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A REVIEW OF FISHERY DATA AVAILABLE FOR SMALL PURSE-SEINE VESSELS, WITH EMPHASIS ON FADs

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1. SUMMARY

This document presents an updated review of the catch and effort data available for small (≤ 363 t carrying capacity) purse-seine vessels. Because trips by small vessels are rarely sampled by observer programs, the vessel's logbook and cannery unloading records continue to be the principal sources of data. However, they do not provide information on tuna discards, and, unlike data collected by onboard observers, which are available in near real-time, cannot be obtained until the trip finishes and the vessel unloads. These deficiencies could be problematic in the implementation of Resolution C-17-01, which requires near real-time monitoring of tuna catches, by species. Moreover, information on catches of non-target species is not always recorded in logbooks, which hampers efforts to conduct even data-limited assessments for such species. A formal, full-year observer sampling program would be needed to estimate catches of non-target species, and to obtain a better understanding of the strategies and dynamics of small vessel operations. Electronic Monitoring Systems might be useful for obtaining some of the data that observers collect on large vessels, and for monitoring some aspects of compliance by small vessels, but experiments would be necessary to evaluate their efficacy.

2. 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 to some degree with a decreasing trend in purse-seine catch-per-set 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 further 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 accompanied by observers. Observer data provide important details about fishing activities and floating-object characteristics, and a lack of detailed information on the fishing activities of small vessels, particularly in relation to floating objects, may

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

adversely affect the management of the purse-seine fishery.

This document presents an updated 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.

3. 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 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 14, Table A-7). Fishing effort by small vessels overlaps in space with areas fished by large vessels, and in some of these areas the fishing effort on unassociated tunas was dominated by small vessels (Román *et al*. 2016). In addition, although catches by small vessels account for only about 11% (range: 8-21%) of the total purse-seine tuna catch in the IATTC catch and effort database (Figure 3), the amount of tuna caught by small vessels in these two set types in some areas was similar to, and in some years greater than, the amount caught by large vessels (Román *et al*. 2016).

Obtaining reliable, near real-time information on catches, both retained and discarded, becomes critical if tuna conservation measures are based on catch limits. Resolution C-17-01, adopted in February 2017, establishes limits on catches of yellowfin and bigeye by vessels of classes 4 to 6, by set type; once a limit is reached, that particular fishery is closed for the rest of the year. Moreover, the Director is required to notify the Members of an estimated closure date once the catch of these species is estimated to have reached 90% of the total catch limit in sets on floating objects or dolphins. In order to implement such species-specific catch quotas effectively, catches need to be monitored in near real-time. This is feasible for Class-6 vessels, which have observers aboard who send weekly catch reports by radio. These reports could easily be expanded to include tuna discards. However, logbook information for small vessels is currently not available until the vessel returns to port, and the real magnitude of the total catches by such vessels, including discards, is not known because data on discards are not recorded on IATTC logbook forms.

Resolution C-00-08, in force since 2000, prohibits all purse-seine vessels from discarding tuna simply because the fish are small, and this has reduced discards by Class-6 vessels to minimal levels in recent years. However, the level of compliance by small vessels with this measure is unknown. Electronic Monitoring Systems (EMS) might offer a solution: in experiments on large vessels, the difference between the retained catches recorded by the observer and by cameras located on the well deck was less than 5% (Krug *et al*. 2016), and the EMS also identified the small amount of discarded tuna recorded by the observer. However, the level of accuracy that EMS may achieve on small vessels, which have different space and equipment constraints, is unknown.

4. BYCATCH AND DYNAMICS ON FLOATING OBJECTS

4.1. Non-target species

Non-target species, including sharks, manta rays, and turtles, as well as fishes such as dorado, wahoo, *etc*., are caught incidentally by purse-seine vessels during normal fishing operations. Most of these species are caught with greater frequency, and in greater amounts, in sets on floating objects (IATTC 2015; Hall and Román 2013), although species like whale sharks and Mobulid rays are most commonly captured in unassociated sets (Hall and Román 2013). Small and large purse-seine vessels fish in overlapping areas using the same gear (Román *et al*. 2016and observer data from trips by small vessels show that bycatches also occur in unassociated and floating-object sets made by small vessels. However, detailed information on composition and amounts, by species, of such bycatches is rarely recorded in vessel logbooks (Duffy *et al*. 2016), usually the only source of information on the activities of small vessels. This lack of information on non-target catches by small vessels is problematic because the ability to conduct even data-limited assessments of these species for the EPO hinges on obtaining reliable biological, ecological, and catch information (Griffiths and Duffy 2017; Griffiths *et al*. 2017).

A formal year-round program of data collection by on-board observers would be needed to quantify these catches of non-target species, and to obtain a better understanding of the strategies and dynamics of small vessels fishing on floating objects. Observers are placed on small vessels only under certain limited circumstances, and the level of observer coverage has been very low (Figure 4), with no formal sampling design in place. It is noteworthy that during the last five months of 2016, observer coverage rose to almost 12%, when 45 trips by small vessels carried observers, 26 as a result of the requirements of Resolution C-17-01 and the other 19 voluntarily, as part of a short-term experimental program between the Ecuadorian national observer program and the International Seafood Sustainability Foundation (ISSF). Because most of these trips departed during the last five months of the year (Figure 5), they did not cover, for instance, the intensive fishing on floating objects that occurs off Ecuador and Peru during the first quarter of the year.

In some cases, EMS may be able to provide information on catches of non-target species when data from on-board 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, Krug *et al*. 2016), 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).

4.2. 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 6; IATTC 2017). Since 2008, more than 90% of all floating-object sets by large vessels are estimated to have been sets on FADs (IATTC 2017). This increase in fishing effort on FADs may be correlated with a decreased density of schools of bigeye in the EPO (Maunder and Aires-da-Silva 2016).

It is not known whether the floating objects involved in sets by small and large purse-seine vessels have similar characteristics. Observers aboard large purse-seine vessels collect detailed information on floating-object characteristics, including type (natural or FAD), dimensions and materials, sensing equipment attached to the object, 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 study the effects of FAD dimensions on both catch and bycatch; object depth has been found to be associated with increased chances of catching bigeye (Lennert-Cody *et al*. 2016), and is used in stock status indicator models for silky sharks (Lennert-Cody *et al*. 2016(1)). However, this type of information is typically not recorded in the logbooks of small vessels fishing on floating objects.

The areas of operation of small and large purse-seine vessels fishing on floating objects overlap (Román *et al*. 2016), but the extent to which the fishing dynamics of the two classes of vessels may be similar is unknown. The area where both small and large vessels make floating-object sets is characterized by high levels of FAD interactions by large vessels (Figure 7). 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 EMS could provide useful information in this regard. FADs are large objects, and would not be difficult to monitor by EMS, nor would their deployments and removals. As EMS technology evolves and is increasingly adopted by different fleets (Kennelly 2016), it is important to be aware of new approaches, and to keep the scientific community informed about the advantages and limitations of implementing EMS on tuna purse-seine vessels of all sizes (Román 2016).

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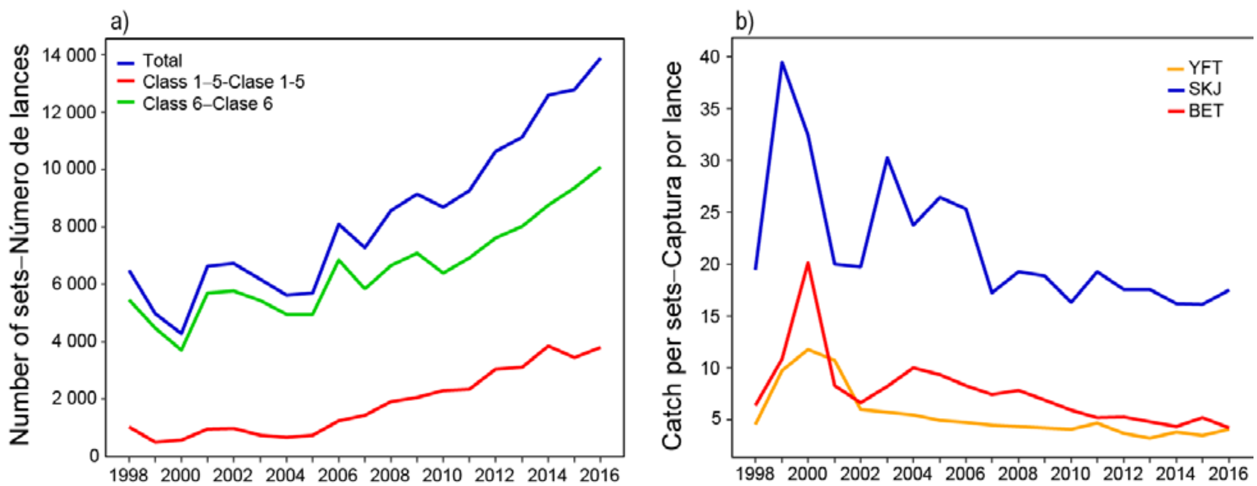

FIGURE 1. Number of floating-object sets, by vessel capacity class (a), and tuna catch, by species, in floating-object sets, in metric tons (b), 1998-2016.

FIGURA 1. Número de lances sobre objetos flotantes, por clase de capacidad del buque (a), y captura de atún, por especie, en lances sobre objetos flotantes, en toneladas (b), 1998-2016.

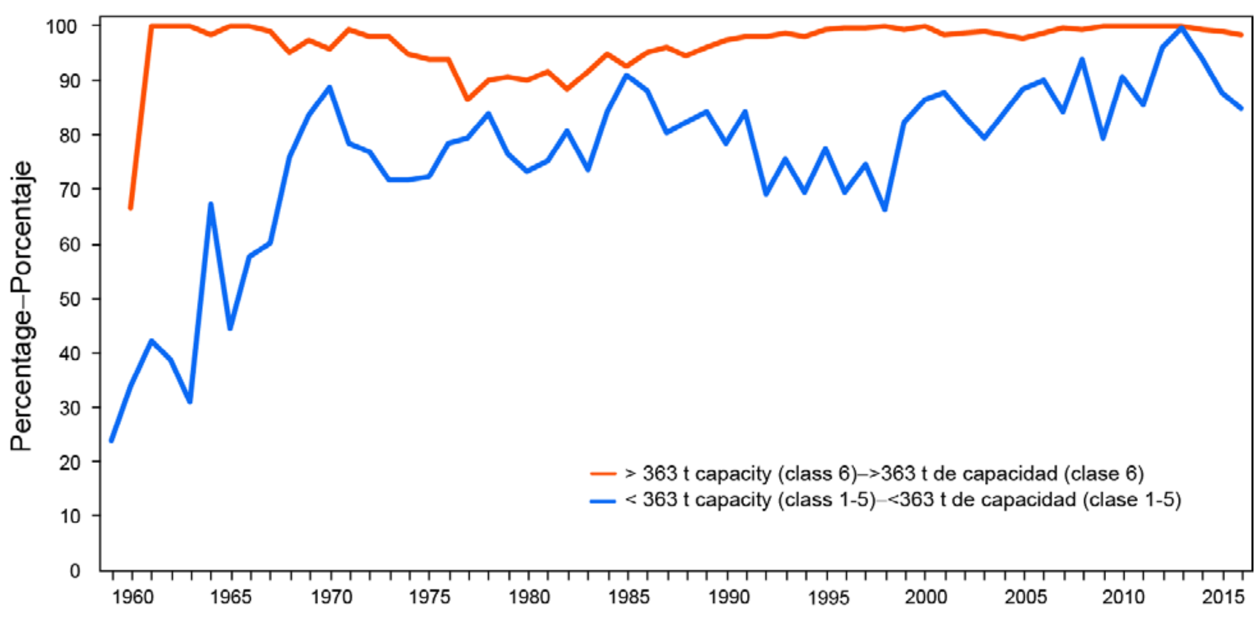

FIGURE 2. Percentage of trips with logbook information, by vessel capacity class, 1958-2016.

FIGURA 2. Porcentaje de viajes con información de bitácora, por clase de capacidad del buque, 1958-2016.

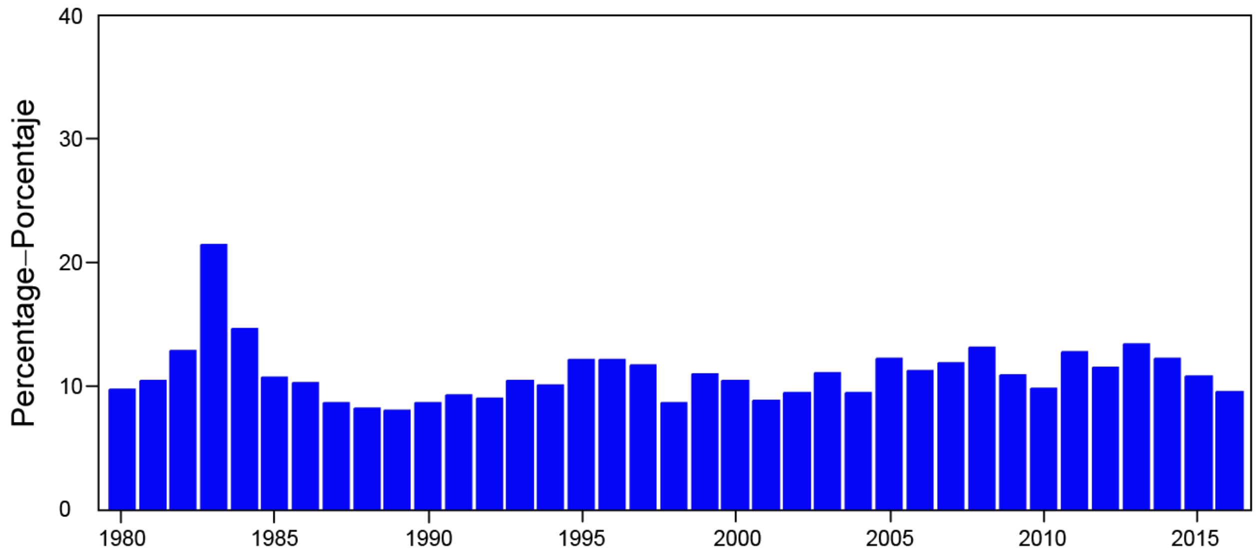

FIGURE 3. Percentage of total purse-seine catch of yellowfin, skipjack and bigeye tunas caught by Class 1-5 vessels, 1980-2016.
FIGURA 3. Porcentaje de la captura cerquera total de atunes aleta amarilla, barrilete, y patudo capturado por buques de clases 1 a 5, 1980-2016.

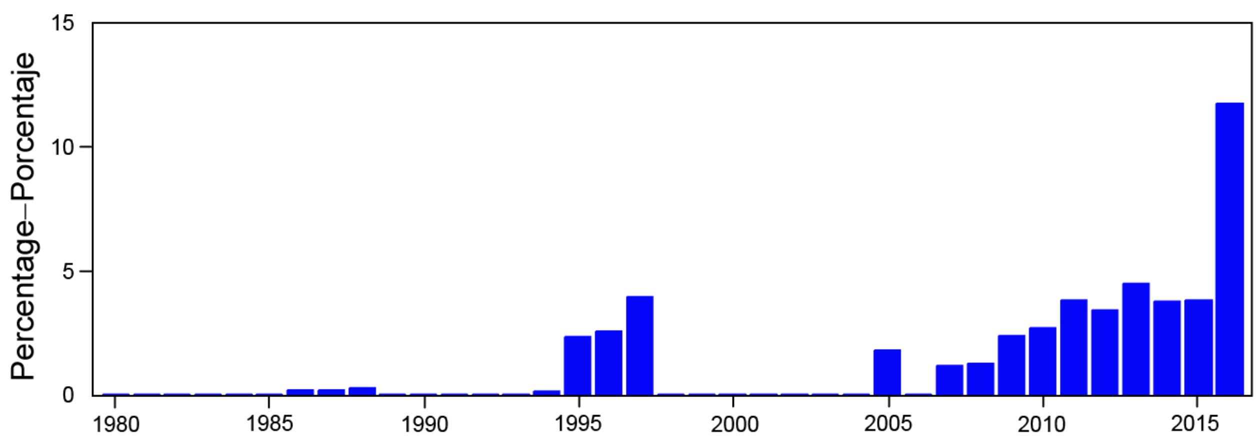

FIGURE 4. Percentage of trips by Class 1-5 vessels that carried an observer, 1980-2016.
FIGURA 4. Porcentaje de viajes por buques de clases 1 a 5 que llevaron observador, 1980-2016.

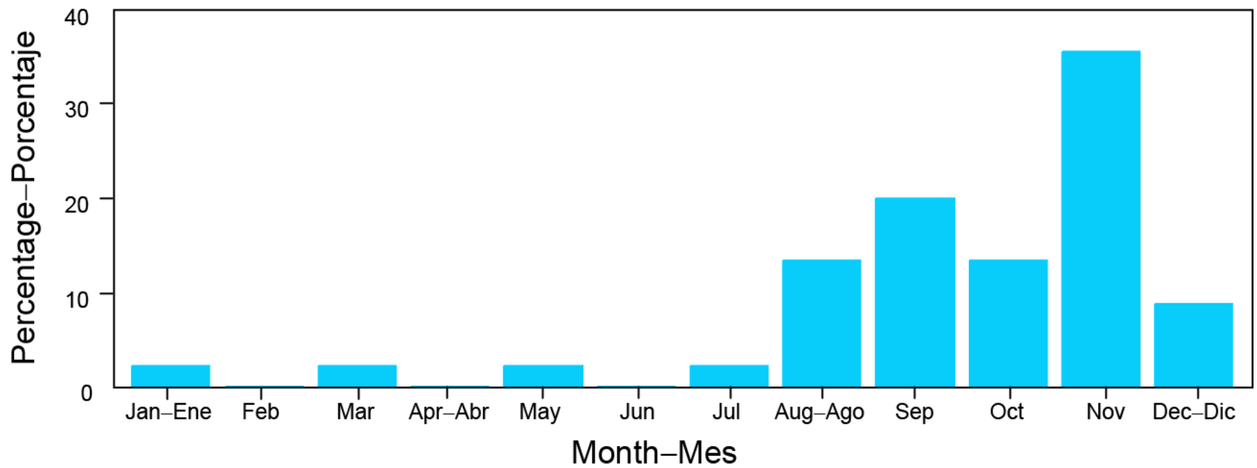

FIGURE 5. Percentage of trips by Class 1-5 vessels starting in 2016 that carried an observer.
FIGURA 5. Porcentaje de viajes por buques de clases 1 a 5 iniciados en 2016 que llevaron observador.

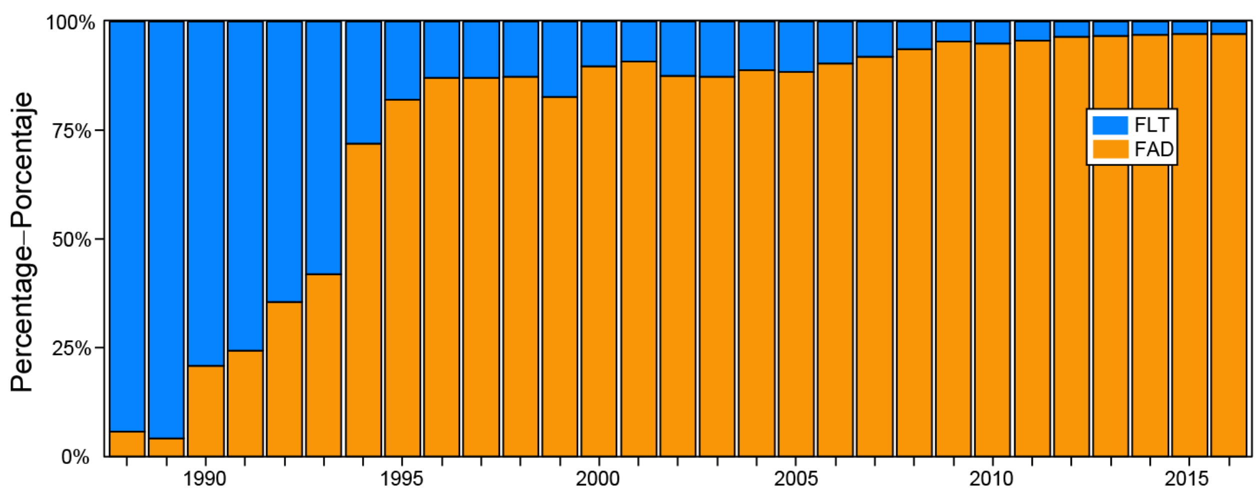

FIGURE 6. Percentages of floating-object sets by Class-6 vessels made on FADs and on natural floating objects (FLT), 1988-2016.
FIGURA 6. Porcentajes de lances sobre objetos flotantes por buques de clase 6 realizados sobre plantados (FAD) y objetos flotantes naturales (FLT), 1980-2016.

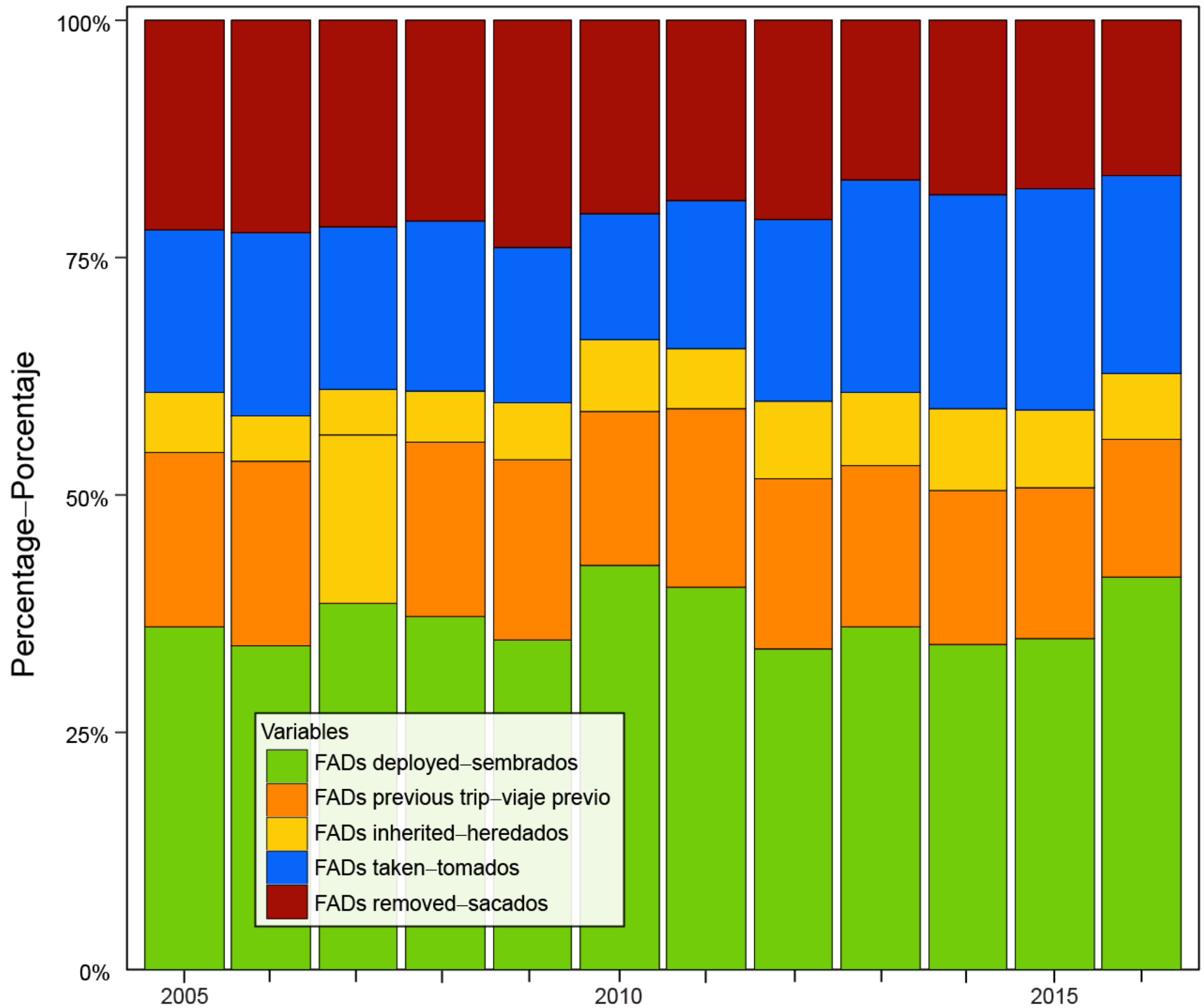

FIGURE 7. Percentage of FAD interactions by Class-6 vessels in the area of operation of Class 1-5 vessels.
FIGURA 7. Porcentaje de interacciones con plantados por buques de clase 6 en la zona de operación de los buques de clases 1-5.