enhance dispersal in turbulent marine environments. (*Marine Biology*, 84(3), 1989, pp. 301–308)

In *The American Heritage® Dictionary of the English Language*, one of the senses of the term *deploy* is "to distribute (persons or forces) systematically and strategically". The other sense is "to position (troops) in readiness for combat, as along a front or line". This means that the military sense metaphorically arises from the dynamic image of an expanding group of entities or mass. The military sense in turn gives rise to the marine biology concept, which in concordance (50) refers to post-larval mussels producing expanding and drifting threads to enhance dispersal in turbulent marine environments, and ultimately, be exposed to predators as briefly as possible. Therefore, there is a superimposition of images whose metaphorical motivation is behaviour. This metaphor could thus very well be considered as a resemblance metaphor, while at the same time, the deployment action can be regarded as an abstract concept that can be subsumed by the conceptual metaphor LIFE/SURVIVAL IS WAR. This fact leaves the door open for the claim, which was tested in this research study, that the boundaries between resemblance and non-resemblance metaphors are not as clear as Conceptual Metaphor Theory suggests (see § 4.2.4.2.).

The pattern *despl** was searched for in the Spanish subcorpus with a view to obtaining terms such as *desplegar* and *despliegue* — the literal Spanish equivalents of *deploy* and *deployment*, respectively. However, neither of them occurred in the Spanish subcorpus to designate a non-resemblance metaphor. We retrieved the resemblance metaphor term *despliegue* (concordance (51), which refers to the growth and expansion of the vitellus within the chorionic membrane of an egg. This dynamic image is compared to the way a rolled entity is unrolled. This metaphor does not belong to the WAR metaphor since the deployment of the vitellus is not a protection strategy against predators, but rather exclusively answers developmental purposes. In other words, this is an example of what Ruiz de Mendoza (1999: 55) calls a *one-correspondence metaphor*, which results from one single cross-domain correspondence or mapping, and thus, does not form a part of a productive, *multiple correspondence* metaphor.

(51) A las 11 h: 26 min se observó un total de 16 cromatóforos en la parte frontal del embrión y otros entre las divisiones de los somitos, aumentó el **despliegue del vitelo** de la membrana coriónica, las cápsulas ópticas son totalmente visibles y se observan 9 cromatóforos al final del notocordio. (*Revista de Biología Marina y Oceanografía*, 38(1), 2003, pp. 27–37)

As most of the concordances provided so far in this section show, it was easy to establish interlinguistic equivalents since we found both English and Spanish tend to use the same non-resemblance metaphors to conceptualise marine organisms and processes. Unbalanced pairs were also ascertained, but they were far less numerous (see concordances (122) and (123)). A quick strategy to identify interlinguistic pairs was to analyse the bilingual texts as well as those texts whose figures and tables had captions both in English and Spanish. Context (17), which shows an exact pair, is a case in point.

(17) Tabla 1. Estadísticos básicos para una **cohorte** de *O. chilensis* a los 34 meses de edad, utilizada como población base en el programa de selección. Grupos Control y Seleccionado, para los caracteres peso vivo, longitud, ancho y alto de la valva.

Table 1. Basic statistics from a 34 m-old *O. chilensis* **cohort**, used as a base population in a genetic selection program. Control and Selected (Seleccionado) groups for the traits live weight, shell length, shell wide and shell height (*Revista de Biología Marina y Oceanografía*, 39(2), 2004, pp. 53–59)

The encompassing metaphor LIFE/SURVIVAL IS WAR presents marine life as a community that is exposed to invasion, which bespeaks the idea of an integrated personified community (Larson 2008: 177). The key concept *personified community* can be extrapolated to the data in our corpus, which seemed to contain a network of metaphorical terms depicting marine life as a complex social structure. A significant number of terms were retrieved at this stage which led us to formulate the encompassing metaphor MARINE HABITATS ARE COMMUNITIES. The incidence of this metaphor was ratified by the results obtained. Reasonably enough, the English metaphor ***community*** and its Spanish equivalent ***comunidad*** turned out to be recurrent terms in the marine biology corpus. The terms ***community*** in concordance (52) and ***comunidades*** in concordance (53) were retrieved by analysing the co-text of the keywords ***fish*** and ***peces***, respectively.

(52) Shore **fish community** structure off the Jordanian Red Sea coast was determined on fringing coral reefs and in a seagrass-dominated bay at 6 m and 12 m depths. (*Helgoland Marine Research*, 55(4), 2002, pp. 252–284)

(53) En el mar Caribe, se han realizado varios estudios sobre la estructura de **comunidades [community] de peces** en praderas de fanerógamas y sus relaciones tróficas (*Investigaciones Marinas*, 34(2), 2006, pp. 125–136)

As shown, we first identified terms belonging to the conceptual metaphor MARINE HABITATS ARE COMMUNITIES in the co-text of the keywords used to find resemblance metaphor keywords and in the co-texts of their markers. In concordance (54), the non-resemblance metaphor term ***population*** was detected by scrutinising the co-text of the taxonomic designation *Epinephelus striatus*. The keyword ***peces*** [fishes] in concordance (55) signalled the presence of the metaphorical term ***población*** [population].

(54) We examined the utility of otolith minor and trace element chemistry, assayed with inductively coupled plasma mass spectrometry (ICP-MS), as a means of delineating **population structure** in the Nassau grouper (*Epinephelus striatus*). (*Coral Reefs*, 18(2), 1999, 171–178)

(55) En **poblaciones de peces** la dinámica reproductiva es un proceso que depende del tamaño de los individuos, aspecto que tiene notable importancia en términos de la intensidad y duración de la actividad reproductiva. (*Investigaciones Marinas*, 32(2), 2004, pp. 59–69)

Afterwords, we explored the source domain COMMUNITY to find further metaphorical terms. We thought that a parallelism could be established between sea organisms and humans. The latter are *residents* in a *community* or have to *migrate*, they *settle* in new communities to set up *colonies*, *associate* with other organisms to become *partners* and form *guilds*, establish hierarchies whereby there are *dominant* and *subordinate* individuals, and engage in *social* activities. On this basis, we concordanced all of these lexical units, and found many metaphorical terms in our corpus. Concordances (56)–(58) contain some of these terms in English and Spanish. The rest of the metaphorical terms involved in this conceptual network are provided in the results section.

(56) **Male migration** to and **residency** in waters adjacent low-latitude nesting beaches in the western Atlantic suggest that this is where mating occurs, and return migration to these areas reveals male fidelity for breeding sites. (*Marine Biology*, 147(4), 2005, pp. 845–853)

(57) Juveniles and adults are distributed in the same habitat and strongly associated with corals, in particular, *Pavona decussata* when available, for **settlement** and **residence**. (*Environmental Biology of Fishes*, 74(1), 2005, pp. 9–18)

(58) Los islotes y rocas que rodean la isla alojan **colonias [colonies] de anidamiento** de **aves marinas migratorias [migratory]** y **residentes [residents]** como el piquero marrón y de patas rojas *(Sula leucogaster* y *S. sul*a, Sulidae), la tijereta de mar *(Fregata minor* y *F. magnificens,* Fregatidae), la palomita del espíritu santo *(Gygis alba,* Laridae) y la tiñosa común *(Anous stolidu*s, Laridae). (*Revista de Biología Tropical*, 49(3–4), 2001, pp. 1147–1157)

The terms *residency* and *residence* in concordances (56) and (57), respectively, provide evidence of the existence of synonymy in marine biology non-resemblance metaphors. We will provide further instances throughout this section, and the results and discussion section includes all of the synonyms identified in our corpus.

As with *target*, the term *migrate* and the rest of terms stemming from it (migration, migratory) can refer either to a multicellular organism (see concordances (56) and (58)) or to any types of cell inside it. Concordance (59) shows one of the retrieved occurrences of *migrate*, which involves hemocytes in molluscs.

(59) In bivalve molluscs, **defence** against pathogens mainly relies on fast tissue infiltration by immunocompetent hemocytes that **migrate** from circulating hemolymph to sites of infection, in order to deliver, *in situ*, an effective immune response. (*Fish and Shellfish Immunology*, 28(2), 2010, pp. 372–386)

Love and flirting are further examples of social interaction in human communities. Again, sea organisms are personified to feature these aspects.

(60) The effect of nest aggregation in **courtship behaviour** was tested experimentally in an ecologically constrained, sex-role reversed population of the peacock blenny *Salaria pavo*. (*Journal of Fish Biology*, 74(4), 2009, 754–762)

(61) Se efectuó la observación de los **procesos de cortejo [courtship]**, fecundación y desarrollo embrionario de *Antennarius striatus*, fenómenos que se presentaron bajo condiciones controladas luego de la captura de dos ejemplares adultos en la región de bahía Gaira (Santa Marta – Caribe colombiano). (*Revista de Biología Marina y Oceanografía*, 40(1), 2005, pp. 23–31)

(62) In a sex–role reversed population of the peacock blenny, *Salaria pavo*, two alternative male types are present: (a) older and larger nest–holder males that defend nests in which females come to spawn, and (b) younger and smaller sneaker males that mimic **female–courtship behaviour** and **nuptial colouration** in order to try to sneak fertilizations during spawning episodes. (*Fish Physiology and Biochemistry*, 28(2), 2003, pp. 241–243)

No evidence was found of the existence of *nupcial*, the literal Spanish equivalent of *nuptial*, in the Spanish subcorpus.

Another way to find terms under the encompassing metaphor MARINE HABITATS ARE COMMUNITIES was to analyse the co-text of keywords belonging to the WAR source domain since the corpus data analysed so far seemed to indicate that both conceptual systems were closely related. This assumption was confirmed by further examples retrieved at this stage of the study and later on in the results. For instance, the concordanced keyword *conflict* signalled the presence of *social*, with which it forms a marine biology lexical unit.

(63) Stress induced by **social conflict** in rainbow trout is known to result in physiological and haematological alterations as well as immune suppression. (*Fish and Shellfish Immunology*, 1(1), 1991, pp. 17–31)

Further examples are given in concordance (64).

(64) Phylogenetic analysis of the origin and elaboration of male **nuptial color** and breeding behavior indicate two forces, intersexual selection and natural selection during **guarding** of young (in decreasing order of significance), have been important in shaping the evolution of ventral body color in sticklebacks (McLennan et al. 1988, McLennan 1991). Experimental and field observations support the macroevolutionary hypothesis: the intensity of male color is lowest during **territory acquisition** and nest building, highest during **courtship**, and reaches a second but lower peak following the appearance of young. (*Environmental Biology of Fishes*, 55, 1999, pp. 237–244)

Such close relation between both systems enabled us to formulate the conceptual metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL. This formulation is sanctioned by Lakoff's (1993) claim of *inheritance hierarchies,* whereby general conceptual metaphors derive more specific ones, and by Kövecses's (1995) assumption that a specific metaphor can emerge from the interaction between two or more general ones. The interrelation of LIFE/SURVIVAL IS WAR and MARINE HABITATS ARE COMMUNITIES makes a case for experts' pursuit for coherence in their discourse. As Charteris-Black (2004) argues,

> Interrelating conceptual metaphors through the identification of conceptual keys can assist in accounting for coherence in particular discourses. Identification and description of these conceptual levels [...] contributes to theory building because it provides a point of access into the thoughts that underlie language use.

In one of the concordances of *target*, this WAR metaphor term co-occurred with *host* (see concordance (65)).

(65) Further experiments showed that PmAV did not bind to the WSSV implying that the antiviral mechanism of this protein was not due to inhibition of the attachment of virus to **target host** cell (*Fish and Shellfish Immunology*, 27(2), 2009, pp. 79–88)

We then thought that if marine organisms organise themselves into communities and form societies, their dwelling structure, which is part of a society, would presumably derive futher metaphorical terms besides *host*. Moreover, thanks to our previous basic knowledge of other areas of biology, we were aware of concepts such as *inquiline*, *commensal*, *neighbour*, and *housing*. Thus, we searched for these terms in our marine biology corpus, and indeed, a good number of hits were obtained. Concordances (66) and (67) show an example. In these concordances, the stem *house* appears as a noun (concordance (66)) and as a verb (concordance (67)). Furthermore, concordance (67) provides evidence of the strong relationship between the concepts *settlements*, *colonies* and *housing*, which often co-occur very closely in the same discourse unit.

(66) The **houses** of oikopleurid larvaceans are of such a delicate structure that their preservation and storage for reference collections and post-collection study has been essentially impossible. (*Marine Biology*, 108(1), 1991, pp. 105–110)

(67) **Settlement patterns** on Kn1 and Kn2 were highly consistent during 2003 and 2004 (Table IV). Of the 13 Kn1 **colonies** occupied by adults, five were **settled** during both years [$P_r(k)$ = 0·008]. None of the unoccupied colonies were settled during these years. The same five colonies were **settled** again during 2005, despite not **housing** adults. (*Journal of Fish Biology*, 73(4), 2008, pp. 1005–1018)

The term *home*, synonymous with *house*, was also concordanced, and results were obtained, as shown by concordance (68). This concordance includes *neighbouring*, which belongs to the COMMUNITY metaphor as well.

(68) Males defend their boundaries by chasing **neighbouring males** and have significantly larger **home ranges** than females. (*Environmental Biology of Fishes*, 74(1), 2005, pp. 9–18)

The literal Spanish equivalents of the abovementioned terms were searched for in the Spanish subcorpus, yielding positive results too. Examples are concordance (69), which contains the term *casa*, Spanish for *house*, and concordance (70), which contains the term *hogar*, Spanish for *home*. This concordance also includes the resemblance metaphor *galería* (gallery), which is a natural passageway that is compared in shape to "a roofed promenade extending along the wall of a building and supported by arches or columns on the outer side (*The American Heritage® Dictionary of the English Language*).

(69) El cangrejo ermitaño depende de conchas de moluscos para hacer de ella su **casa**. (*Investigaciones Marinas*, 33(2), 2005, pp. 217–219)

(70) El hábitat más utilizado por *L. felina* es el litoral rocoso escarpado y expuesto, con presencia de **galerías** naturales, y su actividad se desarrolla en un ámbito de **hogar** que abarca cerca de 4 km lineales de costa y 100 m mar adentro, hasta 30 m al interior de la franja costera continental. (*Revista de Biología Marina y Oceanografía*, 44(2), 2009, pp. 409–415)

Since we already had evidence of the existence of synonymy for both resemblance and non-resemblance metaphor terms, we used the bilingual articles of the journal *Ciencias Marinas* to try to easily detect further instances of non-resemblance metaphor synonyms. Hardly any variants were identified. One of them is shown in contexts (18–20). In this case, the strategy was to search for the English term *host* in the *Ciencias Marinas* articles. Whenever a hit of *host* was obtained, we consulted its Spanish counterpart, and found three possible interlinguistic equivalents for this term: *hospedero*, *hospedador*, and *huésped*.

(18) La interacción consecuente que se genera entre epifito y **hospedero** presenta efectos tanto negativos como positivos, entre los que sobresalen la reducción de energía lumínica, traducida en la reducción de la actividad fotosintética del **hospedero** (Dixon et al. 1981, Hurd et al. 2000).

The interaction generated between epiphyte and **host** can have negative and positive effects. One of the main negative effects is the reduction of luminic energy, and consequently a decrease in the photosynthetic activity of the **host plant** (Dixon et al. 1981, Hurd et al. 2000).

(*Ciencias Marinas*, 33(3), 2007, pp. 311–317)

(19) Material estudiado: 150 ejemplares. Las medidas que se indican corresponden a 25 hembras. Localización en el **hospedador**: Vejiga natatoria. **Hospedador**: *Merluccius hubbsi* Marini, 1993.

Material studied: 150 specimens. The measurements given correspond to 25 females. Location in the **host**: Swim bladder. **Host**: *Merluccius hubbsi* Marini, 1993.

(*Ciencias Marinas*, 25(3), 1999, pp. 439–444)

(20) Prayitno y Latchford (1995), Hameed (1995), Harris y Owens (1999) y Saulnier et al. (2000b) demostraron que la virulencia de las species de *Vibrio* está relacionada con la cepa de *Vibrio*, el método de infección y las características del **huésped** (especie, edad, estado fisiológico).

Prayitno and Latchford (1995), Hameed (1995), Harris and Owens (1999) and Saulnier et al. (2000b) showed that the virulence of *Vibrio* species is related to the *Vibrio* strains, method of infection and **host factors** (species, age, physiological state).

(*Ciencias Marinas*, 29(1), 2003, pp. 77–88)

Sea organisms are conceptualised as humans, who declare war on one another, compete and associate for survival, take care of their houses, and can also have their own houses invaded. The co-texts of the terms *invade* and *invadiendo* in concordances (71) and (72) include the terms *host* and *hospedadores*, respectively. This is thus another example of the macro-metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL, which is used both by English and Spanish-speaking specialists in marine biology.

(71) The presence of an adult female alone with its CV molt in a third medusa suggests that females **invade** the **host** regardless of the presence of the male in it. (*Marine Biology*, 151(1), 2007, pp. 233–242)

(72) Muchos autores han coincidido en adjudicar a *L. chapmanii* características que le dan potencialidad para actuar como agente de control biológico,

como la alta mortalidad generada en organismos blancos y la especificidad de **hospedadores [hosts]** entre otras. El ciclo de vida de *L. chapmanii* comienza con la liberación de zoosporas móviles, las cuales se enquistan, y por mediación de factores mecánicos y enzimáticos, penetra el cuerpo de la larva, crece rápidamente en su interior **invadiendo [invading]** los distintos órganos y tejidos, y ocasiona su muerte. (*Revista de Biología Tropical*, 57(2), 2009, pp. 371–380)

Evasion, another concept belonging to the domain MILITARISM, is the final strategy for invaders when they do not manage to defeat their hosts, as shown by concordance (73).

(73) Knowledge of the **evasion strategies** adopted by parasites will help us to understand **host**-parasite interactions and may therefore help in the discovery of novel immunotherapeutic agents or **targeted vaccines**, and permit the selection of host-resistant strains (*Fish and Shellfish Immunology*, 25(4), 2008, pp. 358–372)

As shown so far, the interrelation of metaphorical systems in the marine biology corpus provides evidence of the systematicity in the use of metaphor in discourse. Both metaphor interrelation and systematicity were detected because of metaphor clustering in the texts. In fact, the co-occurrence of linguistic metaphors in the English and Spanish marine biology texts facilitated the identification of another macro-metaphor, which we decided to formulate as SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS. Terms such as *cost*, *pay*, *expensive*, *stock*, *capitalise*, and *monopolise* can be subsumed under this metaphor.

Concordances (74–76) show examples of these terms, which occurred in close proximity with terms belonging to the macro-metaphors previously identified. The term *costly* in concordance (74) was retrieved by concordancing the term *defence*, which is highly representative of the WAR source domain. The terms *tactics* and *courtship*, which belong to the macro-metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL and MARINE HABITATS ARE COMMUNITIES, respectively, were also detected in the same discourse unit. The term *pay-off* in concordance (75) was retrieved by concordancing the term *competition*, which is representative of the abovementioned metaphor. The same applies to the term *estrategia* [estrategia] in concordance (76), which signalled the presence of *costo energético* [energetic cost], which belongs to the encompassing metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

(74) Behavioural qualities such as **courtship** (Knapp & Kovach 1991) or **territory defence** (Goldschmidt et al. 1992) also influence male reproductive success. Such fitness-enhancing factors, however, are **costly** (Abrahams 1993, Rangeley & Godin 1992) and low-quality males, that cannot support these ‘traits’, are avoided by females and effectively prevented from access to reproduction. Therefore such males may employ **alternative reproductive tactics** (ART) and obtain partners or parasitic fertilizations from other successful males (reviewed by Taborsky 1998, 2001). (*Environmental Biology of Fishes*, 70(1), 2004, pp. 23–30)

(75) Three factors may pre-dispose teleost to ART’s: (1) indeterminate growth, resulting in a large variation in individual size, leading in turn to a high probability of exclusion of small individuals, (2) external fertilization, that makes it difficult to exclude **sperm competition**, (3) male parental care that involves a high **pay-off** to **sneakers**. (*Environmental Biology of Fishes*, 70(1), 2004, pp. 23–30)

(76) La adopción de una de estas **estrategias** puede tener una consecuencia importante para el organismo, ya que la movilización de iones con carga eléctrica genera un importante **costo energético** (Kirschner 1991, Withers 1992). (*Revista de Biología Marina y Oceanografía*, 44(3), 2009, pp. 715–724)

Identified by analysing the co-text of COMMUNITY metaphor terms in the corpus (see concordance (77), the the English term *stock* originally comes from the BUSINESS domain, where it refers to the total merchandise kept on hand by a merchant, commercial establishment, warehouse, or manufacturer. In marine biology, it designates a whole race, family, or other related group of animals or plants that is to be analysed or captured.

(77) Some other small **stocks** had similarly high growth rates of 20–50%, which must be explained by **immigration** from the larger **colonies**, as sustained

autochthonous increase cannot exceed 13% per year in the species. (*Helgoland Marine Research*, 63(2), 2008, pp. 177–180)

This marine biology term is used as a borrowing in the Spanish specialised texts (see concordance (78)), which obviously implies that both English- and Spanish-speaking experts rely on the same metaphor to refer to this concept.

(78) La influencia del factor ambiental ha sido considerada a dos niveles: sobre la abundancia y sobre la capturabilidad del **stock** (*Investigaciones Marinas*, 23, 1995, 25–47)

The strategy of analysing the co-texts of keywords of resemblance metaphor terms and of their taxonomic designations was also exploited. The ECONOMY metaphor term ***energetic expenditure*** in concordance (79) was retrieved through the keyword ***sea***. ***Gasto energético***, its Spanish counterpart in concordance (80), which is based on the same conceptual metaphor, was retrieved through the taxonomic designation ***Anadara tuberculosa***.

(79) **Energetic expenditure** during spawning of male and female 1 -sea-winter Atlantic salmon, *Salmo salar* L., was measured. (*Journal of Fish Biology*, 39(5), 739–744)

(80) En *Anadara tuberculosa* no ocurre lo anterior porque los periodos de desove coinciden con las menores concentraciones de clorofila ***a*** (se observó una relación inversa significativa entre esta fase del ciclo gonadal y la disponibilidad de alimento). Esto indica la posibilidad de que el **gasto energético** necesario para la expulsión de gametos esté sostenido por sustancias energéticas almacenadas, debido a la alta frecuencia de organismos en fase de emisión de gametos y el poco alimento. (*Revista de Biología Marina y Oceanografía*, 43(1), 2008, pp. 143–152)

Evidence was also found of the systematicity of the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS, whereby a number of linguistic items belonging to this macro-metaphor co-occur in close proximity in the same text.

(81) Partial **stock replenishment** in carp hatcheries is practised to overcome the problem of inbreeding, which otherwise leads to **poor growth** of carps.

Similarly, gametes of improved **stock** are cryopreserved and utilized for quality **seed production** (*Fish Physiology and Biochemistry*, 33(4), 2007, pp. 413–427)

(82) Los humedales de manglar son ecosistemas altamente productivos**,** poseen una elevada tasa de **producción primaria** [**primary production**] y además **exportan** [(they) **export**] materia orgánica a destinos variados sirviendo de sustrato para el desarrollo de diversos microorganismos. (*Boletín de Investigaciones Marinas y Costeras,* 38(1), 2009*,* pp. 59–84)

These examples seemed to be indicative of a rich network of closely interrelated metaphor systems that underlies marine biology expert knowledge. In our view, such systems give insights as to how experts develop their discourse and ultimately, make and communicate science. The results section ratifies this inference with more metaphorical terms.

Concordances such as (80) show the existence of a variety of metaphorical terms containing the words *ciclo*/*cycle*. According to *The American Heritage® Dictionary of the English Language*, a cycle is “an interval of time during which a characteristic, often regularly repeated event or sequence of events occurs. The *Diccionario de la Real Academia Española* defines *ciclo* as “serie de fases por las que pasa un fenómeno periódico” [a series of phases in which a periodical phenomenon takes place]. It could thus be argued that the concept that these terms designate is not metaphorical in nature. However, on closer examination of their definitions, it becomes evident that both terms stem from Late Latin *cyclus*, which in turn comes from Greek *kuklos*, whose meaning is *circle*. Therefore, the terms *cycle* and *ciclo* actually are a metaphor, but the metaphor is opaque or latent, rather than transparent. The conception of sea life as a cyclical process is visually depicted by Figure 30, which features the life history of the seaweed *Durvillaea antarctica* (cf. *Revista de Biología Marina y Oceanografía*, 37(1), 2002, pp. 93–112). As can be seen, this life history is traced by a number of arrows that delineate a perfect circle. This figure opens the door to an interesting research line, which would identify marine biology metaphorical concepts represented by pictures and drawings included in specialised publications.

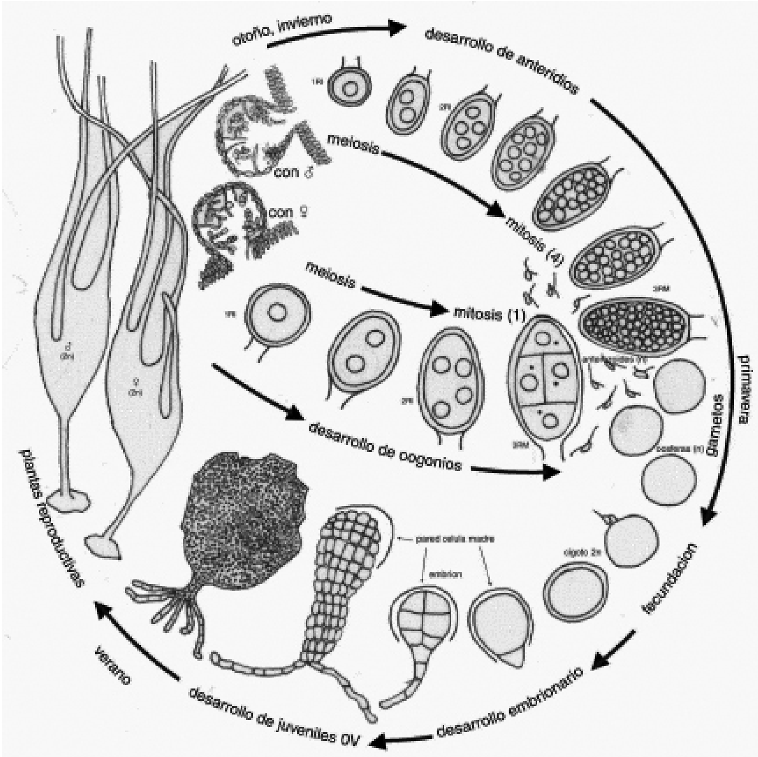


Figure 30. Life history of the seaweed *Durvillaea antarctica*.

Based on this, we concordanced the stems *cycl** in English and *ciclo* in Spanish to find further cases. An extensive body of terms was then retrieved. Thus, we decided to formulate the encompassing metaphor MARINE PROCESSES ARE CIRCLES. Concordances (83) and (84) include an example of an exact interlinguistic pair that can be emcompassed by this metaphor. Concordance (83) also reveals the term *import*, which belongs to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

(83) Changes in the seasonal **cycle of nutrients** might be used as a direct indicator of changes in organic matter **import** and remineralisation rates. (*Environmental Biology of Fishes*, 73(1), 2005, pp. 75–88)

(84) Adicionalmente, se han encontrado hongos solubilizadores de fosfatos y hongos formadores de micorrizas arbusculares, que participan activamente en el **ciclo de** estos **nutrientes** en los manglares, tal como se describe a continuación. (*Boletín de Investigaciones Marinas y Costeras*, 38(1), 2009, pp. 39–57)

The terms *cycle* and *ciclo* were thus keywords that helped us identify further metaphorical terms under this macro-metaphor. For instance, *cycle* and *ciclo* signalled the presence of the metaphorical term *food chain* and *cadena trófica* [trophic chain] in concordances (85) and (86), respectively. Thus, this is still another case in which the interlinguistic pair terms are based on the same conceptual metaphor.

(85) We hypothesise that the coelenterazine requirement in secretory bioluminescence exceeds that which could be assimilated from the **food chain**. The significant increase of coelenterazine during the **life cycle** of secretory decapods supports this hypothesis. (*Marine Biology*, 124(2), 1995, pp. 197–207)

(86) El uso sistemático de esta capacidad en sistemas intensivos consistiría en un hito ecológico pues las microalgas, al ser la base de la **cadena trófica** acuática, son los microorganismos apropiados para cerrar el **ciclo** ecológico con el aprovechamiento de compuestos inorgánicos que las normatividades actuales consideran como peligrosos cuando están libres en el ambiente. (*Interciencia*[35], 28(8), 2003, pp. 450–456)

Previously used keywords, such as *sea*/*mar*(*ino*), were also of help to identify further metaphorical terms, including terminological variants. A case in point is concordance (87), in which the keyword *sea*, in the compound *seagrass*, co-occurs with *trophic chain*, a variant of *food chain*. The keyword *marino* in concordance (88) shows the term *cadenas alimenticias* [alimentary chains], a variant of *cadena trófica*. Concordance (88) also reveals the existence of *productividad primaria* [primary productivity], one metaphorical term belonging to the macro-metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

(87) These results indicate that bacteria may play a key role in the benthic **trophic chain** of the Mediterranean seagrass system. (*Marine Biology*, 127(1), 1996, pp. 1–139)

(88) En este contexto, el zooplancton marino sirve como enlace en las **cadenas alimenticias** pelágicas, ya que al estar ubicados en un nivel secundario, transfiere la energía de la **productividad primaria** a los niveles superiores. (*Investigaciones Marinas*, 35(1), 2007, pp. 117–122)

[35] As with *Revista Peruana de Biología*, only one article of the journal *Interciencia* was exploited in our study.

By simply concordancing *cadena*, we found still another variant, *cadena alimentaria*, shown in concordance (89).

(89) Por otra parte, Riisgard y Hansen (1990), en un estudio experimental llevado a cabo en el bivalvo *Mytilus edulis*, tendiente a evaluar la capacidad de biomagnificación de Hg total y CH_3Hg (*i.e*: acumulación progresiva del agente químico a lo largo de la **cadena alimentaria**[36] **[alimentary chain]**), concluyeron que la tasa de acumulación parece ser dependiente de la talla. (*Revista de Biología Marina y Oceanografía*, 36(1), 2001, pp. 15–29)

Concordancing the term *cadena* in the Spanish texts of the bilingual journal *Ciencias Marinas* helped us find another variant of *trophic chain*. When we obtained a hit for *cadena* in these texts, we searched for its interlinguistic equivalent in the English text. *Trophic web*, the variant of *trophic chain*, is shown in concordance (91). *Producers*/*productores* and *consumers*/*consumidores*, pertaining to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS ASPECTS, were also retrieved here.

(90) Esto también implica una **cadena trófica** para el flujo del carbono de **productores** y **consumidores**, diferente a la sugerida tradicionalmente (Conover y Huntley, 1984).

(91) Accordingly, these results also point to the existence of a **trophic web** for the flow of carbon between **producers** and **consumers**, which is much different from that traditionally suggested for these **populations** (Conover and Huntley, 1984).

(*Ciencias Marinas*, 23(1), 1997, 71–81)

Further examples of non-resemblance metaphors belonging to any of the four macro-metaphors are provided in the next section.

3.5.2.1.2. Finding non-resemblance metaphors by means of target domain keywords

[36] The *Diccionario de la Real Academia Española* currently provides two senses for *alimenticio*: 1. nutritious, nourishing. 2. concerned with food. *Alimenticio* is synonymous with *alimentario* when used as in sense 2, and this is precisely the sense assigned to *cadena alimentaria* and *cadena alimenticia* —besides *cadena trófica*— in marine biology. In English, this specialised concept has been lexicalised as *food chain* or *trophic chain*, but not as *alimentary chain*.

As with resemblance metaphors, a way of retrieving compound non-resemblance metaphor terms was to analyse the co-text of target domain lexical units with a view to finding complex terminological units. We took as a reference the vocabulary that was conceptually salient to or representative of the domain of marine biology, and had a high frequency of occurrence in the corpus. These lexical units became keywords. Apart from the already used target domain keywords, we focused on two interlinguistic pairs: *species*/*especie*(*s*) and *organism*/*organism*. As shown in the methodology section, the terms *species* and *especie* occurred 8,823 and 8,317 times in their respective subcorpora. The terms *organism* and *organismo* occurred 4,532 and 4,379 times, respectively.

The concordances of the terms *marine* and *marino* revealed a curious interlinguistic metaphorical exact pair, *marine snow*/*nieve marina*, which refers to the small particles of organic biogenic marine sediment that slowly drift down to the sea bottom. This fall of particles is compared to the fall of actual snowflakes onto dry land. The carbon molecules in these organic particles are then used by primary producers to build carbohydrates, thus initiating the biogeochemical cycle (a definition of this concept is given in 3.5.2.2.2.), a phenomenon that continually occurs to preserve sea life. In this way, marine snow can be regarded as part of the biogeochemical cycle, and therefore, part of the metaphor MARINE PROCESSES ARE CIRCLES. Concordances (92) and (93) show occurrences of the terms *marine snow* and its Spanish equivalent *nieve marina*.

(92) Nearly every species' diet contained a considerable amount of olive-colored debris, which may have been **marine snow** generated in the epipelagic zone. (*Marine Biology*, 118(4), 1994, pp. 651–661)

(93) La **nieve marina** es un conjunto de agregados macroscópicos que consiste en cantidades variables de organismos vivos (e.g. bacterias, fitoplancton, zooplancton), materia inorgánica (e.g. arcilla), materia orgánica (e.g. polímeros), peloides fecales, etc, unidos por un exopolímero transparente (polisacarido) excretado por el fitoplancton y bacterias marinas. (*Boletín de Investigaciones Marinas y Costeras*, 32(1), 2003, 93–123)

The terms *species* and *especie* were then concordanced. An extensive number of metaphorical multiword expressions were retrieved. Not surprisingly, many of them were encompassed by the macro-metaphor MARINE HABITATS ARE COMMUNITIES, since they designated species that are *sedentary*, that is, they stay as *residents* in their habitats or they are *vagrant* species with no particular destination, or behave as *tourist* and *visitant* species to other communities. There are also species that occur around the world, which signifies that they are *cosmopolitan*. Concordances (94) and (95) are given as examples. The rest of terms retrieved from the corpus are given in the results section.

(94) Estuarine **resident** and marine dependent **species** are the most abundant and frequently collected fishes in the estuarine area, whereas **vagrant species** are less frequently captured throughout the year. (*Environmental Biology of Fishes*, 68(3), 2003, pp. 215–228)

(95) A total of 23 waterfowl species were observed: 6 transients, 10 winter **visitants**, and 7 residents.(*Hydrobiologia*, 467(1–3), 2002, pp. 123–131)

The Spanish texts contained the exact interlinguistic equivalents of many of these multiword expressions. Concordance (96) provides two examples.

(96) De acuerdo con la frecuencia de aparición, el 58% de las especies se categorizó como **visitante [visitant]** ocasional, el 26% como visitante frecuente y el 16% como **residente [resident]** (*Boletín de Investigaciones Marinas y Costeras*, 32(1), 2003, 231–242)

Stealing, another activity that unfortunately takes place in human communities, is also mapped onto marine communities.The keyword *species* revealed the terms *robbery* and *kleptoparasitic* in concordance (97). The examination of the co-text of *species* also showed the presence of *usurped* in concordance (98), whereas the taxonomic designation in concordance (99) signalled the presence of *steal*. The target domain keyword *marino/a* [marine] in concordance (100) showed the terms *robar* and *cleptoparásitas*, the interlinguistic equivalents of *steal* and *kleptoparasitic*, respectively.

(97) Both body length and body mass of the birds can well explain species order in the **robbery index** but not in the foraging success index. Our hypothesis that the most successful species employ particular feeding techniques and/or exhibit the strongest **kleptoparasitic abilities** could be confirmed to a large extent but not totally. (*Helgoland Marine Research*, 52(2), 1998, pp. 187–196)

(98) Not all exotics are harmful to endemics, however it is generally agreed that they use some resources within the system they invade, some of which may be **usurped** from endemics. We now know that introduced species can cause major changes in community structure and ecosystem function (*Environmental Biology of Fishes*, 66(3), 2003, pp. 293–305)

(99) Waiting (keeping motionless on the substrate, waiting for a known prey) was used by some adult females when they tried to **steal** eggs of the mouthbrooder *Cyathopharynx furcifer* on the bower and by adult males when they targeted an eel having hidden under a rock. (*Environmental Biology of Fishes*, 39(1), 1994, pp. 59–72)

(100) Todas las especies tienen sus sitios de anidación en zonas cercanas a los polos y se comportan como **cleptoparásitas [parasitical robbers]**, es decir, atacan a otras aves marinas para **robar [steal]** su alimento. (*Boletín de Investigaciones Marinas y Costeras*, 33(1), 2004, pp. 245–250)

According to *The American Heritage® Dictionary of the English Language*, the term *usurp* means "to take over or occupy without right or legal authority". This concept, which figures prominently in the knowledge domain of law, is mapped onto the domain of marine biology. *Usurpar*, its literal Spanish translation equivalent, was not found in the corpus. The term that had the closest sense to *usurpar* in the corpus is *ocupar* (occupy), as shown by concordance (101). *Usurp* and *ocupar* are an unbalanced pair since *ocupar* does not have a figurative meaning. Concordance (101) also shows the term *equipada*, Spanish for *equipped*, which was a term highlighted in concordance (25). Both terms refer to the anatomical or molecular *arms* that an organism has to fight an enemy or adapt to a particularly awkward environment. Thus, *equipped* and *equipada* are an exact pair.

(101) En contraste, aunque *O. suensonii* está **equipada** para **ocupar** visible y epizoicamente esponjas y otros componentes elevados del sustrato, mostró preferencia por algunas especies de esponjas, atribuible a la disponibilidad de diferentes ventajas conferidas según sus formas de crecimiento. (*Boletín de Investigaciones Marinas y Costeras*, 33(1), 2004, pp. 29–47)

Not only are there negative social actions in a community, but also positive ones. Some marine organisms are pioneering species, which colonise previously uncolonised habitats, starting a chain of events that lead to a habitable ecosystem.

(102) Further studies on the early development of minnow, in particular comparing the ontogeny of natural laboratory-reared specimens, is needed to identify why this species is particularly adaptable and **pioneering species** amongst European cyprinids. (*Environmental Biology of Fishes*, 56(1), 1999, pp. 117–128)

(103) La comunidad instalada sobre la parte externa del arrecife es prácticamente homogénea, presentando especies de **carácter** marcadamente **pionero**; no obstante, parece presentar tendencia hacia comunidades esciáfilas en modo relativamente calmado. (*Revista del Instituto Español de Oceanografía*, 12, 1993, Publicación especial)

Concordancing target domain keywords, such as *species*/*especie*, provided further evidence of the interrelation between the metaphor systems LIFE/SURVIVAL IS WAR and MARINE HABITATS ARE COMMUNITIES, which resulted in the macro-metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL. Concordances (104) and (105) are given as examples.

(104) Simultaneously, **non-indigenous invasive species** of invertebrates and fishes increased, and, in some cases, exotics became the **dominant species**. (*Environmental Biology of Fishes*, 68(3), 2003, pp. 215–228)

(105) **Bioinvasiones**, legislación, manejo, ENI y Pacífico suroriental Se presenta el primer listado completo de poliquetos perforadores en Chile, con información sobre el estatus de cada especie como nativa o especie no indígena (ENI), rangos nativos e introducidos, las **especies hospedadores** afectadas, los probables vectores de introducción y áreas donantes. (*Revista de Biología Marina y Oceanografía,* 36(1), 2001, pp. 99–108)

The keyword *species* also co-occurred with *opportunists*, another term that can be subsumed by the COMBAT metaphor. An opportunistic person is one who adapts his/her actions and behaviour to a specific situation in order to take advantage of it. This sense is metaphorically mapped onto those sea organisms that (re)colonise a habitat, and take advantage of its resources by adapting to the habitat. They manage to do so because they are able to withstand adverse conditions and situations, such as fighting native species.

(106) Cool–temperate estuaries were generally dominated by migratory species (estuarine migrants and **marine migrant opportunists**) while the importance of species dependent on estuaries (estuarine residents and estuarine-dependent marine migrants) was higher in warm–temperate and subtropical regions. (*Journal of Fish Biology*, 73(10), 2008, pp. 2542–2570)

(107) La abundancia de algunas especies de **carácter oportunista**, sobre todo poliquetos como *Capitella capitata* (Fabricius, 1780) y *Pseudopolydora* cf. *paucibranchiata* (Okuda, 1937), ha experimentado un fuerte incremento algunos meses después del vertido, alcanzando valores hasta 30 veces superiores a los normales en el caso de *P.* cf. *paucibranchiata*. (*Boletín del Instituto Español de Oceanografía*, 23, 1997, pp. 71–82)

The term *fugitive* was retrieved by means of the keyword *species*. It designates organisms that colonise those marginal habitats, such as deserts and saline areas, which are not exploited by other organisms. The metaphor is based on the idea that these species *run away* from where they lived to thrive somewhere else. Thus, a fugitive species can be regarded as a type of opportunistic species. Concordance (108) shows an instance of this term. We also concordanced *fugitivo*, the literal Spanish translation equivalent of *fugitive*, and obtained results such as concordance (109), which includes the term *oportunista* as well.

(108) These results suggest that the lakes' environmental conditions contribute to the patterns of presence and abundance of perch, but that interspecific interactions override a similar contribution for the mudminnow, which is regarded as a **fugitive species**. (*Environmental biology of fishes*, 33(4), 1992, pp. 399–404)

(109) Entre este amplio intervalo de estructuras, ambos complejos habitaron en varios tipos de espacios disponibles tales como: intersticios, comisuras, superficies externas e inferiores. Ello concuerda con el hábito generalista, oportunista y **fugitivo**, señalado por Hendler *et al.* (1995) para varias de las

especies que conforman estos complejos. (*Boletín de Investigaciones Marinas y Costeras*, 33(1), 2004, pp. 29–47).

The *Clusters* option in Wordsmith Tools revealed that the exact pair terminological units *invasive exotic species* and *especie exótica invasora* occurred in the English and the Spanish subcorpora, respectively. Concordances (110) and (111) include two instances of such terminological phrases. Again, it is hardly a coincidence that they co-occur with terms belonging to the metaphor MARINE HABITATS ARE COMMUNITIES, such as *populations* and *colonizar* (colonise).

(110) **Invasive exotic species** refer to exotic species that have established their **populations** in natural or semi- natural ecological systems or habitats, and have brought threats to local ecological systems, habitats, species and human health. (*Environmental Biology of Fishes*, 85(4), 2009, pp. 337–357)

(111) Estos resultados demuestran claramente que la **especie exótica invasora** presenta mayor capacidad que *M. pyrifera* para **colonizar** rápidamente el sustrato denudado, denotando el mayor éxito de la primera, al menos a corto plazo. (*Revista de Biología Marina y Oceanografía*, 43(2), 2008, pp. 335–344)

The concordanced terms *organism* and *organismo* showed further instances of multiword expressions that fit the metaphor LIFE/SURVIVAL IS WAR (concordances (112) and (113)). As can be seen, the tendency is for English and Spanish-language experts to use the same metaphors.

(112) Biochemical characterization of the antioxidant system in the scallop Adamussium colbecki, a **sentinel organism** for monitoring the antarctic environment (*Marine Biology*, 146(2), 2005, pp. 355–362)

(113) La selección de moluscos como **organismos centinelas** responde a su reconocida capacidad como bioindicadores de contaminación por metales. (*Revista de Biología Marina y Oceanografía*, 41(2), 2006, pp. 167–176).

The crossed combination of the two keyword pairs, *species*/*especie* and *organism*/*organismo*, was also productive, as concordances (114) and (115) show. The keyword *species* pointed to the COMMUNITY metaphor *architecture*, and the keyword *organismo* pointed to its Spanish equivalents *arquitectónico* (adjectival form) and *arquitectura* as well as *familia* (family), another COMMUNITY metaphor.

(114) This is most probably related to differences in the internal composition and **architecture** of the shell in the four species. (*Marine Biology*, 150(4), 2006, pp. 585–597)

(115) Muchos organismos generan estructuras biogénicas, que proveen complejidad estructural debido a su intrincada **forma arquitectónica** […] La compleja **arquitectura** de los tubos ocasiona la acumulación de sedimentos y materia orgánica favoreciendo el establecimiento en altas densidades de organismos detritívoros como los poliquetos de la **familia** Lumbrineridae y el anfípodo *Monocorophium insidiosum*. (*Investigaciones Marinas*, 34(2), 2006, pp. 197–203)

These keywords also helped us identify terms pertaining to other macro-metaphors, such as *advertise* and *consumer*, which can be subsumed by SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS. These terms are regarded as metaphorical because they evoke the idea of a chain of economic/business activities involving individuals advertising their products (concordance (116)) and some others consuming them (concordance (117)). Thus, sea organisms are presented as having a personified behaviour.

(116) It is suggested that the acoustic emissions in this species may play a role in **advertising** the presence and spawning readiness of males and in synchronizing gamete release. (*Journal of Fish Biology*, 62(3), 2003, pp. 658–672)

(117) In a study to assess qualitatively the importance of organic matter derived from kelp production in the Aleutian Islands of subarctic Alaka, replicated samples of autotrophic sources and primary and secondary **consumer organisms** (*Marine Biology*, 116(1), 1993, pp. 147–160)

The Spanish term *comportamiento* was also concordanced. Since its interlinguistic equivalent can be written either as *behaviour* (British English) or *behavior* (American English), we concordanced the stem *behavio**. Even though these terms did not rank high among the most frequent words in the Wordsmith Tools Wordlist, we considered them to be conceptually relevant. However, not many new metaphorical terms were retrieved. Concordances (118–120) show several interesting terms under the metaphor MARINE HABITATS ARE COMMUNITIES.

(118) To investigate site **fidelity** and **homing** behaviour in juvenile loggerheads (*Caretta caretta*, L.), a mark-recapture study spanning four years (1998–2001) was conducted in Core Sound, N.C., USA. (*Marine Biology*, 143(2), 2003, pp. 211–220)

(119) Specimens showed **gregarious behaviour** and moved independently only on reaching a size greater than 30–35 mm (in March). (*Fish Physiology and Biochemistry*, 32(2), 2006, pp. 159–166)

(120) Se destacan las migraciones horizontales y verticales (Matthews *et al.*, 1991; Pillar & Barange, 1997; Aglen *et al.*, 1999), el ocultamiento a depredadores (Steiner *et al.*, 1982), detección visual y escape de la red de arrastre (Walsh & Hickey, 1993) o **comportamiento gregario** [**gregarious**] (Walsh, 1991; Sierra *et al.*, 1994). (*Investigaciones Marinas*, 34(1), 2006, pp. 23–42)

An explanation of the metaphorical nature of the term *gregarious* is provided here. The second sense of this word in *The American Heritage® Dictionary of the English Language* is the following:

> Tending to move in or form a group with others of the same kind or species.

This sense is based on the first sense of the word, which is:

> Seeking and enjoying the company of others; sociable. See Synonyms at *social*.

The adjective *behavioral* in the phrase *behavioural acts* in concordance (121) revealed the existence of the terminological unit *time budget*, which can be assigned to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

(121) Two experiments were designed, one examined the **time budget** of various behavioral acts and the degree of association with the sea anemone, the other analyzed the behavioral response to algae and anemones. (*Marine Biology*, 151(3), 2007, pp. 1111–1116)

The usual Spanish literal translation equivalent of *budget* is *presupuesto*. We searched for this term in the Spanish subcorpus, but obtained no items that could be regarded as the equivalents of *budget*. Our strategy was then to search for *budget* in the bilingual articles of the journal *Ciencias Marinas*. As context (22) shows, the Spanish terminological equivalent of *budget* in marine biology is *balance* [balance], which belongs to the ECONOMICS domain as well. Curiously enough, the English term *balance* is also used by experts in this field to designate the same concept as *budget*, as shown by context (21) with *N03 balance*. Therefore, this is another case of terminological variation.

(21) The **nutrient budget** was scaled up to an estimate of net community production (NCP) using the compositional relationship of local phytoplankton. The mean annual NCP predicted by the **NO3 balance** was 24.o mgC m-2 h-1, and 35.8 mgC m-2 h-1 by the **PO4-3 bugdet**.

(22) Se estimó la producción neta (NCP, *net community production*) en base al **balance de nutrientes** y la composición elemental de fitoplancton local, obteniéndose un valor medio anual de 24.0 mgC m-2 h-1 en base al nitrato y de 35.8 mgC m-2 h-1 a partir del fosfato.

Ciencias Marinas, 31(1), 2005, pp. 213–220)

3.5.2.2. Annotation of non-resemblance metaphor terms and quantitative analysis

An annotation schema was devised to quantitatively describe non-resemblance metaphor terms. As with resemblance metaphors, non-resemblance metaphor terms were tagged to obtain absolute frequencies and statistics of the interlinguistic pairs.

3.5.2.2.1. Tagging to obtain absolute frequencies

The five aforementioned macro-metaphors were formulated after coming across sets of instances that we considered to be numerous enough to be subsumed by one of these metaphorical systems. Whenever a non-resemblance metaphor term was identified by means of any of the strategies used for this purpose, such a term was given one of the following tags:

- *METAPH_COM*, if the term belonged to the metaphor MARINE HABITATS ARE COMMUNITIES.
- *METAPH_SUR*, if the term belonged to the metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL.
- *METAPH_ECO*, if the term belonged to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.
- *METAPH_CYC*, if the term belonged to the metaphor MARINE PROCESSES ARE CIRCLES.

We decided to leave the metaphor LIFE/SURVIVAL IS WAR out of the quantitative analysis because, in our view, most of its terms implicitly evoke the idea of social interrelations involving tension and fights between individuals belonging to one community or to different ones.

Figure 31 shows how the annotation process was carried out with Wordsmith Tools. This figure shows English-language concordances of the tag *METAPH_SUR*, which contain terms belonging to the metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL. Two MARINE HABITATS ARE COMMUNITIES terms, *population* and *residents*, can also be seen.

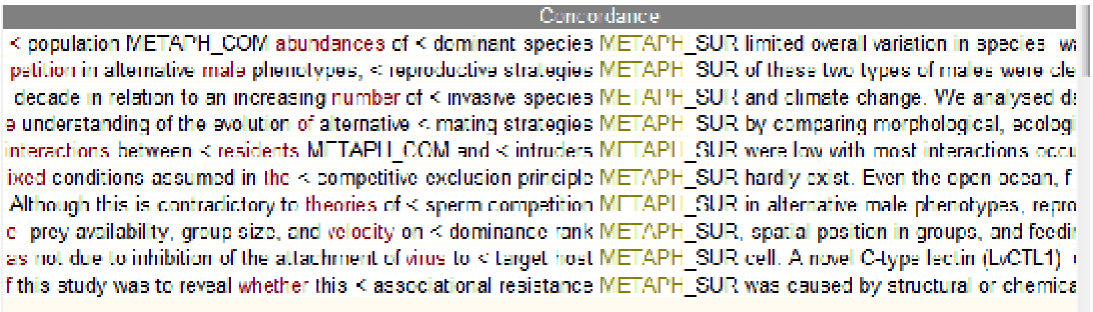


Figure 31. Instances of English-language concordances tagged with *METAPH_SUR*.

The annotation process revealed further instances of terminological synonyms, apart from those previously shown. Figure 32 contains the terms *throughput* and *total* (*reproductive*) *output*, which are two synonyms pertaining to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

Figure 32. Instance of non-resemblance metaphor synonyms in English.

Figure 33 shows the synonymous terms *vicinity* and *neighbourhood*, which can be subsumed by the COMMUNITY metaphor.

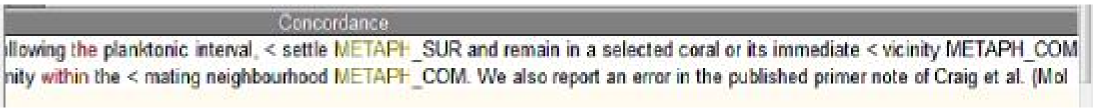


Figure 33. Another instance of non-resemblance metaphor synonyms in English.

A case of synonymy in Spanish is shown by the concordance lines in Figure 34, where *floración algal* and *florecimiento algal* refer to the same concept, i.e. a rapid increase and accumulation in the population of algae in an aquatic system as a result of sudden favourable environmental conditions, mainly excess of nutrients. This metaphor, which does not fit any of the four macro-metaphors established in this study, arises from the comparison of the blossoming of flowers (*florecimiento*, *floración*) in plants and rapid algal proliferation since both concepts involve thriving and healthy vital development. This algal proliferation can be harmful, as shown by the term *florecimiento algal nocivo* in the second concordance line. Its English equivalent, *harmful algal bloom*, is based on the same metaphor, but no synonyms or terminological variants were found for this term. As with *harmful algal bloom*, *floración algal nociva* was identified in the Spanish texts by means of the *Clusters* option in Wordsmith Tools because both are fixed lexical units that frequently occurred in the corpus.

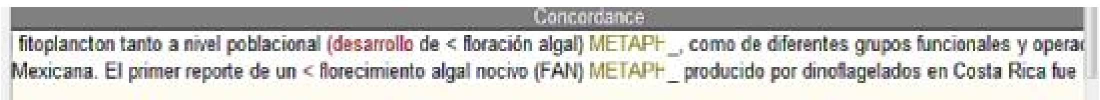


Figure 34. Instance of non-resemblance metaphor synonyms in Spanish.

Once all occurrences of non-resemblance metaphor terms were tagged in English and Spanish (including both repeated units and hapaxes), they were computed. The absolute frequency of individual items was then calculated for each language and for both languages as a whole. The distribution of the non-resemblance metaphor terms across the four macro-metaphors was numerically accounted for as well. The numerical data of all these patterns are given in the results section, together with a discussion of such data.

3.5.2.2.2. Tagging to obtain interlinguistic term pairs

Since non-resemblance metaphor terms are not associated with any taxonomic designations or biologists' names, we had to exclusively rely on source and target domain keywords to retrieve them. This would in principle have implied missing metaphor patterns in the corpus, and ultimately, would have been an obstacle to identifying interlinguistic term pairs. However, this was not the case. As previously seen, source and target domain keyword stratagies already provided preliminary though enlightening results. More specifically, the vast majority of the non-resemblance metaphor term pairs identified were exact, hardly any unbalanced interlinguistic term pairs were found, and no separate pairs were identified.

These results were ratified in the annotation process, where we followed the same procedure for all of the metaphorical terms identified. On most of the occasions, the source and target domain keyword pairs used for each language (*invade*/*invadir*, *community*/*comunidad*, *species*/*especie*, *organism*/*organism*, etc.) and the analysis of their co-texts revealed that almost all of the interlinguistic term pairs were exact. Another strategy that we used was to search for the literal translation equivalents of the metaphorical terms retrieved in one language in the other language. To facilitate this task, we used the merged English-Spanish corpus that we created for the retrieval of resemblance metaphor terms. We also annotated the non-resemblance metaphor terms with the same tag codes used for the interlinguistic analysis of the resemblance metaphor terms. Consequently, we used the following tags to quantify exact pairs:

- *METAPH_ COM_EXA*
- *METAPH_SUR_EXA*
- *METAPH_ECO_EXA*
- *METAPH_CYC_EXA*

Figure 35 shows concordances of the tag *METAPH_ECO_EXA*, which contain instances of metaphorical term pairs belonging to the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS. The pairs are *monopolize*/*monopolización* (monopolization) and *investment*/*inversión*. Another ECONOMY term, *throughput*, occurs in concordance (4), and the term *tactic*, which pertains to the metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL, occurs in concordance (1). The total number of exact term pairs belonging to each of the macro-metaphors established for this study is given in the results section.

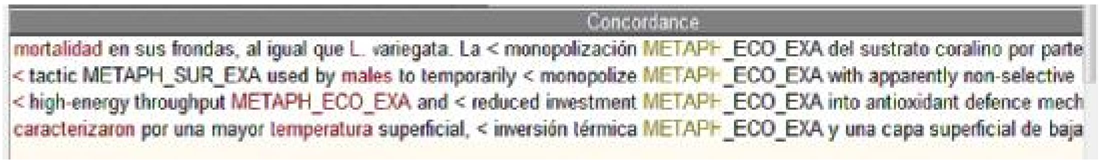

Concordance
mortalidad en sus frondas, al igual que L. variegata. La < monopolización METAPH_ECO_EXA del sustrato coralino por parte
< tactic METAPH_SUR_EXA used by males to temporarily < monopolize METAPH_ECO_EXA with apparently non-selective
< high-energy throughput METAPH_ECO_EXA and < reduced investment METAPH_ECO_EXA into antioxidant defence mech
caracterizaron por una mayor temperatura superficial, < inversión térmica METAPH_ECO_EXA y una capa superficial de baja

Figure 35. Instances of non-resemblance metaphor term pairs tagged with *METAPH_ECO_EXA*.

Unbalanced non-resemblance metaphor term pairs were also found in the corpus. Given the fact that there were so few, it was not necessary to annotate them. Some of them were detected while comparing word strings containing the keywords *species* and *especies* in the bilingual texts of the journal *Ciencias Marinas*. One instance is the interlinguistic pair *upwelling*/*surgencia* [emergence] in concordance lines (122), extracted from a bilingual article. *Surgencia*, the Spanish constituent of the pair, does not have a figurative meaning. The motivation of the metaphorical term *upwelling* is the comparison between fresh water going up through a well and marine water going up through the sea water column[37]. Upwellings are part of the biogeochemical or nutrient cycle, a phenomenon which involves the circulation of organic matter in the sea, iniciated in the form of carbohydrates, produced by algae and plants (primary producers) through photosynthesis, and afterwards consumed by heterotrophic life forms (fish, marine arthropods, etc.). The upwelling of organic particles (remains of organisms, faecal matter, and the shells of planktonic oganisms) by means of sea currents allows the consumption of such particles by heterotrophs, which finally die, and decompose on the seabed, prompting the nutrient cycle to begin again. Thus, as with the pair *marine snow*/*nieve marina*, the metaphor *upwelling* can be regarded as part of the encompassing metaphor MARINE PROCESSES ARE CIRCLES.

Concordance lines (123) show another case of unbalanced pair. The term *nursery* arises because of the comparison between the way adult fish take care of their alevines

[37] The term *water column* is a metaphor which occurs both in English and Spanish, and reinforces the idea of a body of water flowing through a current *corridor*.

in a specific territory in the sea and the way nurses take care of sick people at hospitals. This term could fit into the macro-metaphor MARINE HABITATS ARE COMMUNITIES, where individuals assume their social commitment to help one another and make their community thrive. Furthermore, the English text of concordance lines (123) shows a variant of *nursery* in the non-figurative phrase *feeding ground*.

(122) fringing reefs (Pauls 1982, Sant 1999). These ecosystems are very particular in their composition, since the **periodical upwelling** that characterizes the area generates high rates of turbidity and sedimentation in the **water column** resulting in the occurrence of coral species different from those of typical reefs and in a predominance of organisms capable of tolerating low temperatures and turbidity conditions.

Estos ecosistemas son muy particulares en su composición, ya que las **surgencias [emergence] periódicas** que caracterizan la zona generan altas tasas de turbidez y de sedimentación en la **columna de agua** que conllevan al establecimiento de especies de corales distintas a las de arrecifes típicos, y un predominio de organismos capaces de tolerar bajas temperaturas y condiciones de turbidez.

(*Ciencias Marinas*, 32(4), 2006, pp. 683–693)

(123) For the species that use these areas as **nursery** or feeding **grounds**, the history of previous heavy metal exposure can be an important issue as it may affect subsequent metal uptake and bioaccumulation at different biological levels.

Para las especies que usan estas áreas como **criaderos [breeding grounds]** o zonas de alimentación, la historia de exposición a metales pesados puede ser importante ya que puede afectar la futura captación y bioacumulación de metales a diferentes niveles biológicos.

(*Ciencias Marinas*, 34(3), 2008, pp. 283–296)

Concordancing the lexical marker *known as* revealed the only case of partial pair that we found in the corpus involving non-resemblance metaphor terms. Since this lexical marker and its corresponding metaphorical term occurred in a bilingual text, it was easy to detect its Spanish equivalent. In concordance lines (124), both the English and the Spanish metaphorical terms co-occur with variants, which are *herviborous feeding* and *herviboría*, respectively.

(124) Phytoplankton consumption by zooplankton, known as **grazing** or herviborous **feeding**, is of the main causes of mortality of phytoplankton, just as cell sedimentation in the euphotic zone (Raymont, 1980), virus inflected diseases (Suttle et al., 1990), etc.

El consumo de fitoplancton por el zooplankton, denominado **pastoreo [shepherding]** o herviboría, es una de las causas de mortalidad del fitoplancton, al igual que el hundimiento de las células de la zona eufótica (Raymont, 1980), enfermedades causadas por virus (Suttle et al., 1990), etc.)

(*Ciencias Marinas*, 23(1), 1997, pp. 71–81)

This is an interesting interlinguistic pair. Both terms are based on the same metaphor. However, the Spanish term, *pastoreo* [shepherding], involves a complex metaphorical structure. The activity of shepherding entails a shepherd who takes his flock/herd (cows, sheep, goats) out to the countryside so that they can feed on the grass. Thus, this generic scenario implies the more specific action of grazing. The source domain, ruminant feeding, is mapped onto the target domain, herviborous sea feeding. Spanish-language experts call on the generic scenario, shepherding, to refer to the herviborous sea feeding, whereas English-language experts focus on the grazing activity itself.

We did not detect any separate non-resemblance metaphor terms in the corpus. This does not mean that they do not exist, but only that we were not able to find any by means of the strategies used in this research study.

The different strategies used in this study signalled the presence of a few non-resemblance metaphors that only appeared in English. The metaphorical motivations of the terms that linguistically represent such metaphors arise from all the source domains proposed in this study, except for the CYCLE domain. Most of these terms are so standard, recursive, and central to their domains that we expected their literal equivalents to occur in the Spanish texts as well, but this was not the case. We were not dealing with unbalanced pairs, but with English terms whose interlinguistic equivalents were not found in the Spanish texts, and thus, such English terms were simply tagged

METAPH_SUR and *METAPH_ECO* so that they could be computed as part of the frequency figures. We are not presenting these metaphorical terms in concordances extracted as Wordsmith Tools snapshots, but in simple concordances, which have a wider textual scope. In this way, it can be seen how marine biology experts exploit the network of interrelated terms belonging to a macro-metaphor in their discourse. The terms related to the source domain WAR and whose interlinguistic equivalents were not found in the Spanish texts appear in bold in concordances (125–127). Also in bold are the English terms related to the source domain ECONOMY and BUSINESS in concordances (128) and (129). Concordances (130) and (131) include the English terms belonging to the COMMUNITY metaphor.

(125) Although it is not known if at Seal Island sharks are **stalking** seals from depth as has been shown at the Farallons (Goldman and Anderson 1999), a depth range of 26–30 m may be optimal for sharks to remain undetected while stalking seals from below, with enough vertical distance to build up momentum required for **launching a** debilitating **strike** at the surface. (*Environmental Biology of Fishes*, 76(3), 2006, pp. 341–350)

(126) They have adapted to all available macro-habitats (littoral, offshore pelagic and offshore benthic), using different techniques (**ambush**, pursuit and **cruising**), a unique scenario for barbs. (*Journal of Fish Biology*, 63(1), 2003, pp. 226–245)

(127) **Retreating** into shelters and reducing locomotory activity during summer (Edsall et al. 1993; Carl 1995; Pääkkönen 2000) prevent the need for frequent predation activity in burbot. (*Fish Physiology and Biochemistry*, 34(2), 2008, pp. 103–116)

(128) Previously we have shown that longfin damselfish benefit from cleaning interactions by a significant but small reduction in ectoparasite loads and we suggested that the costs of travelling and seeking cleaners by territorial damselfish may limit the net benefit of cleaning to the **client** (*Journal of Fish Biology*, 63(1), 2003, pp. 226–245)

(129) Although sounds in other cichlids are typically emitted in early stages of courtship, *O. mossambicus* produced sounds in all phases, but especially

during late stages of courtship, including spawning. It is suggested that the acoustic emissions in this species may play a role in **advertising** the presence and spawning readiness of males and in synchronizing gamete release. (*Journal of Fish Biology*, 62(3), 2003, pp. 658–672)

(130) This analysis suggests that the host-cell environment may set the upper limit on the rate of dinoflagellate cell-cycle progression and thereby coordinate the relative growth rates of the autotrophic and **heterotrophic partners** in this symbiotic association. (*Marine Biology*, 134(3), 1999, pp. 405–418)

(131) Together, these observations indicate the existence of a general rule which states that if an invader becomes established, it is permitted to do so by an **accommodation** on the part of the species that occupies the preferred ecological space. (*Marine Biology*, 157(10), 2010, pp. 1490–1499)

The metaphorical term *cruise* is particularly interesting. According to *The American Heritage® Dictionary of the English Language*, one of the literal meanings of this term is “to search for enemy vessels in a warship (military)”. This threatening behaviour is compared to that of a fish, who seeks a prey to attack.

The methodology of our study consisted of an observational corpus analysis involving a set of effective metaphor retrieval techniques, which have been shown to yield rich empirical data concerning both resemblance and non-resemblance metaphors. In the next section, these empirical data are discussed, and numerical results regarding such data are provided and explained.

4. RESULTS AND DISCUSSION

This section is divided into two subsections. The first one presents and discusses the results derived from the observational analysis of the marine biology corpus, described in the methodology section. Firstly, we discuss the results concerning resemblance metaphor, and secondly, those concerning non-resemblance metaphors.

The second subsection presents the introspective research carried out in this study and the results obtained in such research.

4.1. Results and Discussion of the Observational Analysis

4.1.1. Resemblance metaphors

The corpus analysis yielded two types of resemblance metaphor terms: those designating marine organisms and those designating body parts of these marine organisms. Since these metaphors designate live entities, they are all linguistically rendered by nouns — in the case of terms designating marine organism, by names. The motivations for metaphorical transfer of resemblance metaphor terms can be classified as follows:

- § Resemblance to inanimate entities (object-like): shape, colour, size, type of material, and function.
- § Resemblance to animate entities (human-like, animal-like, plant-like): shape, colour, size, type of material, and habits/behaviour.

It should be noted that these motivations are not exclusive of one another since there are also cases in which two or even three of them are combined to give rise to a terminological metaphor (for instance, shape plus colour, shape plus behaviour, and shape plus colour plus behaviour).

As previously shown, the metaphorical expressions extracted from the marine biology corpus are representative of the following contrastive differences between English and Spanish:

- § Exact pairs: the metaphorical motivation and the subsequent terminological naming are alike in both languages.
- § Partial pairs: the metaphorical motivation is the same, but named differently in each language, depending on the degree of semantic specificity.

- § Separate pairs: the metaphorical motivation is not the same in both languages. In the analysis of these pairs, a number of conceptual differences rooted in cultural aspects were identified.
- § Unbalanced pairs: just one term of the pair is metaphorical. Culture-derived conceptual differences were found as well.

All of the resemblance metaphor term pairs extracted from the corpus are arranged in tables in the following subsections. The synonyms of the standard terms are shown in brackets — by *standard* we mean those terms occurring in the corpus more often than their synonymous expressions. The curly brackets contain the abbreviations corresponding to the metaphorical motivations of the term pairs. These abbreviations shoud be read as follows.

- § {b} behaviour (involving both the source and the target concepts)
- § {b/f} behaviour (involving the target concept) and function (involving the source concept)
- § {c} colour
- § {f} function
- § {m} type of material
- § {p} position
- § {s} shape
- § {si} size

As some of the terms in the tables will show, resemblance in position requires resemblance in shape. In other words, position is contingent on shape in terms of metaphorical conceptualisation. This is reasonable because position alone does not seem to be a conceptual item robust enough to give rise to metaphorical thought.

We will first be addressing metaphorical terms designating marine organisms, and secondly, metaphorical terms designating body parts of marine organisms.

4.1.1.1. Metaphorical terms designating sea organisms

Once all occurrences of resemblance metaphor terms were tagged in English and Spanish (including both repeated units and hapaxes), they were computed. The absolute frequency of individual items was then calculated for each language. The results are provided in Table 7.

	Number of tokens	**Number of resemblance metaphor occurrences designating sea organisms**	**% of resemblance metaphor terms designating sea organisms in each sub-corpus**
English corpus	2,240,327	16,920	0.75
Spanish corpus	2,309,863	15,327	0.66
Total	4,550,190	32,247	0.70

Table 7. Absolute frequency figures of individual items in English and Spanish.

As can be seen, the overall percentage of metaphorical terms is 0.70, which is not very high. However, it is sufficient to prove the incidence of metaphorical thought in scientific discourse. Moreover, it should also be pointed out that this percentage only applies to one type of metaphor, resemblance metaphor designating sea organisms. The number of resemblance metaphor terms designating body parts of sea organisms and that of non-resemblance metaphor terms are still to be computed.

The statistics in Table 7 showed that the Spanish corpus had more tokens than the English one, probably because the rhetorical style of Spanish is generally wordier than English. However, the likelihood of encountering metaphorical terms was found to be higher in English because this language allows the repetition of the same lexical unit in close proximity in a text. In contrast, such repetition is generally avoided in Spanish. Moreover, metaphorical names for sea creatures are also more frequent in English than in Spanish. This fact was justified by the subsequent calculation and analysis of interlinguistic term pairs. According to the percentages in Table 7, the likelihood of encountering metaphorical terms is higher in English texts than in Spanish texts.

This fact was further justified by the subsequent calculation and analysis of interlinguistic term pairs (Table 8). For their computation, we did not consider the synonyms of the standard terms since this would have disrupted the balance of the pairs.

TYPE OF PAIR	NUMBER OF PAIRS	
Exact pairs	44	
Partial pairs	2	
Separate pairs	22	
Unbalanced pairs	**Only the English term is metaphorical**	**Only the Spanish term is metaphorical**
	27	9
	Total number of pairs: 104	

Table 8. Figures of the four types of English-Spanish resemblance metaphor term pairs designating sea organisms.

The figures show that English and Spanish often conceptualise marine organisms in the same way. Nevertheless, considering the influence that English as a *lingua franca* exerts on the rest of languages in international scientific contexts, many Spanish metaphorical names might very well be the literal translations of their English counterparts. As far as unbalanced pairs are concerned, the figures suggest that while English language experts tend to give marine organisms a metaphorical name, Spanish language experts often either use a literal common name or simply use the taxonomic name alone.

The *METAPH TAXO* concordances revealed that a high number of taxonomic designations and their corresponding metaphorical terms were only quoted in one language, something which stands to reason, since we are dealing with a comparative rather than a parallel corpus[38]. Consequently, this study only provides a tentative, though illustrative, picture of the percentage of exact, separate, and unbalanced resemblance metaphor pairs featuring marine organisms.

Table 9 contains the exact term pairs extracted from the corpus. The distribution of the types of motivation for metaphorical transfer across the exact term pairs as well as across the three other pair types is commented in what follows.

EXACT TERM PAIRS			
angel shark / tiburón ángel (angelote {s}, escuadro)	brain coral / coral cerebro {s}	clownfish / pez payaso {c}	crown-of-thorns starfish / estrella de mar corona de espinas {s}
date mussel / dátil de mar {s, c}	diamond squid / calamar diamante {s}	elephant ear sponge / esponja oreja de elefante {s, si}	elephant seal / elefante marino (foca elefante) [elephant seal] {s}
fireworm / gusano de fuego {c}	ghost crab / cangrejo fantasma {b}	guitarfish / pez guitarra {s}	hammerhead shark / tiburón martillo {s}
hermit crab / cangrejo ermitaño {b}	humpback whale / ballena jorobada {s, p}	lancetfish / pez lanceta {s}	lanternfish / pez linterna {b/f}

[38] The terms *comparative* and *parallel* are used here in the same sense as in Corpus Linguistics studies. Comparative texts are L2 texts that share the subject, level of expertise, formal structure, and communicative purposes of L1 texts. Parallel texts are L2 texts that are translations of L1 texts.

EXACT TERM PAIRS			
loggerhead sea turtle / tortuga boba {b}	monk seal / foca monje (foca fraile) [friar seal] {s}	parrotfish / pez loro {s, p}	porcelain crab / porcelánido {m}
Portuguese man-of-war / carabela portuguesa {s}	rainbow trout / trucha arcoiris {c}	ray (skate) / raya {s}	razor shell / najava {s}
roosterfish / pez gallo {s, p}	sailfish / pez vela {s, p}	sawfish / pez sierra {s}	scorpionfish (sea scorpion) / pez escorpión (escorpión marino){b}
sea cucumber / pepino de mar {s}	sea fan / abanico de mar (s}	sea hare / liebre de mar {s, p}	seahorse / caballito de mar {s}
sea lettuce / lechuga de mar {s, c}	sea nettle / ortiga de mar {b}	sea urchin / erizo de mar {s}	silky shark / tiburón sedoso {m}
spider crab / cangrejo araña {s}	surgeonfish / pez cirujano {b}	swordfish / pez espada {s}	vampire squid / calamar vampiro {b,s}

EXACT TERM PAIRS			
violinist crab / cangrejo violinista {s, p}	wolffish / pez lobo {s, p}	whale shark / tiburón ballena {si}	zebrafish / pez cebra {c}

Table 9. Exact interlinguistic resemblance metaphor term pairs designating sea organisms.

Two interesting metaphorical term pairs are *vampire squid*/*calamar vampiro* and *loggerhead sea turtle*/*tortuga boba*. The species *Vampyroteuthis infernalis* is commonly called *vampire squid* because mature adults have a pair of membranous, ear-like fins projecting from the lateral sides of the mantle. Thus, these fins resemble vampires' membranous extremities. The fins serve as the adult's primary means of propulsion, so vampire squids *fly* through the water by flapping their fins. Therefore, there is also comparison in behaviour.

The species *Caretta caretta* is called *loggerhead sea turtle*/*tortuga boba* because, after eating a lot, it usually rests afloat at the sea surface, so that it can easily be caught by humans. In fact, loggerheads are an endangered species, protected by the International Union for the Conservation of Nature.

The pair *roosterfish* / *pez gallo* is one of the cases showing that position as motivation for metaphorical transfer is intrinsically linked to shape. The spines situated on the rear of this fish' head resemble a rooster's crest, which sticks out on its head. Thus, position and shape are closely interrelated here.

Apart from terms integrating the more natural combination of shape plus position, we found terms having a more complex double metaphorical motivation. For example, the metaphor *sea lettuce*, which designates a marine plant, emerges because of the comparison in colour and shape with a lettuce. This double metaphorical motivation thus relies on a one-to-one concept comparison. In contrast, the corpus data also revealed terms whose double metaphorical motivation is grounded in two different source concepts, in other words, a one-to-two concept comparison, which inevitably requires a complex or multiword terminological expression. An illustrative example is the exact pair *manta ray / manta raya*. On the hand one, these terms are based on the metaphor *manta* — literally, a rough-textured cotton fabric or blanket made and used in Spanish America and the southwest United States. The metaphorical motivation is shape because of the extensive flattened body of the fish designated. On the other hand, these terms arise from the metaphor *ray*/*raya*. The metaphorical motivation of *raya*, which literally translates as *line* or *stripe* into English, is transparent in Spanish because the fish is flat and long in shape. However, the metaphorical motivation of *ray* is harder to identify since we have to turn to the etymology of this term. According to it, *ray* stems from Latin *raia*, which means *line*.

There are even terms involving three metaphors. The exact pair *crown-of-thorns seastar* and *estrella de mar corona de espinas* entails a comparison in shape between a bright star and the echinoderm. The spines that cover all of its body resemble thorns. There is a line of longer spines that surrounds the roundish body, and which resembles a crown.

Two partial term pairs were identified in the marine biology corpus. The first pair, *croaker* / *corvina* [crow-like (fish)], was already explained in the methodology section. The second pair is *triggerfish* / *pez ballesta* [crossbow fish]. This fish erects the first two dorsal spines to scare potential predators away. This behaviour is compared with the functioning of a crossbow, whose trigger is pulled to keep enemies away. The English term focuses on the specific concept *trigger*, whereas the Spanish term designates the generic concept *crossbow*, which eventually constitutes the whole source domain. Thus, the conceptualisation of this sea organism through metaphor shows a clear *degree of specificity* (Kövecses 2005) from an interlinguistic perspective.

Table 10 contains the separate term pairs retrieved from the corpus by means of the strategies applied in the methodology section. The equivalents of those non-figurative names that can be literally translated into the other language appear in square brackets.

SEPARATE TERM PAIRS			
boarfish {s} / ochavo {s}	bottlenose dolphin {s} / delfín mular [mule dolphin] {b}	bramble shark {s} / tiburón de clavos [nail shark] {s}	cookie-cutter shark {s, b/f} / tollo cigarro [cigarette shark] {s}

SEPARATE TERM PAIRS			
damselfish {c} / castañeta {b/f}	dolphin fish {s} / dorado [golden (fish)] {c}	dusky shark {c} / jaquetón lobo [wolf shark] {c} (tiburón arenero) [sand-dwelling shark]	horseshoe crab {s} / cacerolita de mar [little sea saucepan] (cangrejo cacerola) [saucepan crab] {s}
large head hairtail eyes[39] {s} / pez sable [sabre fish] {s}	leatherback turtle {m} / tortuga laúd [lute turtle] {s} (tortuga baula)	lemon shark {c} / tiburón galano [adorned/elegant shark] {c}	mutton snapper {c} / pargo palomero [palm fish] {s}
ocellated fringed frogfish {s, p} / pez esponja [sponge fish] {s}	pilot whale {b} / calderón común [common cauldron whale] {s}	pipefish {s} / pez aguja [needle fish] {s}	sally lightfoot crab {b, f, p} / cangrejo moro [Moorish crab] {c}

[39] This metaphorical term has a metonymic basis as well since the partitive concept *eyes* stands for the whole concept *fish*. As shall be seen in § 4.2., this dual figurative nature is commonplace in marine biology figurative terms.

SEPARATE TERM PAIRS			
sandtiger shark {s} (raggedtooth shark) (grey nurse shark {b}) / tiburón toro {s} (tiburón nodriza {b})	Senegalese sole {s} / lenguado senegalés [Senegalese tongue-shaped fish] {s}	smooth dogfish {b}/ tiburón viuda [widow shark] {b}	thornfish {s} / torito [little bull] {s}
thresher shark {b} / tiburón zorro {s, p}	weever[40] fish {b} / pez araña [spider fish] {b}		

Table 10**.** Separate interlinguistic resemblance metaphor term pairs designating sea organisms.

An interesting term is *ocellated fringed frogfish*, which integrates three metaphors based on resemblance in shape. This fish is compared with a frog because of its round-shaped body and because of its pectoral fins, adapted for grasping, which look like a frog's legs. This fish also has pectoral fringe-like protuberances. Finally, it is ocellated because of the spots on its skin resembling ocelli, small primitive eyes found in many invertebrates consisting of of a few sensory cells and a single lens.

Also interesting is the exact pair terms *grey nurse shark* and *tiburón nodriza,* which are synonymous with the separate pair terms *sandtiger shark* and *tiburón toro*, respectively. The pair *nurse shark*/*tiburón nodriza* is based on a comparison in behaviour. The shark *Ginglymostoma cirratum* is called *nurse shark* because it

[40] The term *weever* stems from Latin *vīpera*, which means *serpent.* This fish is compared with a serpent because it uses venomous spines on the gill cover and first dorsal fin to hurt potential predators and scare them away —thus, this is a case of resemblance in behaviour. The metaphorical motivation of its Spanish equivalent, *pez araña* [spider fish], is also behaviour since spiders also use venom for survival.

reproduces through internal fecundation, similar to human reproduction. The young are born after four to six months within the female shark's reproductive tract.

As previously stated, one of the goals of this research study was to search the marine biology corpus for culture-specific metaphorical terms (i.e. terms designating concepts that are only found in a specific linguistic community) and metaphorical terms with a high degree of cultural typicality. The metaphorical term retrieval techniques used in this study yielded some terms of this type.

Let us first focus on culture-specific terms. The Spanish metaphorical term *ochavo* [no literal translation into English] is a case in point. It refers to a fish with a roundish shape that resembles the coin used in Spain until the 19th century. Thus, a comparison in shape is prompted between a community-specific concept and a fish concept. This fish is called ***boarfish*** in English because of its elongated snout, which resembles that of a boar.

Another case of culture-specific metaphor is *cangrejo moro* [Moorish crab] (taxonomic name *Grapsus grapsus*). A Moor is “one of the Muslims who invaded Spain in the 8th century and established a civilization in Andalusia that lasted until the late 15th century” (*The American Heritage® Dictionary of the English Language* and *DRAE).* Thus, this concept is specifically associated with Spanish culture and history. The Moors’ dark skin colour is compared with the black colour of the juvenile shell of *Grapsus grapsus*. In contrast, English-language biologists use the term *sally lightfoot crab* to designate this crab. The metaphor refers to this crab’s extraordinary speed along the upright sides of rocks and uncanny ability to hide away in crevices to escape being eaten by rapacious birds. Their speed also enables them to pursue smaller animals in their immediate vicinity.

We also found metaphorical terms with a high degree of cultural typicality among the separate term pairs. One of them is *castañeta*. This fish receives its name because of its roundish shape resembling a castanet, which is a typically Spanish musical instrument. The English equivalent of *castañeta* is *damselfish*, whose attractive bright colours are compared with the beauty and charm of a damsel. Another case is the term *cookie-cutter shark*, a metaphor arising from the comparison between the cookie-shaped plugs of flesh extracted by the shark from its prey and the actual shape rendered by a cookie-cutter on cookie dough. Cookie-cutters are particularly prominent utensils in the American English culture, but not in the Spanish one. Evidence of this is that Spanish-language experts refer to this shark as *tiburón cigarro* [cigarette shark] because of its thin, elongated shape.

One more instance of cultural typicality is the metaphor *torito* [little bull], which emerges because of the comparison between the big head and mouth as well as the bulging eyes of this fish and those of a bull. Curiously enough, its scientific name *Bovichtus* does not refer to a bull but rather to a cow since this name derives from Greek *bous* (cow) and *ichtys* (pez). This is incidental because the heads of bulls and cows are morphologically alike (except for the horns on bulls).

These terms furnish evidence of the claim that although basic aspects of experience-based conceptualisation through metaphor are believed to be shared by speakers across languages, "universal embodiment can be overridden by either socialcultural context (experiences) or cognitive processes (cognitive preferences)" (Kövecses 2005: 293).

Table 11 contains all of the unbalanced term pairs retrieved from the marine biology corpus. As explained in the methodology section, we found pairs in which the non-metaphorical constituent is exclusively referred to by its taxonomic designation, and pairs in which this type of constituent is referred to by a non-figurative common name that is not its standard name (i.e. fish, mussel, worm, etc.). As with separate pairs, the translation equivalents of those non-figurative common names that can be literally translated into the other language are given in square brackets. Synonyms are provided in simple brackets.

UNBALANCED TERM PAIRS			
Only the English term is metaphorical			
anglerfish {s, b/bf} / rape	bib {s, p} / faneca	bullseye stingray {s} {s} / raya {s} *Dasyatis brevis*	butterfish {m} / pampanito

bowhead whale {s} / ballena de Groenlandia [Greenland's whale]	chicy ruff {s} / cojinova	dwarf sperm whale {si} / *Kogia simus*	earthworm eel {s} / *Chendol keelini*
cownose ray {s, si} {s, p} / raya {s} *Rhinoptera steindachneri*	Cuvier's beaked whale {s, p} / zifio de Cuvier [Cuvier's whale]	grunt {b} / corocoro	horse mackerel {b} / jurel
fan mussel {s} / *Pinna nobilis*	fat innkeeper worm {b} / *Urechis caupo*	moon jelly {s, c} {m} / *Aurelia aurita*	olive ridley turtle {c} / tortuga golfina [gulf turtle]
king[41] crab {si} / centolla	milkfish {c} / sabalote	ribbed mussel {s} / *Aulacomya ater*	school shark {b} / cazón
queen conch {si} / caracol rosado [rosy snail]	rose shrimp {c} / gamba blanca [white shrimp]	Spanish dogfish {b} / *Squalus acanthias*	Spanish hogfish {s} / *Bodianus rufus*

[41] This term, together with *queen conch*, is grounded both in a resemblance metaphor (physical appearance, specifically, size) and in the primary metaphor IMPORTANT IS BIG (Grady 1997). This is not an isolated case. As shall be explained in § 4.2.4., certain marine biology resemblance metaphors shared some aspects with primary metaphors.

sea gooseberry {si} / *Pleurobrachia bachei*	snakelocks sea anemone {s, b} / anemone de mar común [common sea anemone]	velvet swimming crab {m} / nécora	
Only the Spanish term is metaphorical			
camarón café [coffee shrimp] {c} / brown shrimp	cangrejo buey de mar [sea ox crab] {si} / edible crab	delfín acróbata [acrobat dolphin] {b} (delfín tornillo) [screw dolphin] {b/f, s} / spinner dolphin	lobo fino [slender wolf] (león marino) {m, c} / fur seal
pata de mula [mule's leg] {s, si} (concha prieta) [tight conch] (concha negra) [black conch} / Anadara cockle	pez luna [moon fish] {s} / sunfish	pez ballesta Picasso [Picasso crowbow fish] {b/f, c} / triggerfish {b/f}	tamboril [small drum] {s} (pez globo) [balloon fish] {s} / puffer
tiburón peregrino [pilgrim shark] {b} / basking shark	tortuga lora [female parrot turtle] {s, p} (tortuga carpintera) [carpenter turtle] {b} / Kemp's ridley		

Table 11**.** Unbalanced interlinguistic resemblance metaphor term pairs designating sea organisms.

The pair *rose shrimp* / *gamba blanca* is interesting because the domain of colours is a clear example of the extent to which human conceptualization can be culturally constrained. Theoretically, colours might be considered consensual, standard concepts because of their markedly visual nature. However, interlinguistic term pairs such as this show that the diverse cognitive perspectives adopted by languages — which in Cognitive Linguistics is known as *construal* (Langacker 1987) — lead their speakers to conceive colours in different ways.

Three special unbalanced pairs were also identified. They are special because their English constituents include two metaphors, whereas the Spanish ones only include one. In all three cases, the interlinguistic equivalents share one metaphor, and the other metaphors in the English terms are what makes them unbalanced pairs. The English terms are *bullseye stingray*, *cownose ray* and *snakelocks sea anemone*. Concerning the first two, their Spanish counterparts occurred in the corpus texts in the form of *raya* (ray), which is the shared metaphor, together with their corresponding taxonomic designations, which were *Dasyatis brevis* and *Rhinoptera steindachneri*, respectively. In this way, the Spanish-speaking readers can tell what species of ray the experts are referring to in their articles. The polyp *snakelocks sea anemone* is named *sea anemone* because of its tentacles, which, when extended, make this animal look like anemone flowers, a land plant. Thus, this first metaphor is grounded in resemblance in shape. The second metaphor is based on resemblance in shape because the tentacles of this polyp are long and thin like a snake, but also in behaviour, because the sea currents cause these tentacles to move in a wave-like manner, which is similar to the way a snake slithers on the ground. The Spanish equivalent, *common sea anemone*, is only based on the first metaphor.

The pair *moon jelly* / *Aurelia aurita* is also worth commenting. The term *moon jelly* includes two metaphors: the animal is compared to the moon because of its roundish shape and whitish colour, and to jelly because of its soft, semisolid texture (type of material).

The taxonomic name for the animal *triggerfish*/*pez ballesta* is the family name *Balistidae*. However, there are different species within this family, some of which having their own common names. In our corpus, we found that the species' taxonomic name, *Rhinecanthus aculeatus,* co-occurred with the metaphorical common name, *Picasso triggerfish,* in the Spanish subcorpus, whereas it simply co-occurred with *triggerfish* in the English subcorpus. Thus, while the English common name only includes one metaphor, the Spanish one includes two: *ballesta* [crossbow], whose motivation was previously explained, and *Picasso*, whose motivation is colour. This fish displays exuberant grey, blank, white, and yellow colours that remind the observer of Picasso's artwork because the fish looks like it is painted. Apart from its evident metaphorical nature, the term *Picasso triggerfish* is also metonymic because the artist's name is used to refer to his work, which in turn is the basis for the metaphorical pattern. Finally, this is also a culture-specific term since Picasso was a very famous Spanish painter of international renown.

A culturally marked metaphorical term is *tamboril*, a musical instrument typically played in the Iberian Peninsula. The roundish shape of a tamboril lends its name to a type of marine fish, which inflates its whole body when threatened by swallowing water or air, thus taking on a roundish shape.

The English terms *bullseye stingray* and *olive ridley turtle* are based on entities which can be regarded as typically Spanish, in the case of bulls, and typically Mediterranean, in the case of olives. Paradoxically, these culturally marked concepts were not considered by Spanish-language biologists to designate a species of ray and a species of turtle, respectively. This means that prominent socio-cultural patterns of a specific community of speakers can be discarded by such a community, while at the same time, be adopted by a different community to conceptualise a specialised meaning.

The specification of the motivations for metaphorical transfer is essential for a clear classification of resemblance metaphors. From a cross-linguistic perspective, this specification should also be quantified. Table 12 provides the numerical distribution of the metaphorical motivations across each of the different types of resemblance metaphor pair terms designating sea organisms retrieved from the corpus. As with the computation of the interlinguistic term pairs, the synonyms of the terms were not considered for the numerical distribution of their metaphorical motivations because this would disrupt the balance of the interlinguistic pairs.

	Shape	Color	Size	Material	Behavior	Combina-tion of any of them
Number of metaphorical English pair terms (exact, partial, separate, unbalanced)	18, 0, 10, 7	4, 0, 4, 3	1, 0, 0, 4	2, 0, 1, 1	6, 2, 4, 5	9, 0, 3, 6
Number of metaphorical Spanish pair terms (exact, partial, separate, unbalanced)	18, 0, 12, 2	4, 0, 3, 1	1, 0, 0, 1	2, 0, 0, 0	6, 2, 2, 2	9, 0, 2, 3
Total number of metaphorical pair terms per type	82	25	7	6	27	32
Total number of metaphorical pair terms [total number of pair terms]	179 [208]					

Table 12. Number of metaphorical pair terms arranged according to their motivation.

The data showed that both English-language and Spanish-language experts most frequently use shape to conceptualise sea organisms. Behaviour stands in the second position, closely followed by colour. Combinations of motivations were also recurrent, being the pair shape/position the most frequent because of the dependency of position on shape. Combinations of behaviour and shape are the least frequent in both languages because they feature complex patterns, which cannot always be combined in the metaphorical conceptualisation (see § 4.2.3. for a thorough explanation). The data also showed that the metaphorical motivations are evenly distributed across the two languages, with a higher number of terms in English because of the lower number of Spanish metaphorical terms in the unbalanced pairs.

4.1.1.2. Metaphorical terms designating body parts of sea organisms

This section provides tables including the total number of body part metaphor terms found in the English and Spanish texts, their absolute frequencies (Table 13), as well as the number of exact pairs, partial pairs, separate pairs, and unbalanced pairs.

	Number of tokens	**Number of resemblance metaphor occurrences designating body parts of sea organisms**	**% of resemblance metaphor terms designating body parts of sea organisms in each sub-corpus**
English corpus	2,240,327	8,784	0.39
Spanish corpus	2,309,863	7,973	0.34
Total	4,550,190	16,757	0.37

Table 13. Total number of body part metaphor terms in English and Spanish.

There is a significant decrease in the number of corpus occurrences of resemblance metaphor terms designating the body parts of sea organisms (16,757) in comparison to the resemblance metaphor terms designating sea organism themselves (32,247). In our view, this is largely due to the fact that body parts are very specific concepts that are referred to in very particular contexts, mostly when describing the anatomical structures and function of marine organisms. In contrast, it is easier for sea organism names to occur because experts continually use them in articles and reports to account not only for their anatomical structure, but also their living habits: behaviour, ecology, etc.

From an interlinguistic point of view, Table 13 shows that the difference between English and Spanish body part resemblance metaphors (811 more metaphorical term occurrences in the English corpus) decreases as compared to the difference between English and Spanish resemblance metaphor designating sea organisms (1593 more metaphorical term occurrences in the English corpus).

Table 14 reflects the number of interlinguistic term pairs arranged according to type. As with resemblance metaphor terms referring to marine organisms, the pair type featuring most of the body part terms identified in the corpus is the exact one. Again, this is evidence of a clear tendency of English-language and Spanish-language biologists to use the same conceptual metaphors to conceptualise and designate the (body parts of) sea organisms. This tendency is even greater in the case of interlinguistic body part metaphor pairs since only four of them were separate and only five were unbalanced.

Finally, the total number of body part term pairs (72) is also notably lower than the total number of pairs of metaphorical terms designating sea organisms.

TYPE OF PAIR	**NUMBER OF PAIRS**	
Exact pairs	56	
Partial pairs	7	
Separate pairs	4	
Unbalanced pairs	**Only the English term is metaphorical**	**Only the Spanish term is metaphorical**
	4	1
	Total number of pairs: 72	

Tabla 14. Number of interlinguistic body part term pairs arranged according to type.

The following pages show four tables containing all of the interlinguistic exact, partial, separate, and unbalanced term pairs identified in the marine biology corpus. In some cases, we added contextual data to those body part metaphor terms that might be semantically opaque or vague. Such contextual data are intended to help situate the metaphorical terms conceptually. The metaphorical terms appear in italics to differentiate them from their contextual data. Table 15 includes the exact term pairs found in the corpus.

EXACT TERM PAIRS			
Aristotle's lantern of a sea urchid / *linterna de Aristóteles* de los erizos de mar {s}	atrial branch / rama atrial {s, b}	basal disc / disco basal {s}	*beak* of a squid / *pico* de calamar {s, f}
branchial arch / arco branquial {s}	branchial leaf / hoja branquial {s}	branchial tuft / penacho branquial {s}	buccal funnel / embudo bucal {s}
cellular sheath / vaina celular {s}	cellular comb seta / seta celular pectinada {s}	connective tissue / tejido conectivo {s}	copulatory bell / campana copulatoria {s}
copulatory tube / tubo copulatorio {s}	coupling hooks (cincinnuli) / ganchos de unión {s, f}	cranial roof / techo craneal {s, p}	cranial vault / bóveda craneal (bóveda craneana) {s, p}

EXACT TERM PAIRS			
crystalline style / estilete cristalino {s}	dental crown / corona dental {s, p}	dental cusp / cúspide dental {s, p}	dental root / raíz dental {s, p, f}
dermal sac / saco dérmico {s}	egg capsule / cápsula ovígera {s}	flame cell / célula flamígera {s}	*floor* of the palate / *piso* del paladar {s, p}
foot of a nudibranch {s, p, f} / *pie* de los nudibranquios	gastric chamber / cámara gástrica {s}	gastric mill / molino gástrico {b}	gastric pocket / bolsillo gástrico {s}
germinative cord / cordón germinativo {s}	growth ring / anillo de crecimiento {s}	harpoon notosetae / notosetas arponadas {s}	*lamella* of a rhinophore (plate) / *lamela* de los rinóforos {s}
larval kidney / riñón larvario {s}	*lip* of a shell / *labio* de las conchas {s}	*livery* of a fish / *librea* de los peces {c}	muscular wall (muscular partition) / pared muscular (tabique muscular) {s, f}
mantle of a squid / *manto* de calamar {s, f}	manubrium / manubrio {s}	*melon* of odontocete / *melón* de los odontocetos {s}	nasal curtain / cortina nasal {s, f}

EXACT TERM PAIRS			
nasal valve / válvula nasal {f}	oral arm / brazo oral {s, f}	parietal fossa / fosa parietal {s}	patch reef / parche arrecifal {s}
rib of a ciliated cell / *varilla* de las células ciliadas {s}	sagittal crest / cresta sagital {s}	serrated edge / margen serrado {s}	*siphon* of a squid / *sifón* de calamar {f}
vertebral column (spinal column, spine) / columna vertebral {s}	subcaudal keel / quilla subcaudal {s, f}	*tendril* of egg capsules / *zarcillo* de las cápsulas de huevos {s}	trunk / tronco {s}
umbilicus of a shell / *ombligo* de las conchas {s}	*veil* (velum) of a bivalve / *velo* de los bivalvos {s, f}	*vestibule* to the ear of fish/ *vestíbulo* del oído de los peces {p}	vitelline sac (vitelline envelope, chorion) / saco vitelino {s, f}

Table 15. Exact interlinguistic resemblance metaphor term pairs designating body parts.

The term *Aristotle's lantern* is a striking metaphor. This complex anatomical structure of sea urchins is named after Aristotle because he was the first one to describe it. An Aristotle's lantern is a sea urchin's jaw apparatus, consisting of five jaws, each with one tooth to graze algae, and a fleshy elongated structure within that links the mouth to the stomach. Aristotle compared this structure to a horn lantern. Used in ancient times, this lantern consisted of a candle surrounded by five horn-made plates, which protected the candle from the wind. The five teeth of a sea urchid resemble the five horn-made plates, and the elongated structure resembles the candle.

Table 16 shows the partial term pairs detected in the corpus. The generic terms in each pair appear in bold. Curiously enough, in almost all pairs it is the English terms that are generic, whereas the Spanish terms designate a more specific conceptual level.

The only case in which the Spanish term is the generic one is the pair *groove* / *canal* [channel] since a groove is defined as “a long narrow furrow or channel” (*The American Heritage® Dictionary of the English Language*).

PARTIAL TERM PAIRS			
alisphenoid groove / **canal** aliesfenoides [alisphenoid channel] {s}	**bloodstream** / torrente sanguíneo [blood torrent] {s, b}	**braincase** / caja craneana [cranial box] {s, f}	hemolymphatic **vessel** / vaso linfático [hemolymphatic glass] {s, f}
pen of a squid {s} (gladius) {s} (cuttlebone) / ***pluma*** de calamar [feather of a squid] {s} (gladio) {s}	precaudal **pit** / fosa precaudal [precaudal fossa] {s}	tentacular **club** / maza tentacular [tentacular mace] {s}	

Table 16. Partial interlinguistic resemblance metaphor term pairs designating body parts.

Table 17 contains the separate term pairs that were detected in the corpus data. Interestingly, there is a pair in which one term is more descriptive than its interlinguistic equivalent. The concept *pelvic girdle* implies two comparisons, one in shape (this anatomical structure encircles the pelvic area just like an actual girdle does) and the other in function (it provides support like an actual girdle). In contrast, its interlinguistic equivalent, *cintura pélvica*, only involves comparison in shape (it is a roundish structure, like a waist).

Another pair that is worth explaining is *frontal ridge* / *puente frontal*. *Puente frontal* [frontal bridge] entails two types of comparison: shape and function. The shape of this anatomical piece is long and thin, and its function is to link two points in a more complex anatomical structure. *Frontal ridge* only implies one type of comparison, i.e. shape. However, it involves two dimensions of shape: length and margin. In fact, the body part designated is long and has irregular, sloping sides. Length is alluded to by *puente frontal* but not margin, which is missed in Spanish.

SEPARATE TERM PAIRS			
frontal ridge {s} / puente frontal [frontal bridge] {s, f}	gill rakers {s} / branquiespinas [branchial thorns] {s}	*oral hood* of a nudibranch {s} / *velo oral* de los nudibranquios {s}	pelvic girdle {s, f}/ cintura pélvica [pelvic waist] {s}

Table 17. Separate interlinguistic resemblance metaphor term pairs designating body parts.

Table 18 includes the unbalanced term pairs that we identified in the marine biology texts. The term *shoot* has a complex metaphorical basis. It first entails a comparison in shape between a projectile (a thin, elongated entity) coming out of a weapon and a sprout (a thin, elongated entity) growing on a plant. Apart from resemblance in shape, there is also a resemblance in behaviour. Specifically, there is a comparison in motion, but it is two types of motion that are compared. While shooting implies a very rapid movement in an extremely short time span, the dynamic structure of a plant shoot involves a very slow motion over a long time span. The growth of this shoot is so slow and intermittent that it is unnoticeable to our eyes in the short run. However, real movement is still occurring. Thus, this is not a case of *ception* or *fictive motion* (Talmy (1999 [1996]: 245), a psychological strategy based on our tendency to think in terms of dynamic patterns, and which leads us to build dynamic mental representations of entities that are motionless in nature. This notion will be extensively explained in § 4.2.3.3. to describe a specific set of resemblance metaphors.

UNBALANCED TERM PAIRS		
Only the English term is metaphorical		**Only the Spanish term is metaphorical**
nurse egg {f} / huevo nutritivo [nutritional egg]	*shoot* in a sea plant {s, b} / *rebrote* en las plantas acuáticas	banda de dentina [dentine band] {s} / dentine layer
spur reef formation {s} / arrecife de montículo [mound reef]	spurred seta {s} (forked seta) {s} / seta furcada [furcate seta]	

Table 18. Unbalanced interlinguistic resemblance metaphor term pairs designating body parts.

Finally, Table 19 shows the distribution of the body part metaphor terms, according to type of motivation and to type of pair in English and Spanish. Unlike sea organism terms, we found no cases of body part metaphor terms based on type of material or size. However, both types of resemblance metaphors coincide in that shape is the most frequent metaphorical motivation, in that it mostly concerns exact pairs, and in that behaviour and colour are the second and third most frequent motivations, respectively. Nevertheless, the number of behaviour-based and colour-based metaphor terms designating body parts of marine organisms is significantly lower than that of behaviour-based and colour-based metaphor terms designating marine organisms. Like the terms designating sea organisms, the number of English body part metaphor terms in the unbalanced pairs is higher than that of Spanish body part metaphor terms.

From an interlinguistic viewpoint, Table 19 shows that the distribution of metaphorical terms according to their motivation and pair type is almost the same in English and Spanish.

	Shape	**Colour**	**Behaviour or Function**[42]	**Combina-tion of any of them**
Number of metaphorical English pair terms (exact, partial, separate, unbalanced)	34, 5, 3, 2	1, 0, 0, 0	3, 0, 0, 1	17, 3, 1, 1
Number of metaphorical Spanish pair terms (exact, partial, separate, unbalanced)	34, 5, 3, 1	1, 0, 0, 0	3, 0, 0, 0	17, 3, 1, 0
Total number of metaphorical pair terms per type	84	2	7	42
Total number of metaphorical pair terms [total number of pair terms]	137 [142]			

Table 19. Distribution of the body part metaphor terms according to type of motivation and type of pair in English and Spanish.

[42] The distinction between behaviour and function only applies when the metaphor is based on a dynamic structure. The distinction reflects the difference between the independent, and mostly, unconscious activity of a body structure (e.g. gastric mill), which refers to behaviour, and the activity of a body part purposely carried out by an organism (e.g. the siphon of a squid, which is used by this animal to project itself through the water mass). Exceptions to this assumption are the pairs *atrial branch* / *rama atrial* and *lymphatic vessel* / *vaso linfático*, which are based on function since it is impossible to speak of the behaviour of a branch (*rama*), even less of a glass (*vaso*).

After glossing the data concerning the two types of marine biology resemblance metaphors, we now present the results concerning the non-resemblance metaphors.

4.1.2. Non-resemblance metaphors

As the qualitative corpus analysis revealed, and the quantitative analysis finally ratified, non-resemblance metaphors do not designate either specific sea organisms representing particular taxons — as resemblance metaphors do — or their body parts, but rather they designate more generic groups of organisms. The corpus data also showed that non-resemblance metaphors can be instantiated by a wider range of grammatical classes than that of resemblance metaphors. This stands to reason because while resemblance metaphors only designate marine organisms, which are linguistically represented by nouns (mostly names), non-resemblance metaphors either designate sea organisms or explicitly[43] refer to processes, actions and changes of state, as well as attributes, which are linguistically rendered by verbs and adjectives, respectively.

In contrast, the array of metaphorical motivations of non-resemblance metaphor terms is less varied than that of resemblance metaphor terms. The latter could be based on shape, colour, behaviour, material, and combinations of them, whereas the former are grounded in complex behavioural patterns. As the data in the methodology section showed, such patterns arise from the personification of sea organisms, whose behaviour is compared to that of humans.

Table 20 shows the absolute frequency figures of non-resemblance metaphor terms. The total number of occurrences is 45,173, which is a high number. This fact supports the claim that ecologists (and biologists in general) do not see the world “as it is”, but through the eyes of their professional culture (Larson 2008: 171), which entails the deployment of a net of metaphors that is devised to easily make and communicate science.

The total number of 45,173 non-resemblance metaphor occurrences is significantly higher than that of resemblance metaphor terms, which was 32,247. This is a significant difference, which may be due to the prolific nature of non-resemblance macro-metaphors. As previously shown, these macro-metaphors are easily exploited by marine

[43] We have emphasized *explicitly* because, unlike non-resemblance metaphors, the processes and actions featured by some resemblance metaphors (most behaviour-based metaphors) are implicitly instantiated by names (e.g. triggerfish).

biology experts, who use them to structure and give cohesion to their discourse. This implies the exploitation of hosts of interrelated metaphorical terms belonging to such macro-metaphors. In § 4.2.4.2., evidence is given of the existence of resemblance macro-metaphors. Even though they have rich inferential inner structure, this is not as rich and complex as that of non-resemblance metaphors, and thus, the exploitation of metaphorical expressions under resemblance macro-metaphors is harder to carry out.

The percentage of non-resemblance metaphor terms is 0.99, which is a significant figure since it means that almost one out of one hundred words in the corpus is a non-resemblance metaphor. This percentage arguably shows the incidence of this type of metaphor in the marine biology discourse. Moreover, the sum of the percentages of resemblance and non-resemblance metaphor terms is 1.6% (0.70% + 0.90%), which signifies that more than one word out of one hundred in the marine biology corpus is metaphorical in nature. This percentage arguably gives evidence of the influence of figurative thought in specialised language.

	Number of tokens	**Number of metaphorical occurrences**	**% of metaphorical terms in each sub-corpus**
English sub-corpus	2,240,327	23,367	1.04
Spanish sub-corpus	2,309,863	21,806	0.94
Total	4,550,190	45,173	0.99

Table 20. Absolute frequency figures of non-resemblance metaphor terms.

From a cross-linguistic viewpoint, the figures in Table 20 show that English-language scientists rely on non-resemblance metaphors more than Spanish-language scientists do. There is thus a convergence in the way scientists make use of resemblance metaphors, since these are also more frequently used by English-language experts. As with resemblance metaphors, one of the reasons why the English non-resemblance metaphor terms outnumber the Spanish ones is the fact that English rhetoric style does not avoid the repetition of lexical units in close proximity. Still another reason, which exclusively concerns non-resemblance metaphors, is that English-language experts exploit certain macro-metaphors and carry them a step further than Spanish-language experts. This results in a higher number of metaphorical expressions, as shown in the methodology section.

There is another inter-linguistic similarity between both types of metaphor. The difference between the number of English non-resemblance metaphor occurrences and that of Spanish non-resemblance metaphor occurrences (23,367 - 21,806 = 1,561) is similar to that between the English resemblance metaphor occurrences designating sea organisms and the Spanish resemblance metaphor occurrences designating sea organisms (16,920 - 15,327 = 1,593).

Table 21 shows the distribution of the non-resemblance metaphor terms across the four macro-metaphors that were established in this research study. As can be seen, MARINE HABITATS ARE COMMUNITIES is the most common macro-metaphor in the corpus, both in English and Spanish. It is followed by MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL, which arises from the interrelation of two generic ones, LIFE/SURVIVAL IS WAR and MARINE HABITATS ARE COMMUNITIES. The fact that these are the two most common metaphor systems is hardly a coincidence since social concepts — including non-competitive ones, such as *communities*, *visiting*, and *migration*, as well as competitive ones, such as *dominance*, *invasion*, and *intrusion* — are basic aspects of human behaviour.

The two other macro-metaphors trail far behind as evidenced in the number of metaphorical tokens. This is especially true for MARINE PROCESSES ARE CIRCLES, which is only represented by 4,110 metaphorical occurrences. This metaphor is also the only one whose Spanish tokens outnumber the English ones. However, this is incidental because both languages use the same metaphor types within this macro-metaphor, as shown in Table 28. Even though economy and business are basic aspects of humans, the metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS is less prolific than the community metaphor. In our view, this is due to the fact that ECONOMY and BUSINESS constitute a very specific specialised knowledge domain in comparison to basic social activies, such as competition and association. Moreover, the ECONOMY and BUSINESS domain has little to do with the MARINE BIOLOGY domain, another very specific field. All this makes the adaptation of the former to the latter more complicated.

	Number of tokens for MARINE HABITATS ARE COMMUNITIES	Number of tokens for MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL	Number of tokens for SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS	Number of tokens for MARINE PROCESSES ARE CIRCLES
English sub-corpus	9,267	8,030	4,397	2,047
Spanish sub-corpus	8,909	7,173	3,287	2,063
Total	18,176	15,203	7,684	4,110

Table 21. Distribution of non-resemblance metaphor terms across the macro-metaphors.

The application of the typology of term pairs established by the English-Spanish contrastive analysis of resemblance metaphors to the analysis of non-resemblance metaphors yielded the results reflected in Table 22. This table contains the number of interlinguistic term pairs arranged by macro-metaphors. We provide this information because, as Stefanowitsch (2006: 69) notes, a statistical assessment of the importance of a given mapping yields crucial information about the relative importance of the corresponding cognitive model. The figures in Table 22 show that the pairs are proportionately distributed across the four macro-metaphors. Accordingly, the COMMUNITY metaphor is the one that includes the highest number of pairs, whereas the CIRCLE metaphor includes the lowest. The number of pairs in Table 22 exclusively represents bare forms, including synonyms, and not each of the grammatical classes that a bare form can take on. The grammatical classes of these forms are provided in Tables 23 to 28.

	Number of exact term pairs	Number of partial term pairs	Number of separate term pairs	Number of unbalanced term pairs
MARINE HABITATS ARE COMMUNITIES	33	1	0	2
MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL	25	0	0	2
SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS	20	0	0	0
MARINE PROCESSES ARE CIRCLES	9	0	0	1
Total amount per type	87	1	0	5
Total	93			

Table 22. Number of interlinguistic non-resemblance metaphor term pairs arranged by macro-metaphors.

As with resemblance metaphors, the majority of the non-resemblance metaphor equivalents found in the corpus are exact pairs. This fact lends support to the assumption that the cultural conditions during the ontogeny of most biologists (Westerners in general) are relatively consistent, and thus the schema is conventional (Larson 2008: 174). Despite this convergence, such schema is also socioculturally situated (Larson *ibid.*), which explains the emergence of partial and unbalanced term pairs. However, they are scarce in comparison to the number of exact pairs. Moreover, no separate pairs were identified in the corpus, which strengthens the abovementioned claim that English-speaking and Spanish-speaking biologists share *most* of their cultural schemas. An emphasis is put on *most* because we should also take into account the separate and unbalanced pairs of resemblance metaphor terms previously retrieved from the corpus.

A comprehensive enumeration of the different types of term pairs identified in the corpus is provided in Tables 23 to 28. These tables contain the grammatical classes (excluding gerunds and past participles of verbs) of the metaphorical terms that occurred in the marine biology articles, as well as the synonyms (in brackets) of such terms that were detected in the corpus. They are all arranged according to the macro-metaphors that they belong to. Table 23 includes the exact interlinguistic term pairs subsumed by the macro-metaphor MARINE HABITATS ARE COMMUNITES.

<table>
<tr><th colspan="5">MARINE HABITATS ARE COMMUNITIES</th></tr>
<tr><td colspan="5">Exact term pairs</td></tr>
<tr><td rowspan="2">English term / Spanish term</td><td>arquitecture / arquitectura

— / arquitectónico (adj.)</td><td>association / asociación

associate / asociarse

associative / asociativo</td><td>bacterial consortium / consorcio bacteriano

microbial consortium / consorcio microbiano</td><td>colony / colonia

colonise / colonizar

coloniser / colonizador</td></tr>
<tr><td>commensal / comensal

commensalism / comensalismo</td><td>community / comunidad</td><td>cosmopolitan / cosmopolita</td><td>courtship / cortejo

court / cortejar</td></tr>
</table>

<table>
<tr><th colspan="6">MARINE HABITATS ARE COMMUNITIES</th></tr>
<tr><td colspan="6">Exact term pairs</td></tr>
<tr><td rowspan="3">English term / Spanish term</td><td>family / familia</td><td>fugitive / fugitivo</td><td>guild / gremio
— / gremial (adj.)</td><td>gregarious / gregario</td></tr>
<tr><td>host / hospedador (huésped, hospedero)</td><td>house (home) / casa (hogar)
housing / hospedaje</td><td>inquiline / inquilino</td><td>migration / migración
migrate / migrar
migratory / migratorio</td></tr>
<tr><td>mutualism / mutualismo
mutualist / mutualista</td><td>neighbour / vecino
neighboring / vecino (adj.)
neighbourhood (vicinity) / vecindad</td><td>opportunist (n. and adj.) / oportunista (adj.)</td><td>peregrinate / peregrinar</td></tr>
</table>

<table>
<tr><th colspan="5">MARINE HABITATS ARE COMMUNITIES</th></tr>
<tr><td colspan="5">Exact term pairs</td></tr>
<tr><td rowspan="4">English term / Spanish term</td><td>philopatry / filopatria

philopatric / —</td><td>pioneering / pionero</td><td>population / population

populate / poblar

— / poblacional (adj.)</td><td>resident / residente

residency / residencia</td></tr>
<tr><td>ritual / ritual</td><td>sedentary / sedentario</td><td>settlement / asentamiento

settle / asentarse</td><td>shelter / refugio</td></tr>
<tr><td>site fidelity / fidelidad al sitio</td><td>society / sociedad

social / social</td><td>territory / territorio</td><td>visit (v.) / visitar

visitant / visitante</td></tr>
<tr><td>tourist species / especie turista</td><td></td><td></td><td></td></tr>
</table>

Table 23. Exact interlinguistic term pairs subsumed by the macro-metaphor MARINE HABITATS ARE COMMUNITES.

The terms *settle*, *colonise*, and *associate* can also fit the metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL. It all depends on whether these actions imply an aggressive settlement/colonisation (i.e. invasion) of the native sea organisms' territory and whether the organisms that associate gain some kind of protection against potential predators. Thus, when aggressive settlement and protection are involved — which is not always the case —, it is the COMBAT metaphor that is activated. The same applies to the term *host*, which belongs to the COMMUNITY metaphor if there is a mutualistic (symbiotic) relationship or to the COMBAT metaphor if the relationship is parasitic.

As previously explained, we detected one case of partial pair and two cases of unbalanced pair that belong to the COMMUNITY metaphor. Table 24 contains all three pairs. The partial pair, *grazing* / *pastoreo*, and the unbalanced pair *nursery* / *criadero* were already commented on in the methodology section. As concerns the unbalanced pair *vagrant* / *errante*, it is the English term that is metaphorical. The *American Heritage® Dictionary of the English Language* defines the adjective *vagrant* as "wandering from place to place and lacking any means of support". Having no means of support, i.e. having no help or income to get by, is a human condition, which is mapped onto the domain of marine biology to designate organisms that lead a nomadic life to survive. According to the *Diccionario de la Real Academia Española*, the adjective *errante* is defined as "que anda de una parte a otra sin tener asiento fijo", in other words it refers to someone who wanders without a definite destination. Thus, there is no metaphorical sense playing a role here. *Shepherding*, the literal translation equivalent of *pastoreo*, is given in square brackets. *Errante*, the translation equivalent of *wandering*, is given in brackets. The synonym of the term *nursery*, *feeding ground*, is given in brackets. *Criadero* is the literal interlinguistic equivalent of *feeding ground*.

MARINE HABITATS ARE COMMUNITIES		
English term / Spanish term	**Partial term pair**	**Unbalanced term pairs**
	grazing / pastoreo [shepherding]	vagrant / errante (wandering)
		nursery (feeding ground) / criadero

Table 24. One partial pair and two unbalanced pairs belonging to the COMMUNITY MACRO-METAPHOR.

Table 25 contains all of the exact term pairs identified in the corpus that can be subsumed by the macro-metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL. Again, synonyms are given in brackets.

MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL				
Exact term pairs				
English term / Spanish term	armament / armamento arm (weapon) / arma evolutionary arms race / —	association / asociación associate / asociarse associative (associational) / asociativo	cohort / cohorte	colony / colonia colonise / colonizar coloniser / colonizador

MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL				
Exact term pairs				
English term / Spanish term	combat / combatir	conflict / conflict conflictive / conflictivo	competition (competency) / competencia competitor (rival) / competidor competitive superiority / superioridad competitiva competitive exclusion principle (Gause's Law) / principio de exclusión competitiva (Ley de Gause)	dominance hierarchy (rank) / jerarquía de dominancia

MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL				
Exact term pairs				
English term / Spanish term	equipped / equipado	estrategia / strategy	evasion / evasión	gene gun (bioballistic method) / pistola de genes (método biobalístico)
	host / hospedador (huésped, hospedero)	intrusion / intrusión intruder / intruso intruding / — intrusive / intrusivo[44]	invasion / invasion invader / invasor invade / invadir invasive / invasivo invasive exotic species / especie exótica invasora	kleptoparasitic / cleptoparásito

[44] These terms occurred in several articles, but they do not designate sea organisms, but water or rocky bodies that invade other structures.

MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL				
Exact term pairs				
English term / Spanish term	line of defence / línea de defensa	particle bombardment / bombardeo de partículas	raid (incursion) / incursión	robbery / — steal / robar
	sentinel / centinela	shelter / refugio	shotgun sequence / secuencia por *shotgun* shotgun sequencing / secuenciación por *shotgun*	tactic / táctica
	target / diana target (v.) / —			

Table 25. Exact term pairs under the macro-metaphor MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL.

Table 26 includes the two unbalanced term pairs identified in the corpus belonging to the COMBAT metaphor. In both of them, it is only the English terms that are metaphorical. It is not accidental that these metaphorical terms belong to the COMBAT metaphor. As the corpus data already revealed in the methodology section, English-language scientists exploit the WAR domain more extensively than Spanish-speaking scientists to conceptualise marine biology entities and processes. The pair *usurp* / *ocupar* was already explained in the methodology section. The term *win out over* stems from the domain of WAR, and is metaphorically mapped onto the marine biology domain to designate an action whereby an organism either kills (*matar*, in Spanish) another one or ousts (*excluir*, in Spanish) it from its territory. *Matar* and *excluir* are the two terms found in the Spanish corpus that have the closest meaning to *win out over*, and do not have a figurative meaning.

MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL		
Unbalanced term pairs		
English term / Spanish term	usurp / ocupar	win out over / matar (kill), excluir (oust)

Table 26. Unbalanced term pairs belonging to the COMBAT macro-metaphor.

The corpus exact term pairs encompassed by the macro-metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS are provided in Table 27.

SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS		
Exact term pairs		
English term / Spanish term	balance (budget) / balance	capitalise / capitalizar
	consumer / consumidor consume / consumir	cost / coste (costo) costly / costoso
	expenditure / gasto expensive / —	exploitation / explotación exploit / explotar
	export (n.) / exportación export (v.) / exportar	gross / bruto

SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS		
Exact term pairs		
English term / Spanish term	import (n.) / importación import (v.) / importar	investment / inversión invest / inverter
	monopolise / monopolizar	net (adj.) / neto
	output (throughput) / rendimiento	pay-off / beneficio
	poverty / pobreza poor / pobre	(primary, secondary, terciary) production / producción (primaria, secundaria, terciaria) producer / productor produce / producir
	(primary, secondary, terciary) productivity[45] / producción (primaria, secundaria, terciaria)	richness / riqueza rich / rico
	spend / gastar	trade-off / compensación trade off / compensar

Table 27. Exact term pairs encompassed by the macro-metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

As previously explained, the term *stock* is used both in English and Spanish, which means that both languages exploit the same metaphor to refer to a particular marine

[45] Regarding the terms *productivity* and *production*, *The American Heritage® Dictionary of the English Language* defines *productivity* as the rate at which energy is used by producers to form organic substances as food for consumers, whereas *production* is defined as the total output of such energy.

biology concept. However, we cannot call it an exact pair because it is a borrowed term. In other words, the same lexical unit is used in the two languages. As for the other pair types, no partial or unbalanced term pairs were found for the macro-metaphor SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS.

The exact term pairs under the macro-metaphor MARINE PROCESSES ARE CIRCLES are included in Table 28. Although many of them involve the term *cycle*, this term refers to different cyclical processes depending on the modifier preceding it. For example, the circadian cycle is an approximate daily periodicity in the biochemical, physiological or behavioral processes of living beings, including plants, animals, fungi and cyanobacteria (*The American Heritage® Dictionary of the English Language*), whereas the (marine) nutrient cycle refers to the phases whereby organic matter is decomposed on the seabed, and broken down in the food chain.

MARINE PROCESSES ARE CIRCLES		
Exact term pairs		
English term / Spanish term	biogeochemical cycle[46] (nutrient cycle, organic cycle) / ciclo biogeoquímico (ciclo de nutrients, ciclo orgánico)	circadian cycle / ciclo circadiano
	circulation pattern / patrón de circulación circulate / circular	food chain (food web, trophic chain) / cadena alimenticia (cadena alimentaria, cadena trófica)
	life cycle (vital cycle) / ciclo de vida (ciclo vital)	marine snow / nieve marina

[46] The most well-known and important biogeochemical cycles include the carbon cycle, the nitrogen cycle, the oxygen cycle, the phosphorus cycle, and the water cycle. All of these terms were also retrieved from the marine biology corpus.

	molt cycle / ciclo de muda	recycling / reciclaje

Table 28. Exact term pairs under the macro-metaphor MARINE PROCESSES ARE CIRCLES.

As previously explained, we only retrieved one unbalanced pair, the terms *upwelling* (metaphorical) and *surgencia* (literal), which fit this macro-metaphor. Nevertheless, the corpus data yielded no cases of partial pairs or of separate pairs.

Finally, it should be highlighted that it was difficult to mark the conceptual domains involved in the marine biology macro-metaphors as well as to build the metaphors themselves. We are aware that connecting linguistic materials with conceptual structures always involves the risk of partiality and biased results. In fact, it is argued that linguistic formalisations can usually be related to more than one conceptual domain (cf. Ritchie 2003; Semino et al. 2004). For example, Ritchie (2003: 132) notes that "most of the metaphorical expressions Lakoff and Johnson (1980) cited as evidence for an underlying metaphor, ARGUMENT IS WAR, are also consistent with ARGUMENT IS CHESS or ARGUMENT IS BOXING". However, the results of this research study are fairly straightforward and conclusive since we filtered out irrelevant options and specifically focused on certain items and materials.

Another problematic issue that arises in the specification of macro-metaphors concerns the number of linguistic expressions to be analysed in order for the overall study to hold water (Steen 2007: 388). The macro-metaphors postulated in this study are based on at least nine terminological formalisations both in English and Spanish, which was the minimum number that we considered to be significant. Such submissions are valid because they are derived from the analysis of corpus-based data. The ample number of expressions guarantees a robust analysis. Nevertheless, it is also true that Conceptual Metaphor Theory particularly and Cognitive Linguistics as a whole are frequently criticised for exclusively relying on linguistic analyses for conceptual metaphor identification. It is often argued that this methodology is unable to ascertain and give credit to potential conceptual metaphors. As Gibbs and Perlman (2006: 212) point out, psychologists and psycholinguists complain about "the lack of explicit criteria for identifying conceptual metaphors from a sytematic analysis of conventional expressions".

4.2. Reviewing Imagery in Resemblance and Non-resemblance Metaphors: An Introspective Approach to Terminological Metaphor

This section discusses the nature of mental imagery in metaphorical thought as envisaged by the contemporary theory of metaphor (Lakoff 1993; Grady 1997, 1999). This perspective explores the psychological underpinnings of metaphorical representation by analysing terminological — and thus conventionalised — units in the field of marine biology. The study draws on two crucial aspects of mental imagery, namely dynamicity and pervasiveness. We will first focus on image metaphors and behaviour-based metaphors. In our view, the dynamicity of certain mental images highlights inherent similarities between these two types of metaphor, and makes the differences between them more apparent than real. For this reason, we propose a more refined description of this type of metaphors in terms of the static or dynamic nature of the mental images underlying them. Secondly, we address conceptual-structural metaphors (Lakoff 1993) and primary metaphors (Grady 1997a), and compare them with image and behaviour-based metaphors. We argue that mental images permeate all classes of metaphor, and that the pervasiveness and dynamicity of mental images affords insights into all metaphor types.

It should be noted that this section approaches terminological metaphor as behaviour, in other words, as a cognitive process and result. It is an introspective and qualitative study of metaphorical names of organisms extracted from our corpus of marine biology texts. Their occurrence in specialised journal articles proves that they are grammatical units (in the sense of being conventionalised terminological expressions).

4.2.1. Introduction

Conceptual Metaphor Theory and Primary Metaphor Theory establish a sharp distinction between metaphors that arise from physical or behavioural analogy and metaphors motivated by abstract or subjective cognitive processes. In the case of Conceptual Metaphor Theory, Lakoff (1993) and Lakoff and Turner (1989) distinguish between *conceptual-structural*/*conventional metaphors* and *image metaphors*. However, Grady's (1997a, 1999) Primary Metaphor Theory distinguishes between *correlation metaphors* and *resemblance metaphors*. These classes of metaphor arise by virtue of our embodied conceptualisation system.

In our study, we use the term *resemblance metaphor* to refer to image metaphors and behaviour-based metaphors, and *non-resemblance metaphor* to refer to conceptual/conventional metaphor and correlation metaphor. We prefer the term *non-resemblance metaphor* for three reasons. Firstly, it encompasses any type of metaphor that does not arise from resemblance. Secondly, the term *conceptual metaphor* is not felicitous because resemblance metaphors are also conceptual, as underlined in other studies (Kövecses 2002; Alexiev 2005). Thirdly, the term *conventional metaphor* is not a good choice because resemblance metaphors are also conventional.

According to Grady's (1999) characterisation of resemblance metaphors, image metaphors are associated with motionless visual images, whose motivation for metaphorical transfer is based on physical properties (e.g. shape and colour). In contrast, there are other metaphors that result from behavioural comparison, and therefore, are typically linked to motion and dynamicity.

Our research study of marine biology resemblance metaphor challenges this classification, suggesting that image metaphors and behaviour-based metaphors are closely linked. In fact, what truly differentiates these metaphors is the static or dynamic nature of their underlying images[47]. Rather than belonging to two different categories, they should be regarded as belonging to a graded category in which members differ in terms of the dynamicity of their images. As shall be seen, imagery is also important in non-resemblance metaphors. This means that images and their analysis should go far beyond mere physical or behavioural resemblance.

4.2.2. Defining imagery

Imagery has two related senses. First of all, it refers to quasi-perceptual experience, which significantly resembles perceptual experience, but occurs in the absence of the appropriate perceptual stimuli (Thomas 1999: 208). This definition includes image schemas and mental images, both of which are key ideas in Cognitive Linguistics (cf. Johnson 1987; Lakoff and Johnson 1999).

An image schema can be regarded as an instance of *imagery simpliciter* or "an especially 'unsaturated' form of imagery, produced by simulating only the very earliest and most generally applicable stages of the process of a perceptual exploration"

[47] In this regard, this research work is on a par with other studies. For instance, Caballero (2006) explores a host of image metaphors that are dynamic, and Peña (2003) makes a distinction between situational and non-situational metaphors that is based on the feature of dynamicity.

(Thomas 2009). Apart from being an unsaturated form of imagery, image schemas are non-intentional because they do not participate in the conscious act of perceiving. In other words, image schemas are emergent properties of unreflective bodily experience (Gibbs and Colston 2006: 247).

In contrast, a mental image is a more substantiated kind of mental representation. It cross-cuts any sensory mode, and embodies our perceptual and imagistic awareness[48]. Mental images are intentional insofar as they involve a conscious mental act of perceiving. In other words, they are the result of more effortful cognitive processes (Gibbs and Colston 2006: 247). Mental images also have content specificity, the complexity of which is constrained by linguistic and environmental situatedness. Image schemas may also be complex, but in the sense that they can combine to give structure to conceptual domains (cf. Cienki 1997: 9; Kimmel 2005). This structure entails conceptual relationships, and accordingly, it has been shown that some image schemas are subsidiary or subordinate to others (Peña 1999).

The second sense of *imagery* is related to a well-entrenched view in cognitive psychology that mental images are a key factor in creative thought (cf. Finke, Ward, and Smith 1992; Gibbs 2006; Weisberg 1986). Consequently, imagery not only refers to true imagination, but also to the production of mental images that arise from our capacity to separate, shuffle, distort and recombine simpler mental images in the first sense. This ability has its cognitive uses (Finke, Pinker, and Farah, 1989; Finke, Ward, and Smith 1992), including the generation of metaphorical thought. In our view, both senses of *imagery* are essential to account for mental images in metaphorical thought.

4.2.3. Image metaphors and behaviour-based metaphors

Grady (1999), Lakoff (1993), and Lakoff and Turner (1989) agree that the core feature of image metaphors is the comparison between the images of two entities. Lakoff (1993: 230) writes that because two images are being compared, these metaphors are

[48] The notion of “mental image” is admittedly rather vague. Because of this, a mental image need not refer to a “mental picture”, but can also refer to sensory images or image simulations in different sensory modes. As Pylyshyn (2003: 113) aptly points out, this is due to the fact that “neither language nor pictures are sufficient to represent the content of thought and that most thought is not available to conscious inspection [...] If there is something special about the format in which we think when we have the experience of ‘seeing with the mind’s eye’, nobody has satisfactorily articulated what it is”.

called *image metaphors*:

> Metaphoric image-mappings work in just the same way as all other metaphoric mappings: by mapping the structure of one domain onto the structure of another. But here, the domains are conventional mental images.

The prototypical conception of an image metaphor is a metaphor based on resemblance in shape and/or colour. In this way, clear instances of marine biology image metaphors are *seahorse* (*Hippocampus*), which refers to a fish with a horse-like head (see picture in Table 29 in Appendix I), and *milkfish* (*Chanos chanos*) because of the white underside of this fish (see picture in Table 29 in Appendix I). These metaphors are based on visual perception, which is the dominant component of our embodied conceptualisation system (Watt 1991). For this reason, this type of metaphor has the highest degree of iconicity (i.e. physical resemblance) shared by the source and target concepts. These metaphors clearly differ from behaviour-based metaphors, such as *hermitcrab* (*Paguroidea*) in which the crab acts like a hermit instead of looking like one.

According to Grady (1999), behaviour-based metaphors cannot be called *image metaphors* because they are based on behavioural rather than physical resemblance. By way of example, Grady (1999: 89) mentions the well-known metaphor *Achilles is a lion.* Since Achilles' courageous actions resemble the aggressive behaviour of lions without any claim about his physical appearance, this metaphor cannot be considered an image metaphor.

Strictly speaking, according to Grady's classification, marine biology terms such as *sea nettle*, *archerfish* or *triggerfish* are not image metaphors either, since they are based on behavioural or functional resemblance. Nevertheless, we argue that these metaphors also evoke mental images, and that mental images are not exclusively associated with metaphors based on physical comparison.

4.2.3.1. Images in behaviour-based metaphors

There is a growing body of research in cognitive psychology showing that mental representations of perceptual experience are central to cognition (cf. Damasio 1994;

Finke 1989; Paivio 1971, 1986; Thomas 1999[49]). In this section we show that behaviour-based metaphors are grounded in mental images that can be either dynamic or static.

4.2.3.1.1. Dynamic images in behaviour-based metaphors

Behaviour-based metaphors, such as *Achilles is a lion,* emerge from the visual experience of a motor action, which yields a set of images that are fleshed out by spatial-dynamic actions. In this metaphor, we evoke images of Achilles bravely confronting his enemies and a lion fiercely fighting other animals for survival (also in Ruiz de Mendoza and Peña 2008). The nature of these images is constrained by the image-schematic topology of the target domain, which cannot be violated by the cognitive topology of the source domain, while still remaining consistent with it. This is in consonance with Lakoff's Invariance Principle (Lakoff 1990, 1993). In spite of this constraint, the images retrieved by this type of metaphor are disperse since each individual may re-create these actions in different mental scenarios. As Deane (2005: 247) points out, "the same spatial relation may receive distinct representations in multiple representational modalities".

Although most research on imagery in contemporary cognitive psychology focuses on visual perception (and, to a much lesser extent, on audition), there is growing evidence that kinaesthetic, somaesthetic and haptic perception is also pivotal to mental image formation (cf. Gibbs 2006; Gibbs, Beitel, Harrington and Sanders, 1994; Gibbs and Colston 2006 [1995]; Popova 2005). This means that mental images need not necessarily be visual in nature, and that visual imagery (i.e. iconicity) and kinaesthetic imagery "share a common representational, and possibly neuropsychological substrate" (Gibbs 2006: 124).

According to Paivio's (1971, 1986) dual coding approach, cognitive tasks are mediated not only by linguistic processes, but also by a nonverbal imagery model of thought as well. What Paivio calls the *image system* in our brains refers to both non-

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[49] Thomas (1999) dwells on the three major theories of imagery in Conceptual Science, namely Picture Theory, Description or Propositional Theory, and Perceptual Activity Theory. He aligns himself with Perceptual Activity Theory, according to which "perceptual learning is not viewed as a matter of storing descriptions (or pictures) of perceived scenes or objects, but as the continual updating and refining of procedures or *schemata*" (Thomas 1999: 218).

verbal objects and events, and arises not only from visual stimuli, but also from auditory, kinesthetic, and other sensory components of non-verbal information. Accordingly, behaviour-based and function-based metaphors can also be regarded as image metaphors because they are closely linked to conventional mental images representing events, which are not necessarily based on visual stimuli. Moreover, since behaviour and function mostly involve (loco)motion on account of a correlation or cause-effect event, most behaviour-based images (i.e. images that feature the behaviour of a living being) and function-based images (i.e. images that feature the functioning of an instrument, device or machine) are unquestionably dynamic.

4.2.3.1.1.1. Sea wasp

In the field of marine biology, many specialised concepts have basic-level category denominations. This guarantees richly contoured and easily retrievable mental images, since the basic level is the level of rich mental images and rich knowledge structure (Lakoff 1993: 212). For example, the metaphor *sea wasp*, which is an alternative scientific name for jellyfish *Chironex fleckeri* (see picture in Table 29 in Appendix I), evokes an easily retrievable image that primes kinaesthetic perception. It also gives priority to the more subjective sensory image of actually participating in an event, rather than to the objective and visual pattern of observing it. In this case, the perceptual experience foregrounded is touch, which is a somaesthetic and kinaesthetic sense, and like vision, also a spatial sense (Popova 2005: 402).

This metaphor evokes the dynamic event image of our touching a wasp, its stinging us, and our subsequent experience of pain. This image is mapped or superimposed onto the image of a jellyfish injecting its stinging capsules or nematocysts under our skin, which causes the pain.

This metaphor has a metonymic basis. The close relationship and interaction between metaphor and metonymy has been underlined in recent research (cf. Barcelona 2003; Radden 2002). More precisely, the sea wasp metaphor is based on two conceptual metonymies operating on the two domains or categories connected by the metaphor. In the metonymies, the source is the STINGING CAPACITY, which is a shared attribute of the targets WASP and JELLYFISH. In other words, both wasps and this type of fish have to be metonymically understood *from* their salient property STINGING CAPACITY as metonymic source, which creates the abstract similarity that makes the metaphorical connection between the source (WASP) and the target (JELLYFISH).

4.2.3.1.1.2. Archerfish

Another example of a behaviour-based metaphor relying on dynamic images is *archerfish* (Toxotidae). The behaviour of this fish is compared to that of an archer, which includes the *function* of an archer's bow, which shoots arrows at a target. The reason for this comparison is that archerfish have the ability to spit water droplets at aerial insects (either on the wing or while resting on surfaces above the water), and thus knock them onto the water to be eaten (see picture in Table 29 in Appendix I). Thus, the dynamic image of an archer shooting an arrow at his target is superimposed onto the image of an archerfish spitting water at an insect. This metaphor also has a metonymic basis. The source domain of the metonymies is SHOOTING CAPACITY as instantiated by: (i) the archer's use of a bow and arrow; (ii) the archerfish's projection of water droplets to hit insects. The source domain of the metonymies stands for the targets, ARCHER and ARCHERFISH, and is in turn responsible for the abstract similarity that makes the metaphorical connection between the source (ARCHER) and the target (ARCHERFISH).

All of these metaphors can also be approached from the perspective of Conceptual Blending Theory (Fauconnier and Turner 1998a, 2002). They are clear instances of formal blending, more specifically, of compounding. For example, *archerfish* involves two input spaces relating to *archer* and *fish*, plus the conventional array of meanings linked to these lexical items. However, the projection to the blended space is selective, including only the subset of semantic features associated with the concepts of both *archer* and *fish*, along with their forms (i.e. *word projection*). Thus, both conceptual structure and linguistic structure are projected onto the blend, giving rise to a new emergent structure. Figure 36 illustrates this scenario.

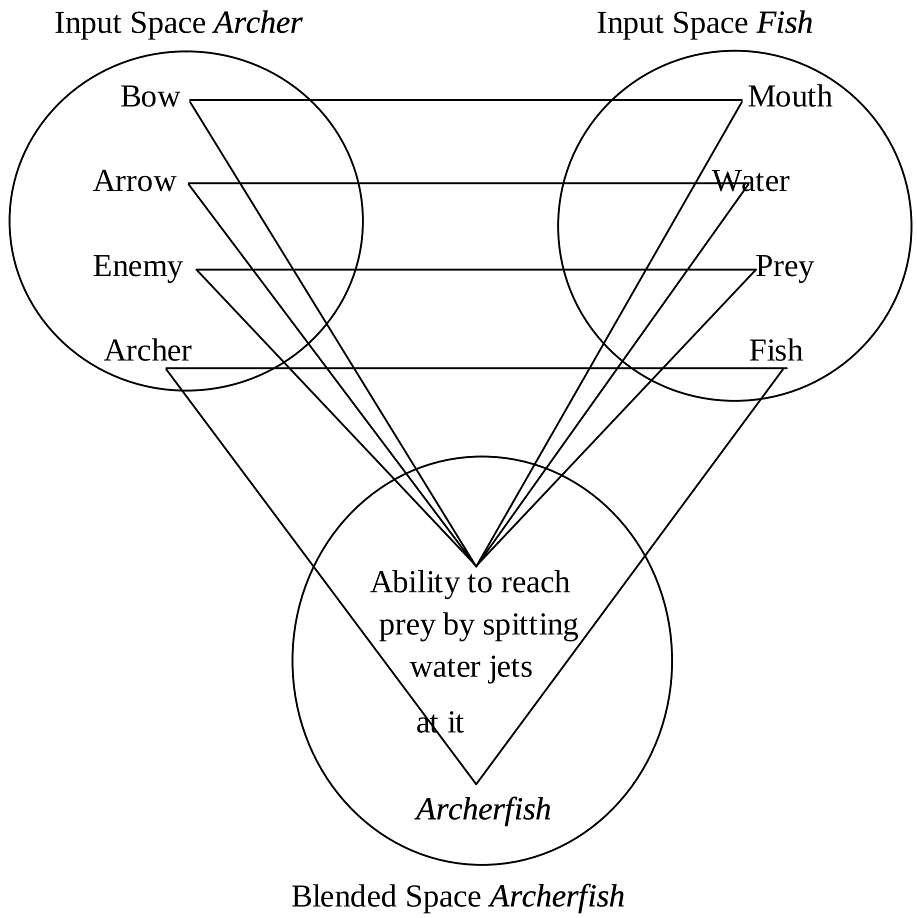

Figure 36. Blended space of *archerfish*.

This structure is novel both from a linguistic point of view (the creation of a new word) and from a semantic point of view (the creation of a new meaning).

4.2.3.1.2. Static images in behaviour-based metaphors

Although behaviour most frequently implies dynamic mental images, curiously enough, we have found behaviour-based metaphors in the field of marine biology that are based on static images.

For instance, the metaphor *hawkfish* (*Cirrhitidae*) refers to a fish that behaves like a hawk because it rests atop the highest point on the coral reefs, waiting for potential prey to appear (see Table 29 in Appendix I). The fish then dives down to capture its prey. The initial image of a motionless hawkfish awaiting its prey on a high vantage point maps onto that of a motionless hawk on a tree branch or cliff, waiting to capture its prey.

Still another example is the metaphor *garden eel* (*Heterocongridae*). Garden eels receive this name because they live in colonies, keeping the main portion of their bodies buried in the sandy sea bottom while the rest remains upright in the open sea (see Table 30 in Appendix I). This behaviour retrieves a motionless image which resembles that of slender plants growing in a garden. The garden eel metaphor also entails a physical aspect motivation: the mass-effect shape of the eels licenses the comparison of these animals to a garden. On this basis, we argue that this is another metonymy-based metaphor. The source of the metonymies, i.e. the STATE OF STANDING STILL, maps onto the targets, i.e. PLANTS IN THE GARDEN and EEL, and thus prompts the metaphorical connection between them.

4.2.3.2. Dynamic image metaphors

In marine biology, most of the examples refer to either a behavioural/functional model or a physical-aspect model. For instance, the metaphors *sea nettle* and *sea wasp* are based on behaviour. *Archerfish* integrates behavioural and functional motivations, whereas *triggerfish* arises from resemblance in function. Independently, *horseshoe crab* is a shape-induced metaphor, and *sea lettuce* emerges as a result of comparison in shape and colour (see Table 29 in Appendix I).

Generally speaking, we tend to think of shape and colour as more static than dynamic attributes. However, it is evident that an entity can change its shape as well as its colour. Accordingly, there are also dynamic metaphors based on physical comparison. This fact supports the claim that "people find it easier to make sense of [...] moving objects over those that are stationary" (Gibbs and Colston 2006: 252). Concerning shape, Deane (2005: 249–250) affirms that "there are multiple representations of shape: one representation depicts static forms; the other depicts dynamic form". Lakoff (1993: 229) provides the following example when describing the characteristics of image metaphors: "the image of the slow, sinuous walk of an Indian woman is mapped onto the image of the slow, sinuous, shimmering flow of a river". Though involving dynamicity, this example features an image metaphor because it is moving shapes or lines that are compared.

However, dynamism also entails behavioural or functional patterns. These are processed in our brains, and create interrelated experience-based concepts that become meaningful because of these regular patterns. This evidently leads to behaviour-based or function-based metaphors. Thereby, the slow and sinuous walk of the Indian woman is part of the way she walks, and thus, of her behaviour. Likewise, the slow and sinuous flow of a river is also part of its ***behaviour***. Thus, this is a resemblance metaphor which integrates physical and behavioural motivations.

There are also resemblance metaphors in marine biology that combine both behaviour and physical appearance. Such is the case of the ***anglerfish*** (*Lophius*). This fish behaves like, and thus, resembles an angler for two reasons: (i) the shape of the foremost spine of its dorsal fin looks like a fishing rod with its fishing line and fleshy bait at its tip (see picture in Table 30 in Appendix I); (ii) this spinal fishing rod is used as a lure for attracting prey which stray close enough for the anglerfish to swallow. Since catching a prey is an action or event, this can be regarded as a dynamic image.

Still another example is the metaphor ***boxer crab*** (*Lybia tessellata*). This crab holds an anemone in each pincer, and uses these anemones for protection (usually against octopuses) in the same way as a boxer uses his fists against his opponent (see picture in Table 30 in Appendix I). These little round-shaped anemones resemble boxing gloves, while the action of attacking predators with the anemones is a type of behaviour that resembles that of a boxer.

Regarding colour, an example of a dynamic resemblance metaphor is ***chameleon fish*** (*Badis badis*). This is a freshwater fish that changes its skin colour when it is hungry, threatened or protecting its eggs, offspring, or territory (see pictures in Table 30 in Appendix I). This change of skin colour occurs within a single static locus (i.e. *loco*motion is not involved). Yet, this type of effect creates mental video-clips of sequentially unfolding images, which naturally implies change or dynamic structure. This is the reason why we recruit the superimposed dynamic images of a real chameleon and of this fish, altering their skin colour. This physical ability is part of their behaviour.

The metaphorical common name ***Spanish dancer*** designates a species of nudibrach (scientific name *Hexabranchus sanguineus*). This common name is an interesting metaphor because the dynamic image that it evokes integrates three closely interrelated metaphorical motivations. First of all, the intense red colour of this nudibrach is like the colour of a typical flamenco dancer's dress (female gypsy dress). Secondly, the spirals of the nudibrach look like the frills and flounces on the skirt of the dress. Thirdly, the nudibrach behaves like a flamenco dancer insofar as the nudribrach moves its spirals in a fluttering manner to advance through the water mass, much like the flamenco dancer moves the flounces on her skirt while performing. Thus, this metaphor combines physical appearance and behavioural patterns. The vivid mental image evoked by

Spanish dancer is visually fleshed out by the picture of this nudibrach in Table 30 (see Appendix I). This picture is full of dynamicity.

Spanish dancer is another example of metaphorical conceptualisation critically constrained by cultural patterns. In this case, the cultural aspect which gives rise to a metaphor privative of Spain is adopted by the English-speaking community to designate a specialised concept. Other similar cases are *bullseye stingray* and *olive ridley turtle*. In this case, however, the Spanish corpus yielded no occurrences either of its scientific name, *Hexabranchus sanguineus*, or of *bailarina española* (the literal translation of *Spanish dancer*). It was thus impossible for us to know whether Spanish-language experts use the same metaphor to designate this nudibrach, or even if they use any metaphor at all[50].

In summary, image metaphors and behaviour-based metaphors are not clearly differentiated categories, since there are a group of metaphors that possess characteristics of both, and thus reside in a transition zone between the two.

It should finally be noted that, in our view, the emergence of mental images to give rise to terminological resemblance metaphors does not always occur in the minds of all language users. As explained in this research study (§ 1.6.), we depart from Conceptual Metaphor Theory in that, in our opinion, conventionalised lexical units are not metaphorically processed either conceptually (as cross-domain mappings) or psychologically (as mental images that merge). The same applies to terminological metaphor. We thus argue that the mental processes and products referred to in this section (proto)typically take place in the minds of: (i) experts who give a novel name to new marine biology organisms and activities; (ii) experts when proposing a metaphorical alternative to a cryptic term that ends up becoming a terminological unit; (iii) laymen who have access to the names of such organisms and activities for the first time. Nevertheless, we are sceptical as to whether such processes and products occur in other cases. At any rate, this is a matter that should best be approached through the analysis of experimental data analysis that deals with metaphor as a conventionalised behavioural phenomenon (Q_7 in Table 1).

[50] Although the common name *bailarina española* [female Spanish dancer] is used in everyday conversation, we found no evidence of its occurrence in the marine biology corpus, and thus, its terminological status is still to be confirmed.

4.2.3.3. Fictive dynamicity in resemblance metaphors

Humans' tendency to think in terms of dynamic patterns has been documented (cf. Talmy 1999 [1996]). Such tendency hinges upon representations that are motionless in nature. These representations emerge from what Talmy (1999 [1996]: 245) calls *ception* or *fictive motion*, which involves "sensory stimulation, mental imagery, and ongoingly experienced thought and affect".

Metaphor is found in fictive motion constructions dealing with spatial description (Talmy 1996). Regarding specialised language, Caballero (2006) identifies instances in architectural discourse where metaphor plays a role in fictive motion. Example (3) given by Caballero (2006: 180) includes motion verbs codifying actual static scenes, which are conceptualised as non-veridical dynamic images through metaphorisation:

(3) Based on a boomerang shaped plan, the new building *steps down* from a prow at its south end to *embrace* a new public space.

In the field of marine biology, we also found metaphorically extended motion verbs that evoke visual mental images involving fictive dynamic structure, as shown in the examples (4) to (6):

(4) The Røst Reef, the world's largest known deep water coral reef, forms a structure that *fades away* to depths between 300 and 400m.

(5) The seaward edge of a reef is fairly steep and *slopes down to* deeper water. Since the water is generally clearer, corals may grow to the depths of 50m depending on light available.

(6) In tile Pulmonate tile rudimentary velum, v, is marked by a line of granular ciliated cells, which [...] *bends up towards* the dorsal surface, in such a way as to almost *encircle* the tentacles.

These metaphors are clearly imagistic in nature, and form a part of the expert's *visual thinking* (Caballero 2006: 3). What makes this type of metaphors interesting is their complex nature. They can be regarded as instantiations of the more general metaphor FORM IS MOTION (Lakoff and Turner 1989: 142–144). At the same time, these metaphors emerge because the form that they evoke matches the actual shape of the entities, and is based on how they are visually scanned. In other words, despite the fact that they are often classified as non-resemblance metaphors, resemblance is involved here, but of a more sophisticated kind.

We can thus conclude that while the two types of resemblance metaphor cannot be regarded as clear-cut categories because dynamic structure and static structure permeate both categories, in some resemblance metaphors it is the boundaries between static structure and dynamic structure that are fuzzy. However, the fuzzy boundaries between both schemas in these resemblance metaphors respond to psychological strategies rather than reflect the actual state of affairs. In short, the conceptualisation of factive statis or stationariness through this kind of metaphor is biased because it results in images involving fictive change.

4.2.4. Non-resemblance metaphors

Resemblance metaphors emerge from the superimposition of easily retrievable mental images. Yet, non-resemblance metaphors also involve the retrieval of mental images. Precisely, the great bulk of research on figurative mental imagery is currently on non-resemblance metaphors. Consequently, both types of metaphor are more closely linked than previously assumed. The pervasiveness of mental imagery is due to the logic of our embodied conceptual system, which licenses the creation of any type of metaphor on the basis of mental images. Therefore, strictly speaking, mental imagery constitutes the grounding of metaphorical thought.

4.2.4.1. Mental images in non-resemblance metaphors

Lakoff (1993: 229) writes that the rationale of conceptual metaphors, namely understanding abstract concepts through concepts directly grounded in bodily experience, involves mental imagery, which is the mental realisation of such experience:

> Abstract reasoning is a special case of imaged-based reasoning. Image-based reasoning is fundamental and abstract reasoning is image-based reasoning under metaphorical projections to abstract domains.

As a general rule, words can designate portions of conventional mental images (Lakoff and Johnson 1999: 69). Recent research provides evidence that language makes much greater use of the brain’s mental imagery than previously thought (Rohrer 2005: 166). In keeping with the two-domain-of experience mapping system proposed by

Conceptual Metaphor Theory, “when both domains are active, imagery associated with source-domain entities can be activated, and thereby associated with the target-domain entities neurally connected to them” (Lakoff and Johnson 1999: 56).

As previously discussed, kinaesthetic perception involves motor activity or bodily (loco)motion, which occurs in space. In fact, mental imagery is prominent in the form of spatial-dynamic images, especially when it comes to real or imagined body action. As pointed out by Rohrer (2005: 169), “mental imagery can also be kinaesthetic, as in the felt sense of one’s own body image”. Mediation of the *lived body* action for mental image formation is called *embodied simulation* (Gallese 2005a).

Gibbs and Perlman (2006: 223) affirm that “processing metaphoric meaning is not just a purely cognitive act, but involves some imaginative understanding of the body’s role in structuring abstract concepts”. Examples of embodied simulation can be found in expressions such as *chewing on the idea* and *grasping an idea*, which arise from the conceptual metaphor IDEAS ARE OBJECTS. Gibbs, Gould and Andric (2006) demonstrated that people imaginatively engage in the act of chewing or grasping something to better understand these metaphorical phrases. Furthermore, it has been shown that the literal re-enactment of figurative verbal cues activates the primary motor and somatosensory cortices in our brains (Rohrer 2005). This underscores the significance of embodiment or sensorimotor experience for metaphorical concept formation.

Since Conceptual Metaphor Theory posits that abstract concepts are ultimately grounded in perceptual or bodily grounded experience (Kövecses 2005; Lakoff 1990; Lakoff and Johnson 1980), mental imagery is thus an integral part of all metaphors. As Caballero (2003a: 152) stresses in the field of architecture, if a distinction is to be made between images and concepts, such a distinction should not lie in the image component, since all the information organised and processed in our minds is essentially imagistic. In a like way, it can also be argued that all the information organised and processed in our minds, including images, is also conceptual.

Mental images are likewise present in an extensive class of metaphorical or *imageable* idioms (Lakoff 1987; Lakoff and Johnson 1999). An imageable idiom comes “with a conventional rich mental image and knowledge about that image” (Lakoff and Johnson 1999: 68). According to Lakoff and Johnson (1999), a significant portion of the array of linguistic expressions stemming from the conceptual metaphor LOVE IS A

JOURNEY consists of idioms. They give the expression ***spinning one's wheels*** as an example.

In marine biology we have also found non-resemblance metaphors based on dynamic mental images. This is the case of ***recruitment***, which refers to the incorporation of new members of one species to the stock of the already existing individuals, particularly those living in communities. This includes shoals of fish and planktonic aggregates. This metaphor can be subsumed by the more general metaphor MARINE COMMUNITIES ARE MILITARY STRUCTURES, which gives rise to metaphorical terms, such as ***intrusion***, ***cohort***, ***sentinel organism***, ***invasive exotic species***, ***evolutionary arms race*** and ***line of defence***. ***Recruitment*** activates the generic dynamic mental image of a group of organisms that increases as new organisms join them. The specific details of this image largely depend on the context in which the metaphor is embedded. For instance, the recruitment of individuals of the species *Engraulis encrasicolus,* which is a type of anchovy, evokes a different mental image from that evoked by the recruitment of individuals of the species *Labidocera scotti,* a kind of marine planktonic copepod (i.e. a small crustacean).

A second factor constraining and modelling the mental image activated is encyclopaedic meaning. According to Lakoff and Johnson (1999: 69), a metaphorical word "is not just a linguistic expression of a metaphorical mapping, but the linguistic expression of an image plus knowledge about the image plus one or more metaphorical mappings". Thus, the mental image of the recruitment of anchovies evoked by an expert in marine biology is certainly richer than that evoked by a layman. However, it is also true that cognitive patterns give priority to the objective aspects of images rather than to their subjective implications (Dewell 2005: 386).

Moreover, culture, as a specific type of contextual factor, also has a decisive role in forming conventional rich images, which "appear to be pretty much the same from person to person in the same culture" (Lakoff 1987: 450). However, when cultures differ, so do images. Consequently, when a European biologist builds a mental image of the recruitment of anchovies, in all likelihood the image brought to mind is that of an anchovy of the species *Engraulis encrasicolus*, most frequently found in the Mediterranean Sea. The physical features of this species of anchovy are different from those of the species *Encrasicholina heterolobus,* which inhabits the Indo-Pacific region. A biologist from Australia would probably activate an image of this species of anchovy, when he or she is thinking about *recruitment*.

It can thus be concluded that mental images permeate both resemblance metaphors and non-resemblance metaphors.

4.2.4.2. Similarities between non-resemblance metaphors and resemblance metaphors

The previous section showed that mental images, traditionally associated with resemblance metaphors, have an important role in non-resemblance metaphors as well. In this section we argue that resemblance metaphors also have features that are traditionally considered to pertain exclusively to non-resemblance metaphors.

Conceptual Metaphor Theory has primarily focused on conceptual/conventional metaphors, which emerge from multiple mappings between two content-rich domains of experience. In other words, they have rich knowledge and rich inferential structure (Lakoff and Turner 1989: 91). A great deal of research on such metaphor has led to its application to a wide range of theoretical constructs in Cognitive Linguistics, such as image schemas and neurocomputational and neuropsychological modelling (cf. Dodge and Lakoff 2005; Gallese and Lakoff 2005; Lakoff and Johnson 1999).

Although this work is of undeniable interest, it has also meant that image metaphor has been more or less left out in the cold, and has been regarded as a kind of second-class metaphor. The main reason for this is that image metaphor is regarded by Lakoff and others as a fleeting kind of metaphor with an impoverished inner structure (Lakoff 1987, 1993; Lakoff and Turner 1989). Grady (1999: 91) also highlights the lack of entrenchment of resemblance metaphors: “resemblance is not the basis for the sorts of entrenched mappings which prompted the development of conceptual metaphor theory”. For this reason, Conceptual Metaphor Theory has traditionally limited the treatment of image metaphors in particular and of resemblance metaphors as a whole to literature and poetry within *Cognitive Poetics* (cf. Gavins and Steen 2003; Lakoff 1993; Lakoff and Turner 1989; Stockwell 2002; Turner 1996).

Nevertheless, in recent years there has been a renewed interest in resemblance metaphor. Corpus-based research both in general language (Deignan 2007) and specialised discourse (Caballero 2003ab, 2006 in architecture) shows that resemblance metaphors are well-established, conventional metaphors that arise from enduring and productive patterns of figurative thought, and that they are not only subscribed to literature, but also to general and specialised language.

For example, our corpus-based research in marine biology shows that certain well-entrenched resemblance metaphors designating marine organisms in English and

Spanish can be brought together under productive, encompassing metaphors. Accordingly, terms found in our corpus, such as *elephant seal*/*elefante marino* (*Mirounga*), *seahorse*/*caballito de mar* (*Hippocampus*), *sea lion*/*león marino* (*Otariidae*), *spider crab*/*cangrejo araña* (*Maiidae*) and *wolffish*/*pez lobo* (*Anarhichas lupus*), can be subsumed by the general metaphor SEA ANIMALS ARE LAND ANIMALS.

Another such metaphor is MARINE ORGANISMS ARE WORKERS, which stems from the multiple-correspondence process involving metaphorical terms such as *surgeonfish*/*pez cirujano* (*Acanthuridae*), *pilot fish*/*pez piloto* (*Naucrates ductor*), *fiddler crab*/*cangrejo violinista* (*Uca*), and *monk seal*/*foca monje* (*Monachus*). Further English terms that can be encompassed by this general metaphor are *anglerfish* (*Lophius*), *harvestfish* (*Peprilus alepidotus*), *by-the wind sailor* (*Velella spirans*), *nurse shark* (*Ginglymostoma cirratum*), *fat innkeeper worm* (*Urechis*), and *rock cook* (*Centrolabrus exoletus*)[51].

The possibility of being subsumed by an encompassing metaphor also concerns resemblance metaphor terms designating body parts of sea organisms. Based on terms extracted from our corpus, such as *chamber*/*cámara*, *cranial vault*/*bóveda craneana*, *floor*/*piso*, *vertebral column*/*columna vertebral*, *partition*/*tabique*, *wall*/*pared*, and *zygomatic arc*/*arco zigomático*, it can be stated that THE BODY STRUCTURES OF MARINE ORGANISMS ARE BUILDING STRUCTURES, or that MARINE ORGANISMS ARE BUILDINGS. Likewise, terms such as *atrial branch*/*rama atrial*, *branchial leaf*/*hoja branquial*, *dental root*/*raíz dental*, and *trunk*/*tronco* suggest that BODY STRUCTURES OF MARINE ORGANISMS ARE PLANT PARTS or that MARINE ORGANISMS ARE PLANTS.

Still another aspect that places resemblance metaphors on the same level as non-resemblance metaphors is that resemblance metaphors meet the two generalisation principles proposed by Lakoff (1993: 209) for non-resemblance metaphors, namely, the polysemy generalisation and the inferential generalisation. According to the polysemy generalisation, certain linguistic expressions of the source domain acquire related senses.

For example, terms like *thresher* and *sponge* have two or more senses, one of which refers to marine organisms. The main sense of *thresher* refers to a man who threshes the grain by beating it with a flail (a long, thin tool). In marine biology, a thresher is a shark of the genus *Alopias*. The metaphorical motivation is resemblance in both shape and

[51] As shown in § 4.2.3.3., the resemblance metaphors involving fictive dynamicity can also be subsumed by a more general metaphor (i.e. FORM IS MOTION).

behaviour. Regarding shape, the shark's abnormally long, thin, caudal fin looks like a flail, and insofar as behaviour is concerned, the shark uses its flail-like fin to strike its preys and daze them.

In the case of *sponge*, the central meaning of the concept is the marine biology sense. Sponge refers to a marine invertebrate animal of the phylum *Porifera*, characteristically having a porous skeleton composed of fibrous material or siliceous or calcareous spicules. The metaphorical sense of *sponge*, namely, porous plastics, rubber, cellulose, or other material chiefly used for washing, bathing, and cleaning, arises on account of physical resemblance because the porous structure of this object looks like the skeleton of the marine organism.

By virtue of the inferential generalisation, "each mapping defines an open-ended class of potential correspondences across inference patterns" (Lakoff 1993: 10). This is true for metaphors in the domain of marine biology because new species are continually being discovered. Such species are usually given metaphorical names that fit into existing metaphorical systems within the domain, and thus increase the number of cross-domain correspondences and mappings that characterise a given resemblance metaphor. This capacity to infer, which emerges from the topological or gestaltic structure of conceptual (as opposed to *linguistic*) metaphors (Lakoff and Johnson 1980), follows a robust domain logic to create terms for marine organisms, as well as other terms.

Accordingly, surgeonfish have *scalpels*; anglerfish use *bait*; harvestfish *harvest* food for survival; pilotfish usually *travel* together with sharks (see picture in Table 29 in Appendix I); a burrow of innkeeper worms is occupied by several *commensals*; and the common eagle ray (*Myliobatis aquila*) swims by flapping its *wings*. These examples clearly reflect the role played by visually-biased figurative language as an efficient instrument to organise thought through prolific inferential processes and evaluation (Caballero 2006: 3). More concretely, these examples show the importance of visual thinking in the creation of conceptually rich domain knowledge, which is enhanced by the high number of systematic cross-domain correspondences.

In this respect, the difference between both classes of metaphors lies in the type and nature of mappings involved since both have multiple mappings as well as polysemic and inferential conditions.

4.2.4.3. Mental images in primary metaphors and correlation metaphors

Grady (1999: 87) highlights the role of imagery in primary metaphors:

> Quantity, desire [...] may take place at the level of cognition whose operation is not directly accessible to consciousness. In order to manipulate them at the conscious level it may be necessary to tie these elements of mental experience to specific sensory images.

Grady (1997a: 100) affirms that the direct bodily basis of primary source concepts is processed in our brains in the form of images (*image content*), which are paired to target concepts to build *primary scenes*, viz. "simple aspects or dimensions of subjective experience, not confined to any particular rich domain, but cross-cutting these domains". Primary scenes are further divided into *subscenes*, which are "distinguishable dimensions of recurring, locally defined experiences types" (Grady and Johnson 2002: 540). Although he states that primary scenes are not necessarily fleshed out by rich content, at the same time, he holds that primary scenes are local structures, motivated by particular moments in our experience. He thus argues for the participation of down-to-earth conceptual structure in the source domain that cannot be as abstract as image schemas[52]. This conceptual structure would therefore have a greater level of specificity than image schemas, and illustrate the need of our cognitive system to resort to more or less specific images when constructing (metaphorical) meaning. Grady's view is likewise endorsed by Lima (2006: 115):

> For instance, all cases of containers can be included in the image schema of a container, but each case may involve many primary scenes, such as (a) *going into a room* or (b) *taking something out of a box*, which can generate distinct metaphors. Even if we can have a schematic mental representation that is abstract enough to include all cases, the experiences that generate the metaphors do not seem to be the same in all of them. For example, in scene (a) *going into a room*, we experience going into spaces with certain characteristics and certain limits; in (b) *taking something out of a box*, we experience interacting with a container and its contents.

[52] Far from criticising image schemas, we are underlining the important role of images in metaphorical thought that is not resemblance-based.

It could be argued that high-level primary metaphors such as ORGANISATION IS PHYSICAL STRUCTURE are not based on images of a specific type. However, we should not forget that these are metaphorical formulations, namely, abstractions or generalisations of concrete linguistic and environmental situations. As research shows, language processing draws on location-specific perceptual images of entities and their attributes (Bergen, Lindsay, Matlock and Narayanan 2007: 734). Therefore, we can only have mental images of more or less specific types of physical structure (e.g., solids, liquids, etc.) if the abstraction is substantiated and situated. Evidently, the more information that we have about an entity, the richer its mental image will be. Moreover, “mental images are generated by assembling the parts of the image one part at a time” (Gibbs and Colston 2006: 247). In other words, we can speak of a procedural representation, in which the mental image of an entity is not built all at once, but rather sequentially by scanning its parts. It is our claim that mental images rather than solely image schemas are often the grounding for both resemblance metaphor and non-resemblance metaphors.

According to Grady (1997a), primary metaphors differ from resemblance metaphors in that primary metaphors involve what he calls ***experiential correlation***, which consists of establishing a strong conceptual link between two events that iteratively co-occur. This phenomenon usually gives rise to conceptual metaphors because after repeated co-occurences in our experience of the world, we come to conceive one event in terms of another. This evidently makes correlation metaphors different from resemblance metaphors.

These are basic correlation-induced physical experiences are generally recurring events throughout our life. For instance, the experience of one’s body moving through space generates the metaphor ACTIONS ARE SELF-PROPELLED MOTIONS and expressions, such as *I am moving right along on the project* (Lakoff and Johnson 1999: 52). This expression is linked to the dynamic image of us moving through space.

Since experiential correlation underlying primary scenes always implies a cause-effect event (“causation is a phenomenon which inheres in all sorts of scenes which we participate in”, Grady and Johnson 2002: 548), it could be assumed that the retrieval of dynamic mental images for primary metaphors is at the centre of this process. Thus, what Grady and Johnson (2002) call the ***temporal locality*** of primary scenes is often dynamic in nature. As they put it, “[...] as experience-types and dynamic conceptualisations, they [primary scenes] can unfold in their entirety over a very short time span – speaking intuitively, these experiences can be registered in an instant" (Grady and Johnson *ibid.*: 544).

However, this is not always the case, because "primary scenes and subscenes [...] need not have natural endpoints or culminations, and they need not be instantaneous (or "punctual") events. In fact, they need not involve change over time" (Grady and Johnson *ibid.*). In this regard, the range of sensorimotor domains activated in primary metaphors also includes static experiences, involving domains such as temperature (AFFECTION IS WARMTH), size (IMPORTANT IS BIG), location (STATES ARE LOCATIONS) and physical configuration (UNINTERESTING IS FLAT)[53].

To sum up, although the mental images triggered by the subscenes giving rise to any of these primary metaphors could be temporally bound, "there is no change to register, no complex sequence of states or events involved" (Grady and Johnson 2002: 545).

4.2.4.4. Similarities and differences between correlation metaphors and resemblance metaphors

As explained in § 1.3.2., Grady (1997ab, 1999) claims that two *separate* experience-based cognitive operations that give rise to metaphorical conceptualisation are resemblance and experiential correlation — the latter exclusively associated with primary metaphors. Experiential correlation is grounded in our sensory-motor experience. For example, the metaphor MORE IS UP is based on the correlation between QUANTITY and HEIGHT, which is evidenced when we say that we pile *up* books on a table. This metaphorical process is related to what Lakoff and Johnson (1999: 216) call ***epistemic causation***, viz. "deducing the existence of causation in the world from evidence proceeds from knowledge of the effect".

This cause-effect correlation can be experienced by our bodies through *direct* interaction with entities around us. In the field of marine biology, we have found resemblance metaphors based on cause-effect relationships, rather than physical similarity. The reliance on the cause-effect schema thus brings this type of resemblance metaphors close to correlation metaphors. In resemblance metaphors of this kind, the two entities involved share some facet of their behaviour or function (in the case of the source concept). In the case of the sea nettle, this property is a defence mechanism

[53] See Grady (1997a) for an overview of other primary metaphors, or Lakoff and Johnson (1999: 50–54), who also provide an inventory.

shared by both the plant and the marine organism. The experience involves a cause-effect experience of touching a nettle/sea nettle (cause/stimulus) and the subsequent perception of an itchy sensation (effect/response)[54].

As can be deduced from the sea nettle example, resemblance and experiential correlation can sometimes jointly contribute to the creation of metaphorical concepts. We argue that both cognitive operations are not incompatible and can simultaneously be at work in the metaphorisation of marine biology concepts, i.e. these two cognitive operations are interdependent.

The example of the sea nettle is a cause-effect metaphor that highlights active (kinaesthetic) sensorial experience, i.e. direct interaction. However, there are also cases in which cause-effect events are backgrounded because passive (visual or auditory) experience is primed. For example, the term ***ghost crab,*** which is based on a resemblance metaphor, only implies the visual experience of a motor action. The ghost crab (*Ocypode*) receives its name because of its ability to disappear from sight almost instantly by sprinting and scuttling at speeds up to 10 miles per hour while making sharp directional changes. This crustacean behaves this way when it establishes visual contact with a potential predator (correlation or cause-effect event).

Consequently, marine biology resemblance metaphors could be classified in terms of the sensorimotor experiences that the terminological designations are based upon. The specification of the motivations for metaphorical transfer is essential for a clear classification of resemblance metaphors. Grady (1999: 98) acknowledges that an in--depth analysis is needed in order to further refine the different types of metaphor by carefully considering the motivations for these metaphors. This emphasises the

[54] Ruiz de Mendoza and Peña (2005: 259–260) also discuss a metaphor which combines comparison (or contrast) and correlation: *Journalists dug up some interesting facts.* Journalists *behave* like treasure hunters and archeologists in that both search for valuable things (news and treasures/archeological remains, respectively), which licenses the metaphor INVESTIGATING (A PROBLEM) IS EXPLORING (A LANDSCAPE). Thus, this metaphor arises from comparison in behaviour. At the same time, the correlation metaphor KNOWING IS SEEING, which is based on the primary scene of getting information through vision, supports the metaphor INVESTIGATING (A PROBLEM) IS EXPLORING (A LANDSCAPE). What makes this metaphor different from the marine biology metaphors analysed is that the journalist metaphor is lexicalised not as a terminological unit but as a sentence in general language.

This fact also provides evidence of the conceptual dimension of behaviour-based metaphors, which can readily be subsumed under formulations such as the abovementioned.

significance of our embodied conceptualisation system, which licenses the formation of any type of metaphor on the basis of mental images, and involves all manner of sensorimotor experiences.

Cause-effect structure can also be at work in resemblance metaphors where behavioural comparison operates together with physical comparison. This is the case of the ***cookie-cutter shark*** (*Isistius brasiliensis*). This shark remains motionless at the sea bottom while its body emits a vivid, greenish phosphoresecent gleam, except for a black band around its throat. The prey of this shark is usually large fast-swimming fish. They are lured by what appears to be the silhouette of a small fish, which is actually the shark's non-luminiscent black collar (see Figure 37, extracted from the journal *Environmental Biology of Fishes*, 53(3), 1998, pp. 267–273)). The shark behaves like a cookie-cutter in that once it has locked onto its lured prey (cause), the shark extracts cookie-shaped plugs of flesh (physical resemblance) from the victim (effect).

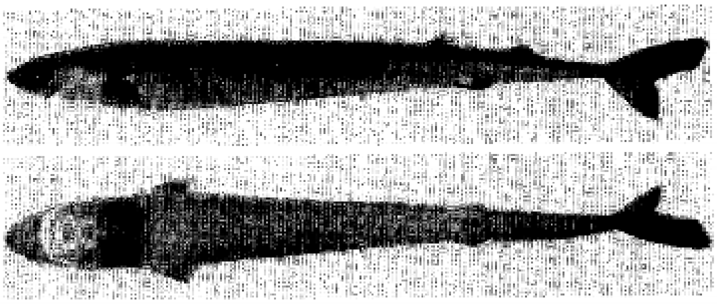

Figure 1. The bioluminescent shark, *Isistius brasiliensis*, showing the darkly pigmented 'dog collar' under the jaw. Approximate length, 50 cm (reproduced with permission from Tinker 1978).

Figure 37. The darkly pigmented collar of the cookie-cutter shark (*Environmental Biology of Fishes*).

Another aspect shared by experiential correlation in the sea nettle metaphor and experiential correlation in primary metaphors is causal simplicity, which is another identifying property of subscenes in primary metaphors (Grady and Johnson 2002: 545). Grady and Johnson (*ibid.*: 546) describe the physical basis of the UNDERSTANDING IS SEEING metaphor (Lakoff and Johnson 1980; Sweetser 1990) to explain how causal simplicity operates:

> Light carrying the information of a visual scene hits the retina and the scene enters the seer's consciousness. This event can be construed as an instance of physical causation or of affective causation because the person who sees can be construed either as a physical or a sentient being. A cause in the physical subscene has an

> effect in both the physical and the mental subscenes. Therefore the mental subscene has the same temporal structure as a simple physical event by virtue of being causally connected to a simple physical event.

The schema in Figure 38 shows the temporal correlation between the perceptual subscene and the cognitive subscene, which are both linked by the same simple physical cause event.

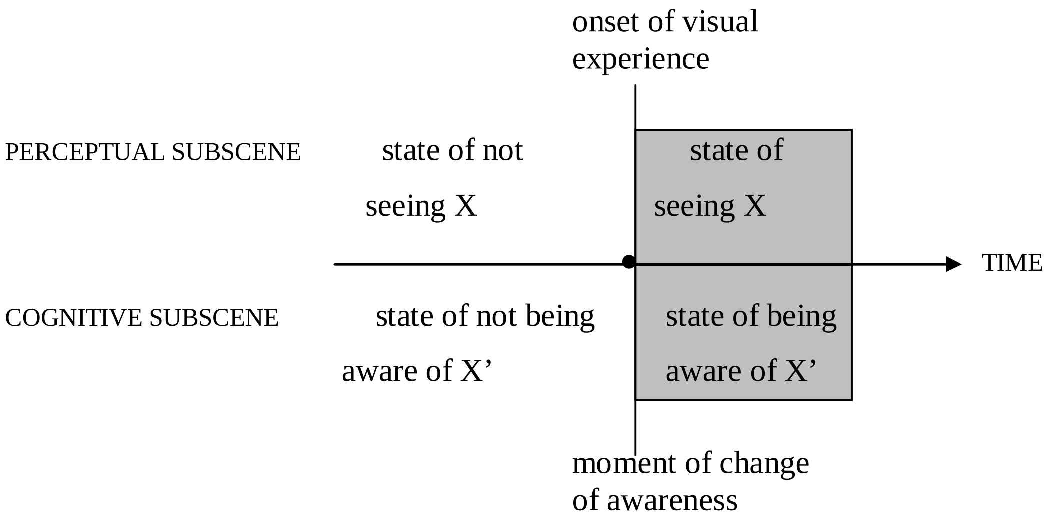

Figure 38. Primary scene: Becoming aware by seeing (Grady and Johnson 2002: 541).

The emergence of the figurative mental image retrieved by the subscenes of the sea nettle metaphor is shown in the diagram in Figure 39.

As with the UNDERSTANDING IS SEEING metaphor, the sea nettle metaphor is based on a simple correlation or cause-effect event in which the person that is touched by this jellyfish can be construed as either a physical or sentient being. The correlation also arises from the interplay of the subscenes of perception and cognitive awareness.

It should be noted that correlation in resemblance metaphors, while also entailing a cause-effect schema[55], differs from correlation in primary metaphors in that in primary metaphors there is correlation between the source concept and the target concept. In other words, the source has a bearing on the target. Such source-target correlation does not exist in resemblance metaphor. For instance, in the sea nettle metaphor, the

[55] Correlation is not exclusively a matter of cause-effect links. In fact, Radden (2002: 414) argues that there are positive correlations, which tend to evoke a causal interpretation, and negative correlations, which do not invite a causal interpretation. However, in dealing with metaphor, we bind correlation to cause-effect structure because cause-effect correlation (i.e. positive correlation) is the only type of correlation that pertains to metaphor (Radden 2002: 414).

correlation between the hand touching the sea nettle (marine organism) or nettle (plant), and the resulting painful sensation is limited to either the source or the target. In other words, there is no co-occurrence of the events of touching the marine and the non-marine nettle, but only a resemblance between the overall cause-effect structure of source and target.

What occurs in resemblance metaphors of this kind is that the type of correlation operating in the source concept is mapped onto the target concept. This mapping is sanctioned by the nature of the experience, which is the motivation for the correlation in the target concept. Accordingly, the stinging plant is an appropriate source for the sea nettle because the former does not violate the conceptual topology of the latter (Invariance Principle), and both share their overall cause-effect structure. In this way, the source helps to activate relevant aspects of the target, and even allows the perceiver to infer other properties about it.

Still another difference between resemblance metaphors grounded in a cause-effect schema and correlation metaphors is the metonymic nature of the latter. The prototypical example which illustrates this claim is the MORE IS UP metaphor. Radden (2002: 414) writes:

> In order to correlate two variables, they have to be conceptually contiguous. The correlation of quantity and verticality provides a perfect example of conceptual contiguity in that both variables originate from the same experiential basis.

Radden argues that the metonymic grounding of correlation metaphors is based on a continuum ranging from literalness via metonymy to metaphor. This process ties in with the notions of *conflation* and *deconflation*, as well as the developmental model of primary scenes, which gives rise to primary metaphors (Grady 1997). The metaphor MORE IS UP comes into its own in four stages. The first stage involves UP being literally conceptualised. At the second stage, the variable or dimension ***quantity*** is conceptualised through partial metonymy (UP FOR UP). At the same time, ***quantity*** is linked to the dimension ***verticality*** by means of the experiential basis of conflation (i.e. UP + MORE). Conceptual conflation takes place in primary scenes, such as seeing the level of fluid in a container go up when more fluid is poured into it. As Radden (2002: 10) points out, the two manifestations of this highly frequent scene, rise of level and rise of quantity, occur simultaneously and are intimately correlated. The third stage is deconflation, whereby UP and MORE become a full metonymy (i.e. UP FOR MORE). At the final stage of the continuum, this full metonymy becomes the primary metaphor MORE IS UP. Thus, it can be stated that the immediate basis of primary metaphors is metonymic.

Radden (2002: 414) further states that the causal relation between quantity and verticality strengthens the metonymic basis of both these variables and licenses the reversibility principle of metonymic relationships, according to which “the flow of causation may be seen in either direction: ‘something is more *because* its level is higher’ or ‘the level is higher *because* its quantity is more’”. In contrast, the pairs of cause-effect correlations that give rise to resemblance metaphors such as *sea nettle* occur independently (one pair in the source domain and another pair in the target domain). Thus, they are not contiguous, which is the essential feature of metonymic mappings.

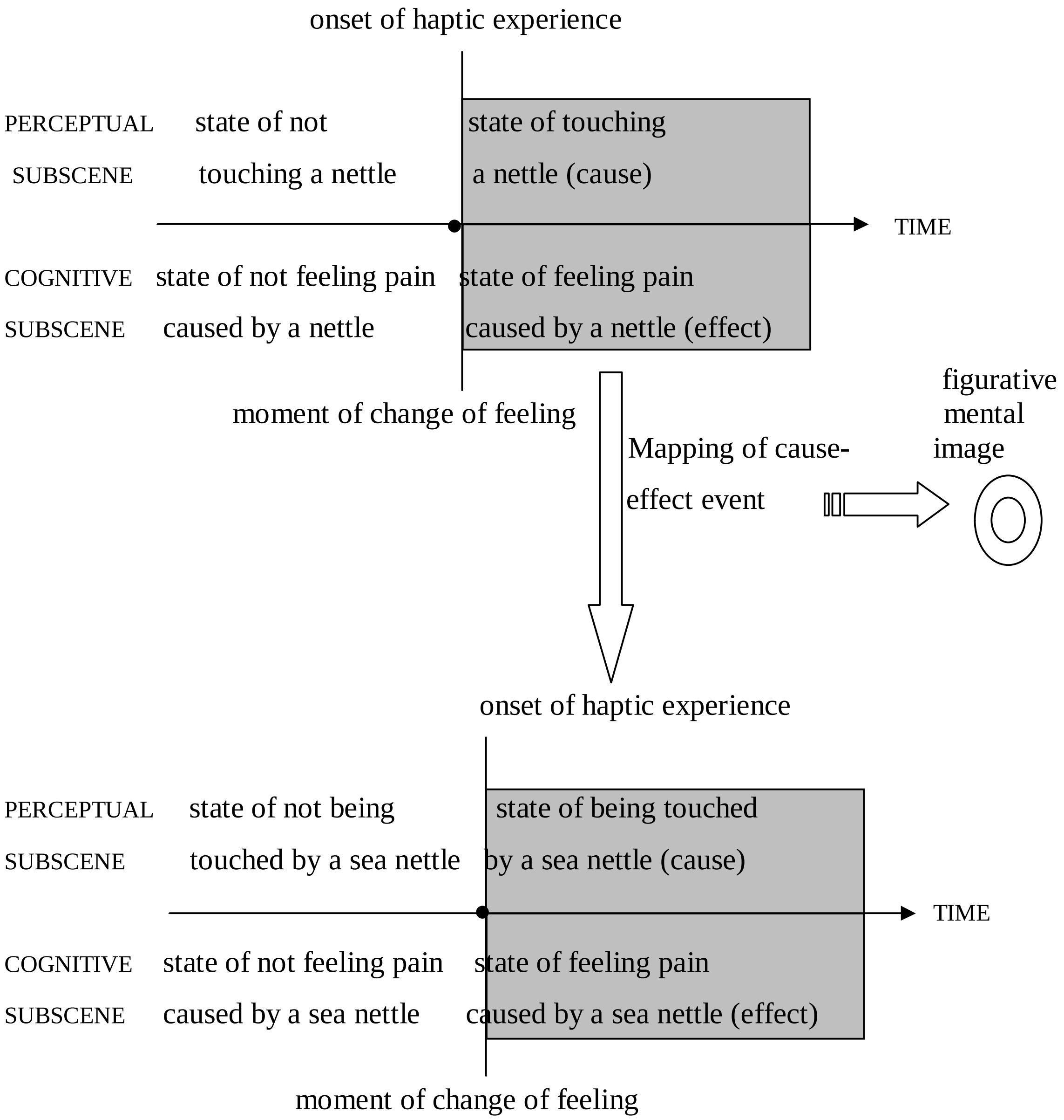

Figure 39. Mapping of correlation that produces the sea nettle metaphor.

5. CONCLUSIONS

5.1. Observational analysis

Apart from manual searching, the observational analysis carried out in this research study drew on three of the strategies traditionally used to semi-automatically retrieve metaphorical units in corpora: (i) searching for source domain keywords; (ii) searching for target domain keywords; and (iii) searching for lexical markers of metaphor.

Our study is innovative because it analyses terminological metaphor in a naturally-occurring corpus of texts from a cross-linguistic perspective, and applies a systematic and time-efficient method of identifying metaphorical terms in corpora. Earlier corpus-based studies of terminological metaphor (e.g. Alexiev 2005; Caballero 2006) do not propose a method of this nature, and some of them do not even analyse metaphorical terms in discourse, but rather isolated instances extracted from specialised dictionaries and glossaries (e.g. Alexiev 2005). Our method was extremely productive and reliable since it detected resemblance metaphor terms in English and Spanish as well as interlinguistic term pairs in the marine biology corpus. It should be highlighted that the advantages of the strategies used for semi-automatic term retrieval not only lie in their potential to yield reliable results, but also in the fact that the size of the corpus can be increased without these strategies losing their effectiveness.

In the first phase, the corpus was searched for source and target domain terms as well as for lexical markers that are indicative of metaphors. The combination of these search strategies for metaphor extraction resulted in a set of English-Spanish term pairs. After analysing and comparing these metaphors, a quantitative analysis was performed, which involved annotating the corpus manually. The quantitative results showed that our annotation system is more time-efficient than manual searching, and confirmed the potential of combining the abovementioned strategies to discover metaphorical terms. The quantitative analysis complemented the qualititative results since it revealed interlinguistic term pairs that had not been detected previously. It also provided valuable statistical information regarding cross-linguistic terminological metaphor, an area in which such data are virtually non-existent.

Two types of metaphor were identified in the specialised corpus: resemblance metaphor and non-resemblance metaphor. Resemblance metaphors can be divided into those designating sea organisms and those designating body parts of sea organisms. The number of resemblance metaphor terms in the corpus is 49,004 (32,247 designating sea organisms + 16,757 designating body parts), and that of non-resemblance metaphors is 45,173. This makes 2.06% (0.70% sea organism metaphors + 0.37% body part metaphors + 0.99% non-resemblance metaphors). Although this percentage is not high, it is sufficiently indicative of the great potential of metaphor to model scientific thought both in English and Spanish.

The two subtypes of resemblance metaphors are rendered by terminological nouns, the grammatical form that turned out to be most represented in the corpus. This corroborates Goatly's (1997: 84) observation that nouns, referring directly to things [physical entities], can more directly evoke images than other parts of speech since the meaning of nouns is conceptualised as bundles of semantic features.

A method based on three strategies was proposed to verify the metaphorical nature of term candidatess. The first strategy was an adaptation of the MIP (Pragglejaz Group 2007) to the domain of marine biology. It involved the consultation of dictionaries and other resources containing encyclopedic information. The second strategy entailed the analysis of contextual data extracted from the corpus, and the third involved the analysis of visual images from the journal articles consulted, an online marine biology database, and from the Google search engine.

The following types of metaphorical motivation were identified in the marine resemblance metaphors:

- Resemblance to inanimate entities (object-like): shape, position, colour, size, type of material, and function.
- Resemblance to animate entities (human-like, animal-like, plant-like): shape, position, colour, size, type of material, and habits/behaviour.

These motivations are not exclusive of one another since there are also cases in which two or even three of them are combined to give rise to a terminological metaphor (for instance, shape plus colour, shape plus behaviour, and shape plus colour plus behaviour).

Shape was the most frequent motivation both in English and Spanish, behaviour stands in the second place, closely followed by colour. Combinations of motivations were also recurrent, being the pair shape/position the most frequent because of the dependency of position on shape. Combinations of behaviour and shape (and colour) are the least frequent in both languages because they feature complex patterns, which cannot always be combined in the metaphorical conceptualisation.

Concerning non-resemblance metaphors, the corpus data showed that non-resemblance metaphors can be rendered not only by nouns, but also by verbs, and adjectives. They can be encompassed by four macro-metaphors, which are MARINE HABITATS ARE COMMUNITIES, MARINE COMMUNITIES ARE STRUCTURES THAT COMBAT OTHERS FOR SURVIVAL, MARINE PROCESSES ARE CIRCLES, and SEA ACTIVITIES ARE ECONOMIC AND BUSINESS AFFAIRS. In both languages, the most frequent of all was the metaphor MARINE HABITATS ARE COMMUNITIES (9,267 in the English subcorpus and 8,909 in the Spanish one), whereas the CIRCLE metaphor was the least frequent (2,047 in English and 2,063 in Spanish).

Four types of interlinguistic term pairs were extracted for both resemblance and non-resemblance metaphors: (i) exact pairs (both terms are based on the same conceptual metaphor); (ii) separate pairs (the two terms are based on different conceptual metaphors); (iii) partial pairs (the two terms are based on the same conceptual metaphor, but one of them focuses on a more or less specific/generic aspect of the source conceptual domain than the other term does); and (iv) unbalanced pairs (only one of the terms is metaphorical).

From a cross-linguistic perspective, the statistics showed that the metaphorical motivations are evenly distributed across the two languages, with a higher number of terms in English because of the scarcity of Spanish metaphorical terms in the unbalanced pairs. In fact, the numerical data showed that English is more prone to conceptualising marine organisms metaphorically than Spanish. Exact pairs were the most frequent type (100 resemblance metaphor pairs and 87 non-resemblance metaphor pairs), which signifies that English- and Spanish-language scientists tend to conceptualise marine biology entities in the same way. The number of separate pairs was also significantly high in resemblance metaphors (26), which bespeaks the claim that conceptualisation (through metaphor) across languages yields differences in specialised discourse as well. In contrast, separate non-resemblance metaphor pairs were not detected in the corpus. The interlinguistic pairs were proportionately distributed across the four macro-metaphors. Accordingly, MARINE HABITATS ARE COMMUNITIES is the metaphor that included the highest number of pairs (36), whereas the CIRCLE metaphor included the lowest (10).

The corpus provided mounting evidence of the incidence of soci-cultural factors in the (metaphorical) conceptualisation of specialised referents, which cam give rise to inter-linguistic differences. Regarding resemblance metaphors, we established a dichotomy between culture-specific metaphors and culture-typical metaphors. In culture-specific metaphors, the source-domain concept is *solely* found in, i.e. is unique to, the expert community where such concept occurs. Culture-typical metaphors feature concepts typical — though not exclusive — of their corresponding community of speakers.

Empirical evidence was found of the existence of intralinguistic synonyms both in English and Spanish and in both resemblance and non-resemblance metaphors. This disproves the frequent assumption that scientific discourse is exempt of synonymy and terminological variation.

5.2. Introspective analysis

It has been shown that the corpus data support the cognitive claims about metaphor description and the status of corpora as a legitimate means to explore (metaphorical) thought (Deignan 2005a; Stefanowitsch and Gries 2006). Specifically, the metaphorical terms retrieved from the marine biology corpus reflect aspects of cognitive organisation and representation, thus giving insights into the conceptual level of the symbolic area of metaphor analysis.

Within the category of resemblance metaphors there are certain very clear examples of image metaphors and behaviour-based metaphors. Prototypical image metaphors are based on visual stimuli in the form of static images. In contrast, prototypical behaviour-based metaphors are based on motion and dynamicity. However, other resemblance metaphors do not clearly belong to one category or the other. In our opinion, resemblance metaphor is a graded category, in which members are better or worse exemplars, based on the static or dynamic nature of the mental images underlying them. In other words, image metaphors and behaviour-based metaphors can be differentiated in terms of their degree of dynamicity. The existence of resemblance metaphors which combine behaviour and shape and/or colour seems to point to the need for a new, more refined classification.

Evidence from specialised fields, such as architecture and marine biology, shows that there is a more complex type of resemblance metaphors that are grounded in fictive dynamicity. Such dynamicity answers psychological strategies rather than reflects the actual state of affairs. In this case, it is the boundaries between static structure and dynamic structure that are fuzzy.

Recent corpus-based research shows that resemblance metaphors and non-resemblance metaphors share features, which up until now have been attributed exclusively to non-resemblance metaphor. The reason for this is the nature of mental imagery, which is an integral part of every stage of metaphor formation. For example, certain clusters of marine biology resemblance metaphors have shown to have logical inner structure, with metaphorical terms arising from previous ones. This enabled us to generate conceptual metaphors, such as MARINE ORGANISMS ARE WORKERS and MARINE ORGANISMS ARE BUILDINGS, by analysing groups of cases to decide for each group what can be inferred about their conceptual structure.

The hurdles posed in studies that aspire to take account of behavioural aspects of metaphor in general language are pretty much the same as those in all fields of expertise. In a general respect, Steen (2007: 106) highlights that “there is no guarantee that people have adequate insight into their own behavior (production, comprehension, acquisition, storing)”. We are aware that “cognitive-linguistic aspirations to behavioral adequacy are largely based on symbolic analyses of linguistic forms and conceptual structures, which is a matter of concern and criticism in psycholinguistic circles” (Steen 2007: 391). For this reason, the claims made in this section are undoubtedly in need of further empirical demonstration. (In fact, a near future line of investigation is to test the claims made in this research study against different psycholinguistic experiments with biologists as well as with translation and English language university students.) Nevertheless, we consider the introspective study presented to be a mild form of qualitative data analysis of terminological metaphor in both language and thought since our conclusions, though explanatory in nature, are testable through experimental research both in observation and manipulation environments.

Finally, our account of terminological metaphor in marine biology essentially follows the tenets of Conceptual Metaphor Theory — apart from some assumptions of Blending Theory. However, in our view, we can be sure that a metaphorical linguistic expression is metaphorically processed in the minds of language users only when its corresponding concept has just been created (i.e. when it is a novel metaphor) or a specific language user initially learns of it and uses it for the first time. The same can be affirmed when a metaphorical expression is conventionalised. In specialised knowledge, metaphor occurs as a behavioural process and product when (i) experts create a novel concept out of direct analogy between two entities; (ii) experts propose a metaphorical alternative to a cryptic term that ends up becoming a terminological unit; (iii) laymen have access to a metaphorical term for the first time. Only in such cases can we be sure that there is a direct relation between the conceptual structure of idea systems as revealed by cognitive-linguistic analysis on the one hand, and cognitive processes and their products, cognitive representations, as revealed by behavioural research on the psychology of language on the other.

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APPENDIX I

TABLES WITH RESEMBLANCE METAPHOR TERMS AND PICTURES OF THEIR CORRESPONDING SEA ORGANISMS

Tables 29 and 30 show the marine biology resemblance metaphors discussed in the introspective analysis section. The metaphors in Table 29 represent separate, clear-cut categories, and are either image metaphors or behaviour/function-based metaphors. In contrast, Table 30 contains resemblance metaphors that are based both on behaviour/function and physical appearance. Pictures are provided to help understand the motivation for metaphorical transfer.

	Metaphorical term	**Type of metaphorical motivation**	**Picture**
IMAGE METAPHORS (MOTIONLESS MENTAL IMAGES)	Seahorse	Shape	 [56]
	Milkfish	Colour	 [57]

[56] Picture provided at www.divegallery.com/seahorse_page1.htm. Last access 21 May 2009.

[57] Picture provided by Bryan Harry at http://www.nps.gov/archive/npsa/NPSAfish/fish_pops/chanidae/milkfish01.htm. Last access 21 May 2009.

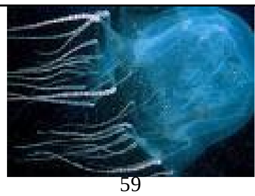
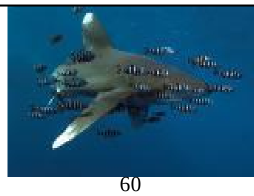
	Metaphorical term	Type of metaphorical motivation	Picture
	Sea lettuce	Shape + colour	 [58]
BEHAVIOUR/FUNCTION-BASED METAPHORS (DYNAMIC MENTAL IMAGES)	Sea wasp	Behaviour	 [59]
	Pilot fish	Behaviour	 [60]
	Archerfish	Behaviour + Function	 [61]
BEHAVIOUR-BASED METAPHOR (MOTIONLESS MENTAL IMAGE)	Hawkfish	Behaviour	 [62]

Table 29. Resemblance metaphors that are either image metaphors or behaviour/function-based metaphors.

[58] Picture provided by Guy Werner at http://home.vicnet.net.au/~earthcar/sgreport2.htm. Last access 21 May 2009.

[59] Picture provided by Dr. Zoltan Takacs at http://zoltantakacs.com/zt/pw/in/album.php?idx=18. Last access 21 May 2009.

[60] Picture provided by Eric Orchin at http://photo.net/photodb/photo?photo_id=5270518. Last acces 21 May 2009.

[61] Picture provided by Stefan Anitei at http://news.softpedia.com/images/news2/Archerfish-Tunes-its-Shot-Power-to-the-Prey-Size-2.jpg. Last access 21 May 2009.

[62] Picture provided by Mark Pidcoe at http://week.divebums.com/2006/Nov06-2006/index.html. Last access 21 May 2009.

	Metaphorical term	Type of metaphorical motivation	Picture
METAPHORS BASED ON DYNAMIC MENTAL IMAGES	Chameleon fish	Behaviour + Colour	  [63]
	Boxer crab	Behaviour + Shape	 [64]
	Anglerfish	Behaviour + Function + Shape	 [65]

[63] Pictures provided by LA Productions at http://aqualandpetsplus.com/Oddball,%20Badis%20badis.htm. Last access 21 May 2009.

[64] Pictures provided by Linda Johnston at http://www.lembehresort.com/photo_image_pic_boxer_crab_by_linda_johnston_g8m38.html. Last access 21 May 2009.

[65] Picture provided by Bruce Robison/Corbis at http://animals.nationalgeographic.com/animals/fish/anglerfish.html. Last access 21 May 2009.

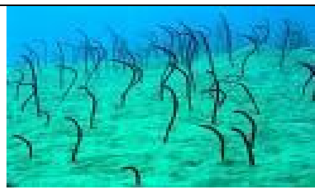
	Metaphorical term	**Type of metaphorical motivation**	**Picture**
	Spanish dancer	Behaviour + Shape + Colour	 [66]
METAPHOR BASED ON A MOTIONLESS MENTAL IMAGE	Garden eel	Behaviour + Shape	 [67]

Table 30. Resemblance metaphors that can be regarded as both image metaphors and behaviour/function-based metaphors.

[66] Picture provided at http://www.oceanwideimages.com/categories.asp?cID=65.

[67] Picture provided by the Gull Dive Center at http://www.gullboatsandrv.com/index.aspx/Dive_Shop. Last access 21 May 2009.

APPENDIX II

DICTIONARIES, ENCYCLOPAEDIAS, AND DATABASES USED IN THIS THESIS

In English

Atlas of Marine Invertebrate Larvae

Encyclopedia of Marine Mammals

Integrated Taxonomic Information System (ITIS) [http://www.itis.gov]

SeaLifeBase [http://www.sealifebase.org/search.php]

Sharks of the World – An Annotated and Illustrated Catalogue of Shark Species Known to Date (volumes 1 and 2)

The American Heritage® Dictionary of the English Language [http://www.thefreedictionary.com]

In Spanish

Diccionario de la Real Academia Española [http://www.rae.es/rae.html]

Diccionario Etimológico de Malacología

Guía de Identificación de los Peces Marinos de Europa y del Mediterráneo

Guía Submarina de Invertebrados no Artrópodos

ACADEMIC JOURNAL ARTICLES USED IN THIS THESIS

ENGLISH-LANGUAGE ARTICLES

Coral Reefs

Recruitment and post-recruit immigration affect the local population size of coral reef fishes (*Coral Reefs*, 16(3), 1997, pp. 139–149)

Analysis of otolith chemistry in Nassau grouper (*Epinephelus striatus*) from the Bahamas and Belize using solution-based ICP-MS (*Coral Reefs*, 18(2), 1999, 171–178)

Corals as light collectors: an integrating sphere approach (*Coral Reefs*, 24(1), 2005, pp. 1–9)

Symbiont diversity in scleractinian corals from tropical reefs and subtropical non-reef communities in Taiwan (*Coral Reefs*, 24(1), 2005, pp. 11–22)

Coral reef distribution, status and geomorphology–biodiversity relationship in Kuna Yala (San Blas) archipelago, Caribbean Panama (*Coral Reefs*, 24(1), 2005, pp. 31–42)

Growth, reproduction and survival of a tropical sea anemone (Actiniaria): benefits of hosting anemonefish (*Coral Reefs*, 24(1), 2005, pp. 67–73)

A model for wave control on coral breakage and species distribution in the Hawaiian Islands (*Coral Reefs*, 24(1), 2005, pp. 43–55)

High densities of the Elkhorn coral *Acropora palmata* in Cayo de Agua, Archipelago Los Roques National Park, Venezuela (*Coral Reefs*, 24(1), 2005, pp. 86)

Evolution of fringing reefs: space and time constraints from the Gulf of Aqaba (*Coral Reefs*, 24(1), 2005, 165–172)

Annual cycle of symbiotic dinoflagellates from three species of scleractinian corals from coastal reefs of northeastern Brazil (*Coral Reefs*, 24(2), 2005, pp. 191–193)

Detriments to post-bleaching recovery of corals (*Coral Reefs*, 24(2), 2005, pp. 230–246)

An evaluation of the antimicrobial properties of the eggs of 11 species of scleractinian corals (*Coral Reefs*, 24(2), 2005, pp. 248–253)

Asexual reproduction does not produce clonal populations of the brooding coral *Pocillopora damicornis* on the Great Barrier Reef, Australia (*Coral Reefs*, 25(1), 2006, pp.7–18)

Coral disease dynamics at a subtropical location, Solitary Islands Marine Park, eastern Australia (*Coral Reefs*, 25(1), 2006, pp. 37–45)

Early life-history dynamics of Caribbean coral species on artificial substratum: the importance of competition, growth and variation in life-history strategy (*Coral Reefs*, 25(1), 2006, pp. 59–71)

Is there a reproductive basis to solitary living versus pair-formation in coral reef fishes? (*Coral Reefs*, 25(1), 2006, pp. 85–92)

Sexual reproduction of Acropora reef corals at Moorea, French Polynesia (*Coral Reefs*, 25(1), 2006, pp. 93–97)

Phytoplankton grazing by epi- and infauna inhabiting exposed rocks in coral reefs (*Coral Reefs*, 25(1), 2006, pp. 153–163)

A modern soft-bottom, shallow-water crinoid fauna (Echinodermata) from the Great Barrier Reef, Australia (*Coral Reefs*, 25(1), 2006, pp. 164–168)

Phage therapy of coral disease (*Coral Reefs*, 26(1), 2007, pp. 7–13)

Spatial variation in sea urchins, fish predators, and bioerosion rates on coral reefs of Belize (*Coral Reefs*, 26(1), 2007, pp. 71–78)

Swimming speed performance in coral reef fishes: field validations reveal distinct functional groups (*Coral Reefs*, 26(2), 2007, pp. 217–228)

Recognition of separate genera within Acropora based on new morphological, reproductive and genetic evidence from *Acropora togianensis*, and elevation of the subgenus *Isopora Studer*, 1878 to genus (Scleractinia: Astrocoeniidae; Acroporidae) (*Coral Reefs*, 26(2), 2007, pp. 231–239)

High apex predator biomass on remote Pacific islands (*Coral Reefs*, 26(1), 2007, pp. 47–51)

Corals in deep-water: will the unseen hand of ocean acidification destroy cold-water ecosystems? (*Coral Reefs*, 26(3), 2007, pp. 445–448)

Real-time PCR reveals a high incidence of *Symbiodinium* clade D at low levels in four scleractinian corals across the Great Barrier Reef: implications for symbiont shuffling (*Coral Reefs*, 26(3), 2007, pp. 449–457)

Footprints on water: the genetic wake of dispersal among reefs (*Coral Reefs*, 26(3), 2007, pp. 463–473)

Genomic and microarray approaches to coral reef conservation biology (*Coral Reefs*, 26(3), 2007, pp. 475–486)

Use of fractal dimensions to quantify coral shape (*Coral Reefs*, 26(3), 2007, pp. 541–550)

Predictability of coral bleaching from synoptic satellite and in situ temperature observations (*Coral Reefs*, 26(3), 2007, pp. 695–701)

Decadal trends in a coral community and evidence of changed disturbance regime (*Coral Reefs*, 27(1), 2008, pp. 1–13)

Cross-shelf variation in the role of parrotfishes on the Great Barrier Reef (*Coral Reefs*, 27(1), 2008, pp. 37–47)

Coral reef benthic productivity based on optical absorptance and light-use efficiency (*Coral Reefs*, 27(1), 2008, pp. 49–59)

Nocturnal relocation of adult and juvenile coral reef fishes in response to reef noise (*Coral Reefs*, 27(1), 2008, pp. 97–104)

Predation risk assessment by olfactory and visual cues in a coral reef fish (*Coral Reefs*, 27(1), 2008, pp.105–113)

Non-kin egg cannibalism and group nest-raiding by Caribbean sergeant major damselfish (*Abudefduf saxatilis*) (*Coral Reefs*, 27(1), 2008, pp. 115)

Coexistence of congeneric spiny lobsters on coral reefs: differences in conspecific aggregation patterns and their potential antipredator benefits (*Coral Reefs*, 27(2), 2008 pp. 275–287)

An alternative to ITS, a hypervariable, single-copy nuclear intron in corals, and its use in detecting cryptic species within the octocoral genus Carijoa (*Coral Reefs*, 27(2), 2008, pp. 323–336)

Re-evaluation of the systematics of the endemic corals of Brazil by molecular data (*Coral Reefs*, 27(2), 2008, pp. 423–432)

Habitat associations of juvenile versus adult butterflyfishes (*Coral Reefs*, 27(3), 2008, pp. 541–551)

Prevalence of virus-like particles within a staghorn scleractinian coral (*Acropora muricata*) from the Great Barrier Reef (*Coral Reefs*, 27(3), 2008, pp. 569–580)

Maintenance of fish diversity on disturbed coral reefs (*Coral Reefs*, 28(1), 2009, pp. 3–14)

Diving behavior and movements of juvenile hawksbill turtles Eretmochelys imbricata on a Caribbean coral reef (*Coral Reefs*, 28(1), 2009, pp. 55–65)

Local variation in herbivore feeding activity on an inshore reef of the Great Barrier Reef (*Coral Reefs*, 28(1), 2009, pp. 127–133)

The influence of colony size and coral health on the occupation of coral-associated gobies (Pisces: Gobiidae) (*Coral Reefs*, 28(1), 2009, pp. 137–142)

Reef habitats and associated sessile-benthic and fish assemblages across a euphotic–mesophotic depth gradient in Isla Desecheo, Puerto Rico (*Coral Reefs*, 29, 2010, 277–288)

Environmental Biology of Fishes

Age, growth and reproductive biology of the silky shark, *Carcharhinus falciformis*, and the scalloped hammerhead, *Sphyrna lewini*, from the northwestern Gulf of Mexico (*Environmental Biology of Fishes*, 19(3), 1989, pp. 161–173)

Nest defense and aggressive interactions between a small benthic fish (the johnny darter *Etheostoma nigrum*) and crayfish (*Environmental Biology of Fishes*, 24(4), 1989, pp. 301–306)

Alternative mating tactics of arctic charr, *Salvelinus alpinus*, in Thingvallavatn, Iceland (*Environmental Biology of Fishes*, 26(3), 1989, pp. 159–176)

An experimental study of factors affecting the distribution of yellow perch and central mudminnows along a species richness gradient (*Environmental biology of Fishes*, 33(4), 1992, pp. 399–404)

Foraging behavior of the scale-eater *Plecodus straeleni* (Cichlidae, Teleostei) in Lake Tanganyika, Africa (*Environmental Biology of Fishes*, 39(1), 1994, pp. 59–72)

A predatory use of counterillumination by the squaloid shark, *Isistius brasiliensis* (*Environmental Biology of Fishes*, 53(3), 1998, pp. 267–273)

Black male bellies and red female throats: color changes with breeding status in a threespine stickleback (*Environmental Biology of Fishes*, 55(3), 1999, pp. 237–244)

Correspondence between ontogenetic shifts in morphology and habitat use in minnow *Phoxinus phoxinus* (*Environmental Biology of Fishes*, 56(1), 1999, pp. 117–128)

Aspects of reproductive biology of the scalloped hammerhead shark, *Sphyrna lewini*, off northeastern Brazil (*Environmental Biology of Fishes*, 61(2), 2001, pp. 151–159)

Ontogenetic variation in the diurnal food and habitat associations of an endemic and an exotic fish in floodplain ponds: consequences for niche partitioning (*Environmental Biology of Fishes*, 66, 2003, pp. 293–305)

Spatiotemporal variation in shallow-water freshwater fish distribution and abundance in a large subtropical coastal lagoon (*Environmental Biology of Fishes*, 68(3), 2003, pp. 215–228)

Colonial nesting and the importance of the brood size in male parasitic reproduction of the Mediterranean damselfish *Chromis chromis* (Pisces: Pomacentridae) (*Environmental Biology of Fishes*, 70(1), 2004, pp. 23–30)

Character displacement in sailfin mollies, *Poecilia latipinna*: allozymes and behavior (*Environmental Biology of Fishes*, 73(1), 2005, pp. 75–88)

Life history of the cownose ray, *Rhinoptera bonasus*, in the northern Gulf of Mexico, with comments on geographic variability in life history traits (*Environmental Biology of Fishes*, 73(3), 2005, pp. 321–331)

Habitat association and social structure of the chocolate hind, *Cephalopholis boenak* (Pisces: Serranidae: Epinephelinae), at Ping Chau Island, northeastern Hong Kong waters (*Environmental Biology of Fishes*, 74(1), 2005, pp. 9–18)

Effects of environmental conditions on predator–prey interactions between white sharks (*Carcharodon carcharias*) and Cape fur seals (*Arctocephalus pusillus pusillus*) at Seal Island, South Africa (*Environmental Biology of Fishes*, 76(3), 2006, pp. 341–350)

Australian lungfish, *Neoceratodus forsteri*, threatened by a new dam (*Environmental Biology of Fishes*, 84(2), pp. 211–221)

Movements of brown smoothhounds, *Mustelus henlei*, in Tomales Bay, California (*Environmental Biology of Fishes*, 85(1), 2009, pp. 3–13)

Observations of spawning in the Leather Bass, Dermatolepis dermatolepis (Teleostei: Epinephelidae), at Cocos Island, Costa Rica (*Environmental Biology of Fishes*, 85(1), 2009, pp. 15–20)

Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) growth in off-channel and main-channel habitats on the Sacramento River, CA using otolith increment widths (*Environmental Biology of Fishes*, 85(2), 2009, pp. 141–151)

Influences of wind-wave exposure on the distribution and density of recruit reef fishes at Kure and Pearl and Hermes Atolls, Northwestern Hawaiian Islands (*Environmental Biology of Fishes*, 85(4), 2009, pp. 319–332)

Status of research on Yangtze fish biology and fisheries (*Environmental Biology of Fishes*, 85(4), 2009, pp. 337–357)

Water velocity preferences of Coho Salmon during the parr-smolt transformation (*Environmental Biology of Fishes*, 88(1), 79–84)

Energy allocation in juveniles of a warm-temperate reef fish (*Environmental Biology of Fishes*, 88(4), 2010, pp. 389–398)

Stable carbon and nitrogen incorporation in blood and fin tissue of the catfish *Pterygoplichthys disjunctivus* (Siluriformes, Loricariidae) (*Environmental Biology of Fishes*, 89(2), 2010, pp. 117–133)

Otolith elemental signatures reflect residency in coastal water masses (*Environmental Biology of Fishes*, 89(3–4), 2010, pp. 341–356)

Larval stage duration, age and growth of blue lanternfish *Tarletonbeania crenularis* (Jordan and Gilbert, 1880) derived from otolith microstructure (*Environmental Biology of Fishes*, 89(3–4), 2010, pp. 493–503)

Timing and selectivity of mortality in reared Atlantic cod revealed by otolith analysis (*Environmental Biology of Fishes*, 89(3–4), 2010, pp. 513–519)

Sulfur isotopes in otoliths allow discrimination of anadromous and non-anadromous ecotypes of sockeye salmon (Oncorhynchus nerka) (*Environmental Biology of Fishes*, 89(3–4), 2010, pp. 521–532)

Displacement, velocity preference, and substrate use of three native California stream fishes in simulated pulsed flows (*Environmental Biology of Fishes*, online first, 2010)

Rainbow trout *Oncorhynchus mykiss* energetic responses to pulsed flows in the American River, California, assessed by electromyogram telemetry (*Environmental Biology of Fishes*, online first, 2010)

Fish and Shellfish Immunology

The histocompatibility system in teleostean fishes: From multiple histocompatibility loci to a major histocompatibility complex (*Fish & Shellfish Immunology*, 1(1), 1991, pp. 1–16)

Social stress induces structural and functional alterations of phagocytes in rainbow trout (*Oncorhynchus mykiss*) (*Fish & Shellfish Immunology*, 1(1), 1991, pp. 17–31)

Fish DNA vaccine against infectious hematopoietic necrosis virus: efficacy of various routes of immunisation (*Fish & Shellfish Immunology*, 10(8), 2000, pp. 711–723)

Evaluation of biofilm of *Aeromonas hydrophila* for oral vaccination of *Clarias batrachus*—a carnivore model (*Fish & Shellfish Immunology*, 16(5), 2004, pp. 613–619)

The development of the lymphoid organs of flounder, *Paralichthys olivaceus*, from hatching to 13 months (*Fish & Shellfish Immunology,* 16(5), 2004, pp. 621–632)

Cloning, characterisation and expression of *Aeromonas hydrophila* major adhesin (*Fish & Shellfish Immunology*, 16(5), 2004, pp. 645–658)

Simultaneous flow cytometric assessment for cellular types and phagocytic abilities of the haemocytes of the hard clam, *Meretrix lusoria* (*Fish & Shellfish Immunology,* 23(1), 2007, pp. 16–23)

Dopamine depresses immunity in the tiger shrimp *Penaeus monodon* (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 24–33)

RAG-1 and IgM genes, markers for early development of the immune system in the gadoid haddock, Melanogrammus aeglefinus, L. (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 71–85)

First report of invertebrate Mx: Cloning, characterization and expression analysis of Mx cDNA in disk abalone (*Haliotis discus discus*) (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 86–96)

Influence of different yeast cell-wall mutants on performance and protection against pathogenic bacteria (*Vibrio campbellii*) in gnotobiotically-grown Artemia (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 141–153)

Supra dietary levels of vitamins C and E enhance antibody production and immune memory in juvenile milkfish, *Chanos chanos* (Forsskal) to formalin-killed *Vibrio vulnificus* (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 154–163)

Stress and immune response in the mussel *Mytilus galloprovincialis* (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 171–177)

Blood and inflammatory cells of the lungfish Lepidosiren paradoxa (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 178–187)

Oxidative burst in hard clam (*Mercenaria mercenaria*) haemocytes (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 188–196)

An attenuated plasmid-cured strain of *Aeromonas hydrophila* elicits protective immunity in *Clarias batrachus* L. (*Fish & Shellfish Immunology*, 23(1), 2007, pp. 222–230)

Transcriptional analysis of the common carp (*Cyprinus carpio L.*) immune response to the fish louse *Argulus japonicus Thiele* (Crustacea: Branchiura) (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 76–83)

Monospecies and multispecies probiotic formulations produce different systemic and local immunostimulatory effects in the gilthead seabream (*Sparus aurata* L.) (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 114–123)

Studies on *Bacillus subtilis* and *Lactobacillus acidophilus*, as potential probiotics, on the immune response and resistance of *Tilapia nilotica* (Oreochromis niloticus) to challenge infections (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 128–136)

The effect of different acclimation temperatures on the prophenoloxidase system and other defence parameters in *Litopenaeus vannamei* (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 137–142)

Lysozyme gene expression and hemocyte behaviour in the Mediterranean mussel, *Mytilus galloprovincialis*, after injection of various bacteria or temperature stresses (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 143–152)

Family association between immune parameters and resistance to *Aeromonas hydrophila* infection in the Indian major carp, *Labeo rohita* (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 163–169)

Isolation and characterisation of two antimicrobial peptides from haemocytes of the American lobster *Homarus americanus* (*Fish & Shellfish Immunology*, 25(1–2), 2008, pp. 181–187)

Selecting a set of housekeeping genes for quantitative real-time PCR in normal and tetraploid haemocytes of soft-shell clams, *Mya arenaria* (*Fish & Shellfish Immunology*, 25(3), 2008, pp. 202–207)

MHC polymorphism and disease resistance to *Vibrio anguillarum* in 12 selective Japanese flounder (Paralichthys olivaceus) families (*Fish & Shellfish Immunology*, 25(3), 2008, pp. 213–221)

Molecular cloning and immune responsive expression of a novel C-type lectin gene from bay scallop *Argopecten irradians* (*Fish & Shellfish Immunology*, 25(3), 2008, pp. 231–238)

Regulation of phagocytosis against bacterium by Rab GTPase in shrimp *Marsupenaeus japonicus* (*Fish & Shellfish Immunology*, 25(3), 2008, pp. 258–263)

Zebrafish as a model for infectious disease and immune function (*Fish & Shellfish Immunology*, 25(4), 2008, pp. 341–350)

Modulation of the immune system of fish by their environment (*Fish & Shellfish Immunology*, 25(4), 2008, pp. 373–383)

Cell markers and determinants in fish immunology (*Fish & Shellfish Immunology*, 25(4), 2008, pp. 326–340)

Living off a fish: A trade-off between parasites and the immune system (*Fish & Shellfish Immunology*, 25(4), 2008, pp. 358–372)

Antiviral immunity in crustaceans (*Fish & Shellfish Immunology*, 27(2), 2009, 79–88)

Molecular cloning of the terminal complement components C6 and C8beta of cartilaginous fish (*Fish & Shellfish Immunology*, 27(6), 2009, pp. 768–772)

Characterisation of *Mytilus edulis* hemocyte subpopulations by single cell time-lapse motility imaging (*Fish & Shellfish Immunology*, 28(2), 2010, pp. 372–386)

Fish Physiology and Biochemistry

Molecular biology and enzymology of elasmobranch 3ß-hydroxysteroid dehydrogenase (*Fish Physiology and Biochemistry*, 19(4), 1998, pp. 293–304)

The effect of arginine vasotocin on courtship behaviour in a blenniid fish with alternative reproductive tactics (*Fish Physiology and Biochemistry*, 28(2), 2003, pp. 241–243)

Analysis of stress-induced gene expression in trout red blood cells following Tributyltinchloride exposure (*Fish Physiology and Biochemistry*, 30(3–4), 2004, pp. 231–240)

Dietary arachidonic acid alters tissue fatty acid profile, whole body eicosanoid production and resistance to hypersaline challenge in larvae of the temperate marine fish, striped trumpeter (*Latris lineata*) (*Fish Physiology and Biochemistry*, 30(3–4), 2004, 241–256)

Involvement of gonadotropin-releasing hormone in thyroxine release in three different forms of teleost fish: Barfin founder, masu salmon and goldfish (*Fish Physiology and Biochemistry*, 30(3–4), 2004, 267–273)

Hematology and stress physiology of juvenile diploid and triploid shortnose sturgeon (*Acipenser brevirostrum*) (*Fish Physiology and Biochemistry*, 31(4), 2005, pp. 303–313)

The interrelation between temperature regimes and fish size in juvenile Atlantic cod (*Gadus morhua*): effects on growth and feed conversion efficiency (*Fish Physiology and Biochemistry*, 31(4), 2005, pp. 347–361)

Intracranial injections induce local transcription of a gene encoding precerebellin-like protein (*Fish Physiology and Biochemistry*, 31(4), 2005, pp. 363–372)

Meristic character counts and incidence of skeletal anomalies in the wild *Diplodus puntazzo* (Cetti, 1777) of an area of the south-eastern Mediterranean Sea (*Fish Physiology and Biochemistry*, 32(2), 2006, pp. 159–166)

Live microbial feed supplement in aquaculture for improvement of stress tolerance (*Fish Physiology and Biochemistry*, 32(2), 2006, pp. 167–177)

Purification and characterization of stomach protease from the turbot (*Scophthalmus maximus L.*) (*Fish Physiology and Biochemistry*, 32(2), 2006, pp. 179–188)

Dmrt1 expression analysis during spermatogenesis in pejerrey, *Odontesthes bonariensis* (*Fish Physiology and Biochemistry*, 32(3), 2006, pp. 231–240)

Embryonic expression of UCP2 in rainbow trout (*Oncorhynchus mykiss*) (*Fish Physiology and Biochemistry*, 32(3), 2006, pp. 249–253)

Cellular responses to temperature stress in steelhead trout (*Onchorynchus mykiss*) parr with different rearing histories (*Fish Physiology and Biochemistry*, 32(3), 2006, pp. 261–273)

Effects of open- and closed-system temperature changes on blood O2-binding characteristics of Atlantic bluefin tuna (*Thunnus thynnus*) (*Fish Physiology and Biochemistry*, 32(4), 2006, pp. 283–294)

Ontogeny of protease, amylase and lipase in the alimentary tract of hybrid Juvenile tilapia (*Oreochromis niloticus* × *Oreochromis aureus*) (*Fish Physiology and Biochemistry*, 32(4), 295–303)

Nutritional and environmental regulation of the synthesis of highly unsaturated fatty acids and of fatty-acid oxidation in Atlantic salmon (*Salmo salar L.*) enterocytes and hepatocytes (*Fish Physiology and Biochemistry*, 32(4), 2006, pp. 317–328)

Cloning and analysis of transcripts and genes encoding fish-specific proteins related to PrP (*Fish Physiology and Biochemistry*, 32(4), 2006, pp. 339–353)

Neuronal nitric oxide synthase immunoreactivity in forebrain, pineal, and pituitary of *Oreochromis mossambicus* (Tilapia) (*Fish Physiology and Biochemistry*, 33(4), 2007, pp. 297–309)

Seminal vesicle and its role in the reproduction of teleosts (*Fish Physiology and Biochemistry*, 33(4), 2007, pp. 383–398)

Recent advances in carp seed production and milt cryopreservation (*Fish Physiology and Biochemistry*, 33(4), 2007, pp. 413–427)

Histopathology of respiratory organs of certain air-breathing fishes of India (*Fish Physiology and Biochemistry*, 33(4), 2007, pp. 441–454)

Seasonal morphological and biochemical changes of Dahlgren cells implies a potential role of the caudal neurosecretory system (CNSS) in the reproduction cycle of teleostean fish (*Fish Physiology and Biochemistry*, 34(1), 2008, pp. 37–42)

Growth and lipid composition of Atlantic cod (Gadus morhua) larvae in response to differently enriched Artemia franciscana (*Fish Physiology and Biochemistry*, 34(1), 2008, pp. 77–94)

Energy allocation in juvenile roach and burbot under different temperature and feeding regimes (*Fish Physiology and Biochemistry*, 34(2), 2008, pp. 103–116)

Pectoral fins of *Micropogonias furnieri*: a histochemical and ultrastructural study (*Fish Physiology and Biochemistry*, 35(3), pp. 317–323)

Cloning, characterization and expression analysis of a CXCR1-like gene from mandarin fish *Siniperca chuatsi* (*Fish Physiology and Biochemistry*, 35(3), pp. 489–499)

Helgoland Marine Research

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Formación inicial de los espermatóforos en el testículo del cangrejo *Uca uruguayensis* (Brachyura: Ocypididae) (*Revista de Biología Tropical*, 55(1), 2003, pp. 9–14)

Selectividad del zooplancton y solapamiento trófico entre tallas del pez *Menidia humboldtiana* (Atheriniformes: Atherinopsidae) en el embalse Danxhó, México (*Revista de Biología Tropical*, 57(2), 2009, pp. 187–194)

Efecto de la calidad del agua de criaderos de mosquitos (Diptera: Culicidae) sobre la patogenicidad e infectividad de las zoosporas del hongo *Leptolegnia chapmanii* (Straminipila: Peronosporomycetes) (*Revista de Biología Tropical*, 57(2), 2009, pp. 371–380)

Impacto de la luz artificial sobre la anidación de la tortuga marina *Dermochelys coriacea* (Testudines: Dermochelyidae), en playa Cipara, Venezuela (*Revista de Biología Tropical*, 57(3), 2009, pp. 515–528)

Crecimiento y mortalidad de la concha nácar *Pteria sterna* en bancos silvestres de Baja California Sur, México (*Revista de Biología Tropical*, 57(3), 2009, pp. 659–670)

Biodiversidad, morfometría y alimentación de los cangrejos del género Callinectes (Decapoda: Portunidae) en Santiago de Cuba (*Revista de Biología Tropical*, 57(3), 2009, pp. 671–686)

Actividad alimentaria de los peces herbívoros y su impacto en arrecifes con diferente nivel de degradación antrópica (*Revista de Biología Tropical*, 57(3), 2009, pp. 687–697)

Crecimiento y mortalidad natural del pez Haemulon aurolineatum (Teleostei: Haemulidae) del suroeste de la isla de Margarita, Venezuela (*Revista de Biología Tropical*, 57(3), 2009, pp. 699–706)

Variación lipídica en los ovocitos de la medusa *Stomolophus meleagris* (Scyphozoa: Rhizostomeae), durante el desarrollo gonádico, en la laguna Las Guásimas, Sonora, México (*Revista de Biología Tropical*, 58(1), 2010, pp. 119–130)

Condición somática de la almeja *Polymesoda solida* (Veneroidea: Corbiculidae) durante el periodo lluvioso, en el Parque Natural Isla de Salamanca, Caribe colombian (*Revista de Biología Tropical*, 58(1), 2010, pp. 131–145)

Peces criptobentónicos de arrecifes coralinos en el Parque Nacional Archipiélago de Los Roques, Caribe de Venezuela (*Revista de Biología Tropical*, 58(1), 2010, pp. 311–324)

Interacciones tróficas de las seis especies de peces más abundantes en la pesquería artesanal en dos bahías del Pacífico Central Mexicano (*Revista de Biología Tropical*, 58(1), 2010, pp. 383–397)

Distribución espacio-temporal de variables fisicoquímicas y biológicas en el hábitat del tiburón ballena *Rhincodon typus* (Orectolobiformes: Rhincodontidae) al norte del Caribe Mexicano (*Revista de Biología Tropical*, 58(1), 2010, pp. 399–412)

Composición de ácidos grasos de los caracoles marinos *Phyllonotus pomum* y *Chicoreus brevifrons* (Gastropoda: Muricida (*Revista de Biología Tropical*, 58(1), 2010, pp. 645–654)

Metabolitos secundarios, letalidad y actividad antimicrobiana de los extractos de tres corales y tres moluscos marinos de Sucre, Venezuela (*Revista de Biología Tropical*, 58(1), 2010, pp. 677–688)

Revista Peruana de Biología

Temporary distribution of mollusks and tropical crustaceans in the Peruvian Province and its relation with the events El Niño / Distribución temporal de moluscos y crustáceos tropicales en la Provincia Peruana y su relación con los eventos El Niño (*Revista Peruana de Biología*, 11(2), 2004, pp. 213–218)

BILINGUAL ARTICLES

Ciencias Marinas

Evidence of different feeding rates within an anchovy shoal / Evidencia de diferentes tasas de alimentación dentro de un cardumen de anchoveta (*Ciencias Marinas*, 21(3), 1995, pp. 281–293)

Daily zooplankton grazing rates off the coast of baja California / Tasas diarias de pastoreo del macroplancton en la costa de baja California (*Ciencias Marinas*, 23(1), 1997, 71–81)

Ichthyofilaria argentinensis sp. nov. (Nematoda: Philometridae) parasite of *Merluccius hubbsi* (Pisces: Merlucciidae) / *Ichthyofilaria argentinensis* sp. nov. (Nematoda: Philometridae) parásita de *Merluccius hubbsi* (Pisces: Merlucciidae)] (*Ciencias Marinas*, 25(3), 1999, pp. 439–444)

Skull development of the California sea lion (*Zalophus californianus californianus*) / El desarrollo del cráneo del lobo marino de California (*Zalophus californianus californianus*) (*Ciencias Marinas*, 26(1), 2000, pp. 145–176)

Age and growth of the annular seabream, *Diplodus annularis* (Pisces: Sparidae), from the Canarian archipielago / Edad y crecimiento del raspallón, *Diplodus annularis*, en el archipiélago canario (*Ciencias Marinas*, 28(1), 2002, pp. 1–11)

Proteinaceous exotoxins of shrimp-pathogenic isolates of *Vibrio penaeicida* and *Vibrio nigripulchritudo* / Exotoxinas proteicas de cepas de *Vibrio penaeicida* y *Vibrio nigripulchritudo* (*Ciencias Marinas*, 29(1), 2003, pp. 77–88)

Embryonic and intracapsular larval development of *Plicopurpura pansa* (Gould, 1853) (Prosobranchia, Muricidae) under laboratory conditions / Embriogénesis y desarrollo larvario intra-capsular de *Plicopurpura pansa* (Gould, 1853) (Prosobranchia, Muricidae) en condiciones de laboratorio (*Ciencias Marinas*, 30(2), 2004, pp.297–310)

Net autotrophy and heterotrophy in the Pontevedra Ria upwelling system (NW Iberian margin) / Autotrofia y heterotrofia neta en un sistema costero de afloramiento, la Ría Pontevedra (noroeste de la plataforma ibérica) (*Ciencias Marinas*, 31(1), 2005, pp. 213–220)

Fish community of a fridging reef at Mochima National Park, Venezuela / Comunidad íctica de una franja arrecifal del Parque Nacional Mochima, Venezuela (*Ciencias Marinas*, 32(4), 2006, pp. 683–693)

Dynamics of epiphytism on *Padina concrescens* (Dictyotales: Phaeophyta) from the southwestern coast of the Baja California Peninsula, Mexico / Dinámica del epifitismo en *Padina concrescens* (Dictyotales: Phaeophyta) en el suroeste de la Península de Baja California, México (*Ciencias Marinas*, 33(3), 2007, pp. 311–317)

Benthic prey quantity and quality in the main mudflat feeding areas of the Tagus Estuary: Implications for bird and fish populations / Cantidad y calidad de las presas bénticas en las principales zonas de alimentación de las planicies lodosas del estudiario del Tajo: Implicaciones para las poblaciones de aves y peces (*Ciencias Marinas*, 34(3), 2008, pp. 283–296)

APPENDIX III

SUMMARY OF THIS DOCTORAL THESIS IN SPANISH

Presentación

Es ya un hecho totalmente aceptado que la metáfora existe de manera natural en los lenguajes especializados (Lakoff 1987; Nunberg 1995; Turner and Fauconnier 1995). Solo algunas décadas atrás, esta afirmación no habría sido bienvenida en los círculos científicos. Entonces, se creía que las expresiones metafóricas —y el lenguaje figurado en general— tenían un papel marginal en los dominios de especialidad, pues estos debían ser precisos e inambiguos. Sin embargo, existe un gran número de estudios que subrayan la trascendencia de la metáfora como instrumento de generación y desarrollo de teorías científicas y como recurso para explicar conceptos complejos al lego (e.g. Bono 2001; Boyd 1993; Collins and Gentner 1995; Emmeche and Hoffmeyer 1991; Hesse 1966, 1974, 1993; Knudsen 2003; Paton 1993, 1997; Paton et al. 1994; Stambuk 1998; Stengers 1989; Thagard 1992).

Esta tesis doctoral proporciona datos empíricos que demuestran que la metáfora terminológica es esencial para la conceptualización, tratamiento y difusión del conocimiento científico. Para ello, se presenta un estudio contrastivo inglés-español en el dominio de la biología marina. Llevamos a cabo un análisis observacional a partir de datos obtenidos de un corpus de textos extraídos de artículos de investigación de revistas especializadas en biología marina. Con este análisis pretendemos describir cómo el pensamiento metafórico varía o se comparte en las dos lenguas de trabajo. Además, realizamos un estudio introspectivo de términos metafóricos, extraídos del mismo corpus especializado, con el objetivo de identificar y describir los procesos psicolingüísticos que subyacen a los conceptos metafóricos.

Nuestro estudio se nutre de premisas teóricas de la Terminología y de la Semántica Cognitiva. Por tanto, el trabajo se enmarca dentro de la Terminología cognitivista. Respecto a la Terminología, se exploran diferentes modelos teóricos que dan cuenta de la metáfora terminológica. En cuanto a la Semántica Cognitiva, nos centramos en aquellos modelos que dan cuenta de la metáfora conceptual. En concreto, elegimos las teorías de la metáfora que adoptan una perspectiva experiencialista (Lakoff and Johnson 1980) y demostramos su validez para el estudio de la metáfora en biología marina.

Introducción

Metáfora en la lengua general

Antes de abordar los modelos teóricos de la metáfora terminológica, se describen las teorías cognitivistas de la metáfora en la lengua general, pues de ellas extraeremos los principios teóricos que se aplicarán a nuestro estudio de la metáfora terminológica en biología marina.

De Bustos (2000: 171) afirma que existen dos teorías cognitivistas de la metáfora: (i) Teoría de la Metáfora Conceptual (Lakoff and Johnson 1980, 1999a; cf. Johnson 1987; Lakoff 1987, 1993); (ii) Teoría de la Relevancia (Sperber and Wilson 1986, 1987, 2004). A su vez, Steen (2007: 48–49) identifica cuatro enfoques que definen la metáfora como un fenómeno esencialmente conceptual, siguiendo los patrones actuales, que consideran la metáfora como un elemento básico de pensamiento:

- § El enfoque de los dos dominios, es decir, la Teoría de la Metáfora Conceptual (Lakoff and Johnson 1980, 1999a; cf. Johnson 1987; Lakoff 1987, 1993);
- § El enfoque de los espacios multiples, es decir, la Teoría de la Integración Conceptual (Fauconnier and Turner 1996, 1998, 1999, 2002; Turner and Fauconnier 1995, 1999, 2000; cf. Fauconnier 1997);
- § El enfoque de la inclusión de clases (Glucksberg 2001; Glucksberg, Brown, and McGlone 1993; Glucksberg and Keysar 1990, 1993; Glucksberg and McGlone 1999; Glucksberg, McGlone and Manfredi 1997; Keysar and Glucksberg 1992; Keysar et al 2000); y
- § El enfoque de la carrera de la metáfora (Bowdle and Gentner 2005; Gentner and Bowdle 2001; Gentner, Bowdle et al 2001; Gentner and Rattermann 1991; Gentner and Wolff 1997; Wolff and Gentner 2000).

Es necesario mencionar también la Teoría de la Metáfora Primaria (Grady 1997ab, 1999; Grady 2005a; Grady and Johnson 2002), que describe a las metáforas basadas en esquemas conceptuales de correlación (sobre todo, esquemas de causa-efecto). Aunque surge a partir de la Teoría de la Metáfora Conceptual y pertenece a esta, la Teoría de la Metáfora Primaria constituye un modelo sólido que presenta mejoras importantes de ciertos postulados experiencialistas propuestos por Lakoff y sus colegas.

En nuestro dominio de especialidad, la Teoría de la Metáfora Conceptual fue el principal modelo en el que nos basamos para dar cuenta de la metáfora terminológica. También incluimos premisas y principios pertencientes a la Teoría de la Integración Conceptual y a la Teoría de la Metáfora Primaria, especialmente para analizar las bases psicológicas que dan lugar a las imágenes mentales (*mental imagery*), en las cuales se sustenta el pensamiento metafórico. Aunque la Teoría de la Integración Conceptual se centra principalmente en el análisis de ejemplos únicos de uso metafórico (Steen 2007: 118), nuestro estudio demuestra que también es válida para el análisis de expresiones metafóricas totalmente asentadas en la lengua —en nuestro caso, en el dominio especializado de la biología marina. En cuanto a la metodología utilizada para la identificación de terminos metafóricos en el corpus, se siguieron postulados propuestos por los enfoques observacionales de la metáfora que toman como referencia a la Teoría de la Metáfora Conceptual (e.g. Charteris-Black 2004, Deignan 2005, Stefanowitsch and Grieg 2006).

La Teoría de la Metáfora Conceptual establece dos grandes tipos de metáforas: las metáforas de imagen y las metáforas conceptuales-estructurales (Lakoff y Johnson 1980, Lakoff y Turner 1989). Las primeras surgen por comparación física (prototípicamente color y forma). Su hábita natural es la literatura, son de naturaleza efímera y carecen de estructura conceptual e inferencial, esto es, son conceptualmente simples. En cambio, las conceptuales-estructurales no implican parecido físico, sino un tipo de comparación abstracta y compleja, con estructura inferencial muy rica. La presente tesis doctoral presenta una alternativa a esta tipología, que se describirá más adelante. A su vez, Grady (1999) establece una diferencia entre las metáforas de imagen y las de comportamiento, a las que denomina *resemblance metaphors*. Igualmente, nuestro estudio propone una clasificación que mejora la propuesta por Grady.

Uno de los conceptos esenciales de la Semántica Cognitiva es el denominado *embodiment*[68], que fue presentado en primera instancia por Lakoff y Johnson (1980) como un elemento que complementa y refuerza a Teoría la Metáfora Conceptual. El *embodiment* es una manera de categorizar la realidad inherente al raciocinio humano, una razón indisolublemente asociada a nuestros cuerpos y a las peculiaridades de

[68] No existe un equivalente consensuado en español que recoja exactamente la carga semántica que posee *embodiment* (una posible propuesta es *corporeidad*). Por ello, hemos preferido mantener el término en inglés.

nuestros cerebros (Lakoff and Johnson 1999: 17). En otras palabras, los conceptos son creados en nuestra mente a través de la proyección de nuestra estructura corporal y percepción sensorial sobre las entidades que nos rodean.

Por esta razón, el *embodiment* se ha convertido en una parte muy importante de la investigación en metáfora conceptual. El *embodiment* y la metáfora se consideran constituyentes esenciales de la conceptualización, por lo que existe una gran cantidad de metáforas que son compartidas por los hablantes de todas las lenguas. La presente tesis pretende encontrar metáforas conceptuales compartidas por biólogos marinos angloparlantes y hispanohablantes. Igualmente, buscamos metáforas diferentes en cada idioma para referirse al mismo concepto especializado con el fin de demostrar que también existen diferencias interlingüísticas motivadas por aspectos cognitivos y, en algunas ocasiones, por factores socioculturales.

La tendencia a considerar los procesos cognitivos únicamente en términos de parámetros físicos y fisiológicos (cf., por ejemplo, el proyecto actual de Lakoff, la Teoría Neuronal del Lenguaje) está perdiendo terreno a favor de estudios que analizan tanto la mente y el cuerpo como los factores socioculturales como causantes de las diferencias interlingüísticas en los procesos metafóricos (cf. Al-Zoubi et al. 2006 para un estudio contrastivo de vocabulario en inglés y árabe utilizado en política y religión; cf. Kövecses 2002, 2005 para un estudio contrastivo de unidades léxicas de la lengua general que designan estados corporales en inglés, húngaro, chino y español).

En nuestra opinión, independientemente del dominio de conocimiento en el que se esté trabajando, el análisis de la metáfora conceptual debe basarse en inferencias senso-motoras y factores culturales, pues están íntimamente interrelacionados. Consecuentemente, esta aseveración también debe incumbir al ámbito de la biología marina. Es nuestro objetivo proporcionar datos empíricos que lo constaten.

Metáfora en los lenguajes especializados

Desde el reconocimiento de su incidencia en los dominios de conocimiento especializados y, concretamente, en ciencia, la metáfora ha sido ampliamente descrita por lingüistas y filósofos de la ciencia. Es importante resaltar a Boyd (1993), quien establece tres tipos de metáforas en ciencia: metáforas constitutivas de teorías, metáforas heurísticas y metáforas exegéticas. Las primeras son parte irremplazable de la maquinaria lingüística de la teoría científica, ya que son utilizadas por los científicos cuando no encuentran formas de conceptualizar y parafrasear de forma literal (Boyd

1993: 486). Las heurísticas no son preteoréticas, pero ayudan al desarrollo de las teorías presentando nuevos enfoques para problemas específicos. Son utilizadas cuando es difícil expresar premisas teóricas literalmente. Por último, las metáforas exegéticas, aunque no son terminológicas, son utilizadas por los científicos como ejemplos claros sobre procesos y conceptos complejos para legos en la materia. Tienen, por tanto, una función pedagógica. Nuestro estudio se centra en la identificación y análisis de los dos primeros tipos de metáfora en el corpus de textos de biología marina.

Evidentemente, los modelos teóricos actuales de la Terminología también reconocen el papel que desempeña la metáfora como mecanismo básico de pensamiento. La Teoría Comunicativa de la Terminología (Cabré 1998c, 1999, 2000a, 2003), que surgió como contraposición a la Teoría General de la Terminología (Wüster 1968), reconoce la existencia de variación terminológica, especialmente en forma de sinonimia y polisemia, dejando, por tanto, la puerta abierta al lenguaje figurado, en el que la metáfora destaca. Además, una vez reconocida la existencia de variantes y sinónimos en los lenguajes especializados, la presente tesis aspira a encontrar casos de sinonimia entre los términos metafóricos de la biología marina. Igualmente, la Teoría Comunicativa de la Terminología se desmarca de la Teoría General de la Terminología en que el término no está sujeto a la forma nominal (sustantivo), sino que el espectro de formas gramaticales que abarca incluye verbos, adjetivos, adverbios e incluso preposiciones. Uno de nuestros objectivos es comprobar si este hecho también tiene lugar en el corpus de biología marina.

Dentro de la Lingüística Cognitiva, el modelo experiencialista de la Semántica Cognitiva ha tenido su proyección en los dominios de conocimiento especializados. Destacamos tres propuestas que integran postulados cognitivistas a la descripción de la metáfora terminológica. La primera es la Teoría Socio-Cognitiva de la Terminología (Temmerman 2000, 2006), que subraya la importancia del estudio histórico y diacrónico de los términos. En consonancia con la Semántica Cognitiva, Temmerman defiende la prototipicidad y la flexibilidad de los conceptos especializados, incluyendo los metafóricos del ámbito de la genética e ingeniería molecular, que evolucionan a la par de los avances y descubrimientos científicos. Estos, a su vez, están influenciados por el entorno sociocultural, que los moldea.

La segunda propuesta es el enfoque terminológico experiencialista de Alexiev (2005) en el dominio de la minería e ingeniería civil. En su estudio contrastivo inglés-búlgaro-español, Alexiev explora los aspectos estructurales, funcionales, conceptuales y contrastivos de los términos de dichos dominios de especialidad con el fin de mejorar la práctica terminográfica multilingüe orientada a la traducción. Alexiev también resalta la importancia de los socioculturales en la formación de conceptos metafóricos especializados.

La tercera propuesta es la de Caballero (2006), que analiza los términos metafóricos extraídos de un corpus de textos del género de la arquitectura en que se valora soluciones de diseño de los edificios. En primer lugar, Caballero demuestra la incidencia de la metáfora conceptual y lingüística en este campo especializado y cómo el estudio de la metáfora arroja luz sobre su potencial retórico. En segundo lugar, Caballero aporta un análisis muy interesante de la metáfora de imagen. La trascendencia de las metáforas visuales en el discurso arquitectónico es una reivindicación de la importancia conceptual —esto es, de la capacidad de organización conceptual y riqueza inferencial— de un tipo de metáfora que, hasta ahora, había tenido un papel marginal en la Lingüística Cognitiva.

Metodología

El corpus de textos analizados es una selección de las siguientes revistas especializadas en biología marina:

Revistas en lengua inglesa	Number of articles	Number of tokens
Fish and Shellfish Immunology	34	276,929
Coral Reefs	46	365,173
Marine Biology	62	356,736
Helgoland Marine Research	22	172,441
Journal of Fish Biology	28	196,570
Environmental Biology of Fishes	31	373,249
Marine Ecology	30	235,477

Fish Physiology and Biochemistry	27	188,960
Ciencias Marinas (bilingüe inglés-español)	11	74,792
	Total: 291	**Total**: 2,240,327

Revistas en lengua española	Number of articles	Number of tokens
Ciencias Marinas (bilingüe inglés-español	11	74,792
Revista de Biología Marina y Oceanografía	57	450,335
Boletín del Instituto Español de Oceanografía	64	609,998
Investigaciones Marinas	56	449,506
Revista de Biología Tropical	33	252,069
Boletín de Investigaciones Marinas y Costeras	56	473,163
	Total: 277	**Total**: 2,309,863

En primer lugar, para llevar a cabo un estudio eficaz de la metáfora terminológica, es necesario establecer los siguientes criterios:

§ Criterios para decidir si una unidad lingüística se considera término:

a. Consulta de las bases de datos en línea sobre biología marina *Integrated Taxonomic Information System* (ITIS) y *SeaLifeBase®* para ratificar la naturaleza terminológica de ciertas unidades léxicas.
b. Consulta con un profesor experto en biología marina de la Universidad de Granada.
c. Frecuencia de aparición de una unidad léxica. Este criterio no garantiza su carácter terminológico, pero si ayuda a inferirlo.

§ Criterios para decidir si una unidad lingüística se considera metafórica:

a. Consulta con un profesor experto en biología marina de la Universidad de Granada.
b. Aplicación de tres pasos basados en el procedimiento propuesto por el Grupo Pragglejaz (2007). Estos pasos son: (i) determinar si el término tiene un significado contemporáneo más básico que el supuestamente metafórico en un discurso diferente al de la biología marina; (ii) comparar ambos significados; (iii) determinar si dicha comparación da lugar a tensión semántica y si esta lleva a incongruencia referencial (Caballero 2006, Kittay 1987). En ese caso, el término en cuestión puede considerarse metafórico.
c. Exploración del contexto lingüístico del término en los artículos académicos recopilados en busca de explicación implícita o explícita.
d. Examen de imágenes de organismos marinos disponibles en las bases de datos consultadas, en los artículos de revistas recopilados y en el motor de búsqueda de imágenes de Google.

§ Criterios para establecer tipos de términos metafóricos: tomamos como base la tipología tradicional propuesta por la Teoría de la Metáfora Conceptual (Lakoff y Johnson 1980, Lakoff 1987, Lakoff 1993) y la Teoría de la Metáfora Primaria (Grady 1997, 1999). Como veremos en el apartado de Resultados y Conclusiones, dicha tipología es mejorada tomando como referencia la metáfora en biología marina.

§ Criterios para llevar a cabo un análisis constrastivo interlingüístico de términos metafóricos. Nos planteamos las siguientes preguntas propuestas por Kövecses (2005: 133):

a. ¿La expresión en cuestión es la misma o diferente en las dos lenguas?

b. ¿El significado literal de esta expresión es el mismo o diferente en las dos lenguas?
c. ¿El significado figurado de esta expresión es el mismo o diferente en las dos lenguas?
d. ¿La metáfora conceptual que subyace a la expresión con dichos significados literal y figurado es la misma o diferente en las dos lenguas?

Tras considerar estos criterios, se aplicó una serie de estrategias que garantizaron la recuperación semi-automática de los términos metafóricos tanto en inglés como en español. La metodología que se presenta es innovativa porque incluye el análisis de la metáfora terminológica en contextos de uso real y porque permite identificar parejas interlingüísticas de términos metafóricos de forma eficaz y productiva.

En primer lugar, se llevó a cabo un análisis cualitativo. Para la identificación y recuperación de metáforas de imagen, que, a partir de ahora, llamaremos *metáforas resemblance* (es decir, basadas en el parecido físico y/o en el comportamiento), utilizamos las siguientes estrategias:

§ Palabras clave correspondientes al dominio conceptual meta (p. ej. *pez*/*fish*, *cangrejo*/*crab*)
§ Marcadores léxicos: (i) designaciones taxonómicas; (ii) apellidos de taxonomistas; (iii) *known as* y *conocido*/*a como*
§ Extracción manual

Para la identificación y recuperación de metáforas conceptuales-estructurales, que, a partir de ahora, llamaremos *metáforas non-resemblance*, utilizamos las siguientes estrategias:

§ Palabras clave correspondientes al dominio conceptual meta (p. ej. *organismo*/*organism*, *especie*/*species*)
§ Palabras clave correspondientes a los dominios conceptuales fuente (p. ej. *comunidad*/*community*, *invadir*/*invade*, *ciclo*/*cycle*)

También se realizó un análisis cuantitativo, que implicó la anotación manual del corpus de textos especializados en ambos idiomas. El sistema de anotación aplicado demostró ser más productivo y eficiente que la búsqueda manual de términos metafóricos y confirmó el potencial de combinación de las estrategias de extracción semi-automática arriba mencionadas. Así pues, el etiquetado optimizó la recuperación de términos metafóricos y de parejas terminológicas inglés-español, tanto de metáforas *resemblance* como de *non-resemblance*, y proporcionó datos estadísticos sobre ambos tipos de metáforas. Dichos datos son relevantes en cuanto que existen pocos estudios que proporcionen información numérica sobre el uso de la metáfora en lengua (Sardinha 2008: 127). Los datos aportados incluyen frecuencias absolutas de aparición de términos y número de parejas interlingüísticas.

Resultados y conclusiones

Análisis observacional

La metodología utilizada en nuestro estudio permitió obtener conclusiones interesantes sobre la tipología, el comportamiento, así como las diferencias y similitudes a nivel interlingüístico de los términos metafóricos en contextos de uso real.

Dos tipos de metáfora fueron identificados en el corpus especializado: metáforas *resemblance* y metáforas *non-resemblance*. Las primeras se dividen entre aquellas que designan a organismos marinos (p. ej. *pez linterna*/*lanternfish*) y aquellas que designan a partes de los organismos marinos [p. ej. *disco basal* (de un calamar)/*basal disc* (of squids)]. El número total de metáforas *resemblance* en el corpus es 49.004 (32.247 designando a organismos marinos y 16.757 designando partes de dichos organismos). El número total de metáforas *non-resemblance* es 45.173. Esto se traduce en un 2,06% (1,07% para metáforas *resemblance* y 0,99% para metáforas *non-resemblance*). Aunque este porcentaje no es muy alto, sí es indicativo del gran potencial de la metáfora terminológica para modelar y organizar el conocimiento científico tanto en inglés como en español).

Los dos subtipos de metáforas *resemblance* son expresadas lingüísticamente a través de sustantivos terminológicos, que resultaron ser la forma gramatical más frecuente en el corpus. Los siguientes tipos de motivación metafórica fueron identificados para estas metáforas:

- Semejanza con entidades inanimadas: forma, posición, color, tamaño tipo de material y función.

- § Semejanza con entidades animadas: forma, posición, color, tamaño, tipo e material y comportamiento.

Estas motivaciones no son excluyentes, ya que se encontraron casos en que dos o incluso tres motivaciones se combinan para crear una metáfora terminológica. Ejemplos son “forma más color” (*lechuga de mar*/*sea lettuce*), forma más comportamiento (*anglerfish* [*pez pescador de caña*]) y “forma más color más comportamiento” (*Spanish dancer* [*bailarina española*]). Semejanza por forma fue la motivación más frecuente en ambos idiomas, seguido de comportamiento y, en tercer lugar, color. Las combinaciones de motivaciones también fueron recurrentes, siendo la pareja “forma más posición” la más frecuente. La combinación “comportamiento más forma (más color)” es la menos frecuente, tanto en inglés como en español, pues precisan de patrones cognitivos complejos que no siempre pueden coincidir en la conceptualización metafórica.

Respecto de las metáforas *non-resemblance,* los datos del corpus indicaron que estas pueden expresarse no solo por sustantivos, sino también por verbos y adjetivos. Pueden incluirse en una de las siguientes macro-metáforas: LOS HÁBITATS MARINOS SON COMUNIDADES, LAS COMUNIDADES MARINAS SON ESTRUCTURAS QUE COMBATEN PARA SOBREVIVIR, LOS PROCESOS MARINOS SON CÍRCULOS y LAS ACTIVIDADES MARINAS SON ASUNTOS ECONÓMICOS Y DE NEGOCIOS. En ambas lenguas, la macro-metáfora más productiva y recurrente fue LOS HÁBITOS MARINOS SON COMUNIDADES (9.267 en el subcorpus en inglés y 8.909 en el español), mientras que la metáfora LOS PROCESOS MARINOS SON CÍRCULOS fue menos recurrente (2.047 en inglés y 2.063 en español).

Establecimos cuatro tipos de parejas terminológicas interlingüísticas tanto para las metáforas *resemblance* como para las *non-resemblance*:

- § Parejas exactas → ambos términos están basados en la misma metáfora conceptual (metáforas *resemblance*: *gusano de fuego*/*fire worm*; metáforas *non-resemblance*: *organismo centinela*/*sentinel organism*).
- § Parejas parciales → ambos términos están basados en la misma metáfora conceptual pero uno de ellos se centra en un aspecto más o menos específico/genérico del dominio conceptual fuente (metáforas *resemblance*: *corvina rubia*/*white croaker*; metáforas *non-resemblance*: *pastoreo* [*shepherding*]/*grazing*).

- § Parejas distintas → los términos están basados en metáforas conceptuales diferentes. Sólo encontramos casos de este tipo en metáforas *resemblance* (p. ej. *bottlenose dolphin*/*delfín mular* [*mule dolphin*]).
- § Parejas desequilibradas → sólo uno de los dos términos es metafórico. (metáforas *resemblance*: *king crab*/*centolla* [—]; metáforas *non-resemblance*: *usurp*/*ocupar* [*occupy*]).

Desde una perspectiva interlingüística, las estadísticas muestran que las motivaciones metáforicas están uniformemente distribuidas en las dos lenguas, con un mayor número de términos en inglés debido a la escasez de términos metafóricos en español en las parejas desequilibradas de metáforas *resemblance*. De hecho, los datos numéricos constatan que los expertos de lengua inglesa son más proclives a conceptualizar organismos marinos metafóricamente que los de lengua española. Las parejas exactas fueron las más frecuentes (100 para las metáforas *resemblance* y 87 para las *non-resemblance*), de lo que se deduce que ambos grupos de especialistas tienden a conceptualizar los organismos marinos de la misma manera. El número de parejas distintas también fue significativamente alto para las metáforas *resemblance* (26), lo que refuerza la idea de que la conceptualización (a través de la metáfora) también causa diferencias interlingüísticas en el discurso especializado. Por el contrario, no se identificaron parejas distintas de metáforas *non-resemblance*. Las parejas interlingüísticas se distribuyeron proporcionalmente en las cuatro macro-metáforas. LOS HÁBITATS MARINOS SON COMUNIDADES es la que incluye el mayor número de parejas (36), mientras que LOS PROCESOS MARINOS SON CÍRCULOS es la que incluye el número más bajo (10).

El corpus proporcionó datos empíricos que demuestran la incidencia de los factores socio-culturales en la conceptualización (metáforica) de entidades pertenecientes a la biología marina. Estos factores son una de las causas directas de las diferencias de conceptualización de dichas entidades entre las lenguas y, en nuestro caso, entre inglés y español. Estos factores se reflejaron en el corpus en las metáforas *resemblance*. En nuestro estudio, distinguimos entre metáforas culturalmente específicas y metáforas culturalmente típicas. En las primeras, el concepto del dominio fuente existe exclusivamente en la comunidad de expertos donde se utiliza dicho concepto. Un claro ejemplo es el término español *cangrejo moro*, equivalente del término inglés *sally lightfoot crab*, que no está culturalmente marcado. Las metáforas culturalmente típicas designan conceptos típicos —aunque no exclusivos— de su correspondiente comunidad de hablantes. Un ejemplo es el término inglés *cookie-cutter shark*, cuyo equivalente interlingüístico es *tollo cigarro*, que no está marcado culturalmente.

Finalmente, también hallamos un número significativo de sinónimos intralingüísticos tanto en inglés como en español para metáforas *resemblance* (p. ej. *tortura lora*/*tortuga carpintera*; *Provence oyster*/*dwarf oyster*) y para *non-resemblance* (p. ej. *floración algal*/*florecimiento algal*; *vicinity*/*neighbourhood*). Este hecho desacredita la concepción tradicional de la terminología, según la cual el discurso especializado está y debe estar exento de sinonimia y variación terminológica.

Análisis introspectivo

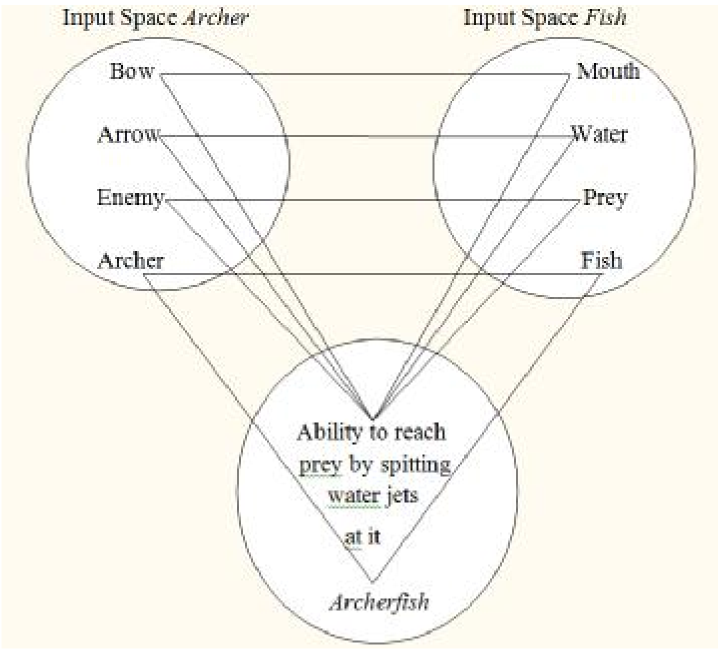
Los términos extraídos del corpus de biología marina reflejan aspectos de organización y representación cognitivas de dicho dominio de conocimiento. Por tanto, proporcionan información esclarecedora del *nivel conceptual* del *área simbólica* del análisis de la metáfora (Steen 2007).

Dentro de la categoría *metáforas resemblance*, encontramos claros ejemplos de metáforas de imagen y metáforas basadas en el comportamiento. Las metáforas de imagen prototípicas están basadas en estímulos visuales en forma de imágenes estáticas (p. ej. *coral cerebro*/*brain coral*). Las metáforas de comportamiento prototípicas surgen a partir de patrones de movimiento y dinamicidad. Sin embargo, el análisis del corpus de biología marina demuestra que existen metáforas *resemblance* que no pertenecen íntegramente a ninguno de estas dos subcategorías, sino que comparten aspectos de ambas. Podemos afirmar que las metáforas *resemblance* son una categoría graduada donde sus miembros constituyen ejemplares más o menos prototípicos en función de la naturaleza estática o dinámica de las imágenes mentales que los sustentan.

Por lo tanto, las metáforas basadas en comportamiento evocan imágenes mentales (p. ej. el término *sea wasp* (avispa de mar) (*Chironix fleckeri*) evoca una imagen mental que prima la percepción kinescética) y las metáforas de imagen pueden implicar dinamicidad. Tal es el caso del cangrejo denominado en inglés *boxer crab* [cangrejo boxeador], que lleva su nombre porque acostumbra a “blandir” trozos de anémona en cada pinza a modo de guantes de boxeo para disuadir a su predadores (comparación por forma y por comportamiento). En otras, palabras, las metáforas *resemblance* se diferencian por su grado de dinamicidad. Sorprendentemente, también encontramos metáforas basadas en comportamiento que no comportan dinamicidad. Por ejemplo, la motivación metáforica de ***garden eel*** [anguila jardín] (Heterocongridae) proviene de su comportamiento estático, parecido al de las plantas en un jardín: estas anguilas viven en colonias, manteniendo gran parte de su alargado cuerpo erecto mientras el resto de su cuerpo permanece bajo tierra.

Muchos de estos términos también poseen una base metonímica. Por ejemplo, el comportamiento del pez arquero (*archerfish*) (Toxotidae) es comparado con el de un arquero, implicando la función del arco, que dispara flechas a su objetivo. Este pez tiene la habilidad de disparar gotas de agua a insectos voladores, provocando su caída al agua para ser devorados por el pez. Esta metáfora también tiene una base metonímica. El dominio fuente de las metonimias es la capacidad de disparar, desempeñada, por un lado, por el uso que hace el arquero de su arco y flecha y, por otro, por la expulsión de gotas de agua hacia los insectos ejecutada por el pez arquero. El dominio fuente de las metonimias sustituye a los dominios meta, ARQUERO y PEZ ARQUERO

Todos estos términos pueden describirse desde la perspectiva de la Teoría de la Integridad Conceptual (Fauconnier and Turner 1996, 1998, 1999, 2002; Turner and Fauconnier 1995, 1999, 2000; cf. Fauconnier 1997). Como ejemplo el concepto ***archerfish***, los tres espacios múltiples e íntimamente interrelacionados, propuestos por esta Teoría, se aprecian en la imagen bajo estas líneas.



El corpus de biología marina también demuestra que existen metáforas *resemblance* que están basadas en dinamicidad ficticia. Esta responde a estrategias psicológicas más que a la intención de reflejar el verdadero estado de las cosas (*state of affairs*). En este caso, son las fronteras entre la estructura estática y la dinámica las que son difusas. Un claro ejemplo aparece en cursiva en el siguiente contexto:

> In tile Pulmonate tile rudimentary velum, v, is marked by a line of granular ciliated cells, which [...] *bends up towards* the dorsal surface, in such a way as to almost encircle the tentacles.

Igualmente, nuestro estudio de investigación ofrece datos que demuestran que las metáforas *resemblance* y las *non-resemblance* comparten características que, hasta ahora, sólo se las había asociado con estas últimas. Son las siguientes:

- Ambos tipos pueden organizarse bajo macro-metáforas productivas, con lógica interna y capacidad de inferencia. Macro-metáforas *resemblance* son LOS ORGANISMOS MARINOS SON TRABAJADORES y LOS ORGANISMOS MARINOS SON EDIFICIOS.
- Al igual que las metáforas *non-resemblance* primarias (Grady 1997), algunas metáforas *resemblance* se basan en esquemas causa-efecto que implican una correlación. Sin embargo, en la correlación de las metáforas primarias, el dominio fuente influye directamente o tiene una relación indisoluble con el dominio meta (p. ej. IMPORTANT IS BIG). En las metáforas *resemblance*, la relación entre dominios no es tan estrecha. Por ejemplo, la metáfora *resemblance ortiga de mar* (*sea nettle*) la correlación entre la mano que toca esta medusa y la mano que toca la ortiga, por un lado, y la consecuente sensación de dolor (esta es la motivación metafórica), por otro, está limitada al dominio fuente o al meta, es decir, son correlaciones estancas.

Por último, es importante resaltar que estas conclusiones, aunque basadas en datos empíricos obtenidos de textos producidos por expertos en contextos naturales, son de carácter introspectivo. Por ello, una de las futuras líneas de investigación es realizar estudios experimentales psicolingüísticos que arrojen resultados que refuercen y complementen los reflejados en esta tesis doctoral.