UNIVERSIDAD INTERNACIONAL DE LAS AMÉRICAS

VICERRECTORIA ACADÉMICA

SCHOOL OF EDUCATION AND FOREIGN LANGUAGES

EFFECT OF THE PROCEDURES AND METHODS USED TO TRANSLATE “THE FIRE INVESTIGATOR” FROM ENGLISH INTO SPANISH FOR CUERPO DE BOMBEROS DE COSTA RICA AND SOME DOCUMENTS FROM SPANISH INTO ENGLISH FOR UNIVERSIDAD NACIONAL

THESIS SUBMITTED TO OBTAIN THE BACHELOR IN ENGLISH

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APRIL, 2018

Contents

Tables

Dedication

I am grateful to the God for the good health and well-being that were necessary to complete this work. I would like to thank my family for being supportive and accountable to accomplish one of the most valuable challenges in this stage of my life; those who also inspired me to pursuit my dreams with tenacity even when I thought I could fail. Especially to my father, my grandmother, and mother, who have taken a big part of this effort.

Acknowledgements

I wish to express my sincere gratitude to my advisor Prof. Catalina Guerrero Troyo, for her continuous support in my investigation study, for her patience, motivation, and immense knowledge. Her guidance helped me all the time.

I am also grateful to Margarita Perez and Amalia Molina Rojas; I am extremely thankful and indebt to them for sharing their expertise and sincere and valuable guidance, and encouragement that they extended to me.

I take this opportunity to express gratitude to all of the Department faculty members for their help and support, who directly or indirectly, have let their hand in this venture.

Abstract

This main purpose of this investigation is to provide the effect of the procedures and methods used to translate the documents *"The Fire Investigator"* From English into Spanish for Cuerpo de Bomberos de Costa Rica and "*Análisis Espacial de los Hábitat Críticos del Delfín Nariz de Botella (Tursiops Truncatus) y la Ballena Jorobada (Megaptera Novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de Un Proyecto de Construcción de Marina",* "*Aspectos Reproductivos de Chicoreous Brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la Laguna de la Restinga, Isla Margarita, Venezuela"* and, "*Proyeccion de Cambios en la Tempertura Superficial del Mar del Golfo de California y Efectos sobre la Abundancia y Distribución de Especies Arrecifales"* from Spanish into English for Universidad Nacional.

The intention to translate both documents was to illustrate the different methodologies and translation procedures recommended by some of the most relevant linguistics in translation background. It has been demonstrated that all of their theories allowed the investigator to render target texts that were as accurate and natural as the original. Therefore, the implementation of instruments was crucial to develop a deep analysis of the translation through the color-coding technique to identify procedures, as well as the elaboration of supportive glossaries to help the translator through the process.

At last but not least, the goal of the translator was to provide to the non-profit organizations high level translations, where the readership is able to read the documents in a different kind of language and thus, can be able to be familiar with them.

Resumen

El propósito inicial de esta investigación es dar a conocer el efecto de los procedimientos y métodos de traducción utilizados para traducir los documentos “The Fire Investigator” de inglés a español de la institución de Cuerpo de Bomberos de Costa Rica y ¨Análisis Espacial de los Hábitat Críticos del Delfín Nariz de Botella (Tursiops Truncatus) y la Ballena Jorobada (Megaptera Novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de Un Proyecto de Construcción de Marina’,‘Aspectos Reproductivos de Chicoreous Brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la Laguna de la Restinga, Isla Margarita, Venezuela and, ‘Proyección de Cambios en la Temperatura Superficial del Mar del Golfo de California y Efectos sobre la Abundancia y Distribución de Especies Arrecifales¨ de español a inglés de la Universidad Nacional.

La intención de traducir ambos documentos fue para demostrar las diferentes metodologías y procesos de traducción enseñados por los traductores más importantes de esta época. Por lo tanto, se demostró que las traducciones del lenguaje inicial se mantuvieron precisas y naturales al transferirlas al idioma término según las teorías mencionadas en la investigación.

Asimismo, es importante rescatar que la implementación de instrumentos para un mejor análisis de las traducciones fue de gran ayuda, basándose en las herramientas de código de color para identificar los procesos utilizados, y de igual manera la creación de dos glosarios que sirvió como ayuda para el traductor durante el proceso.

Por último, pero no menos importante, el objetivo del traductor era proporcionar a las organizaciones sin fines de lucro con traducciones de alto nivel, en la que los lectores puedan leer los documentos en un idioma diferente, y por ende, puedan familiarizarse con ellos.

Chapter I

Introductory Framework

1.1 Background of the Study

Translation is one of most natural and effective ways to understand another language easily. In order to understand the message from another text accurately, a translator should have knowledge about both source and target language. Therefore, a deep understanding of translation will help in doing a good translation of a text.

According to the History of Translation (2006-2014), translation derives from a Latin word meaning, "to bring or carry across." The Ancient Greek term is 'metaphrasis' ("to speak across"), and this gives the term 'metaphrase' (a "literal or word-for-word translation") as opposed to 'paraphrase' ("saying in other words"). This distinction has been the core of the theory of translation throughout its history. For this reason, this work is aimed at emphasizing the important role that translators have had since ancient times, and thus far, the translations performed have worked as cultural and social base worldwide.

Since the age of the tower of Babel (where the Bible stays that different languages were first introduced) to the age of Babel Fish (and other instant translation services) there has been growing necessity for translation (History of Translation, 2006-2014). As far as the citation shows, religion texts have played an important role in the history of translation since the 3rd century BC where the Old Testament was translated into Greek. Thus, this translation has been the basis for translations into other languages, as well.

The aim of this study is to highlight the importance and relevance of the methods and techniques used in a document translated into a foreign language. According to Newmark (1981, p. 7), translation is “A craft consisting in the attempt to replace a written message and/or statement in one language by the same message and/or statement in

another language.” However, the intention of this document is to demostrate that a translator is also able to perceive the forethought and personality of the author. This is why, the goal of the translator is to use the methods of translation accordingly; notwithstanding, techniques will also be analyzed to keep the authenticity and veracity of the original work.

Nidia (as quaoted in Zakhir, 2008, p. 3) affirms that translators must “Reproduce in the receptor language the natural equivalent of the source language message, first in terms of meaning and second in terms of style.” In reference to what Nida affirms, Nida diminishes the importance of the utilization of translation methodologies and, at the same time, he highlights, the influence of the translator in terms of style. According to Nida, only a translator has the sensitivity to understand and scrutinize a translation document in a strategical manner where the source of translation will not reflect any violation in meaning (Nidia as quaoted in Zakhir, 2008).

This investigation consists of the translation of two different documents from non-profit organizations the goal of the translation is to communicate, raise awareness, and educate the audience. The first document to be translated from English to Spanish is ¨Fire Investigator”, which is a complete masterpiece of the principles and practices to be taught and learned by professionals with a detailed knowledge of the obstacles a firefighter faces every day. These sources, provide practical, hands-on, time saving tools to enlighten learners and instructors, as stated in the introduction. In spite of the fact that this book contains more than one subject, it focuses on how and what to document during a fire, as well as fire evidence. The importance of translating such topic(s) will provide a better understanding to all of our national organizations of Firefighters on how to gather and use useful equipment such as cameras, video recorders and others to be used when a fire is caused by arson and then using those tools to collect the correct samples as evidence to determine the root cause of the conflagration.

Furthermore, this paper also aims at translating three articles on Natural Science subjects into Spanish; first, 'Análisis espacial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina' secondly, 'Aspectos reproductivos de *Chicoreous brevifrons* (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela and lastly, 'Proyección de cambios en la tempertura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales.¨ The documents were obtained from the Natural Science area of the Universidad Nacional of Costa Rica and belong to a set of fourteen volumes of article collection RWMAR about exotic marine animals and their ecosystems.

The first study offers a detailed spatial analysis of the utilization of the distribution of bottlenose dolphins and humpback whales assessing the potential impacts due to coastal development by a marina project overlapping their critical habitats. Records yielding spatial and behaviour information were analysed through: 1) the average nearest neighbour index and 2) kernel density estimates using two contours to illustrate the utilization of the distribution, a 50% contour for core critical areas and 95% contour for the potential home range. Bottlenose dolphins' non-random aggregations are associated to all the major river drainages at the inner basins and still areas of Golfo Dulce, which represents key critical foraging habitats. Results suggest that the development of a luxury marina project has the potential of negatively affecting the critical habitats of both local species by becoming an important source of anthropogenic impacts due to increased maritime traffic and the associated noise pollution.

The second study of Chicoreous brevifrons analyses some reproductive aspects of the species in La Restinga lagoon, Margarita Island, Venezuela, at four stations in the

inner and outer sides of this lagoon. Samples were taken monthly and used to determine sex ratio; in addition, some eggs were also taken monthly from the site for description and observation of initial growth of the species. Further biological and population studies of this species are recommended in order to know more about its ethology, commercial importance and how they affect mollusc cultures. The third article emphasises the importance of the California Gulf due to its high biodiversity and as a key area for artisanal fisheries in Mexico. However, there is a current concern regarding threats to the Gulf such as a Global warming which have caused major changes in marine communities. Consequently, the aim of that study was to estimate the possible impact of increasing ocean temperatures on key species.

1.2 Research Question

According to Biddix .D (2009), a research question is the core of any research. A research question derives from the philosophy of finding a problem or investigation that needs to be addressed. In other words, a research question must be very well investigated. It should contribute to knowledge, improve education, be feasible, clear, concise, and to be the core of your research. A good research question will help the author to concentrate and develop a coherent logical investigation. In other words, it ought to delimit from a general all-about topic to a specific and well-explained subject of study.

The purpose of this research is to make a deep analysis of the different types of translation techniques and methodologies as utilized in a translation of documents from two different languages. Doing a study of those processes in both translations will prove that the techniques are not the same when translating a document from English to Spanish or from Spanish into English. What is the effect of translating the document of ¨The Fire Investigator" from English into Spanish and ¨Análisis espacial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae)

en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina','Aspectos reproductivos de Chicoreous brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela and lastly, 'Proyeccion de cambios en la tempertura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales¨ from Spanish into English?

1.3 Purpose and Significance of the Study

Nowadays, the increasing and constant use of technology, the demand for information, and the urgency to find a quick response to an investigation has affected the impact of having a good translation; that is to understand the significance of a text in a different language to reproduce an equivalent in the other one.

The main purpose of this investigation is to facilitate the understanding of both documents to the reader and prove on how the methods and techniques of translation are applied to give value to a translation. The importance of those documents is crucial to improve the education of the audience as, shown in the translation of the Fire Investigator, which was published in the United States. Many members of the organization feel uncomfortable reading it, due to their lack of technical knowledge of English. Facilitating the understanding of the book will help the firefighters to develop more tools and knowledge on how to prevent a fire incident, what equipment can be used to collect evidence, roles and responsibilities of a fire investigator, photography, and many other topics that will be useful to minimize a fire and maximize the outcome of the investigation for the court.

The other documents to be translated are also very technical; and their purpose is to raise awareness and educate the reader about the damage caused by new technologies in the development of a maritime project in the Golfo Dulce of Costa Rica. Likewise, the

other article intends to inform about the reproduction of a mollusk, which is characterized by being carnivorous, microphagous, and relatively abundant in Venezuelan coasts, this mollusk has a great economic and ecological importance since it preys on oysters and other mollusks in marine environments and culture systems. Finally, the third article states an increase of the sea temperature in the California Gulf that could bring about an imbalance in the composition and ecological function of the coral reef systems gradually changing the relative abundances of species. Therefore, the implementation of effective monitoring programs of communities would be an essential factor to detect future effects of global warming.

1.4 Objectives of the Investigation

1.4.1 General Objective

To evaluate the procedures and methods used to translate "The Fire Investigator" from English into Spanish for the Cuerpo de Bomberos of Costa Rica and "Análisis espacial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construccion de marina' and 'Aspectos reproductivos de Chicoreous brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela" and ´Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales' from Spanish into English for the Universidad Nacional.

1.4.2 Specific Objectives

- To translate the documents "The Fire Investigator" from English into Spanish and "Análisis especial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo

Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina' and 'Aspectos reproductivos de Chicoreous brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela" and ´Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales' from Spanish into English for Universidad Nacional.

- To apply various translation procedures to the documents in order to achieve understandable texts.
- To analyze the effect of the translation procedures applied to the translations.
- To design a glossary with the most relevant terminology found in both texts.

1.5 Limitations of the Study

The limitations of the study are also known as those characteristics of design or methodology that impacted or influenced the interpretation of the findings from research. In other words, the shortcomings, conditions or influences that may affect or restrict the methods and analysis of the data, which cannot be controlled by the researcher to place the conclusion of the investigation (Biddix, 2009).

Although this investigation is meant to achieve every item of the research, there were some unavoidable limitations. First of all, the technical terms of the general documentation has limited the translation; due to the fact that, there has been some vocabulary which is not available or easy to find in standard dictionaries or the Internet. But rather than that, the technical vocabulary can be only analyzed in the application of the study of expertise shown in the documentation to be translated. This is the case of some of the chapters of "The Fire Fighter Investigator" text that contains a lot of photography and camera vocabulary, as well as, descriptive physical evidence that can be comprehended only by reading the content of the text.

On the other hand, not having the document to translate from Spanish into English has been a critical limitation for the research; thus, it delayed the elaboration and exposition of the document to be investigated, and also, it has affected the due date for the delivery of the work. At the same time, is influencing the awareness to know to whom the translation is going to be directed to and what type of procedures and methodologies of translation may be used.

Furthermore, the time limit has played an important role for the research. Not having enough time to develop the document could restrict the comprehension, elaboration, wide exposition of ideas, and dissection of the research may not be the same as when elaborating the study. Knowing that, the purpose of this investigation is to describe the utilization of qualitative strategies of translation to review analysis of concepts as a possible solution to the limitations encountered.

Chapter 2

Theoretical Framework

The following chapter is going to be oriented towards the different methodologies and procedures of translation. The idea is to mention and discuss the importance of each one in order to understand the research of documents to be translated. As it was mentioned in the previous chapter, the target of the thesis is to identify and analyse the different practices of the translation techniques used in the translation process of four documents: “Fire Investigator” (in English) “Análisis espacial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina”, “Aspectos reproductivos de *Chicoreous brevifrons* (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela”, and Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales”, articles used from the Universidad Nacional of Costa Rica. Therefore, the paper is going to expose some of the main translation authors, the different meanings and usages of their techniques and why they become important to be implemented. In the last section, an introductory glossary will be included. Thus, the reader can clearly understand the unknown vocabulary.

2.1 Text Analysis

Toury (1978) mentions that translation is an activity that involves at least two languages and two cultural traditions. Thus, people understand the message of translation by applying the elements of their own culture. As Newmark says (1988, p.7), translation is the meeting point of different cultures and civilizations, and it has been instrumental in transmitting culture. Furthermore, each translation performed should have its own

purpose and cross-cultural bilingual communication bridge. In other words; it can be said, that a translation task is a cross-cultural as the languages being compared. In order to accomplish those tasks, a deep research and investigation of the text and culture must be done in order that, the translation can be read as coherent and logically as the original.

Newmark interpreted culture "as the way of life and its manifestations that are peculiar to a community that uses a particular language as its means of expression" (1988, p.95). Newmark does not see language as a component or feature of culture (Toury 1978, p. 200). As mentioned before, there is a set of cultural words that translators must consider when translating every specific text, as there could be as many versions of the same document as many cultures could be identified. Therefore, text analysis in translation has become a very important field of study in terms of the functionality and approach of the translation. Frequently, translation theories classify translatable texts according to their subject matter: non-literaty, literary, scientific, terminological, etc. However, Newmark (1988) prefers to categorize texts based on their language usage. Therefore, understanding a text demands both a close and a general reading. In other words, it is important for the translator to read the books, at least, a couple of times in order to understand and analyse it.

A translator begins his/her work by reading a text for two purposes: first, to understand what the document is about, and secondly to analyse it from a translator´s perspective. A text is understood by reading it the first time. That is called general reading to get the gist and function of the document. According to Newmark (1988), "for the translator the function precedes the description" in the reading of a text. While, close reading brings the readers close to the text. As translators, we should need to know all the words, letter by letter and in their context. In other words, close reading is a way to create a deep understanding and of the text. For instance, *'Psychoanalytic literary criticism*

*privileges two basic analogies. First, 'mind': the literary text can be understood as the human mind is understood. Second, 'mother': all relationships, including literary ones between persons and texts, reverberate with the strong emotion ungendered by and associated with one's childhood family ties" (*Gardiner, 1985, p.113-4). To understand that subtitling grammatically, one single passage will not be enough without a close reading to interpret it and then be translated accordingly.

According to Newmark (1988), "Translation theory's main concern is to determine appropriate translation methods for widest possible range of text or text categories" (p. 19). Moreover, he believes that a translation may lose its meaning before of being translated. Because of this, he suggested some criteria for analysing translatable text. First of all, the intention of the text, which means the point of view of the text: what is the purpose of the text. Different texts may describe a particular incident differently using the same facts and figures; however, the type of language used in the text, the ways of describing, and the style demonstrate the intention of a text.

Secondly, the intention of the translator, the aim of every translator, is to be guided by an identical intention as that of the author (Newmark, 1988). Nonetheless, there could be some circumstances where a translator may differ, but translators are expected to follow the original according to the user´s needs. Third, it is known that a translation is ultimately meant for a specific audience. Therefore, it is important to comprehend and scrutinize the readership (age, informed, ignorant, teenagers, adults, etc.). Knowing the reader and the setting of the text would be easier to keep the nature of the translation and its style of presentation. Lastly, a translator has to take into account the quality of writing and the authority of the original text (Newmark. 1988).

One of the main prerequisites for a translator is to be acquainted with the text he/she is translating. An expert translator should be able to identify what the text is all about, the

intention of the author, as well as, the function it is accomplishing. To do so, Newmark (1988) suggests the analysis of the text be divided into several points. The analysis of a text will be discussed in terms of the relationship of concepts to the practical problems of translation.

2.1.1 Text Styles

It is important not only to translate the idea transmitted by the original document in another language but also to ensure that the translation has a specific writing style to facilitate its reading and understanding. According to Newmark (1981, p.19), "Translation theory's main concern is to determine the appropriate translation methods for the widest possible range of texts or text categories." However, he believes that a translator has to make some generalizations about his/her text before translating it. Thus, there are some writing techniques that might be used when translating a text, Newmark (1988, p.13) cites different types of texts according to Nida.

1. Narrative: A dynamic sequence of events, where the emphasis is on the verbs or, for English, “Dummy” or “Empty” verbs plus verb-nouns.
2. Description: This is static, with emphasis on linking verbs, adjectives and adjectival nouns. A statement or account that describes; representation in words.
3. Discussion: A treatment of ideas, with emphasis on abstract nouns (concepts), verbs of thought, mental activity (consider, argue, etc), logical argument and connectives.
4. Dialogue: With emphasis on colloquialisms and phaticisms.

2.1.2 Stylistic Scales

Newmark states (1988, p. 15) ¨Note that there is some correlation between formality and emotional tone, in that an official style is likely to be factual, whilst colloquialisms

and slang tend to be emotive. In translating, the effusiveness of Italian, the formality and stiffness of German and Russian, the impersonality of French, the informality and understatement of English have to be taken into account in certain types of corresponding passage.¨ In other words, it can be said that stylistic scale also known as register, text style, applies when a translator´s main purpose is to analyse the type of language in a document.

2.1.2.1 Scale of Formality

As Newmark mentions (1988, p. 13) ¨The average text for translation tends to be for an educated, middle-class readership in an informal, not colloquial style). The scale of formality remains in the formality of the translation, and it may differ from environment and relation. In other words, the style of the document will depend on the relation with the other participant. Thus, it was divided into the following categorization:

Officialise: The Consumption of any nutriment is categorically prohibited in this establishment.

Official: The consumption of nutriments is prohibited.

Formal: You are requested not to consume food in this establishment.

Neutral: Eating is not allowed here.

Colloquial: You can't feed your face here.

Slang: Lay off the nosh.

Taboo: Lay off the fucking nosh.

It is also important to mention that even though this style can be volatile in all languages not all formalities are commonly used in different cultures and societies. Thus, it is valuable to understand that all ideas can be expressed through every type of formality, some ideas cannot be changed from formal to slang and vice versa (Newmark, 1988).

2.1.2.2 Scale of Generality or Difficulty

The scale of generality or difficulty refers to the level of complexity of the documents. Thus, one of the main purposes of a translator is to investigate the educational level of the readership. Newmark (1988, p. 14) contributes with the following list of difficulty scales:

Sample: The floor of the sea is covered with rows of big mountains and deep pits.

Popular: The floor of the oceans is covered with rows of big mountains and deep pits.

Neutral: A graveyard of animal and plant remains lies buried in the earth's crust.'

Educated: The latest step in vertebrate evolution was the tool-making man.

Technical: Critical path analysis is an operational research technique used in management.

Opaquely technical: Neuraminic acid in the form of its alkali-stable methoxy derivate was first isolated by klenk from gangliosides.

2.1.2.3 Scale of Emotional Tone

The scale of tone is related to the vocabulary used in a written document. It can be said that the emotional tone gives to the document a "personality". For instance, the intense tone in documents focuses more on giving a message by using marked vocabulary; while a warm tone in texts gives a message with a gentler one, and a factual tone can be a variation of both styles in a text to convey a message with a gentler way of expression.

In regard to the scale tone, Newmark (1988, p.14) proposes the following,

Intensive: Absolutely wonderful… ideally dark bass… enormously successful… superbly controlled.

Warm: Gentle, soft, heart-warming melodies.

Factual: Significant, exceptionally well-judged, personable, presentable, considerable. Understatement. Not… undignified.

According to Newmark (1988, p. 15), there is some connection between the emotional and formality tone; an official style is likely to be factual, while colloquialisms and slang tend to be emotive. Scales that should be taking into consideration according to the formality, effusiveness, formal, informal and impersonality of the source of the TL.

2.1.3 Text Function

The nature of a translation is the nature of the language itself; similarly, the function of the translation is to communicate. Therefore, theories of translation should mirror theories of language. In this respect, there are two linguists, and the functions of language are presented by two well-known linguists: Karl Buhler (1934) and Roman Jakobson (1960). Karl Buhler mentions three functions of language, representational, referring to objects in the real world; expressive, referring to the writer of the text and conative, referring to the reader of the text, Jakobson (1960, p. 350-377). Buhler exposed three functions but expanded them up to six linguistic functions:

1. Referential: Referring to objects in the real world.
2. Expressive: Referring to the writer of the text.
3. Conative: Referring to the reader of the text
4. Phatic: There the function of language is to establish, maintain, prolong or discontinue communication.
5. Metalinguistic: referring to when the text is focused on the code itself.
6. Poetic: When the text is focused on the message for its own sake.

The idea of a text function is to accommodate the translation based on the culture is which the text is going to be translated. It means that certain requests on language have to suit the functions of speech and writing. Newmark (1981, p. 21) quotes as follows; "…

The main three functions of language are the 'expressive' (the subjective 'I' form), the descriptive or 'informative' (the 'it' form) and the 'vocative' or directive or persuasive (the 'you' form) and the minor functions being the 'phatic', the 'metalingual' and the 'aesthetic.' There are some text types according to functions of language:

2.1.3.1 Expressive Function: The main core of this function is the mind of the speaker, the writer, the originator of the expression. Expression stands to expose the feeling regardless of any response. According to Newmark (1988), 'the main feature of the Expressive Function of language is the mind of the writer.' Some characteristics of utterance text-types can be found as serious imaginative literature, lyrical poetry, short stories, novels, plays, authoritative statements, political speeches, legal and academic documents, autobiographies, essays, and personal correspondence.

2.1.3.2. Informative Function: The purpose of an informative function of language is the external situation, the facts of the topic, reality outside language, and it includes reported ideas or theories. In other words, the main factor of the informative function of language is the fact of the topic and of the author. As Newmark (1988) states the typical informative texts are about any topic of knowledge. The format of an informative text is often standard: a textbook, a technical report, an article in a newspaper or a periodical, a scientific paper, a thesis, and an agenda of a meeting. High parts of such texts are poorly written and sometimes inaccurate, and the aim of the translator is usually to correct their style and facts.

2.1.3.3. The Vocative Function: The essence of the vocative function of language is the readership, the addressee, Newmark (1988). It is related to force the reader to react to what has been written. Also, based on Newmark (1988) the core of this function is the readership, and has been given lots of other names such as: "conative" (denoting effort), "instrumental" (instrumental), "operating," and "pragmatic" (in the

sense of used to produce a certain effect on the readership). In addition to what has been mentioned, it must be written in a language that is immediately comprehensible to the readership.

Inflected Language: In other words, a language that changes the form or ending of some words when the way in which they are used in sentences changes. It includes: the genitive 's, the plural –s, the third-person singular –s, the past tense -d, - ed, or –t, the negative particle 'nt, -ing forms of verbs, the comparative -er and the superlative –est. Aesthetic Function: The aesthetic function (called by Jakobson the poetic). This is a language designed to please the senses, firstly through its actual or imagined sound, and secondly through its metaphors, Newmark (1988). In the majority of cases, it is not possible to translate sound effects unless one transfers the relevant language units: compensation of the kind is usually possible but not hard to translate, unless the word is simply missing in the other language (lexical gap.) For instance, onomatopoeia, alliteration, assonance, rhyme, metre, intonation, stress. Similarly, rhythm, contrasts of sentences, and balance also play an important role when applying this function.

2.1.4 Translation Methods

A method is a procedure to accomplish or approaching something, specifically something that has been already created, in this case, the documents to be translated. Newmark (1988, p.45) mentions the difference between translation methods and translation procedures. He states, "[w]hile translation methods relate to whole texts, translation procedures are used for sentences and the smaller units of language" (p.81). He goes on to refer to the word for word translation, literal translation, faithful translation, semantic translation, adaptation and free translation as follows:

- Word-for-word translation: in which the SL word order is preserved and the words translated singly by their most common meanings, out of context.

- Literal translation: in which the SL grammatical constructions are converted to their nearest TL equivalents, but the lexical words are again translated singly, out of context.
- Faithful translation: it attempts to produce the precise contextual meaning of the original within the constraints of the TL grammatical structures.
- Semantic translation: which differs from 'faithful translation' only in as far as it must take more account of the aesthetic value of the SL text.
- Adaptation: which is the freest form of translation and is used mainly for plays (comedies) and poetry; the themes, characters, plots are usually preserved, the SL culture is converted to the TL culture and the text is rewritten.
- Free translation: it produces the TL text without the style, form, or content of the original.
- Idiomatic translation: it reproduces the 'message' of the original but tends to distort nuances of meaning by preferring colloquialisms and idioms where these do not exist in the original.
- Communicative translation: it attempts to render the exact contextual meaning of the original in such a way that both content and language are readily acceptable and comprehensible to the readership (Newmark 1988, pp. 45-47).

In addition to what was mentioned before, we can conclude that a method of translation is a process, technique, or even a particular discipline of art whose main objective is to develop a language ability to allow one to understand and create a great number of correct sentences. In addition, Newmark (1988, p. 45) quoted that, "The central problem of translating has always been whether to translate literally or freely." However,

it is important to take into consideration the reader's perception and the kind of text that is going to be translated. Considering what has been said before, Newmark proposed some methods of translation, which are the Semantic and the Communicative.

2.1.4.1 Semantic Translation

Semantic translation represents one of the main contributions of Peter Newmark to general translation theory. The main purpose of a semantic translation is to render, as closely as the syntactic structures of the second language, allow the exact contextual meaning of the original (Newmark-1981). Therefore, the semantic translation has to deal more with the meaning and nature of the text than specific techniques and procedures of translation.

Anderman and Rogers (2003) mentioned that in the semantic translation the translation is based on meaning and it is the job of the translator to interpret the message and convey it as faithfully as possible into the target language (p.70). However, this is much more complicated since it has to stick to the original and be faithful without distorting the message (Lonsdale 1996, p.29).

2.1.4.2 Communicative Translation

Different from semantic translation, a communicative translation deals with the understanding of the readers. According to Newmark (1988, p, 41) a "Communicative translation, attempts to render the exact contextual meaning of the original in such a way that both content and language are readily acceptable and comprehensible to the readership". Thus, the translator has to focus on the target text and ensure that the readers will understand the message of the text.

In addition, Anderman and Rogers (2003) emphasize that communicative translation should provide and easy and understandable language or everyday language, so it can be comprehensible to the reader (p.71). Generally a communicative translation

tend to be smoother, simplier, clearer, more direct, more conventional in terms to finally create an easy and comprehensible text. According to Newmark (1988, mentioned by Lonsdale, 1996), the differences between communicative and semantic translation can be appreciated in detail in the following chart (p.30):

Figure2.1

Semantic translation	**Communicative translation**
Source language bias	Communicative Language Bias
Literal	Free
Faithful	Idiomatic
Semantic	Communicative

2.2 Translation Procedures

In popular belief, to translate, a person only needs a reasonable knowledge of a foreign language and a few dictionaries. To others, translation is an intuited process that is based on the translator's creativity and capability. On the other hand, there are those who believe that only specialists can translate. Those who make these assertions fail to make a distinction between factual knowledge and procedural knowledge. However, before moving forward into the topic, it would be relevant to mention the differences between methods and procedures in translations.

According to Newmark (1988), translation methods are related to the whole text, whereas translation procedures are used for the translation of sentences and other smaller units of language. For instance, in order to translate a text, the translator has first to choose a method to reach unity and keep the style; nonetheless, in the technical

translation of the same text, the translator has to use as many procedures as needed to make it as the author desires.

Because of that, there are some skills required that can be used to translate from one language to another in agreement with some theoreticians, such as Nida, Vinay, Darbelnet, Isadore Pinchuk, López Guiz and Brinton and more recently, Newmark and Vázquez Ayora. The majority of them, agree with the procedural and name of the techniques, and others enlarge the list by providing more detailed specifications of the procedures, for instance, Newmark.

In the chart below (Guerrero 2011), the contributions that all of the theoreticians made is presented:

Vazquez Ayora	Lopez Guix	Brinton	Newmark
Transposition	Transposition	Transposition/Rephrasing	Transposition
Modulation	Modulation	Modulation	Modulation
Equivalence	Equivalence	-	Equivalence (Cultural, functional and descriptive)
Adaptation	Adaptation	Adaptation	Adaptation
-	Calque/Loan	-	Direct Translation
Amplification	Expansion	Insertion	Extension/Paraphrasig
Omission	Reduction	Omission	Reduction
Compensation	Compensation	-	Compensation
Literal Translation	Literal Translation	-	-
Explicitation	-	-	-

-	-	-	Recommended Translation (Ethics)
-	-	-	Doubles
-	-	-	Additional Notes

2.2.1 Transposition

Vázquez Ayora (1997, p. 268) mentions that transposition has as its main objective to substitute some of the elements of the speech mostly in the part of syntax. Besides, Newmark (1988) considers that this procedure consists on a variation in the elements and structure of the language. So, it can be considered that the transposition process is where parts of speech change their sequence when they are translated, without forgetting that grammatical structures are often different in different languages. Transposition is often used between English and Spanish because of the preferred position of the verb in the sentence; while, English often has the verb near the beginning of a sentence; Spanish can have it closer to the end. This requires that the translator knows that it is possible to replace a word category in the target language without altering the meaning of the source text.

Example:

She likes driving sport cars.

A ella le gusta conducir autos deportivos.

2.2.2 Modulation (Oblique)

Modulation consists of using a phrase that is different in the source and target languages to convey the same idea. It changes the semantics and shifts the point of view of the source language (Modulation in Translation, 2004). Also, Vázquez Ayora (1997,

p.291) explains modulation means to transform a complete unit without losing the parameters of language and without getting out of context while the sense is kept. Through modulation, the translator generates a change in the point of view of the message without altering meaning and without generating a sense of awkwardness in the reader of the target text. In addition, we can say that the importance of the modulation process lies very much in the reader and the intention of not noticing that he/she is reading a translation but an original text. It is often used within the same language.

Example:

Normal temperature for humans is about 98°F

La temperatura normal humana es de 37°C

2.2.3 Adaptation

According to Adaptation in Translation (2004), adaptation occurs when something specific to one language culture is expressed in a very different way that is familiar or appropriate to another language culture. Newmark (1988) also mentions that this is the freest form of translation mainly used for plays and poetry: themes / characters / plots / preserved, SL culture converted to TL and the text is rewritten. In other words, it involves changing the cultural reference when a situation in the source culture does not exist in the target culture. Here something specific to the source language culture is expressed in a totally different way that is familiar or appropriate to the target language culture.

2.2.4 Compensation

According to Fawcett (1958, p. 189), compensation is defined as "...Making good in one part of the text something that could not be translated in another. Also, Newmark

(1988) mentions that a compensation methodology occurs when loss of meaning, sound-effect, metaphor or pragmatic effect in one part of a sentence is compensated in another part, or in a contiguous sentence. In general terms, compensation can be used when something cannot be translated into the target language, and the meaning that is lost will be expressed somewhere else in the translated text. For example, the use of "you," which means tú o usted in Spanish.

2.2.5 Equivalence or Reformulation

This procedure is used to adapt words that cannot be literary translated from the Source language into the Target language. In addition, Newmark (1988, p.83) states that ¨This is an approximate translation where a SL cultural word is translated by a TL cultural word¨ he also adds that ¨Their translation uses are limited, since they are not accurate, but they can be used in general texts, publicity and propaganda, as well as for brief explanation to readers who are ignorant of the relevant SL culture. They have a greater pragmatic impact than culturally neutral terms. Therefore, equivalent procedure aims to adjusting something in a completely different way, for example, when translating idioms, sayings, or advertising slogans. For example;

I have to dress up for the meeting.

Debo vestir formal para la reunión.

2.2.6 Calque (Loan)

According to Fawcett (1958, p.35), ¨A calque is a literal translation at the level of the phrase¨ and it has been mentioned that Vinay and Darbelnet do not consider its use at the morphemic level in translating terminology. In other words, a calque or loan translation is a phrase borrowed from another language and translated literally word-for-word into the target language. The task of the translator is crucial in this type of

procedure, since it may indicate the lack of expertise of the translator in the target language. For example;

Me gustan las películas de ciencia ficción.

I like science fiction movies.

2.2.7 Direct Translation

As stated by Vinay and Darbelnet (1958) ¨… note that due to structural and metalinguistic parallelisms that occur between languages it is often possible to overcome gaps (or lacunae) between the source language and the target language by transposing the SL message piece by piece into the TL¨. Direct translation is used when structural and conceptual elements of the source language can be transposed into the target language. Direct translation techniques include borrowing and calque. Borrowing, which is considered one of the simplest procedures used for translation that involves using foreign phrasing in the target text. And calque, as mentioned before, is a special kind of borrowing; which the TL borrows an expression from the source language by translating literally each of the elements.

2.2.8 Literal Translation

As the name of the procedure is called, literal translation is when a text can be translated from the source language into the target language with no changes other than those grammatically required. Vázquez –Ayora (1977, p. 257) describes this process as, "If, given two utterances, one in English and the other in Spanish, there exists between them a precise correspondence of 'structure' and of 'signification,' and the equivalence is achieved moneme by moneme. Literal translation results and can be applied without risk." He also says (p.257) that, "The translator should not alter this process out of an itch

to change things or out of simple fear of the criticism (from he ignorant) that the translation is literal in the pejorative sense of the term" For example;

I have a headache.

Me duele la cabeza.

2.2.9 Paraphrasing

Paraphrasing, according to Vázquez-Ayora (1977), “cannot be a translation method because when using it a text it loses its characteristics. Too many explanations destroy the conciseness of the work and makes it subject to the same distortion of its counterpart-literal translation.” In addition to that, the art of translation does not mean explaining or commenting on a text or writing it in our own way. It goes deeper than only interpreting and comment about something the translator understood. However, Newmark (1988, p. 90) emphasizes an excellent scenario where this technique can be implemented ´´This is an amplification or explanation of the meaning of a segment of the text. It is used in an 'anonymous' text when it is poorly written or has important implications and omissions.

2.2.10 Omission

According to Omission in Translation (2004), this procedure tries to omit redundancy and repetition that is characteristic of the SL. Additionally, eliminating unnecessary words and avoiding the over-translation, which can be so common when translating documents from Spanish into English. For example;

The committee has failed to act.

La comisión dejó de actuar.

2.2.11 Inversion

The purpose of the translation procedure of inversion is when two elements of the text change their position. For example,

The phone rang.

Sonó el teléfono.

2.2.12 Amplification

Also called addition because its main purpose is to add words to amplify the idea. Vázquez-Ayora says that translations from English into Spanish tend to be longer than the other way around (1977, p. 336).

2.2.13 Transference

A SL word is directly taken into the TL text with no translation, (retrieved from Transference in Translation, 2004). Moreover, this procedure can be used in proper names, geographical names, and names of companies and institutions, literary works addresses, and in technical terms that do not have equivalents in SL.

2.3 Glossaries

Most of us believe that a glossary is only used for term papers and reference books. However, it can revolutionize a daily work life and more than that to comprehend in a wider way a translated document. Translators or students that are becoming future professionals in the art of languages must be constantly updated and aware of learning new vocabulary of all topics. Therefore, the creation of a glossary could be considered as a life saver to the translators, writers and readers, as it will avoid inconsistencies, and redundancies in the original language. So, it is important to start creating a glossary of approved terms in each target language at the beginning of the translation project.

According to the Real Academia (2001), a glossary consists of a list in alphabetical order with terms and words that belong to a specific subject or area of study, and each one of those terms is explained in different contexts, which also includes its equivalent in the target language. Furthermore, as stated by Veraldi et al. (2004), the first procedure when building a glossary is to have it clear which the main objective will be and how it is going to be useful for other people.

2.4.1 Relevance for the Translator

Lionbridge (1996) mentions that a glossary is an important tool or document that helps to mitigate inconsistencies. The glossary contains key terminology in the source language (typically English) and approved translations for that terminology in all the target languages. The glossary may also contain other metadata such as the definition, context, part of speech, and approval/review date. Veraldi et al. (2004) also refers to a database of terminology which will assist in keeping the terms organized. Therefore, a translation glossary is a document or database that contains abundant terminology in the source language and will store all of the approved translation variants of terminology in the target language. Thus, glossaries that differ in size are found, from spreadsheets, large databases; nonetheless, all of them will help a translator to standardize the terminology and use definitions consistently and correctly.

2.4.2 Relevance for the Translation Process

One of the main goals of the translator is to meet the dead lines of the translated documents; for that reason when preparing to go through the process developing a translation glossary can help to speed up the process and ensure a smoother transition. Therefore, a well-developed glossary is one of the most important tools for a translator, since it will help to save time when looking for an specific word plus its meaning and, at the same time, it will keep a record of unknown words that may be useful in future

translations. In addition to what was mentioned before, the importance of a translation glossary is a necessity for quality translation. It is a valuable process since it will improve accuracy and avoid confusions.

2.4.3 How to Create a Glossary

Moreover, it is crucial to understand or, at least, to have an idea of how to create a glossary. To write a glossary, first it will be necessary to identify the terms of the main text that will need to go into the glossary. Then, can be added the creation of the definition for those unknown or unusual words, making sure the formatting is correct and easy to read. In order to achieve that, it will be necessary to take into account the necessary steps:

1. **Identifying Terms for the Glossary**

   First, it is necessary to read the text carefully; until unfamiliar terms will be located. After that, an editor would be fundamental to identify the unknown terms of the text. There are many kinds of editors; some are proofreaders, grammar and format reviewers to make the writers' works more readable. Authors' editors will work with a writer before the submission of the book/text. The reader would also be critical to identify terms for you and using them in the glossary.

2. **Create definitions for the glossary terms**.

In order to keep track of the terms that are going to be used in the glossary, it is required be needed to write a brief summary for each term, so that none of the terminology will be lost. Once, all the vocabulary is listed and ready to appear up in the glossary; it is important to keep the definitions simple, avoiding the usage of abbreviations and most of all; keeping it reader-friendly.

3. Formatting the Glossary

At the end of the work, the terms must be placed in alphabetic order by separating them with bullet points or spacing. It may vary in the style or creativity of the writer´s preference. The terms or words to be defined should be italicized or in bold in the glossary. Finally, the writer will choose to place the glossary before or after the main text.

To sum up, Rosten (2016) mentions that, a glossary is a mini-dictionary of words, acronyms and abbreviations tied to and part of a specific book, manual, treatise, website or another document. The glossary will be limited to include only terms used in the material that may not be understood by all readers, so it needs not be huge. It is very helpful to the novice reader. A well-thought-out glossary allows for maximum comprehension to all in a minimum amount of time and eliminates confusion even among those well versed in the discipline. Thinking of a glossary ought to be as a way of living, breathing document, growing and evolving with the translator or translations needs. It will make the work valuable and will ensure consistency and clarity in all the translated materials.

Chapter III

Methodological Framework

This section provides a deep description of the research method, as well as, its primary scope. The process of selecting the texts to be translated, in addition to the background of every institution where those documents were taken from and the type of population to whom these texts are intended to, also the strategies implemented to accomplish the research method and also the instruments and validation of those resources.

3.1 Research Method

The intention of a research method will depend on the question that the investigation is about. In other words, the investigation will gather all the information and data to accomplish the translation of both documents by executing specific methodologies. According to Creswell (2008), "Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis…" (p.3); therefore, he explains that there are different kinds of research approaches that can be implemented during the decision of studying the topic. There are three types of strategies of inquiry: qualitative, quantitative and mixed methods.

According to Creswell (2010), there are some preliminary considerations of the alternative strategies, as shown in the table below (p.12).

Quantitative	*Qualitative*	*Mixed Methods*
Experimental designs	Narrative research	Sequential
Non-experimental designs, such as surveys	Phenomenology	Concurrent
	Ethnographies	Transformative
	Grounded theory	
	Case study	

Table 1. Alternative Strategies of Inquiry.
Taken from Creswell (2010)

Qualitative research is determined by its objective, which is related to the understanding of some aspects of social life through data collection; therefore, quantitative methodology is focused on testing the theories through measurement tools, and lastly, mixed methodologies also known as pragmatism; which are a combination of both methodologies mentioned above.

The mixed method can be defined as the union that between the qualitative and quantitative paradigm, when one or more instruments of both paradigms can work together in a research (Biber, 2010; p.3). Also, Creswell (2010, p.10) mentioned that "Pragmatism is not committed to any one system of philosophy and reality. This applied to mixed methods research in that inquirers draw liberty from both quantitative and qualitative assumptions when they engage in their research." Furthermore, it can be said the individual has a freedom to select which procedure will meet his necessities during the investigation. It is important to mention, that if the mixed methodology is going to be used, the researcher has to set a purpose of why both methods need to be mixed in the first place, but as for Plano and Creswell (2010), the mix method also helps to clarify and unravel the inquiries that can come during the research.

The qualitative strategy is primarily investigative research. According to Benzin and Lincoln (as cited in Newman and Benz 1998, p.16) the qualitative research is based mainly on the events and situations happening on everyday life in order to perceive living beings attitude towards a specific situation. In the same way, Murray (2003) states that when there is a description of some characteristics of the human beings or events, these ones can be analyzed thanks to the qualitative method (p.1). Therefore the qualitative methodology is used to achieve an understanding of concealed reasons, motivations, and opinions through the data collection from individual interviews, observations, cultural groups, and many other resources where a narrative research is constructed. In order to have a clearer vision of a qualitative strategy (Creswell 2010, p. 13) divided the research into some behavior strategies.

- Ethnography is a strategy where a cultural group of people is observed; thus, the main goal of this study is to see people's behavior in their own terms.
- Grounded Theory is a research method which will help to arise a new theory about a main concern of a population and how it is processed. Grounded Theory is simply the discovery of emerging patterns in data. Grounded Theory is the generation of theories from data. (Glaser in Walsh, Holton et al 2015)
- Case studies are methods where the researcher deeply investigates actions, programs and focuses on temporary events. Otherwise, the goal of a case study is to determine the parameters that are going to be applied into the entire research.
- Phenomenological research is research that describes the lived experienced through a phenomenon. As he also mentioned (Creswell, 2018) an analysis of meaning focused on experiences and behaviors.

- Narrative research is the study which is mainly emphasized in the story of experiences of an individual or group of people through the written or spoken words of their own experiences.

In short, it may, therefore, be concluded that qualitative research illustrates how it is supported all through the investigation of human behaviors and experiences that are kept across extensive research of data collection.

On the contrary, as mentioned by Wyse (2011), the quantitative research method is useful to "quantify the problem by way of generating numerical data or data that can be transformed into usable statistics" (p. 3). It is understood as the investigation of a problem or hypotheses generating numerical data. This strategy is used to quantify attitudes, opinions, behaviors among others by means of a variable. (Creswell 2018, p. 12)

As a final point, the definitions mentioned above will give global idea on how the investigation about the translated documents is going to take place according to the qualitative methodology based on previous researchers and studies performed by experienced translators. Thus, instead of focusing the research into human behaviors, this investigation is going to scrutinize the results of processes and methodologies of translation techniques.

3.2 Selection and Description of the Population

The main function of a selection and description of a population in research is that it will give background information to derive the strategies applied in the investigation. However, this section in particular is focused on the history of the institutions, as well as, their mission and vision. It also will illustrate the purpose of the documents for the institutions and so on; there will be an enunciation on how those strategies, techniques or

any kind of resources used were implemented in the translation of both documents from English into Spanish and vice versa.

3.2.1 Description of the Institution

The first translation document is from Bomberos de Costa Rica, which is the Benemirita institution of firefighters. According to its history, the first incidents of fires have been known since 1543, where the natives as a sign of protest to the humiliation of their Caciques burnt two villages. Throughout the years, the incidents have become more regular in our country and most of them caused by arson. The state of things continued the same way until the nineteenth century, Costa Rica still did not have a formal and organized group of people to fight fires at that time.

History records registered booked many events on January 26th, 1864 in San José, due to an enormous fire incident, which damaged the property of Francisco María Iglesias who was an important member of Costa Rican political groups and a church historiographer encouraged the Costa Rican people to create the first properly organized fire bridge. On February 15 on the same year, The Town hall of San José started gathering volunteer contributions from the citizens to bring the first firewater pump from United States. Simultaneously, the City Council prepared and presented to the Poder Ejecutivo the official regulations of the fire fighters bridge and which was approved until July 1865.

This event started the beginning of the activities of that kind of organization in Costa Rica. From that moment, a new era for firefighters´ organizations began. The National Insurance Bank was concerned to provide firefighters with modern equipment, specialization members, and many other circumstances so they decided to invest money to start building fire stations across the country. The Bank authorized the Fire Department

to create a volunteer service for firefighters, the first of which was organized in 1927, formally being constituted on July 25. Upon reaching a hundred years of service of its foundation in 1965, with 20 fire stations in the country; the Fire Department of Costa Rica received an honorary name to the nation ¨benemeritazgo.¨ Furthermore, it is important to mention that their primary services are to contribute to the prevention, protection and improvement of its members; thus the mission is to provide prevention and protection to services to safeguard life, property, and the environment. Likewise, its vision is to be a reference for quality and innovation at national and international levels.

Moreover, the other document presented is from a public prestige institution of Costa Rican Universities known as Universidad Nacional. It is nationally and internationally recognized because of its dedication to investigation matters and ranks as one of the best universities around the world. The university was created on February 15th, 1973 under the government of the president José Figueres Ferrer and the Minister of Education Uladislao Gámez Solano and only after one month of the proposal on March 14th, the university was housing the first school activities. It is located in Heredia province, under the slogan of ¨Truth makes us free¨, its main campus, also located in the same place, nowadays offers more than 100 undergraduate and postgraduate options in different fields of human knowledge, such as natural and exact sciences, earth and sea sciences, education, social sciences, health sciences, philosophy, letters, and arts.

As it frequently grew not only in time but also in quality, the university gathered the best of Latin-American students and it was defined as a ¨necessary university¨, which made the path as a service institution of the less privileged sectors of the Costa Rican society, by offering equality of access to higher education; this led the university to create a project to contribute to the Costa Rican society “scientific, cultural, and social

educational project that is comprehensive, inclusive and, above all, to the service of the Costa Rican society" (Universidad Nacional, 2015, p.2).

In addition to that, it is of high importance to mention the mission of the Universidad Nacional has to do with the devotion given in preparing professionals thoroughly and disseminating knowledge that contributes to the production of positive changes in society through teaching, researching, and other means which are primarily for the disadvantaged sectors of the population (Universidad Nacional, Costa Rica, 2015).

There is as well, a benchmark for its academic excellence for the practice of its autonomy, innovation and social commitment at the regional and national levels and its primary vison on ¨its substantive action will promote a sustainable, comprehensive and inclusive human development that will be based on the exercise and promotion of respect for human rights, the dialogue of knowledge, interdisciplinary and critical thinking. Its institutional management will be characterized by being agile, flexible, deconcentrated, with democratic participation, transparent, equitable and inclusive, that promotes healthy lifestyles.¨ (Universidad Nacional, Costa Rica, 2015).

3.2.2 Description of the Population

It is known that a research of population is generally a collection of individuals and objects; however, as it has been pointed out in previous paragraphs, this particular research is about two translated documents from non-profit organizations; in other words, the translated documents would function as part of the research population on this study. This part of the investigation is going to give an overview of the documents, what they are about, and what their fundamental characteristics are. Thus, a better understanding of those documents will give a wider point of view to the investigation.

First, Fire Investigator; principles and practice to NFPA 921 And 1033 is a set of principles and practices known as an user's manual for fire investigators, detectives and any other investigation related to fire incidents. The core of the book is to illustrate an integrated teaching and learning system for a fire investigator program. It was originally written in English by talented professional fire investigators from the International Association of Arson Investigators (IAAI) and has an approximately 472 pages.

This book was a total touchstone for investigators when managing and as a collaborating guide for conducting safe and systematic investigations. The editor is Jones & Bartlett and was published around 2012. The third edition of the fire investigators book is split into twenty-six sections, which include case-based learning ¨You Are the Fire Investigators, Voices of Experiences, and Fire Investigator in action scenarios¨. It also emphasizes on safety and experience by providing safety tips and fire investigator tips in every unit, it also has full-colour pictures and photographies (most of them are fake) to provide a real picture of the scenarios for future investigators. In short, the process of translation from English into Spanish is going to take place from a small part of the book, there were taken out only 25 pages from the chapters of ¨*Documentation of the Investigation* and *Physical Evidence*¨.

On the other side, the Faculty of Exact and Natural Sciences, which has its own school library located at the Universidad Nacional has provided three articles from REWMAR magazine to be translated from Spanish into English. Universidad Nacional of Costa Rica has a thirty-year history of elaborating scientific documents but with limited options about the marine field. In response to those needs, the institution created a space for prestigious researchers to share their findings nationally and internationally; from this, emerged the REWMAR magazine, known in Spanish as *Revista Ciencias Marinas y Costeras.* The purpose of those documents is to incorporate original publications related

to marine sciences, such as biology, geology and marine ecology, evolution, systematics and taxonomy of marine organisms, oceanography, pollution, fisheries, marine biotechnology, conservation and integrated management of marine and coastal resources.

REWMAR is annually offered thorough printed form and digital version on its website. The mission of this magazine ¨responds to the necessity to offer and spread to the community of well-prepared researchers an option of high quality and strictness to include unpublished investigations about marine science and promote its maximum reach and visibility¨ (REWMAR, 2015).

In regard to the three articles, they differ from each other, however altogether, they make an amount of 25 translated pages. The first article is about the *Spatial analysis on the critical habitats of bottlenose dolphins and humpback whales in Golfo Dulce* (Costa Rica), the second one of *Forecasting changes in sea surface temperature in the Gulf of California, and their effects on abundance and distribution of reef species* and, lastly the *Reproductive aspects of Chicoreus brevifrons from La Restinga lagoon, Margarita Island, Venezuela*. Similarly, they contain a short abstract information which develops the research and findings accordingly.

3.2.3 Sample

As previously explained in the description of the population, the translated documents are considered as part of the samples in the investigation. Because of that, it is important to understand what a sample is meant for. A sample is only a small portion, just a specific part of whose objective is to represent the complete population (Wimmer & Dominick, p.88). In the same way, Powell (1997) states that it consists of only a specific part that needs to be included in the research. He also states that it is better to use a sample than a whole population, since time and other factors can become an obstacle

(p.67). In order to have a better understanding of sample of population, it can be defined as a small section of the whole population.

In regard to this research, the sample of investigation will work in a small part of the translated documents. For every translation a quota of 15 paragraphs were taken in order to analyze the different processes, techniques, and translation methodologies. Once, the researcher decided the sample to investigate, an in-depth analysis will be executed in the following chapters of the investigation. In addition, it is significant to quote that a number of fifteen paragraphs were chosen as an estimate to evidence the translation analysis.

3.3 Implemented Strategies

The importance of implemented strategies comes from comprising the specific means or methods to support the translation analysis. Thus, it is going to establish a background on how the analysis went throughout the whole translation process in the research. Firstly, the documents were obtained from two non-profit organizations, Bomberos de Costa Rica from English into Spanish and UNA from Spanish into English. The investigator will have the responsibility to carry out the procedures to perform an accurate translation. The first task of the translator is to read the documents in order to understand and analyze the content of the originals; the documents can be read as many times as possible as long as the meaning is comprehended by the researcher. As Nord (2005) mentions, getting a full comprehension of the source text is guaranteeing that the message is properly understood before rendering it to the target language, thus, ensuring a transparent and faithful translation.

Hence, there has to be an in-depth analysis of the documents and articles in regard to the context and meaning to understand the intention of the author. After that, what kind

of text style applies in the translation process is determined: narrative, descriptive, with a treatment of ideas or emphasized in colloquialisms and phaticisms. Once, the style of the text is comprehended, the researcher can move forward to identify the documents within the type of scales represented a range of possibilities such as; formal, general and emotional tone can be utilized. This will give a general idea to the translator and she will be able to accommodate the documents based on cultural background. In other words, the language the translator is going to use has to meet the functions of the writing, ¨Text function¨ (Newmark (1981, p. 21).

After the process of analysis is finished, the next action will be to apply the translation techniques to be explained later with different kinds of instruments. A variety of translation procedures are going to be applied in order to translate the documents; so that the readers would have a clear understanding of the document in the target language. The translator has to decide if to apply a translation in a single unit, word, sentence, phrase or a complete paragraph.

Secondly, the researcher is going to develop another strategy to identify the translation procedures; she will apply a color-coding flow in order to emphasize and easily find out each technique used in the translation of the documents. 15 paragraphs of each document of translation and the procedures of modulation, literal translation, transposition, omission and any other kind of technique applied to analyze them, will be chosen and illustrated with different kinds of colors.

At knowing that both translation documents are elaborated with a high level of language to be translated, a third strategy has to be implemented to simplify the translation efforts. As mentioned by, Gapper (2008) it is not expected for a translator to know the meaning of all the existent words; however, designing a customized glossary for

each translation is like having a handy dictionary that includes all the proper names, abbreviations, technical words, and so on, that have been previously selected by the translator. In other words, a glossary will be designed to better understand the content of the documents.

3.4 Data Collection Instruments

Instruments are the main term that researcher use in regard to the research question. Any kind of instrument can be applied and will be suitable to achieve the work. In the same way, instruments are fundamental to prove the investigation, it supplies real facts and credibility to the development of the research. In addition to that, Wilkinson & Brimingham (p.3) states that research instruments are essential when it is necessary to obtain the most relevant information simply**.**

3.4.1 Text Analysis Chart

As previously mentioned, the first task of a translator is to identify the style, scale, and text function the translator is going to use in the analysis. According to Grammel and Unrau (2010, p.482), these types of instruments are essential when the information is numerous and has to be summarized or just to include the most important aspects. Therefore, a text analysis makes qualitative research faster and easier by categorizing important terms.

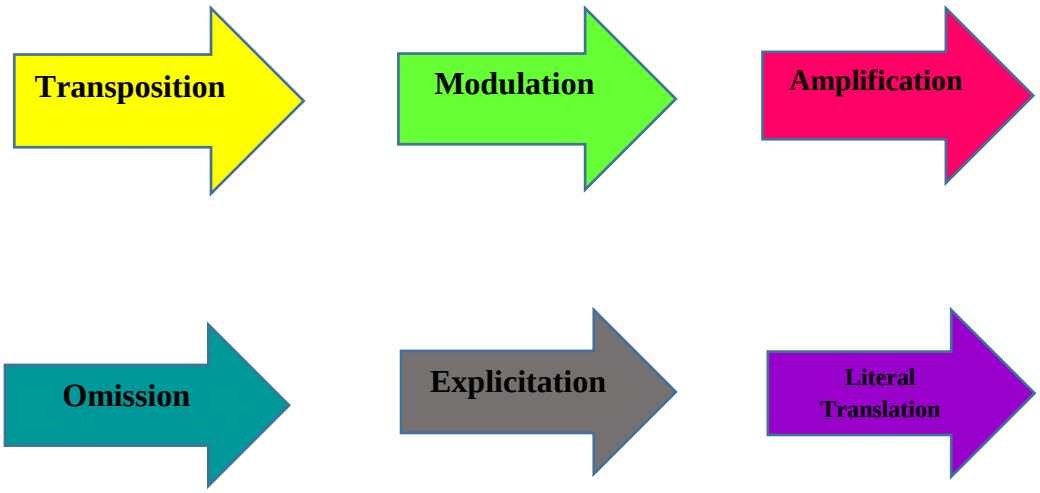
The purpose of the chart is to show the main characteristics of both source texts, especifically the text styles; formality, difficulty, emotional tone, text function, and translation type.

Text Analysis	The Fire Investigator	Análisis espacial de los hábitats críticos del delfín nariz de botella y la ballena jorobada en Golfo Dulce, Costa Rica	Aspectos reproductivos de Chicoreous brevifrons de la laguna de La Restinga, isla Margarita, Venezuela	Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales
Text style				
Formality				
Difficulty				
Emotional tone				
Text function				
Translation type				

Table 2 shows the text analysis instrument.
Source: Researcher's own creation

3.4.2 Color Coding

Color coding is one of the most useful instruments to show how the translation techniques are implemented during the analysis of the documents. A color coding is a visual system which reduces language and barriers when exposing a procedure. For that reason, a coloring system will be explained to understand how the six translation tecniques are differiantiated. In other words, a set of six different colors are choosen by the reasercher; such us, yellow which will locate the transposition process, green to find the modulation changes, fucsia to identify amplifications, turqouise to find out omissions and, grey and purple to detect explicitations and literal translations.



Block arrow shapes shows the color that represents each technique in the color-coding instrument. Source: Researcher's own creation

That way, the color-coding will be highlighted through the 15 paragraphs and will indicate the changes of translations used in both documents merged into the target language.

3.4.3 Glossary

Finally, an essential type of instrument for a translator is the creation of a glossary. The elaboration of a glossary could be considered as a lifesaver to the translators, writers and readers, as it will avoid inconsistencies, redundancies in the original language. Hence, it is important to start creating a glossary of approved terms from unknown vocabulary that will help to understand meaning and content in the documents.

Two bilingual glossaries will be elaborated for each translation; in other words, one glossary for the document translated from English into Spanish and another one from Spanish into English. First of all, it is important to mention the table will be elaborated as simple as possible (user friendly). After clarifying that, the glossary will be divided into four main categories to identify what information will be filled in each row. The first columns show the ¨Source language¨ of the vocabulary that may be difficult or impossible

to understand, then the second one includes the ¨Target language¨ which will provide the ¨how¨ it has to be translated into the target language, and next to it will appear the meaning according to the content in the documents.

In addition to that, a special column was added to better illustrate concepts when a specific concept of translation was difficult to find. The font to be used is Times New Roman size 12, and all of the terms will be filtered from A to Z and numerically ordered.

Source Language	Target Language	Meaning	Picture
1.			
2.			
3.			
4.			

Table 3. Format of the glossaries that will be created after gathering the most relevant terminology found in both texts.
Source: Researcher's own creation

Chapter IV

Translations

4.1 Translation from Spanish into English

Spatial Analysis on the Critical Habitats of Bottlenose Dolphis *(Tursiops Truncatus)* and Humpback Whales *(Megaptera Novaengliae)* in Golfo Dulce, Costa Rica: Considerations for a Marina Construction Project

Abstract

Introduction

The critical habitats are defined and classified in important biological contexts, such as feeding, reproduction and breeding protection from predators, resting and migration among others (Hooker and Gerber, 2004; Hoyt, 2011). To state if an established habitat must be considered as critical, has ecological consequences in a legal level related to management and preservation processes (e.g., FWS, 1998); thus it is important to clarify key concepts, such as habitat and the processes that are linked to. For a better understanding in this study it is adopted the conceptualization of habitat as the sum of the resources that an organism needs for its survival. Habitat is a definition that is specific to each organism, since it is related to a species population, or individual (Hall etal. 1997). In this way, the selection of such resources implies a process of decisions that lead to innate and learned behaviours, as well (Johnson, 1980). Consequently, it results in the disproportionate use of a resource over another (Hall et al. 1997).

Golfo Dulce is a very important habitat for species of costal cetaceans (Oviedo et al, 2009 2015). Among the structural characteristics of this internal sea, it is found a great number of rivers that drain into the intern basin, carrying big amount of dissolved and

particulate organic matter, as well as contaminants associated to anthropogenic activities (agriculture, livestock and urbanization) that take place in the area. Such situation has brought as a consequence the degradation of the water column due to the incorporation of heavy metals and organic compounds of synthetic origin into the Gulf (Spongberg and Davis, 1998; Umaña, 1998). The environmental impacts caused by these activities vary and synergistically increase in the long term, leading to a disrupt in the habitat of coastal cetaceans (Thompson et al, 2000; Hooker and Gerber, 2004).

The objective of this study is to identify the areas of critical use of Humpback Whales and Bottlenose dolphis in the Golfo Dulce by estimating the potential impact of current coastal developing projects due to a spatial overlap with such essential habitats; specifically, the plan to establish a luxury marina in the outskirts of Puerto Jimenez. The analysis proposes an approach where the distribution of use is associated to ecological solutions, in the way in which the Tursiops truncates are feed behaviours related to courtship and reproduction of the Megaptera novaeangliae, contextualized in conservation and management.

Materials and Methodologies

Area of the study: Golfo Dulce (Fig.1) is an internal sea; usually called tropical fjord, with 50 km length and 10-15 km width, located in the South Pacific area of Costa Rica between the 8° 33’ N and 83° 14’ 0. It has a humid tropic climate with a rainy season that goes from May to November; therefore, this generates an average monthly precipitation of 100-700 mm (Quesada-Alpizar and Morales-Ramirez, 2004). The main contribution of freshwater comes from the rivers Coto Colorado, Tigre, Esquinas, and Rincón, with a direct influence in the circulation pattern of a remarkably stratified estuary (Svendsen et al, 2006). The peculiarities that make the Golfo Dulce to resemble a true fjord, are shown

in the structure of its water bodies. Two layers are highlighted: (a) superficial warm layer (32° C average) diluted with an average salinity of 31 UPS, to a depth between 50 to 60 m, upon the threshold located outside the bay. (b) The other layer is made of deep and homogeneous waters, where temperature can reach a minimum of 15.4 °C and salinities extend to 34.8 UPS. Tidal and wind forces and the inflow of water into the system, influence directly the mixture and circulation of these waters, along with the upwelling of subsurface water and the topography of the basin (Quiros, 2003; Quesada Alpizar and Morales-Ramirez, 2004). The structure of the tides of the Gulf has three layers in the outside and a circulation of estuarine type in the inside (Svendsen et al, 2006). As mentioned before, the area of study is going to be divided in the inner basin, the threshold area (Quiros, 2003), and the oceanic transition area.

Data Collection: The samplings were focused to the registering and monitoring of cetaceans. They were carried out in 7m length vessel, with a 115 HP four-stroke, in the three subareas described above. With the goal of covering the largest possible area, samplings followed a zigzag pattern (variable) from the place of origin (Bahia Rincón or Puerto Jiménez). The sampling presented in this analysis include two seasons: dry (November to May) and rainy (June to October), from March from 2005 till December 2014. Samplings started in the morning (07:00-08:00) and ended in the middle of the afternoon (14:00-16:00). The sample unit and sightings integrated the definition the group used by Karczmarski et al. 2005, and the behavioural observations, according to Lusseau and Higham (2004) and Oviedo (2008), as well. Detectability conditions required of a periodical registering in order to have an effective behavioural and acoustic sampling. Therefore, a GPS positioning reading was made every 30 minutes (Garmin etrex H, 5 meters error approx), along with some environmental variables; such as condition of the sea (Beaufort scale), surface temperature (measured through a field thermometer), tidal

cycle (tide table of the MIO-CIMAR oceanographic information module), and the appearance or lack of it of cetaceans (Fig. 1). The above described, allowed the follow-up of the field effort and the creation of a presence-absence matrix of cetaceans, as mentioned in Gowans and Whitehead (1995).

During every encounter the boat approached to a distance of 100 m from the sighting target. Relevant notes about the sighting were taken, such as: encounter time, specie type, size and group composition; as well as behaviour (at the beginning and 10 minutes after it). These data were recorded along with the spatial position of the boat through GPS readings (assumed as the relative position of the sighting item, since there is a separation of 100 m). Once the initial standard data collection of the sightings was completed, depending on the aim of sighting and the behaviour monitoring to determine significant abnormalities, that a group follow-up protocol was started: a) an ethological sampling following the methodology of Lusseau and Higman (2004) and Oviedo (2008) to determine critical habitats, and b) an acoustic sampling. The register of acoustic information was restricted to humpback whales sightings and for the purposes of this contribution, that attempted to document the relevance of the area in the acoustic behaviour of the specie, vocalization is considered as the unit to process such sampling, with the respective qualifications that guarantee the non-temporal and spatial autocorrelation of each georeferenced vocalization. This registers are data associated with an acoustic study of these species in the area of study, which are still in progress, including the effective quantification of potential males by capture and recapture. The acoustic sampling was executed through a previous monitoring of the ambient noise conditions. The recordings of the vocalizations were made through a combination of recorders (Sony TCD D-5 *digital tape recorder; sampling rate 48kHz*) and hydrophone (NSF-PW, SCH40) calibrated in a range between 5db (12.0 Hz to 35.0 kHz). Once the

relationship of the acoustic signal/ambient noise was corroborated, the hydrophone was deployed to verify the presence of whales, the occurrence of singing vocalizations (all seasons 2010-2013, n=55), for a short period of 5 minutes, where additionally some spatial data registers (GPS readings) were collected, as well as environmental data (surface, temperature, tides). Once the vocalizations and particularly the completion of songs were confirmed, it was proceeded to record the cycle of the song and to take photographs of the individuals singing, according to Oviedo et al. (2008).

Data Analysis: The spatial data gathered from the methodology previously described, were processed to evaluate the distribution of bottlenose dolphins and humpback whales in the area under of study in contrast with behaviour of such species. For M. Novaeangliae sightings, groups were segregated among those where offspring (including mother-offspring and triads pairs) were included and groups without offspring (adults and sub- adults); additional to the acoustic records that corresponded to singing whales. The use distribution was described trough the ratio of the nearest neighborhood (Average Near Neighbour Ratio-ANNR), which averages the real distance of the centroid of each spatial element under evaluation and contrasts it with the average distance of each element, with a hypothetical random distribution. From above mentioned, it is obtained spatial dispersion measurement (incorporated, eventful, evenly) among elements and their ecological implications (Forting et al. 2002; Begon et al. 2006). The statistical significance of such measurement, is obtained through the ¨Z-score¨ calculation, which is associated to a normal distribution and allows to establish significant and build trust actions.

The previous analysis was combined with Kernel density estimations (KDE), using the *least square cross validation* method, through the ArcGIS 9.3 (ESRI, 2008) software. Two edges of the kernel density estimations were specified to illustrate: a) the

potential household area by the edges that contains 95% of the volume of the records by species, and b) the nucleus area that represents the critical habitat through the edges that consolidate the 50% of the volume of all the records associated to the behavioural observations by species.

The main purpose of these edges is to show the complete distribution of the species in the totality of the area under study and highlight the locations where there is an important aggregation of key activities associated (behaviour records) with survival (Hooge and Eichenlaub, 2000; Lusseau and Higman, 2004).

Case Study: ***Luxury Marina in Puerto Jiménez Bay:*** The development project of a marina in the Puerto Jiménez area, consists on the building and operation posts for the berthing of ships. The effective amount of berths for sale or rent is about 257 units, which in total are equal to 5000 meters in length. Apart from that, the project includes an area of 9000 m, from which 2674 m² would be destined to commercial purposes and the remaining 6326 m², to the construction of 74 rooms hotel for the marina to the users (Araya-Montero et al, 2006). The environmental impact assessment of the Luxury Marine in Puerto Jiménez was approved by the Secretaria Técnica Nacional Ambiental through resolution N°2424-2008-SETENA on August 8th, 2008; granting the environmental feasibility to the project, and then was modified by resolution N° 2084-2011-SETENA on August 30th, 2011; in this way, modifying the constructive projects contemplated within the approved environmental impact assessment, reducing the capacity of vessels in the design according to the level previously described.

Results

After 10 years of taking samplings in the Gulf, it has been obtained a homogeneous spatial coverage in the internal basin, around 40 000 Km = 50% of the total

effort (Fig 1), while the coverage for the threshold zone and the oceanic transition zone present a constant increase. This has involved an investment of 3490 field hours, equivalent to approximately 79300 km travelled in active search and individual tracking. It was collected around 422 registers from bottlenose dolphin's observations and 167 records of humpback whales in coastal areas. Figure 2 shows the most important behavioural details in activities carried out.

Spatial Distribution of Bottlenose Dolphins: The spatial pattern of groups of T. truncates grow is of an aggregated type, according to what the average nearest neighbour index. Such spatial clustering pattern This type of clustering is statistically significant, as it is reflected by the statistical ¨Z score¨, and the measures of likelihood in Table 1. The distribution and habitat usage of T. truncatus in Golfo Dulce is exemplified in Figure 3, through some registers associated to behavioural feeding evidence (N=244 = 60% of the total of sightings).

The usage distribution is expressed through the edge that includes 95% of the bottlenose dolphins' records (KDE-adaptive: Density 5.50 records/km^2; H=0.042; H-REF=0.40), belonging to the home ranking. The home range of bottlenose dolphins is found along the Golfo Dulce coastline, in the inner basin of the coasts, especially in the surrounding areas of Puerto Jiménez. These critical feeding areas are bound with the threshold area. The nucleus concentration areas are centralized in a affluence zones of the river mouths and its adjoining; specifically along the Rincón, Esquinas, Coto Colorado rivers, with special mention to the subsystem formed by Tigre and Platanares rivers. According to the above mentioned, we can identify as areas of a higher usage, the river mouths as critical feeding habitats to the bottlenose dolphins.

Spatial Distribution of Humpback Whales: The humpback whales in Golfo Dulce are allocated in significant aggregated groups (< 0.001, table 1) of significant character; as it stated by the average nearest neighbor index. Aggregations of humpback whales, including mothers and calves groups, as well as males in courtship are illustrated in Figure 4, which has the corresponding edges of the home range (KDE-adaptive: Density 1.33 records/ km2; H=0.25; h-ref= 0.49) and the edge that defines the aggregation nucleus area (KDE-adaptive: Density 21.36 records/km2; H=0.25; h-ref= 0.49). The sighting records mentioned before are supplemented by the results from the samplings, where 64% of the vocalizations identified as male singing potentially in courtship (n=35), they are located in the nucleus area (Fig 4).

The threshold of Golfo Dulce area is consolidated as a critical reproduction area and calving habitat of humpback whales. This species use the entire coastal-marine extension of the Golfo Dulce as a stational range during its annual migration; nevertheless 50% of the records are located in an exclusive area, adjacent to the mouth of the river Platanares in Puntarenitas, until getting to the portion of the occidental threshold and the transition of the Gulf to the Pacific Ocean. This area has significant records of females with calves, as well as whales in their reproductive years, executing and carrying out complex characteristics of behavioral reproduction in competitive groups and vocal registers of male singers. The previous results, throughout the edges of usage distribution and the type of grouping aggregation, established geographical elements that support this key spatial elements that support the intense usage of this area as an important refuge zone for females with calves. In addition, there is a high incidence of vocalizations (males singing) that are found in the threshold area.

Figure 5 shows the mid-portion of the Golfo Dulce coastline in the surroundings of Platanares river, where it can be observed a coincidence between the highest feeding

area of bottlenose dolphins and the greatest presence of female-calves of humpback whales. It also illustrates, the specific location of the development project of the marina in Puerto Jimenez Bay by pointing the critical foraging habitat of bottlenose dolphins and humpback whales, mentioned before.

Discussion

Critical Feeding Habitat of Bottlenose Dolphins: According to the cetaceans critical analysis of coastal habitats in Golfo Dulce, the bottlenose dolphin has an aggregation pattern associated to discrete feeding areas (Parrish and Edelstein-Keshet, 1999). The critical feeding habitat was identified in the nucleus areas of Tigre and Platanares rivers; and it is mainly based on behavioral feeding records in the present study and in previously researches (Pacheco-Polanco and Oviedo, 2007; Oviedo, 2007; Oviedo et al, 2012). Feeding is a fundamental biological activity that may affect the reproductive success of a species. This behavior reflects an ecological dynamic response of the organism to the available resources and habitat structure (Gowans et al. 2007); therefore, not only the usage of the habitat would be evident, but also a selection process that results from an intensive consumption (in a general way) of particular resources that such discrete locality offers; in contrast to what is available in the whole Gulf area (Wheeler et al, 2012). The overlap among the critical feeding areas with the marina can have significant effects in this community, since in this same area it has been found dermal conditions; specifically the disease called LLD (*Lacaziosis Like Disease),* according to what it was mentioned in Bessesen et al. (2014). It is a fungus infection related to the degradation of environmental conditions. It is estimated that a previous frame of immunotoxin compromise by exposure to pollutants, could promote the morbidity of this dermic disease (Reif el al, 2009). This illness affects the coastal dolphins species (Van Breseem

et al, 2009) as they are more exposed to human activities in their critical areas (Bowen, 1997; Thompson et al; 2000; Gowans et al, 2007; Jefferson et al, 2009).

Critical Reproduction and Nursery Habitat of Humpback Whales: The portion of the adjacent umbral area to the Puerto Jimenez bay offers special conditions to protect and preserve the energy for groups of mother and calves (Craig et al, 2014). Márquez-Artavia et al. (2012) suggested that those aggregations actively avoid the mix-areas, where the regimen of water flows promote the creation of turbulence, in order to facilitate the preservation of energy during nursing (Clapham, 2008). The singing of humpback whales aspect is an important behavioural element that stands out as a crucial courtship and breeding aspect (Tyack, 1981; 2000; Clapham, 2000); Oviedo et al, 2008; Smith et al. 2008). This particular reproductive behaviour defines the usage of the in this area in particular habitat. The differential habitat use among female with calves and males singing in courtship is diffused by the small scale of geographical scale where these events happened and by the relationship between the availability of females and the greater population of males in areas of wintry aggregation (Craig et al, 2002; Clapham, 2008), which in turn can generate a competitive group of males chasing females (Craig et al, 2002; Spitz et al, 2002) even those females who already have calves of the season (Clapham, 2000).

Case Study: Luxury Marina in Puerto Jimenez Bay: The spatial data provided previously have as a purpose to highlight that results derive from observation and behavioral records, associated to an ecological ¨fitness¨ value of the species under study, as considered in Spencer (2012); in the case of the bottle dolphins, such value is the energy gain due to feeding, while for humpback whales, the value is the probabilities of copulation and reproduction. The creation of a marina project of such magnitude, that leads to an abrupt environmental alteration, would limit the availability of the resources in

the area of usage, which affects the obtantion of energy to the resident population of bottle dolphins. The constant behavioral changes such as feeding, resting, and socialization have an impact on the vital biological functions (Constantine et al. 2004; Lusseau, 2006; Lusseau et al, 2009) resulting in negative effects in the population growth (Lusseau, 2004; Bejder et al. 2006). It is important to take into consideration that the area already shows evidence of individuals affected with LLC (Bessesen et al, 2014); therefore, it is expected that a habitat with more disruption than the current, would increase the spread of the disease in number of the affected dolphins and chronical evolution of the mycosis in them.

The increase of the ship traffic due to the creation of a marina would result in negative impacts in the existing critical reproduction and nursing habitats. The negatives effects of sea traffic in whale-breeding areas, has been studied in detail (Jensen and Silber, 2003; Hinch and De Santo, 2011; Guzman et al, 2013; Laist et al, 2014); in addition, it has been reported boats collisions with whales in areas with high concentration of aggregation animals (Guzman et al, 2013; Laist et al, 2014). In EE. UU is documented that there is 80% of collision between boats and humpback whales which involve young and calves less than three years old (Laist et al. 2001).

The increase in ship traffic would affect the process of courtship-reproduction since, it might cause a masking effect in the songs due to sonic pollution (Nowacek et al, 2007; Sousa-Lima and Clark, 2008). Therefore, this continues to be a potential aspect in the behaviour of males, which may affect in their reproduction (Darling, 2008). In the reproduction and breeding area of humpback whales in the Abrolhos National Park in Brasil, it was determined that the increase of boat traffic affects negatively the increase of sounds that mask the singing process of humpback male whales (Sousa-Lima and Clark, 2008). In those scenarios, the song was much shorter and had less vocal structures or got

completely interrupted, forcing males to leave the courtship zone; in contrast to the observations in areas where the prevailing conditions did not present any alterations by boats.

The management and conservation strategies to mitigate the anthropogenic effects listed before should underpinned in a comprehensive understanding of the habitat requirements of the susceptible species (Gerrodete and Eguchi, 2011). The fact of not considering the presence of critical habitats jeopardies the sustainability of the local populations by directly affecting key biological functions for survival (Lusseau et al, 2009). The consequences of the generated impacts are not only in a local fashion, as in the case of the coastal population of bottlenose dolphins in Golfo Dulce, as it could also affect migratory species.

The establishment of the *Marina in Puerto Jimenez Bay* could affect two kinds of migratory subpopulations of humpback whale; those who feed on critical habitats located in the temperate zones of the Northeast Pacific (M. n. *kuzira*, Jackson et al, 2014) and the ones who feed in the temperate zones of the Southeast Pacific (M. n. *australis*, Jackson et al. 2014), but that reproduce and raise their calves in critical habitats along the coastal zone of Osa Peninsula, including Golfo Dulce.

The management and conservation objectives in Golfo Dulce should emphasize the precautionary principle and stablish conservative decisions that favor the protection of the resources, as the Scientific Committee of the International Whaling Commission recommends in its 66th meeting (IWC, 2015). At last, the study suggested to relocate the project in coasts outside the Golfo Dulce, since this area represents key habitat in the survival of residents and migratory populations of coastal cetaceans.

Acknowledgements

The authors appreciate the financial support of the following institutions: Earthwatch Institute, International Student Volunteers, Society for Marine Mammalogy, American Society International. In the same way, we are thankful for the collaboration of Marcos ‘’Taboga’’ Loaiciga, Jorge Medina, and Azucena Herra-Miranda. This manuscript benefit from the input of three anonymous reviewers; we thank you for your valuable contribution.

Reproductive Aspects of *Chicoreus brevifrons* (Lamarck, 1822) (Neogastropoda: Muricidae) from La Restinga lagoon, Margarita Islan, Venezuela

Introduction

In the eastern shores of Venezuela, *Chicoreus brevifrons* is commonly known as chirigua, chivato or arrechon (Itriago, 1977) and it is characterized by having a large shell (approximately 200 mm Tl), tapered, large coil, flat cord, winding and serrated outer lip, oblique siphonal canal, bordered by thorns, somewhat curved towards the back; robust varicose veins with thick, foliated spines (Marval, 1981; Nieto-Bernal et al. 2011). It may have a great color variation and in the development of the spinal processes; according to the function of the different environmental conditions in which it lives (Diaz and Puyana, 1994).

The high trophic availability in mangrove areas *Rhizophora mangle (*red mangle) constitutes a good substrate for sessile organisms, providing protection to larvae and juveniles of numerous invertebrate species, such as *C. brevifrons* (Quinceno and Palacio, 2008); therefore, these shallow-waters are their habitat (Marval, 1981: D’ Armas et al. 2009). This natural habitats facilitate the growth and development of the species; thus, its wide distribution and have the necessary food.

The aspects that determine the reproductive behaviour of shellfish may vary according to its nature; for this reason, it is important the execution of samplings that allow the collection of information to develop biological studies (Tresierra and Culquichicon, 1993; Baquiero and Aldana, 2003).

Many species of the Muricidae family are of great commercial importance; consequently, the fishermen exploit them for consumption purposes and handmade use of the shell. The study of spawning, eggs capsules, and gastropods embryos are important not only to understand biological reproduction in general, but also their dispersion, biogeography, and taxonomy implications (Mostafa et al, 2013). In Venezuela, it has been developed many investigations about *C. brevifrons*, among which it can be pointed out the work of Itriago (1977), who carried out a cytogenetic and anatomical study of the species; Marval (1981) made comparative studies about the digestic track and contributed to the biology of *C. brevifrons* and *Chicoreus pomun*; Cabrera et al. (1990) evaluated their biology; Miloslavich et al. (2207), by analysing the gastropods Imposex, they considered the specie as susceptible to this phenomenon; Galindo (2009) carried out dimorphism studies; D'Armas at al. (2009) found out the composition of fat acids; and Ordaz et al. (2010) investigated the secondary metabolites of the species. Given the economic and ecological importance of the species as predators of oysters and other mollusks in crops and marine environments; there were evaluated reproduction aspects of the species in order to provide up-to-date information to be used as a basis to suggest sustainable management strategies, as well as considering potential cultivation of *C. brevifrons* in Venezuela.

Materials and Methodologies

Area under study and Sampling: The Laguna de la Restinga National Park is located between 10° 58’ and 11° 05’ North latitude and 64° 01’ and 64° 17’ West longitude, in the isthmus that joins the Macanao peninsula with the eastern area of Margarita Island, Nueva Esparta state.

The lagoon is segregated from the Caribbean ocean by a rail sand or restinga is about 23 km long and 50 m wide, and this is the only natural union between Margarita Island and Macanao peninsula (Ramirez, 1996). There were carried out monthly sampling in four areas of the Restinga lagoon: El Pato, Manamo, El Gato, and El Indio; considering the location of such areas from the inside of the lagoon to the outside (Figure 1). In every trip, specimens of *C. brevifrons* were recollected by means of free diving, in order to obtain animals of all the sizes observed in the area. These were extracted from hard (mangrove roots) and muddy substrate; they were stored in bags previously identified with the respective location name, to take them later to the lab.

Sexual Proportion: The general sexual proportion was gathered from monthly samples of the species. The shells of Muricides snails lack of sexual dimorphism (Naegel and Gomez del Prado, 2004); therefore, to determine sex, it is necessary to extract the individuals from the shells to observe the sex of each one, by macroscopically identifying the presence of the penis in males and absence of it in females, who have an albumin capsule, the gland of the capsule, and the vagina (Miloslavich et al. 2007). The sexual proportion, by months and in total, was analysed through the Chi-square test (Zar, 1996) to prove if it differs from the 1:1 relationship.

Evaluation of the Posture Development and Initial Growth: They were gathered from some postures for their description and the observation of growth of juveniles.

The samples were photographed in the environment and placed in water containers to keep them safe during the relocation to the laboratory; thus, to keep the water temperature. At the same time, the capsules were extracted from the aquarium inasmuch as it was observed changes in their colouring, keeping this procedure until the moment of eclosion, besides registering the time of eclosion and initial growth with measurements in a total longitude of every 5 days, time established after a previous study.

Results and Discussion

Sexual proportion: It was recollected a total of 381 samplings of *C. brevifrons* with sizes among 40 and 140 mm, respectively (69.37 = 28.00), among which, 224 were females (58.79%) and 157 males (41.21%). Females were more frequent than males. In general, the sexual proportion was not diverted towards 1:1; even though, in April and July females prevailed over males (Figure 2; Table 1).

The estimated sexual proportion between sexes for *C. brevifrons* did not vary from value 1:1, as stated by Marval (1981), who got a 1:1 proportion for the same species in Mochima, Araya Peninsula; allocating such results to the fact that the species were in breeding season and the sexual proportions were match. It is likely that our results are because the months in which females were more abundant (March, April, July, and November), regarding males, represented the spawning seasons. On the other hand, different results have been published about different species of Muricides; Olabarria (1999) had a significant sex proportion different from 1:1 for the *Hexaplex erythostomus* specie; as well as Morfin (2000), who got it for *Plicopurpura pansa,* concluding that the sexual proportion may be affected by changes in the spatial distribution of the organisms.

Chicoreus brevifrons growth:

In Figure 3, it can be observed the posture carried out by *Chicoreus brevifrons.* It consists of a cluster, with 65 to 165 small capsules (white color recently laid) (Fig. 3-A), where each capsule has an spindle-shaped appearance, with the upper part sealed by a mucous plug that breaks when hatching, and inside them are the fertilized eggs. As the days pass by and the individuals start developing in their capsules, the external ones darker their color to a yellowish one and in the internal parts, it can be observed small lilac masses (Fig 3-B and C).

An important feature of the species under study is its ability to reproduce itself through internal fertilization and the realization of the egg laying in special capsules. According to Roman et al. (2001), the number of eggs per capsule may vary; this could be due to the size of the adults or the environmental conditions. The kind of posture matches the descriptions of Mostafa et al. (2013) to the *Chicoreus brevifrons* species, the quantity of individuals that come from each capsule is the same to the data reported by Gonzalez (1970); however, on the other hand, Cabrera et al. (1990) points out the presence from two to four eggs per capsule, so 40 capsules is the total number for the same species in Venezuela. Mostafa et al. (2013), *C. ramosus* in laboratory conditions, reported a total of 12 to 27 developed eggs in the shape of an embryo and the rest ones became nutritional material.

21 days later it can be noticed the presence of nutritional eggs, which are the eggs that do not reach effectively their development inside the capsule, they have initial appearance. On the other hand, the eggs that have a good growth are bigger, with a more asymmetric shape by the initiation of the torsion process and it can be observed the newly formed shell (Fig 3-D and E).

Roman et al. (2001) and Cognetti et al. (2008) mentioned that non-viable eggs are an important source of food for the organisms that are growing and developing inside the ovigerous mass. At the same time, Leiva et al. (1998) mentioned that embryos begin to ingest the nutritional eggs as of 21 to 25 days of development.

From day 42, the individuals dissipate to the ovigerous mass and show a well-developed shell, inside the capsules it can be observed a brown color, which is its final appearance before hatching. This takes place as of 45-50 days after they are laid, and every capsule gives origin to 3 to 5 individuals. The initial sizes were between 1.60 and 3.90 mm long (Tl), presenting 15 days after hatching, average sizes of 4.60 mm, and at 30 days a total lengths of 5.48 mm. Besides, the shell is fully developed but, without well-formed spines (Figure 3-F and G).

The average temperature of the lagoon where the species were extracted is about 27° C; therefore, this temperature was kept in the aquarium where the organisms were developed inside the capsules, since Mostafa et al. (2013) suggested that it is important to control the environmental conditions in embryonic development studies, as they play an important role in the success of hatching and in the rate of growth of the gasteropods to cultivate. The amount of days needed for the hatching of the *Chicoreus brevifrons* individuals was about 45, which was inferior to the reported by Cabrera et al. (1990), who indicated reported hatching around day 52 since the laying of the ovigera mass and an average initial mass of 2.22 mm. However, Mostafa et al. (2013) published that a total of 40 days are necessary for the eclosion of the organisms in a juvenile state for the *C. ramosus* species. This indicates that this gender presents a possible variation in rate and hatching season.

Temperature affects the larval development of the gasteropods, contributing to the hatching of the organisms (Gongora et al. 2007), as keeping a constant temperature of 27°C favored the capsule development and survival of the animals. At the same time, Cabrera et al. (1990) indicate that temperatures lower to the habitat where *C. brevifrons* developed delays the growth of the organism inside the capsule, making the period inside the capsule; for that reason, there are some differences in the days of eclosion mentioned in the previous and present study (where temperature was 22°C). Nonetheless, it is important to point out that the length of time of the capsule development of the species in its natural environment is unknown.

The impact of the cultivation of gasteropods larval development has been recorded in other Muricides' species, such as: *C. concholepas, Xanthochorus cassidiformis, Plicopurpura pansa,* and *Murex pomum* (Naegel and Gomez del Prado, 2004). In all cases, it is concluded that a high water temperature decreases the length of larval development, while low temperatures slow down the hatching time.

Other aspects that affect the rate of hatching and growth, are the availability of food, as well as the presence of nutritional eggs. In this study, the hatching of the organisms was carried out to a maximum of 45 days with species of a minimum size of 1.60 mm. The growth rate of the organisms once outside the capsules is mainly reflected mainly in length, rather than in weight; due to the expense of energy, when feeding and in periods of shell growth. According to Gongora et al. (2011), the differences in the hatching times can be mainly explained by the incubation and feeding temperature, as well as the size and origin of their makers.

Conclusions

The general sexual proportion was of 1:1, the number of females was about 58.79% and males 41.21%, of a grand total of species (381).

The postures were shaped by a maximum of 165 capsules of white color recently laid. After 21 days of development, it can be noticed the presence of nutritious eggs that work as food to the more developed organisms.

Hatching is done after 45 days, giving as a result a minimum of 3 to 5 individual per capsule.

Forecasting Changes in Sea Surface Temperature in the Gulf of California, and their Effects on Abundance and Distribution of Reef Species

INTRODUCTION

The Gulf of California is an internal sea located between the Baja California Peninsula and the states of Sonora and Sinaloa, Northeast of Mexico. It houses more than 800 species of fish and approximately 4500 invertebrates (Brusca et al, 2005); in addition to be an important area to artisanal fishing in Mexico (Rodriguez-Quiroz et al, 2010). This area has multiple coastal ecosystems, including sandy plains, mangroves, rhodolith beds, estuaries, and rocky and coral reefs (Lluch-Cota et al, 2007). Especially, the latter ones have received a scientifically and commercially attention for their areas rich species (Roberts et al. 2002).

The economic growth of the coastal states of the Gulf of California has notably increased the commercial and touristic activities; therefore, it was an increase in the level of anthropogenic disturbances to ecosystems (Enriquez-Andrade et al, 2005). Consequently, even though this is one of the best preserved marine areas in the Eastern

Tropical Pacific, and has a high number of conservational programs, there exists a big concern about potential coastal polluters, habitat alterations, overfishing, and exceeding the load capacity of areas due to excessive tourism (Aguilar et al, 2007). In adittion, the California Gulf is not immune to the effects of global warming. The Intergovernmental Panel on Climate Changes (2014) mentioned that in the last hundred years, the global average temperature (land and oceanic) has increased from 0.65° to 1.6° C, and the sea level has raised from 0.17 to 0.21 m since the past century (1900). In global terms, the surface temperature of the ocean has increased between 0.09 to 0.13°C every decade from the last 40 years.

Different models show that surface temperature (land and oceanic) could rise between 0.3°C and 4.8°C by the end of century (2081-2100), and the sea level could increase between 0.26 and 0.85 m (IPCC, 2014). As a result, there have been reported changes in the distribution and composition of marine species communities in temperate and subtropical zones (Albouy et al. 2012; Pont et al. 2015).

There is a particular concern about what might happen in the communities due to the coral whitening generated by the increase of oceanic temperatures (Hoegh-Guldberg, 1999; Baker et al. 2008; Logan et al. 2014; Li and Reidenbach, 2014), which has apparently caused a strong reduction in the number of corals worldwide. For the California Gulf, there is only anecdotal data (e.g., Reyes-Bonilla, 2003) given the lack of important long series of biological data or detailed oceanographic. Nevertheless, the use of large-scale spacial information can help to approach this problem and allow to build physiological tolerance patterns of species, from which its distribution can be predicted (Smith et al. 2008).

It is a fact that the conditions will be different the future, reason why it is necessary to start doing investigations to prevent the impact that this phenomenon would have on the distribution, abundance, and richness of the different species, of ecological and commercial importance.

This kind of macro-ecological tools have a huge application to predict the impact that global warming might have on marine communities, and open the possibility of providing recommendations to improve the strategic planning of the creators of management plans and decision makers. Form this point of view, the objective of the study was to evaluate the tendency of change of surface temperature in the Gulf of California between 1983 and 2014, and later to use the results as inputs to project modifications in the distribution and abundance of some relevant species.

Materials and Methodologies

The California Gulf is located in Northeast Mexico. It is an inner sea with an elongated shape, oriented from northwest to southeast. It has an approximate length of 1500 km and in its widest part it is 205 km wide in the south and a minimum of 117 km in the middle of the gulf. The Baja California Peninsula is the western border, the continental clump of Mexico Northeast is its eastern border, to the north it meets the mouth of the Colorado river, and to the south, the border is an imaginary line that extends from the southern tip of the peninsula at Cabo San Lucas (23° N) through Cabo Corrientes, Jalisco, Mexico (20°) (Rusnak et al 1964; Alvarez-Borrego, 1983; Thompson et al. 2000). It is important to mention that the oceanic information to build the models is from 2007 and current, so they matched the biological data information (visual organisms surveys), which is from 2004 to 2007.

The first part of the investigation consisted on building an oceanographic database to support the models of biological changes. The Gulf was divided in gridlines of 1° x 1° of latitude-longitude (N=27), and from each one it was gotten superficial records (averages and maximum values and yearly lows) of saltiness (UPS), nitrates, silicate and phosphate (micromole), and concentration of chlorophyll (mg/m3). The information was provided from the World Ocean Atlas (2015; values from 1950-2007) and pictures from the Ocean Color Web satellite, 2005 (facts from 1987 to 2007). Additionally, in order to understand the trends of surface temperature changes in the Gulf, there were taken monthly averages of each grid of 1° x 1° between 1983 and the 2006 (NOAA, 2013; 2015), and it was calculated the annual average, as well. These values were included in a simple linear regression that used the year as a test factor and where the pending value represents the annual elevation rate of the temperature in the area (Neter et al. 1997). Lastly, with the regression equation the values until the year 2050 is calculated, with the aim of obtaining annual temperature forecosts and plan possible scenarios.

Regarding the biological data, it was made use of a temporary set of records (2005-2007) that contain visual censuses (approximately, 500 censuses) in line transects of 20 m x 5 m for fish and 20 m x 2 m for invertebrates, executed by members of the Reef System Laboratory of Autonomous University of Baja California (among them, all authors of this study). There were taken into account, mainly key species in six rocky reef ecosystems of the peninsula of Baja California (Bahia de Los Angeles, 28° N; Santa Rosalia, 27° N, Loreto, 26° N; La Paz, 24°; Cabo Pulmo, 23° N, and Los Cabos, 22° N).

From the total of censuses carried out, there were taken the abundance data of the Leopard grouper *Mycteroperca rosacea* (Streets, 1877), the Angel fish of Cortes *Pomacanthus zonipectus* (Gill, 1862), and brown sea cucumber *Isostichopus fuscus* (Ludwing, 1875), with the aim of working with them individually. The three species have

a huge economic importance and they are commercialized in at least two of the coastal states of the Gulf (SAGARPA, 2010); besides that the last two are within the Official Mexican Standard under the Special Protection category (Diario Oficial de la Federacion, 2010). In order to model the factors that determine its affluence, we used a lineal regression by steps (¨Stepwise¨), with a routine of ¨ridge, ¨ that avoids introducing correlated variables in the model (Neter et al, 1997). The tests of temperature, salinity, and nutrients were applied as variables to predict the current abundance of the three species, in every studied area in the Baja California peninsula; and it was created a model that selected the variables that most affected abundance. Later on, there were forecast the abundances of the species by area from only the oceanographic data. The last statistical analysis was addressed to assess the possible effects of ocean warming on the species mentioned before.

To that end, in the regression equation was substituted the coefficient valve of temperature value, either directly or indirectly. In this case, thanks to the results of the models there were created local change abundance scenarios caused by the increase in temperature + 1°, + 2° and + 3 ° C.

Results and Discussion

Figure 1, it can be observed the temperature elevation rate of the California Gulf in grids of 1° x 1°. In addition, it shows that the area of southern Sonora and northern Sinaloa (central-eastern Gulf of California) is where the warming is more intense, while in the Whale Channel (large islands of the northern Gulf) the variable of years-temperature regression is almost cero, which states a thermal stability in the last two decades and a half. Taking into account the information provided from all the grinds, we estimate that by the year 2050 the average elevation of the surface temperature in the Gulf

of California will be 0.63, but it will depend on the geographical area. However, in 2050 practically the whole south will have average temperatures superior to 25° C (Figure 2).

On the other hand, the graphics of estimated abundance of the angel de Cortes *(P zonipectus)* and the Leopard grouper (*M rosacea*) show that the warming of California Gulf brings a noticeable decrease in the numbers of the individual of each species, and actually the model suggests that the Leopard grouper will disappear in the middle and southwest of the Baja California Peninsula if temperature rises to 3° C (Fig 3). By checking the regression equations, such changes have their origin as both species have affinity to cold waters and areas of high productivity, variables that will be affected by warming in the future. This information matches the actual distribution of both species, where their highest abundances occur in areas of upwelling and temperate waters (Diaz-Uribe et al, 2001).

In the same way, the analysis of possible changes trends of change in brown cucumber (*Isostichopus fuscus*) show, that populations can decrease considerably, if temperatures rise more than 1°C (Fig 4).

The brown cucumber population has a high relationship with oceanic temperatures, and breeding periods are strongly linked to temperature changes (Herrero-Perezrul et al, 1999); consequently, abrupt surface temperatures changes may cause visible changes in such population. In addition, according to the model, the southern area of the Peninsula could experience a decrease of 30% of the population of this organisms, if temperature rises 3 degrees.

It suggests that the fishing of this resource will be disproportionately affected, so the decrease of this resource will be more significant in Southern Baja California than in Baja California. Finally, we performed an analysis of the 20 species most abundant in the

seven reef areas of interest in California Gulf (taxonomic list in Ayala-Bocos and Reyes-Bonilla, 2009). As seen in Figure 5, current associations were grouped on the left side of the dendrogram. However, once temperature rises, the position of the stations within the branches is modified in a disordered and non-gradual manner. Our conclusion is that given the differences in the levels of tolerance to environmental changes, each species will show different behaviors and not necessarily match those of the rest.

Such idiosyncratic variations involve two key aspects: a) sea warming will bring a strong imbalance in its composition, and therefore, in the ecological function of the coral reef systems of the Gulf of California; and b) It is not to be expected the modifications are distinguishable by means of local extinctions or abrupt changes in the composition of the communities, but rather gradual alterations in the relative abundances of the species. The imbalance in the communities, due to the increase of the oceanic temperature, has been already recorded in other world places, causing similar effects (Perry et al, 2005; McKenzie et al, 2007; Albouy et al, 2012).

Given this situation, we recommend the implementation of effective monitoring programs of the communities and of the level of populations of key species, as a crucial tool to detect the future effects of such warming.

Governmental and non-profit organizations seek to generate policies to balance the use of natural resources with the protection of environmental quality. From this perspective, the models of climate change and niche space, and the resulting predictions on the future conditions of the populations and ecosystems are critical to offer probable scenarios, which serve as prevention and guidance in decision making. Furthermore, to provide this kind of information to society (once it has been validated or completed) will allow many parties to deliberate and plan their own current and future activities,

increasing the impact towards conservation. In summary, the tools mentioned can become key inputs to support the management and conservation of the Gulf of California, and strengthen its applicability. The use of these models to project the vulnerability of endangered species or distribution changes, has become a potential tool to report resource management decisions.

The models can be more useful to identify conservation opportunities and recognize new available habitats or if any existing habitat will no longer be available in future due to climate changes (Schwartz, 2012).

The results introduced in this study are a first formal and quantitative attempt to state potential changes in the distribution and abundance of marine species in north-western Mexico.

The projections are even more inaccurate and should be reviewed with updated oceanographic and biological information in the years to come. In other words, to have permanent and continuous monitoring plans.

However, we are constantly working on the economic, social and ecological development and improvement to the residents of the coastline of the Gulf of California, which have to be discussed and prioritized by the authorities in order to enhance and create alternative strategies for management and making decisions. It is precisely the possibility to offer specific contexts that the scope of the macro-ecological approach are so important.

This work presents a formal attempt on how to carry out and use these models, but, in addition to the example given before, it is possible to develop models with other variables and information, since the required information to carry such kind of models is already available. Thank to the existence of long temporary series of fishery statistics,

monitoring in protected areas, and oceanographic records created by governmental and non-governmental agencies, both national and international, it is possible carry out such models to create tools and strategies of management.

Undoubtedly, the many efforts to understand the functionality of Gulf ecosystems in different scales of time and space will pay off and improve our chances of preserving this important region of the Eastern Pacific.

Acknowledgments

We appreciate the participation of Saúl González in the development of this article, as well as Gabriela Díaz Erales (Fondo Mexicano para la Conservacion de la Naturaleza) for the creation of the maps. In the same way, we thank to the Instituto Nacional de Ecologia for allowing us to present this investigation in the Bienal del Golfo de California. Finally, we acknowledge three anonymous reviewers for the additional input to this work.

4.2 Translation from English into Spanish

Investigador de Incendios

Documentación de la investigación

NFPA 921 (*National Fire Protection Association*): Asociación Nacional de Protección contra el Fuego. Esta sección abarca el Capítulo 15 en NFPA 921, Guía para Investigaciones de Incendio y Explosión.

NFPA 1033 Generales

4.3 Documentación de la escena. Entre las funciones por realizar están un diagrama de la escena, fotografiarla y tomar notas de campo para el reporte. (pp 198-205, 207)

4.3.1 Diagrame la escena, con las herramientas y el equipo necesario, para que de esta manera, pueda representarse en forma adecuada y, por ende, se puedan identificar contenidos pertinentes, patrones significativos y áreas o puntos de origen. (pp 200-202, 204-205, 207)

(A) Conocimiento requerido. Símbolos y leyendas son comúnmente utilizados para esclarecer el diagrama, los tipos de evidencia y patrones que necesitan ser documentados, y los formatos de diagramación. (pp 205-207)

(B) Habilidades requeridas. Habilidad para bosquejar la escena, dibujo básico y reconocimiento de evidencia, y habilidades de observación. (pp 204-205)

4.3.2 Documentar la escena por medio de fotografías, con ayuda de herramientas y equipo “estándares”, de tal manera que la escena se represente adecuadamente con precisión y las fotografías sustenten los hallazgos de la escena. (pp 198-204)

(A) Conocimiento requerido. Conocimiento avanzado de cámaras de alta resolución y flash, tipos de película, medios de comunicación, flash disponibles, fortalezas y limitaciones de los mismos. (pp 199-200, 202, 204)

(B) Habilidades requeridas. Habilidad para usar una cámara de alta resolución, flash y accesorios. (pp 199,-200, 202, 204)

4.3.3 Tomar notas de la investigación, según la escena del incendio, documentos disponibles (por ejemplo: reportes de antes del incendio e inspección) e información de entrevistas, de tal forma que las notas tomadas sean precisas; proporcionar documentación adicional de la escena y presentar un informe completo acerca de los hallazgos. (p 207)

(A) Conocimiento requerido. Relación entre las notas, el diseño y las fotografías; saber cómo resumir la información de la escena en notas breves e, igualmente, implementarlas en un reporte escrito o de procesos legales. (pp. 198-205, 207)

(B) Habilidades requeridas. Habilidad para resumir los datos, tomar notas, de observación y correlación. (pp 202-204, 207)

4.6.2 Evaluar el documento de investigación; dado en todos los archivos para que de esta manera las áreas que necesitan investigarse a profundidad puedan ser identificadas. La relación entre los documentos recopilados e información, debe ser interpretada, y así descubrir evidencias corroborativas y discrepancias de información. (pp 198-207)

(A) Conocimiento requerido. Archivos de prueba o métodos de evaluación que incluyan documentación de prácticas veraces y elementos de investigación indispensables.

(B) Habilidades requeridas. Evaluación de la información y los métodos de evaluación, entre ellas la documentación precisa de las prácticas y elementos de investigación (pp 198-207)

4.7 Presentaciones. Entre las obligaciones se deben entregar los hallazgos de terceras personas que no estuvieron involucradas en la investigación. (pp 198-207)

4.7.4 Realizar presentaciones educativas para el público, según los datos relevantes, para que la información sea precisa y apropiada, y respalde claramente las necesidades de información al público. (pp 198-207)

(A) Conocimiento requerido. Información disponible de la pérdida por incendio y los problemas que la comunidad debe saber.

(B) Habilidades requeridas. Capacidad para almacenar, organizar y presentar la información. (pp 198-207)*Describir la importancia de tomar notas, uso de bosquejos y diseños para analizar una escena de incendio.

(pp204-205, 207)

Usted es el investigador de incendios

Usted debe investigar un incendio que causó bastante daño a una residencia. La investigación demuestra que el incendio fue provocado. El incendio fue iniciado cerca de un receptáculo eléctrico, en un intento de engañar al investigador. Después de finalizar la investigación, el archivo del caso fue enviado al agente local, quien después de revisar el documento deduce que el dueño de la residencia debe ser culpado por incendio intencional. Dos años después de que el incendio ocurrió, el caso fue llevado a la corte y usted debe testificar.

1. ¿Qué información debe documentarse en el reporte de la escena del incendio?
2. ¿De qué otras maneras usted podría documentar el incendio?
3. ¿De qué manera los diagramas y las fotografías le pueden ayudar en su testimonio?

Introducción

A la hora de registrar una escena de incendio u explosión, la meta del investigador debe ser registrar la escena a través de un medio que le ayude a recordar sus observaciones y después, documentarlas. La compilación de estos datos permite el apoyo y la verificación de opiniones y conclusiones en un procedimiento judicial. Entre los tipos de documentación que más se utilizan están las fotografías, el video digital, las cintas de video, los diagramas, mapas, superposiciones, grabaciones, notas y reportes.

Fotografía

En la escena, el primer método de registro son los de medios visuales. La fotografía ya sea digital, fija o video, le proporciona al investigador imágenes de la escena que pueden ser utilizadas como punto de referencia cuando se redacte el reporte investigativo. Estas imágenes le presentan al investigador, y a otros examinadores, representaciones más concisas del estado de la escena, y así mejorar el proceso de identificación de patrones. Además, dado que el informe puede escribirse algún tiempo después de la investigación real del sitio, las grabaciones visuales son una forma efectiva de recordarle al investigador el estado de la escena del incendio en el momento en que se investigó.

Las fotografías son aceptadas en un tribunal; sin embargo, se prefieren las de color. Usualmente, la corte acepta imágenes que sean objetivas y que no exageren. Quien presenta las imágenes a la corte debe ser capaz de afirmar que las imágenes muestran ¨una

representación verdadera y precisa de la escena¨ en comparación con lo que se observó en la escena. A pesar de que el tiempo y los gastos son importantes para lograrlo, siempre es preferible tener más fotos de la cuenta.

Antes de iniciar el proceso de grabación, el investigador debe tener conocimiento acerca de fotografía, así como estar familiarizado con el equipo, accesorios, iluminación, movimiento, película y su velocidad. Esto es de suma importancia, porque el color predominante que se encuentra en una escena de incendio o explosión, es el negro. En las fotografías de interiores de las estructuras que han sido comprometidas por los efectos termales o falla mecánica, los distintos tonos de negro deben representarse de forma realista en la película. La iluminación y exposición adecuada de las fotografías permiten mostrar con precisión lo que el investigador observó.

Para obtener una representación apropiada de lo que ocurrió en la escena, es ideal y más efectivo tener varios tipos de documentación; por ejemplo, una cinta de video o video digital, además de las fotografías.

Si el investigador desea estar más familiarizado con el equipo de cámaras o video, puede tomar un curso, ya que muchas academias locales o estatales ofrecen capacitación en cuanto a fotografía criminal o bien, se pueden tomar cursos universitarios, unirse a clubes de fotografía o tiendas de suministros fotográficos.

Sincronización

Grabar la escena a través de representación visual debe realizarse tan pronto como sea posible en la investigación; es decir, antes de que la escena sea alterada o destruida, debido al encubrimiento de la evidencia u otras actividades. Además, al documentar la escena anticipadamente, le garantiza al investigador una representación precisa de la situación en caso de un colapso posterior de la estructura; o bien, otros

peligros, tales como cambios ambientales y mecánicos, los cuales pueden poner en peligro la escena.

Asimismo, es beneficioso fotografiar la escena continuamente a través del cribado de las etapas de reconstrucción y examinación de la evidencia. Fotografiar una escena después de que fue excavada y reconstruida es una etapa final de suma importancia en el curso del examen de la escena de incendio.

Fundamentos

La manera más fácil de entender cómo funciona una cámara es comparándola con el ojo humano. La cámara posee un lente, un diafragma y un medio de grabación, tal como una película o un sensor electrónico. Esto se compararía con el lente, el iris y la retina del ojo. A menudo, tanto la cámara como el ojo, requieren de una fuente de iluminación adicional para ver o definir mejor el objeto, como por ejemplo el flash, cuando se habla de una cámara, o un bombillo, cuando se habla del ojo.

Tipos de cámaras

Existe una gran cantidad y gama de precios disponibles para las cámaras. El investigador se ve limitado en la elección de estas, principalmente por los recursos financieros y su nivel de habilidad para manipularlas. Las cámaras comerciales se pueden categorizar según su precio u operación; es decir, manual o automática. Las cámaras automáticas son las más sencillas de manipular, ya que estas determinan el alcance primario de la fotografía y luego enfocan la imagen más cercana al visor. Estas cámaras le pueden proporcionar una sensación de confort a algunos investigadores, debido a que determinan en forma automática la exposición adecuada, ajustan la apertura del lente y velocidad del obturador, y enfocan el lente con un rayo de luz infrarroja. Estas funciones eliminan muchas dificultades latentes, que un fotógrafo inexperto puede tener.

Sin embargo, algunos investigadores expertos prefieren las cámaras manuales, dado que le permiten al usuario ajustar el enfoque y otras configuraciones específicas que se adaptan a situaciones inmediatas. Además, las cámaras manuales permiten el uso del horquillado; es decir, tomar una serie de fotografías con exposiciones ajustadas secuencialmente, lo cual garantiza al menos una buena imagen en situaciones donde se dificulta determinar la configuración correcta de la exposición. Incluso algunas cámaras son tanto manuales como automáticas.

La gran mayoría de los investigadores usan cámaras digitales SLR (cámara digital re ‘Flex o de objetivo simple). Estas cámaras muestran automáticamente la imagen digital de la fotografía uno o dos segundos después de que la misma se haya tomado. Esto le permite al fotógrafo revisar la imagen para una exposición y enfoque adecuados, y así eliminar las fotos que no quedaron bien. Muchas de estas cámaras tienen la capacidad de tomar cientos de fotos, las cuales pueden descargarse muy fácilmente en muchas computadoras, para su almacenamiento. La tarjeta de video (SIM CARD) se puede borrar y, por lo tanto, la cámara puede ser utilizada de inmediato en la próxima emergencia; lo que elimina la necesidad de costosas películas y procesamiento.

Película

La mayoría de los investigadores de incendios públicos y todos los privados utiliza cámaras digitales SLR para tomar fotografías y video en su trabajo de campo. En el presente, el video está haciendo la transición de almacenamiento de DVD a dispositivos de memoria flash, a medida que la tecnología avanza.

Algunas agencias continúan utilizando cámaras de película para documentar la escena del crimen y de incendio. La película y la velocidad de esta son aspectos importantes a considerar, ya que determinan la máxima calidad de las diapositivas e impresiones tomadas en la escena. La velocidad de la película puede variar de 25 a 1600

ASA (por sus siglas en inglés) para fotografías a color y, hasta 6400 en fotos a blanco y negro. Cuanto mayor sea el ASA, la fotografía será capaz de representar objetos en la oscuridad para con mejor precisión. Sin embargo, entre más alto sea el ASA, la calidad de las ampliaciones de las fotografías disminuirá; es decir, tendrá una apariencia granulada y los detalles de la imagen se pueden perder. La mayoría de los investigadores utilizan películas a color entre los 100 y 400 ASA. Sin importar la velocidad o el tipo de película empleado, el investigador debe usar película a color para representar de una mejor forma las imágenes en las fotografías.

Consejos de los investigadores de incendios

La batería se gasta más rápido en climas fríos; por lo que debe llevar baterías extra. Mantenga la cámara en un vehículo cálido hasta que la misma deba utilizarse en una escena de incendio que esté muy fría, y así las baterías durarán más tiempo.

Etiquete los cartuchos de película después de utilizarlos, para así evitar confusiones o pérdidas. No combine varios sucesos en un mismo rollo de película.

Fotografía

Debido a los recientes avances en la fotografía digital, su uso se ha visto incrementado en las investigaciones de incendios. El punto más pequeño en una fotografía es conocido como ‘pixel’. A menudo, las cámaras digitales se caracterizan por la cantidad de ‘megapixeles’. Una cámara de 8 megapixeles tiene la capacidad de grabar una imagen usando 8 millones de pixeles; es decir, entre mayor sea la cantidad de pixeles, así será la calidad de la imagen.

Una vez que la imagen ha sido tomada, debe guardarse en un medio inalterable, tal como un DVD o CD ROM. Lo anterior debe hacerse una vez que las fotos fueron

tomadas, para así evitar cualquier impugnación legal de las imágenes. La agencia de investigación debe tener una política escrita sobre esta práctica. Una vez que la imagen se almacenó en un medio confiable, puede manipularse para aumentar el brillo, ajustar el color y contraste, de tal forma que se mejorarán las imágenes que se impriman en un papel de alta calidad. Esta manipulación no cambia la fotografía, la cual está almacenada en un DVD/CD ROM. Sin embargo, la manipulación debe documentarse e incluirse en el registro; esto, ya que es posible que algunos tribunales no acepten fotografías alteradas electrónicamente.

Lentes

El lente de una cámara se utiliza para ajustar la luz y enfocar la imagen en la superficie de la película. Los lentes de cámara ayudan a resaltar la calidad de la fotografía. El investigador debe entender que existen diferentes tipos de lentes, los cuales producen diferentes efectos en las fotografías. Los teleobjetivos le permiten al camarógrafo ver más detalles desde la distancia o bien resaltar los minuciosos. Además de eso, ciertos tipos de lentes pueden distorsionar los detalles de las fotos; por ejemplo, un lente de ojo de pez puede representar un mayor porcentaje del interior de una habitación pequeña; sin embargo, también puede distorsionar la periferia de la fotografía y exagerar las curvas en los objetos.

La distancia focal de un lente se refiere a lo que la cámara ve a través de un lente determinado. Los lentes varían en tamaño desde los 50 mm, los cuales dan una imagen similar a la del ojo humano, a lentes de gran angular y teleobjetivos. Un lente utilizado comúnmente por investigadores de una escena de incendio es el 18-55 con capacidad de enfoque cercano, el cual puede brindar una gama de exposiciones fotográficas de la

escena del incendio. No obstante, los investigadores deben evitar cambiar los lentes de cámara dentro de la escena de investigación, por obvias razones.

Consejos de Investigador de Incendios

Para un dado lente de distancia focal, los detalles se representan según el tamaño de la apertura o f-stop (parada focal). Entre más pequeño sea el obturador de apertura, mayor será la profundidad del campo. Por el contrario, entre más grande sea la apertura del obturador, menor será la profundidad de campo. Las aperturas o f-stop ayudan a regular la cantidad de luz recibida en el lente que se transmite a la película o al sensor de la cámara (fotografía digital).

El investigador debe buscar la ayuda de una persona que tenga conocimiento en el uso de cámaras digitales a la hora de comprar o usar cámaras de este tipo con lentes intercambiables. La distancia de enfoque que se utiliza para los lentes de cámaras de películas tradicionales de 35-mm es diferente a la mayoría de los lentes de las cámaras digitales.

Filtros

Se recomienda el uso de un filtro neutral ultravioleta en una cámara SLR digital o de película para aquellas fotografías que se puedan utilizar en procedimientos legales. El filtro ultravioleta no altera el tono ni el color de la imagen, sino que le proporciona protección a la delicada superficie del lente.

Iluminación

La iluminación juega un papel muy importante en la fotografía. La fuente de luz que los investigadores pueden usar o conseguir más fácilmente es el sol; no obstante, las circunstancias del análisis de la investigación de la escena no siempre van a dar durante el

día. En tales ocasiones, se debe utilizar una fuente de luz alternativa, y el más popular es el flash, el cual puede montarse en forma permanentemente o temporal, o bien puede estar separado de la cámara. Debido a las grandes áreas de oscuridad y luz, e inclusive, las superficies carbonizadas en una escena de incendio, estas son más difíciles de iluminar de una manera eficaz. Por consiguiente, un flash de alta calidad capaz de proporcionar una gran área de iluminación para múltiples exposiciones es una herramienta muy necesaria en una investigación de incendios. Otras fuentes de luz alternas comprenden las luces portátiles, como focos y linternas. El resplandor de un flash o reflector puede distorsionar la apariencia de un objeto, por lo tanto, el uso de los flashes de rebote y difusores de luz, entre otras técnicas, ayudarán a evitarlo.

Se recomienda que el investigador utilice una unidad de flash que pueda separarse de la cámara, lo que permite tener una mejor perspectiva de la iluminación según las necesidades y circunstancias de la escena. Lo anterior le permite al fotógrafo utilizar un flash incorporado en la cámara con una unidad de flash separada, para incrementar la cantidad de luz disponible para la exposición adecuada. Los montajes de flash portátiles también se pueden usar para 'pintar' luz a través de una fotografía detallada, tomada en un momento de poca visibilidad. Esto se conoce como pintura fotográfica. Por ejemplo, al bloquear el obturador en una posición abierta y utilizar el flash remotamente desde el sistema de la cámara, el investigador puede acentuar una vista particular e iluminarla con varias exposiciones de luz desde diferentes direcciones. Como resultado, la fotografía se muestra con una apariencia de iluminación proveniente de múltiples direcciones.

A menudo, el flash de anillo se usa para acercamientos. Esta unidad de flash especializada cabe en el extremo del lente y es comúnmente utilizado cuando se fotografía una pieza de evidencia fundamental, como una marca de arco o la marca de una herramienta.

Tipos especiales de fotografía

Los avances en la tecnología de la fotografía han creado nuevas herramientas para el investigador, tal como las imágenes que usan fotografía infrarroja, láser y microscópica, las cuales pueden ser útiles para documentar la investigación.

Composición y técnica

Las fotografías son parte fundamental de la investigación y deben reflejar la condición de la escena tal como lo vio el investigador. Las fotografías deben tomarse de una manera predeterminada de acuerdo con las prácticas aceptadas en el campo de la investigación de incendios y explosiones. Por ejemplo, ilustrando la filosofía de investigación de las áreas de menor daño a las áreas de mayor daño.

Una técnica muy práctica y efectiva en una escena de incendio, es documentar primero el perímetro exterior y luego el interior, para después proseguir con las áreas menos dañadas, y por ultimo las más dañadas de una manera secuencial. La evidencia crucial debe documentarse al fotografiar el objeto desde diferentes tipos de ángulos e inclusive desde lo alto de una escalera.

Fotografía secuencial

La documentación fotográfica del suceso debe presentar vistas secuenciales de la escena. La fotografía de un objeto relativamente pequeño (por ejemplo: una silla) debe tomarse primero desde la distancia (quizás desde la entrada de la habitación) para mostrar la posición del objeto en relación con otros objetos fijos, como el marco de una puerta o radiador; seguido de una toma a distancia media que muestre más detalles y para así finalizar con un acercamiento del objeto (figura 13.1). Las fotografías secuenciales le

permiten al investigador comprender mejor la totalidad del panorama y la relación de los objetos con la derivación en general.

Mosaicos

Otra técnica para mostrar la totalidad de la escena, es el uso de los mosaicos de fotografías. Este método se constituye por una serie de fotografías que abarcan una gran área, superponiendo el inicio de una fotografía donde la fotografía anterior terminó (figura 13.2). Las fotografías de los mosaicos se utilizan cuando no se dispone de un objetivo gran angular y se desea obtener una vista panorámica. Para crear un mosaico, el investigador debe identificar la amplitud de la fotografía de acuerdo con puntos de referencia identificables. Cada fotografía subsiguiente debe abarcar una parte de dicho punto de referencia, para que así la imagen final sea de una fotografía grande que constituya una vista general de un área en particular.

Diagrama de fotografía

Cuando se documenta la escena, el investigador debe realizar un diagrama del lugar, e identificar el punto desde donde se tomó cada fotografía, la dirección, la ubicación del elemento y el número de la fotografía. Esto se le conoce como diagrama fotográfico (figura 13.3). Existen ocasiones en donde el tiempo en que se tomó la fotografía es importante y debe registrarse en el diagrama. El fotógrafo debe identificar las imágenes adjuntando sus iniciales, la fecha, la ubicación de la escena y cualquier otro aspecto que sea relevante. Un diagrama como este es de suma ayuda para las personas que no estuvieron presentes en la escena de incendio. Lo anterior, para que les pueda dar una imagen general de la condición del evento y lo que el equipo de investigación observó.

Muchas cámaras digitales tienen la opción de poner la hora y fecha en la imagen. Una fotografía de la escena de incendios puede ser muy beneficiosa para el investigador de incendios. Sin embargo, el investigador debe estar al tanto de que las fotografías deben detallar la escena, por lo que es necesario que tome fotografías en diferentes ángulos o con detalles especiales que tengan la misma intención del elemento.

La fotografía y los tribunales

Uno de los usos potenciales de las fotografías es para dar testimonio ante un tribunal. Antes que una imagen sea admitida en la corte, pueden existir varios desafíos para su uso. La fotografía debe ser una ‘’verdadera y precisa representación de la escena y su contenido’’. La corte puede excluir fotografías que sean muy perturbadoras para el jurado; como por ejemplo, fotografías que incluyan una muerte horrible. Asimismo, las fotografías pueden rechazarse si carecen de claridad o si son irrelevantes para el caso. La mayoría de los tribunales acepta fotografías a color, blanco y negro, blanco y negro en formato de película y digitales.

Video-Fotografía

La Video-fotografía se ha convertido en un medio aceptable para orientar a los espectadores en la escena. La variedad de formatos disponibles incluye tecnología antigua como VHS, beta y 8 mm. Las cámaras de video más recientes son digitales, por lo que esta nueva tecnología ofrece funciones con poca luz y enfoque automático.

Una gran ventaja del uso de cámaras de video es la de orientar a los espectadores en el lugar del incendio por medio de la grabación de las áreas más importantes. Además, se recomienda que la video-fotografía no sea el único medio utilizado para detallar las condiciones de la escena. La fotografía fija es muy importante a la hora de documentar.

Cuando la documentación del testimonio es necesaria, las cámaras de video se pueden utilizar para entrevistar al testigo, sospechosos, ocupantes y propietarios.

La grabación de video es un método de documentación y grabación de la escena. De esta forma, el investigador puede registrar y narrar la escena en forma simultánea. La grabación (la cual no siempre es necesariamente usada para presentarla) puede utilizarse por el investigador para después recordar mejor la condición y ubicación de la evidencia. La mayoría de las cámaras de video digitales de primer nivel no cuenta con la opción de apagar el micrófono; por lo tanto, los investigadores deben evitar comentarios inapropiados o análisis fuera de lugar, los cual más adelante pueda causar una situación incómoda.

Actividades que deben documentarse

Es importante documentar la totalidad de la escena. Sin embargo, se sugiere documentar las condiciones en que estaba la escena a la hora de llegada, supresión, revisión, observación, origen y causa del incendio. La progresión del incendio, sus colores, su reacción a las actividades de supresión y los procedimientos de reconocimiento empleados, son aspectos de suma importancia, ya que todos le ayudan al investigador a determinar la causa de origen del incendio. Las fotografías también pueden ayudar a documentar el alcance del daño a las víctimas y a la estructura.

Las fotografías de la multitud que observa la escena del incendio, pueden ayudar a los investigadores a identificar a aquellas personas que tengan conocimiento favorable para la investigación. Asimismo, estas fotografías pueden ayudar a los investigadores a identificar a los individuos observados en forma recurrente en escenas de incendio, o bien, que son conocidos por la policía o por la comunidad del departamento de bomberos.

Todos los investigadores de incendios deben siempre determinar si el testigo inicial que reportó dicho incendio al 911, documentó lo que observó con la cámara de un teléfono o cámara digital. Muchas veces, los medios de comunicación tienen personal o intermediarios que asisten a grandes incendios. A veces, estos profesionales llegan a la escena antes que el equipo de bomberos y, a menudo, tienen acceso a mejor equipo fotográfico. Por otro lado, los reporteros también pueden estar ocupados entrevistando a las víctimas y testigos antes de la llegada de los investigadores, por lo que es necesario contactarlos.

Las fotografías de las actividades de supresión pueden ayudarle al investigador a entender por qué el incendio reaccionó en una manera en particular. También, al documentar las actividades de supresión, se debe además incluir la ubicación de los hidrantes, las herramientas y las mangueras.

Las fotografías de exteriores son indispensables para establecer la ubicación de la escena del incendio. Estas deben incluir los letreros de las calles (Figura 13.4), el número de la casa u otros tipos de referencia identificables que permanezcan en su lugar por algún tiempo (Figura 13.5), así como las áreas circundantes a la escena y todas las vistas angulares del exterior de la escena del suceso (Figura 13.6). También, se pueden tomar fotos de la ubicación de los edificios dañados, las cuales podrían ser útiles para fines de documentación y órdenes de cateo.

Las fotografías estructurales documentan los daños a las estructuras, causados por el calor y la exposición a las llamas, durante el incendio. Estas fotografías deben tomarse desde múltiples ángulos, para que quede un registro del daño causado por el calor y las flamas. De igual manera, las fallas o deficiencias estructurales deben documentarse en las imágenes, dado que estas pueden desempeñar un papel importante en el resultado de los

hechos. Por último, las fotografías tomadas son muy útiles para que el investigador de incendios pueda exponer su análisis de la escena a los supervisores, fiscales, tribunal y a los representantes de seguros.

Las fotografías en el interior de la escena le ayudan al investigador a documentar el hecho y a describir más profundamente las condiciones de la estructura. Todos los puntos importantes de acceso aquellos creados por el incendio deben fotografiarse, así como patrones de humo, calor y quemaduras.

La condición de las habitaciones dentro de la escena del incendio deben ser fotografiadas para documentar las condiciones térmicas y del humo. De igual manera, todos los artefactos o equipos que produzcan calor deben fotografiarse para documentar su estado con respecto al área donde se originó el incendio. Asimismo, es de suma importancia documentar por medio de fotografías la condición de los muebles y del inmueble, que muestren cómo se movilizó el calor y el humo.

También debe documentarse la condición de las rutas de salida y de entrada, especialmente las puertas y las ventanas. Las fotografías deben mostrar su condición en el momento del incendio (es decir, si las puertas y ventanas estaban cerradas o abiertas, etc.). La condición de los dispositivos de detección y control de incendios en el interior, también debe documentarse (si las chispas lo activaron, si se utilizaron los extintores o si se activaron los detectores de humo).

Los servicios presentes en una estructura deben documentarse exhaustivamente, para así incluir la condición de los controles y dispositivos tales como transformadores, paneles, medidores, reguladores y válvulas. El punto en el cual los servicios ingresan a la estructura debe registrarse, para así incluir su ubicación y condición en el momento de incendio. En la escena del incendio, el investigador debe documentar, por medio de

fotografías, el estado de los aparatos y la posición de todas las válvulas y controladores. El estado de los fusibles y de los interruptores de los circuitos es de suma importancia.

Durante la examinación de la escena, se deben tomar fotografías de todos los elementos de valor probatorio. Por ejemplo, en la imagen 13.7 se muestra la mecha de una bomba molotov encontrada en una escena de incendio. Las fotografías de la evidencia le permiten al observador ubicar el elemento en la escena y su apariencia. Sin embargo, se pueden tomar fotografías más detalladas de la evidencia, una vez que se quitaron de la escena, si el fotógrafo no pudo obtener fotografías detalladas debido a limitaciones en la escena, tales como la iluminación, la ubicación o los peligros. Se puede utilizar una regla para proporcionar una escala e identificar el tamaño de los elementos en la fotografía. Por lo tanto, debe haber una foto que muestre la evidencia y otra fotografía donde se tenga la regla al lado de la evidencia.

También se deben documentar las acciones y ubicaciones de los inquilinos y víctimas en la escena del incendio. Estas imágenes registran la ubicación de los sobrevivientes o víctimas a la hora del incendio, cualquier indicador de las acciones tomadas durante el incendio y cualquier resultado final, como lesiones graves o incluso la muerte. Si la escena incluye una fatalidad, la posición de la víctima debe documentarse en forma detallada. En dado caso que la condición completa de la víctima en el lugar del suceso no pueda documentarse debido a la iluminación, peligros en el área u otros obstáculos, se deben tomar fotos adicionales en las instalaciones del médico forense.

Cuando un testigo o víctima informa que observó un evento potencialmente importante, el fotógrafo debe intentar fotografiar la vista desde la misma posición del testigo.

Las fotografías aéreas pueden ayudarle al investigador a aclarar la disposición de la escena y elementos evidenciales más grandes, como un vehículo o un cuerpo.

Entrega de las fotografías

Cuando se muestran o se entregan las imágenes de la observación de la escena de incendios, el investigador debe elegir el medio, video o fotografía, que presente con mayor claridad la examinación y la determinación casual de la investigación. De igual manera, debe determinar que medios son los más aceptables para el tribunal judicial, organismos de seguridad, departamentos de bomberos y compañías de seguros.

Los videos son un medio muy efectivo para detallar las condiciones de la escena y acciones tomadas. Muchos organismos de seguridad, academias de bomberos y policía, sistemas escolares y tribunales, poseen proyectores de video o diapositivas para usar en presentaciones, computadoras o presentación de video. Las ampliaciones de las fotografías siguen siendo uno de los recursos más utilizados en los juicios. Las presentaciones en computadora se han convertido en una manera muy efectiva y completa para exhibir gran cantidad de material visual, dado que permiten la integración de diferentes tipos de formatos en una misma presentación. Sin embargo, hay que asegurarse de tener un respaldo en caso de que la computadora falle en el tribunal.

Diagramas y bocetos

Los diagramas y los bocetos se utilizan para recordar al investigador lo que observó en la escena y así documentar más ampliamente los detalles de la misma. Por ejemplo, un diagrama puede utilizarse para entrevistar a un testigo importante o como medio de orientación en las fotografías. Asimismo, los bocetos pueden ayudar a identificar los patrones de fuego, su crecimiento y las condiciones de la escena. La precisión de los datos empleados para crear estos materiales es esencial.

Tipos de esquemas

Los diagramas son dibujos formales que se completan después de la investigación y los bocetos son diagramas hechos a mano alzada o diagramas realizados con las herramientas mínimas, los cuales se completan en la escena. La diferencia entre ellos, se relaciona con la cantidad del tipo de construcción de la estructura y sus características de la estructura, el equipo y otros factores importantes en cuanto al origen, la causa y la propagación del incendio. Toda investigación debe incluir bocetos de la escena del incendio. Esto es sumamente importante para las investigaciones, que involucren un litigio criminal o civil.

Cuando el investigador escoge qué tipo de dibujo va a utilizar, este debe decidir qué va a mostrar en sus dibujos. Si el detective es incapaz de crear un dibujo detallado de la escena, debe crear una descripción esquemática del área del origen del incendio, la distribución de los elementos dentro de dicha área, puertas y ventanas. La descripción esquemática también debe incluir mediciones precisas de paredes y techos; ubicación de las puertas, ventanas y otros objetos; así como también muebles y electrodomésticos dentro del área de origen. La figura 13.8 evidencia un ejemplo de una descripción esquemática de la estructura que muestra la posición básica de la estructura, así como el diagrama terminado a partir de dicho boceto.

Se pueden utilizar varios tipos de dibujos para ilustrar la condición de la escena de incendio. A veces, es necesario realizar un diagrama detallado para obtener mejor información. Sin embargo, en otras circunstancias bastará con un esquema aproximado cuando el análisis y las conclusiones sean simples. El tipo de dibujo que se elige depende del grado de detalle requerido en la investigación.

Cuando la escena del suceso es más compleja, el detective puede necesitar desarrollar o adquirir recursos adicionales, como los planos del edificio o documentación sobre la construcción. La tabla 13.1 describe los detalles que pueden ser necesarios.

Herramientas de dibujo y equipo

Existe una gran variedad de opciones de herramientas de dibujo que el investigador puede utilizar para crear el diagrama de la escena. A menudo, el tamaño y la complejidad de la escena y de la investigación imponen el tipo y grado de detalles a incluir. En casos críticos como en incidentes mortales, homicidios, fuegos incendiarios o incendios mayores o de tipo comercial, el detective debe buscar los planos arquitectónicos o a los fabricantes de equipo.

Los topógrafos pueden ser útiles para cartografiar con precisión escenas a mayor escala o los organismos de seguridad municipales federales y federales, pueden realizar un mapeo asistido por computadora por medio de dispositivos láser.

Avances recientes en computadoras y software le han permitido a los investigadores utilizar varios tipos de programas para desarrollar diagramas. De igual manera, el investigador puede decidir si el diagrama representa mejor la escena en un formato tridimensional. Pueden utilizarse los programas de dibujo asistidos por computadora (CAD) o en combinación con modelos informáticos de incendio. Un buen paquete de dibujo le brinda muchas herramientas al detective; algunos de ellos ofrecen varias capas en él, que proveen las condiciones posibles antes y después del incendio. No importa el tipo o la marca del programa que se utilice, el detective debe elegir uno que ofrezca flexibilidad de diseño, acotación automática y variedad de ´´bibliotecas´´ que tengan objetos pre-diseñados como muebles, plomería eléctrica y componentes HVAC.

Elementos del diagrama

Según la complejidad de la investigación, existirán varios elementos que se deberán incluir en bocetos y diagramas.

- Información General: El detective debe indicar el nombre de la persona que creó el diseño, el título del diagrama y el día en que se diseñó.
- Identificación de la orientación de la brújula: La mayoría de veces el boceto indicará el norte en la parte superior de la página.
- Escala: El investigador debe dibujar a escala e indicar en el dibujo si no es una escala exacta o si es una escala aproximada.
- Símbolos: El detective debe ser consistente con la simbología y no utilizar el mismo símbolo para fines múltiples. Se recomienda que el investigador utilice una simbología empleada en ingeniería o arquitectura. Los símbolos de prevención de incendios pueden encontrarse en NFPA 170, Estándar de seguridad contra incendios y símbolos de emergencia.
- Leyenda: El investigador debe crear una leyenda para cualquier dibujo donde se representan los símbolos utilizados.

Diseños preparados y diagramas de construcción

Los diseños preparados y diagramas de construcción son aquellos que fueron desarrollados para construir o diseñar un edificio, equipo o incluso electrodomésticos. Se debe tener cuidado con la interpretación de los elementos del diagrama de construcción, dado que los artículos o edificios pudieron modificarse durante la construcción o uso de un edificio.

Dibujos arquitectónicos y de ingeniería

Durante la fase de construcción, los contratistas utilizan varios tipos de dibujos. Estos diagramas pueden mostrar solo servicios, equipos de detección y supresión de incendios y aspectos topográficos u otros aspectos únicos utilizados en el proceso de la construcción. Por lo tanto, es importante que el detective esté familiarizado con dichos dibujos.

Programa arquitectónico y de ingeniería

A menudo, en grandes edificios, es necesario especificar el tipo de equipo que se utilizó en la elaboración de la estructura. Una lista detallada con esta información se conoce como programa. Los programas, pueden desglosarse según el tipo de equipo y generalmente, puntualizar todos los tipos de equipo utilizados en la estructura. Por ejemplo, un programa de puertas muestra la ubicación de todas las puertas en el edificio. Además, otros ejemplos donde se incluyen programas de acabado de interiores, eléctricos, HVCA, de iluminación y de plomería.

Especificaciones

Cuando un arquitecto o un ingeniero preparan un dibujo, este hace una lista de los materiales de construcción utilizados en la hoja de especificaciones, en la que se emparejan los materiales con su ubicación específica. Por ejemplo, en esta se podría anotar el uso de aislamiento R-17 en el área del ático, madera contrachapada de 5/8 pulgadas en un dormitorio de la planta baja, y así sucesivamente. Estos diseños se pueden conseguir por medio del contratista o el departamento de inspección de edificios de la comunidad en la que se construyó. Asimismo, estos diseños incluyen los dibujos de desplante del arquitecto; los cuales son del exterior del edificio, que también son útiles en aquellos eventos en que los que el edificio queda completamente destruido. Si es posible,

también se deben conseguir los planos de la construcción, los cuales son descripciones arquitectónicas de cómo se construyó la estructura; sin embargo, pueden variar de los planes originales.

Toma de notas

Además de la representación visual de la escena, el investigador debe incorporar la toma de notas investigativas para complementar aquellos elementos que no pueden fotografiarse o dibujarse. A estas notas, también se les pueden llamar ‘notas de campo’. La toma de notas incluye nombres, direcciones, modelo o números de serie, declaraciones de testigos, registros de fotografía, identificación de artículos, tipos de materiales u observaciones del detective tales como, patrones de quemaduras o condiciones de la construcción. En los apuntes también se puede incluir la información obtenida de las entrevistas a los testigos y revisiones de los documentos relacionados con el suceso. Aunque los formularios no son necesarios y no se pueden utilizar como informe de incidentes, existen otros que se han elaborado especialmente para la recopilación de datos. Estos formularios pueden ayudarle al investigador a reunir los datos suficientes para preparar el informe.

Muchos investigadores indican que los dispositivos de grabación digital son muy útiles para grabar las entrevistas de los testigos, victimas, sospechosos y otros; así como también grabar notas fácilmente mientras examinan la escena. Las notas y declaraciones electrónicas se descargan fácilmente en un archivo en la computadora, junto con las fotos y otra información digital importante. La ventaja de estos dispositivos es que no requieren casetes y pueden grabar hasta 24 horas de material.

El detective debe ser cuidadoso para no depender únicamente de solo un medio para documentar la escena del incendio; por ejemplo, el uso de una grabadora portátil u

otro dispositivo no debe ser el único medio para recopilar información. Cuando el investigador está listo para completar el reporte final detallando la información recopilada en la escena, él o ella encontrará que los documentos presentados y grabados durante el proceso son invaluables. La revisión de notas, formularios, fotografías y bocetos le ayudarán al investigador a proporcionar un informe más completo y pormenorizado.

Muchos departamentos han establecido una política común sobre la retención de notas. Todas están sujetas a examinación o detección por parte de las personas interesadas, incluso después de que la información fue recolectada o el informe realizado. El detective debe examinar la política de su departamento o compañía sobre la retención de notas y cumplirla durante cada investigación.

Informes

El propósito de un informe es comunicar lo observado, el análisis y las conclusiones realizadas durante la investigación. Los informes generalmente contienen información descriptiva, hechos pertinentes, opiniones y conclusiones (Tabla 13.2).

Cada agencia puede tener un formato diferente para reportar el proceso. NFPA 921 no prescribe un formato particular para realizar el reporte. Todos los informes deben realizarse en forma clara, precisa y de manera exacta. El informe a menudo se le distribuye a otras personas fuera del departamento o empresa del investigador; por lo tanto, el mismo debe incluir todas las conclusiones u opiniones expresadas.

Opiniones de expertos

Muchos años atrás, cuando fui asignado como investigador de incendios, me llamaron por un incendio en progreso en un edificio. Mientras iba de camino y escuchaba

por radio las actividades en la escena, inicié el proceso de investigación al hacerme las siguientes preguntas:

- ¿Qué parte de la estructura está involucrada?
- ¿Estará ocupada?
- ¿Cuánta parte de la estructura está dañada?
- ¿Será seguro llevar a cabo la investigación de la escena cuando llegue?

Al llegar a la escena, observé un edificio de dos pisos con estructura de madera. Yo utilizaba el equipo de protección personal y luego me reuní con el comandante de la escena para que me informase sobre lo ocurrido. El comandante me informó que la estructura fue evacuada antes de su llegada y que él observó un humo gris claro que provenía de las ventanas del primer piso. Él le aconsejó a los dos primeros camiones de bomberos que llegaron al lugar de la escena hacer un ataque inicial a través de la puerta de entrada del primer piso, identificada como el lado A de la estructura.

Mi primera tarea fue realizar una caminata alrededor del edificio para fotografiar y documentar todos los cuatro lados de la estructura. Una vez que lo realicé, tomé las declaraciones de los primeros bomberos y les hice las siguientes preguntas:

- ¿Forzó la entrada?
- ¿Dónde se localizaba el incendio?
- ¿De qué color era el incendio?
- ¿De qué color era el humo?
- ¿Observó algo inusual?

El bombero que ingresó de primero con la manguera, declaró que la puerta no estaba cerrada y que al entrar observó tres incendios separados y que fue capaz de apagarlos rápidamente.

Al realizar una observación más detallada de la escena y con el departamento de bomberos demandando el rescate y la revisión de los hechos, pude identificar los tres puntos de origen de los incendios. Documenté cuidadosamente todas las declaraciones y los bocetos de la escena, y la fotografié completamente desde varios ángulos, identificando la ubicación de cada fotografía. Toda la información compilada fue primordial para la formulación final de la investigación de la escena.

Jeffry J.Harran
Assistant Chief
Buckskin Fire Department
Parker, Arizona

Opinión de un experto

Recolectar y preservar la evidencia es una de las responsabilidades del investigador de incendios. En ocasiones, encontrar la evidencia y determinar su importancia puede ser difícil. Hace unos años atrás, yo era el asistente de un detective de policía en una investigación de incendio que involucraba dos vehículos recreativos (RV's). Las casas rodantes estaban estacionadas al lado de un taller en un negocio que vendía y reparaba vehículos recreativos y auto caravanas, entre otros. El incendio fue reportado y apagado durante las horas de la tarde. Los dos vehículos resultaron completamente destruidos por el incendio, y solo quedó la estructura metálica.

Nuestra investigación comenzó a mediados de la mañana. Mientras examinaba el área alrededor del taller, pude notar lo que parecía ser un guante tirado en el suelo a poca

distancia del incendio. Al realizar una inspección más detallada, se pudo demostrar que el guante era de cuero o de ´´mecánico´´. A poca distancia del guante había también otro guante, pero de látex.

A primera vista, parecía como si los guantes hubiesen sido olvidados accidentalmente por los bomberos o posiblemente pertenecían a un mecánico que trabajaba en el taller más cercano al incendio. Dejamos los guantes en su lugar de origen y continuamos examinando el área que rodeaba las casas rodantes.

A poca distancia de la ubicación de los guantes, observamos una línea de pasto quemado que conducía hacia otras dos caravanas. Muchas nuevas hipótesis comenzaron a surgir en cuanto a la importancia de los guantes. ¿Fue el responsable del incendio quién dejó los guantes mientras manipulaba un fósforo o encendedor? O tal vez, los descartó porque derramó líquido inflamable sobre ellos.

Ambos guantes fueron recolectados y enviados al Laboratorio Criminológico del Estado de Wisconsin para analizar el líquido y ADN. Los guantes no solo contenían pequeñas cantidades de gasolina, sino que también ADN. Y mejor aún, el ADN le pertenecía a un delincuente conocido.

Se extendió una orden de allanamiento para revisar la casa del sospechoso, donde se encontraron guantes similares y otra evidencia, incluyendo la confesión del sospechoso con la cual se le pudo declarar culpable del incendio y fue condenado a 18 meses de prisión.

Identificar una pieza de evidencia física, que no está directamente ligada a la escena, jugó un papel muy importante en la conclusión exitosa de este caso.

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Usted es el investigador de incendios

Al llegar a una escena de incendio, usted encuentra un contenedor de plástico rojo en el garaje de la casa, y por su seguridad, lo traslada a la parte delantera del jardín. A medida que avanza la investigación, todo parece indicar que el incendio fue intencional. Usted determina, con base en la información, que el contenedor podría haber sido utilizado para agilizar el incendio.

- ¿Existe algún problema que deba ser abordado en cuanto a la ubicación actual del contenedor de gasolina?
- ¿Qué debe hacer el investigador para relacionar que el contenedor de gasolina y el patrón dentro de la residencia están conectados entre sí?

Introducción

La evidencia física, también conocida como evidencia real, es cualquier elemento físico o tangible que tiende a probar o refutar un hecho o problema en particular. En un incendio, toda la escena, incluyendo los patrones de fuego, las fuentes de ignición, el equipo de seguridad y los elementos asociados a la detección de incendios, se consideran evidencia física. Este tipo de evidencia se puede presentar en los tribunales u otros procesos, donde se identifica, documenta, recolecta, preserva y analiza adecuadamente la evidencia.

El investigador es el responsable de localizar la evidencia, identificarla, recogerla, documentarla, examinarla, almacenarla y organizar las pruebas o evidencias físicas encontradas en la escena. Sin embargo, la primera etapa de conservación de la evidencia es primordial, ya que se inicia con la extinción y supresión del incendio. En una jurisdicción, los investigadores pueden ayudarse a sí mismos, al capacitar a las brigadas de bomberos y a los oficiales de bomberos, sobre la importancia de la preservación de la evidencia y la forma básica de cómo evitar la destrucción accidental de la misma. Los investigadores y los organismos de seguridad pueden proveer entrenamiento básico a los bomberos y a los oficiales de bomberos a nivel estatal o nacional en la preservación de la evidencia física en incendios, explosiones, accidentes de tránsito y otras operaciones en conjunto.

Evidencia física

La evidencia física más común en una escena de incendio puede incluir rastros de líquido inflamable en el piso, la marca de una herramienta que se encuentre en una entrada forzada o que indique ajustes de una válvula, un circuito eléctrico dañado, huellas digitales, sangre u otro elemento físico o marcas que le puedan ayudar al investigador a establecer un hecho.

La evidencia física puede ser muy obvia, como por ejemplo el contenedor derretido de un acelerante en el vestíbulo de una tienda minorista, o bien puede estar latente (oculto), como una huella digital en una herramienta que puede no estar visible sino hasta que se desarrolle la investigación. Este es el desafío de la investigación, identificar la evidencia física potencial.

Patrón de las llamas; los efectos físicos visuales o medibles que se pueden apreciar después de un incendio, son evidencia física; una clase de evidencia llamada evidencia de

artefacto. Este tipo puede incluir los rastros de combustible, la fuente de ignición que desató el combustible u otros materiales que influyen en el crecimiento y desarrollo del fuego.

Los investigadores con más experiencia pueden identificar objetos que parecen estar fuera de lugar así como determinar la evidencia que deba recolectarse de la escena de incendio. La decisión puede basarse en el objetivo de la investigación, los requisitos legales, o la prohibición. De igual manera, inicialmente el investigador debe adoptar una actitud inclusiva en lo que respecta a la evidencia física. Si el objeto parece estar en el lugar equivocado, el investigador puede asumir que es evidencia potencial hasta que el proceso de investigación demuestre lo contario.

Los investigadores de incendios pueden mejorar sus resultados al capacitarse en el reconocimiento y recopilación de evidencia física y al tener acceso al equipo adecuado. Aunque los investigadores son los mejores al reconocer evidencia dañada por el fuego, ciertos tipos de evidencia, tales como marcas de herramientas, huellas de calzado, marcas de neumáticos y huellas dactilares, es mejor dejárselos a los técnicos de la escena del crimen. En investigaciones complejas, se recomienda establecer una relación más estrecha de trabajo con los técnicos encargados de hacerle frente a la escena del crimen, quienes son expertos en la identificación, recopilación, análisis y preservación de la evidencia y a su vez poseen el equipo necesario.

Generalmente, la evidencia física requiere examinarse en un laboratorio y el testimonio de un testigo experto para establecer su importancia en un juicio o proceso judicial. Los investigadores de incendio deben estar en contacto con los técnicos forenses de laboratorio que evaluarán la evidencia para determinar la cantidad, el embalaje, el

almacenamiento, y los métodos de transporte apropiados para la categorización de la evidencia física, durante el análisis de la escena.

La evidencia física es algo que puede observarse y manipularse físicamente por un juez o jurado, y difiere de otros tipos de evidencia, tal como la evidencia directa (testimonios de personas que observan actos o detectan algo a través de sus cinco sentidos u equipo de vigilancia, como CCTV), evidencia demostrativa (fotografías, mapas, rayos X, pruebas visibles y demostraciones) o evidencia circunstancial (hechos que usualmente conllevan a otros hechos para resolverse y se infieren por la lógica).

Chapter V

Data Analysis

The main objective of this chapter is to show the evidence of the text analysis of both documents from non-profit organizations. As mentioned in previous chapters, the methodology of this investigation is qualitative, since its focus is the measurement of the data to prove the type of translation and different procedural techniques. In addition to that, it is important to mention that there are many benefits of data analysis; one of them is to help in structuring the findings from different sources of data collection and it helps to keep away any human bias from research conclusions.

According to Naghi (2000), the data analysis refers basically to how the information gathered is handled and applied during a research in order to prove or disapprove the behavior and changes in the objects of study (p. 281). In other words, the data analysis is of outmost importance for both research and researcher to diagnose the purpose of the investigation objectives. Therefore, this chapter is going to disclose the whole process carried out to demonstrate and agree to the theories applied, as well as to show how an analysis of translation can be developed and supported by the implementation of glossaries.

5.1 Text Analysis

It is known that the first step in a translation process is to read the documentation a couple of times in order to understand and get familiar with it; so that a translator can start the process of translation by having a deep comprehension of the document and guarantee accuracy from the source language to the target language. As Newmark (1988) mentioned, the first step in this source-text analysis stage is to simply read the entire document for two main objectives: “First, to understand what it is about; second, to

analyze it from a translator's point of view, which is not the same as a linguist's or a literary critic's" (p. 11). Therefore, it will become easier to determine the intention and style of the document to visualize the methodologies and translation techniques to be used in the analysis.

Text Analysis	The Fire Investigator	Análisis espacial de los hábitats críticos del delfín nariz de botella y la ballena jorobada en Golfo Dulce, Costa Rica	Aspectos reproductivos de Chicoreous brevifrons de la laguna de La Restinga, isla Margarita, Venezuela	Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales
Text style	narrative	narrative	narrative	narrative
Formality	formal	formal	formal	formal
Difficulty	technical	technical	technical	technical
Emotional tone	factual	factual	factual	factual
Text function	informative	informative	informative	informative
Translation type	Communicative and Semantic	Communicative and Semantic	Communicative and Semantic	Communicative and Semantic

Table 2 shows the text analysis instrument.
Source: Researcher's own creation

5.2 Color-Coding

The purpose of using a color-coding methodology remains in the usability to better identify the different types of techniques used in both translated documents. Being said that, it will be visually easier to find out what specific procedure was applied to translate the documents. Below it will be found a set of fifteen paragraphs from Spanish

into English and fifteen more from English into Spanish with the six relevant procedures applied.

5.2.1 Spanish – English Translation

Análisis especial de los hábitats críticos del defín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangliae) en el Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina

1. **Original**

Los hábitats críticos se definen y clasifican en contextos biológicos importantes como alimentación, reproducción y crianza, protección de depredadores, descanso, migración, entre otros (Hooker & Gerber, 2004; Hoyt, 2011). El definir si un hábitat determinado debe ser considerado como crítico, tiene implicaciones ecológicas que se trasladan al plano legal en procesos de manejo y conservación (por ejemplo, FWS, 1988), por lo tanto, es importante clarificar conceptos claves como hábitat y los procesos que se asocian a este. Para este estudio se adopta la conceptualización del hábitat como la suma de recursos que necesita un organismo para su supervivencia, hábitat es una definición que es específica por organismo, ya que se relaciona con un especie, población o individuo (Hall et al. 1997).

Translation

The critical habitats are defined and classified in important biological contexts, such as feeding, reproduction and breeding protection from predators, resting and migration, among others (Hooker and Gerber, 2004; Hoyt, 2011). To state if an established habitat must be considered as critical, has ecological consequences in a legal level related to management and preservation processes (e.g., FWS, 1998); thus, it is important to clarify key concepts, such as habitat and the processes that are linked to. For a better understanding, in this study it is adopted the conceptualization of habitat as the

sum of the resources that an organism needs for its survival. Habitat is a definition that is specific to each organism, since it is related to a species population or individual (Hall etal. 1997).

2. Original

El Golfo Dulce provee de un hábitat importante para especies de cetáceos costeros (Oviedo et al. 2009; 2015); entre las características estructurales de este mar interno, se tiene un número importante de ríos que drenan en la cuenca interna, transportando grandes cantidades de materia orgánica disuelta y particulada, así como contaminantes asociados a las actividades antropogénicas (agricultura, ganadería y urbanización) que se realizan en la zona. Tal situación ha traído como corolario una degradación de la columna de agua por la introducción de metales pesados y compuestos orgánicos de origen sintético al Golfo (Spongberg & Davis, 1998; Umaña, 1998). Los impactos ambientales producidos por estas actividades se diversifican y acumulan sinérgicamente a largo plazo induciendo un deterioro del hábitat crítico de cetáceos costeros (Thompson et al. 2000; Hooker & Gerber, 2004).

Translation

Golfo Dulce is a very important habitat for species of costal cetaceans (Oviedo et al, 2009 2015). Among the structural characteristics of this internal sea, it is found a great number of rivers that drain into the intern basin, carrying big amounts of dissolved and particulate organic matter, as well as contaminants associated to anthropogenic activities (agriculture, livestock, and urbanization) that take place in the area. Such situation has brought as a consequence the degradation of the water column due to the incorporation of heavy metals and organic compounds of synthetic origin into the Gulf (Spongberg and

Davis, 1998; Umaña, 1998). The environmental impacts caused by these activities vary and synergistically increase in the long term, leading to a disrupt in the habitat of coastal cetaceans (Thompson et al, 2000; Hooker and Gerber, 2004).

3. **Original**

Este estudio tiene como objetivo identificar las áreas de uso crítico para las ballenas jorobadas y los delfines nariz de botella en el Golfo Dulce, valorando el impacto potencial de proyectos actuales de desarrollo costero, por traslape espacial con estos hábitats esenciales, en específico, el plan para establecer una marina de lujo en las adyacencias de la bahía de Puerto Jiménez. El análisis se presenta con un enfoque donde la distribución de uso se asocia a respuestas ecológicas, en la forma de conducta alimentaria para Tursiops truncatus y conductas relativas al cortejo y reproducción para Megaptera novaeangliae, contextualizándolas en términos de conservación y manejo.

Translation

The objective of this study is to identify the areas of critical use of Humpback Whales and Bottlenose dolphins in the Golfo Dulce by estimating the potential impact of current coastal developing projects due to a spatial overlap with such essential habitats; specifically, the plan to establish a luxury marina in the outskirts of Puerto Jimenez. The analysis proposes an approach where the distribution of use is associated to ecological solutions, in the way the feeding behaviors of Tursiops truncates related to courtship and reproduction of the Megaptera novaeangliae, contextualized in conservation and management.

4. **Original**

Área de estudio: El Golfo Dulce (Fig. 1) es un mar interno, usualmente denominado fiordo tropical, de 50 km de largo y 10-15 km de ancho, situado en la región del Pacífico Sur de Costa Rica, entre los 8° 33’ N y 83° 14’ O. El clima es tropical húmedo con una estación lluviosa de mayo a principios de noviembre, lo que genera una precipitación promedio mensual de 100-700 mm (Quesada-Alpízar & Morales-Ramírez, 2004). El aporte principal de agua dulce lo proveen los ríos Coto Colorado, Tigre, Esquinas y Rincón, con influencia directa en el patrón de circulación de un estuario notablemente estratificado (Svendsen et al. 2006). Las particularidades que hacen que el Golfo Dulce se asemeje a verdaderos fiordos se muestran en la estructura de sus masas de agua. Se evidencian claramente dos capas:a) una capa superficial cálida (≈32°C en promedio) y diluida con una salinidad promedio de ≈ 31 UPS, a una profundidad entre 50 a 60 m, sobre el umbral ubicado en la parte externa del Golfo. b) La otra capa está constituida de aguas profundas y homogéneas, donde la temperatura puede alcanzar un mínimo de 15.4°C y salinidades que alcanzan los 34.8 UPS. Las fuerzas de mareas, el viento, el ingreso de agua al sistema influencian directamente la mezcla y circulación de estas aguas, en conjunto con el afloramiento de agua subsuperficial y la topografía de la cuenca (Quirós, 2003; Quesada-Alpízar & Morales-Ramírez, 2004). La estructura de corrientes del Golfo es de tres capas en la parte externa y una circulación de tipo estuarino en la parte interna (Svendsen et al. 2006). Como se mencionó anteriormente, el área de estudio se dividirá en la cuenca interna, el área del umbral (Quirós, 2003) y la zona de transición oceánica.

Translation

Area of the study: Golfo Dulce (Fig.1) is an internal sea; usually called tropical fjord, with 50 km length and 10-15 km width, located in the South Pacific area of Costa Rica between the 8° 33’ N and 83° 14’ 0. It has a humid tropic climate with a rainy

season that goes from May to November; therefore, this generates an average monthly precipitation of 100-700 mm (Quesada-Alpizar and Morales-Ramirez, 2004). The main contribution of freshwater comes from the rivers Coto Colorado, Tigre, Esquinas, and Rincón, with a direct influence in the circulation pattern of a remarkably stratified estuary (Svendsen et al, 2006). The peculiarities that make the Golfo Dulce to resemble a true fjord, are shown in the structure of its water bodies. Two layers are highlighted: (a) superficial warm layer (32° C average) diluted with an average salinity of 31 UPS, to a depth between 50 to 60 m, upon the threshold located outside the bay. (b) The other layer is made of deep and homogeneous waters, where temperature can reach a minimum of 15.4 °C and salinities extend to 34.8 UPS. Tidal and wind forces and the inflow of water into the system, influence directly the mixture and circulation of these waters, along with the upwelling of subsurface water and the topography of the basin (Quiros, 2003; Quesada Alpizar and Morales-Ramirez, 2004). The structure of the tides of the Gulf has three layers in the outside and a circulation of estuarine type in the inside (Svendsen et al, 2006). As mentioned before, the area of study is going to be divided in the inner basin, the threshold area (Quiros, 2003) and the oceanic transition area.

5. Original

Recolecta de datos: Los muestreos fueron dirigidos al registro y monitoreo de cetáceos, estos se llevaron a cabo en una embarcación de 7 m de eslora, con un motor cuatro tiempos de 115HP, en las tres subáreas descritas anteriormente. Con la intención de abarcar la mayor área posible, los muestreos siguieron un patrón zigzag (variable) desde el punto de origen (Bahía de Rincón o Puerto Jiménez). Los muestreos presentados en este análisis abarcan dos temporadas: la seca (noviembremayo) y la de lluvia (junio-octubre), desde marzo del 2005 hasta diciembre del 2014; los muestreos se iniciaban en periodos matutinos (07:00-08:00) y culminaban a mitad de la tarde (14:00- 16:00), donde

la unidad de muestreo, los avistamientos, integra la definición de grupo usada por Karczmarski et al. (2005) y las observaciones de conducta de acuerdo con lo descrito en Lusseau & Higham (2004), así como en Oviedo (2008). Las condiciones de detectabilidad requieren de un registro periódico para el muestreo efectivo de conducta y acústico, por lo tanto, cada 30 min se realizó una lectura de posicionamiento por GPS (Garmin etrex H, 5 metros de error aproximado), junto con algunas variables ambientales, como la condición del mar (escala Beaufort), la temperatura superficial (medida a través de un termómetro de campo), el ciclo de mareas (tabla de marea del módulo de información oceanográfica MIO-CIMAR) y la presencia o no de cetáceos (Fig. 1). Lo descrito anteriormente permitió a su vez el seguimiento del esfuerzo de campo y la creación de una matriz de presenciaausencia de cetáceos tal como se detalla en Gowans & Whitehead (1995).

Translation

Data Collection: The samplings were focused to the registering and monitoring of cetaceans. They were carried out in 7m length vessel, with an 115 HP four-stroke, in the three subareas described above. With the goal of covering the largest possible area, samplings followed a zigzag pattern (variable) from the place of origin (Bahia Rincón or Puerto Jiménez). The sampling presented in this analysis include two seasons: dry (November to May) and rainy (June to October), from March 2005 until December 2014. Samplings started in the morning (07:00-08:00) and ended in the middle of the afternoon (14:00-16:00). The sample unit and sightings integrate the definition of group used by Karczmarski et al. 2005, and the behavioral observations, according to Lusseau and Higham (2004) and Oviedo (2008), as well. Detectability conditions required of a periodical registering in order to have an effective behavioral and acoustic sampling. Therefore, a GPS positioning reading was made every 30 minutes (Garmin etrex H, 5 meters error approx.), along with some environmental variables; such as condition of the

sea (Beaufort scale), surface temperature (measured through a field thermometer), tidal cycle (tide table of the MIO-CIMAR oceanographic information module), and the appearance or lack of it of cetaceans (Fig. 1). The above described, allowed the follow-up of the field effort and the creation of a presence-absence matrix of cetaceans, as mentioned in Gowans and Whitehead (1995).

Original

Análisis de datos: Los datos espaciales derivados de los métodos descritos anteriormente fueron procesados para evaluar la distribución de uso del delfín nariz de botella y la ballena jorobada en el área de estudio en contraste con la conducta de estas especies. Para los avistamientos de M. novaeangliae se segregaron los grupos entre aquellos donde se incluían crías (incluyendo pares madre-cría y tríadas) y los grupos sin crías (adultos y subadultos), adicionalmente a los registros acústicos que correspondían con ballenas cantando. La distribución de uso fue descrita por medio del índice promedio del vecino más cercano (Average Near Neighbour Ratio-ANNR), la cual promedia la distancia real del centroide de cada elemento espacial en evaluación y la contrasta con el promedio de la distancia de cada elemento, con una distribución aleatoria hipotética, lo anterior resulta una medida de la dispersión espacial (agregada, azarosa, uniforme) entre elementos y sus implicaciones ecológicas (Forting et al. 2002; Begon et al. 2006), la significancia estadística de dicha medida se obtiene por medio del cálculo de un "Z score", el cual se asocia a la distribución normal y permite establecer medidas de significancia y confianza.

Translation

Data Analysis: The spatial data gathered from the methodology previously described, were processed to evaluate the use distribution of bottlenose dolphins and humpback

whales in the area under study in contrast with the behavior of such species. For M. Novaeangliae sightings, groups were segregated among those where offspring (including mother-offspring and triads pairs) were included, as well as groups without offspring (adults and sub- adults); additional to the acoustic records that corresponded to singing whales. The use distribution was described through the ratio of the nearest neighborhood (Average Near Neighbour Ratio-ANNR), which averages the real distance of the centroid of each spatial element under evaluation and contrasts it with the average distance of each element, with a hypothetical random distribution. The above mentioned is obtained from a spatial dispersion measurement (incorporated, eventful, evenly) among elements and their ecological implications (Forting et al. 2002; Begon et al. 2006). The statistical significance of such measurement is obtained through the ¨Z-score¨ calculation, which is associated to a normal distribution and allows to establish significant and build trust actions.

6. Original

El análisis anterior se combinó con Estimados de Densidad Kernel (KDE), usando el método least square cross validation, por medio del software ArcGIS 9.3 (ESRI, 2008). Dos contornos de Estimado de Densidad Kernel se definieron para ilustrar: a) el ámbito hogar potencial por medio del contorno que contiene el 95% del volumen de los registros por especie y b) el área núcleo que representa elhábitat crítico por medio del contorno que concentra el 50% del volumen de todos los registros asociados a las observaciones de conducta por especie.

Translation

The previous analysis was combined with Kernel density estimations (KDE), using the *least square cross validation* method, through the ArcGIS 9.3 (ESRI, 2008) software.

Two edges of the Kernel density estimations were specified to illustrate: a) the potential household area by the edges that contain 95% of the volume of the records by species, and b) the nucleus area that represents the critical habitat through the edges that consolidate the 50% of the volume of all the records associated to the behavioral observations by species.

7. **Original**

Caso de Estudio: Marina de Lujo en la Bahía de Puerto Jiménez: El proyecto de desarrollo de una marina contemplado para el área de Puerto Jiménez consiste en la construcción y operación de puestos para el atraque de embarcaciones. La cantidad efectiva de puestos de atraque para venta o renta es de cerca de 257 unidades, que en su conjunto son equivalentes a 5 000 metros de eslora. Adicionalmente, el proyecto incluye un área de 9 000 m², de los cuales 2 674 m² serán destinados a área comercial, y el resto, 6 326 m², serán destinados a la construcción de un hotel con 74 habitaciones para los usuarios de la Marina (Araya-Montero et al. 2006). El estudio de impacto ambiental de la Marina de Lujo en Puerto Jiménez fue aprobado por la Secretaría Técnica Nacional Ambiental mediante Resolución № 2424-2008-SETENA del día 8 de agosto del 2008, otorgándosele la viabilidad ambiental al proyecto, para posteriormente modificarse mediante Resolución № 2084-2011-SETENA del día 30 de agosto del 2011,modificando, de esta manera, las obras constructivas contempladas dentro del estudio de impacto ambiental aprobado, reduciendo la capacidad de embarcaciones en el diseño, de acuerdo con el nivel descrito anteriormente.

Translation

Case Study: *Luxury Marina in Puerto Jiménez Bay:* The development project of a marina in the Puerto Jiménez area, consists on the building and operation of posts for the

berthing of ships. The effective amount of berths for sale or rent is about 257 units, which in total are equal to 5000 meters in length. Apart from that, the project includes an area of 9000 m², from which 2674 m² would be destined to commercial purposes and the remaining 6326 m², to the construction of 74 rooms for the marina users (Araya-Montero et al, 2006). The environmental impact assessment of the Luxury Marine in Puerto Jiménez was approved by the Secretaria Técnica Nacional Ambiental through resolution N°2424-2008-SETENA on August 8th, 2008; granting the environmental feasibility to the project, and then was modified by resolution N° 2084-2011-SETENA on August 30th, 2011; in this way, modifying the constructive projects contemplated within the approved environmental impact assessment, reducing the capacity of vessels in the design according to the level previously described.

8. Original

En una década de muestreos en el Golfo se ha obtenido una cobertura espacial homogénea en la cuenca interna de cerca de 40 000 km ≈ 50% del esfuerzo total (Fig. 1), mientras que la cobertura espacial para la zona del umbral y la zona de transición oceánica presenta un incremento constante, lo que ha implicado una inversión de 3 490 horas de campo, equivalentes a 79 300 km recorridos aproximadamente en esfuerzo activo de búsqueda y seguimiento de individuos. Se recolectaron 422 registros derivados de las observaciones de delfines nariz de botella y 167 registros de ballenas jorobadas en zonas costeras. La Figura 2 aborda los detalles de las conductas más importantes en los presupuestos de actividad.

Translation

After 10 years of taking samplings in the Gulf, it has been obtained a homogeneous spatial coverage in the internal basin, around 40 000 Km = 50% of the total effort (Fig 1),

while the coverage for the threshold zone and the oceanic transition zone present a constant increase. This has involved an investment of 3490 field hours, equivalent to approximately 79300 km travelled in active search and individual tracking. It was collected around 422 registers from bottlenose dolphin's observations and 167 records of humpback whales in coastal areas. Figure 2 shows the most important behavioral details in activities carried out.

9. Original

Distribución espacial de delfines nariz de botella: El patrón espacial de las agrupaciones de T. truncatus es del tipo agregado, de acuerdo con lo que indica el índice promedio del vecino más cercano. Dicho patrón de agrupamiento espacial es estadísticamente significativo, tal como se refleja por el estadístico "Z score" y la medida de probabilidad detallados en el Cuadro 1. La distribución y uso de hábitat de T. truncatus en el Golfo Dulce se ilustra en la Figura 3 mediante registros que están asociados a evidencias conductuales de alimentación (N=244 ≈ 60% del total de avistamientos).

Translation

Spatial Distribution of Bottlenose Dolphins: The spatial pattern of groups of T. truncates is of an aggregated type, according to what the average nearest neighbor index states. Such spatial clustering pattern is statistically significant, as it is reflected by the statistical ¨Z score,¨ and the measures of likelihood in Table 1. The distribution and habitat usage of T. truncatus in Golfo Dulce is exemplified in Figure 3, through some registers associated to behavioral feeding evidence (N=244 = 60% of the total of sightings).

10. Original

La distribución de uso se expresa mediante el contorno que incluye el 95% de los registros del delfín nariz de botella (KDE-adaptativo: Densidad 5.50 registros/km2; H=0.042; H-REF=0.40), correspondiente al rango hogar; en conjunto con el contorno que refleja las áreas de concentración núcleo que contienen el 50% de los registros de la especie (KDE-adaptativo: Densidad 76.76 registros/km2; H=0.042; H-REF= 0.40). El rango hogar potencial de delfines nariz de botella se encuentra a lo largo de la línea costera del Golfo Dulce, en las costas de la cuenca interna, particularmente en la zona aledaña a Puerto Jiménez. Estas áreas críticas para alimentación se integran con la zona del umbral. Las áreas de concentración núcleo se centralizan en zonas de influencia de las desembocaduras de los ríos y sus adyacencias, en específico, a lo largo de los ríos Rincón, Esquinas, Coto Colorado, con mención particular al subsistema conformado por los ríos Tigre y Platanares. De acuerdo con lo anteriormente descrito, podemos identificar como zonas con mayor importancia de uso, las desembocaduras de los ríos como hábitats críticos de alimentación de delfines nariz de botella.

Translation

The usage distribution is expressed through the edge that includes 95% of the bottlenose dolphins' records (KDE-adaptive: Density 5.50 records/km²,; H=0.042; H-REF=0.40), belonging to the home ranking. The home range of bottlenose dolphins is found along the Golfo Dulce coastline, in the inner basin of the coasts, especially in the surrounding areas of Puerto Jiménez. These critical feeding areas are bound with the threshold area. The nucleus concentration areas are centralized in affluence zones of the river mouths and its surroundings; specifically, along the Rincón, Esquinas, Coto

Colorado Rivers, with special mention to the subsystem formed by Tigre and Platanares rivers. According to the above mentioned, we can identify as areas of a higher usage, the river mouths as critical feeding habitats to the bottlenose dolphins.

11. Original

Distribución espacial de la ballena jorobada: La ballena jorobada en el Golfo Dulce se distribuye en grupos agregados de carácter significativo (P < 0.001, Cuadro 1), según lo refleja el índice promedio del vecino más cercano. Las agregaciones de ballenas jorobadas, entre las que se incluyen los grupos de madres y crías, al igual que grupos de machos en cortejo, se ilustran en la Figura 4, la cual contiene los contornos correspondientes a rango hogar (KDEadaptativo: Densidad 1.33 registros/km2; H=0.25; H-REF= 0.49) y el contorno que define el área núcleo de agregación (KDE-adaptativo: Densidad 21.36 registros/km2; H=0.25; H-REF= 0.49). Los registros de avistamiento referidos anteriormente se complementan con los resultados de un muestreo acústico, donde el 64% de las vocalizaciones identificadas como canto de machos potencialmente en cortejo (n=35), se ubican dentro del área núcleo (Fig. 4).

Translation

Spatial Distribution of Humpback Whales: The humpback whales in Golfo Dulce are allocated in significant aggregated groups (< 0.001, table 1) of significant character; as it stated by the average nearest neighbor index. Aggregations of humpback whales, including mothers and calves groups, as well as males in courtship are illustrated in Figure 4, which has the corresponding edges of the home range (KDE-adaptive: Density 1.33 records/ km2; H=0.25; h-ref= 0.49) and the edge that defines the aggregation nucleus area (KDE-adaptive: Density 21.36 records/km2; H=0.25; h-ref= 0.49). The sighting records mentioned before are supplemented by the results from the samplings, where 64%

of the vocalizations identified as male singing potentially in courtship (n=35), they are located in the nucleus area (Fig 4).

12. Original

La zona del umbral del Golfo Dulce se consolida como hábitat crítico de reproducción y cría de la ballena jorobada. Esta especie usa como rango estacional potencialmente toda la extensión marino-costera del Golfo Dulce durante su migración anual, no obstante, el 50% de los registros están localizados en una zona exclusiva, aledaña a la desembocadura del río Platanares en Puntarenitas, hasta conectar con la porción occidental del umbral y la transición del Golfo con el Océano Pacífico. Esta área contiene una porción notable de registros de madres con crías, así como de ballenas en edad de madurez reproductiva, ejecutando y llevando a cabo aspectos complejos de comportamiento reproductivo, en particular grupos competitivos y registros vocales de machos cantantes. Los resultados anteriores, a través de los contornos de la distribución de uso y el tipo de agrupamiento agregado, establecen elementos espaciales claves que sustentan el uso intensivo de esta área como zona de refugio importante para hembras con crías. Adicionalmente, hay una incidencia alta de vocalizaciones (machos cantando) que se agregan en la zona del umbral.

Translation

The threshold of Golfo Dulce area is consolidated as a critical reproduction area and calving habitat of humpback whales. This species uses the entire coastal-marine extension of the Golfo Dulce as a stational range during its annual migration; nevertheless, 50% of the records are located in an exclusive area, adjacent to the mouth of the Platanares river in Puntarenitas, until getting to the occidental portion of the threshold and the transition of the Gulf to the Pacific Ocean. This area has significant records of females with calves, as

well as whales in their reproductive years, executing and carrying out complex characteristics of behavioral reproduction in competitive groups and vocal registers of male singers. The previous results, throughout the edges of usage distribution and the type of grouping aggregation, establish geographical elements that support these key spatial elements that support the intense usage of this area as an important refuge zone for females with calves. In addition, there is a high incidence of vocalizations (males singing) that are found in the threshold area.

13. Original

Hábitat crítico de alimentación del delfín nariz de botella: De acuerdo con los resultados del análisis espacial de cetáceos de hábitos costeros en el Golfo Dulce, el delfín nariz de botella tiene un patrón espacial agregado, asociado a áreas de alimentación discretas (Parrish & Edelstein-Keshet, 1999). La identificación del hábitat crítico de alimentación en las áreas núcleo de los ríos Tigre-Platanares se basa en registros de conducta de alimentación documentados tanto en el presente estudio como en investigaciones anteriores (Pacheco-Polanco & Oviedo, 2007; Oviedo, 2007; Oviedo et al. 2012). La alimentación es una actividad biológica fundamental que afecta el éxito reproductivo de una especie. Esta conducta refleja una respuesta ecológicamente dinámica del organismo ante los recursos disponibles y la estructura del hábitat (Gowans et al. 2007), por lo que no solo se evidenciaría un uso del hábitat, sino también un proceso de selección que resulta del consumo intensivo (en su sentido más genérico) de recursos particulares que ofrece esta localidad discreta, en contraposición a lo disponible en toda la extensión del Golfo (Wheeler et al. 2012). El traslape de áreas críticas de alimentación con la marina puede tener efectos significativos en esta población, ya que en esta misma área se han evidenciado afecciones dérmicas, en específico, la enfermedad denominada LLD (Lacaziosis Like Disease: Enfermedad Similar a Lacaziosis), de acuerdo con lo

planteado en Bessesen et al. (2014). Esta es una infección por hongos, que está relacionada con la degradación de condiciones ambientales, se estima que un cuadro previo de compromiso inmunotóxico por exposición a contaminantes, podría promover la morbilidad de esta enfermedad dérmica (Reif et al. 2009), la cual afecta a especies de delfines costeros (Van Bressem et al. 2009) por estar estas más expuestas a las presiones por actividades humanas en sus hábitats críticos (Bowen, 1997; Thompson et al. 2000; Whitehead et al. 2000; Gowans et al. 2007; Jefferson et al. 2009).

Translation

Critical Feeding Habitat of Bottlenose Dolphins: According to the cetaceans critical analysis of coastal habitats in Golfo Dulce, the bottlenose dolphin has an aggregation pattern associated to discrete feeding areas (Parrish and Edelstein-Keshet, 1999). The critical feeding habitat was identified in the nucleus areas of Tigre and Platanares rivers; and it is mainly based on behavioral feeding records in the present study and in previous researches (Pacheco-Polanco and Oviedo, 2007; Oviedo, 2007; Oviedo et al, 2012). Feeding is a fundamental biological activity that may affect the reproductive success of a species. This behavior reflects an ecological dynamic response of the organism to the available resources and habitat structure (Gowans et al. 2007); therefore, not only the usage of the habitat would be evident, but also a selection process that results from the intensive consumption (in a general way) of particular resources that such discrete locality offers. This in contrast to what is available in the whole Gulf area (Wheeler et al, 2012). The overlap among the critical feeding areas with the marina can have significant effects in this community, since in this same area it has been found dermal conditions; specifically the disease called LLD (*Lacaziosis Like Disease*), according to what it was mentioned in Bessesen et al. (2014). It is a fungus infection related to the degradation of environmental conditions. It is estimated that a previous

frame of immunotoxin compromise by exposure to pollutants could promote the morbidity of this dermic disease (Reif el al, 2009). This illness affects the coastal dolphins species (Van Breseem et al, 2009) as they are more exposed to human activities in their critical areas (Bowen, 1997; Thompson et al; 2000; Gowans et al, 2007; Jefferson et al, 2009).

14. Original

Hábitat crítico de reproducción y cría de la ballena jorobada: La porción del área del umbral adyacente a la bahía de Puerto Jiménez ofrece condiciones especiales de resguardo y conservación de energía para grupos de madres-crías (Craig et al. 2014). Márquez-Artavia et al. (2012) sugieren que estas agregaciones evitan activamente las zonas de mezcla, donde el régimen de corrientes promovería la formación de turbulencia, con el fin de facilitar la preservación de energía durante la lactancia (Clapham, 2008). El canto en las ballenas jorobadas es el elemento conductual que resalta como aspecto crucial del cortejo y reproducción (Tyack, 1981; 2000; Clapham, 2000; Oviedo et al. 2008; Smith et al. 2008). Este comportamiento reproductivo define el uso de hábitat en esta área en particular. El uso diferencial de hábitat entre pares de hembras con crías y machos cantando en cortejo se disipa por lo reducido de la escala geográfica donde ocurren estos eventos y por la relación implícita entre la disponibilidad de hembras y la mayor proporción de machos en áreas de agregación invernal (Craig et al. 2002; Clapham, 2008), lo que a su vez genera la presencia de grupos competitivos de machos persiguiendo hembras (Craig et al. 2002; Spitz et al. 2002), incluso aquellas con crías de la temporada (Clapham, 2000).

Translation

Critical Reproduction and Nursery Habitat of Humpback Whales: The portion of the adjacent umbral area to the Puerto Jimenez bay offers special conditions to protect and preserve the energy for groups of mother and calves (Craig et al, 2014). Márquez-Artavia et al. (2012) suggested that those aggregations actively avoid the mix-areas, where the regimen of water flows promote the creation of turbulence, in order to facilitate the preservation of energy during nursing (Clapham, 2008). The singing of humpback whales is an important behavioral element that stands out as a crucial courtship and breeding aspect (Tyack, 1981; 2000; Clapham, 2000); Oviedo et al, 2008; Smith et al. 2008). This particular reproductive behavior defines the usage of this area in particular. The differential habitat use among females with calves and males singing in courtship is diffused by the reduced geographical scale, where these events happened and by the relationship between the availability of females and the greater population of males in areas of wintry aggregation (Craig et al, 2002; Clapham, 2008), which in turn can generate a competitive group of males chasing females (Craig et al, 2002; Spitz et al, 2002) even those females who already have calves of the season (Clapham, 2000).

5.2.2 English – Spanish Translation

Fire Investigator

1. **Original**

The primary method of recording the scene is through visual media. Photography - whether digital, still, or video-provides the investigator with pictures of the scene that can be used as points of reference when writing the report. These pictures present the investigator and other examiners with the most concise depiction of the condition of the scene, thus improving the process of pattern identification. Furthermore, because the report may be written sometime after the actual site investigation, the visual recordings are an effective way of reminding the investigator of the condition of the fire scene at the time that it was investigated.

Translation

En la escena, el primer método de registro son los de medios visuales. La fotografía ya sea digital, fija o video, le proporciona al investigador imágenes de la escena que pueden ser utilizadas como punto de referencia cuando se redacte el reporte investigativo. Estas imágenes le presentan al investigador, y a otros examinadores, representaciones más concisas del estado de la escena, y así mejorar el proceso de identificación de patrones. Además, dado que el informe puede escribirse algún tiempo después de la investigación real del sitio, las grabaciones visuales son una forma efectiva de recordarle al investigador el estado de la escena del incendio en el momento en que se investigó.

2. **Original**

Photographs are acceptable for presentation in court, and color photos are preferred. Typically, courts accept photographs that are objective and do not inflame or exaggerate. The presenter of the photographs to the court must be able to affirm that the photographs

show "a true and accurate depiction of the scene" as compared with what he or she saw at the scene. Although time and expense are important considerations in achieving this, it is always preferable to have too many photos rather than not enough photos

Translation

Las fotografías son aceptadas en un tribunal; sin embargo, las de color son preferidas. Usualmente, la corte acepta imágenes que sean objetivas y que no exageren. El que presenta las imágenes a la corte debe de ser capaz de afirmar que las imágenes muestran ¨una representación verdadera y precisa de la escena¨ en comparación con lo que se observó en la misma. A pesar de que el tiempo y los gastos son importantes para lograrlo, siempre es preferible tener muchas fotos y no las suficientes.

3. **Original**

Recording the scene through visual representation should be accomplished as early as possible in the investigation, before the scene becomes altered, disturbed, or destroyed because of suppression or other activities. In addition, by documenting the scene early, the investigator can ensure accurate representation of the condition of the scene in case of subsequent building collapse. Other hazards include environmental or mechanical hazards that can render the scene unsafe.

Translation

Grabar la escena a través de representación visual debe realizarse tan pronto como sea posible en la investigación; es decir antes de que la escena sea alterada o destruida debido al encubrimiento de la evidencia u otras actividades. Además, al documentar la escena anticipadamente, le garantiza al investigador una representación precisa de la situación de la escena en caso de un posterior colapso de la estructura; o bien otros peligros tales como cambios ambientales y mecánicos, los cuales pueden poner en peligro la escena.

4. **Original**

A multitude of cameras are available at a wide range of prices. The investigator is limited in camera choice primarily by financial resources and his or her personal skill level. Commercially available cameras can be categorized according to price and by manual versus automatic operation. Automatic cameras are the easiest to operate. They determine the primary scope of the photograph and then focus on the most obvious image in the viewfinder. These cameras can provide a sense of comfort to some investigators because they automatically determine proper exposure, adjust the lens aperture, and shutter speed, focusing the lens with a beam of infrared light. These features remove many potential pit falls for the inexperienced photographer.

Translation

Existe una gran cantidad de precios disponibles para las cámaras. El investigador se ve limitado en la elección de la cámara, principalmente por los recursos financieros y su nivel de habilidad para manipularlas. Las cámaras comerciales se pueden categorizar según su precio u operación, es decir manual o automática. Las cámaras automáticas son las más sencillas de manipular, ya que estas determinan el alcance primario de la fotografía y luego enfocan la imagen más obvia en el visor. Estas cámaras le pueden proporcionar una sensación de confort a algunos investigadores, debido a que determinan en forma automática la exposición adecuada y ajustan la apertura del lente y velocidad del obturador, y enfocan el lente con un rayo de luz infrarroja. Estas funciones eliminan muchas dificultades latentes que un fotógrafo inexperto puede tener.

5. **Original**

Some agencies continue to use film cameras for crime scene and fire scene documentation. Film and film speed is an important consideration that can determine the

ultimate quality of slides and prints taken at the fire scene. Film speed can vary from 25 to 1600 ASA (American Standards Association) for color photography and up to 6400 ASA for black and white photography. The higher the ASA, the better the photograph is able to depict objects in darker situations. Unfortunately, with higher ASA numbers, the quality of photo enlargements decrease; they appear grainy, and detail is lost. Most investigators use film that has a rating of 100 to 400 ASA. Regardless of the speed or type of film used, the investigator should use color film to depict the objects in the photo better.

Translation

Algunas agencias continúan utilizando cámaras de película para documentar la escena del crimen y la del incendio. La película y la velocidad de película son aspectos importantes a considerar, ya que determinan la máxima calidad de las diapositivas e impresiones tomadas en la escena. La velocidad de la película puede variar de 25 a 1600 ASA (por sus siglas en ingles) para fotografías a color y hasta 6400 en fotos a blanco y negro. Cuanto mayor sea el ASA, la fotografía será capaz de representar objetos en la oscuridad con mejor precisión. Sin embargo, entre más alto sea el ASA, la calidad de las ampliaciones de las fotografías disminuirá; es decir tendrá una apariencia granulada y los detalles de la imagen se pueden perder. La mayoría de los investigadores utilizan películas a color entre los 100 y 400 ASA. Sin importar la velocidad o el tipo de película empleado, el investigador debe usar película a color para representar de una mejor forma las imágenes en las fotografías.

6. Original

Once the digital image has been captured, the image should be preserved on a no alterable medium, such as a DVD/CD- ROM. This should happen as soon as possible

after the images are taken to reduce the chance of legal challenge to the images. The investigating agency should have a written policy regarding this practice. Once the image is preserved on a suitable medium, it can then be manipulated to enhance, brighten, adjust color, and contrast in order to enhance views to be printed to a high- quality paper. This manipulation does not change the original photo preserved on the CD-ROM. Any manipulation of a photo should be documented and included in the photo information log. Some courts may not accept photos that have been electronically altered.

Translation

Una vez que la imagen ha sido tomada, esta debe guardarse en un medio inalterable, tal como un DVD o CD ROM. Lo anterior, debe hacerse una vez que las fotos fueron tomadas, para así evitar cualquier impugnación legal de las imágenes. La agencia de investigación debe tener una política escrita sobre esta práctica. Una vez que la imagen se almacenó en un medio confiable, la misma puede manipularse para aumentar el brillo, ajustar el color y contraste, y de esta forma para mejorar las vistas que se imprimirán en un papel de alta calidad. Esta manipulación no cambia la fotografía, la cual esta almacenada en un DVD/CD ROM. Sin embargo, la manipulación debe documentarse e incluirse en el registro; esto, ya que es posible que algunos tribunales no acepten fotografías alteradas electrónicamente.

7. Original

A camera lens is used to gather light and to focus the image on the surface of the film. Camera lenses can accentuate the quality of the photograph. The investigator should understand that various camera lenses produce different results. Telephoto lenses allow the photographer to see detail from a distance or to accentuate minute details. ln addition, particular types of camera lenses can distort the appearance of detail. For example, a fish-

eye lens can depict a higher percentage of the inside of a small room, but it can also distort the peripheries of the photograph, exaggerating curves in objects.

Translation

El lente de una cámara se utiliza para ajustar la luz y enfocar la imagen en la superficie de la película. Los lentes de cámara ayudan a resaltar la calidad de la fotografía. El investigador debe entender que existen diferentes tipos de lentes, los cuales producen diferentes efectos en las fotografías. Los teleobjetivos le permiten al fotógrafo ver más detalles desde la distancia o bien resaltar detalles minuciosos. Además de eso, ciertos tipos de lentes pueden distorsionar los detalles de las fotos; por ejemplo, un lente de ojo de pez puede representar un mayor porcentaje del interior de una habitación pequeña, sin embargo también puede distorsionar las periferias de la fotografía y exagerar las curvas en los objetos.

8. Original

The photographic documentation of the scene should depict sequential views of the scene. A photograph of a relatively small subject (e.g., a chalk) is taken first from a distance (perhaps from the doorway to the room) to show the position of the subject in relation to other fixed objects such as a door casing or radiator, followed by a shot from a medium distance showing more detail, and ending with a close-up of the subject (figure 13.1). Sequential photography allows the observer of the photograph to understand better the totality of the view and the relationship of the subject to the overall surroundings.

Translation

La documentación fotográfica del suceso debe presentar vistas secuenciales de la escena. La fotografía de un objeto relativamente pequeño (por ejemplo: una silla) debe

tomarse primero desde la distancia (quizás desde la entrada de la habitación) para mostrar la posición del objeto en relación a otros objetos fijos, como el marco de una puerta o radiador; seguido de una toma a distancia media que muestre más detalles, y para así finalizar con un acercamiento del objeto (figura 13.1). Las fotografías secuenciales le permiten al investigador comprender mejor la totalidad del panorama y la relación de los objetos con la derivación en general.

9. Original

Another method for depicting the totality of the scene is to use a mosaic of photographs. Mosaic photographs are a series of photographs that encompass a large area by overlapping the start of one photograph where the previous photograph ended. Mosaics are used when a wide-angle lens is not available and a panoramic view is desirable. To create a mosaic, the investigator should identify the breadth of the photograph according to readily identifiable landmarks. Each ensuing photograph should encompass a portion of that landmark so that the final appearance is of one large photograph encompassing an overall view of a particular area.

Translation

Otra técnica para mostrar la totalidad de la escena, es el uso de los mosaicos de fotografías. Este método se constituye por una serie de fotografías que abarcan una gran área superponiendo el inicio de una fotografía donde la fotografía anterior termino (figura 13.2). Las fotografías de los mosaicos se utilizan cuando no se dispone de un objetivo gran angular y se desea obtener una vista panorámica. Para crear un mosaico, el investigador debe identificar la amplitud de la fotografía de acuerdo a puntos de referencia identificables. Cada fotografía subsiguiente debe abarcar una parte de dicho

punto de referencia, para que así la imagen final sea de una fotografía grande que constituya una vista general de un área en particular.

10. Original

Video recording is a method of documenting and recording the scene. The investigator is able to record the scene and narrate at the same time. The recording, not necessarily used or presentation, can be used by the investigator to later refresh his or her memory of the conditions and evidence location. Most entry-level digital video cameras cannot turn off their micro- phone. Investigators should avoid inappropriate comments or "off the hip" analysis of cause, which may prove embarrassing later.

Translation

La grabación de video es un método de documentación y grabación de la escena. De esta forma, el investigador puede registrar y narrar la escena en forma simultánea. La grabación, la cual no siempre es necesariamente usada para presentarla, puede utilizarse por el investigador para después recordar mejor la condición y ubicación de la evidencia. La mayoría de las cámaras de video digitales de primer nivel no cuentan con la opción de apagar el micrófono; por lo tanto, los investigadores deben evitar comentarios inapropiados o análisis fuera de lugar, los cuales más adelante pueda causar una situación incómoda.

11. Original

lt is important to document as much of the scene as possible. Some suggested activities to record are conditions on arrival, suppression, overhaul, observers, and origin and cause determination. The progression of the fire, its colors, its reaction to suppression activities, and the overhaul procedures employed are all important in helping the fire

investigator to determine the origin and cause. Photographs can also document the extent of damage to the victims or structure.

Translation

Es importante documentar la totalidad de la escena. Sin embargo, se sugiere documentar las condiciones en que estaba la escena a la hora de llegada, la supresión, revisión, observación y origen y causa del incendio. La progresión del incendio, sus colores, su reacción a las actividades de supresión y los procedimientos de reconocimiento empleados, son aspectos de suma importancia, ya que todos le ayudan al investigador a determinar la causa de origen del incendio. Las fotografías también pueden ayudar a documentar el alcance del daño a las víctimas y a la estructura.

12. Original

All fire investigators should routinely determine whether initial witnesses to me fire such as the 911 reporting party (RP) documented what they saw with a camera phone or digital camera. Many times media news outlets have staff or stringers respond to large fires. These professionals sometimes arrive on scene prior to apparatus and often have superior quality photo- graphic equipment. Reporters may be busy interviewing victims or witnesses prior to your arrival and should always be contacted.

Translation

Todos los investigadores de incendios siempre deben determinar si el testigo inicial que reportó dicho incendio al 911, documentó lo que observó con la cámara de un teléfono o cámara digital. Muchas veces, los medios de comunicación tienen personal o intermediarios que asisten a grandes incendios. A veces, estos profesionales llegan a la escena antes que el equipo de bomberos y a menudo tienen acceso a mejor equipo

fotográfico. Por otro lado, los reporteros también pueden estar ocupados entrevistando a las víctimas y testigos antes de la llegada de los investigadores por lo que es necesario contactarlos.

13. Original

Structural photographs document the extent of damage to the structure after heat and flame exposure. These photographs should be taken from multiple views to record heat and flame damage. Structural failures or deficiencies should be captured in photos because these can play a role in the outcome of the fire. The photographs that are taken should be useful to the investigator for explaining their analysis of the fire scene to supervisors, prosecutors, the court system, and insurance representatives.

Translation

Las fotografías estructurales documentan los daños a las estructuras causadas por el calor y la exposición a las llamas durante el incendio. Estas fotografías deben tomarse desde múltiples ángulos para que quede un registro del daño causado por el calor y las flamas. De igual manera, las fallas o deficiencias estructurales deben documentarse en las imágenes, dado que estas pueden desempeñar un papel importante en el resultado de los hechos. Por último, las fotografías tomadas son muy útiles para que el investigador de incendios pueda exponer su análisis de la escena a los supervisores, fiscales, tribunal y a los representantes de seguros.

14. Original

Collecting and preserving evidence is one of the many responsibilities of fire investigators. At times, recognizing evidence and determining its importance may be difficult. A few years ago, I was assisting a police detective in a fire investigation

involving two recreational vehicles (RVs). The RVs were parked next to a service garage at a business that sold and repaired RVs, campers, and related equipment. The fire was called in and suppressed during the evening hours. The two RVs were completely destroyed by fire, leaving behind only their metal frames.

Translation

El recolectar y preservar la evidencia es una de las responsabilidades del investigador de incendios. En ocasiones, el encontrar la evidencia y determinar su importancia puede ser difícil. Hace unos años atrás, yo era el asistente de un detective de policía en una investigación de incendio que involucraba dos vehículos recreativos (RV's). Las casas rodantes estaban estacionadas al lado de un taller en un negocio que vendía y reparaba vehículos recreativos, auto caravanas, entre otros. El incendio fue reportado y apagado durante las horas de la tarde. Los dos vehículos resultaron completamente destruidos por el incendio, dejando solamente la estructura metálica.

15. Original

The fire investigator is responsible for locating the evidence, properly identifying the evidence, collecting the evidence, documenting the evidence, examining and storing the evidence, and arranging for testing of physical evidence from a fire or explosion scene; however, the first stage of preservation of potential physical evidence on a fire ground begins with the firefighting or suppression operation itself. Fire investigators in a jurisdiction can help themselves by offering training to fire crews and fire officers in how to recognize the importance of evidence preservation and basic ways to avoid inadvertent destruction of physical evidence. Fire investigation and law enforcement associations can influence basic fire fighter and fire officer training at the state or county level in the area

of preservation of physical evidence a t fi res, explosions, traffic accidents, and other joint operations.

Translation

El investigador es el responsable de localizar la evidencia, identificarla, recogerla, documentarla, examinarla, almacenarla y organizar las pruebas o evidencias físicas encontradas en la escena. Sin embargo, la primera etapa de conservación de la evidencia es primordial, ya que se inicia con la extinción y supresión del incendio. En una jurisdicción, los investigadores pueden ayudarse a sí mismos, al capacitar a las brigadas de bomberos y a los oficiales de bomberos, sobre la importancia de la preservación de la evidencia y la forma básica de cómo evitar la destrucción accidental de la misma. Los investigadores y los organismos de seguridad pueden proveer entrenamiento básico a los bomberos y los oficiales de bomberos a nivel estatal o nacional en la preservación de la evidencia física en incendios, explosiones, accidentes de tránsito y otras operaciones en conjunto.

5.3 Glossaries

The creation of a glossary will result in one of the most relevant resources in a translation process, since it will help the translator to understand and quickly identify those unknown words found in the translated documents. According to the Real Academia de la Lengua Española (2001), a glossary consists on a list in alphabetical order with terms and words that belong to an specific subject or area of study and each one of those terms are explained in different a context, which also includes its equivalent in the target language. Being said that, glossaries are considered as an essential tool for translators, in order to not waste time and in keep the transparence and accuracy of the documents.

5.3.1 Translation from Spanish into English

Análisis espacial de los hábitats críticos del delfín nariz de botella y la ballena jorobada en Golfo Dulce, Costa Rica

Source Language	Target Language	Meaning	Picture
1. Cetaceos Costeros	Costal Cetaceans	Aquatic mammals	
2. Actividades antropogénicas	Anthropogenic activities	Activities caused by human	
3. Sinergeticamente	synergistically	Pertaining to, characteristic of, or resembling	

4. Fiordo	fjord	A long, narrow arm of the sea bordered by steep cliffs: usually formed by glacial erosion.	
5. Umbral	Threshold	Any place or point of entering or beginning	
6. Estuarino	Estuarine	It is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea	
7. Eslora	Length	The longest extent of anything as measured from end to end	
8. Patron zigzag	Zigzag pattern	pattern made up of small corners at variable Angles, tracing a path between two parallel lines	
9. Avistamientos	Sightings	An occasion when you see something or someone	

10. MIO-CIMAR	MIO-CIMAR Oceanographic information module	It is a table that shows the state and ocean meteorological events	
11. TCD D-5	TCD D-5	Digital tape recorder	
12. Atraque	Berths	A ship's allotted place at a wharf or dock.	
13. Lecturas de GPS	GPS-Readings	Unique identifier of a precise geographic location on the earth	
14. KDE	KDE	Kernel density estimations	
15. Hydrophone	Hydrophone	A microphone that detects sound waves under water	

16. Novaeangliae	Novaeangliae	Cetacean Humback-Whale	
17. ANNR	ANNR	Average Near Neighbor Ratio-ANNR	
18. Z-score	Z-score	It's a measure of how many standard deviations below or above the population mean a raw score is.	
19. T. truncatus	T. truncatus	Bottle-nose dolphin	
20. LLD	LLD	Lacaziosis Like Disease (dermal disease)	
21. Inmunotoxico	immunotoxin	A monoclonal antibody linked to a toxin with the intention of destroying a specific target cell while leaving adjacent cells intact	
22. Morbilidad	morbidity	The proportion of sickness or of a specific disease in a geographical locality.	
23.		Backing	

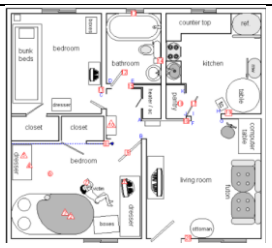
Enmascaramiento	Masking		
24. Chicoreus brevifrons	Chicoreus brevifrons	A marine gastropod mollusk in the family Muricidae	
25 Neogastropoda Muricidae	Neogastropoda Muricidae	It´s a large and varied taxonomic family of small to large predatory sea snails, marine gastropod mollusks.	

5.3.2 Translation from English into Spanish

Fire Investigator

Source Language	Target Language	Meaning	Picture
1. Hazards	Peligros	An unavoidable danger or risk, even though often foreseeable.	
2. Viewfinder	Visor	A little rectangle on top of the camera.	
3. Bracketing	Horquillado	Taking series of photographs with sequentially adjusted	

		exposures.	
4. SLR	SLR (cámara digital re ‘Flex o de objetivo simple)	A camera that typically uses a mirror and prism system. It permits a view through the lens and see exactly what will be captured.	
5. ASA	ASA	Escala de sensibilidad fotográfica	
6. Telephoto lenses	Teleobjetivos	Specific type of a long-focus lens in which the physical length of the lens is shorter than the focal length	
7. Photo painting	Pintura fotográfica	A technique used when the photo will cover a large scene	
8. Ring flash	Flash de anillo	A type of electronic flash in which the light source is arranged in a ring around the lens in order to produce a light without shadows	

9. Sequentially photography	Fotografía secuencial	It shows the relationship of a small subject to its relative position in a known area	
10. Mosaic photography	Fotografías de los mosaicos	A picture (usually a photograph) that has been divided into (usually equal sized) tiled sections	
11. Diagrams	Diagramas	Formal drawings that are completed after the scene investigations is completed	
12. Sketches	Bocetos	Freehand diagrams	
13. Schedule		Used on larger projects, this details the types of equipment in lists	
14. CAD	CAD	Computer-assisted drawing	
15. Libraries	Bibliotecas	Set of predawn objects such us furniture	

16. Insulation	Aislamiento	Material used for insulating	
17. Artifact evidence	Artefacto	Physical evidence	
18. RVs	RVs	Mobile homes	
19. Direct evidence	Evidencia Directa	Testimony of witness	
20. Demostrative evidence	Evidencia demostrativa	Physical evidence as maps, photographs	
21. Circumstantial evidence	Evidencia circunstancial	Facts that usually attend other facts to be proven	
22. Landmark	Punto de referencia	A prominent or conspicuous object on land that serves as a guide	
23. Fingerprints	Huellas digitales	An impression of the markings of the inner surface of the last joint of the thumb or other finger	
24. Molotov cocktail	bomba molotov	A crude incendiary grenade	

		consisting of a bottle filled with a flammable liquid and a wick that is ignited before throwing	
25. Encompassing	Constituya	To include comprehensively	

Chapter VI

Conclusions and Recommendations

The purpose of the following chapter is to restate the main argument. In other words, it will indicate the strengths and reiterate the most valuable evidence supporting the goal of the research. This is considered one of the most important parts of the investigation, since it will confirm the methodologies and techniques applied during the translation of both documents. Therefore, a concise description of every finding will be mentioned in detailed to strehgthen the initial idea of the investigation.

6.1 Conclusions

As mentioned in the University of Southern Carolina Online's Guide for the Development of Research Papers, "The conclusion is intended to help the reader to understand why your research should matter to them after they have finished reading the paper. A conclusion is not merely a summary of the main topics covered or a re-statement of your research problem, but a synthesis of key points and, if applicable, where you recommend new areas for future research." (pp.1). Therefore, this area will emphasize the shortcomings about the objectives presented in previous chapters and the specific objectives will be illustrated in the same way. The idea is to ensure the understanding of arguments in the same manner as the researcher did, which in this case is the translator as well.

6.1.1 To translate the documents "The Fire Investigator" from English into Spanish for Cuerpo de Bomberos de Costa Rica and "Análisis especial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina' and 'Aspectos reproductivos de Chicoreous brevifrons

(Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela" and ´Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales' from Spanish into English for Universidad Nacional.

The purpose of this objective is to point out and evaluate the different translation techniques and processes used during the translation of the documents. According to Vázquez- Ayora (1997), the translation procedures analyze the units of the texts in a very specific and detailed way in order to adapt them to the closest term in another language. In other words, the importance to understand and, as a matter of fact, to know when to apply such techniques when preparing the translation. Consequently, the knowledge and ability of the translator is challenged, since it will require a deep understanding of the documentation to start analysing the content and then proceed to apply which techniques will be suitable to the translation into the target language, and at the same, time keep the accuracy and transparency of the text.

In addition, Newmark (1988) stated that a general and close reading is necessary to identify the text style (narrative, description, discussion, or dialogue), text function (informative, expressive, or vocative), thus to set a landmark to the researcher and also to the readership. Even more because both documents were analysed were intended for experts. By analysing such subjects, it became easier to go deeper into the translation of individual and compound words of the texts.

Similarly, identifying the proper stylistic scale as formal or difficult, and emotional tone was chosen, and at the same time the translation method was also sort out in both cases. It was termed; labels as communicative translation because both documents aim at informing and educating the readership. Newmark (1988) states that "the communicative translation attempts to render the exact contextual meaning of the original

in such a way that both content and language are readily acceptable and comprehensible to the readership" (p.47). On the other hand, it was also identified as semantic translation, because of the technical nature of the documents; thus, it allows the translator to be more flexible without inhibiting the accuracy of the text. Peter Newmark (1988), restates in the semantic translation, the "aesthetic value" (natural and beautiful sound) of the source language text must be considered even if sometimes the "meaning" has to be compromised because of avoiding "assonance, word-play, or repetitions" that may produce cacophonies in the target text (p.46).

6.1.2 To apply various translation procedures to the documents in order to achieve communicative texts.

After analyzing both texts and understanding the properly way to be followed according to Newmark´s input, it is also important to state the different types of techniques used to keep the accuracy of the text. There are six main translation procedures to effectively translate both documents into the target language, which were illustrated in detail with a color coding skin. They are transposition, modulation, amplification, omission, explicitation, and literal translation.

Firstly, it is imperative to mention that both documents were designed from experts in their respective fields, firefighter's investigations and marine natural sciences, due to that reason the content was found as very technical language. By knowing that, one of the most important procedures to translate the documents was ¨literal translation¨, which is a crucial technique to keep the accuracy of the words and respect the intention of the author. This procedure was very useful for the translator since in some scenarios where the sentences and paragraphs contain difficult wording, it helped to find an easy way to

render the message. In other words, the utilization of literal translation made the translation precise in structure and meaning.

The utilization of transpositions were vital to make grammatical changes from the source language into the target language. Newmark (1988) defines transposition as “the translation procedure involving a change in the grammar from SL to TL” (p.85). Various changes from the swap of verbs for adverbs, adverbs for adjectives, but mainly adjectives for a nouns were encountered in the process. The transposition technique was the second most common translation process used when translating both documents.

Furthermore, the omission technique was prevalent in the translations; however, it was more noticeable in the translation of the document from Spanish into English, where the exclusion of redundancy, repetition of unnecessary words was crucial to make the message more intelligible. In the opposite of amplification technique, the omission technique, in which the use of lexemes and morphemes proved very useful based on Malblanc, Vinay and Dalbenet’s viewpoints.

Moreover, modulation was essential for the translator in order to avoid the usage of literal translation, because it helps to translate the same idea of the author without losing the original message. Thus, as Vázquez-Ayora mentions modulation is a stylistic compared notion which consists of a change of structural concepts without altering the main idea. Lastly, there is another useful technique called ¨explicitation¨ that functions in contexts where explication and specification have been useful relevant. Therefore, the usage of this procedure made a faithful translation of the structure of both documents.

It is worth mentioning that without the implementation of those techniques the translation of the documents would loses accuracy and the author’s intention.

6.1.3 To analyze the effect of the translation procedures applied to the translated documents.

As mentioned previously, the translation techniques vary according to the type of text. For instance, some procedures may be more frequent from a translation of the text from Spanish into English than from English into Spanish. To start with the documentation from Universidad Nacional "*Análisis especial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina*' and '*Aspectos reproductivos de Chicoreous brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela*" and *´Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales,*' which were translated from Spanish into English, the presence of literal and transposition teqniques are more appropiate for the task.

On the other hand, it was evident that the use of modulation and amplification procedures when translating the *¨The Firefigher¨* from English into Spanish were more useful for the translation. Every single procedure has been crucial to carry a faithful translation.

6.1.4 To design a glossary with the most relevant terminology found in both texts.

The creation of a glossary helps both the translator and the reader with the technical vocabulary.

6.2 Restatement of the Research Question

What is the relevance of translating the document of ¨*The Fire Investigator"* from English into Spanish and ¨*Análisis espacial de los hábitat críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada (Megaptera novaeangiae) en Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina'*,'*Aspectos reproductivos de Chicoreous brevifrons (Lanmarck, 1822) (Neogastropoda:Muricidae) de la laguna de La Restinga, isla Margarita, Venezuela and lastly, 'Proyección de cambios en la tempertura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales*¨ from Spanish into English?

The purpose of this investigation is to facilitate the understanding of both documents for the readers and demonstrate how the methods and techniques of translation are applied to strengthen the value of the translation work. As a matter of fact, it can be concluded that its aim has been successfully accomplished because both documents are readable, coherent, logical and, well translated.

6.3 Recommendations

Recommendations constitute an important part of any investigation to value the investigation and provide a practical guide for future translators, students and people in general.

The following suggestions will ease the process of translation, firstly, it is important to read the documentation a couple of times in order to get familiar with the nature of the texts, as well as, the intention of the author.

Proceed with the analysis of the texts by investigating the readings according to what Peter Newmark (1988) and other relevant translators proposed, in order to identify the style of the texts, their functions, and specific translation tecniques and procedures.

Translators must be clear about and aware of the diverse translation techniques prior to initiate the translation process.

The implementation of a glossary is crucial to help the translator to be successful with the unknown or difficult vocabulary encountered in the documents. This will save time and will create a faithful translation. Having a glossary will also facilitate the work of the student, because it will keep track of key words that may be useful at any moment for a specific task. Glossaries also help maintain the order of concepts and ideas. They constitute a dictionary of technical terms to ease the translation and understanding of any document.

Finally, the availability of research materials and of any other kinds of scientific resources the translator can consult constitute a valuable instrument to foster further investigation. This research has undoubtedly proved that investigation and translation function as the two sides of a single process.

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Annexes

Original Documents

English Document

Documentation of the Investigation

NFPA 921

This chapter covers Chapter 15 in NFPA 921, Guide for Fire and Explosion Investigations.

NFPA 1033 Standard

4.3 Documenting the Scene. Duties shall include diagramming the scene, photographing, and taking field notes to be used to compile a final report. (pp 198-205, 207)

4.3.1 Diagram the scene, given standard tools and equipment, so that the scene is accurately represented and evidence, pertinent contents, significant patterns, and area(s) or point(s) of origin are identified. (pp 200-202,204-205, 207)

(A) Requisite Knowledge. Commonly used symbols and leg- ends that clarify the diagram, types of evidence and. Patterns that need to be documented, and formats for diagramming the scene. (pp 205, 207)

(B) Requisite Skills. Ability to sketch the scene, basic drafting skills, and evidence recognition and observational skills. (pp 204-205)

4.3.2 Photographically document the scene, given standard tools and equipment, so that the scene is accurately depicted and the photographs support scene findings. (pp 198-204).

(A) Requisite Knowledge. Working knowledge of high- resolution camera and flash, the types of film, media, and flash available, and the strengths and. limitations of each (pp 199-200, 202,204)

(B) Requisite Skills. Ability to use a high-resolution camera, flash, and accessories. (pp 199-200, 202, 204)

4.3.3 Construct investigative notes, given a fire scene, available documents (e.g., prefire plans and inspection reports), and interview information so that the notes are accurate, provide further documentation of the scene, and represent complete documentation of the scene findings. (p 207)

(A)Requisite Knowledge. Relationship between notes, diagrams, and photos, how to reduce scene information into concise notes, and the use of notes during report writing and legal proceedings. (pp 198-:-205, 207)

(B)Requisite Skills. Data-reduction skills, note-taking skills, and observational and correlating skills. (pp 202-204, 207)

4.6.2 Evaluate the investigative file, given all available file information, so that areas for further investigation are identified, the relationship between gathered documents and information is interpreted, and corroborative evidence and information discrepancies are discovered. (pp 198-207)

(A) Requisite Knowledge. File assessment and/or evaluation methods, including accurate documentation practices, and requisite investigative elements.(pp 198-207)

(B)Requisite Skills. Information assessment, correlation, and organizational skills: (pp 198-207)

4.7 Presentations. Duties shall include the presentation of findings to those individuals not involved in the actual investigations. (pp 198-207)

4.7.4 Conduct public informational presentations, given relevant data, so that information is accurate, is appropriate to the audience, and clearly supports the information needs of the audience. (pp 198-207)

(A) Requisite Knowledge. Types of data available regarding the fire loss problem and the issues about which the community must know. (pp 198-207)

(B) Requisite Skills. Ability to assemble, organize, and present information. (pp 198-207)

You Are The Fire Investigator

You investigate a fire that caused significant damage to a residence. The investigation shows that the fire was arson. The fire was set near an electrical receptacle in an attempt to mislead the investigator. After the completion of the investigation, the case file is sent to the local prosecutor who after review feels that the homeowner should be charged with arson.

Two years after the fire occurred, the case is before a jury, and you are called to testify.

1) What information would be documented in the fire scene investigation report?
2) What other ways would you document the fire?
3) How will sketches and photos be useful to you in your testimony?

Introduction

In recording any fire or explosion scene, the investigator's goal is to record the scene through a medium that will allow the investigator to recall his or her observations at a later date and then document those observations. The compilation of these data allows for the support and verification of opinions and conclusions in a court proceeding. The documentation types that are most often used include photographs, digital video or videotapes, diagrams, maps, overlays, tape recordings, notes, and reports.

Photography

The primary method of recording the scene is through visual media. Photography - whether digital, still, or video-provides the investigator with pictures of the scene that can be used as points of reference when writing the report. These pictures present the investigator and other examiners with the most concise depiction of the condition of the scene, thus improving the pro- cess of pattern identification. Furthermore, because the report may be written sometime after the actual site investigation, the visual recordings are an effective way of reminding the investigator of the condition of the fire scene at the time that it was investigated.

Photographs are acceptable for presentation in court, and color photos are preferred. Typically, courts accept photographs that are objective and do not inflame or exaggerate. The presenter of the photographs to the court must be able to affirm that the photographs show "a true and accurate depiction of the scene" as compared with what he or she saw at the scene. Although time and expense are important considerations in achieving this, it is always preferable to have too many photos rather than not enough photos.

Before the visual recording process begins, the investigator should have a fundamental understanding of photography, including familiarity with the equipment and accessories, lighting and movement, and film and film speeds. These issues are important because the predominant color encountered in a fire or explosion scene is black. In interior photograph y of a structure that has been subjected to the effects of thermal and mechanical insult, various shades of black must be realistically depicted on film. Proper lighting and exposure allow the investigators recordings to reflect accurately what he or she observes. To get the proper representation of what occurred on the scene, it is best to obtain various forms of documentation. A videotape or digital video used in conjunction with still photographs, for example, will be more effective.

If the investigator would like to become more familiar with cameras or video equipment, there are many courses available. Training in crime scene photography offered within local or state criminal justice t raining academies, college courses, camera clubs, or camera supply stores is a possibility.

Timing

Recording the scene through visual representation should be accomplished as early as possible in the investigation, before the scene becomes altered, disturbed, or destroyed because of suppression or other activities. In addition, by documenting the scene early, the investigator can ensure accurate representation of the condition of the scene in case of subsequent building collapse. Other hazards include environmental or mechanical hazards that can render the scene unsafe.

It is also advantageous to photograph the scene continuously through the sifting, reconstruction, and evidence examination phases. Photographing a scene after it has been fully excavated and reconstructed is an important final step in any fire scene examination.

Basics

The easiest way to understand how a camera works is to compare it with the human eye. A camera has a lens, a diaphragm, and a recording medium such as film or electronic sensor. These would compare with the lens, the iris, and the retina of the eye. Both a camera and the eye will often require additional light sources to see or better define the object-such as a flash for the camera and a light bulb for the eye.

Types of Cameras

A multitude of cameras are available at a wide range of prices. The investigator is limited in camera choice primarily by financial resources and his or her personal skill level. Commercially available cameras can be categorized according to price and by manual versus automatic operation. Automatic cameras are the easiest to operate. They determine the primary scope of the photograph and then focus on the most obvious image in the viewfinder. These cameras can provide a sense of com fort to some investigators because they automatically determine proper exposure and adjust the lens aperture and shutter speed, focusing the lens with a beam of infrared light. These features remove many potential pit falls for the inexperienced photographer.

Some skilled investigators, however, prefer manual cameras because they allow the user to adjust focus and other settings specifically to suit the immediate circumstances. In addition, manual cameras allow bracketing, taking a series of photographs with sequentially adjusted exposures, which ensures at least one good picture when circumstances make it hard to determine the correct exposure setting. Some cameras are both manual and automatic.

Most fire investigators today use automatic digital SLR (sin-gle lens reflex) cameras. These cameras automatically display a digital image of the photo a second or two after the photo is taken. This enables the fire scene photographer to review the image for proper exposure and focus and to delete any photo that is unsatisfactory. Many of these cameras have the capacity to take hundreds of photos, which can be downloaded very easily into many computers for storage. The media card in the camera can then be erased and the camera readied for the next assignment in minutes, eliminating the need for expensive film and processing.

Film

Most public and virtually all private fire investigators today utilize digital SLR cameras for still photography and digital video in their field work. At this time the digital video is transitioning from DVD storage to flash memory as these media continue to improve. Some agencies continue to use film cameras for crime scene and fire scene documentation. Film and film speed is an important consideration that can determine the ultimate quality of slides and prints taken at the fire scene. Film speed can vary from 25 to 1600 ASA (American Standards Association) for color photography and up to 6400 ASA for black and white photography. The higher the ASA, the better the photograph is able to depict objects in darker situations. Unfortunately, with higher ASA numbers, the quality of photo enlargements decrease; they appear grainy, and detail is lost. Most investigators use film that has a rating of 100 to 400 ASA. Regardless of the speed or type

of film used, the investigator should use color film to depict the objects in the photo better.

Digital Photography

Recent advances in digital photography have increased its use in fire scene investigation. The smallest dot in an electronic image is called a pixel. Often, digital cameras will be described by the "megapixel" count. An 8-megapixel camera has the ability to record an image using 8 million pixels. The higher the pixel count, the higher the image quality. Once the digital image has been captured, the image should be preserved on a nonalterable medium, such as a DVD/CD- ROM. This should happen as soon as possible after the images are taken to reduce the chance of legal challenge to the images. The investigating agency should have a written policy regarding this practice. Once the image is preserved on a suitable medium, it can then be manipulated to enhance, brighten, adjust color, and contrast in order to enhance views to be printed to a high- quality paper. This manipulation does not change the original photo preserved on the CD-ROM. Any manipulation of a photo should be documented and included in the photo information log. Some courts may not accept photos that have been electronically altered.

Lenses

A camera lens is used to gather light and to focus the image on the surface of the film. Camera lenses can accentuate the quality of the photograph. The investigator should understand that various camera lenses produce different results. Telephoto lenses allow the photographer to see detail from a distance or to accentuate minute details. In addition, particular types of camera lenses can distort the appearance of detail. For example, a fish-eye lens can depict a higher percentage of the inside of a small room, but it can also distort the peripheries of the photograph, exaggerating curves in objects.

The focal length of a lens refers to what the camera sees through a given lens. Lenses range in size from 50 mm, which gives a view similar to that of a human eye, to wide-angle lenses and telephoto lenses. One common lens used by many fire scene photographers is an 18-55 mm with close focus capability that provides a range of effective fire scene photographic exposures. Fire investigators should avoid changing camera lenses inside a fire scene for obvious reasons.

For a given focal length lens, detail is depicted in the size of the aperture opening or f-stop. The smaller the aperture opening (or higher f-stop), the larger the depth of field conversely, the larger the aperture opening (or smaller f-stop reading), the smaller the depth of field. The aperture or f-stop regulates the amount of light received at the lens that is transmitted to the film or camera sensor (digital photography).

The investigator should seek the aid of a person knowledgeable in the use of digital cameras when buying or using digital cameras with interchangeable lenses. The focal lengths for lenses used on traditional 35-mm film cameras are different from the focal lengths used on most digital camera lenses.

Filters

The use of a neutral UV filter on a SLR digital or film camera is recommended for any photo to be used in a court proceeding. The UV filter does not alter the tone or color of the image and it provides protection for the delicate surface of a lens.

Lighting

Lighting plays an integral part in photography. The easiest light source available to the investigator is the sun, although the circumstances of the examination may dictate

recording the scene at a time other than during daylight. In those circumstances, an alternative light source should be used. The most popular is the flash attachment, which may be permanently mounted on the camera, temporarily mounted, or separate from the camera. Because of large dark and light areas and the charred surfaces of a fire scene, they are difficult to illuminate effectively for photography. A high-quality flash that is capable of providing a vast area of light for multiple exposures is a necessary tool in fire scene photography. Other alternative light sources include portable lights, such as floodlights and flashlights. The glare from a flash or flood light may distort the appearance of an object. Bounce flashes, light diffusers, and other techniques will help with this.

It is recommended that the investigator utilize a flash unit that can be separated from the camera system, allowing the investigator to angle the light source as needed under the cir-cumstances. This capability enables the photographer to use the built-in flash on the camera with the separate flash unit increasing the amount of light available for a proper exposure.

Separate flash assemblies can also be used to "paint" light across a detailed photograph taken at a time of limited visibility. This is referred to as photo painting. For example, by locking the shutter in an open position and using the flash remotely from the camera system, the investigator can accentuate a particular view and light it with several flash exposures from different directions. The resulting photograph depicts the view with the appearance of light from multiple directions.

A ring flash is often used for close-up work. This specialized flash unit fits on the end of the lens and is often used when shoot-ing a critical piece of evidence such as an arc mark or tool mark.

Special Types of Photography

Advancements in the technology of photography have created new photographic tools for the investigator. Images using infrared, laser, and microscopic photography may be useful to the investigator in documentation.

Composition and Technique

Photographs are an integral part of the examination and should reflect the condition of the scene as seen by the investigator. The photographs should be taken in a predetermined manner and in accordance with accepted practices in the fire and explosion investigation field-for example, by illustrating the philosophy of examination from areas of least damage to areas of most damage.

An effective general technique at a fire scene is to begin film documentation on the exterior perimeter, progressing to the interior, and from the least damaged areas to the most dam- aged areas in a sequential manner. Critical evidence should be documented by photographing the subject from different angles, including downward from a ladder.

Sequential Photos

The photographic documentation of the scene should depict sequential views of the scene. A photograph of a relatively small subject (e.g., a chair) is taken first from a distance (perhaps from the doorway to the room) to show the position of the subject in relation to other fixed objects such as a door casing or radiator, followed by a shot from a medium distance showing more detail, and ending with a close-up of the subject Figure 13-1. Sequential photography allows the observer of the photograph to understand better the totality of the view and the relationship of the subject to the overall surroundings.

Mosaics

Another method for depicting the totality of the scene is to use a mosaic of photographs. Mosaic photographs are a series of photographs that encompass a large area by overlapping the start of one photograph where the previous photograph ended Figure 13-2. Mosaics are used when a wide-angle lens is not available and a panoramic view is desirable. To create a mosaic, the investigator should identify the breadth of the photograph according to readily identifiable landmarks. Each ensuing photograph should encompass a portion of that landmark so that the final appearance is of one large photograph encompassing an overall view of a particular area.

Photo Diagram

When recording the scene, the investigator should annotate a diagram of the site, identifying the point from which each photograph was taken, the direction of the photograph, the placement of the item, and the photo number. This is referred to as a photo diagram.

There are occasions when the time that the photograph was taken is important as well and this should be annotated on the diagram. The photographer should identify the diagram by affixing his or her initials, the date, location of the scene, and any other pertinent identifiers. A diagram like this is helpful to individuals who did not visit the fire scene. It gives them an overall picture of the condition of the source and what was observed there by the investigation team.

Figure 13-1 Sequential photographs of a chair.

Figure 13-2 Mosaic of warehouse burn scene from aerial truck.

Many digital cameras can imprint the date and time on the photographic image. A fire investigator may have assistance in the photography of the fire scene. The investigator should take care that the photos taken depict the needed documentation. The investigator may want photos that are taken at a different angle or with special detail to convey a particular item.

Photography and the Courts

One of the potential uses of photographs is with testimony before a court. Prior to any photo being admitted into the court there may be several challenges to its use. The photo must be a "true and accurate depiction" of the content of the photo. A court may exclude photos that may be too inflammatory to jurors; examples would include photos that depict a gruesome death scene. Photos may also be rejected if they lack clarity or if they lack relevancy to the matter before the court. Most courts readily accept color and black and white photos in film and digital format.

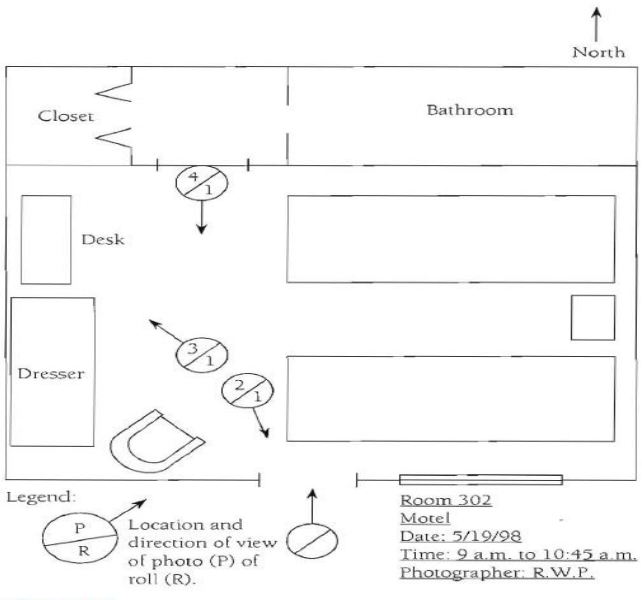

Figure 13-3 A diagram showing photo locations.

Video Photography

Video photography has become an acceptable medium for orienting viewers to the scene. The various formats available include older technology VHS, beta, and 8 mm. The latest video cameras are digital video, and this newer technology provides important low-light and self-focusing features.

A big advantage of using video is the ability to orient viewers to the complete scene by recording complete views of important areas. In addition, video photography should not be the sole medium used to convey conditions at the scene. Still photography is important for documenting the scene, especially for documenting evidence and scene conditions. When documentation of testimony is needed, video cameras can be used to interview witnesses, suspects, occupants, and owners.

Video recording is a method of documenting and recording the scene. The investigator is able to record the scene and narrate at the same time. The recording, not necessarily used for presentation, can be used by the investigator to later refresh his or her memory of the conditions and evidence location. Most entry-level digital video cameras cannot turn off their micro- phone. Investigators should avoid inappropriate comments or "off the hip" analysis of cause, which may prove embarrassing later.

Suggested Activities to Be Documented

It is important to document as much of the scene as possible. Some suggested activities to record are conditions on arrival, suppression, overhaul, observers, and origin and cause determination. The progression of the fire, its colors, its reaction to suppression activities, and the overhaul procedures employed are all important in helping the fire investigator to determine the origin and cause. Photographs can also document the extent of damage to the victims or structure.

Photographs of the crowd observing the fire scene activity can help the investigator to identify individuals who may have knowledge beneficial to the investigation. These photographs can also help the investigator identify individuals who are seen at multiple fires or are known by the law enforcement or fire department community.

All fire investigators should routinely determine whether initial witnesses to me fire such as the 911 reporting party (RP) documented what they saw with a camera phone or digital camera. Many times media news outlets have staff or stringers respond to large fires. These professionals sometimes arrive on scene prior to apparatus and often have superior quality photo- graphic equipment. Reporters may be busy interviewing victims or witnesses prior to your arrival and should always be contacted.

Photographs of the suppression activities can help the fire investigator understand why the fire reacted in a particular manner. Also, when documenting suppression activities, the location of hydrants, engine companies, apparatus, and hose placement should be documented.

Exterior photographs are important and can be used to establish the location of the fire scene. Exterior photographs should include street signs Figure 13-4, house numbers or other identifiable landmarks that are likely to remain for some time Figure 13-5, surrounding locations of the fire scene, and all angular views of the exterior of the fire scene Figure 13-6. Exterior photos could also be taken of the address numbers of affected buildings. This may be useful for documentation and search warrant purposes.

Structural photographs document the extent of damage to the structure after heat and flame exposure. These photographs should be taken from multiple views to record heat and flame damage. Structural failures or deficiencies should be captured in photos because these can play a role in the outcome of the fire. The photographs that are taken

should be useful to the investigator for explaining their analysis of the fire scene to supervisors, prosecutors, the court system, and insurance representatives.

Figure 13-4 Street signs are identifiable landmarks.

Figure 13-5 A fire number is one possible address identifier.

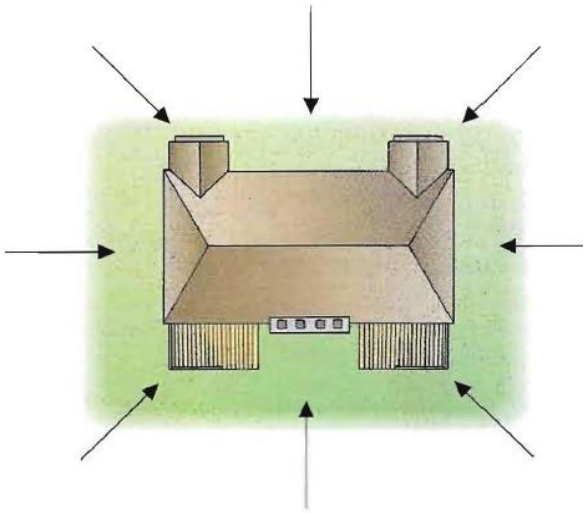

Figure 13-6 Photograph the scene from all angles and corners.

Interior photographs assist the investigator in documenting the scene and more thoroughly describing the conditions within the structure. All significant points that were accessed or cre- ated by the fire should be photographed, along with significant smoke, heat, and burn patterns.

The condition of rooms within the immediate area of the fire should also be photographed to document thermal and smoke conditions. All heat-produ cing appliances or equipment should be photographed to document their condition with regard to the area of fire origin. The condition of furniture and furnishings should also be documented in photographs depicting heat and smoke travel.

The condition of entrance and exit routes, especially doors and windows, should be documented . The photographs should depict their condition at the time of the fire (whether doors were locked or open, whecher windows were open or closed, etc.). The condition of interior fire detection and control devices should also be documented (whether sprinklers activated , whether extinguishers were employed , whether smoke detectors activated).

The utilities present at a structure should be thoroughly documented to include the condition of various controls and appliances such as transformers, panels, meters, regulators, and valves. The point at which the utilities enter the structure should be documented to includ e their location and condition at the time of the fire. The condition of fuses and/or circuit breakers is important. Within the area of fire origin an investigator should photographically document the condition of appliances and the position of all valves and controls.

During the scene examination, photogra phs should be taken of all items of evidentiary value. For instance, the photo in Figure 13-7 documents the wick from a Molotov cocktail found at a fire scene. Photographs of potential evidence should allow the viewer to locate the item in the scene and its general appearance. More detailed photographs of evidentiary items can be taken after they are moved if the photographer is unable to obtain detailed photos due to scene constraints such as lighting, location , or hazards. A ruler can be used to provide a scale to identify the size of items in photographs. There should be one photo showing the evidence and another photo of the ruler next to the evidence.

Figure 13-7 The wick from a Molotov cocktail found at a fire scene.

Photographs should also be taken of occupant or victim actions and locations at the scene. These pictures should docu- ment any survivor's or victim's location at the time of the fire, any indicators of actions taken by them during the fire, and any end result such as serious injury or death. If the scene includes a fatality, the position of the victim should be thoroughly recorded. lf the full condition of the victim cannot be documented at the scene because of lighting, scene hazards, or other obstacles, additional photos should be taken at the medical examiner's facility.

When a witness or victim reports that he or she saw a poten- tially significant event, the photographer should attempt to photograph the view from the position of the witness.

Aerial photographs can help the investigator clarify scene arrangement and large evidence items such as a vehicle or body.

Presentation of Potographs

When displaying or presenting pictures of a fire scene examination, the investigator should choose the media video or photographs that present the examination and causal determination with the greatest clarity. The investigator should determine what media is

most acceptable to the local court system, law enforcement agencies, fire departments, and insurance companies.

Video presentations are an effective means of conveying scene conditions and actions undertaken at the scene. Many law enforcement agencies, fire and police academies, school systems, and courts have video or slide projectors for use in displaying 35-mm slide, computer, or video presentations. Photograph enlargements continue to be the most often used media at trial. Computer presentations are becoming an effective and comprehensive medium for exhibiting large quantities of visual material. They allow for integration of multiple formats into a single presentation . Be sure to have backup hard copies in the event of a computer failure for court room presentations.

Diagrams and Drawings

Diagrams and sketches are used to support the investigators memory and to document details of the scene. For example, a diagram could be used to conduct an important witness interview or to provide a means for orienting photographs. Sketches can aid the investigator in documenting fire patterns, fire growth, and scene conditions. The accuracy of the data used to create these materials is essential.

Types of Drawings

Diagrams are formal drawings that are completed after the investigation. Sketches are generally freehand diagrams or diagrams drawn with minimal tools that are completed at the scene. The differences among the types of drawings relate to the amount of detail that is incorporated, the type of construction of the structure, features of the structure, equipment, and other factors that are important as to the origin, cause, and spread of the fire. Every investigation should include fire scene sketches. This is especially important for investigations likely to be involved in criminal or civil litigation.

When the fire investigator is determining the type of drawing to use, he or she should decide what needs to be shown on the drawing. If a fin investigator is unable to create a detailed drawing, he or she should create a rough sketch that depicts the area of fire origin, the arrangement of items within this area, doors, and windows. This rough sketch should also include accurate taped measurements of walls and ceilings; placement of doors, windows, and other fixed objects; as well as furniture and appliances within the area of fire origin. Figure 13-8 includes an example of a rough sketch that shows basic layout of the structure, as well as the finished diagram made from that sketch.

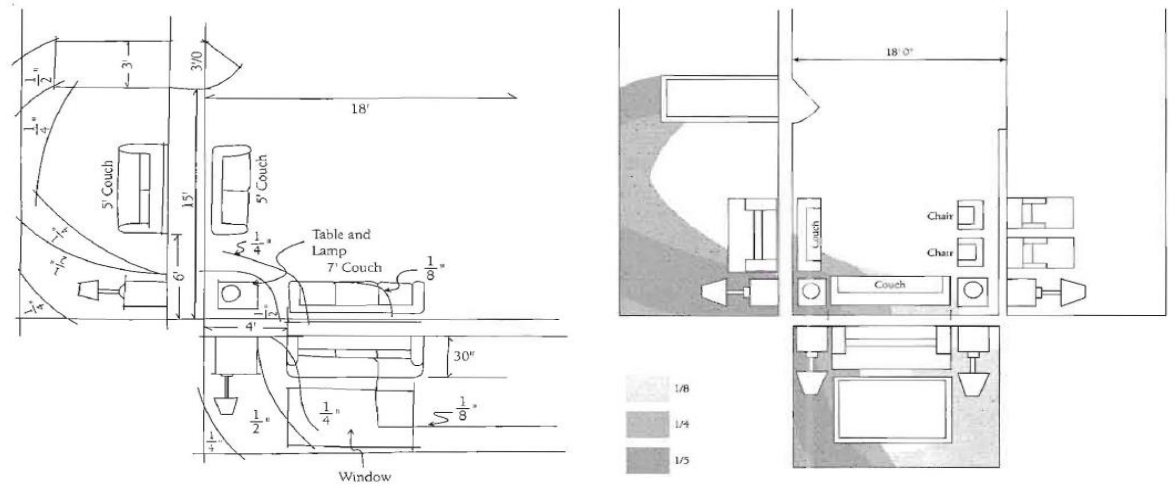

Figure 13-8 **A.** A rough sketch showing layout of a structure. **B.** A finished diagram of a structure.

Several types of drawings can be used to illustrate fire scene conditions. Sometimes a detailed diagram is necessary for proper documentation, but at other times, a rough sketch will suffice when the analysis and conclusions are simple. The type of drawing chosen depends on the degree of detail required.

When the scene or litigation is more complex, the investigator may need to develop or acquire detailed resources such as building plans or construction documentation. Table 13-1 outlines details that may be needed.

Drawing Tools and Equipment

There are a variety of options for the investigator to use in the creation of a scene diagram. Often the size and the complexity of the scene and the investigation dictate the type and degree of detail included. In critical cases such as fatal incidents, homicides, incendiary fires, or large or commercial fires, the investigator should obtain architectural plans or equipment manufacturer. Surveyors may be useful in accurately mapping large scale scenes. Many larger municipalities and state and federal law enforcement agencies are able to perform computer-assisted mapping using laser devices.

Recent advances in computers and software have allowed investigators to utilize various types of programs to develop diagrams. The investigator may decide that the diagram would be best depicted in a three-dimensional format that a program is useful in producing. Computer-assisted drawing (CAD) programs may be used alone or in combination with computer fire models. A good drawing package will offer many tools to the investigator. Some programs provid e for multiple layers in the sketch, which would provide depiction of possible prefire and postfire conditions. No matter what type or brand of program is utilized, the investigator should choose one that offers fexibility of design, automatic dimensioning, and a variety of "libraries" that contain predrawn objects such as furniture, electrical, plumbing, and HVAC components.

Diagram Elements

Depending on the complexity of the investigation, there are many elements that should be included on sketches and diagrams:

- General information: The investigator should identify the name or the person who created the diagram, the diagram title, and date of preparation.
- Identification of compass orientation: Most often the sketch will note north at the top of the page.
- Scale: The investigator should draw to scale and should indicate on the drawing whether it is "not to exact scale" or "approximate scale."
- Symbols: The investigator must be consistent with the use of symbols, not using the same symbol for multiple purposes. It is recommended that the investigator utilize symbols used in enginee1ing or architecture. Fire protection symbols can be found in NFPA 170, Standard for Fire Safety and Emergency Symbols.
- Legend: The fire investigator should create a legend for any drawing, indicating wha t the referenced symbols represent.

Prepared Design and Construction Drawings

Prepared design and construction diagrams are those that were developed for the construction or design of a building, equipment, or even appliance. Care should be taken in the interpretation of the diagrams because items or buildings may have been modified during the construction and/or use of a building.

Architectural and Engineering Drawings

During the construction phase, various drawings will be used by the contractors. These diagrams may depict only utilities, fire detection and suppression equipment, topographical, or other unique aspects needed in the construction process. It is helpful for the investigator to be familiar with these drawings.

Architectural or Engineering Schedules

In larger buildings, it often becomes necessary to detail the type of equipment used within the structure. A detailed list of this type is known as a schedule. Schedules may be broken down by equipment type and generally detail all of that particular type of equipment used within the structure. For example, a door schedule details the placement of all doors within the structure. Other examples whereschedules are used include interior finish schedules, electrical schedules, HVAC schedules, and plumbing and lighting schedules.

Specifications

When an architect or engineer prepares a drawing, the types of materials used in construction are listed on the specification sheet. The specification sheet matches materials to specific placement. For example, the specification sheet could annotate the use of R-17 insulation in the attic area, 5/8-inch plywood in a ground floor bedroom, and so forth. These drawings can usually be obtained from the contractor or building inspection department in the community in which the structure was built. These drawings also include the architect's elevation drawings. These are drawings of the outside of the building, which are helpful if the building is a total loss. If possible, as-built plans should also be obtained. These are architectural representations of how the structure was actually built and may vary from the original plans.

Note Taking

In addition to visual representation of the scene, the investigator should incorporate investigative note taking to supplement those items that cannot be photographed or sketched. These notes may be referred to as field notes. Note taking may include names and addresses, model or serial numbers, witness statements, photo logs, identification of items, types of materials, or investigator observations such as burn patterns and building conditions. Notes may also contain information that is obtained from witness interviews and document reviews that relate to the scene. Although forms are not required and cannot be used as an incident report, there are forms that have been developed for data collection. The forms may aid the investigator in gathering the necessary data to prepare the report.

Many investigators have found that digital recording devices are very useful in taking recorded interviews of witnesses, victims, suspects, and others as well as easily recording notes while making your scene examination. These electronic statements and notes are easily downloaded into the case file on a computer along with digital photos and other digital information. Additionally, these devices do not require tapes and can hold as much as 24 hours of recorded materials.

The investigator should be careful not to rely solely on one medium to record the scene. For example, the use of a portable recorder or another device should not be the only means of gathering data.

When the investigator is ready to complete a finished report detailing the information about the fire scene, he or she will find the documentation produced and recorded during the investigative process to be invaluable. A review of notes, data forms,

photos, and sketches will assist the investigator in providing an accurate and detailed scene report.

Many departments have established a uniform policy on the retention of notes. Any notes maintained are subject to examination or "discovery" by interested parties, and it may be long after the information is collected or the report is written. The investigator should examine their department/company policy on the retention of notes and adhere to it during every investigation.

Table 13-2 **Report Information**

Type of Information	Example
Descriptive information	Date, time, location of incident; date and location of examination; date the report was prepared; name of the person requesting the report; scope of the investigation; nature of the report.
Pertinent facts	Description of the scene; items examined; evidence collected.
Opinions and conclusions	The opinions and conclusions of the investigator; foundation on which the opinion/conclusion is based; name, address, and affiliation of each person who expressed an opinion/conclusion.

Reports

The purpose of a report is to communicate the observation, analysis, and conclusions made during an investigation. Reports generally contain descriptive information, pertinent facts, and opinions and conclusions Table 13-2.

Every agency may have a different format for the reporting process. NFPA 921 does not prescribe a particular format of a report. All reports should be done in a clear, precise, and accurate manner. The report is often distributed to others outside of the investigator's department or company. The report should contain the foundation for any conclusions or opinions that are expressed.

Voices of Experience

Many years ago while assigned as the on-duty fire investigator, I was paged for a working structure fire. While en route and listening to the scene activities on the mobile radio, I started my investigation process by asking myself the following questions:

- How much of the structure is involved?
- ls it occupied?
- How much of the structure is damaged?
- Will it be safe to conduct my scene investigation when I arrive?

Upon arriving on scene I observed a two-story, wood-framed structure. I donned appropriate personal protective equipment and then met up with the incident commander for a briefing. The incident commander advised that the structure was vacant prior to his arrival and that he observed light grey smoke showing from the first floor windows. He

advised the first two engines that arrived on scene to make an initial attack via the first floor entrance door identified as side A of the structure.

My first task was to complete a walk around the structure photographing and documenting all four sides of the structure. Once this was completed I documented statements from the first-in fire fighters; I asked them the following questions:

- Did you use forceable entry?
- Where was the location of the fire?
- What was the color of the fire?
- What was the color of the smoke?
- Did you see anything unusual?

The fire fighter who made entry first with the hand line stated that the door was unlocked and that on entering he observed three separate fires and was able to knock them down quickly.

On closer scene observations and with the fire department delaying salvage and overhaul, I was able to identify the three separate points of origin. I carefully documented all statements and sketches, and I photographed the entire scene from various angles, identifying the location of each photograph. All of this information gathered at the scene was instrumental in formulating my final scene investigation

Jeffry J Harran

Assistant Chief

Buckskin Fire Department

Parker, Arizona

Voice of Experience

Collecting and preserving evidence is one of the many responsibilities of fire investigators. At times, recognizing evidence and determining its importance may be

difficult. A few years ago, I was assisting a police detective in a fire investigation involving two recreational vehicles (RVs). The RVs were parked next to a service garage at a business that sold and repaired RVs, campers, and related equipment. The fire was called in and suppressed during the evening hours. The two RVs were completely destroyed by fire, leaving behind only their metal frames.

Our investigation began around mid-morning. While examining the area around the service garage, we noticed what appeared to be a glove lying on the ground, a distance from the fire scene. Closer inspection showed the glove was a leather "mechanics"-type glove. A short distance from the leather glove was a latex glove.

At first glance, it appeared as though the gloves may have been accidentally dropped by a fire fighter or possibly belonged to a mechanic who worked in the repair shop close by. The gloves were left in place as we continued examining the area surrounding the destroyed RVs.

We observed a short distance from the location of the gloves a line of burned grass that led to two other motor homes. Several new hypotheses began to emerge as to the possible significance of the gloves. Could the perpetrator have dropped them while manipulating a match or lighter' Maybe they were discarded because an ignitible liquid was spilled on them.

Both gloves were collected and sent to the Wisconsin State Crime Laboratory for ignitible liquid and DNA analysis. The gloves not only contained trace amounts of gasoline, but DNA as well. Better yet, the DNA belonged to a known offender.

Search warrants were executed at the suspect's house where similar gloves were located. Other evidence, including a confession, led to the suspect pleading guilty to arson and being sentenced to 18 months in prison.

Recognizing a piece of physical evidence not directly in the fire scene played a large role in the successful conclusion of this case.

Michael Rindt, IAAI-CFI
Special Agent
Division of Criminal Investigation
Wisconsin Department of Justice
Madison, Wisconsin

You Are The Fire Investigator

On arrival at fire scene as the local fire investigator, you find that the fire service has found a red plastic gas container in the garage area of the home, and for their safety, they have removed it to the front yard. As the investigation progresses, there is an indicator that the residence was intentionally set on fire. You determine; based on this information, that the container might have been used to help accelerate the fire.

1. Are there any issues that must be addressed as to the location where the fire investigator found the gasoline container?

2. What must the fire investigator have to make his case that the gasoline container and the pour pattern inside of the residence are connected?

Introduction

Physical evidence, also referred to as real evidence, is any physical or tangible item that tends to prove or disprove a particular fact or issue. At a fire scene, the entire scene, including the fire patterns, sources of ignition, security and fire detection equipment, and items associated with the cause of the fire, is considered physical evidence. This type of evidence can be produced in court or other proceedings if it is properly identified, documented, collected, preserved, and analyzed.

The fire investigator is responsible for locating the evidence, properly identifying the evidence, collecting the evidence, documenting the evidence, examining and storing the evidence, and arranging for testing of physical evidence from a fi re or explosion scene; however, the first stage of preservation of potential physical evidence on a fire ground begins with the firefighting or suppression operation itself. Fire investigators in a jurisdiction can help themselves by offering training to fire crews and fire officers in how to recognize the importance of evidence preservation and basic ways to avoid inadvertent destruction of physical evidence. Fire investigation and law enforcement associations can influence basic fire fighter and fire officer training at the state or county level in the area of preservation of physical evidence at fires, explosions, traffic accidents, and other joint operations.

Physical Evidence

Common physical evidence at a fire scene may include traces of ignitible liquid in flooring, a tool mark that is at a point of forcible entry or that indicates adjustment of a critical valve, a faulted electrical circuit, fingerprints, blood, or other physical item or mark that helps the investigator establish fact.

Physical evidence can be obvious, such as a melted accelerant container in a retail store lobby, or it can be latent (hidden), such as a fingerprint on a tool that might not even be visible until it is developed. It is the challenge of investigation to recognize potential physical evidence.

Fire pattern, the visual or measurable physical effects that remain after a fire are physical evidence, as is a class of evidence called artifact evidence. Artifact evidence at a fire scene may include the remains of the first fuel ignited, the competent source of ignition that ignited the first fuel, and other materials that influenced the fire's growth and development.

Consistently successful investigators are able to recognize objects that seem to be out of place, and it is up to the investigator to identify the evidence that should be collected from a fire scene. The decision may be based on scope of the investigation, legal requirements, or prohibition. The investigator should initially adopt a mind-set of inclusiveness when it comes to physical evidence. If the object seems to be in the wrong place, the investigator can assume that it is potential evidence until the investigation process proves otherwise.

Fire investigators can improve their results by getting training in physical evidence recognition and collection and acquiring the needed equipment. Although fire investigators would probably be better at recognizing fire damaged evidence, certain types of evidence such as tool marks, footwear or tire track impressions, and fingerprints would ordinarily be better left to crime scene technicians. A recommended approach in complex investigations would be to establish a close working relation- ship with law enforcement crime scene evidence technicians who are already skilled in the recognition, collection, analysis, and preservation of trace evidence and who possess all of the needed equipment.

Usually, physical evidence requires laboratory examination and the testimony of an expert witness to establish its significance at a trial or proceeding. Fire investigators should be in contact during the scene examination with the forensic laboratory technician who will be evaluating the evidence to determine the quantity, packaging, storage, and transportation methods appropriate for the category of physical evidence.

Physical evidence is something that can be observed or physically handled by a judge or jury and differs from other forms of trial evidence such as direct evidence (testimony of witnesses who observe acts or detect something through their five senses and surveillance equipment such as CCTV), demonstrative evidence (photographs, maps, X-rays, visible tests, and demonstrations), or circumstantial evidence (facts that usually attend other facts to be proven and are drawn by logical inference from them).

Spanish Documents

Análisis espacial de los hábitats críticos del delfín nariz de botella (*Tursiops truncatus*) y la ballena jorobada (*Megaptera novaeangliae*) en el Golfo Dulce, Costa Rica: Consideraciones acerca de un proyecto de construcción de marina

Los hábitats críticos se definen y clasifican en contextos biológicos importantes como alimentación, reproducción y crianza, protección de depredadores, descanso, migración, entre otros (Hooker & Gerber, 2004; Hoyt, 2011). El definir si un hábitat determinado debe ser considerado como crítico, tiene implicaciones ecológicas que se trasladan al plano legal en procesos de manejo y conservación (por ejemplo, FWS, 1988), por lo tanto, es importante clarificar conceptos claves como hábitat y los procesos que se asocian a este. Para este estudio se adopta la conceptualización del hábitat como la suma de recursos que necesita un organismo para su supervivencia, hábitat es una definición que es específica por organismo, ya que se relaciona con una especie, población o individuo (Hall et al. 1997), de esta manera, la selección de esos recursos implican un proceso de decisiones que conllevan conductas innatas, así como aprendidas (Johnson, 1980), que en consecuencia resultan en el uso desproporcionado de un recurso sobre otro (Hall et al. 1997).

El Golfo Dulce provee de un hábitat importante para especies de cetáceos costeros (Oviedo et al. 2009; 2015); entre las características estructurales de este mar interno, se tiene un número importante de ríos que drenan en la cuenca interna, transportando grandes cantidades de materia orgánica disuelta y particulada, así como contaminantes asociados a las actividades antropogénicas (agricultura, ganadería y urbanización) que se realizan en la zona. Tal situación ha traído como corolario una degradación de la columna de agua por la introducción de metales pesados y compuestos orgánicos de origen sintético al Golfo (Spongberg & Davis, 1998; Umaña, 1998). Los impactos ambientales producidos por estas actividades se diversifican y acumulan sinérgicamente a largo plazo induciendo un deterioro del hábitat crítico de cetáceos costeros (Thompson et al. 2000; Hooker & Gerber, 2004).

Este estudio tiene como objetivo identificar las áreas de uso crítico para las ballenas jorobadas y los delfines nariz de botella en el Golfo Dulce, valorando el impacto potencial de proyectos actuales de desarrollo costero, por traslape espacial con estos hábitats esenciales, en específico, el plan para establecer una marina de lujo en las adyacencias de la bahía de Puerto Jiménez. El análisis se presenta con un enfoque donde la distribución de uso se asocia a respuestas ecológicas, en la forma de conducta alimentaria para Tursiops truncatus y conductas relativas al cortejo y reproducción para Megaptera novaeangliae, contextualizándolas en términos de conservación y manejo.

MATERIALES Y MÉTODOS

Área de estudio: El Golfo Dulce (Fig. 1) es un mar interno, usualmente denominado fiordo tropical, de 50 km de largo y 10-15 km de ancho, situado en la región del Pacífico Sur de Costa Rica, entre los 8° 33' N y 83° 14' O. El clima es tropical húmedo con una estación lluviosa de mayo a principios de noviembre, lo que genera una precipitación promedio mensual de 100-700 mm (Quesada-Alpízar & Morales-Ramírez, 2004). El aporte principal de agua dulce lo proveen los ríos Coto Colorado, Tigre, Esquinas y Rincón, con influencia directa en el patrón de circulación de un estuario notablemente estratificado (Svendsen et al. 2006). Las particularidades que hacen que el Golfo Dulce se asemeje a verdaderos fiordos se muestran en la estructura de sus masas de agua. Se evidencian claramente dos capas: a) una capa superficial cálida (≈32°C en promedio) y diluida con una salinidad promedio de ≈ 31 UPS, a una profundidad entre 50 a 60 m, sobre el umbral ubicado en la parte externa del Golfo. b) La otra capa está constituida de aguas profundas y homogéneas, donde la temperatura puede alcanzar un mínimo de 15.4°C y salinidades que alcanzan los 34.8 UPS.

Las fuerzas de mareas, el viento, el ingreso de agua al sistema influencian directamente la mezcla y circulación de estas aguas, en conjunto con el afloramiento de agua subsuperficial y la topografía de la cuenca (Quirós, 2003; Quesada- Alpízar & Morales-Ramírez, 2004). La estructura de corrientes del Golfo es de tres capas en la parte externa y una circulación de tipo estuarino en la parte interna (Svendsen et al. 2006). Como se mencionó anteriormente, el área de estudio se dividirá en la cuenca interna, el área del umbral (Quirós, 2003) y la zona de transición oceánica.

Recolecta de datos: Los muestreos fueron dirigidos al registro y monitoreo de cetáceos, estos se llevaron a cabo en una embarcación de 7 m de eslora, con un motor cuatro tiempos de 115HP, en las tres subáreas descritas anteriormente. Con la intención de abarcar la mayor área posible, los muestreos siguieron un patrón zigzag (variable) desde el punto de origen (Bahía de Rincón o Puerto Jiménez).

Los muestreos presentados en este análisis abarcan dos temporadas: la seca (noviembre -mayo) y la de lluvia (junio-octubre), desde marzo del 2005 hasta diciembre del 2014; los muestreos se iniciaban en periodos matutinos (07:00-08:00) y culminaban a mitad de la tarde (14:00-16:00), donde la unidad de muestreo, los avistamientos, integra la definición de grupo usada por Karczmarski et al. (2005) y las observaciones de conducta de acuerdo con lo descrito en Lusseau & Higham (2004), así como en Oviedo (2008).

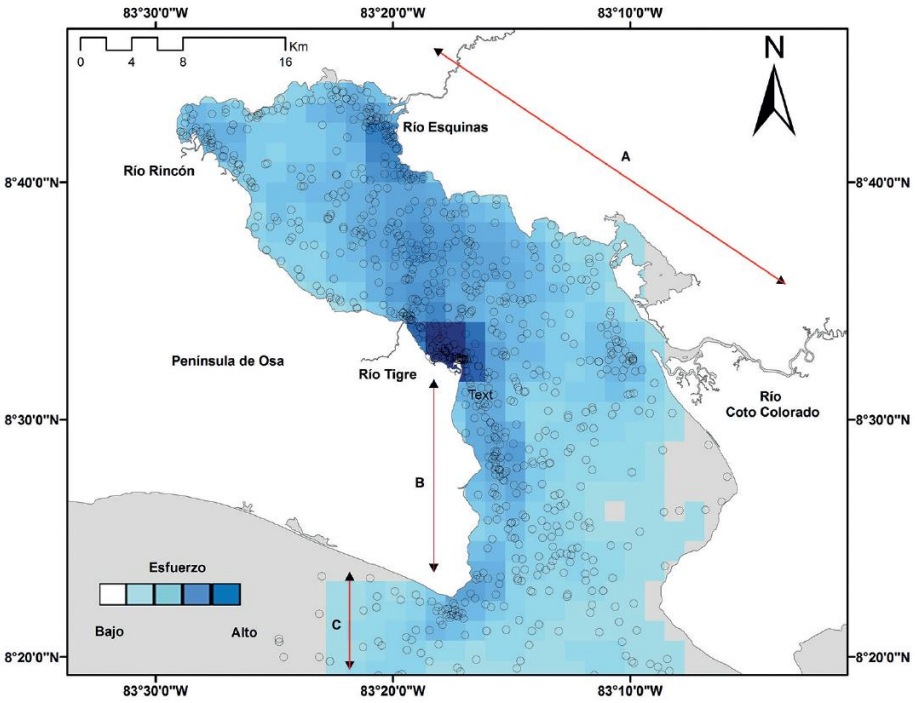

Figura 1. Distribución del esfuerzo de campo en el Golfo Dulce: Se ilustra la cobertura espacial de campo en una escala gradiente cualitativa, donde el nivel máximo de esfuerzo invertido implicó 85 horas y 267 kilómetros recorridos en cada celda de 2.56 km2. Los puntos representan los avistamientos de cetáceos. a) Cuenca Interna, b) Área del Umbral y c) Zona de Transición Oceánica.

Las condiciones de detectabilidad requieren de un registro periódico para el muestreo efectivo de conducta y acústico, por lo tanto, cada 30 min se realizó una lectura de posicionamiento por GPS (Garmin etrex H, 5 metros de error aproximado), junto con algunas variables ambientales, como la condición del mar (escala Beaufort), la temperatura superficial (medida a través de un termómetro de campo), el ciclo de mareas (tabla de marea del módulo de información oceanográfica MIO-CIMAR) y la presencia o no de cetáceos (Fig. 1). Lo descrito anteriormente permitió a su vez el seguimiento del esfuerzo de campo y la creación de una matriz de presencia ausencia de cetáceos tal como se detalla en Gowans & Whitehead (1995).

Durante cada encuentro, el bote se acercó a una distancia aproximada de 100 m del objeto del avistamiento. Se tomaron datos pertinentes del avistamiento como: la hora del encuentro, el tipo de especie, el tamaño y la composición de grupo, así como la conducta (inicial del encuentro y a los 10 min de este), estos fueron registrados junto con la posición espacial del bote, por lecturas de GPS (asumida como la posición relativa del objeto del avistamiento, ya que hay una separación ≈ 100 m). Una vez completada la toma inicial de datos estándar del avistamiento, dependiendo del objeto del avistamiento y el monitoreo de conducta para determinar alteraciones significativas, se iniciaba un protocolo de seguimiento grupal que implicaba: a) muestreo etológico con los métodos referidos en Lusseau & Higham (2004), así como en Oviedo (2008) para la determinación de hábitats críticos y b) muestreo acústico.

El registro de datos acústicos se limitó a avistamientos de ballenas jorobadas, y para los fines de esta contribución, que intenta documentar la relevancia del área en el comportamiento acústico de la especie, se considera la vocalización como la unidad a procesar de este muestreo en particular, con las respectivas salvedades que garantizan la no autocorrelación temporal y espacial de cada vocalización georreferenciada. Estos registros son datos asociados a un relevamiento acústico de esta especie en nuestra área de estudio, que aún se encuentran en progreso, incluyendo la cuantificación efectiva de machos potenciales por captura y recaptura. Dicho muestreo acústico se ejecutó mediante el monitoreo previo de las condiciones de ruido ambiental. Las grabaciones de las vocalizaciones se hicieron por medio de una combinación de grabadora (Sony TCD D-5 digital tape recorder, sampling-rate 48 kHz) y un hidrófono (NSF-PW, SCH40), calibrados para frecuencias dentro de un rango de ±5 dB (12.0 Hz a 35.0 kHz). Una vez corroborada la relación señal acústica/ruido ambiental, se desplegó el hidrófono para confirmar la presencia de ballenas cantando la ocurrencia de vocalizaciones (todas las temporadas 2010-2013, n= 55), por un periodo de 5 min, donde adicionalmente se recolectaron registros de datos espaciales (lecturas de GPS), así como datos ambientales (temperatura superficial, mareas).

Una vez confirmadas las vocalizaciones y en particular la consecución de cantos se procedía a grabar el ciclo de la canción y a tomar fotos de los individuos cantando de acuerdo con lo planteado en Oviedo et al. (2008). Análisis de datos: Los datos espaciales derivados de los métodos descritos anteriormente fueron procesados para evaluar la distribución de uso del delfín nariz de botella y la ballena jorobada en el área de estudio en contraste con la conducta de estas especies. Para los avistamientos de M. novaeangliae se segregaron los grupos entre aquellos donde se incluían crías (incluyendo pares madre-cría y tríadas) y los grupos sin crías (adultos y subadultos), adicionalmente a los registros acústicos que correspondían con ballenas cantando. La distribución de uso fue descrita por medio del índice promedio del vecino más cercano (Average Near Neighbour Ratio-ANNR), la cual promedia la distancia real del centroide de cada elemento espacial en evaluación y la contrasta con el promedio de la distancia de cada elemento, con una distribución aleatoria hipotética, lo anterior resulta una medida de la dispersión espacial (agregada, azarosa, uniforme) entre elementos y sus implicaciones ecológicas (Forting et al. 2002; Begon et al. 2006), la significancia estadística de dicha medida se obtiene por medio del cálculo de un “Z score”, el cual se asocia a la distribución normal y permite establecer medidas de significancia y confianza.

El análisis anterior se combinó con Estimados de Densidad Kernel (KDE), usando el método least square cross validation, por medio del software ArcGIS 9.3 (ESRI, 2008). Dos contornos de Estimado de Densidad Kernel se definieron para ilustrar: a) el ámbito hogar potencial por medio del contorno que contiene el 95% del volumen de los registros por especie, y b) el área núcleo que representa el hábitat crítico por medio del contorno que concentra el 50% del volumen de todos los registros asociados a las observaciones de conducta por especie. La finalidad de estos contornos es primeramente ilustrar la distribución integral de la especie en toda la extensión del área de estudio y resaltar las localidades donde hay una agregación importante donde actividades claves asociadas

(registros de conducta) con la supervivencia estarían concentradas (Hooge & Eichenlaub, 2000; Lusseau & Higham, 2004).

Caso de Estudio: Marina de Lujo en la Bahía de Puerto Jiménez: El proyecto de desarrollo de una marina contemplado para el área de Puerto Jiménez consiste en la construcción y operación de puestos para el atraque de embarcaciones. La cantidad efectiva de puestos de atraque para venta o renta es de cerca de 257 unidades, que en su conjunto son equivalentes a 5 000 metros de eslora. Adicionalmente, el proyecto incluye un área de 9 000 m², de los cuales 2 674 m² serán destinados a área comercial, y el resto, 6 326 m², serán destinados a la construcción de un hotel con 74 habitaciones para los usuarios de la Marina (Araya-Montero et al. 2006). El estudio de impacto ambiental de la Marina de Lujo en Puerto Jiménez fue aprobado por la Secretaría Técnica Nacional Ambiental mediante Resolución № 2424-2008-SETENA del día 8 de agosto del 2008, otorgándosele la viabilidad ambiental al proyecto, para posteriormente modificarse mediante Resolución № 2084-2011-SETENA del día 30 de agosto del 2011, modificando, de esta manera, las obras constructivas contempladas dentro del estudio de impacto ambiental aprobado, reduciendo la capacidad de embarcaciones en el diseño, de acuerdo con el nivel descrito anteriormente.

RESULTADOS

En una década de muestreos en el Golfo se ha obtenido una cobertura espacial homogénea en la cuenca interna de cerca de 40 000 km ≈ 50% del esfuerzo total (Fig. 1), mientras que la cobertura espacial para la zona del umbral y la zona de transición oceánica presenta un incremento constante, lo que ha implicado una inversión de 3 490 horas de campo, equivalentes a 79 300 km recorridos aproximadamente en esfuerzo activo de búsqueda y seguimiento de individuos. Se recolectaron 422 registros derivados de las observaciones de delfines nariz de botella y 167 registros de ballenas jorobadas en zonas costeras. La Figura 2 aborda los detalles de las conductas más importantes en los presupuestos de actividad.

Distribución espacial de delfines nariz de botella: El patrón espacial de las agrupaciones de T. truncatus es del tipo agregado, de acuerdo con lo que indica el índice promedio del vecino más cercano. Dicho patrón de agrupamiento espacial es estadísticamente significativo, tal como se refleja por el estadístico “Z score” y la medida de probabilidad detallados en el Cuadro 1. La distribución y uso de hábitat de T. truncatus en el Golfo Dulce se ilustra en la Figura 3 mediante registros que están asociados a evidencias conductuales de alimentación (N=244 ≈ 60% del total de avistamientos). La distribución de uso se expresa mediante el contorno que incluye el 95% de los registros del delfín nariz de botella (KDE-adaptativo: Densidad 5.50 registros/km2; H=0.042; H-REF= 0.40), correspondiente al rango hogar; en conjunto con el contorno que refleja las áreas de concentración núcleo que contienen el 50% de los registros de la especie (KDE-adaptativo: Densidad 76.76 registros/km2; H=0.042; H-REF= 0.40). El rango hogar potencial de delfines nariz de botella se encuentra a lo largo de la línea costera del Golfo

Dulce, en las costas de la cuenca interna, particularmente en la zona aledaña a Puerto Jiménez.

Estas áreas críticas para alimentación se integran con la zona del umbral. Las áreas de concentración núcleo se centralizan en zonas de influencia de las desembocaduras de los ríos y sus adyacencias, en específico, a lo largo de los ríos Rincón, Esquinas, Coto Colorado, con mención particular al subsistema conformado por los ríos Tigre y Platanares. De acuerdo con lo anteriormente descrito, podemos identificar como zonas con mayor importancia de uso, las desembocaduras de los ríos como hábitats críticos de alimentación de delfines nariz de botella.

Distribución espacial de la ballena jorobada: La ballena jorobada en el Golfo Dulce se distribuye en grupos agregados de carácter significativo ($P < 0.001$, Cuadro 1), según lo refleja el índice promedio del vecino más cercano. Las agregaciones de ballenas jorobadas, entre las que se incluyen los grupos de madres y crías, al igual que grupos de machos en cortejo, se ilustran en la Figura 4, la cual contiene los contornos correspondientes a rango hogar (KDE adaptativo: Densidad 1.33 registros/ km2; H=0.25; H-REF= 0.49) y el contorno que define el área núcleo de agregación (KDE-adaptativo: Densidad 21.36 registros/km2; H=0.25; H-REF= 0.49).

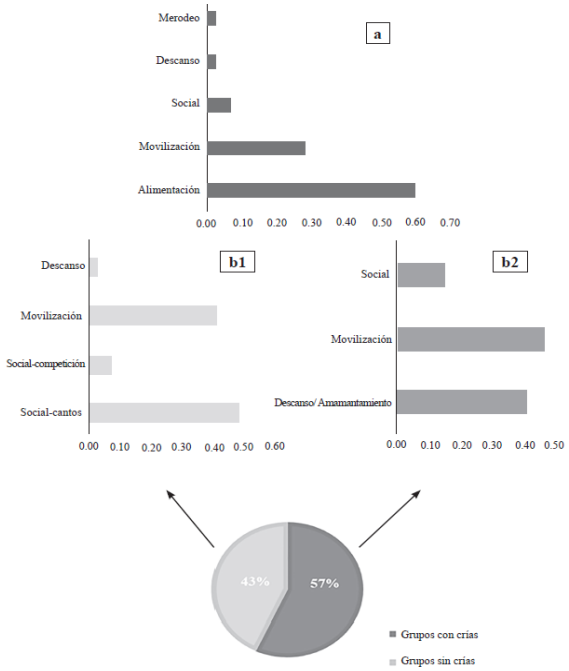

Fig. 2. a) Presupuesto de actividad del delfín nariz de botella en el Golfo Dulce (2005-2014). b) Presupuesto de actividad de la ballena jorobada en el Golfo Dulce: b1) Grupos sin crías, b2) Grupos con crías.

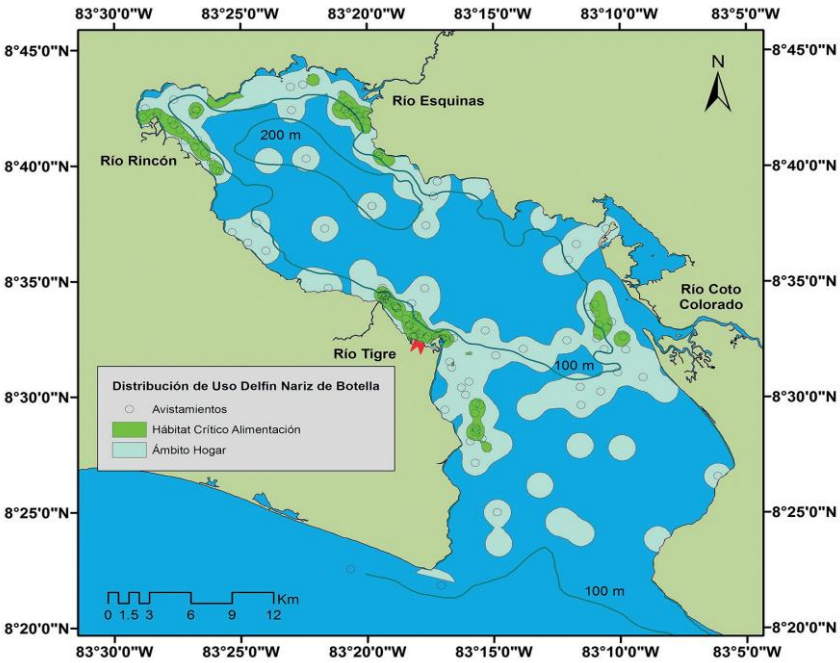

Fig. 3. Distribución de uso del delfín nariz de botella en el Golfo Dulce; el ámbito hogar es denotado por el contorno verde claro, el hábitat crítico de alimentación, en verde oscuro. El área urbana de Puerto Jiménez se muestra en el polígono rojo

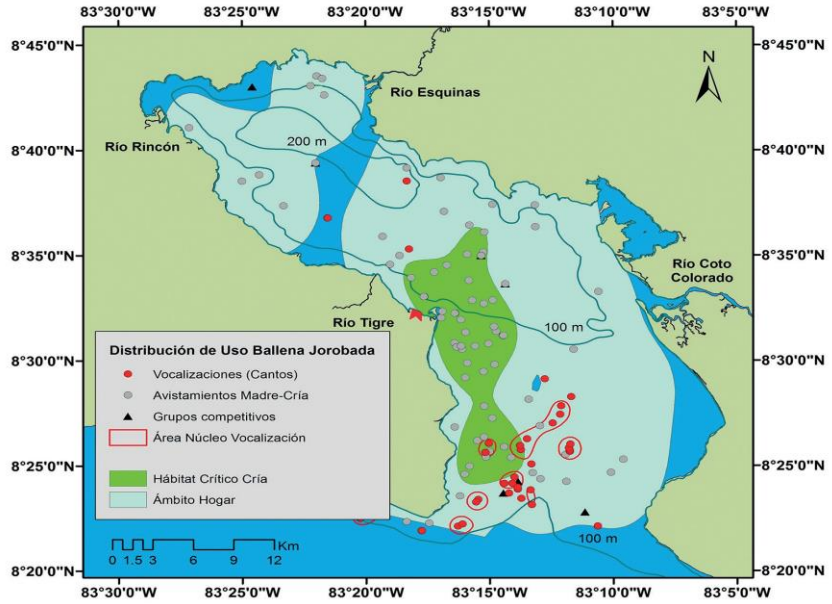

Fig. 4. Distribución de uso de la ballena jorobada en el Golfo Dulce; el ámbito hogar de madres con crías incluyendo tríadas es denotado por el contorno verde claro, el hábitat crítico de reproducción y cría, en verde oscuro. Agregaciones de registros de vocalización (cantos) se denotan por el contorno rojo. El área urbana de Puerto Jiménez se muestra en el polígono rojo.

Los registros de avistamiento referidos anteriormente se complementan con los resultados de un muestreo acústico, donde el 64% de las vocalizaciones identificadas como canto de machos potencialmente en cortejo (n=35), se ubican dentro del área núcleo (Fig. 4). La zona del umbral del Golfo Dulce se consolida como hábitat crítico de reproducción y cría de la ballena jorobada. Esta especie usa como rango estacional potencialmente toda la extensión marino-costera del Golfo Dulce durante su migración anual, no obstante, el 50% de los registros están localizados en una zona exclusiva, aledaña a la desembocadura del río Platanares en Puntarenitas, hasta conectar con la porción occidental del umbral y la transición del Golfo con el Océano Pacífico.

Esta área contiene una porción notable de registros de madres con crías, así como de ballenas en edad de madurez reproductiva, ejecutando y llevando a cabo aspectos complejos de comportamiento reproductivo, en particular grupos competitivos y registros vocales de machos cantantes. Los resultados anteriores, a través de los contornos de la distribución de uso y el tipo de agrupamiento agregado, establecen elementos espaciales claves que sustentan el uso intensivo de esta área como zona de refugio importante para hembras con crías. Adicionalmente, hay una incidencia alta de vocalizaciones (machos cantando) que se agregan en la zona del umbral. La Figura 5 ilustra la porción media de la línea costera del Golfo Dulce en las adyacencias del río Platanares, donde se observa una coincidencia entre el área de mayor uso del delfín nariz de botella para la alimentación y el área de mayor presencia de madres crías de ballenas jorobadas. La Figura5 señala, adicionalmente, la localización específica del proyecto de desarrollo de la marina en la bahía de Puerto Jiménez, destacando su traslape espacial con las áreas críticas para las especies mencionadas anteriormente.

DISCUSIÓN

Hábitat crítico de alimentación del delfín nariz de botella: De acuerdo con los resultados del análisis espacial de cetáceos de hábitos costeros en el Golfo Dulce, el delfín nariz de botella tiene un patrón espacial agregado, asociado a áreas de alimentación discretas (Parrish & Edelstein-Keshet, 1999). La identificación del hábitat crítico de alimentación en las áreas núcleo de los ríos Tigre-Platanares se basa en registros de conducta de alimentación documentados tanto en el presente estudio como en investigaciones anteriores (Pacheco-Polanco & Oviedo, 2007; Oviedo, 2007; Oviedo et al. 2012). La alimentación es una actividad biológica fundamental que afecta el éxito reproductivo de una especie. Esta conducta refleja una respuesta ecológicamente dinámica del organismo ante los recursos disponibles y la estructura del hábitat (Gowans et al. 2007), por lo que no solo se evidenciaría un uso del hábitat, sino también un proceso de selección que resulta del consumo intensivo (en su sentido más genérico) de recursos particulares que ofrece esta localidad discreta, en contraposición a lo disponible en toda la extensión del Golfo (Wheeler et al. 2012).

El traslape de áreas críticas de alimentación con la marina puede tener efectos significativos en esta población, ya que en esta misma área se han evidenciado afecciones dérmicas, en específico, la enfermedad denominada LLD (Lacaziosis Like Disease: Enfermedad Similar a Lacaziosis), de acuerdo con lo planteado en Bessesen et al. (2014).

Esta es una infección por hongos, que está relacionada con la degradación de condiciones ambientales, se estima que un cuadro previo de compromiso inmunotóxico por exposición a contaminantes, podría promover la morbilidad de esta enfermedad dérmica (Reif et al. 2009), la cual afecta a especies de delfines costeros (Van Bressem et al. 2009) por estar estas más expuestas a las presiones por actividades humanas en sus hábitats críticos (Bowen, 1997; Thompson et al. 2000; Whitehead et al. 2000; Gowans et al. 2007; Jefferson et al. 2009).

Hábitat crítico de reproducción y cría de la ballena jorobada: La porción del área del umbral adyacente a la bahía de Puerto Jiménez ofrece condiciones especiales de resguardo y conservación de energía para grupos de madres-crías (Craig et al. 2014). Márquez-Artavia et al. (2012) sugieren que estas agregaciones evitan activamente las zonas de mezcla, donde el régimen de corrientes promovería la formación de turbulencia, con el fin de facilitar la preservación de energía durante la lactancia (Clapham, 2008). El canto en las ballenas jorobadas es el elemento conductual que resalta como aspecto crucial del cortejo y reproducción (Tyack, 1981; 2000; Clapham, 2000; Oviedo et al. 2008; Smith et al. 2008). Este comportamiento reproductivo define el uso de hábitat en esta área en particular. El uso diferencial de hábitat entre pares de hembras con crías y machos cantando en cortejo se disipa por lo reducido de la escala geográfica donde ocurren estos eventos y por la relación implícita entre la disponibilidad de hembras y la mayor proporción de machos en áreas de agregación invernal (Craig et al. 2002; Clapham, 2008), lo que a su vez genera la presencia de grupos competitivos de machos persiguiendo hembras (Craig et al. 2002; Spitz et al. 2002), incluso aquellas con crías de la temporada (Clapham, 2000).

Caso de Estudio: Marina de Lujo en la Bahía de Puerto Jiménez: La información espacial detallada en párrafos anteriores tiene como elemento clave a resaltar que se deriva de la observación y registro de conductas, estas asociadas a un valor del "fitness" ecológico de cada especie en estudio, tal como se considera en Spencer (2012): en el caso del delfín nariz de botella, dicho valor es la ganancia energética por alimentación, mientras que para la ballena jorobada, son las probabilidades de cópula y reproducción. Un proyecto de la magnitud de una marina, que conlleva a una alteración ambiental abrupta, limitaría la accesibilidad a los recursos implícitos en el uso de área, afectando la obtención de energía de la población residente de delfines nariz de botella. La alteración constante de conductas como alimentación, descanso y socialización repercute en funciones biológicas vitales (Constantine et al. 2004; Lusseau, 2006; Lusseau et al. 2009), resultando en impactos negativos del crecimiento poblacional (Lusseau, 2004; Bejder et al. 2006). Se debe tomar en consideración que esta área ya evidencia individuos afectados con LLD (Bessesen et al. 2014), por lo tanto, se esperaría que un hábitat con mayor perturbación de la actual podría incrementar la progresión de la enfermedad en número de delfines afectados y evolución crónica de la micosis en estos.

El aumento del tráfico de embarcaciones por el establecimiento de una marina devendría en impactos adversos directos en el hábitat crítico22 Rev. Mar. Cost. ISSN 1659-455X. Vol. 8 (1): 9-27, Enero-Junio 2016. Herra-Miranda, Pacheco-Polanco, Oviedo e Iñíguez de reproducción y cría de la ballena jorobada. El efecto negativo del

tráfico marítimo en áreas de crianza de ballenas ha sido estudiado en detalle (Jensen & Silber, 2003; Hinch & De Santo, 2011; Guzmán et al. 2013; Laist et al. 2014), y se han reportado casos de colisiones de embarcaciones con ballenas en lugares con altas concentraciones de animales agregados (Guzmán et al. 2013; Laist et al. 2014). En los EE. UU. está documentado que el 80% de los choques de botes con ballenas jorobadas involucran a juveniles y crías de menos de tres años (Laist et al. 2001). El aumento del tráfico de embarcaciones afectaría, igualmente, el proceso de cortejo-reproducción, ya que podría causar un efecto de enmascaramiento en las canciones por la contaminación sónica (Nowacek et al. 2007; Sousa-Lima & Clark, 2008), siendo este un elemento potencial en la conducta de los machos que incidiría en la reproducción (Darling, 2008). En la zona de reproducción y cría de ballenas jorobadas en el Parque Nacional Abrolhos, en Brasil, se determinó que el incremento del tráfico de botes repercute negativamente mediante el aumento de ruidos que enmascaran el proceso de canto de machos de ballenas jorobadas (Sousa-Lima & Clark, 2008); en estos casos la canción se hacía mucho más corta, con menos estructuras vocales o se interrumpía completamente, induciendo a los machos a abandonar el área de cortejo; esto en contraste con las observaciones en áreas donde las condiciones imperantes no presentaban alteraciones por botes.

Las estrategias de manejo y conservación para mitigar los efectos antropogénicos descritos deben sustentarse en un entendimiento integral de los requerimientos de hábitat de especies susceptibles (Gerrodette & Eguchi, 2011). El no considerar la presencia de hábitats críticos pone en riesgo la sustentabilidad de las poblaciones locales, al afectar directamente funciones biológicas claves para la supervivencia (Lusseau et al. 2009). Las consecuencias de los impactos generados no son solo a nivel local, como es el caso de la población costera de delfines nariz de botella en el Golfo Dulce, también se podrían afectar especies de carácter migratorio. El establecimiento de la Marina en la Bahía de Puerto Jiménez afectaría a dos subpoblaciones migratorias de ballenas jorobadas: aquellas que se alimentan en hábitats críticos localizados en zonas templadas del Pacífico Noreste (M. n. kuzira, Jackson et al.
2014) y las que se alimentan en hábitats críticos en el Pacífico Sureste (M. n. australis, Jackson et al. 2014), pero que se reproducen y crían a sus ballenatos en los hábitats críticos a lo largo de la porción costera de la Península de Osa, incluido el Golfo Dulce.

Los objetivos de manejo y conservación en el Golfo Dulce deberían hacer énfasis en invocar el principio precautorio y establecer decisiones de carácter conservativo que favorezcan la protección del recurso, tal como recomienda el comité científico de la Comisión Ballenera Internacional, en su reunión número 66va (IWC, 2015). Por último, Rev. Mar. Cost. ISSN 1659-455X. Vol. 8 (1): 9-27, Enero-Junio 2016. 23 Análisis espacial de los hábitats críticos del delfín nariz de botella (Tursiops truncatus) y la ballena jorobada la recomendación que se genera de este estudio es relocalizar el proyecto en costas afuera del Golfo Dulce, ya que este singular elemento geográfico representa integralmente un hábitat clave en la supervivencia de poblaciones residentes y migratorias de cetáceos costeros.

AGRADECIMIENTOS

Los autores agradecen el soporte financiero de las siguientes instituciones: Earthwatch Institute, International Student Volunteers, Society for Marine Mammalogy, American Society of Mammalogy, Cetacean Society International. Igualmente, agradecemos a Marcos “Taboga” Loaiciga, Jorge Medina y Azucena Herra-Miranda por su gran contribución. Este manuscrito se benefició de los comentarios de tres revisores anónimos, les agradecemos su valiosa colaboración.

Proyección de cambios en la temperatura superficial del mar del Golfo de California y efectos sobre la abundancia y distribución de especies arrecifales

INTRODUCCIÓN

El Golfo de California es un mar interior localizado entre la Península de Baja California y los estados de Sonora y Sinaloa, al noroeste de México. Alberga más de 800 especies de peces y aproximadamente 4 500 de invertebrados (Brusca et al. 2005), además de ser un área clave de gran importancia para las pesquerías artesanales en México (Rodríguez-Quiroz et al. 2010). La región presenta múltiples ecosistemas costeros, incluyendo planicies arenosas, manglares, mantos de rodolitos, estuarios y arrecifes rocosos y coralinos (Lluch-Cota et al. 2007). En especial, estos últimos han recibido una particular atención científica y comercial por representar zonas de alta riqueza de especies (Roberts et al. 2002).

El crecimiento económico de los estados costeros del Golfo de California ha incrementado de manera notable las actividades comerciales y turísticas, causando un aumento en el nivel de perturbaciones antropogénicas a los ecosistemas (Enríquez-Andrade et al. 2005). Por ello, aun cuando esta es una de las regiones marinas mejor conservadas en el Pacífico Oriental Tropical y con un gran número de programas de conservación, existe una gran preocupación por el futuro al considerar potenciales agentes de contaminación costera, modificaciones de los hábitats, sobrepesca y sobrepasarse la capacidad de carga de los sitios por turismo excesivo (Aguilar et al. 2007).

Además, el Golfo de California no es inmune a los efectos que podría causar el cambio climático global. El Panel Intergubernamental sobre Cambio Climático (2014) menciona que en los últimos 100 años la temperatura superficial global (terrestre y oceánica) promedio se ha incrementado entre 0.65°C y 1.6°C, que el nivel del mar Rev. Mar. Cost. ISSN 1659 455X. Vol. 8 (1): 29-40, Enero-Junio 2016. 31 Proyección de cambios en la temperatura superficial del mar del Golfo de California ha subido de 0.17 a 0.21 m desde inicios del siglo pasado (1900). En el ámbito global, la temperatura superficial del océano se ha incrementado entre 0.09 y 0.13°C por década en los últimos 40 años. Diferentes modelos muestran que la temperatura superficial (terrestre y

oceánica) podría ascender entre 0.3°C y 4.8°C para finales de siglo (2081-2100), y que el nivel del mar podría aumentar entre 0.26 y 0.85 m (IPCC, 2014). Como resultado, se han reportado cambios en la distribución y composición de comunidades de especies marinas en zonas templadas y subtropicales (Albouy et al. 2012; Pont et al. 2015). Existe una particular preocupación por lo que podría ocurrir en las comunidades por el blanqueamiento coralino generado por el incremento en la temperatura oceánica (Hoegh-Guldberg, 1999; Baker et al. 2008; Logan et al. 2014; Li & Reidenbach, 2014), aparentemente causando una fuerte disminución de abundancia de corales en el mundo.

Para el Golfo de California solo hay información anecdótica (e.g., Reyes-Bonilla, 2003), dada la carencia de largas series de datos biológicos o de información oceanográfica detallada. Sin embargo, el uso de información espacial a gran escala puede ayudar a abordar este problema al permitir construir modelos de tolerancia fisiológica de las especies, a partir de los cuales se puede predecir su distribución (Smith et al. 2008). Algo cierto es que las condiciones serán distintas en el futuro, razón por la que se deben realizar investigaciones para prever el impacto que tendría este fenómeno sobre la distribución, abundancia y riqueza de las diferentes especies de importancia ecológica y comercial. Este tipo de herramientas macroecológicas tienen una enorme aplicación para pronosticar el impacto que puede tener el calentamiento global sobre las comunidades marinas, y abren la posibilidad de proveer recomendaciones para mejorar la planeación estratégica de los creadores de planes de manejo y tomadores de decisiones. Desde esta óptica, el objetivo del trabajo fue evaluar la tendencia de cambio de la temperatura superficial del mar en el Golfo de California entre 1983 y el 2014, y posteriormente emplear los resultados como insumos para proyectar modificaciones en la distribución y abundancia de algunas especies relevantes.

MATERIALES Y MÉTODOS

El Golfo de California se ubica al noroeste de México. Es un mar interior de forma alargada, orientado de noroeste a sureste. Tiene una longitud aproximada de 1 500 km y en su parte más amplia tiene 205 km de ancho en la zona sur y una mínima de 117 km a la mitad del Golfo. La Península de Baja California Sur es el límite oeste, el macizo continental del noroeste de México es su límite este, al norte se encuentra con la desembocadura del río Colorado, al sur, el límite es una línea imaginaria que se extiende desde la punta sur de la Península en Cabo San Lucas (23° N) hasta Cabo Corrientes, Jalisco, México (20° N) (Rusnak et al. 1964; Álvarez-Borrego, 1983; Thomson et al. 2000) Es importante hacer mención que la información oceanográfica para construir los modelos es hasta el 2007 y no a la fecha, para que coincidieran con la información de datos biológicos (censos visuales de organismos), la cual es de 2004 a 2007.

La primera parte de la investigación consistió en construir una base de datos oceanográficos que sustentara los modelos de cambios biológicos. El Golfo fue dividido en cuadrículas de 1° x 1° de latitud-longitud (N=27), y para cada una se obtuvieron registros superficiales (promedios y valores máximos y mínimos anuales) de salinidad (UPS), nitratos, silicatos y fosfatos (micromol) y de concentración de clorofilas (mg/m3). La información provino del World Ocean Atlas (2015; valores de 1950-2007) y de

imágenes de satélite del Ocean Color Web, 2015 (datos de 1987 a 2007). Adicionalmente, para conocer las tendencias de cambio de la temperatura superficial del Golfo se tomaron los promedios mensuales de cada cuadrícula de 1° x 1° entre 1983 y el 2006 (NOAA, 2013; 2015), y se calculó su promedio anual. Dichos valores se incluyeron en una regresión lineal simple que utilizó el año como factor de prueba y donde la pendiente representa la tasa de elevación anual de la temperatura en el sitio (Neter et al. 1997).

Por último, con la ecuación de regresión extrapolamos los valores hasta el año 2050, con el fin de obtener pronósticos anuales de temperatura y plantear el posible escenario. Para el caso de los datos biológicos, se hizo uso de una serie temporal de registros (2005-2007) que consta de censos visuales (500 censos en total aproximadamente) en transectos de banda de 20 m x 5 m para peces y de 20 m x 2 m para invertebrados, realizados por integrantes del laboratorio de Sistemas Arrecifales de la Universidad Autónoma de Baja California Sur (entre ellos, todos los autores de este trabajo). Se tomaron en cuenta principalmente especies claves en seis regiones arrecifales rocosas de la Península de Baja California (Bahía de Los Ángeles, 28° N; Santa Rosalía, 27° N; Loreto, 26° N; La Paz, 24° N; Cabo Pulmo, 23° N, y Los Cabos, 22° N). Del total de los censos realizados, se extrajeron los datos de abundancia de la cabrilla sardinera Mycteroperca rosacea (Streets, 1877), el pez ángel de Cortés Pomacanthus zonipectus (Gill, 1862) y el pepino de mar café Isostichopus fuscus (Ludwig, 1875), con el fin de trabajarlos de manera individual.

Las tres especies tienen una gran importancia económica y se explotan en al menos dos de los estados costeros del Golfo (SAGARPA, 2010); además de que las dos últimas también están dentro de la Norma Oficial Mexicana, en la categoría de Protección Especial (Diario Oficial de la Federación, 2010). Para modelar los factores que determinan su abundancia usamos una regresión lineal por pasos (“stepwise”), con la rutina “ridge”, que evita introducir variables correlacionadas en el modelo (Neter et al. 1997). Se aplicaron los datos de temperatura, salinidad y nutrientes como factores para predecir la abundancia Rev. Mar. Cost. ISSN 1659-455X. Vol. 8 (1): 29-40, Enero-Junio 2016. 33 Proyección de cambios en la temperatura superficial del mar del Golfo de California actual de las tres especies en cada región estudiada frente a la Península de Baja California, y se creó un modelo que seleccionó las variables que más afectan la abundancia.

Luego se predijeron las abundancias de las especies por zona a partir únicamente de los datos oceanográficos. El último análisis estadístico se dirigió a la evaluación del posible efecto del calentamiento del océano sobre las especies indicadas. Para ello, se sustituyó en la ecuación de regresión el valor del coeficiente de la temperatura, ya sea de forma directa o indirecta. En este caso, con los resultados de los modelos se crearon escenarios de cambio local de las abundancias causado por el aumento de temperatura, en +1°, +2° y +3°C.

RESULTADOS Y DISCUSIÓN

En la Figura 1 se muestra la tasa de elevación de la temperatura del Golfo de California en cuadrículas de 1° x 1°, en ella se nota que la zona del sur de Sonora y norte de Sinaloa

(zona centro-este del Golfo de California) es donde el calentamiento está siendo más intenso, mientras que en el Canal de Ballenas (grandes islas del norte del Golfo) la pendiente de la regresión años-temperatura es casi de cero, indicando estabilidad térmica en las últimas dos décadas y media. Tomando los datos de todas las cuadrículas estimamos que para el año 2050 la elevación promedio de la temperatura superficial en el Golfo de California será de 0.63°C, pero esto depende de la zona geográfica, pues, para el 2050 prácticamente todo el sur tendrá temperaturas medias superiores a los 25°C (Fig. 2). Por otra parte, los gráficos de abundancia estimada del ángel de Cortés (P. zonipectus) y de la cabrilla sardinera (M. rosacea) indican que el calentamiento del Golfo de California traerá aparejada una sensible disminución de los números de individuos de cada especie, y de hecho, el modelo sugiere que las poblaciones de la cabrilla desaparecerán en el centro y suroeste de la Península de Baja California si la temperatura se incrementa 3°C (Fig. 3).

Revisando las ecuaciones de regresión, tales cambios tienen su origen en que las dos especies tienen afinidad con aguas frías y con zonas de alta productividad, variables que se verán afectadas por el calentamiento en el futuro, información que coincide con la distribución actual de ambas especies, donde sus mayores abundancias se presentan en zonas de surgencias y aguas templadas (Díaz-Uribe et al. 2001). De manera semejante, el análisis de las tendencias posibles de cambio en el pepino café (Isostichopus fuscus) muestra, que las poblaciones pueden disminuir de forma considerable si las temperaturas se incrementan más de 1°C (Fig. 4). Las poblaciones del pepino café tienen una alta relación con la temperatura oceánica, y los periodos de reproducción están fuertemente ligados a los cambios de temperatura (Herrero-Perezrul et al. 1999), por lo que cambios considerables de temperatura superficial del mar podrían ocasionar cambios en la población.

En adición, según el modelo, la zona sur de la Península sufrirá una disminución superior al 30% de la población de este organismo, si la temperatura se incrementa 3 grados.

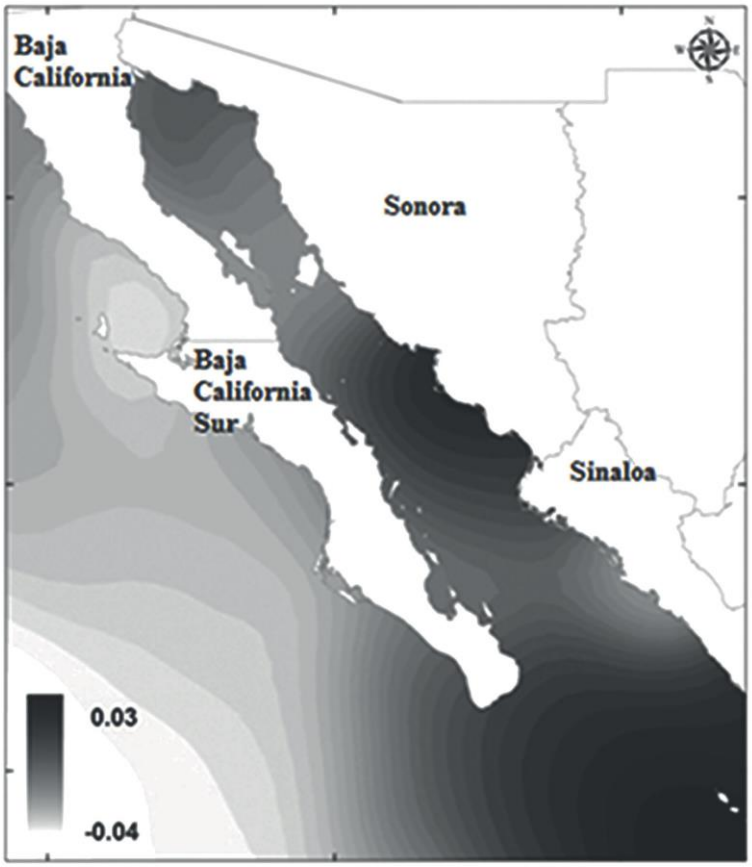

Fig. 1. Tendencias en la elevación de la temperatura del Golfo de California, en grados centígrados por año (1982-2006)

Ello sugiere que la pesca de este recurso sería impactada desproporcionadamente siendo más considerable la disminución de este recurso en Baja California Sur con respecto a Baja California. Finalmente, efectuamos un análisis de la respuesta de las 20 especies más abundantes en las siete zonas arrecifales de interés en el Golfo de California (listado taxonómico en Ayala-Bocos & Reyes-Bonilla, 2009).

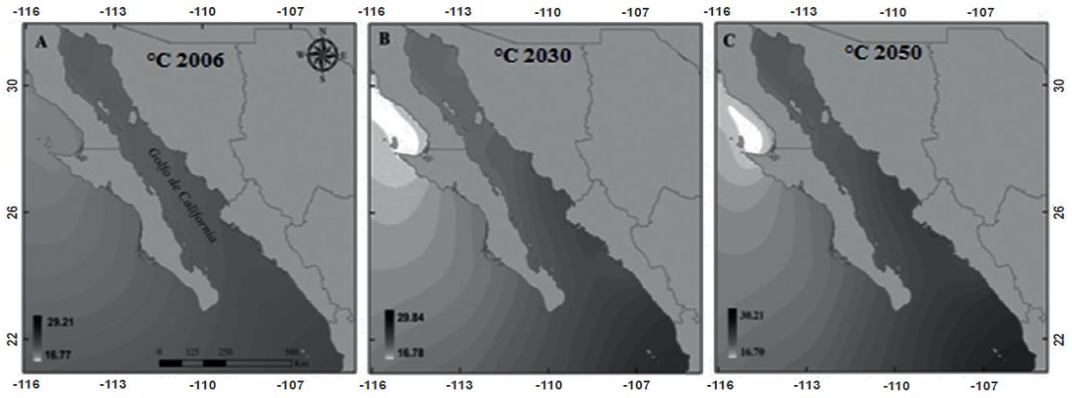

Fig. 2. Temperatura superficial promedio en el 2006 del Golfo de California (en grados centígrados; izquierda) y pronóstico para el 2030 (centro) y el 2050 (derecha).

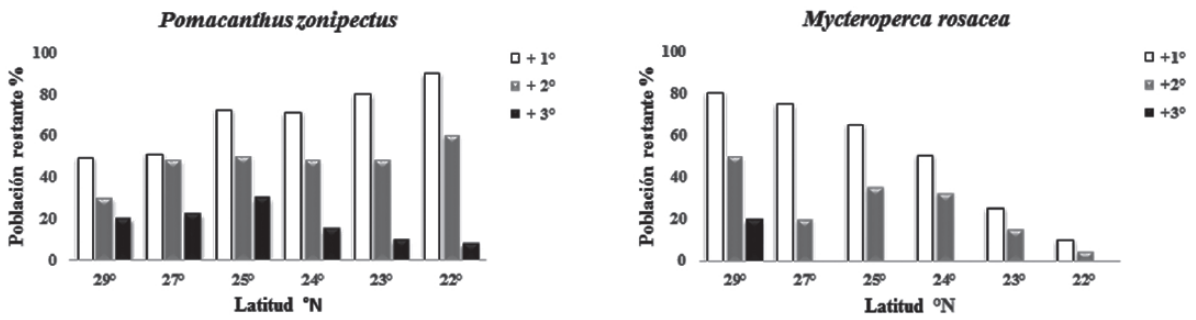

Fig. 3. Proyección de cambios en la abundancia y distribución de Pomacanthus zonipectus (izquierda) y Mycteroperca rosacea (derecha) en la Península de Baja California, según el aumento de la temperatura.

Como se observa en la Figura 5, las asociaciones actuales se agruparon en el lado izquierdo del dendrograma. Sin embargo, una vez que la temperatura asciende la posición de las estaciones dentro de las ramas se modifica de forma desordenada y no gradual. Nuestra conclusión es que dadas las diferencias en los niveles de tolerancia al cambio ambiental, cada especie mostrará comportamientos específicos y no necesariamente congruentes con los del resto. Tales variaciones idiosincrásicas implican dos aspectos claves: a) el calentamiento del mar traerá un fuerte desbalance en la composición y, por ende, en la función ecológica de los sistemas arrecifales del Golfo de California; y b) no es de esperarse que las modificaciones sean detectables por medio de extinciones locales o cambios abruptos de composición de las comunidades, sino más bien serán alteraciones graduales en las abundancias relativas de las especies.

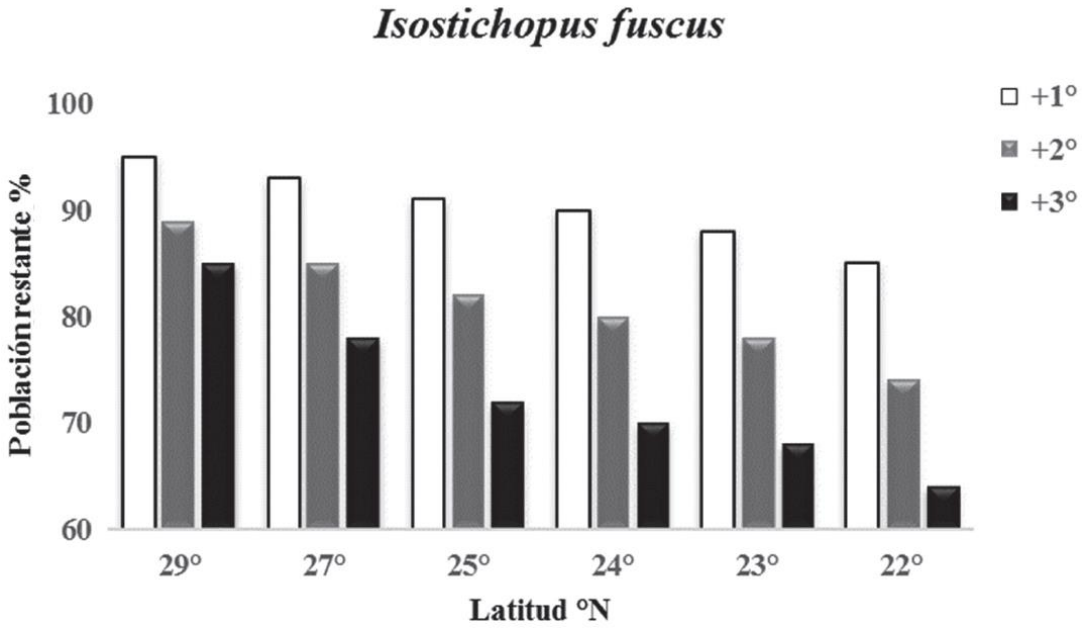

Fig. 4. Proyección de cambios en la abundancia y distribución de Isostichopus fuscus en la Península de Baja California, según el aumento de la temperatura.

Este desbalance en las comunidades por el aumento de la temperatura oceánica, ya se ha registrado en otros lugares del mundo, ocasionando efectos similares (Perry et al. 2005; McKenzie et al. 2007; Albouy et al. 2012). Considerando esta situación, recomendaríamos la puesta en práctica de programas de monitoreo efectivos de las comunidades y de los niveles poblacionales de las especies claves, como una herramienta fundamental para detectar los efectos futuros del calentamiento.Tanto organizaciones gubernamentales como no lucrativas buscan generar políticas para balancear el aprovechamiento de los recursos naturales con la protección de la calidad ambiental. Desde esta perspectiva, los modelos de cambio climático y espacio de nicho, y las predicciones resultantes acerca del estado futuro de las poblaciones y ecosistemas, son fundamentales para ofrecer escenarios probables, los cuales sirvan como prevención y guía en la toma de decisiones. Además, el ofrecer este tipo de información a la sociedad en general (una vez mejor validada o más completa) permitiría que los diversos actores ponderen y planeen sus propias actividades actuales y futuras, maximizando el impacto hacia la conservación.

En resumen, las herramientas ejemplificadas pueden convertirse en insumos claves, para apoyar el manejo y la conservación del Golfo de California, y fortalecer su aplicabilidad. La aplicación de estos modelos para proyectar la vulnerabilidad a la extinción de especies o cambios de distribución se ha convertido en una herramienta potencialmente útil para informar las decisiones de gestión de recursos. Los modelos pueden ser más útiles para la identificación de oportunidades de conservación reconociendo nuevos hábitats disponibles o si algún hábitat actual ya no existirá en virtud de futuros cambios climáticos (Schwartz, 2012).

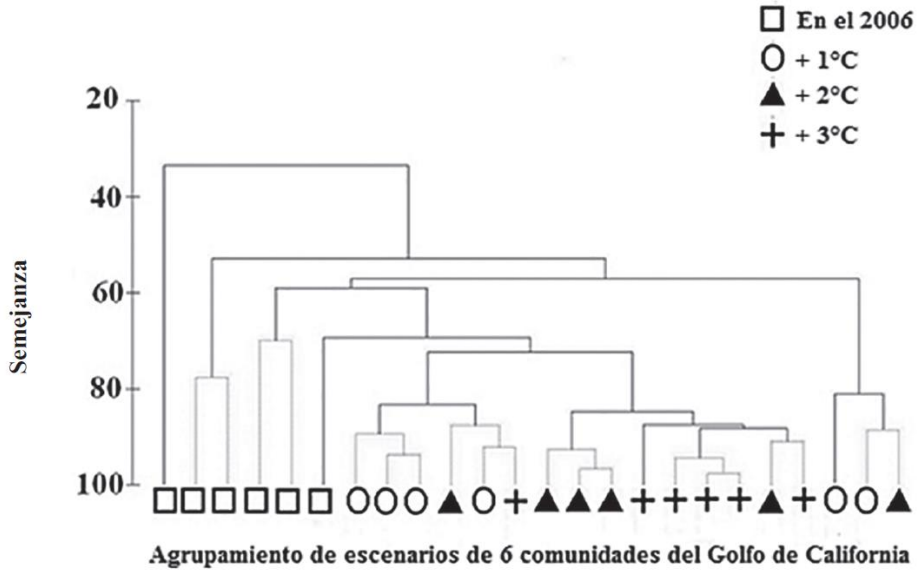

Fig. 5. Dendrograma de agrupamiento que muestra el grado de semejanza (coeficiente de Bray Curtis) entre las comunidades de seis zonas arrecifales del Golfo de California, en el 2006 (cuadros), y los predichos por modelos de elevación de temperatura de 1°C (círculos), 2°C (triángulos) y 3°C (cruces)

Los resultados presentados en este trabajo son un primer intento formal y cuantitativo para denotar cambios potenciales en la distribución y abundancia de especies marinas en el noroeste de México. Las proyecciones son aún imprecisas y deberán ser revisadas con información oceanográfica y biológica actualizada en los años por venir, es decir, contar con planes de monitoreo permanentes y continuos. Sin embargo, constantemente se trabaja en el desarrollo y mejoramiento de manera económica, social y ecológica para los residentes del litoral del Golfo de California, los cuales deberán ser discutidos y priorizados por las autoridades, con el fin de mejorar y crear estrategias alternas para el manejo y la toma de decisiones. Es precisamente por la posibilidad de ofrecer contextos específicos por lo que los alcances del enfoque macroecológico son importantes. En este trabajo se presentó un intento formal de cómo realizar estos modelos y su uso, pero además del ejemplo aquí mostrado es posible desarrollar modelos con otro tipo de variables e información, ya que los datos requeridos para efectuar esta clase de modelos están ya disponibles, gracias a la existencia de series temporales largas de estadísticas pesqueras, monitoreos en zonas protegidas y registros oceanográficos generados por agencias gubernamentales y no gubernamentales, tanto nacionales como internacionales, facilitando así, el realizar este tipo de modelos para crear herramientas y estrategias de manejo.

Sin duda alguna, la amalgama de esfuerzos por conocer el funcionamiento de los ecosistemas del Golfo en distintas escalas de tiempo y espacio rendirá frutos y mejorará nuestras posibilidades de conservar esta importante región del Pacífico Oriental.

AGRADECIMIENTOS

Agradecemos a Saúl González por su participación en la elaboración de este artículo, así como a Gabriela Díaz Erales (Fondo Mexicano para la Conservación de la Naturaleza) por la elaboración de los mapas. Asimismo, agradecemos al Instituto Nacional de Ecología por permitirnos presentar esta investigación en la Bienal del Golfo de California. Finalmente, agradecemos a los tres revisores anónimos por las observaciones realizadas a este trabajo.

Aspectos reproductivos de Chicoreus brevifrons (Lamarck, 1822) (Neogastropoda: Muricidae) de la laguna de La Restinga, isla de Margarita, Venezuela

INTRODUCCIÓN

En las costas orientales de Venezuela Chicoreus brevifrons es conocido vulgarmente como chirigua, chivato o arrechón (Itriago, 1977) y se caracteriza por poseer una concha grande (de aproximadamente 200 mm de Lt), ahusada, de espiral alta; columnela lisa; labio externo sinuoso y dentellado; canal sifonal oblicuo, bordeado por espinas, algo

curvado hacia el dorso; várices robustas, con espinas foliadas y gruesas (Marval, 1981; Nieto-Bernal et al. 2011). Puede presentar una gran variación en su coloración y en el desarrollo de los procesos espinosos, en función de las diferentes condiciones del medio en el que habita (Díaz & Puyana, 1994).

La alta disponibilidad trófica en las áreas de manglar Rhizophora mangle (mangle rojo) constituye un buen sustrato para los organismos sésiles (Prüsmann & Palacio, 2008), brinda protección a las larvas y juveniles de numerosas especies de invertebrados como el C. brevifrons (Quinceno & Palacio, 2008), lo que hace de estas áreas de aguas someras su hábitat (Marval, 1981; D´Armas et al. 2009). Estos hábitats naturales facilitan el crecimiento y desarrollo de la especie, permiten su amplia distribución y disponen del alimento necesario.

Los factores que determinan el comportamiento reproductivo para especies de moluscos son de variada naturaleza, por ello es importante la realización de muestreos que permitan la recolección de información para desarrollar estudios biológicos (Tresierra & Culquichicón, 1993; Baqueiro & Aldana, 2003). Muchas especies de la familia Muricidae son de importancia comercial, siendo explotadas por los pescadores con fines de consumo y para uso artesanal de la concha. El estudio de la eclosión, cápsulas de huevos y embriones de gasterópodos es importante no solo para conocer la biología reproductiva en general, sino también por sus implicaciones para la dispersión, la biogeografía y la taxonomía (Mostafa et al. 2013). En Venezuela se han desarrollado diversas investigaciones sobre C. brevifrons, entre las que se pueden señalar el trabajo de Itriago (1977) quien efectuó un estudio citogenético y anatómico de la especie; Marval (1981) realizó estudios comparativos del tracto digestivo y contribuyó a la biología de C. brevifrons y Chicoreus pomun; Cabrera et al. (1990) evalúan su biología; Miloslavich et al. (2007), analizando el imposex en gasterópodos, consideran la especie como propensa a este fenómeno; Galindo (2009) hizo estudios de dimorfismo; D´Armas et al. (2009) determinaron la composición de ácidos grasos y Ordaz et al. (2010) investigaron los metabolitos secundarios de la especie.

Dada la importancia económica y ecológica que tiene esta especie por ser depredadora de ostras y otros moluscos en los cultivos y ambientes marinos, se evaluaron aspectos reproductivos de la especie, con la finalidad de aportar información actualizada que sirva de base para sugerir estrategias de manejo sustentable, así como considerar el potencial de cultivo de C. brevifrons en Venezuela.

MATERIALES Y MÉTODOS

Área de estudio y muestreo: El Parque Nacional Laguna de La Restinga se encuentra ubicado entre los 10° 58’ y 11° 05’ de latitud norte y los 64° 01’ y 64° 17’ de longitud oeste, en el istmo que une la península de Macanao con el sector oriental de la isla de Margarita, Estado Nueva Esparta. La laguna está separada del mar Caribe por una barra arenosa o restinga de 23 kilómetros de largo y unos 50 metros de ancho, y es la única unión natural entre la isla de Margarita y la península de Macanao (Ramírez, 1996). Se realizaron muestreos mensuales en cuatro estaciones de la laguna de La Restinga: El Pato, Mánamo, El Gato y El Indio, considerando el orden de estas estaciones desde la zona más

interna de la laguna hacia la zona más externa de esta (Fig. 1). En cada salida se recolectaron, por medio de buceo libre, ejemplares de C. brevifrons de manera aleatoria, para poder obtener animales de todas las tallas observadas en el medio.

Estos fueron extraídos del sustrato duro (raíces de manglar) y del sustrato fangoso, guardados en bolsas previamente identificadas con la estación respectiva, para su posterior traslado al laboratorio. Proporción sexual: La proporción sexual general se obtuvo a partir de muestras mensuales de la especie. Las conchas de los caracoles Murícidos carecen de dimorfismo sexual (Naegel & Gómez del Prado, 2004), por lo que para la determinación del sexo es necesario que los individuos vengan extraídos de las conchas para observar el sexo de cada uno, identificando macroscópicamente la presencia del pene en los machos y la ausencia de este carácter en las hembras, quienes presentan la cápsula de la albúmina, la glándula de la cápsula y la vagina (Miloslavich et al. 2007).

La proporción sexual, por meses y total, se analizó mediante la prueba de Ji-cuadrado (Zar, 1996) para comprobar si esta se aleja significativamente de la relación 1:1. Evaluación del desarrollo de la postura y crecimiento inicial: Fueron extraídas del medio algunas posturas para su descripción y la observación del crecimiento inicial de los juveniles. Las posturas se fotografiaron en el medio y se colocaron en recipientes con agua para conservarlas durante el traslado al laboratorio, procurando mantener constante la temperatura del agua. Asimismo, las cápsulas se extrajeron del acuario a medida que se observaban cambios de coloración en estas, manteniendo este procedimiento hasta el momento de la eclosión, además de registrar el tiempo de la eclosión y el crecimiento inicial con mediciones en la longitud total cada 5 días, tiempo establecido luego de un estudio previo.

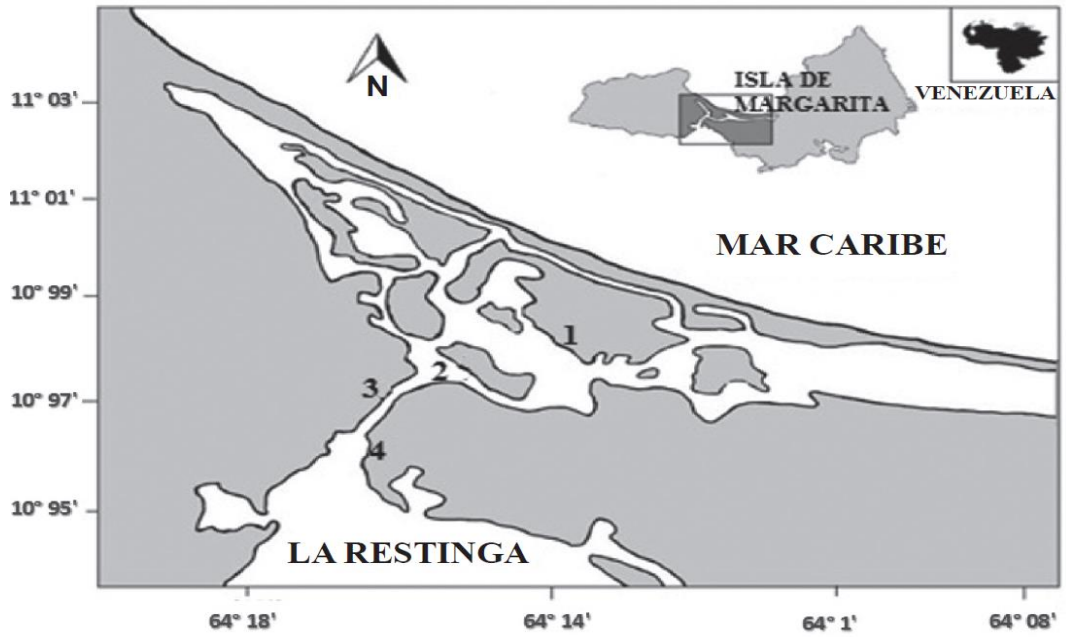

Fig. 1. Ubicación geográfica relativa de las estaciones de muestreo en: 1) El Pato, 2) Mánamo, 3) El Gato y 4) El Indio en la laguna de La Restinga, Venezuela.

RESULTADOS Y DISCUSIÓN

Proporción sexual: Se recolectó un total de 381 ejemplares de C. brevifrons con tallas comprendidas entre los 40 y 140 mm, respectivamente (69.37 ± 28.00), de los cuales 224 fueron hembras (58.79%) y 157 machos (41.21%), siendo las hembras más frecuentes que los machos. De manera general, la proporción sexual no se desvió de la razón 1:1, a pesar de que en los meses de abril y julio las hembras predominaron sobre los machos (Fig. 2; Cuadro 1). La proporción entre sexos estimada de manera general para C. brevifrons no se alejó significativamente de la razón 1:1, concordando con Marval (1981), quien obtuvo una proporción 1:1 para la misma especie en Mochima, Península de Araya, atribuyendo este resultado a que la especie se encontraba en época reproductiva y las proporciones de sexos se igualan.

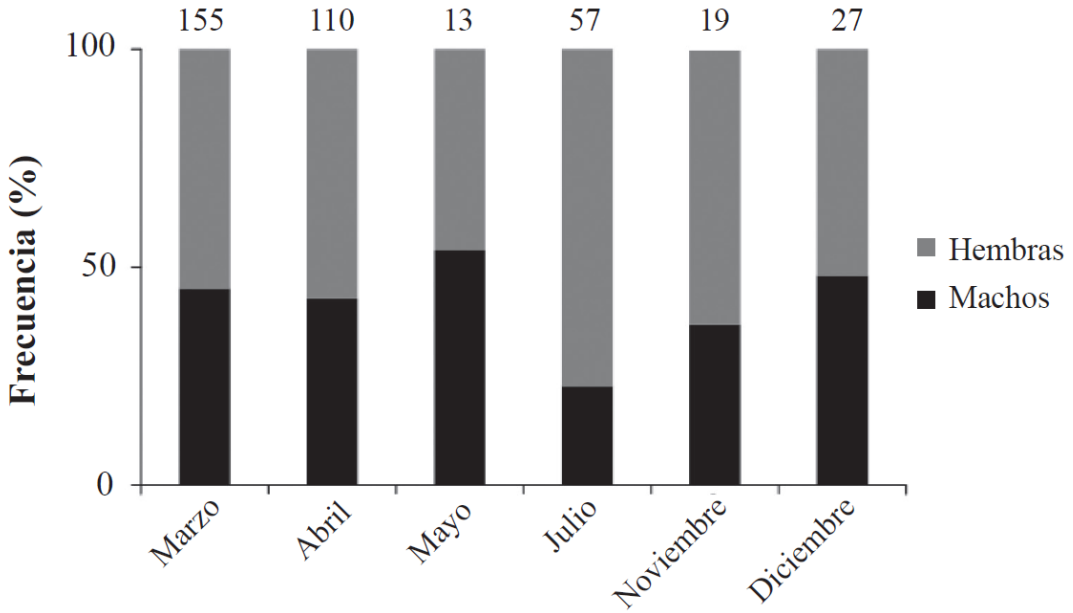

Fig. 2. Proporción sexual de la especie Chicoreus brevifrons de la laguna de La Restinga, isla de Margarita, Venezuela.

Cuadro 1. Análisis Ji-cuadrado y proporción sexual en los meses de estudio de Chicoreus brevifrons

Meses	Fo (machos)	Fo (hembras)	N	X2	*P*
marzo	70	85	155	1.45	> 0.05
abril	47	63	110	2.32	< 0.05
mayo	7	6	13	0.07	> 0.05
julio	13	44	57	16.85	< 0.05
noviembre	7	12	19	1.31	> 0.05
diciembre	13	14	27	0.03	> 0.05
Totales	157	224	381	11.78	> 0.05

Es probable que nuestros resultados se deban a que los meses en los que las hembras son más abundantes (marzo, abril, julio y noviembre), con respecto a los machos, representan las épocas de desove. Por otra parte, se han publicado resultados diferentes en otras especies de Murícidos, Olabarria (1999) obtuvo una proporción de sexos significativamente diferente de 1:1 para la especie Hexaplex erythrostomus, así como Morfín (2000) la obtuvo para Plicopurpura pansa, concluyendo que la proporción sexual puede estar afectada por cambios en la distribución espacial de los organismos.

Desarrollo de Chicoreus brevifrons: En la figura 3 se observa la postura realizada por Chicoreus brevifrons. Esta consiste en un racimo, con 65 a 165 pequeñas cápsulas (de color blanco recién puestas) (Fig. 3-A), donde cada cápsula tiene una apariencia fusiforme, con la porción superior sellada por un tapón mucoso que se rompe al momento de la eclosión y dentro de ellas se encuentran los huevos fecundados. A medida que transcurren los días y los individuos se van desarrollando intracapsularmente, las cápsulas externas van oscureciendo su coloración a un tono más amarillento y en las internas se observan pequeñas masas de color lila (Fig. 3-B y C). Una característica resaltante de la especie estudiada es su capacidad para reproducirse a través de la fecundación interna y la realización de la ovoposición de sus huevos en cápsulas especiales. Según Román et al. (2001), el número de huevos por cápsula varía entre las especies y esto puede deberse al tamaño de los adultos o a las condiciones del medio ambiente.

El tipo de postura coincide con las descripciones de Mostafa et al. (2013) para la especie Chicoreus ramosus, la cantidad de individuos que se originan de cada cápsula es igual a la reportada por González (1970), aunque, por otra parte, Cabrera et al. (1990) señalan la presencia de dos a cuatro huevos por cápsula, siendo el número total de cápsulas de 40 para la misma especie en Venezuela. Mostafa et al. (2013), en C. ramosus en condiciones de laboratorio, reportaron un total de 12 a 27 huevos desarrollados en forma de embrión y el resto pasó a ser material nutricio. A los 21 días de desarrollo comienza a notarse la presencia de los huevos nutricios, que son aquellos huevos que no alcanzan eficazmente su desarrollo dentro de la cápsula, teniendo la misma apariencia inicial; por otra parte, los huevos que obtienen un buen crecimiento son más grandes, con una forma más asimétrica por la iniciación del proceso de torsión y se puede notar la neoformación de la concha (Fig. 3-D y E). Roman et al. (2001) y Cognetti et al. (2008) mencionan que los huevos no viables son una fuente de alimento importante para los organismos que están creciendo y desarrollándose dentro de la masa ovígera. A su vez,

Leiva et al. (1998) consideran que el tiempo para que los embriones comiencen a ingerir los huevos nutricios es a partir de los 21 a 25 días de desarrollo.

A partir del día 42, los individuos se dispersan hacia el interior de la masa ovígera y presentan una concha bien desarrollada, dentro de las cápsulas se observan de color marrón, siendo esta su apariencia final antes de la eclosión, la cual se efectúa a partir de los 45-50 días desde la puesta, donde cada cápsula da origen de 3 a 5 individuos. Las tallas iniciales estuvieron comprendidas entre 1.60 y 3.90 mm de longitud total (Lt), presentando a los 15 días posteriores a la eclosión, tallas promedio de 4.60 mm y a los 30 días, longitudes totales promedio de 5.48 mm; además de observarse la concha completamente desarrollada aun sin
espinas bien formadas (Fig. 3-F y G).

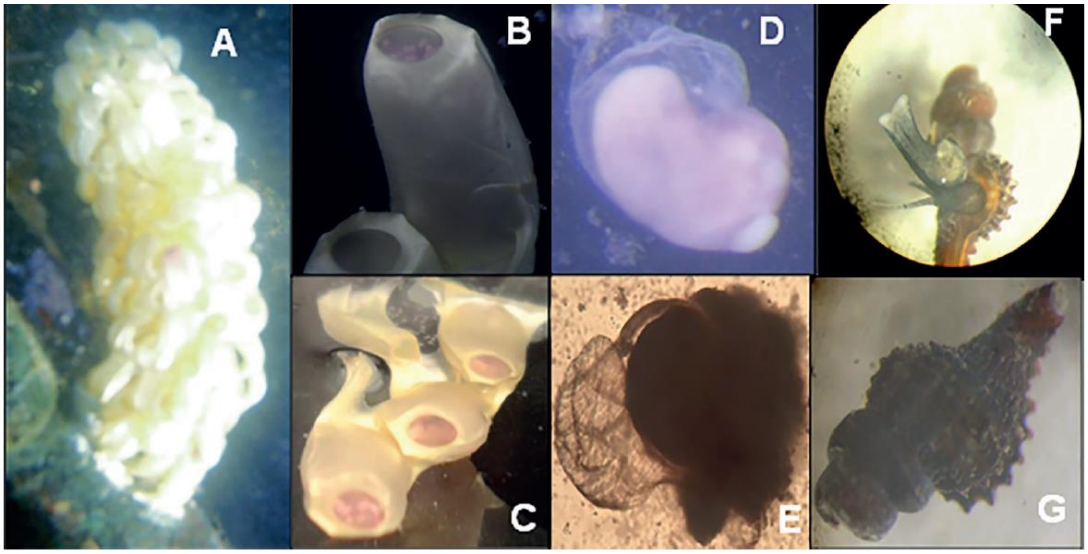

Fig. 3. A.- Masa ovígera de Chicoreus brevifrons. B. y C.- Cápsulas de la masa ovígera. D.- Huevo de Chicoreus brevifrons a los 21 días de desarrollo (observado en lupa a 40X). E.- Huevo de Chicoreus brevifrons a los 21 días de desarrollo (observado en microscopio a 4X). F. y G.- Juveniles luego de la eclosión (15 días)

La temperatura promedio de la laguna donde fueron extraídas las posturas es de 27°C; esta se mantuvo en el acuario donde se desarrollaron los organismos dentro de las cápsulas, dado que Mostafa et al. (2013) sugieren que es importante controlar las condiciones ambientales en estudios de desarrollo embrionario, ya que juegan un papel relevante en el éxito de la eclosión y en la tasa de crecimiento de los gasterópodos a cultivar. La cantidad de días necesarios para la eclosión de los individuos pertenecientes a la especie C. brevifrons fue de 45 días, siendo inferior a la reportada por Cabrera et al. (1990), quienes señalaron la eclosión para el día 52 desde la puesta de la masa ovígera y una talla inicial promedio de 2.22 mm. Sin embargo, Mostafa et al. (2013) publicaron un total de 40 días para que suceda la eclosión de los organismos en estadio juvenil para la especie C. ramosus, lo que estaría indicando que este género presenta una posible variación en la tasa y periodo de la eclosión.

La temperatura tiene influencia sobre el desarrollo larvario de los gasterópodos, interviniendo sobre la eclosión de los organismos (Góngora et al. 2007), por lo que el haber mantenido una temperatura constante de 27ºC favoreció el desarrollo intracapsular y la supervivencia de los animales. A su vez, Cabrera et al. (1990) señalan que temperaturas inferiores al medio donde se desarrolla C. brevifrons retrasa el crecimiento del organismo dentro de la cápsula, haciéndolo más lento y prolongando el periodo de encapsulación, es por ello que probablemente se presentan diferencias entre los días de la eclosión del estudio antes nombrado (donde la temperatura fue de 22ºC) y la presente investigación. Sin embargo, hay que señalar que no se conoce el tiempo de duración del desarrollo intracapsular de la especie en su ambiente natural.

El impacto de la temperatura de cultivo en el desarrollo larvario de los gasterópodos ha sido registrado en otras especies de Murícidos como: C. concholepas, Xanthochorus cassidiformis, Plicopurpura pansa y Murex pomum (Naegel & Gómez del Prado, 2004); en todos los casos se concluye que una temperatura alta del agua acorta el periodo de desarrollo larvario, mientras que temperaturas bajas retrasan el tiempo de eclosión. Otros factores, que influyen en la tasa de la eclosión y la velocidad de crecimiento son la disponibilidad de alimento, así como la presencia de huevos nutricios: en este estudio, la eclosión de los organismos se efectuó a un máximo de 45 días con individuos de tallas mínimas de 1.60 mm.

La velocidad de crecimiento de los organismos una vez fuera de las cápsulas se refleja principalmente en la longitud más que en el peso, debido al gasto de energía en la alimentación y en los periodos de crecimiento de la concha. Según Góngora et al. 2011, las diferencias en los tiempos de la eclosión pueden explicarse fundamentalmente por la temperatura de incubación y la alimentación, al igual que el tamaño y origen de los reproductores.

CONCLUSIONES

La proporción sexual general fue de 1:1, el número de hembras representaron el 58.79% y los machos el 41.21% del total de los individuos (381). Las posturas estaban conformadas por un máximo de 165 cápsulas de color blanco recién puestas. A los 21 días de desarrollo se puede notar la presencia de los huevos nutricios que sirven de alimento para los organismos desarrollados. La eclosión se efectúa pasados los 45 días desde la puesta, eclosionando de 3 a 5 individuos por cápsula.