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CHANGES IN THE PURSE-SEINE FLEET FISHING ON FLOATING OBJECTS AND THE NEED TO MONITOR SMALL VESSELS

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1. BACKGROUND

There has been an increasing trend in the number of floating-object sets by both small (Classes 1-5[1]) and large (Class-6) purse-seine vessels since about 2005 (Figure 1a), which correlates with a decreasing trend in purse-seine catch-per-set, to some degree, for all three major tropical tuna species (yellowfin, skipjack, and bigeye) in floating-object sets (Figure 1b). This change in the dynamics of the purse-seine fishery on floating objects has prompted the need for a review of the data available for Class 1-5 vessels for the purpose of fisheries management. Vessel logbooks, cannery records, and port-sampling data are collected from purse-seine vessels of all size classes. However, while large vessels have nearly 100% on-board observer coverage, trips by small vessels are rarely sampled by observer programs. Observer data provide important details about fishing activities and floating-object characteristics. A lack of detailed information on the fishing activities of small purse-seine vessels, particularly as regards sets on floating objects, may compromise the management of the purse-seine fishery.

This document presents a brief review of the catch and effort data available for small purse-seine vessels. In addition, data deficiencies with respect to bycatch information and floating-object characteristics are discussed.

2. CATCH AND EFFORT DATA

Tuna catch and effort data for small purse-seine vessels come almost exclusively from vessel logbooks and, if available, cannery unloading records. In recent years, the percentage of logbooks abstracted from trips by small vessels has improved, and since about 2005 has been about 85% in most years (Figure 2).

Small purse-seine vessels fish on unassociated schools of tunas and on tunas associated with floating objects (IATTC Fishery Status Report 13, Table A-7). Sets by small vessel on unassociated tunas were mostly clustered in two areas of the eastern Pacific Ocean (EPO): north of 15°N and east of 120°W, and to the south, between the coast and 95°W, from 10°S to 10°N (Figure 3a). These two areas overlap with the main fishing areas for large vessels on unassociated tunas (Figure 3c). In some parts of these areas, particularly in the south, effort was dominated by small purse-seine vessels (Figure 4a). Floating-object sets by small vessels mostly occurred between 75°W and 100°W from 5°S to 10°N (Figure 3b). Although small vessels recorded fishing on floating objects as far west as 130°W and as far south as 25°S, overall the floating-object effort by small vessels was distributed much more coastally than that of large vessels (Figure 3d). Fishing effort on floating objects in coastal areas in the south was dominated by small vessels (Figure 4b), in patterns similar to those seen for

1 Classes 1-5, ≤ 363 t carrying capacity; Class 6, > 363 t

unassociated sets. Note that, despite the large proportion of floating-object sets by small vessels south of 15°S and west of 95°W, the number of sets in that area is not large (Figure 3b).

Although small purse-seine vessels currently account for about 15% of the tuna catch in the IATTC catch and effort database (Figure 5), there are some areas in the EPO where the tuna catch by small vessels is similar to, or in some years greater than, the tuna catch by large vessels (Figure 6). Coastal areas with proportionally higher effort by small vessels (Figure 4) also show proportionally more catch of yellowfin and skipjack by small vessels (Figures 6a-6d). It is important to mention that, despite the large proportion of bigeye tuna caught in unassociated sets by small vessels from 5°S to 5°N and between the coast and 95°W (Figure 6e), the total bigeye catch in unassociated sets in those areas is relatively small. In the area from 5°S to 5°N and east of 90°W, where a large proportion of the floating-object sets by small vessels in the last five years were made (Figure 4b), the proportion of bigeye in the catch by small vessels (Figure 6f) was greater.

3. BYCATCH AND DYNAMICS ON FLOATING OBJECTS

3.1. Non-target species

Non-target species, including sharks, manta rays, and turtles, are caught incidentally by large purse-seine vessels during normal fishing operations (IATTC 2015). The majority of these species are caught with greater frequency, and in greater amounts, in sets on floating objects (IATTC 2015; Hall and Román 2013), but species like whale sharks and Mobulid rays are most commonly captured in unassociated sets (Hall and Román 2013). Given that the fishing areas of small and large purse-seine vessels overlap (Figure 3), incidental bycatches of non-target species may also occur in unassociated and floating-object sets made by small vessels. Logbook data for small vessels, however, may not provide full information on bycatch species composition and amounts (SAC-07-INFC(d)), and they do not provide information on discards of tuna and non-target species at sea. IATTC and national observer programs have placed observers on some trips by small vessels only under certain circumstances, and the overall level of observer coverage of such trips is very low (Figure 7)

In some cases, Electronic Monitoring Systems (EMS) may be able to provide information on bycatches when data from onboard observers are not available (Restrepo *et al.* 2014). Experiments with EMS, using high-definition video, have already taken place on tuna purse-seine vessels (Ruiz *et al*. 2014), and have proven effective for identifying and quantifying bycatches of large-bodied species on the main deck as well as on the well deck. High-definition video can also provide information on fish size and release efforts. However, although promising for large- species, medium- or small-sized species, such as dorado (*Coryphaena hippurus*), are problematic to monitor with EMS because they can come aboard mixed with the catch of target species (Ruiz *et al*. 2014).

3.2. The FAD fishery

The purse-seine fishery on floating objects by large vessels has been dominated by sets on fish-aggregating devices (FADs) since 1994, when the number of sets on FADs surpassed those on natural floating objects (Hall and Román 2013; Figure 8). Since 2008, more than 90% of all floating-object sets by large vessels are estimated to have been sets on FADs (Hall and Román 2016; Figure 8). This increase in fishing effort on FADs is hypothesized to be correlated with a decreased density of schools of bigeye in the EPO (Aires-da-Silva and Maunder 2015).

The similarity of the characteristics of floating objects involved in sets by small and large purse-seine vessels is unknown. Detailed information on floating-object characteristics is collected by observers aboard large purse-seine vessels; it includes the type of floating object (natural or FAD), its dimensions and materials, any sensing equipment carried by the object, its origin and, for FADs, information on deployment and removal. This information is important for proper management of the floating-object fishery. For example, it is used to estimate the level of FAD fishing effort, including the number of FADs deployed annually within the EPO. In addition, it is used to study the effects of these characteristics on both catch and bycatch; object depth has been found to be associated with increased chances of catching bigeye (Document SAC-07-07e), and is used in stock status indicator models for silky sharks (Document SAC-07-06bi). However, other than object type, the detailed information collected by observers is not available for floating-object sets by small vessels recorded on IATTC logbook forms.

As noted above, the areas of operation of small and large purse-seine vessels fishing on floating objects overlap (Figure 3), and therefore the fishing dynamics of small vessels on FADs may be similar to those of large vessels. The area where both small and large vessels make floating-object sets is characterized by high levels of FAD interactions by large vessels (Figure 9). However, the differences in operational range between small and large vessels may lead to different fishing strategies for small vessels. These uncertainties need to be clarified, and it is possible that implementing EMS could provide useful information in this regard. FADs, which are large objects, would not be difficult to monitor by EMS. Also, FAD interactions, such as deployments and removals, could easily be recorded by EMS.

4. REFERENCES

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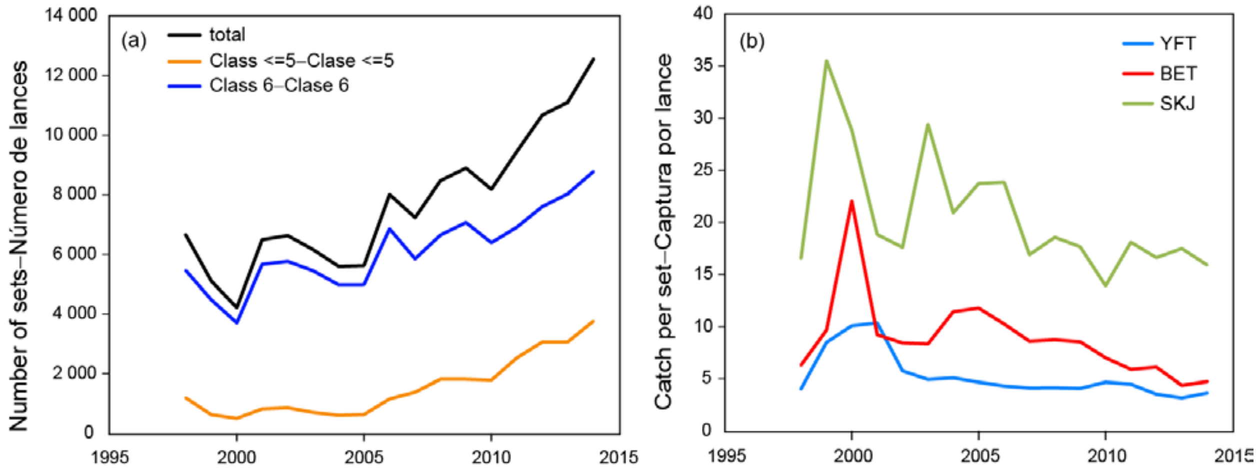

FIGURE 1. Number of floating-object sets (A), and tuna catch in floating-object sets, in metric tons (B).
FIGURA 1. Número de lances sobre objetos flotantes (A), y captura de atún en lances sobre objetos flotantes, en toneladas (B).

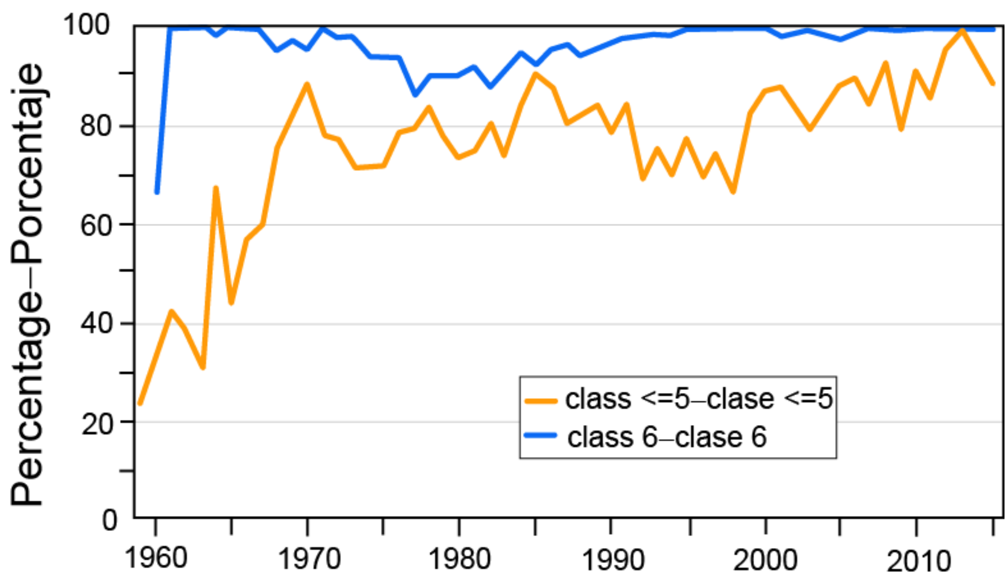

FIGURE 2. Percentage of trips with logbook information.
FIGURA 2. Porcentaje de viajes con información de bitácora.

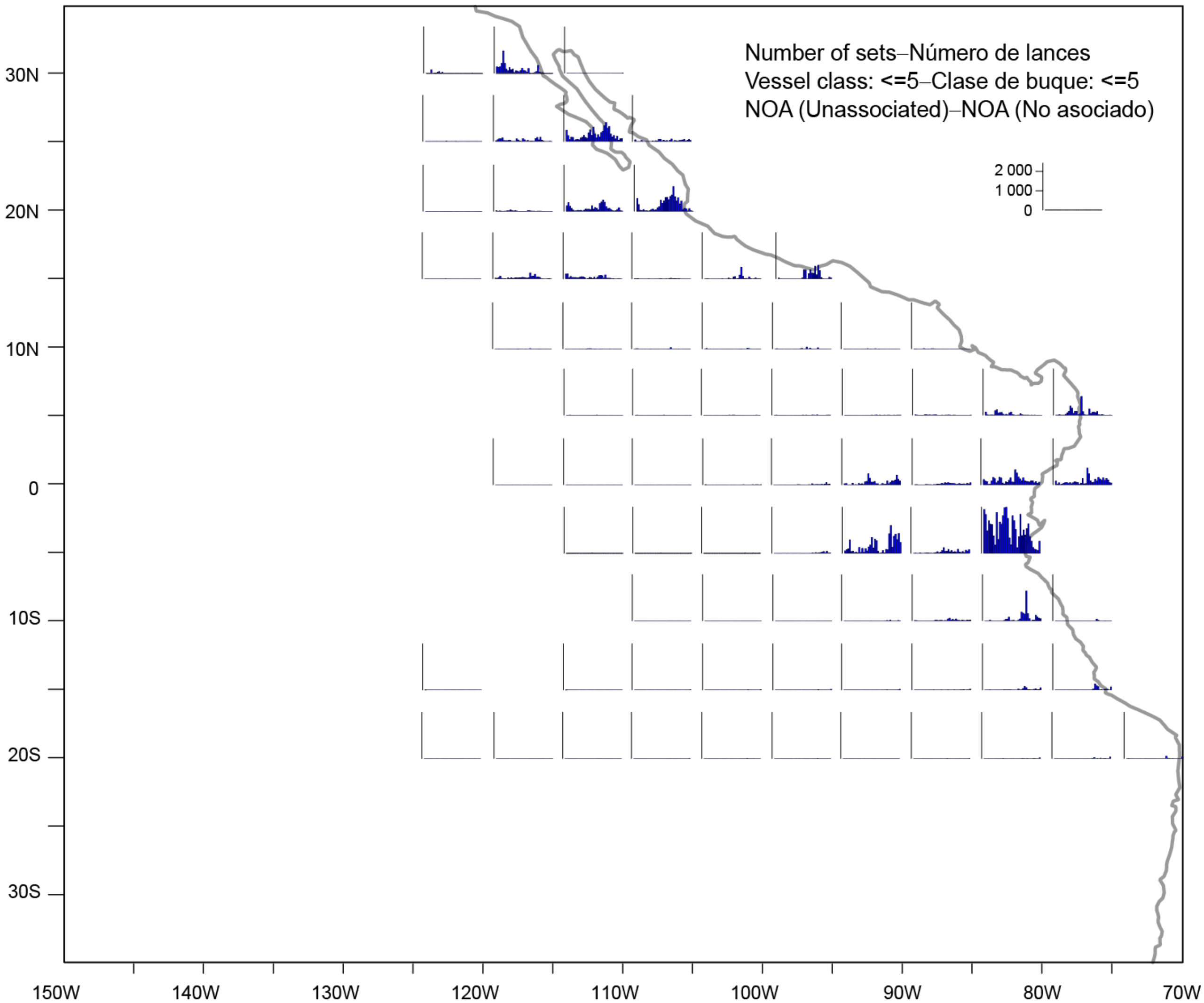

FIGURE 3a. Number of unassociated sets by Class 1-5 purse-seine vessels, by 5° area, 1980-2015.
FIGURA 3a. Número de lances no asociados por buques cerqueros de clases 1 a 5, por área de 5°, 1980-2015.

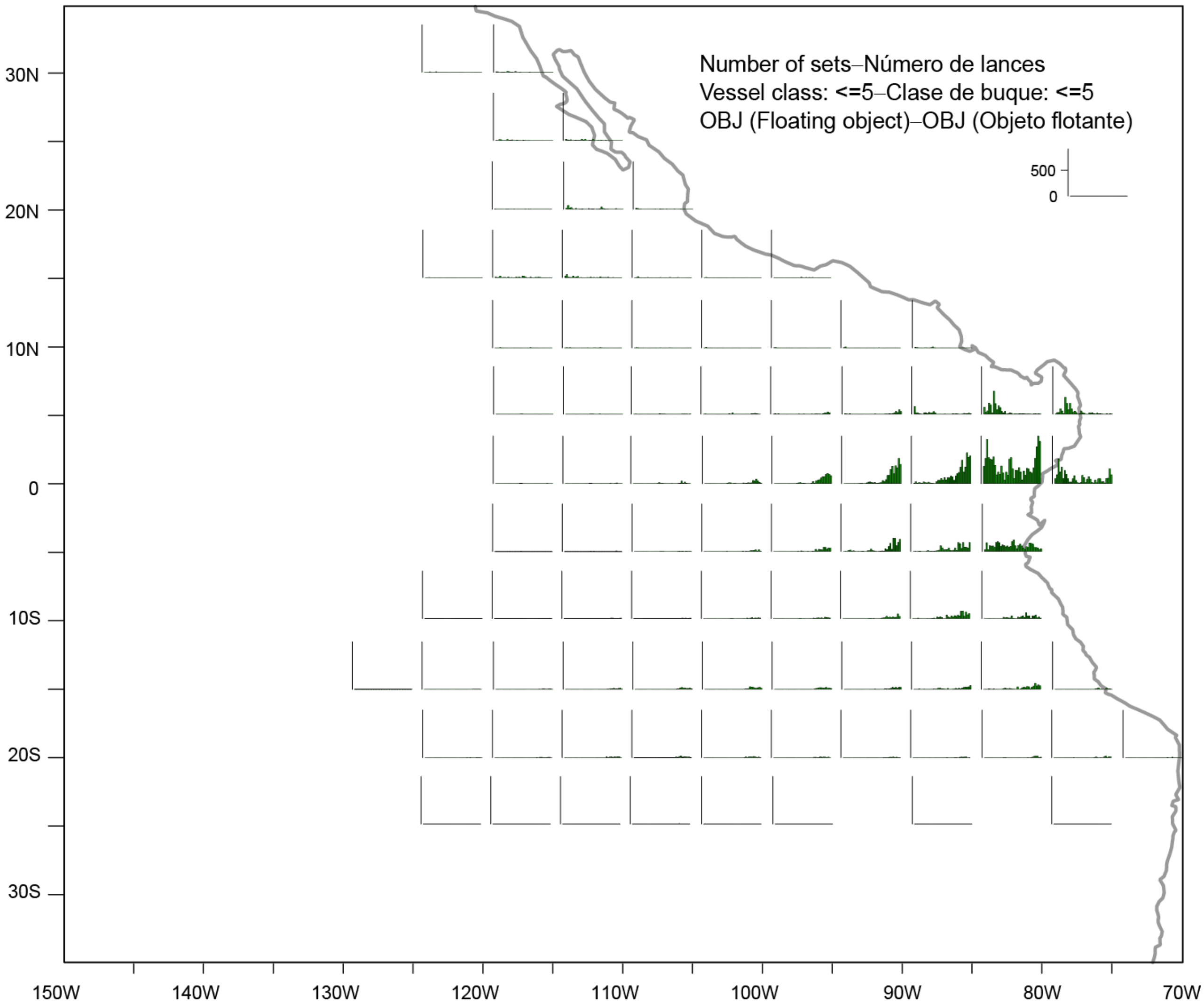

FIGURE 3b. Number of floating-object sets by Class 1-5 purse-seine vessels, by 5° area, 1980-2015**.**
FIGURA 3b. Número de lances sobre objetos flotantes por buques cerqueros de clases 1 a 5, por área de 5°, 1980-2015.

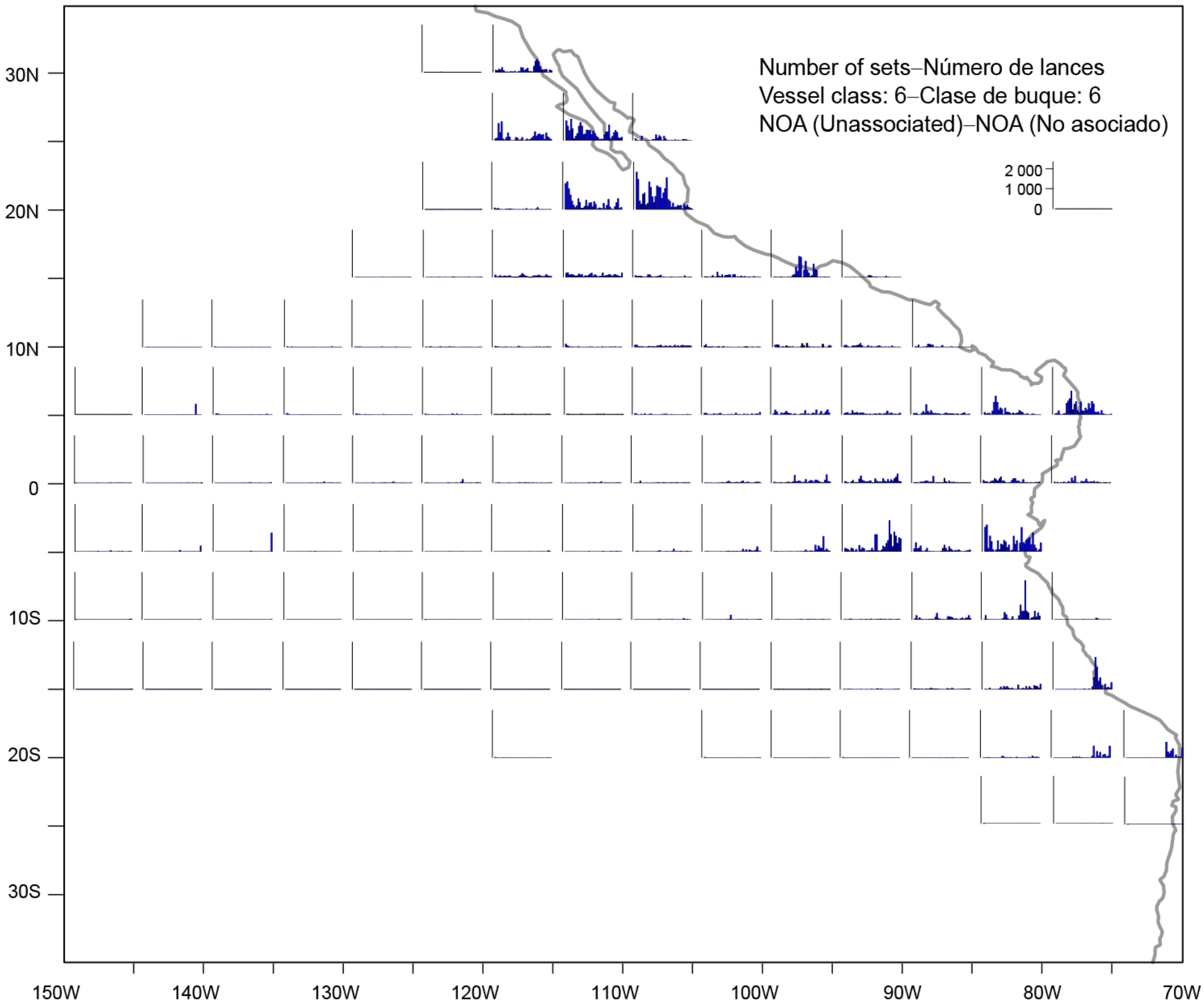

FIGURE 3c. Number of unassociated sets by Class-6 purse-seine vessels, by 5° area, 1980-2015.
FIGURA 3c. Número de lances no asociados por buques cerqueros de clase 6, por área de 5°, 1980-2015.

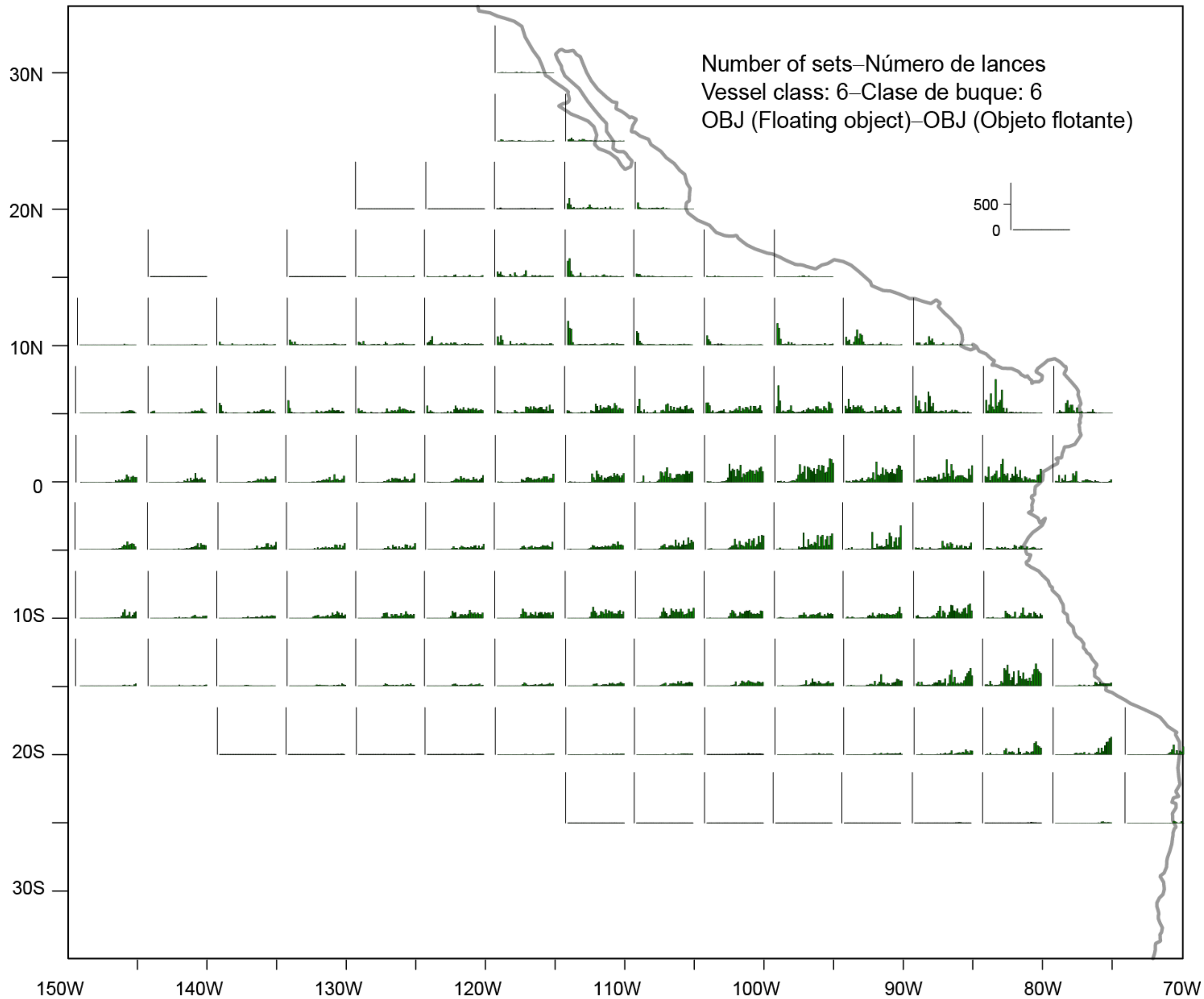

FIGURE 3d. Number of floating-object sets by Class-6 purse-seine vessels, by 5° area, 1980-2015.
FIGURA 3d. Número de lances sobre objetos flotantes por buques cerqueros de clase 6, por área de 5°, 1980-2015.

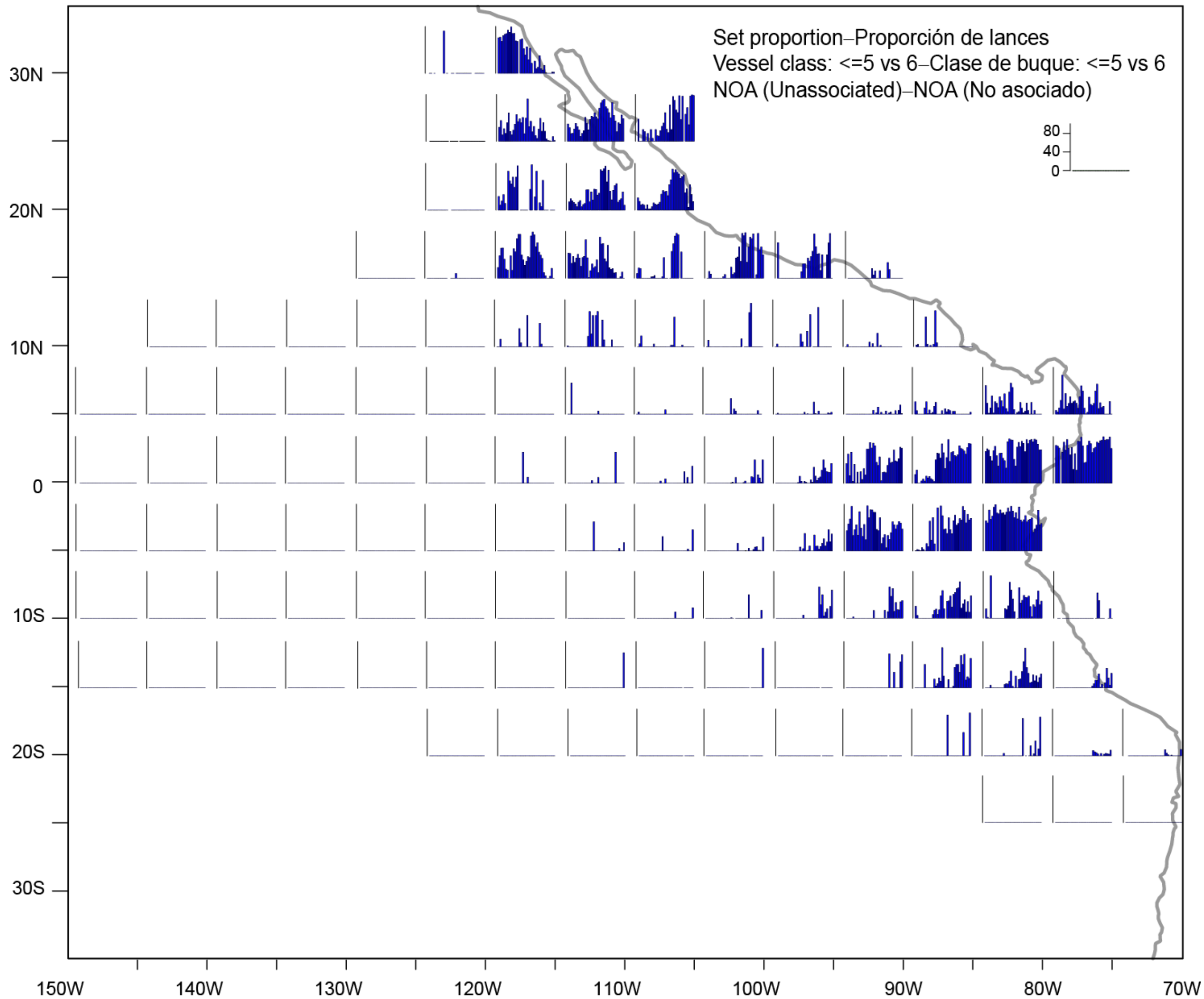

FIGURE 4a. Percentage of unassociated sets by Class 1-5 vessels, relative to unassociated sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 4a. Porcentaje de lances no asociados por buques cerqueros de clases 1 a 5, relativo a lances no asociados por buques de clase 6, por área de 5°, 1980-2015.

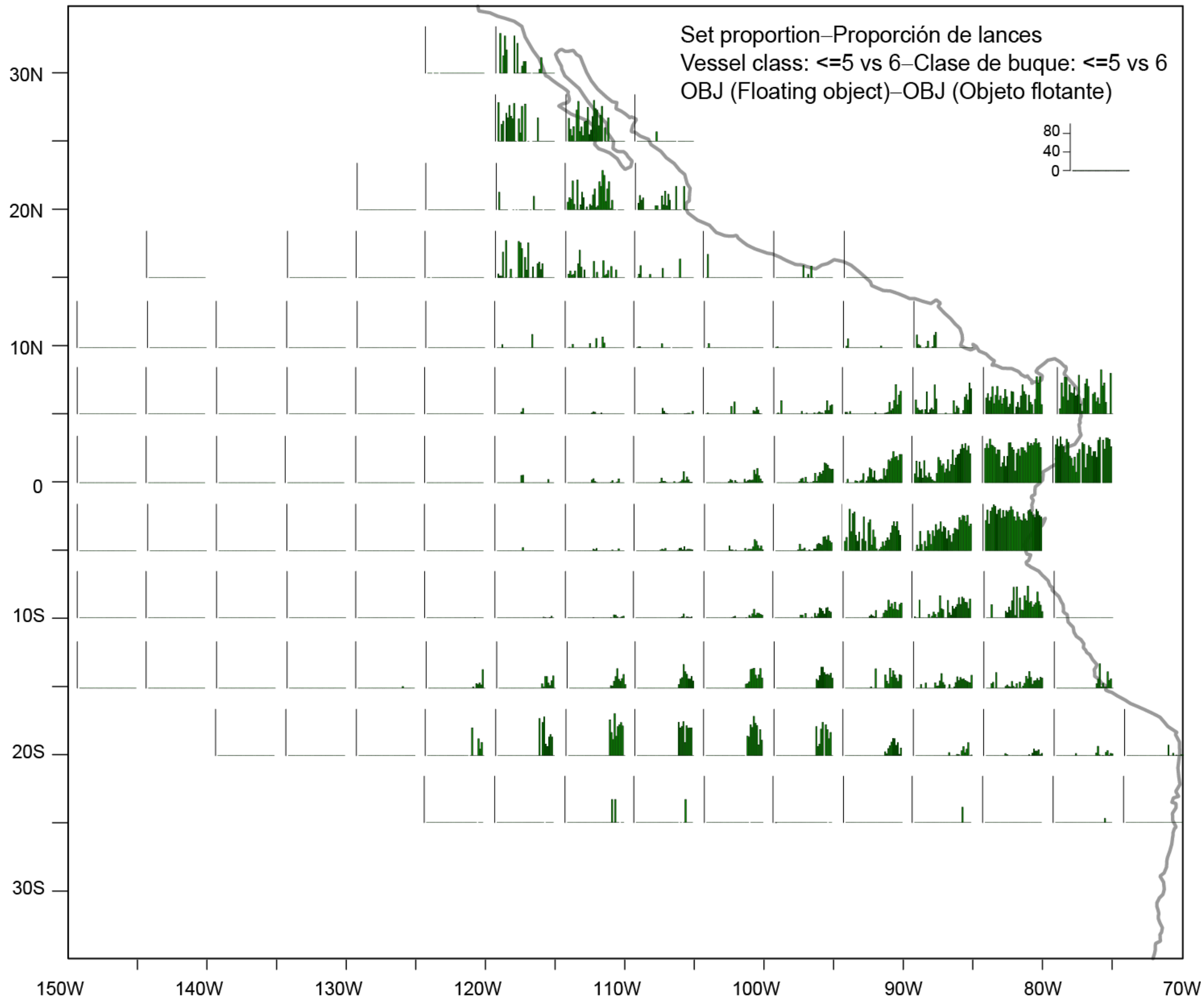

FIGURE 4b. Percentage of floating-object sets by Class 1-5 vessels, relative to floating-object sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 4b. Porcentaje de lances sobre objetos flotantes por buques de clases 1 a 5, relativo a lances no asociados por buques de clase 6, por área de 5°, 1980-2015.

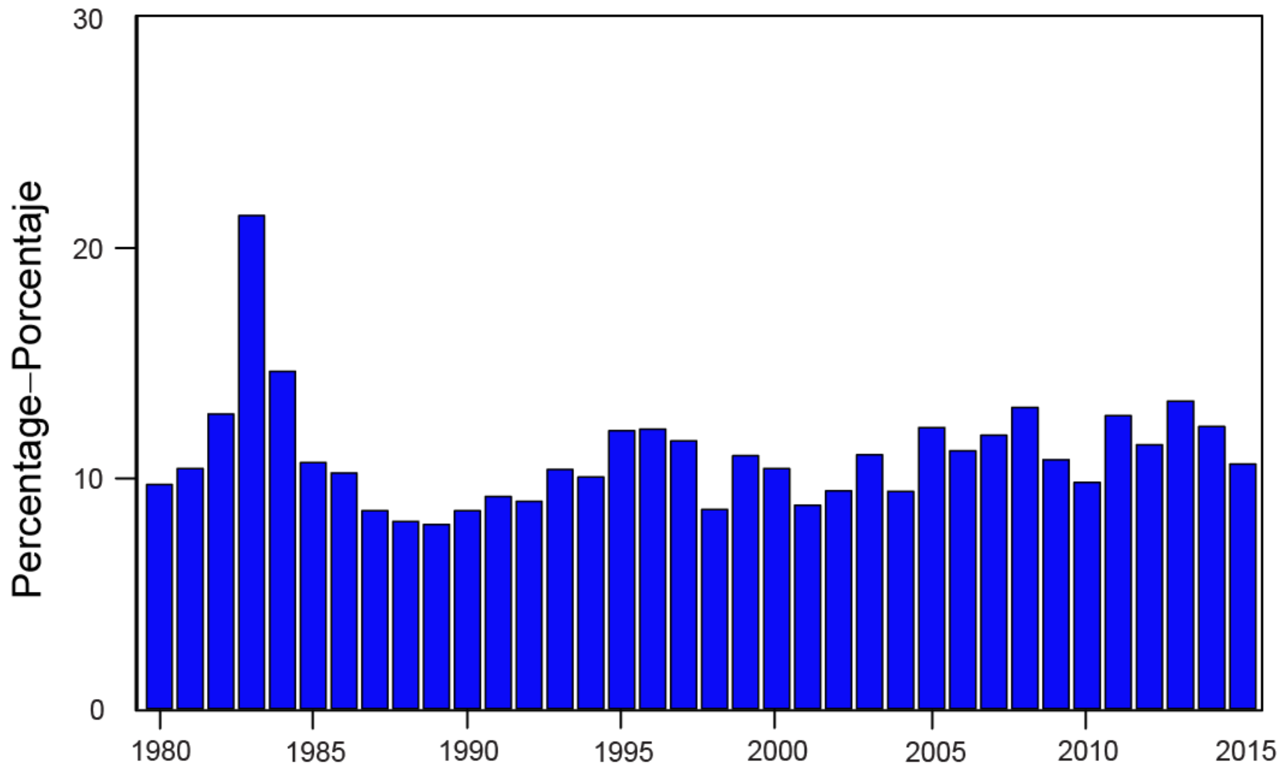

FIGURE 5. Percentage of yellowfin, skipjack and bigeye tunas caught by Class 1-5 vessels, relative to that of Class-6 vessels, 1980-2015.
FIGURA 5. Porcentaje de atunes aleta amarilla, barrilete, y patudo capturado por buques de clases 1 a 5, relativo a las capturas de buques de clase 6, 1980-2015.

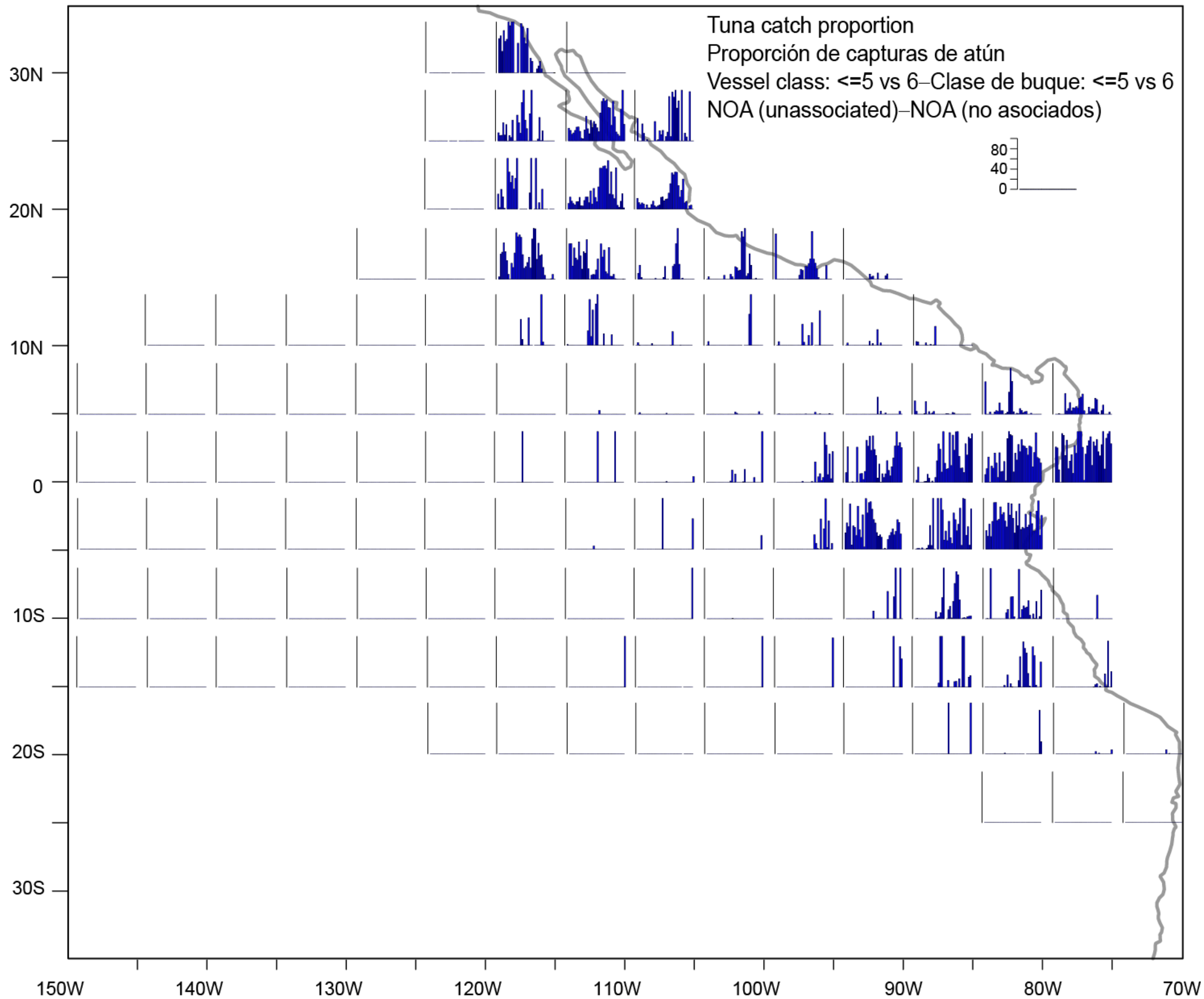

FIGURE 6a. Percentage of yellowfin catch in unassociated sets by Class 1-5 vessels, relative to yellowfin catch in unassociated sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 6a. Porcentaje de la captura de aleta amarilla en lances no asociados por buques de clases 1 a 5, relativo a las capturas de aleta amarilla en lances no asociados por buques de clase 6, por área de 5°, 1980-2015.

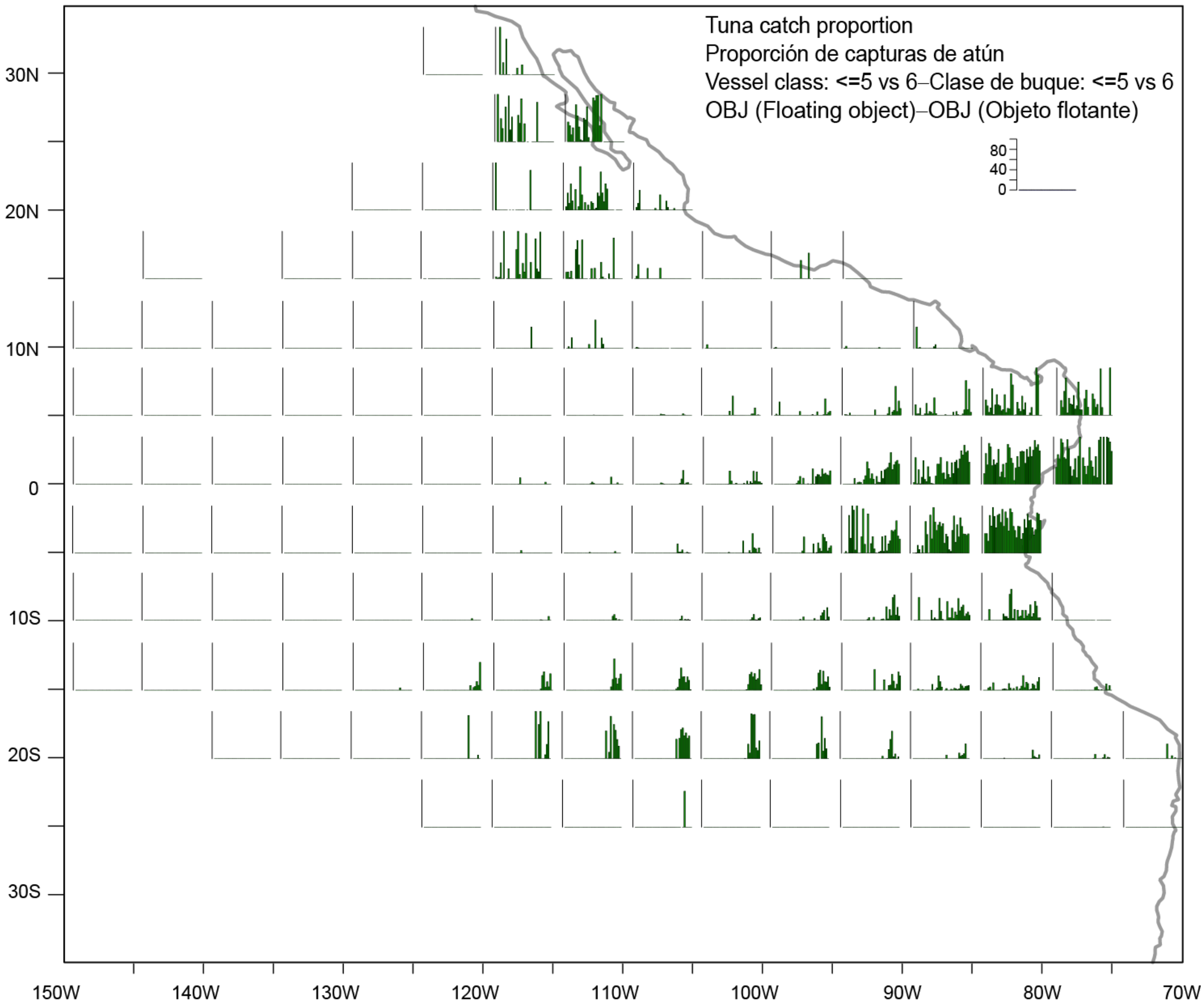

FIGURE 6b. Percentage of yellowfin catch in floating-object sets by Class 1-5 vessels, relative to yellowfin catch in floating-object sets by Class-6 vessels, by 5° area, 1980-2015**.**

FIGURA 6b. Porcentaje de la captura de aleta amarilla en lances sobre objetos flotantes por buques de clases 1 a 5, relativo a las capturas de aleta amarilla en lances sobre objetos flotantes por buques de clase 6, por área de 5°, 1980-2015.

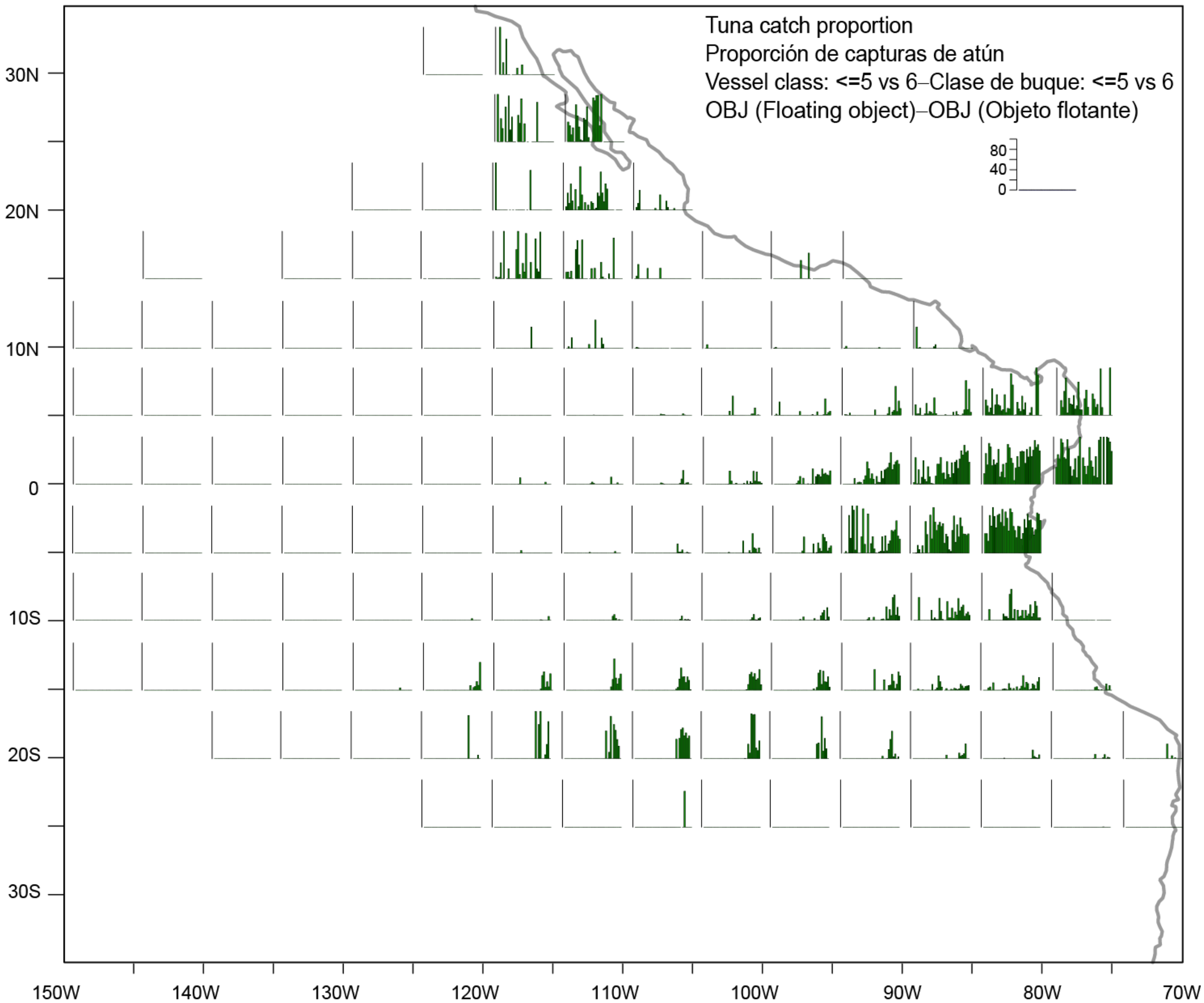

FIGURE 6c. Percentage of skipjack tuna catch in unassociated sets by Class 1-5 vessels, relative to skipjack catch in unassociated sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 6c. Porcentaje de la captura de barrilete en lances no asociados por buques de clases 1 a 5, relativo a las capturas de barrilete en lances no asociados por buques de clase 6, por área de 5°, 1980-2015.

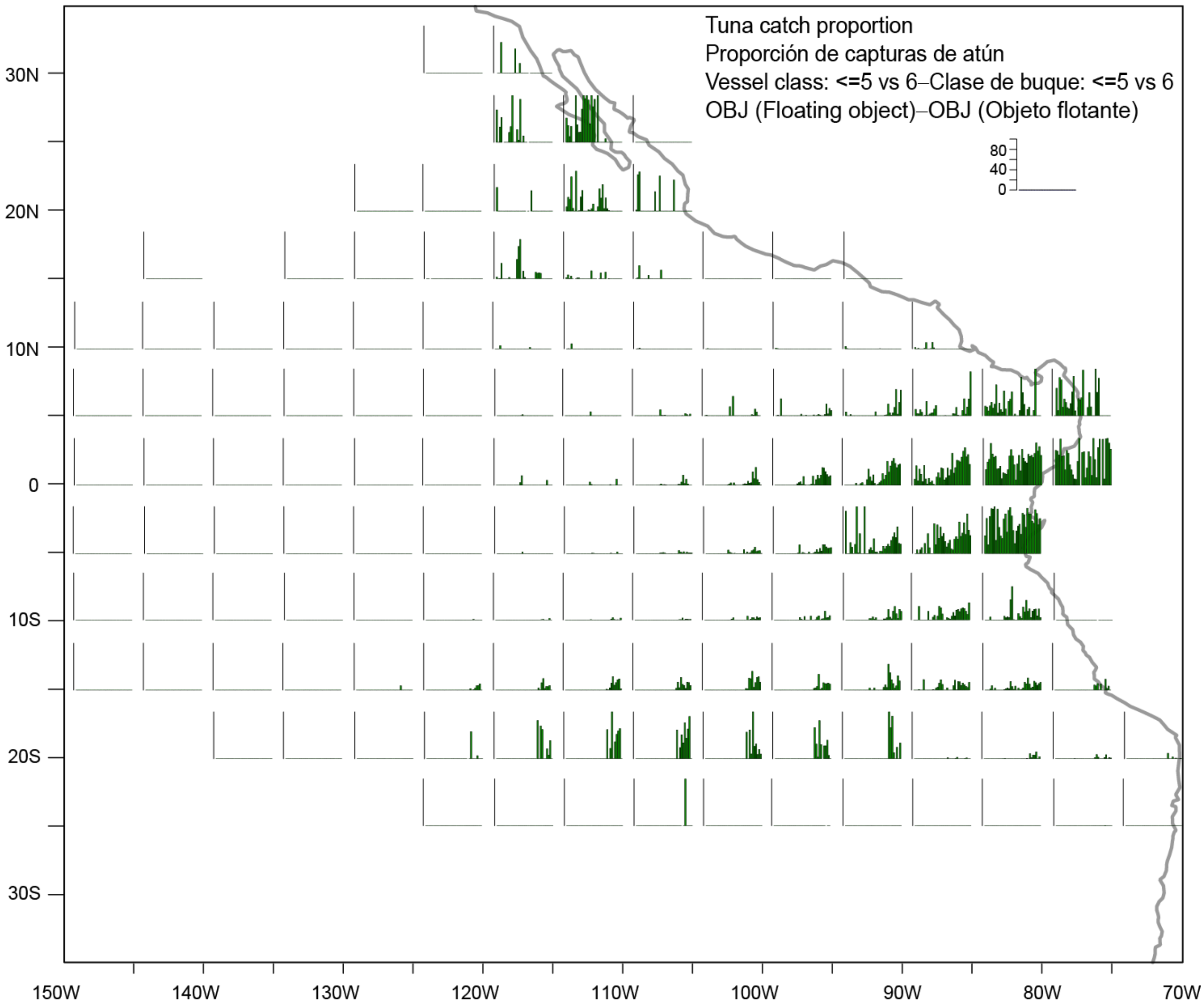

FIGURE 6d. Percentage of skipjack catch in floating-object sets by Class 1-5 vessels, relative to skipjack catch in floating-object sets of Class-6 vessels, by 5° area, 1980-2015.

FIGURA 6d. Porcentaje de la captura de barrilete en lances sobre objetos flotantes por buques de clases 1 a 5, relativo a las capturas de barrilete en lances sobre objetos flotantes por buques de clase 6, por área de 5°, 1980-2015.

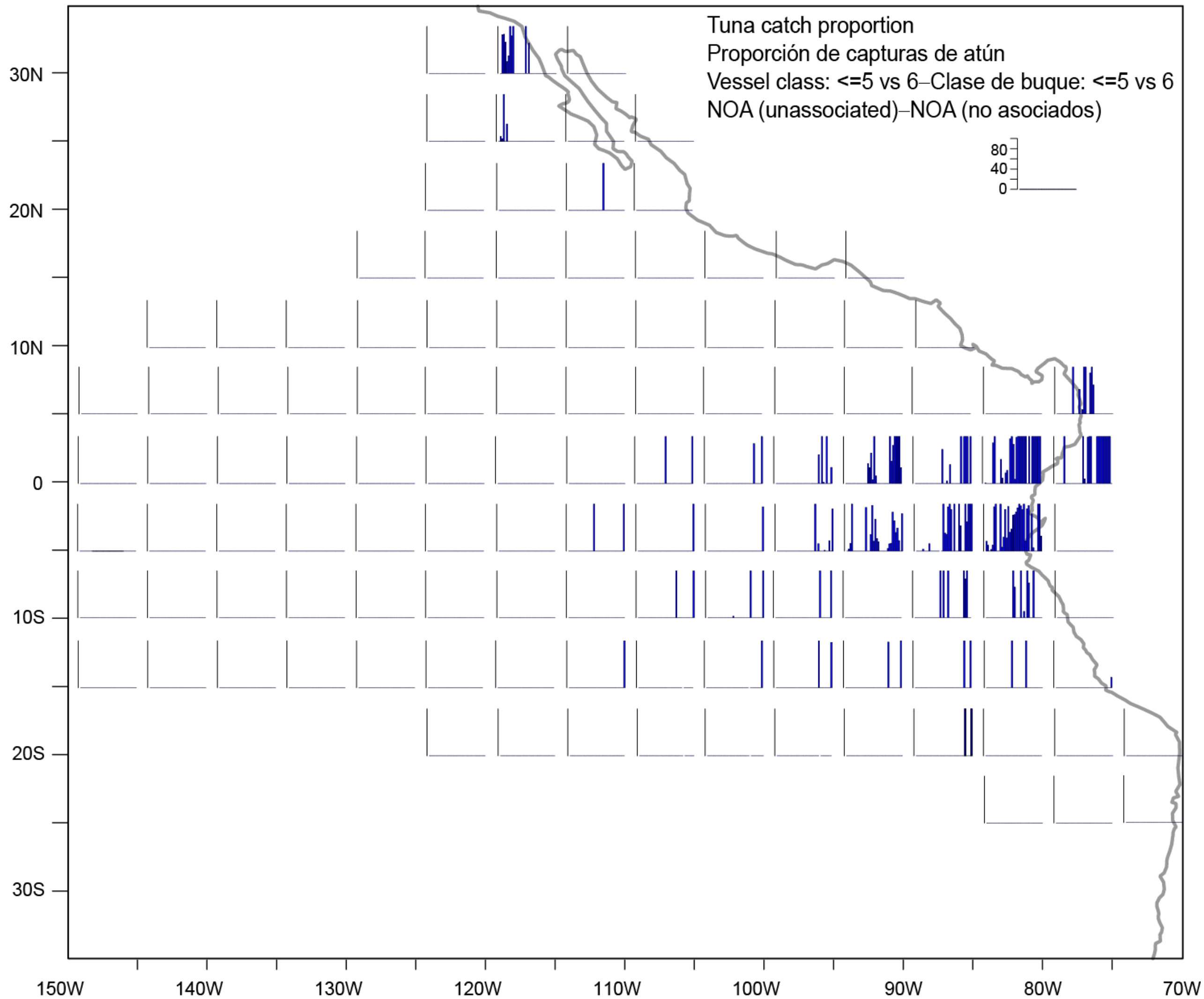

FIGURE 6e. Percentage of bigeye catch in unassociated sets by Class 1-5 vessels, relative to bigeye catch in unassociated sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 6e. Porcentaje de la captura de patudo en lances no asociados por buques de clases 1 a 5, relativo a las capturas de patudo en lances no asociados por buques de clase 6, por área de 5°, 1980-2015.

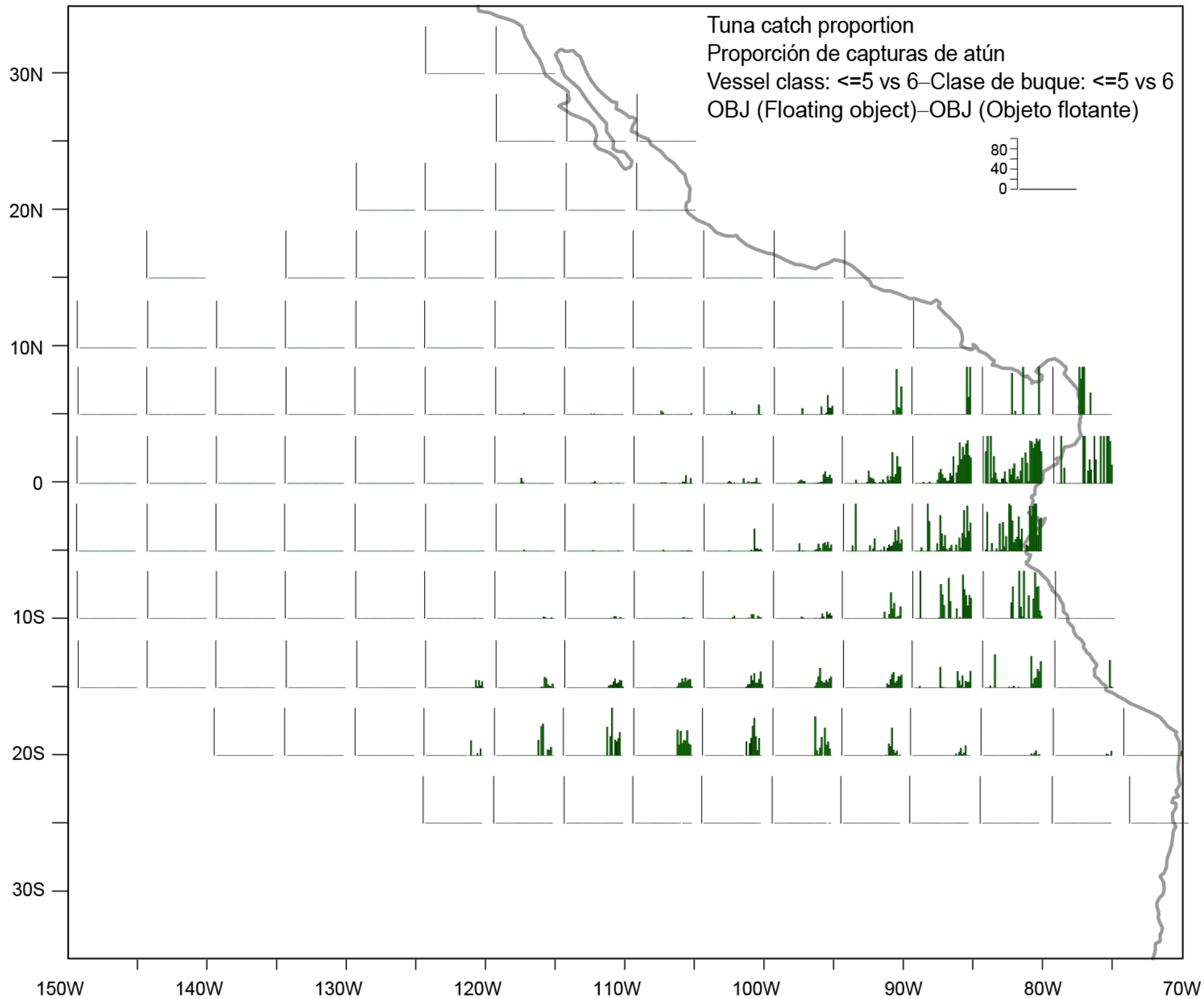

FIGURE 6f. Percentage of bigeye catch in floating-object sets by Class 1-5 vessels, relative to BET tuna catch in floating-object sets by Class-6 vessels, by 5° area, 1980-2015.

FIGURA 6f. Porcentaje de la captura de patudo en lances sobre objetos flotantes por buques de clases 1 a 5, relativo a las capturas de patudo en lances sobre objetos flotantes por buques de clase 6, por área de 5°, 1980-2015.

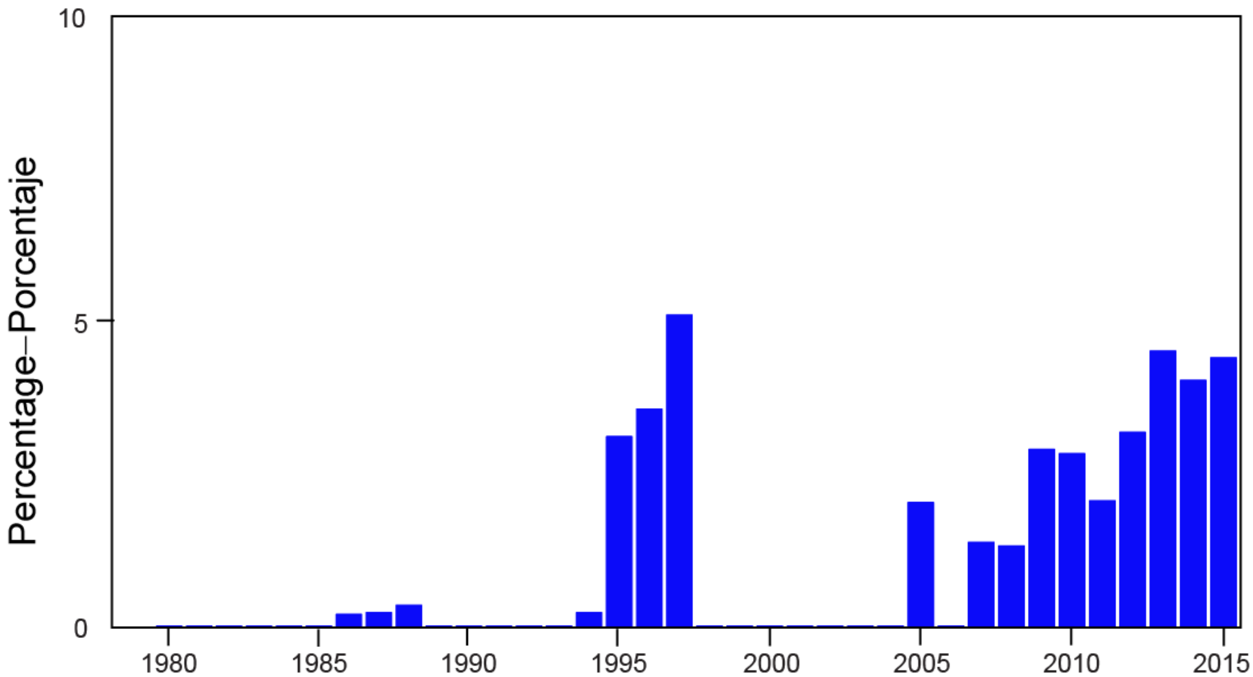

FIGURE 7. Percentage of trips by Class 1-5 vessel that carried an observer, 1980-2015.
FIGURA 7. Porcentaje de viajes por buques de clases 1 a 5 que llevaron observador, 1980-2015.

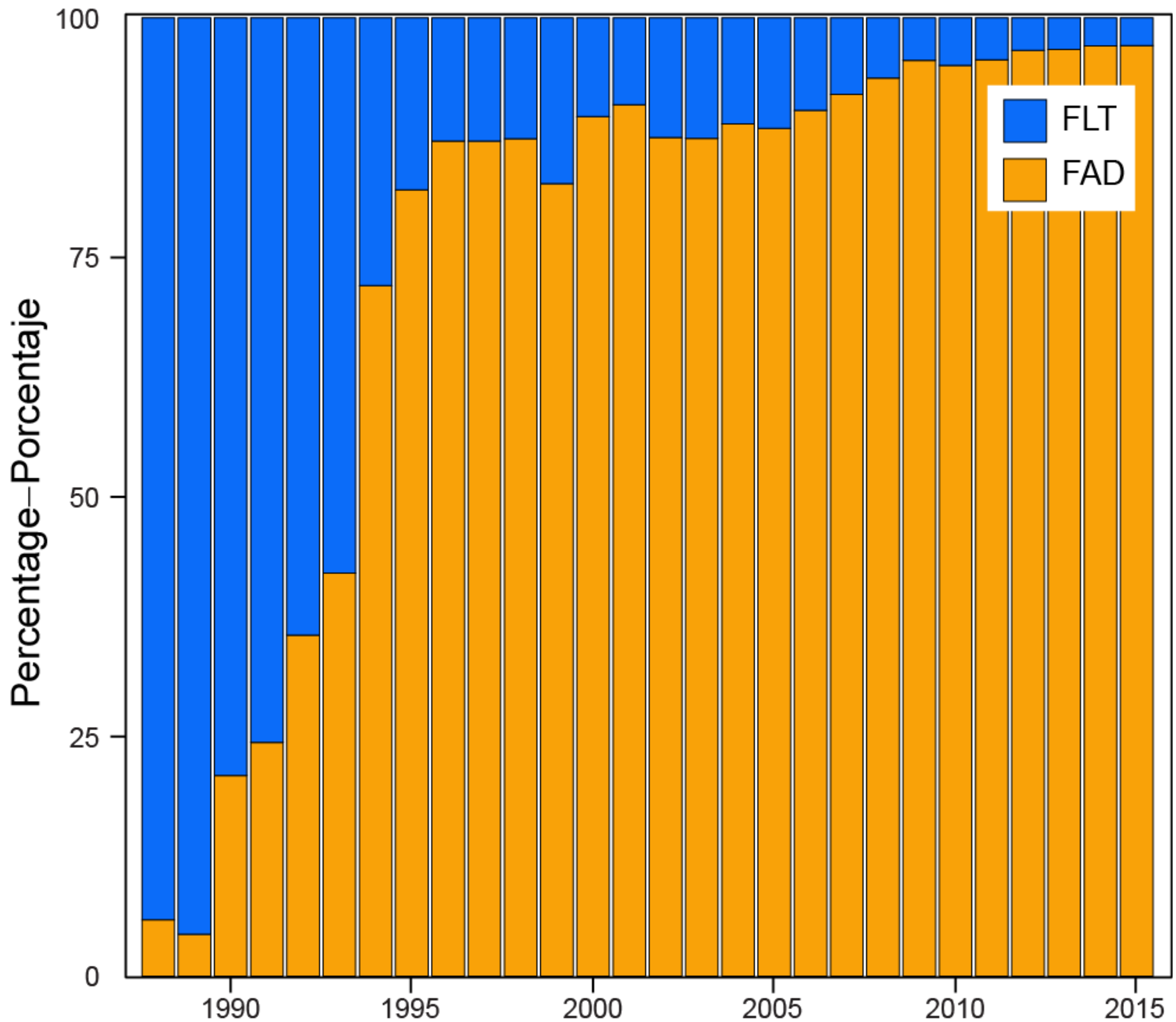

FIGURE 8. Percentages of sets by Class-6 vessels made on FADs and on natural floating objects (FLT), 1988-2015.

FIGURA 8. Porcentajes de lances por buques de clase 6 realizados sobre plantados (FAD) y objetos flotantes naturales (FLT), 1980-2015.

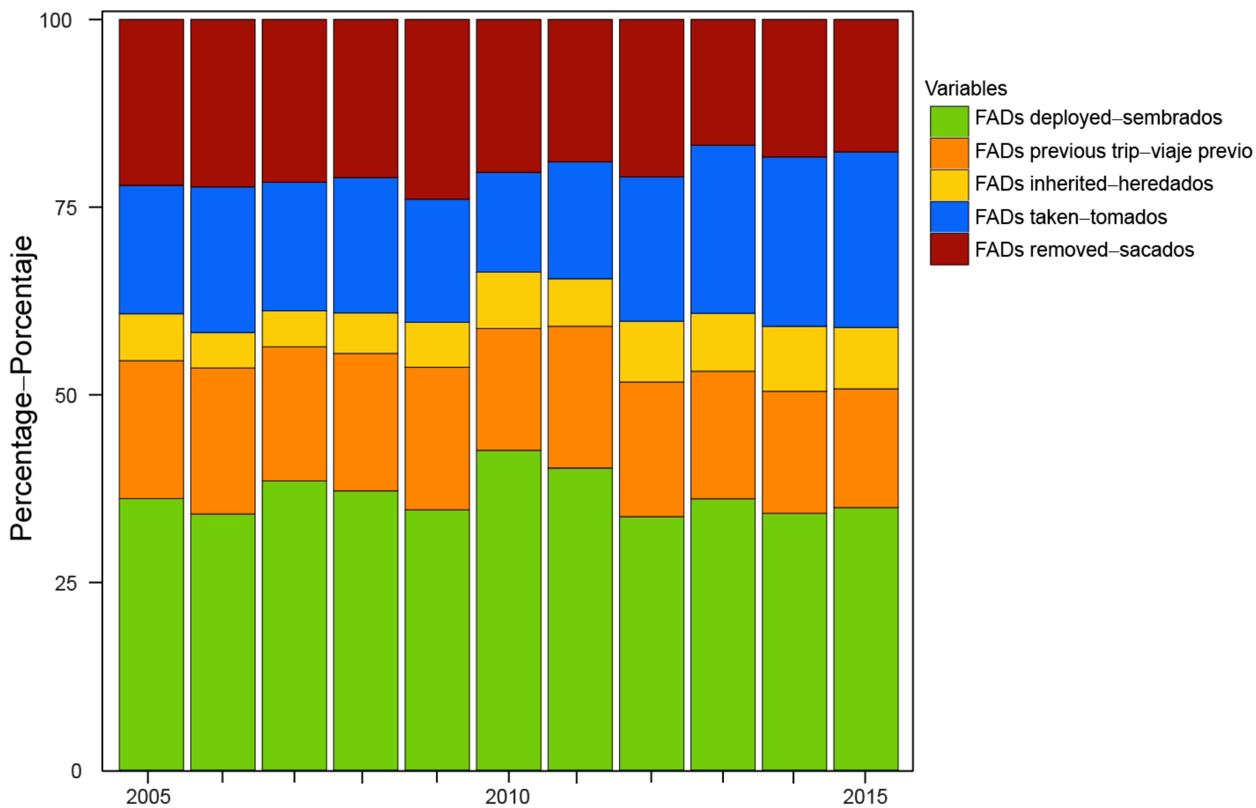

FIGURE 9. Percentage of FAD interactions by Class-6 vessels fishing in the Class 1-5 vessels' area of operation.

FIGURA 9. Porcentaje de interacciones con plantados por buques de clase 6 que pescan en la zona de operación de los buques de clases 1-5.