

ADVANCES IN A PILOT STUDY FOR THE DEVELOPMENT OF A FISH IMAGE DATABASE FROM PELAGIC LONGLINE FISHERY IN THE WESTERN CENTRAL ATLANTIC

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SUMMARY

A pilot study was initiated by the Venezuelan and U.S. Pelagic Observer Programs to develop the rationale and methods to create a fish image database from digitized images of oceanic species and selected internal organs obtained by scientific observers on board commercial pelagic longline vessels. Results during the first year of sampling on board Venezuelan pelagic longline vessels consisted in 1,640 digital images taken by observers from billfish, sharks, tunas and other oceanic species, and its internal organ. In addition, 600 images were taken from similar species off La Guaira by a port sampler. The equipment and functionality of the process of taking images under normal vessel operations offered satisfying results.

RÉSUMÉ

Une étude-pilote a été lancée par les Programmes d'observateurs de pélagiques mis en place par le Venezuela et les Etats-Unis en vue de développer une analyse raisonnée et des méthodes visant à créer une base de données d'images de poissons à partir d'images numériques d'espèces océaniques et d'organes internes sélectionnés obtenus par des observateurs scientifiques postés à bord de palangriers pélagiques commerciaux. Au cours de la première année d'échantillonnage à bord de palangriers pélagiques vénézuéliens, les observateurs ont pris 1.640 photographies numériques d'istiophoridés, de requins, de thonidés et d'autres espèces océaniques, ainsi que de leurs organes internes. En outre, 600 images d'espèces similaires ont été prises au large de La Guaira par un échantillonneur au port. L'équipement et la fonctionnalité du processus de prise d'images lors des opérations normales des navires ont donné des résultats satisfaisants.

RESUMEN

Los programas de observadores pelágicos de Estados Unidos y Venezuela han iniciado un estudio piloto para desarrollar la lógica y métodos para crear una base de datos de imágenes de peces a partir de imágenes digitalizadas de especies oceánicas y órganos internos seleccionados obtenidos por los observadores científicos embarcados en palangreros comerciales pelágicos. Los resultados del primer año de muestreo a bordo de un palangrero pelágico venezolano fueron 1.640 imágenes digitalizadas obtenidas por observadores de marlines, tiburones, túnidos y otras especies oceánicas y de sus órganos internos. Además se obtuvieron 600 imágenes de especies similares en las aguas de La Guaira, mediante un recopilador de muestras en puerto. El equipo y la funcionalidad del proceso de obtener imágenes en el transcurso de las operaciones normales de los buques arrojaron resultados satisfactorios.

KEYWORDS

Digital fish images, tuna by-catch, pelagic longline, Venezuela

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1. Introduction

Oceanic fish species are difficult to study and understanding their relationships within the marine ecosystem requires time and effort that in most cases are very limited. Unless, species have commercial importance (*i.e.*, tunas and swordfish), little effort is devoted to collect biological data in a systematic way that would provide sound scientific information to improve knowledge about their life history characteristics and its essential fish habitat. The main reason is the logistics involved to collect biological data from oceanic species, as most of them are considered highly migratory; they are not readily available in sufficient numbers as would be the case with coastal species. Nowadays, digital imaging can contribute to enhance scientific research in oceanic species. Scientific observers in oceanic commercial fishing vessels equipped with digital cameras and laptop computers, can digitally record species caught, sex organs and gut contents for several selected species. The digitally recorded information can be used to create an image database that can be cross-referenced with the observer's database and serve to reduce time to develop sampling schemes to collect key biological samples (gonads for reproductive studies, and hard parts for age and growth studies), as well as obtain visual information of the species in the catch and its prey that can aid in defining essential fish habitat for selected species.

A pilot study was initiated by the Venezuelan and U.S. Pelagic Observer Programs to develop the rationale and methods to create a fish image database from digitized images of oceanic species and selected internal organs obtained by scientific observers on board commercial pelagic longline vessels. The initiative was planned in two phases. In Phase I, a selected group of observers from the ICCAT sponsored Venezuelan Pelagic Longline Observer Program equipped with digital cameras and laptop computers will acquire and store images of oceanic species and selected internal organs. Phase II is contingent on Phase I results; it will require a selected group from the U.S. Observer Program to develop a similar database.

The advances presented in this document are the results of the first year of sampling on board Venezuelan pelagic longline vessels, which consisted in testing the equipment, the functionality of the process of taking images under normal vessel operations, and focusing on acquiring digital images of billfish species, and sharks.

2. Material and methods

Two observers were trained in the use of the equipment and several species were selected for acquiring digital images of reproductive organs and stomach contents. In addition, a port sampler was trained and assigned to digitally capture all species caught by the artisanal gillnet fishery that targets oceanic species off La Guaira. The observers were assigned to vessels that fish >2500 hooks/set which targets yellowfin and albacore tunas, to ensure a broad range of oceanic species that can be digitized with limited observer coverage.

Two digital cameras with macro function and a camera without a macro function were used. Image resolution was set at 640x480, 1024x768, and 1600x1200 pixels. All species caught were digitized with a 20cm scale. Particular interest was given to all billfish species, and shark species. All digital images included species information (species ID, sex, sexual maturity, prey ID) and set information (trip number, set number, date of set).

3. Results and discussion

Observers have taken a total of 1,640 digital images from late April 2003 to May 2004. Images included complete specimens, reproductive organs, stomach content, individual prey items, shark embryos, and vessel fishing operations. The geographic distribution of the fish images included the Venezuelan Basin in the Caribbean Sea and the northeastern section off the Greater Antilles in the Atlantic Ocean (**Figure 1**).

Classification of images have resulted in sets of billfish species, which included whole specimens of *Makaira nigricans*, *Tetrapturus albidus*, *T. pflugeri*, and *Istiophorus platypterus*, with reproductive organs, stomach contents and prey items (**Figure 2**). Image sets from individual billfish species have proven to be useful for identification and corroboration of macroscopic stages of maturity, as well as identification and corroboration of prey items. In the case of billfish, observers have been classifying gonad stages of maturity using a four stage sexual maturity scale based on external and internal macroscopic appearance of the ovaries (Arocha and Marcano 2004). During this pilot study, gonad samples have been analyzed at the laboratory for ovarian development. The results from the microscopic analysis and the image sets from billfish species have helped validate the field observations made by observers using the macroscopic sexual maturity scale. In addition, visible prey items have been identified from these image sets when possible using reference literature (Cervigón

1994, 1996; Uyeno *et al.* 1983; Froese and Pauly 2004). However, no analyses have been conducted on prey items that have been brought back for confirmation of species ID.

Other image sets included several species of sharks and its embryos, several species of tuna and its stomach contents, and other oceanic epipelagic and mesopelagic species. In sharks, the main purpose of images was to identify species, which were confirmed with jaw and teeth samples from caught specimens, and if females were gravid, embryos were recorded (**Figure 3**). Observers have had difficulty in identifying some of the least common shark species that occur in the tuna target fishery, but with the images and jaw samples brought to the laboratory, shark specialists have been able to identify most of the species recorded.

The importance of recording images of tuna species was to create visual records of gonad development and prey preferences, in particular for *Thunnus obesus* since is one of the tuna species that seems to have preferences for mesopelagic prey species which can be useful when comparing prey preferences with other bycatch species. Recorded prey species from *T. obesus* included boarfishes (*Antigonia sp.*), diamond dories (*Xenolepidichthys sp.*), hatchetfishes (*Sternoptyx sp.*). In the case of oceanic species, the main interest was to know what species are common in the catches that are never recorded and have no commercial interest, but are part of the open ocean environment which can aid in identifying key characteristics of essential fish habitat in overexploited oceanic species. The common non-commercial oceanic species recorded are pomfrets (*Brama sp.*), opah (*Lampris guttatus*), snake mackerels (*Gempylus serpens*, *Nesiarchus sp.*), sunfish (*Mola mola*, *Ranzania laevis*) (**Figure 4**). In some cases, prey items were recorded from species like in *Taraectes rubescens*, where prey species included fanged toothfish, snake-like fish and shrimps (**Figure 4F**).

At present, the images taken by the port sampler total to about 600 images. The majority consists of billfish species and its reproductive organs (**Figure 5**). In very few occasions was the observer able to acquire images from stomach contents, because it's part of the fish handler's pay and will not allow it to be touched. Other images include, shark species, dolphinfish, wahoo, rays, small tunas. Other activities included recording fishing operations and geo-location of fishing grounds (**Figure 5C**), which was unavailable until now.

In general, the equipment and the functionality of the process have proven that it is possible to acquire digital images from oceanic species during normal fishing operations in the western central Atlantic on a regular basis. The equipment during the first year of operation has performed well. However, there are several considerations that need to be considered for optimal functionality. The macro function is critical for acquiring images of small prey species, the most convenient resolution was 1024x768 pixels, the use of zoom is ill-advised because of the movement, and 128 MB memory is sufficient for short trips (<20 sets) without the need of a laptop computer. The use of a field laptop computer is highly recommended over one that is not. The corroding environment affects the functionality of the camera very quick. In cameras with a plastic cover, the corrosion is minimal, but in cameras without protection it affects them very quickly. A solution to reduce the corrosion process was to use plastic new wrap on every image session, and perform cleaning maintenance after every trip.

The next step is to define which software is the most suited to store and retrieve the image and its information which can later be used to define sampling schemes for biological samples and essential fish habitat information.

4. References

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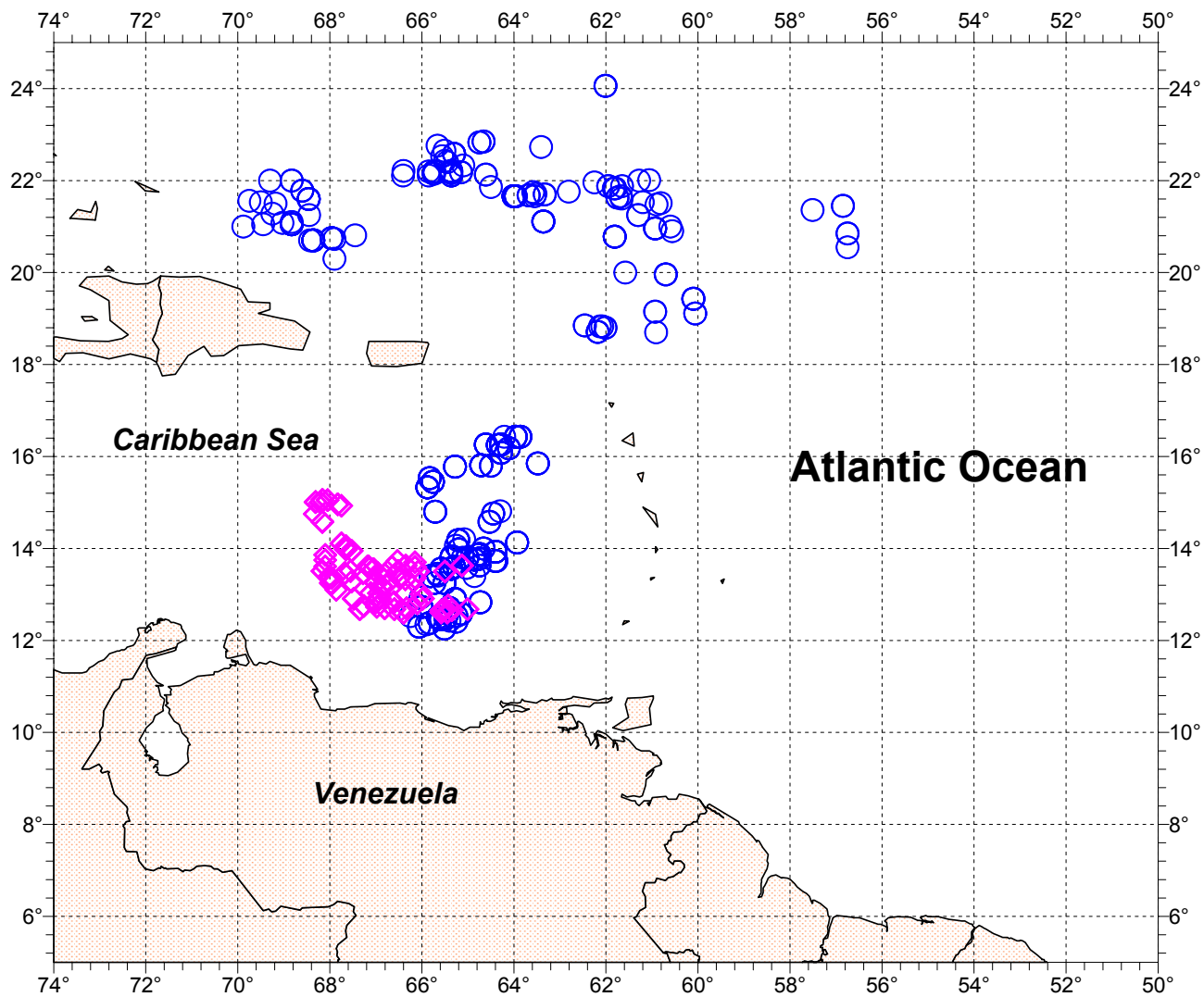


Figure 1. Locations of longline sets from where images were acquired during fishing operations in 2003 (open circles) and 2004 (open rhombs).

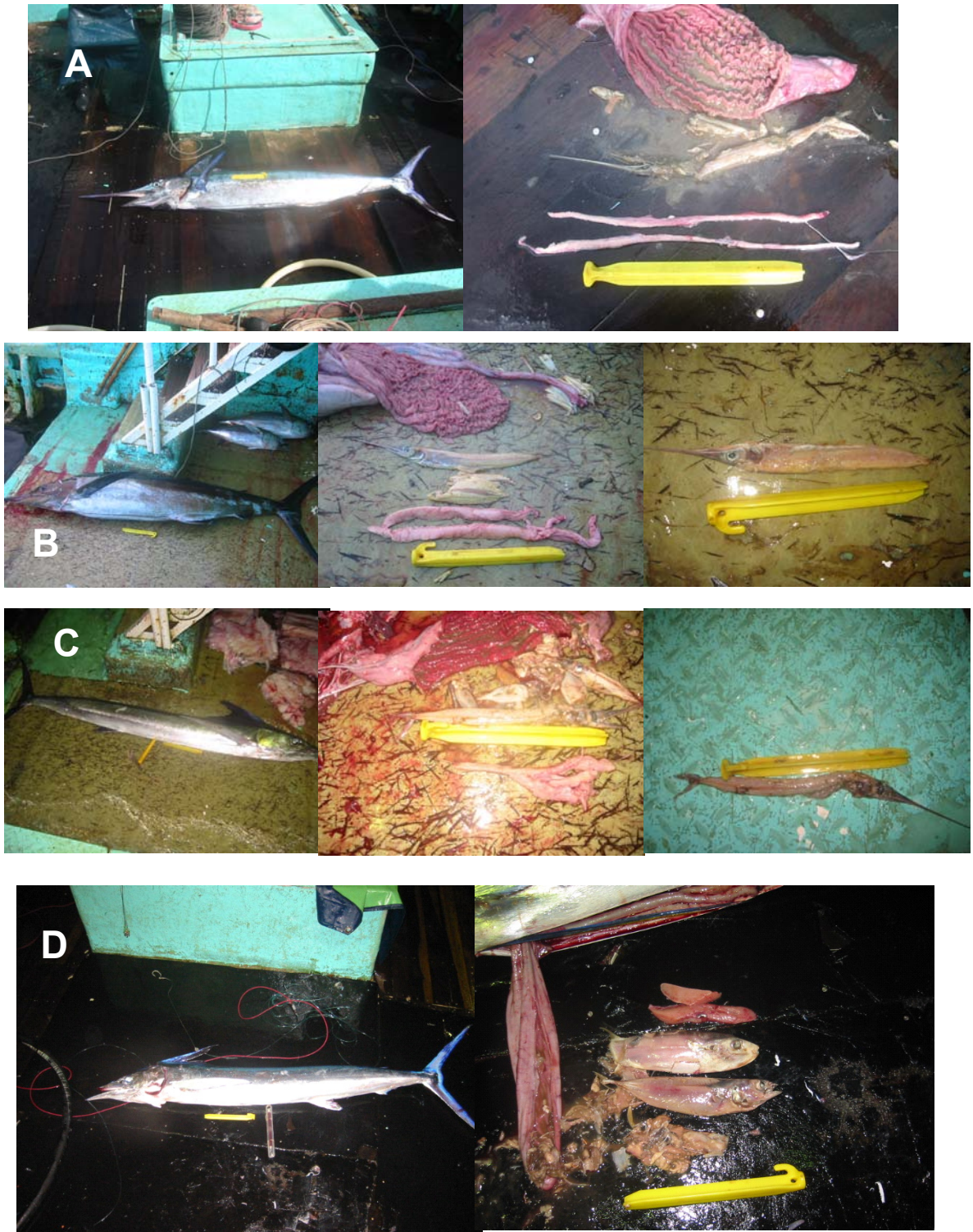


Figure 2. Image sets of billfish species. A) Blue marlin, young male with preyed billfish in gut. B) Blue marlin, resting male with preyed billfish in gut. C) Spearfish, young female with preyed billfish in gut. D) Spearfish, non-mature female with *Ranzania laevis* as prey and other fish species. Scale is 20 cm.

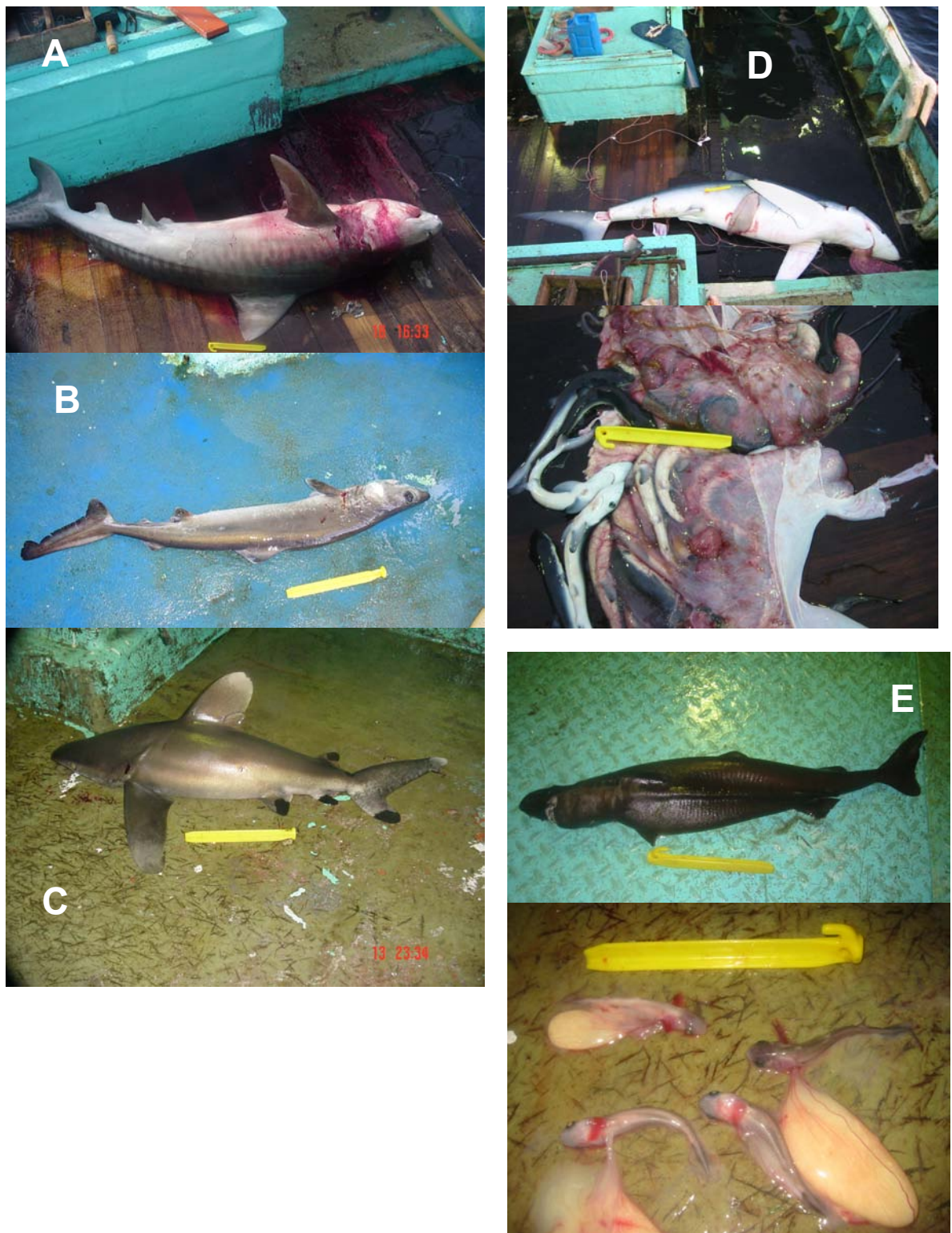


Figure 3. Shark species. A) Tiger shark (*Galeocerdo cuvier*). B) Crocodile shark (*Pseudocarcharias kamoharai*). C) Juvenile oceanic whitetip shark (*Carcharhinus longimanus*). D) Blue shark (*Prionace glauca*) with litter. E) Roughskin dogfish (*Centroscymnus owstoni*) with embryos. Scale is 20 cm.

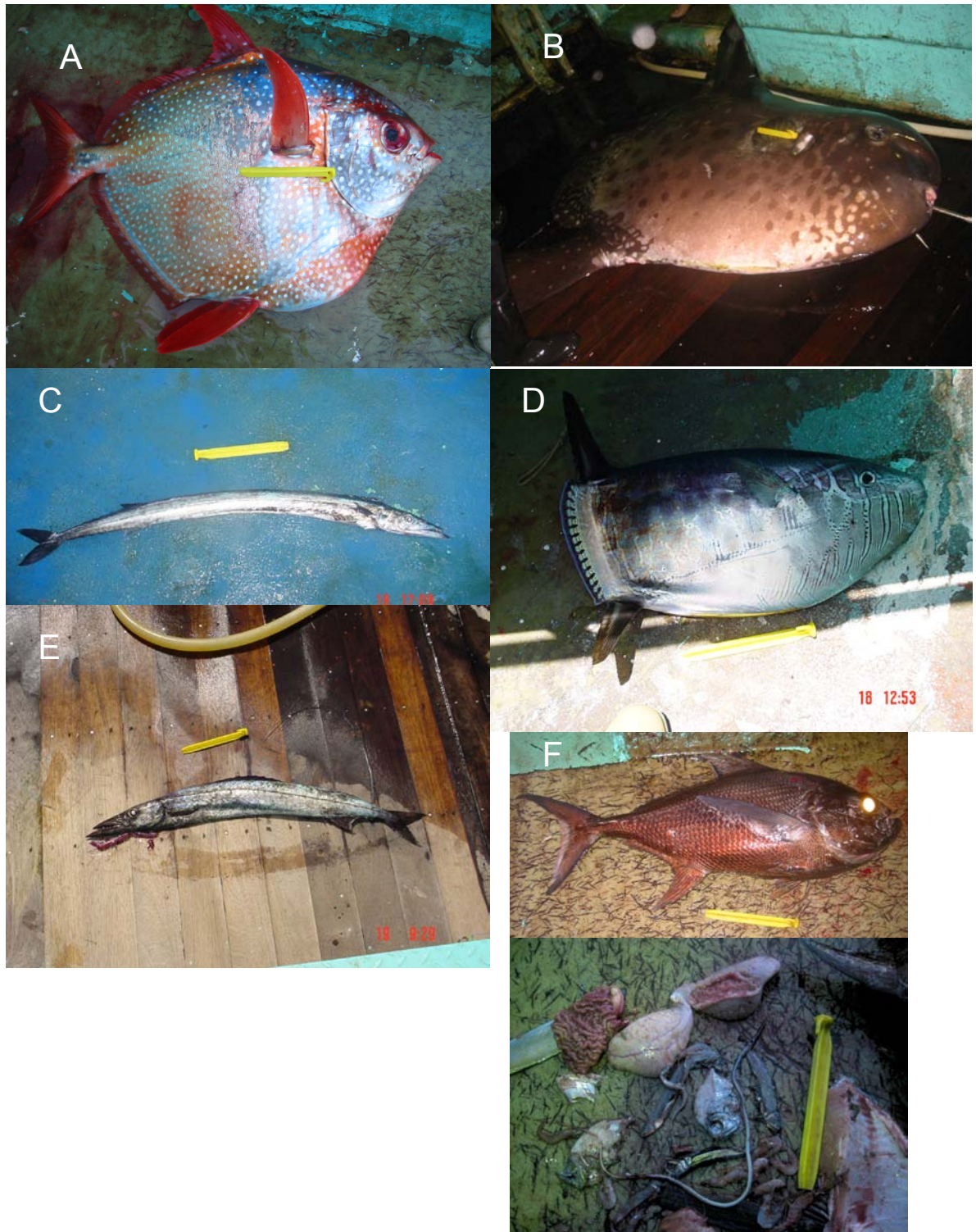


Figure 4. Non-commercial oceanic bycatch species. A) Opah (*Lampris gutatus*), B) Sunfish (*Mola mola*), C) Snake mackerel (*Gempylus serpens*) D) (*Ranzania laevis*), E) Snake mackerel (*Nesiarchus sp.*), F) Mature female Dagger Pomfret (*Taractes rubescens*) with mesopelagic prey in gut. Scale is 20 cm.

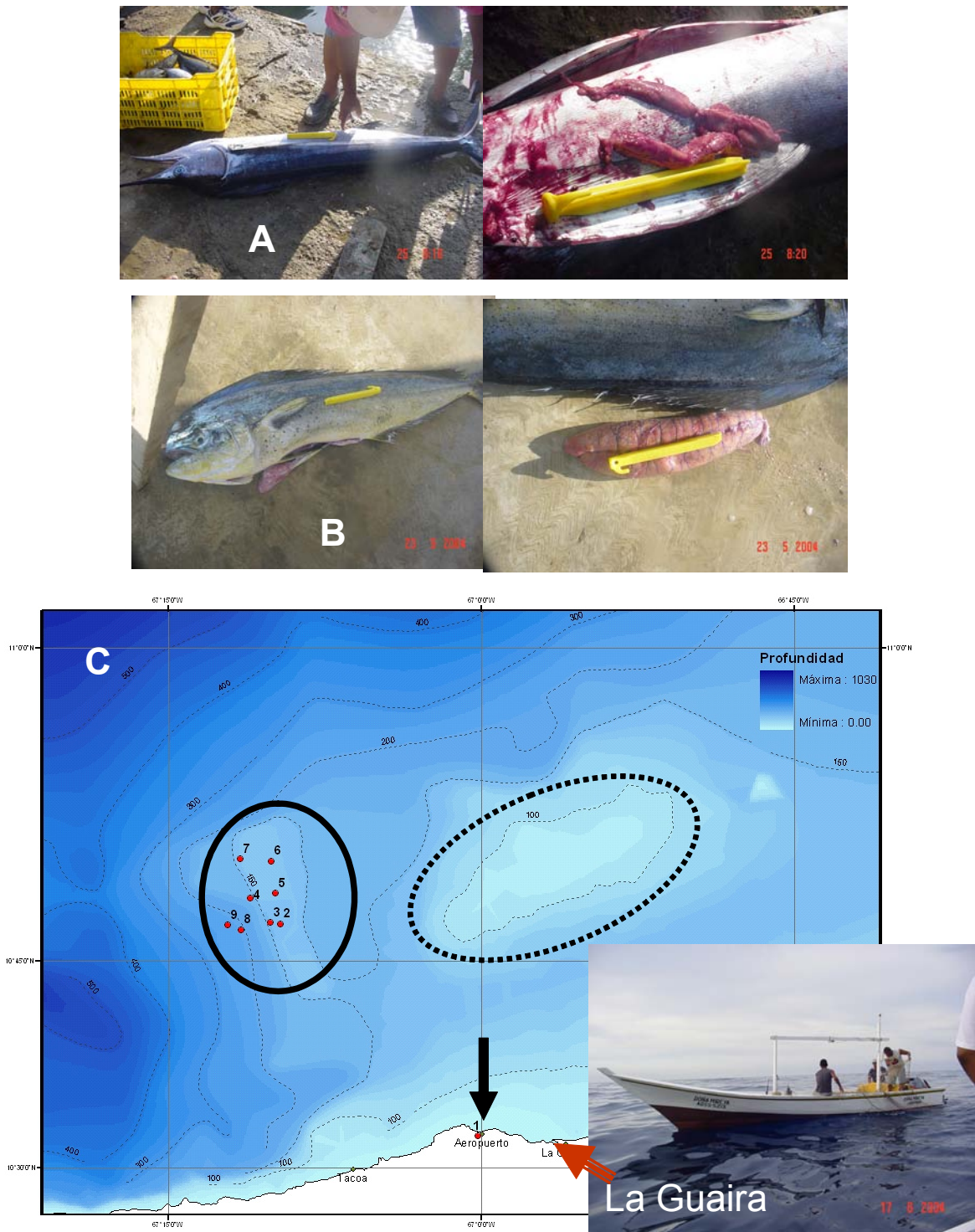


Figure 5. Artisanal fishery off La Guaira. A) Mature male sailfish. B) Mature female dolphinfish. C) Location of artisanal fishing grounds (circles) and fishing operation (picture inset). Black arrow indicates port location (Playa Verde).