INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

FIFTH MEETING

La Jolla, California (USA)
12-16 May 2014

DOCUMENT SAC-05-11b

PRELIMINARY RESULTS FROM IATTC COLLABORATIVE RESEARCH ACTIVITIES ON DORADO IN THE EASTERN PACIFIC OCEAN AND FUTURE RESEARCH PLAN

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1. BACKGROUND

Dorado (*Coryphaena hippurus*) Linnaeus, 1758, has a cosmopolitan distribution in the world's oceans (*e.g.*, Palko *et al*. 1982). Its preferred habitat is the epipelagic waters of the tropical and subtropical regions, but the species is also found to a lesser extent in temperate waters. It is known as dorado in most Latin American countries, but is also called *doradilla*, *lampuga*, *palometa*, and *perico*; in English it is also known as the dolphinfish or mahi-mahi.

For most coastal nations of the eastern Pacific Ocean (EPO), from Guatemala in the north to Peru in the south, dorado is one of the main resources exploited by artisanal fisheries (Lasso and Zapata, 1999; Martinez-Ortiz and Zuniga-Flores, 2012; Patterson and Martinez, 1991). In other oceans of the world, the species is also exploited by coastal nations (Chang and Maunder, 2012; Osamu, 2013; Oxenford and Hunte, 1999; Sakamoto and Kojima, 1999).

The Antigua Convention establishes that one of the Commission's functions is to "adopt appropriate measures to avoid, reduce and minimize … impacts on associated or dependent species."[5] Dorado is caught incidentally in the purse-seine tuna fishery in the EPO[6] (Martinez-Rincon *et al*., 2009), and it is therefore appropriate that the IATTC staff study the species, with a view to determining the impact of the fishery and recommending appropriate conservation measures if required. Requests have been made by some EPO coastal Member States for collaborative research with IATTC staff on dorado and assistance with the design of data collection forms and data-entry programs for dorado fisheries.

This report provides an update of ongoing collaboration on dorado fisheries research by IATTC staff and scientists of coastal Member States. The work done so far includes: analysis of available catch statistics and trade records, improvement of field data collection programs, investigation of seasonal trends, and

[1] Inter-American Tropical Tuna Commission (IATTC)
[2] Subsecretaria de Recursos Pesqueros (SRP), Ecuador
[3] Instituto Costarricense de Pesca y Acuicultura (INCOPESCA), Costa Rica
[4] World Wild Fund (WWF), Ecuador
[5] Article VII.1.g; also f. The Commission shall "adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention, with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened.";
[6] Two species of *Coryphaena* spp. (*C. hippurus* and *C. equiselis*) are caught in the purse-seine tuna fishery, but observer data indicate that the latter accounts for only 1.5% of the catches of this genus.

identification of fishery units. In addition, available fishery data on dorado from IATTC Members and other nations are being analyzed to develop stock status indicators (SSIs) which could potentially provide a basis for advice for managing the species in the EPO. All data for 2013 shown in this report are preliminary.

Finally, a proposed IATTC Stock Assessment Group research plan for low-information and bycatch species, including dorado, is outlined.

2. FISHERY STATISTICS

2.1. Catch and trade statistics

The first step in this collaborative research consisted of building a preliminary time series of dorado catches for the EPO. Catch statistics were compiled from the following sources: 1) FAO FishStat database, 2) US import trade records (United States International Trade Commission, USITC), and 3) statistics reported by EPO coastal nations. From these sources, five time series of dorado catches were constructed: Ecuador, Peru, EPO total, EPO others (EPO total - (Ecuador + Peru)), and world others. These time series cover the period of 2001-2012; US import data extend through 2013. For each country/region, the maximum catch estimates from all data sources were used. The above sources do not include dorado caught incidentally in the tuna purse-seine fishery.

The time series for Peru is based on the Peruvian Ministry of Production's Anuario Estadístico 2010 (2001-2010) and FishStat (2011-2012). For Ecuador, statistics were obtained from FishStat (2001-2007, 2012) and the Ecuadorian Subsecretaría de Recursos Pesqueros (SRP) (2008-2011). The EPO total and world totals were taken from FishStat. There are no catch estimates available in FishStat for some EPO coastal nations known to catch dorado; for this reason, the EPO total and EPO other estimates are conservative.

The data available on world catches of dorado show a 27% increase since 2001, from an average of 82 thousand metric tons (t) during 2001-2004 to 104 thousand t during 2009-2012 (Figure 1a). They also show that the total EPO catch (Peru + Ecuador + EPO other) forms the largest fraction of the total world catch, ranging from 47% to 70% from 2001 to 2012 (Figure 1b).

A closer look at the catch statistics available for the EPO shows a 53% increase from a fairly stable average catch of about 46,000 t during 2001-2007 to 71,000 t during 2008-2012 (Figure 2a). These figures include dorado caught incidentally in the tuna purse-seine fishery in the EPO, available from data collected by observers aboard large[7] purse-seine vessels. During this period, Peru dominated the dorado catch in the EPO, with between 57 and 81% of the total (average 73%), followed by the other EPO coastal nations (2-28%, average 13%), Ecuador (5-20%, average 12%), and tuna purse-seine bycatches (1-5%, average 3%). Given the uncertainties about the catches by some EPO coastal nations, the proportions for this "other EPO" category should be considered as a minimum estimate. The relative proportions for some nations will decrease if catches by other nations increase.

USITC import records show an increasing demand for dorado in the United States during 2001-2013 (Figure 3a). Total imports (fillet and fresh markets pooled) increased 67%, from an average of about 12,000 t during 2001-2005 to about 21,000 t during 2009-2013. During 2001-2007, dorado from the EPO accounted for about 50% of total imports into the United States, but in the most recent five years, this has risen to an average of 77%, peaking at 83% in 2013 (Figure 3b).

Although Peru has the greatest catches of dorado in the EPO (Figure 2), it is second to Ecuador in terms of imports (fillet and fresh) into the United States. During 2009-2013, Ecuador, Peru, and the other EPO nations (mainly Central America) accounted for 41%, 35%, and 24%, respectively, of the dorado from the EPO imported into the United States (Figure 3). Information from other sources indicates that the majority of the Peruvian catch is consumed domestically, whereas most of the catch by Ecuador and the other EPO nations is exported to the United States.

[7] Carrying capacity >363 metric tons; IATTC size class 6

The value of imports of dorado to the US market increased gradually over the historic period of this study, peaking at about US$ 232 million in 2012, of which EPO products accounted for roughly US$181 million (Figure 4). Between 2012 and 2013 imports of dorado from the EPO declined by 30%, from 181 to 123 thousand tons (Figure 4), following a drop in the price of dorado fillets (Figure 5).

2.2. Development of sampling programs

Due to the economic importance of artisanal fisheries for the Central American region, obtaining fisheries data is vital in order to have reliable fisheries statistics to support of regulation and responsible management, especially for pelagic species, such as dorado, sharks, tunas, and billfishes, whose stocks extend beyond individual national Exclusive Economic Zones (EEZs).

To this end, the OSPESCA Working Group on Sharks and Highly Migratory Species has developed two data collection forms (Appendix), one for collecting information on “Fisheries biology sampling”, and the second for “Inspections of landings”. These forms have been standardized among the different fisheries and aquaculture authorities of the OSPESCA member countries and the IATTC staff.

At the same time, a database has been developed for processing the information obtained on the data forms, with the support and technical advice of the IATTC staff.

This information was presented at the XVII Meeting of the OSPESCA Steering Committee, held in Panama on 22-23 August 2013. At that meeting it was agreed that these forms should be implemented as of 1 November 2013 in each OSPESCA member country, in order to facilitate the regional analysis.

2.3. Seasonal trends (Ecuador and Costa Rica)

Collaborative analyses of landings data from the SRP in Ecuador and the Instituto Costarricense de Pesca y Acuicultura (INCOPESCA) in Costa Rica to investigate seasonal trends in the artisanal fisheries for dorado in the EPO found a high degree of seasonality in both fisheries (Figure 6). In 2008-2012, the proportion of the catch (in weight) that was dorado was highest during October-February.

2.4. Identification of fishery units

To identify fishery units, multivariate regression tree analyses of catch species composition are being conducted with existing catch data. An example of such an analysis is illustrated with catch data for Ecuadorian longline vessels from 2008-2012. Fifteen species[8], each representing at least 0.20% of the catch in weight, were included in the analysis, which was applied separately to several trip-level summaries of catch composition: proportion of the catch in weight, catch in weight per hook, and catch in number of fish per hook. For each of these catch summaries, a dissimilarity matrix for species composition was obtained based on the Bray-Curtis index, a commonly-used index in community analysis. The dissimilarity matrix was used as the response for a multivariate regression tree analysis with five predictor variables: 1° latitude, 1° longitude, sea-surface temperature (SST), hook type, and vessel size class.

The dominant structure identified with the tree analyses can be used to provide guidelines as to how to post-stratify the catch data into fishery units. In this example, for all catch composition summaries, the first partition of the data was on hook type (Figure 7). After hook type, catch composition was found to vary most strongly with longitude and latitude. Within areas identified by partitions on longitude and latitude, catch composition also varied with sea-surface temperature. Therefore, at a minimum, longline fishery units should be based on hook type (hook size 1 – dorado; hook size 2 – tuna-billfish-sharks).

3. FISHERY INDICATORS

Conventional stock assessment analyses of dorado are handicapped by incomplete fishery-dependent data

[8] Yellowfin tuna (YFT), bigeye tuna (BET), skipjack tuna (SKJ), dorado (DOL), striped marlin (MLS), escolar (LEC), swordfish (SWO), blue marlin (BUM), sailfish (SFA), blue shark (BSH), silky shark (FAL), bigeye thresher shark (BTH), pelagic thresher shark (PTH), shortfin mako shark (SMA), and smooth hammerhead shark (SPZ).

(reliable catches, indices of abundance, and composition data). In addition, the high productivity of the species (*i.e.* high fecundity, and fast growth rates over a short lifespan) complicates conventional stock assessment analysis. Recruitment seems to be highly variable and strongly influenced by environmental conditions and it is challenging to separate the exploitation and environment effects with conventional stock assessment models. Alternative stock status (or stability) indicators (SSIs) are needed (Hinton *et al*. 2014). The IATTC staff has used SSIs for providing management advice on skipjack tuna since 2008 due to the inability to estimate their absolute abundance (Maunder and Deriso, 2008). SSIs have also been proposed for silky shark (Aires-da-Silva *et al*. 2014). However, the SSIs used by the IATTC have not been validated and no formal reference points or harvest control rules based on these SSIs have been developed. Two types of potential indicators are being investigated: indices based on catch rate data and indices from composition data (counts by size-classes or length-frequency data). Examples are provided below.

3.1. Indices based on catch-rate data

3.1.1. Observer data

Data on catches in floating-object sets collected by observers (Figure 8) can be used to develop indices of relative abundance of species such as dorado. Observers record the amount of catch, in numbers of individuals, and the fork length (FL) of the fish, in three categories, estimated by eye; small: < 30 cm ; medium: 30-60 cm; large: > 60 cm). An index based on nominal catch-per-unit-effort (CPUE) can be computed as number of fish per set. This has been done by sub-area within the EPO for 2005-2013 (Figure 9) for all dorado catch, catch of large dorado (> 60 cm) and catch of young-of-the-year (≤ 60 cm). Trends by sub-area are variable, but show a pattern of stable to increasing trends offshore, and more recent declining trends nearer to the coast. These data can also be used to obtain standardized indices of relative abundance using generalized linear or additive models, and covariates recorded by observers on fishing operations and vessel activity (*cf.* Aires-da-Silva *et al*., 2014). Environmental variables such as sea-surface temperature can also be used as covariates.

3.1.2. Ecuadorian artisanal fisheries

Catch and effort data for Ecuadorian longline fisheries provided by the SRP were used to develop relative indices of abundance. Generalized additive models (GAMs) (negative binomial, zero-inflated negative binomial) were fitted to the data for dorado (in weight) with the following predictor variables: year, latitude, longitude, sea-surface temperature, and number of hooks. Latitude and longitude were represented in the GAMs by smooth spatial surfaces. The fitted coefficients from the GAMs were used to compute indices (standardized CPUE) using the method of partial dependence.

Standardized CPUE trends for the two fishery units identified in Section 2.4 (hook type 1 (dorado) and hook type 2 (tuna-billfish-sharks)) are shown in Figure 10. These trends can be compared to the nominal trend from the purse-seine fishery for all dorado in the southern coastal area (Figure 11). The shape of the trends from the three fisheries shows general agreement.

3.2. Composition data

Length-based indicators (*e.g.*, average length) can be obtained from catch-composition data counts by size-classes and length-frequency data. The two types of available data are illustrated below.

3.2.1. Observer data

Size-class data on dorado caught incidentally in the purse-seine fishery have been collected by observers since 1993. The spatial distribution of sets with capture of dorado shows that this species is widely distributed throughout the EPO (Figure 12), with the majority of the bycatch occurring in floating-object sets (IATTC, 2013, Table 6c).

There is large-scale spatial and seasonal structure in the size composition of the dorado catch from floating-object sets (Figures 13-14). Fish greater than 60 cm dominated the catch west of 130°W and south of 10°S (Figure 13). By quarter, the last quarter of the year has the greatest percentage of catch of individuals > 60 cm (Figure 14). However, it is possible that fish < 30 cm may escape through the purse-seine mesh and hence are underrepresented in the purse-seine catch, relative to the other size classes.

3.2.2. Ecuador artisanal fisheries (length compositions)

Length-composition data for Ecuadorian artisanal fisheries for dorado are available from the SRP. Figure 15 shows an example of these data (pooled over years and gears) for three of the main ports where dorado is caught. These data can be used to compute length-based indicators for dorado, by gear type and season and area, and because sex data are also available, they can also be used to compute length-based indicators by sex.

4. RESEARCH PLAN FOR LOW-INFORMATION STOCKS AND BYCATCH SPECIES

The following outline of tasks summarizes the research plan by the IATTC Stock Assessment Group for low-information stocks and bycatch species, including dorado.

Task	
1.	Develop methods to define stock structure
2.	Conduct "semi-quantitative" analyses: Productivity-susceptibility analysis (PSA), Ecological risk assessment (ERA tools) to prioritize stocks
3.	Extensive literature review on fishery indicators, reference points, decision rules, and management strategy evaluation (MSE)
4.	Select candidate fishery indicators, reference points, and decision rules based on literature review, life history and data available
5.	Apply management strategy evaluation (MSE) to candidates
6.	Routinely produce indicators for management advice

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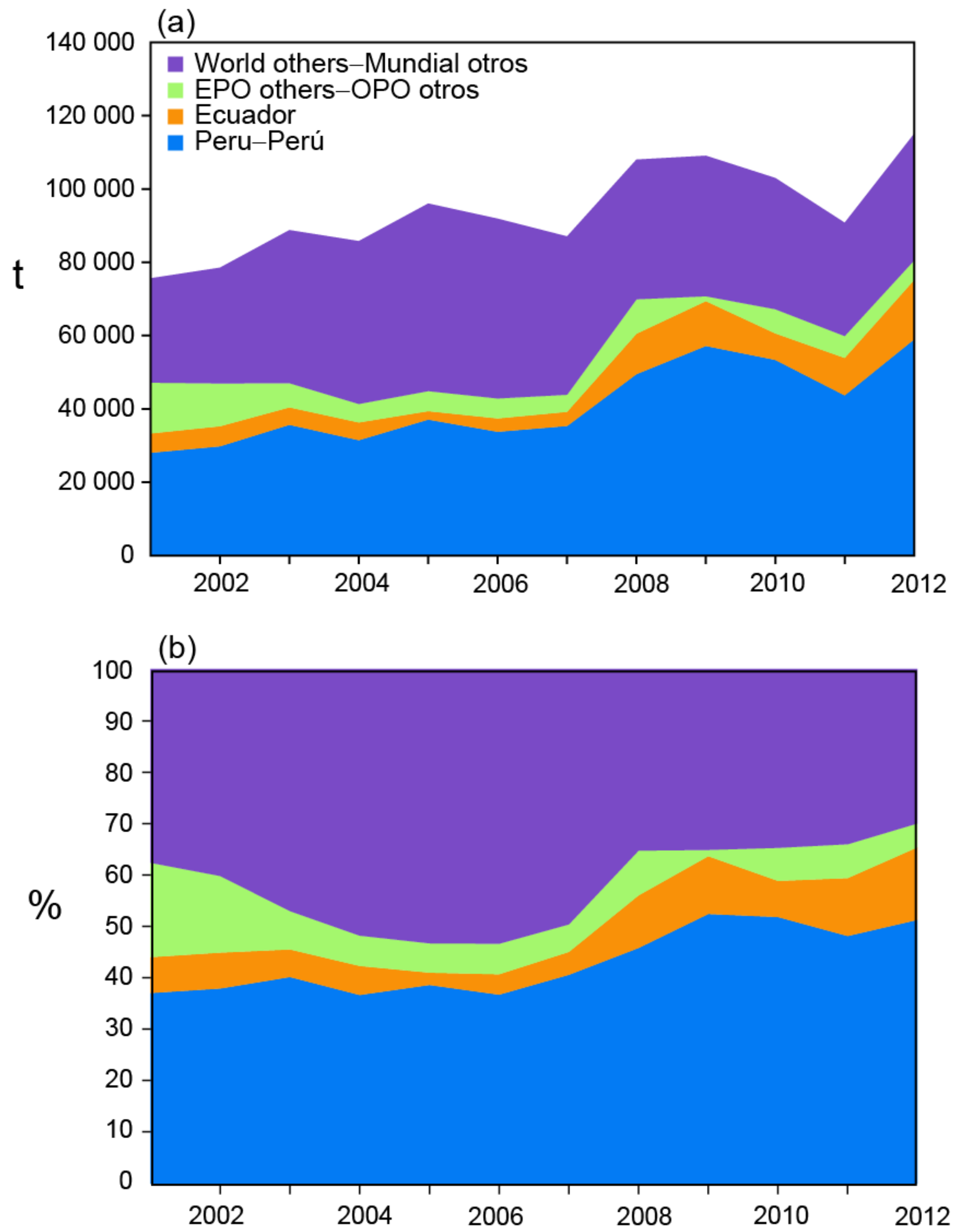

FIGURE 1. World catches of dorado, 2001-2012, by weight (a) and percentage (b). See text for sources of data.

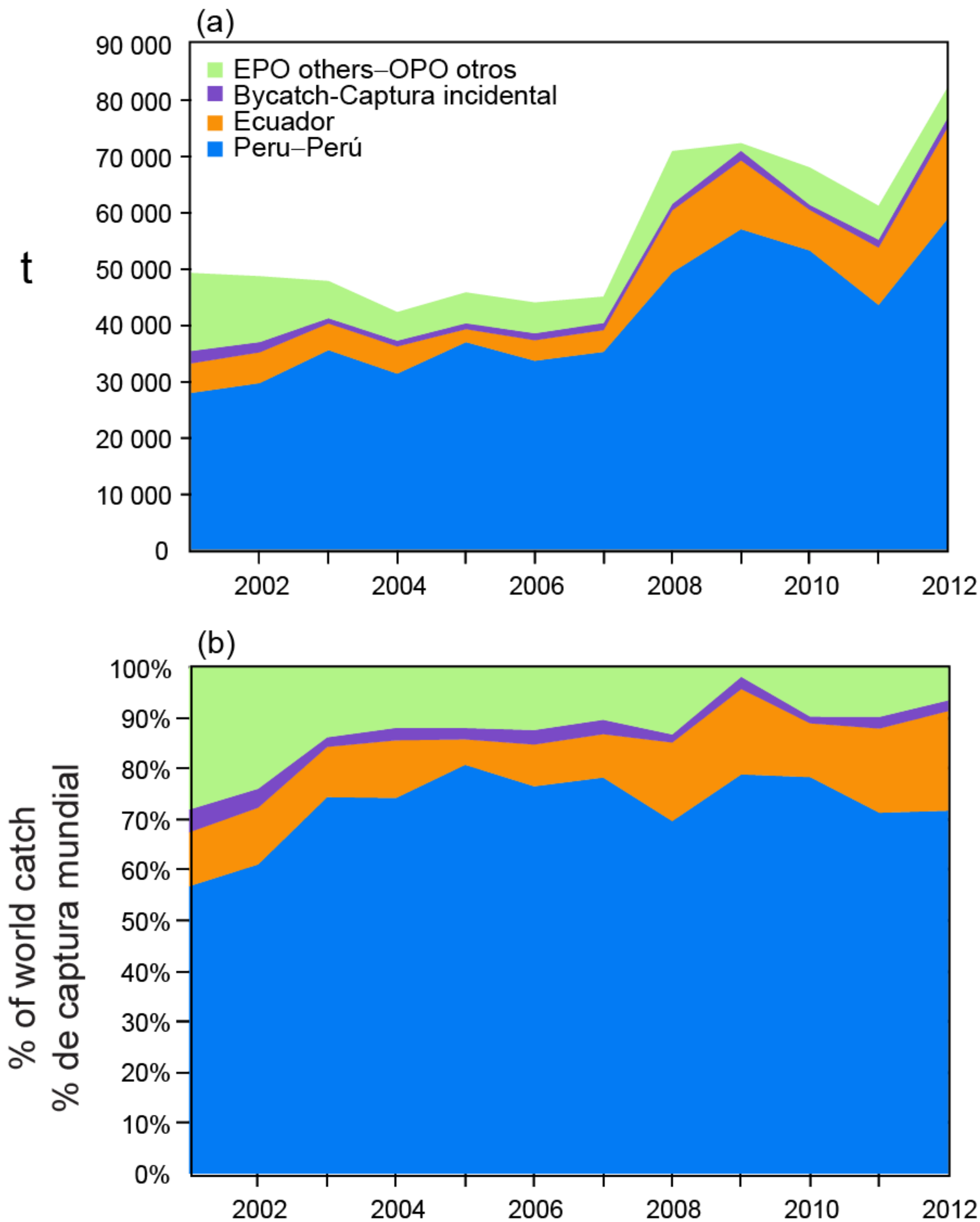

FIGURE 2. Catches of dorado in the eastern Pacific Ocean, 2001-2012, by weight (a) and percentage (b). Bycatch: bycatches by tuna purse-seine vessels of >363 t carrying capacity. See text for sources of data.

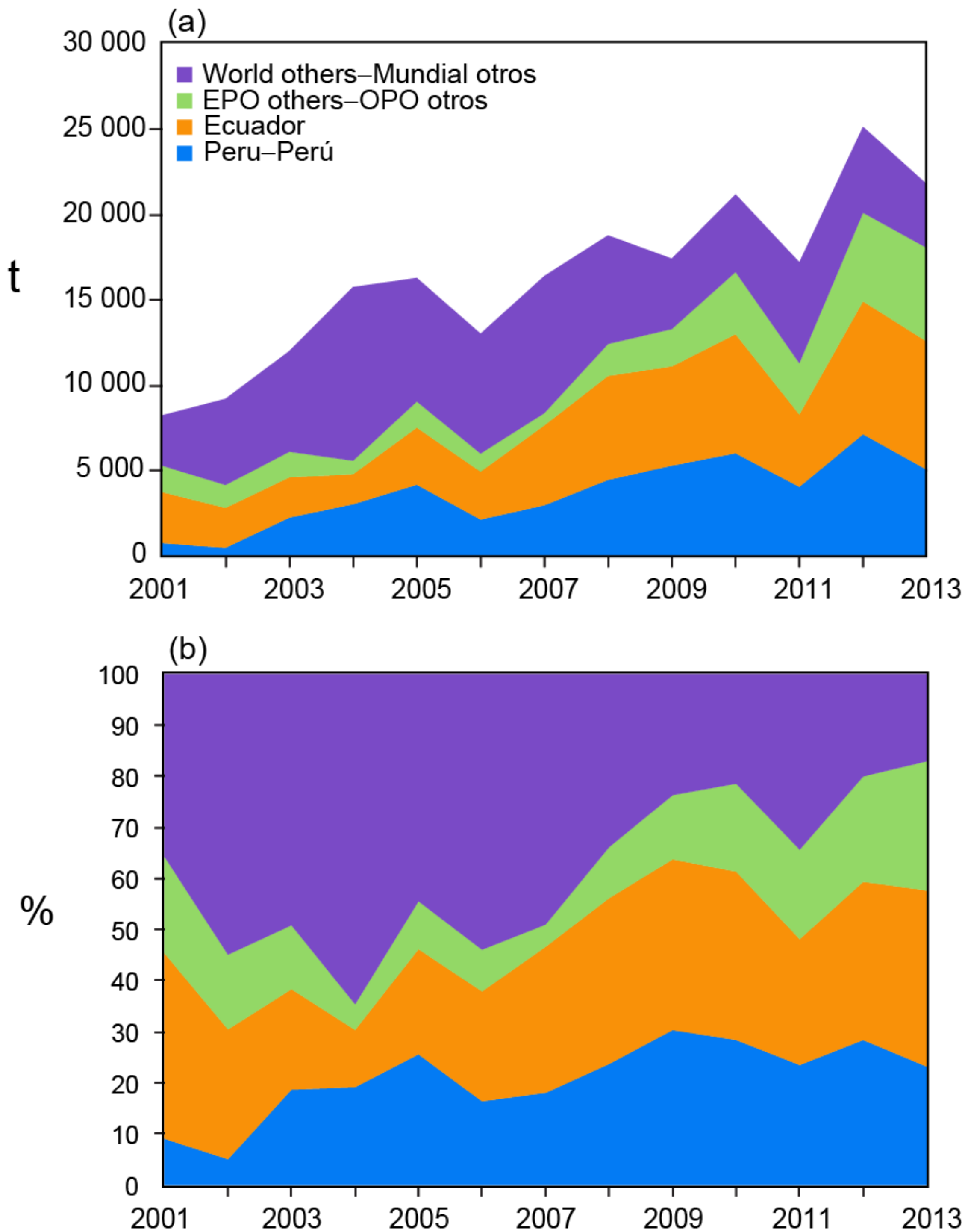

FIGURE 3. Source of imports of dorado to the United States, by (a) weight and (b) percentage, 2001-2013. Source: USITC.

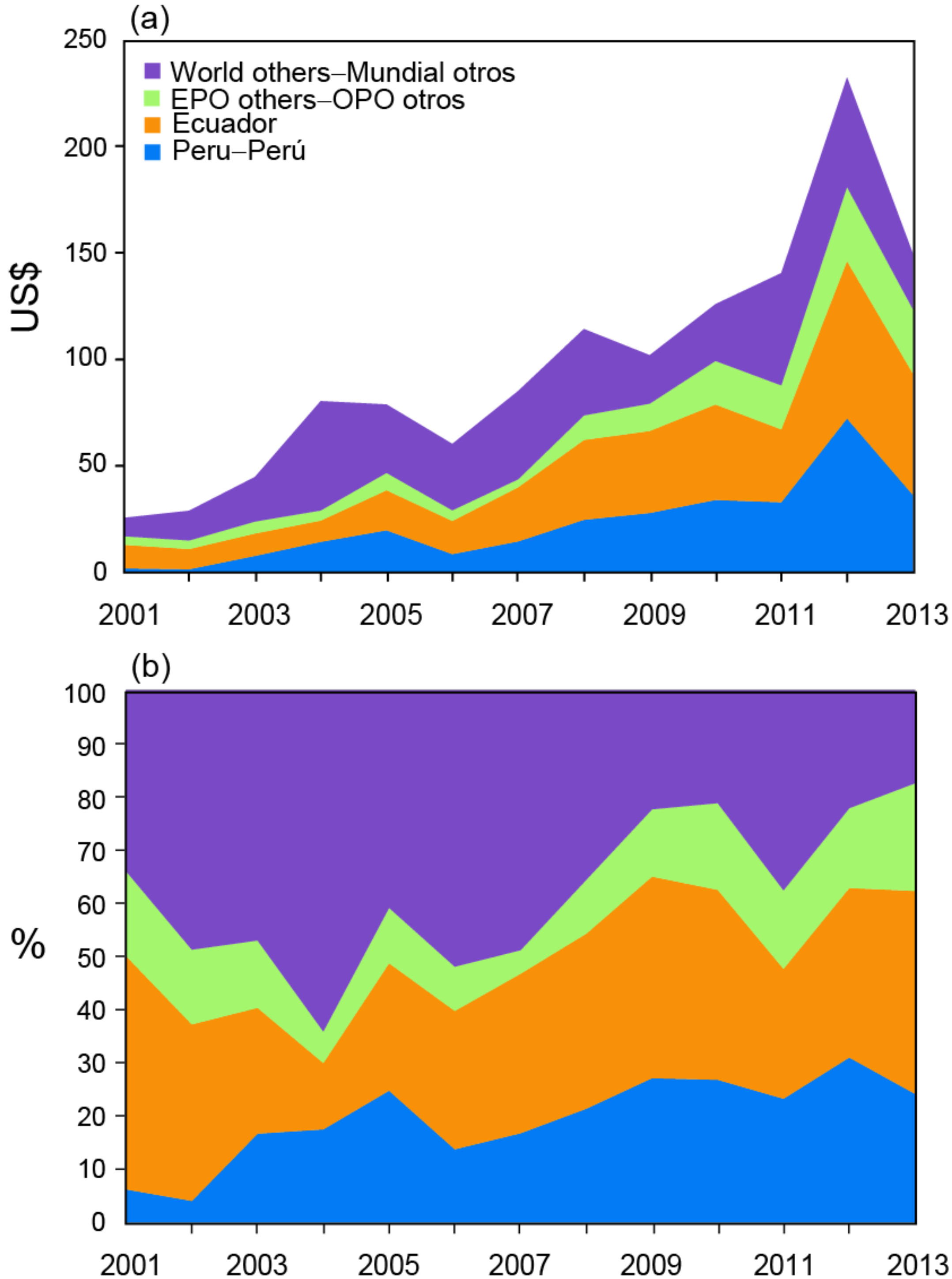

FIGURE 4. Value of imports of dorado to the United States, (a) in US$ and (b) as percentage, 2001-2013. Source: USITC.

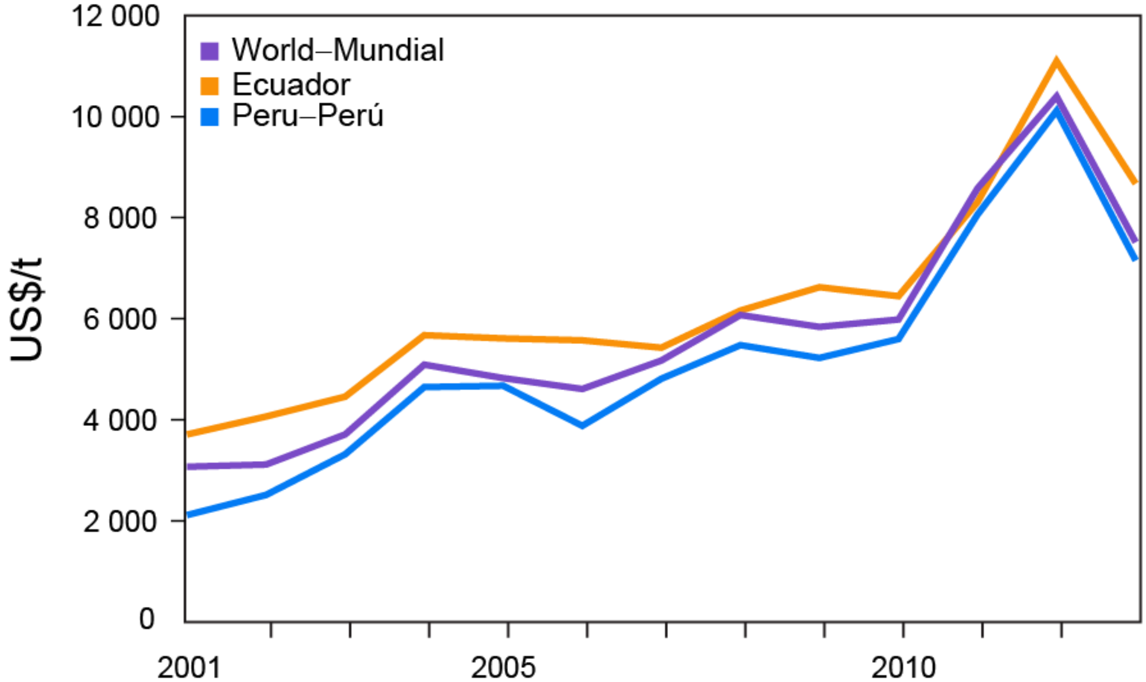

FIGURE 5. Price of dorado fillets imported to the United States, in US$ per metric ton, 2001-2103. Source: USITC.

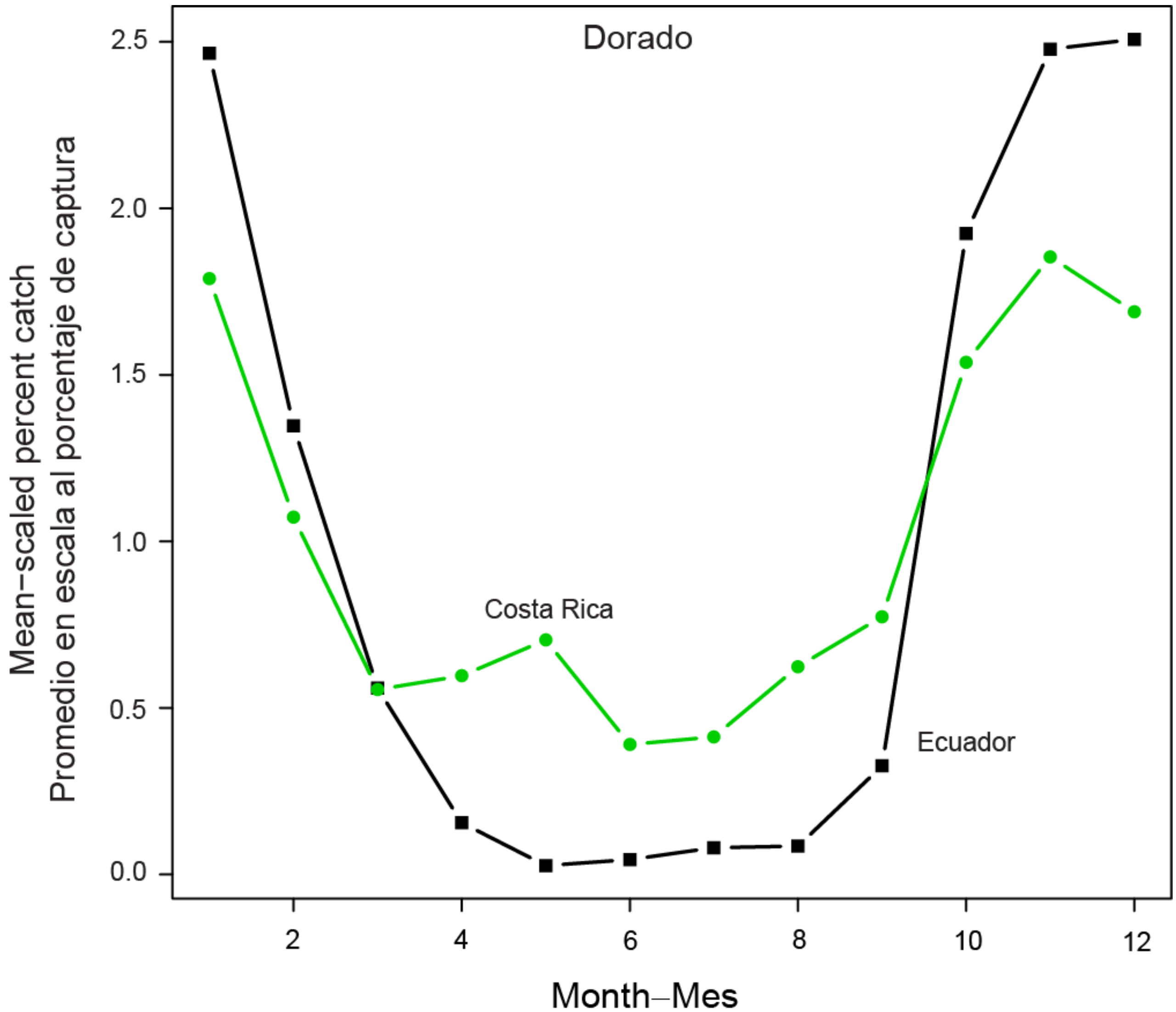

FIGURE 6. Mean-scaled percent catch that was dorado, by month, 2008-2012. Black lines-squares: Ecuador longline *nodriza* fisheries (SRP); green line-circles: Costa Rica fisheries (INCOPESCA).

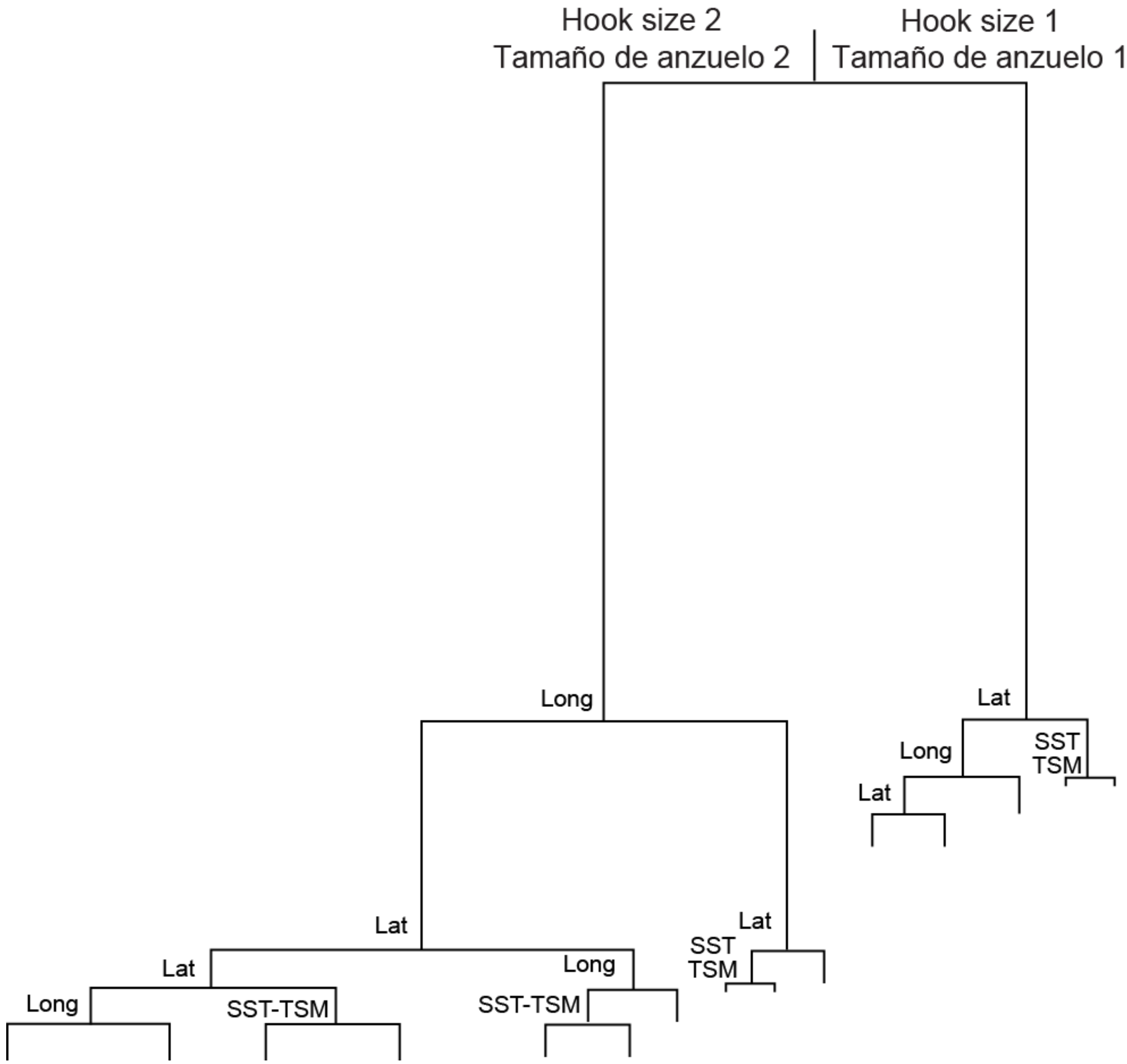

FIGURE 7. Tree produced by the multivariate regression tree analysis of catch species composition data from the Ecuadorian longline fishery, 2008-2012 (data source, SRP-Ecuador).

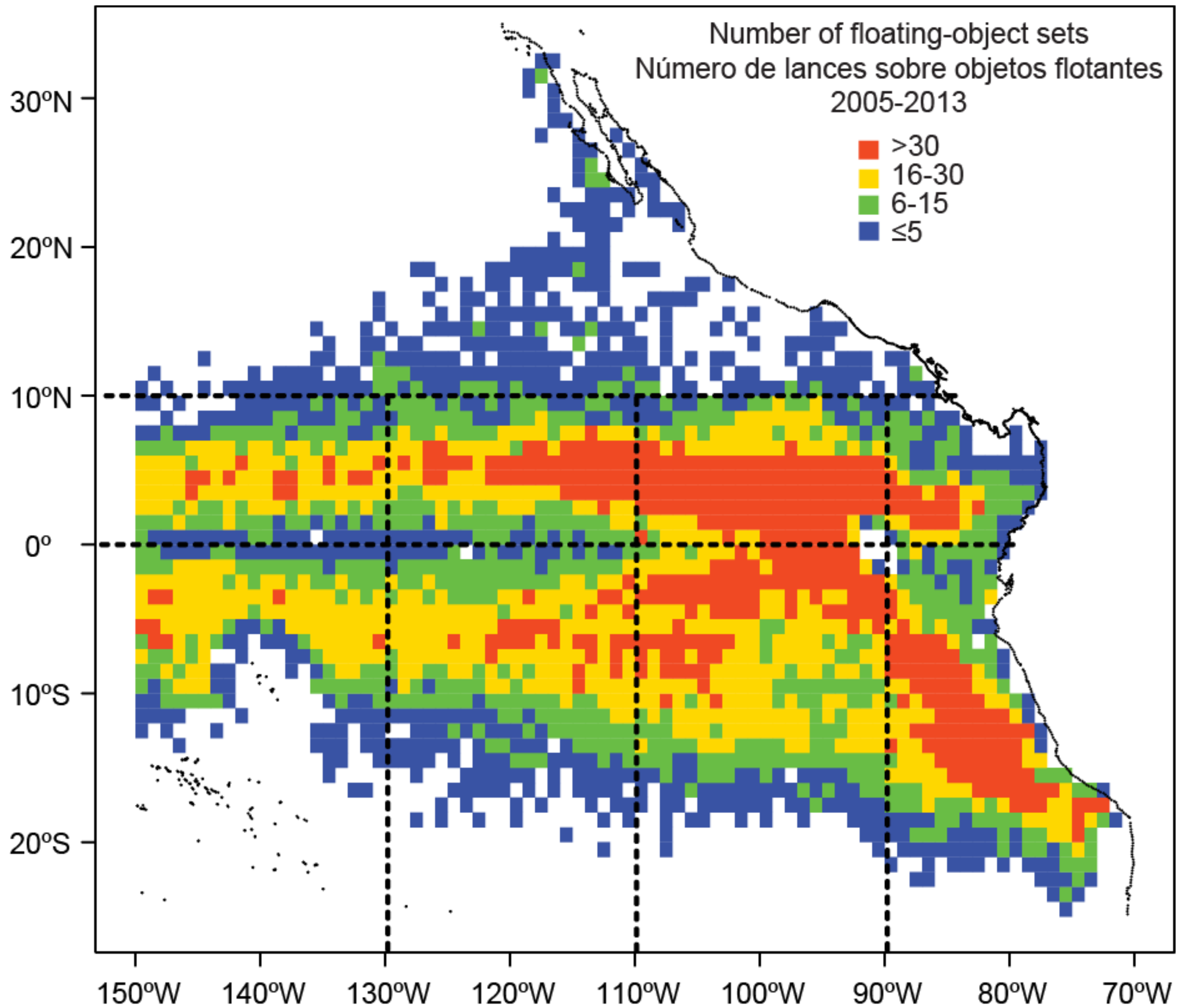

FIGURE 8. Number of sets on floating-objects by large purse-seine vessels, by 1° area, 2005-2013.

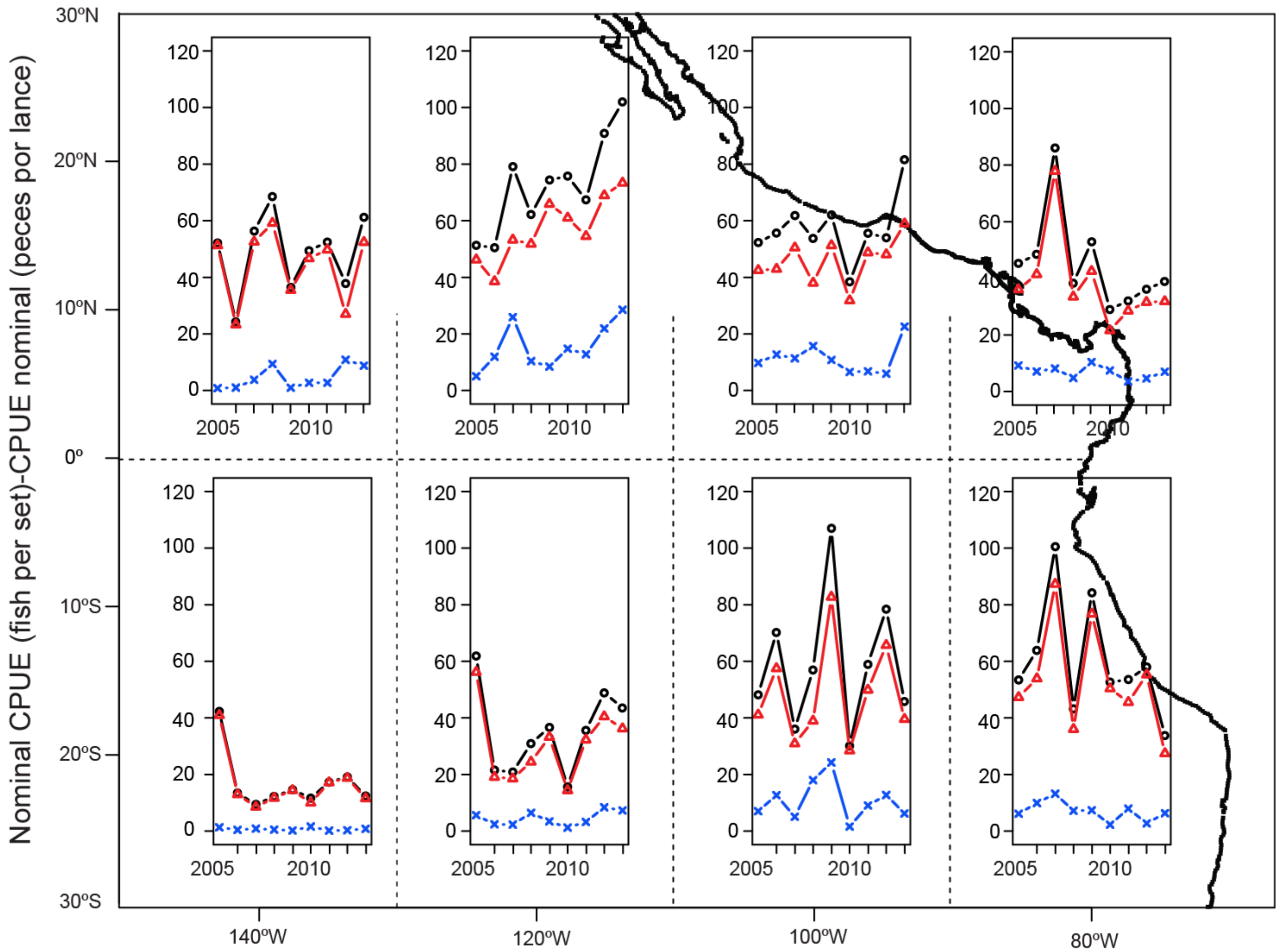

FIGURE 9. Nominal CPUE of dorado (number of fish per set) from sets on floating objects by large purse-seine vessels, 2005-2013, by sub-area. Black: all dorado; red: large dorado (> 60cm); blue: young –of-the-year (≤ 60 cm).

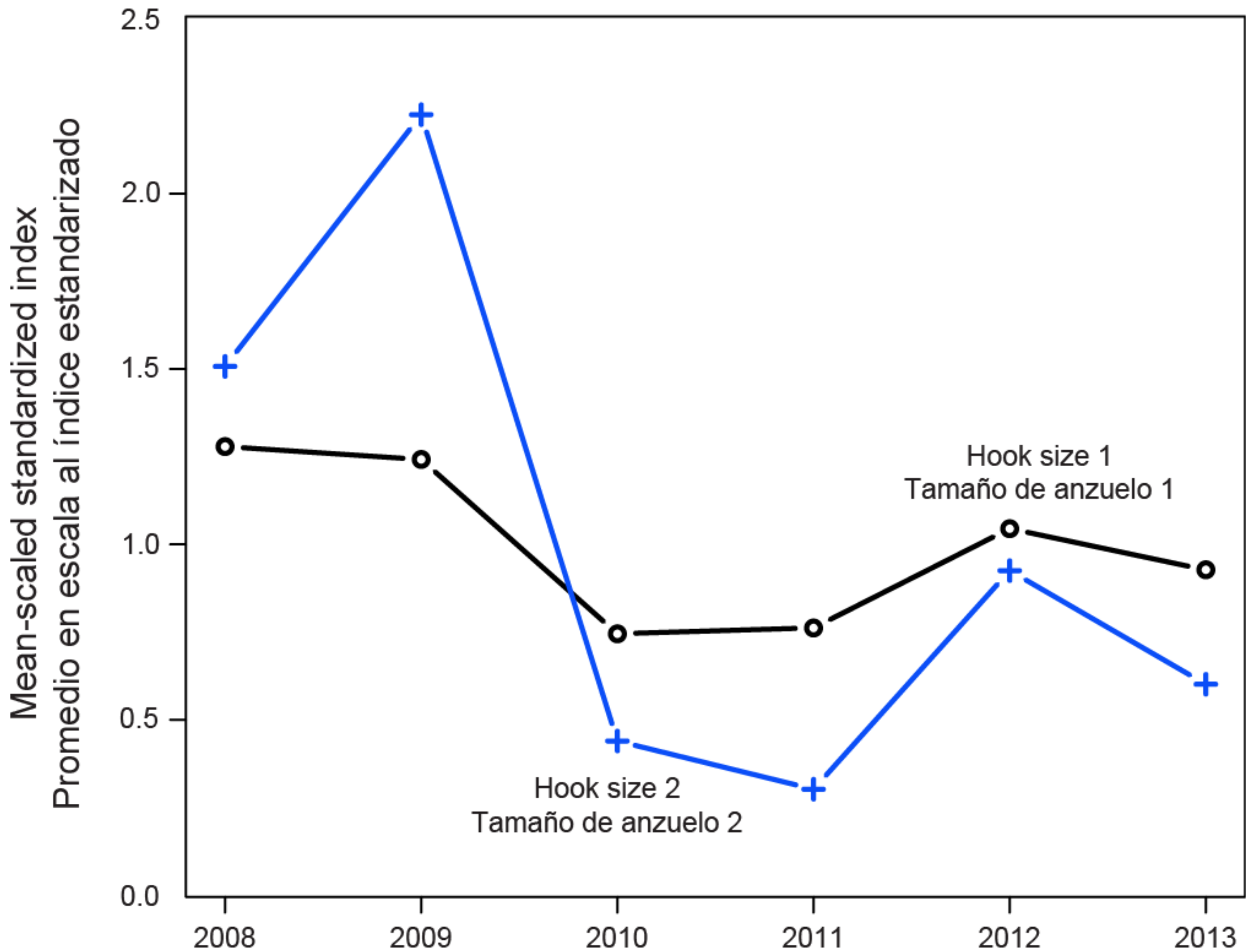

FIGURE 10. Mean-scaled standardized CPUE for the Ecuadorian longline fisheries, by hook type. (Data source: SRP-Ecuador).

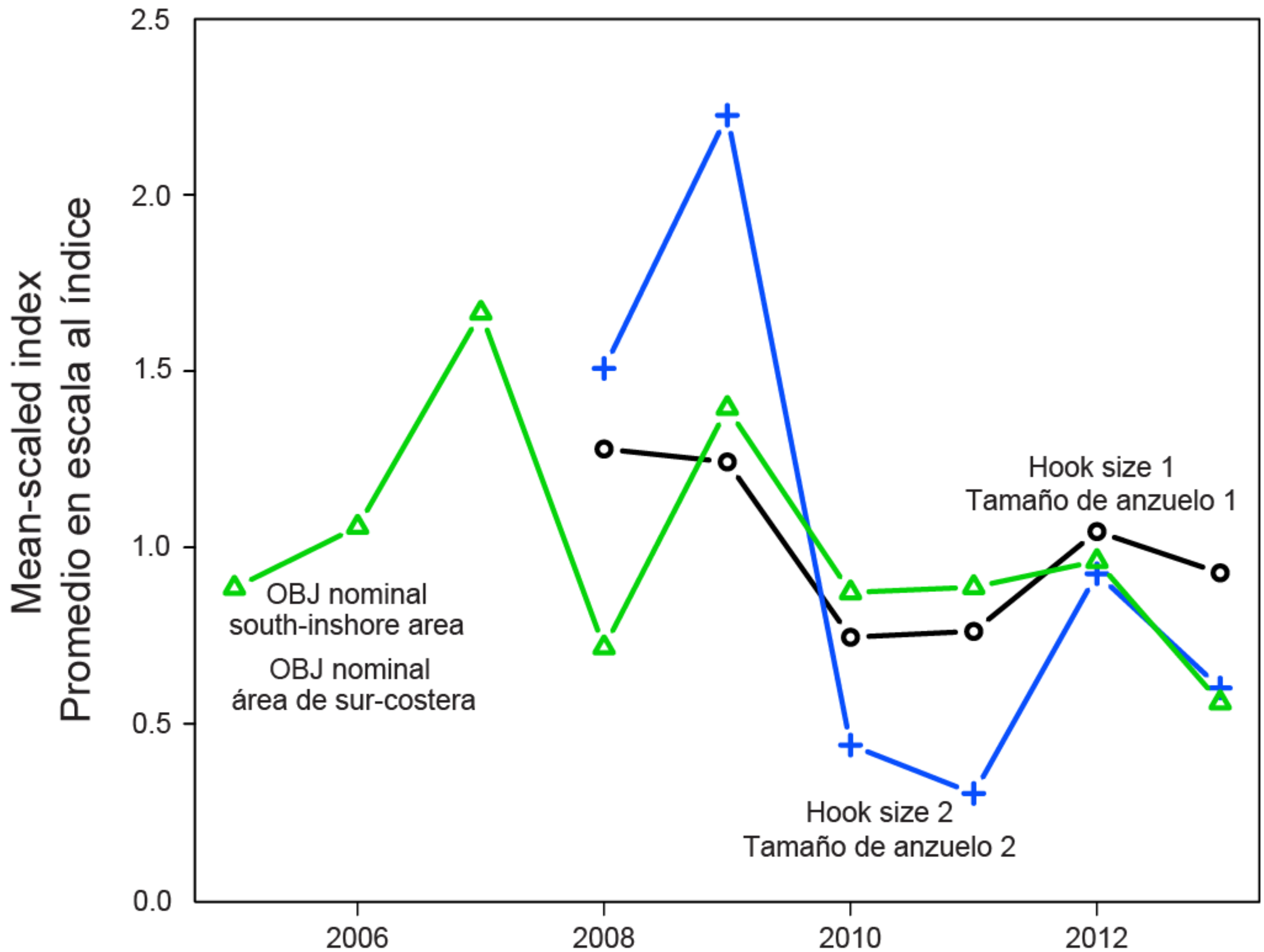

FIGURE 11. Mean-scaled standardized CPUE for the Ecuadorian longline fisheries (Figure 10) and the purse-seine fishery on floating objects in the southern coastal area (Figure 9).

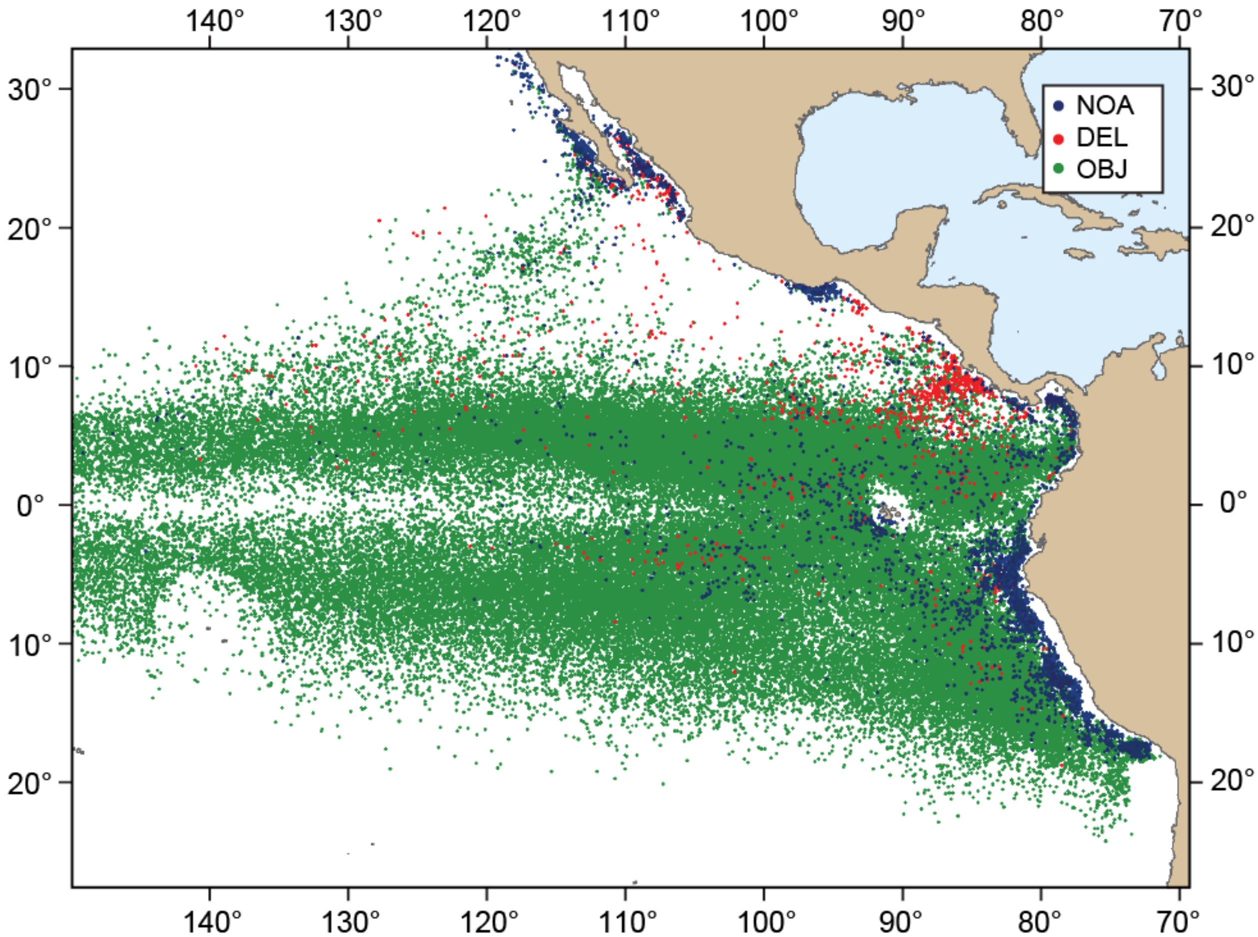

FIGURE 12. Spatial distribution of purse-seine sets with capture of dorado, by set type, 1993- 2013. NOA: sets on unassociated tuna schools; DEL: sets on dolphins, OBJ: sets on floating objects.

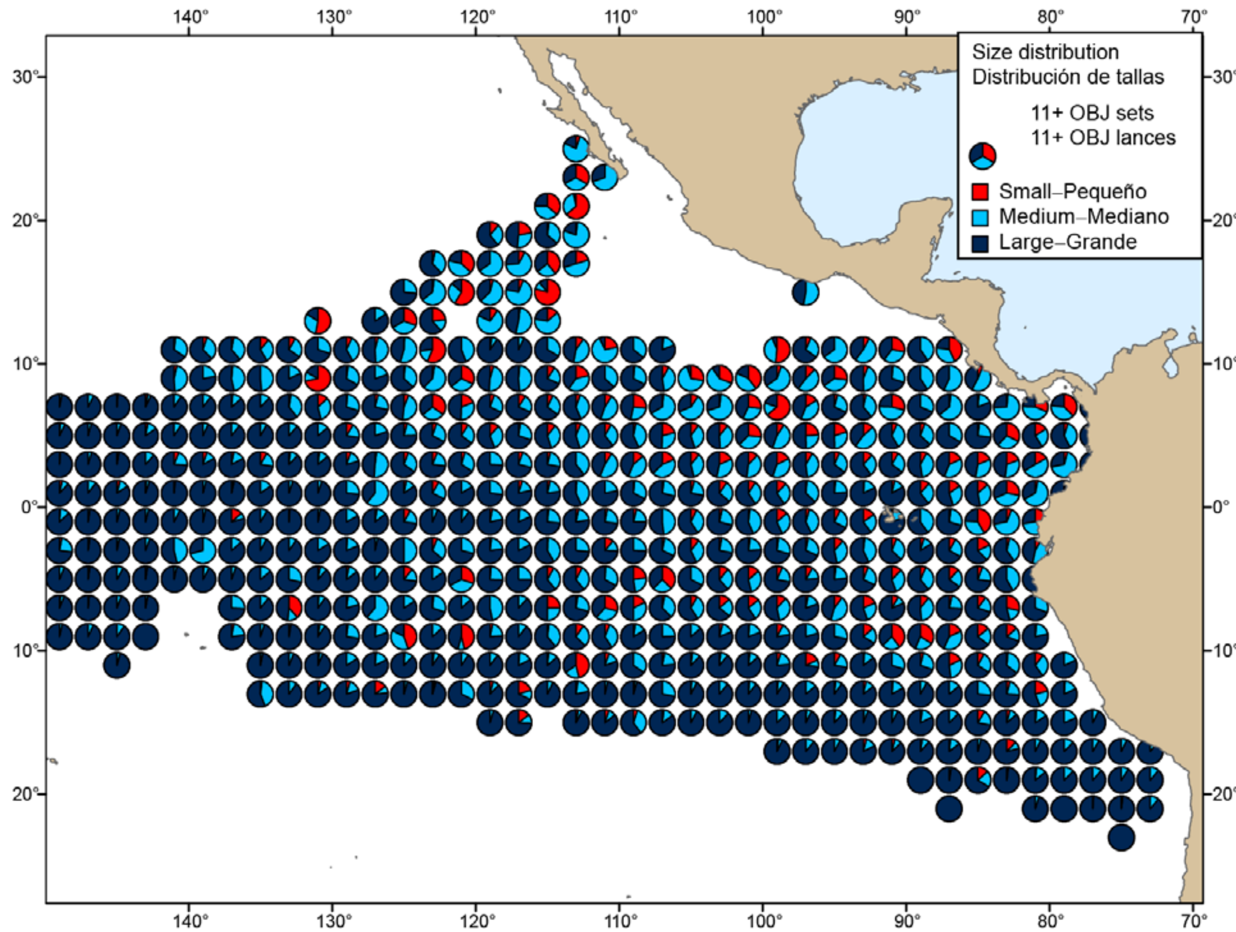

FIGURE 13. Spatial distribution of dorado, by size category (small (< 30 cm FL); medium (30-60 cm FL), and large (> 60 cm FL), in floating-object sets, all quarters combined, 1993-2013.

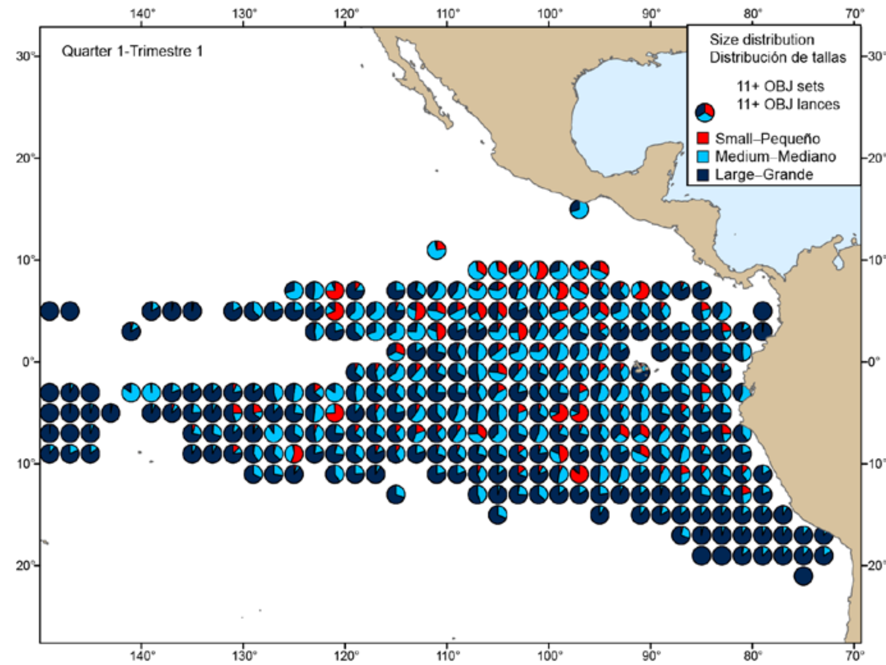

FIGURE 14a. Spatial distribution of dorado, by size category (small (< 30 cm FL); medium (30-60 cm FL), and large (> 60 cm FL), in floating-object sets, during the first quarter (January-March), 1993-2013.

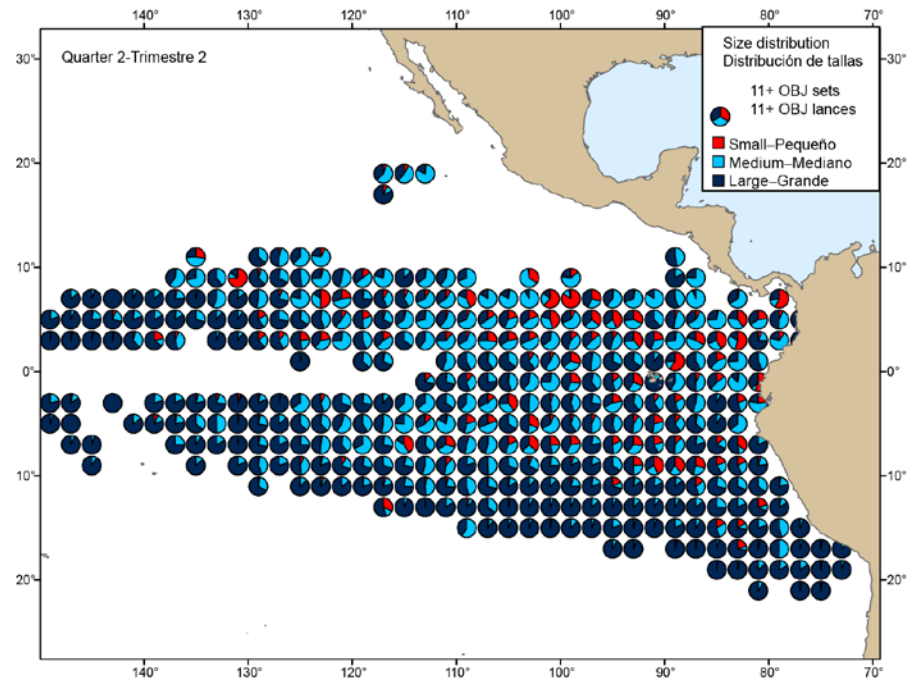

FIGURE 14b. Spatial distribution of dorado, by size category (small (< 30 cm FL); medium (30-60 cm FL), and large (> 60 cm FL), in floating-object sets, during the second quarter (April-June), 1993-2013.

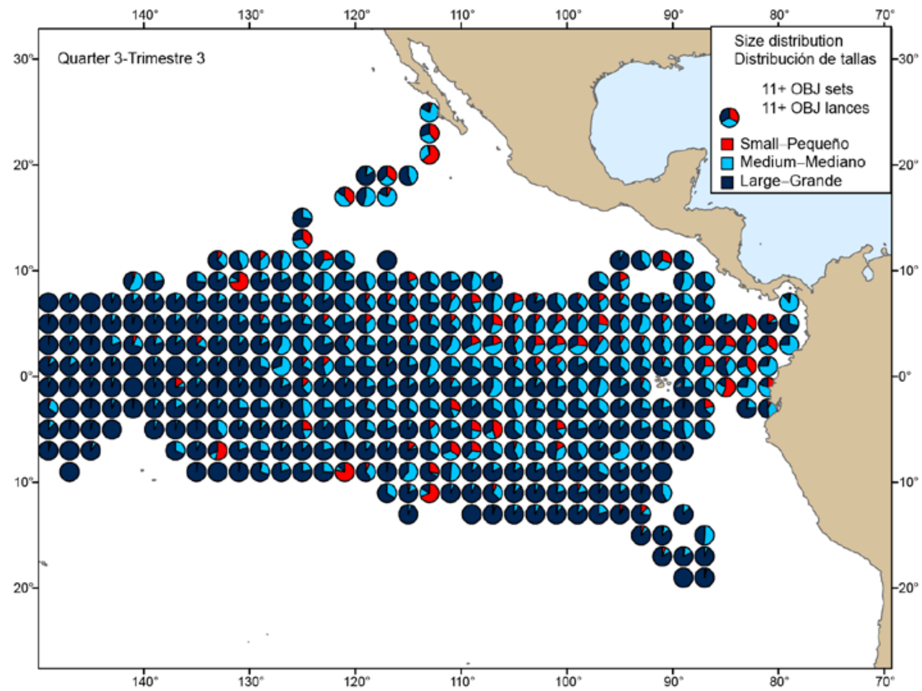

FIGURE 14c. Spatial distribution of dorado, by size category (small (< 30 cm FL); medium (30-60 cm FL), and large (> 60 cm FL), in floating-object sets, during the third quarter (July-September), 1993-2013.

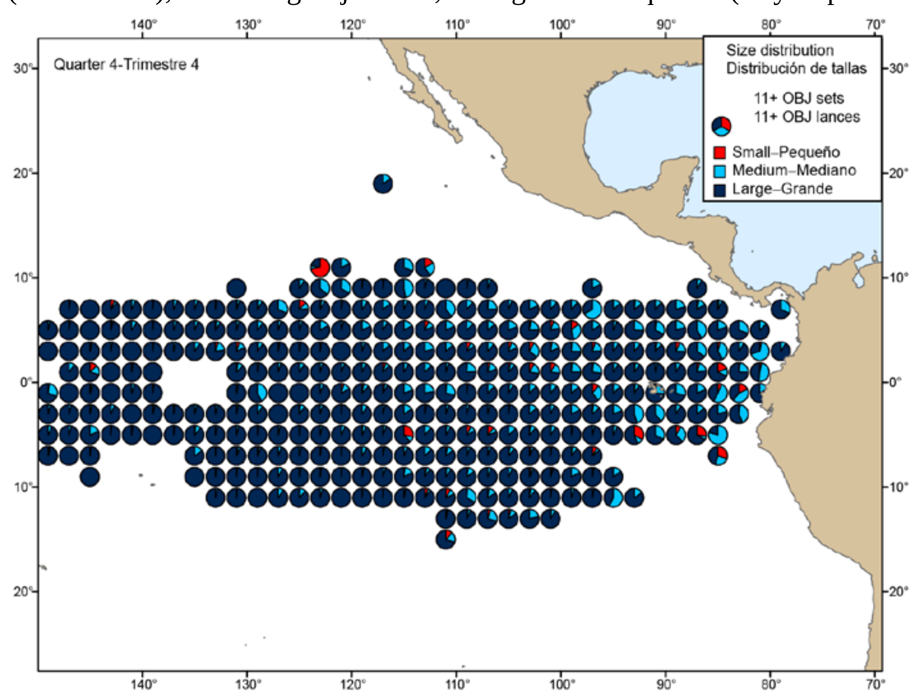

FIGURE 14d. Spatial distribution of dorado, by size category (small (< 30 cm FL); medium (30-60 cm FL), and large (> 60 cm FL), in floating-object sets, during the fourth quarter (October-December), 1993-2013.

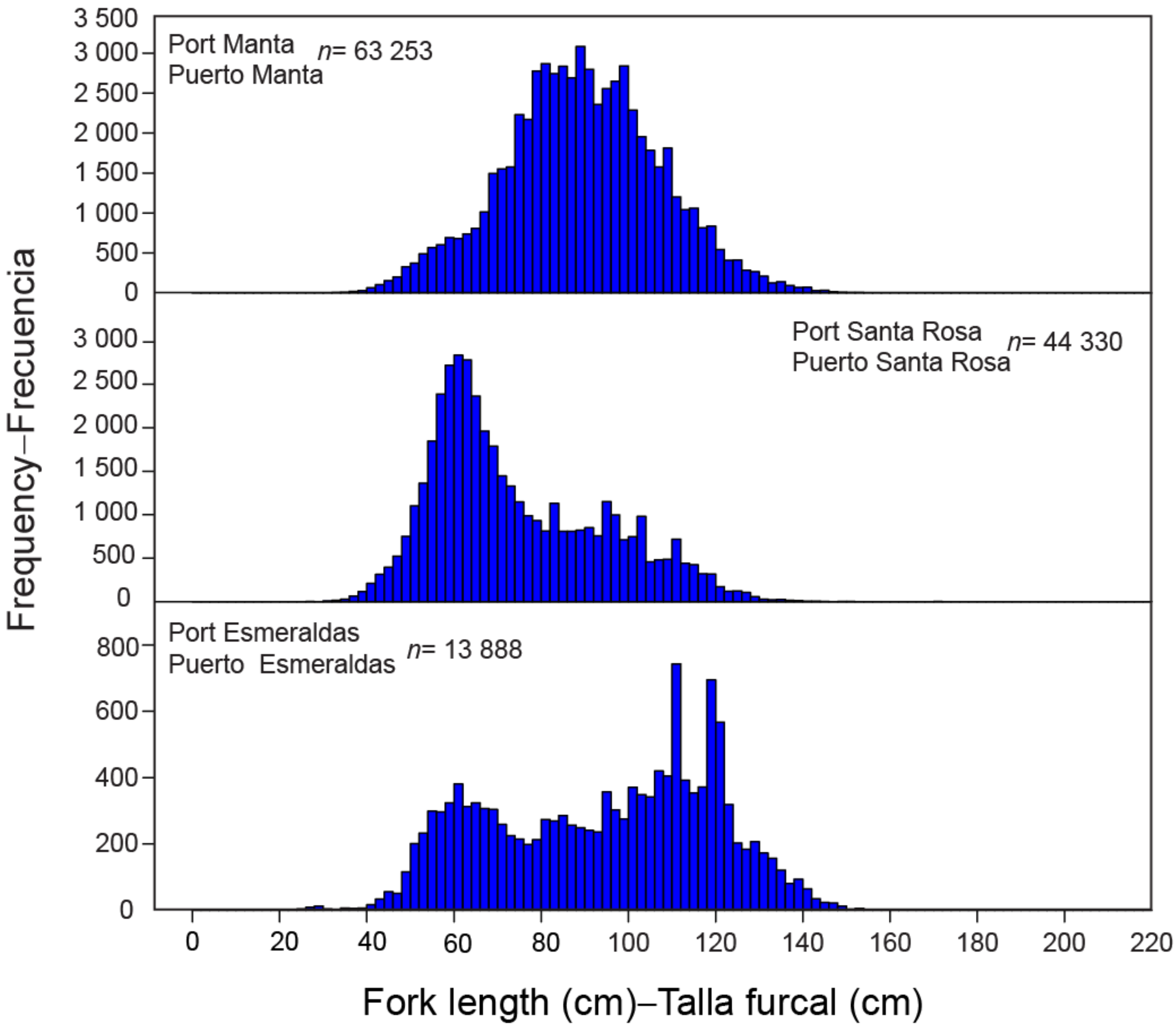

FIGURE 15. Length compositions of dorado from three ports in Ecuador. Data are pooled. Source: SRP-Ecuador.

APPENDIX. OSPESCA biological sampling and landings inspection forms for Central America

Sources:

OSPESCA, 2013. Biological Sampling Form for unloadings in OSPESCA countries. Organización del Sector Pesquero y Acuícola del Istmo Centroamericano (OSPESCA) - Regional Working Group on Sharks and Highly-Migratory Species – GTEAM. Costa Rica, 72 pp.

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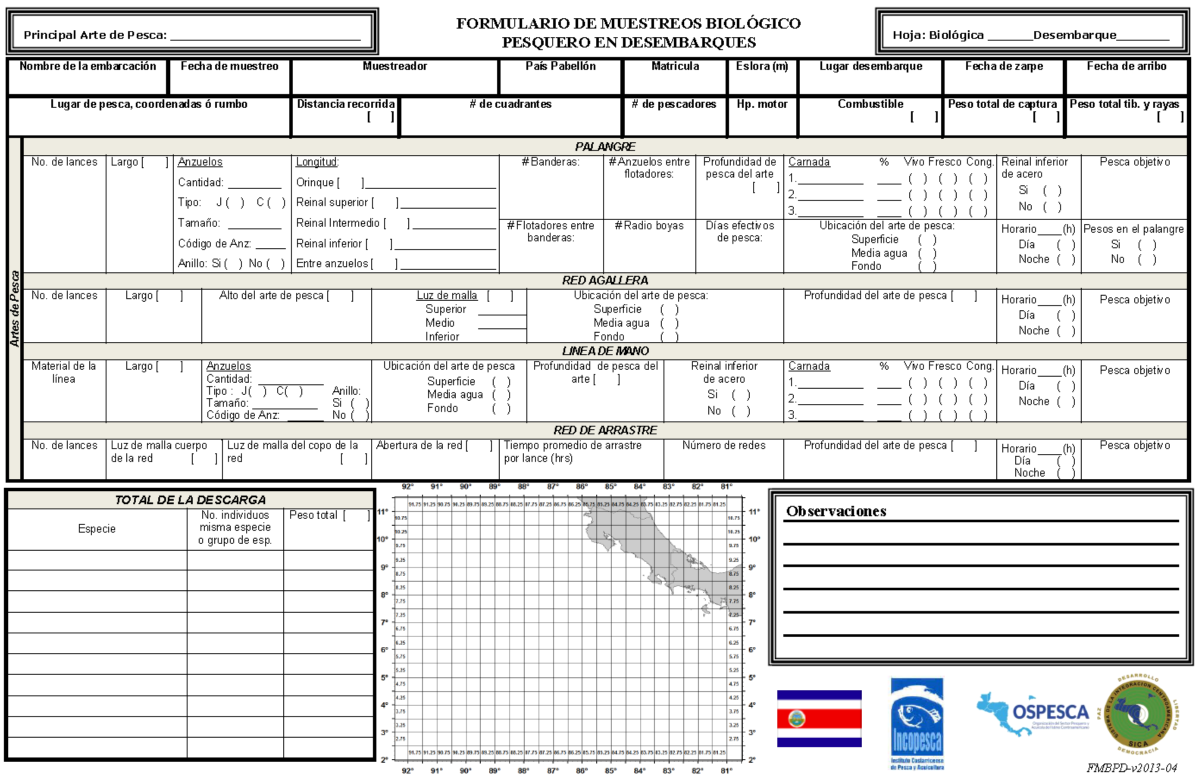
Principal Arte de Pesca: ____
FORMULARIO DE MUESTREOS BIOLÓGICO PESQUERO EN DESEMBARQUES
Hoja: Biológica ____ Desembarque ____
Nombre de la embarcación | Fecha de muestreo | Muestreador | País Pabellón | Matrícula | Eslora (m) | Lugar desembarque | Fecha de zarpe | Fecha de arribo
Lugar de pesca, coordenadas ó rumbo | Distancia recorrida [ ] | # de cuadrantes | # de pescadores | Hp. motor | Combustible [ ] | Peso total de captura [ ] | Peso total tib. y rayas [ ]
Artes de Pesca
PALANGRE
No. de lances | Largo [ ] | Anzuelos: Cantidad, Tipo: J ( ) C ( ), Tamaño, Código de Anz, Anillo: Si ( ) No ( ) | Longitud: Orinque [ ], Reinal superior [ ], Reinal Intermedio [ ], Reinal inferior [ ], Entre anzuelos [ ] | #Banderas | #Anzuelos entre flotadores | Profundidad de pesca del arte [ ] | Carnada % Vivo Fresco Cong. | Reinal inferior de acero Si ( ) No ( ) | Pesca objetivo
#Flotadores entre banderas | #Radio boyas | Días efectivos de pesca | Ubicación del arte de pesca: Superficie ( ) Media agua ( ) Fondo ( ) | Horario ___(h) Día ( ) Noche ( ) | Pesos en el palangre Si ( ) No ( )
RED AGALLERA
No. de lances | Largo [ ] | Alto del arte de pesca [ ] | Luz de malla [ ] Superior, Medio, Inferior | Ubicación del arte de pesca: Superficie ( ) Media agua ( ) Fondo ( ) | Profundidad del arte de pesca [ ] | Horario ___(h) Día ( ) Noche ( ) | Pesca objetivo
LINEA DE MANO
Material de la línea | Largo [ ] | Anzuelos: Cantidad, Tipo: J( ) C( ), Tamaño, Código de Anz, Anillo: Si ( ) No ( ) | Ubicación del arte de pesca: Superficie ( ) Media agua ( ) Fondo ( ) | Profundidad de pesca del arte [ ] | Reinal inferior de acero Si ( ) No ( ) | Carnada % Vivo Fresco Cong. | Horario ___(h) Día ( ) Noche ( ) | Pesca objetivo
RED DE ARRASTRE
No. de lances | Luz de malla cuerpo de la red [ ] | Luz de malla del copo de la red [ ] | Abertura de la red [ ] | Tiempo promedio de arrastre por lance (hrs) | Número de redes | Profundidad del arte de pesca [ ] | Horario ___(h) Día ( ) Noche ( ) | Pesca objetivo
TOTAL DE LA DESCARGA
Especie | No. individuos misma especie o grupo de esp. | Peso total [ ]
Observaciones
FMBPD-v2013-04

FIGURE A1. Biological sampling form for unloadings. Example from Costa Rica, but available for eight countries in Central America.

MONITOREO BIOLOGICO																								
Especie	Sexo		AD (cm)	LD (cm)	LT (cm)	LP (cm)	LF (cm)	LID (cm)	LTR (cm)	LC (cm)	Peso (kg)	El animal tiene			Ombligo		No. de crías		Clasper calcificado		Clasper con esperma	
	M	H										C	V	Co	A	Ce	M	H	SI	No	SI	No
1																						
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3																						
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40																						

Observaciones

LT: Longitud Total. **LP**: Longitud Pre caudal. **LF**: Longitud Furcal. **LID**: Longitud Interdorsal. **LTR**: Longitud Tronco. **LC**: Longitud Clasper.
C: Cabeza. **V**: Vísceras. **Co**: Cola. **A**: Abierto. **Ce**: Cerrado. **M**: Macho. **H**: Hembra

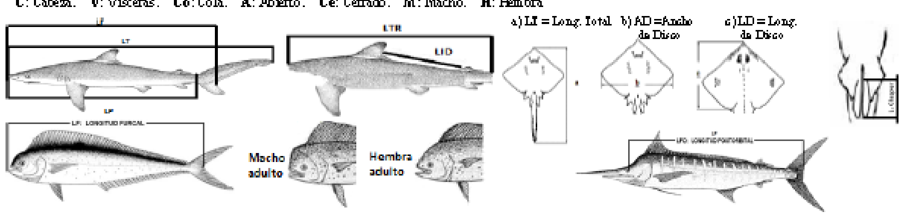
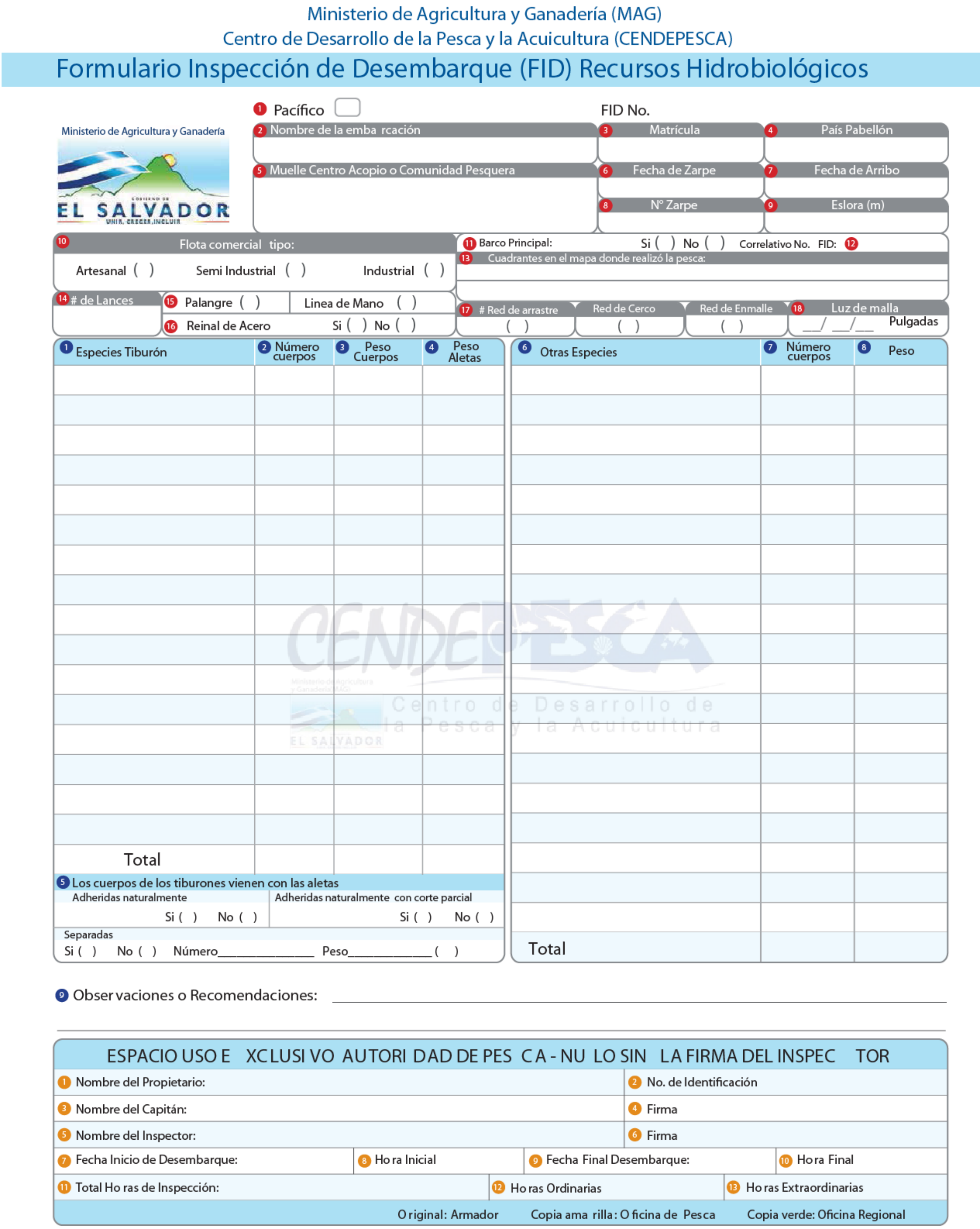


FIGURE A2. Biological monitoring form.



Ministerio de Agricultura y Ganadería (MAG)
Centro de Desarrollo de la Pesca y la Acuicultura (CENDEPESCA)

Formulario Inspección de Desembarque (FID) Recursos Hidrobiológicos

Ministerio de Agricultura y Ganadería
EL SALVADOR

1 Pacífico ☐ FID No.

2 Nombre de la emba rcación	3 Matrícula	4 País Pabellón
5 Muelle Centro Acopio o Comunidad Pesquera	6 Fecha de Zarpe	7 Fecha de Arribo
	8 N° Zarpe	9 Eslora (m)

10 Flota comercial tipo: Artesanal ( ) Semi Industrial ( ) Industrial ( )

11 Barco Principal: Si ( ) No ( ) Correlativo No. FID: 12

13 Cuadrantes en el mapa donde realizó la pesca:

14 # de Lances

15 Palangre ( ) Linea de Mano ( )

16 Reinal de Acero Si ( ) No ( )

17 # Red de arrastre ( ) Red de Cerco ( ) Red de Enmalle ( ) 18 Luz de malla __/ __/__ Pulgadas

1 Especies Tiburón	2 Número cuerpos	3 Peso Cuerpos	4 Peso Aletas
Total			

5 Los cuerpos de los tiburones vienen con las aletas
Adheridas naturalmente Si ( ) No ( )
Adheridas naturalmente con corte parcial Si ( ) No ( )
Separadas
Si ( ) No ( ) Número____________ Peso___________( )

6 Otras Especies	7 Número cuerpos	8 Peso
Total		

9 Observaciones o Recomendaciones: ____________________

ESPACIO USO EXCLUSIVO AUTORIDAD DE PESCA - NULO SIN LA FIRMA DEL INSPECTOR

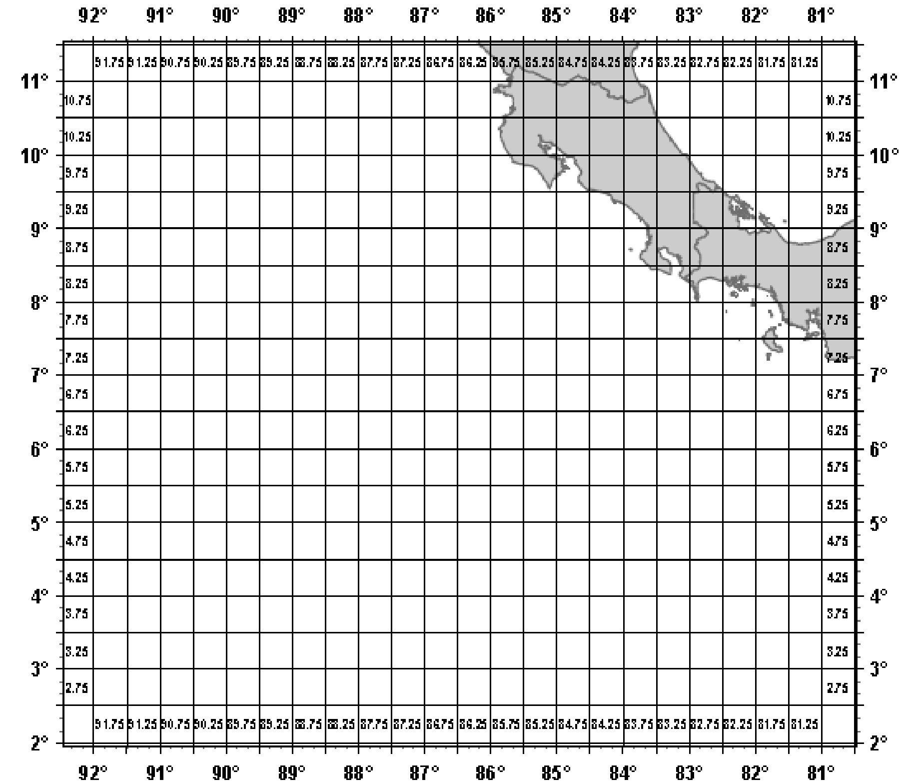
1 Nombre del Propietario:		2 No. de Identificación	
3 Nombre del Capitán:		4 Firma	
5 Nombre del Inspector:		6 Firma	
7 Fecha Inicio de Desembarque:	8 Hora Inicial	9 Fecha Final Desembarque:	10 Hora Final
11 Total Horas de Inspección:	12 Horas Ordinarias	13 Horas Extraordinarias	

Original: Armador Copia amarilla: Oficina de Pesca Copia verde: Oficina Regional

FIGURE A3. Unloading inspection form (FID), marine biological resources

SECCION DE MAPAS DEL FORMULARIO POR PAIS

COSTA RICA



9

FIGURE A4. Map section of the form, by country. Example from Costa Rica, but available for eight countries in Central America.

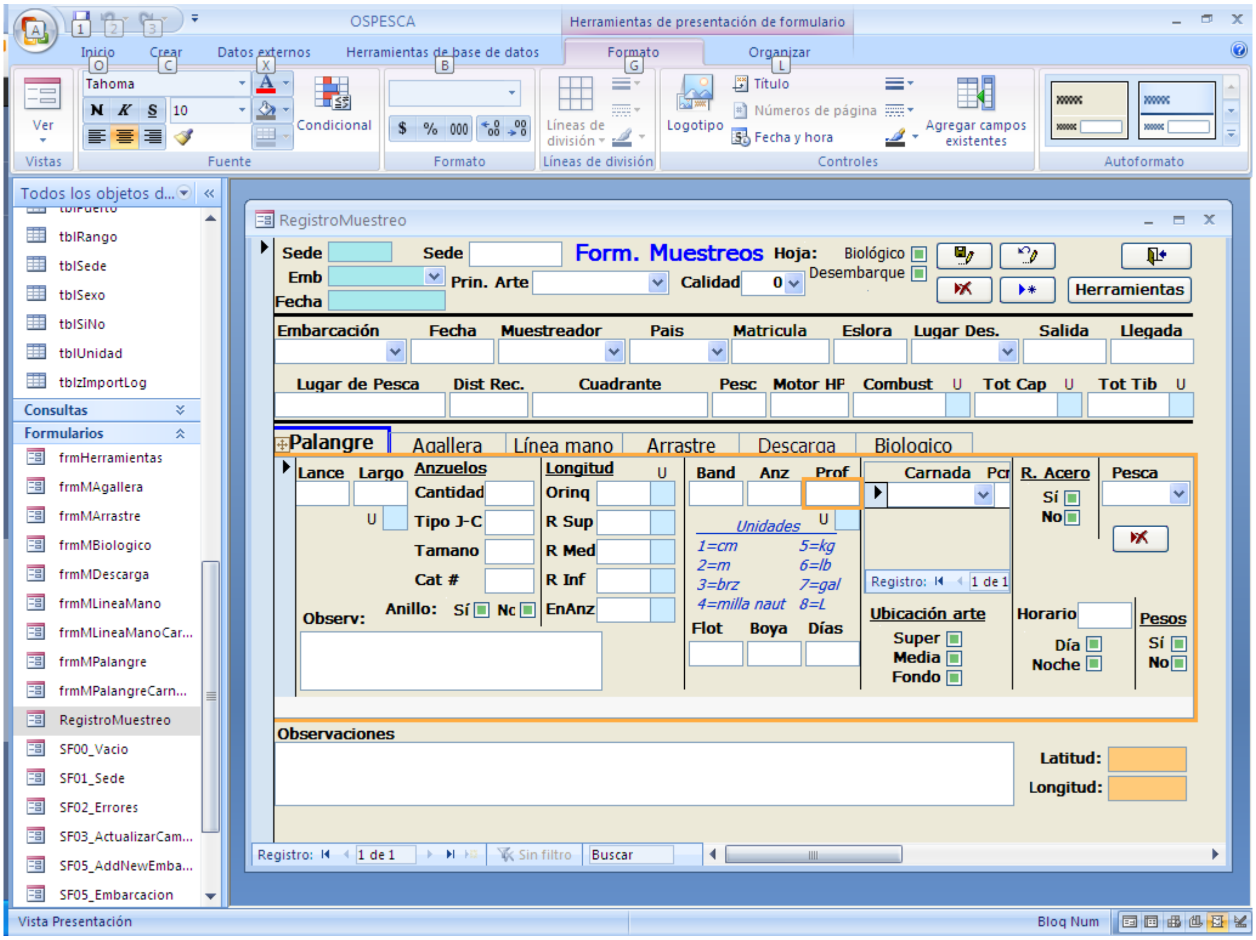


FIGURE A5. OSPESCA data base. Biological sampling form for unloadings.