Estimating Seabird Bycatch Rates in IATTC Industrial Longline Fisheries

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ABSTRACT

- The IATTC Resolution C-05-01[1] on incidental mortality of seabirds calls for the Stock Assessment Working Group to provide an assessment of the impacts of bycatches on seabird populations, the first step of which is to provide a total estimate of seabird bycatch rates within IATTC fisheries.
- This paper reviews the most recent rates of seabird bycatch reported for industrial longline fisheries within the IATTC area.
- There are significant gaps in the available seabird bycatch data, notably from CPCs such as Japan, Ecuador and Peru. However, the levels of observer coverage, and hence bycatch information, in other CPCs remains largely inadequate when faced with the task of estimating incidental seabirds bycatch.
- Currently, observer coverage within IATTC industrial longline fisheries is very low (typically <1% of effort, with the exception of Hawaii pelagic longline fisheries). Combined with the non-random distribution of observer effort throughout the area, this leads to severe restrictions in the ability to make estimates of overall seabird bycatch. An improvement in the level and spread of observer coverage would greatly enhance the ability of IATTC to estimate seabird mortality in its fisheries, and to reduce effectively seabird bycatch.
- Models combining fishing effort data, available bycatch rates and seabird distributions have been used to determine overall seabird bycatch within ICCAT

[1] http://www.iattc.org/PDFFiles2/C-05-01-Seabirds.pdf

longline fisheries (Klaer et al. 2008). A similar approach may be appropriate for IATTC in the future, when greater levels of observer data are available.

- Initial crude estimates would seem to suggest that upwards of 4,000 birds (5,000 including Chile[2]) are killed annually in industrial longline fisheries operating within IATTC waters. Although, as stated, this figure is subject to large data gaps and varying levels of data quality. Hence, it provides merely a rough estimate of minimum bycatch levels in order to illustrate the real need for greater data collection within IATTC.

1. INTRODUCTION

The seabird species most vulnerable to bycatch are albatrosses and larger petrels. Eighteen of the 22 species of albatross are threatened with extinction (BirdLife International 2008). It is recognised that, for most species, the key threat comes from incidental mortality associated with fisheries. The seven species of petrel (*Procellaria* species and *Macronectes* species) listed under the Agreement on the Conservation of Albatrosses and Petrels (ACAP), face similar threats. These species are extremely wide-ranging and a number of albatrosses and petrels have distributions that overlap considerably with the Inter-American Tropical Tuna Commission (IATTC) Convention Area (BirdLife International 2006). Analysis of albatross distribution within IATTC waters and their overlap with longline fisheries (BirdLife International 2006) identifies that the Waved Albatross (*Phoebastria irrorata*) distribution overlaps 100% with 5x5º grid squares in which IATTC longline fishing effort took place (see SAR-9-11b). The IATTC area is also highly important for non-breeding Black-footed Albatross (*P. nigripes*), New Zealand albatross species (which migrate across the South Pacific to rich foraging grounds in the Humboldt Current), and Black-browed Albatross (*Thalassarche melanophrys*) breeding in Chilean waters. There are also two small populations of Laysan Albatross (*P. immutabilis*) that nest on the Mexican islands of Isla de Guadalupe (350 breeding pairs, BirdLife International 2004) and Isla Clarion (~50 pairs, Ross Wanless pers comm.).

Within the IATTC area, the overlap between seabird distribution and IATTC longline fishing effort is high for all species, with the exception of that in the far south of the IATTC area. The majority of albatross species are distributed widely over the Pacific, spanning both WCPFC and IATTC Convention Areas, indicating that there is likely to be a need for coordination

[2] Chile is not a signatory to IATTC, and hence has been excluded from any estimate of IATTC fisheries seabird bycatch. However, this fishery does occur within the IATTC area and therefore should be recognised in any estimate of seabird bycatch for the region.

between the two Commissions regarding data sharing on such issues as seabird bycatch rates and observer protocols.

Reliable seabird bycatch data largely come from established observer programmes, some of which are specifically targeted at collecting seabird bycatch data (e.g. the Albatross Task Force[3]). However, useful seabird bycatch data can also come from national and regional observer programmes that record other forms of bycatch and/or target catch data where sufficient training in seabird identification and data reporting protocols have been established. Ultimately, for a reliable assessment of the impact of IATTC industrial longline fisheries on seabird populations residing and/or utilizing the region, identification of bycatch to species level is a requirement.

2. METHODS

A review was undertaken of available published and unpublished literature on seabird and fishery interactions to obtain a comprehensive list of bycatch data from fisheries within IATTC fisheries. The data presented here were chosen to reflect current known bycatch rates in IATTC fisheries. However, considerable data gaps exist for bycatch rates within large portions of the fishery, and with observer coverage typically low (although there are exceptions within some specific fisheries, e.g. Hawaii longline 'deep-set' tuna fishery), there is a need for greater efforts in both bycatch data collection and observer coverage in IATTC fisheries.

Where possible, bycatch rates, in the form of birds per 1,000 hooks, were taken direct from the literature referred to in Table 1. Where extrapolations were necessary, these are indicated throughout Table 1 in parentheses. Some sources report total birds caught within a fishery, (e.g. the Hawaii 'shallow-set' fishery where there is 100% coverage), while others report estimate bycatch rates (based on observer records for a proportion of hooks within a fishery) and total fishing effort. Where the latter is the case, a total bycatch estimate for a fishery was calculated by multiplying the bycatch rate per 1,000 hooks by the total fishing effort (in 1,000 hooks) reported for the fishery (such extrapolations are indicated by parentheses in Table 1). Total fishing effort data predominantly came from IATTC-75-06. A concerted effort was made to achieve consistency when comparing years for which bycatch rates were available and those for which total fishing effort were available, on a country-by-country basis. However, this was not possible, in all cases, due to the nature of data available.

[3] http://www.savethealbatross.net/

For some fisheries, e.g. Taiwan, data were reported for the whole of the Pacific rather than specifically for the IATTC region. This made compatibility of observer coverage, fishing effort, and bycatch rates problematic.

3. RESULTS

3.1 Available seabird bycatch data

Data on the most recently available bycatch rates are summarised in Table 1. Although many of the CPCs that fish within IATTC waters have observer programmes to some degree, the level of observer coverage is generally very low (Table 2). Typically, programmes have observer coverage c. <1% of their fleet.

3.2 Estimating total seabird bycatch

Estimates of total seabird bycatch must be considered extremely provisional given the data constraints. However, provisional estimates of seabird bycatch by fleet are shown in Table 1 and discussed below by region (**North-eastern Pacific, Central-eastern Pacific, South-eastern Pacific)**.

Table 1. Review of all published and unpublished data on bycatch rates within IATTC industrial longline fisheries. All data included comes from observer records, and where more that one study is available for a particular fishery, the most reliable and/or up-to-date study was included. (Data in parentheses have been extrapolated by the author from published bycatch rates and fishing effort data for the period described).

Region	**Country**	**Fleet**	**Target**	**Fishery Scale**	**Year**	**Effort** (hooks/year)	**BPUE** (Birds/1,000 hooks)	**Total estimated Seabird Bycatch** (individuals)	**Estimated Albatross**	**Estimated Petrel**	**Estimated Shearwater**	**Observer Effort** (hooks/yr, % of fleet)	**Sources**
FAO Area 87	Chile§	Pelagic	Swordfish	Industrial	2007	2,500,000	[0.21-0.37]	517-923	[408-729]	[109-194]	[0]	90,000	Moreno et al 2007 ATF report
IATTC Area, 3-17ºS, 96-146ºW	China	Pelagic	Bigeye Tuna	Industrial	2003	43,289,000	[0.02]	[866]				304,390	Dai et al. 2006, IATTC-75-06
	Ecuador			Industrial								0	Martin Hall (pers comm.)
IATTC Area	Japan	Pelagic	Tuna, Swordfish	Industrial	2005	71,679,000	[0.02]†	[1434]†				0	IATTC-75-06
EPO, 5º42'-11º23'S, 123º39'-146º43'W	Korea	Pelagic	Tuna	Industrial	2004-2005	36,345,000	[0.02]	[727]				51,533	Moon et al. 2005
3-10ºS, 80-86ºW	Peru	Pelagic	Dolphinfish	Industrial	2006-2008		0	0				310,921	Ayala et al. 2008
IATTC Area, 15-40ºS, 75-120ºW	Spain	Pelagic	Swordfish	Industrial	1998-2005	6,496,008	0.04	[260]				2,153,000	Mejuto et al. 2007; Mejuto & Garcia-Cortes, 2005
IATTC Area	Taiwan	Pelagic	Tuna	Industrial	2005	38,345,000	0.016	[614]				[0.6%]*	Chang et al. 2007; Huang et al. 2008
USA West Coast	USA	Pelagic	Swordfish, Tuna	Industrial	2001-04		0.23					348,914	Rivera, 2006, IATTC-SAR-7-05c
Hawaii	USA	Pelagic	Tuna	Industrial	2005	33,600,000‡	0.004	125	125			26%	Rivera, 2008, IATTC-SARM-9-11a
Hawaii	USA	Pelagic	Swordfish	Industrial	2005	1,300,000‡	0.04	69	69			100%	Rivera, 2008, IATTC-SARM-9-11a

* Percentage observer coverage calculated from fishing effort and observer statistics for the entire Pacific.

† Bycatch rate taken from similar fisheries in IATTC (Korea and China) to allow estimation of total bycatch.

‡ Fishing effort reported for large sections of the Pacific (0-45ºN, 125-180ºW), not just IATTC area.

§ Not a signatory to IATTC, but with longline fisheries operating in the region.

Table 2. Observer coverage within IATTC industrial longline fisheries.

Observer programme	**Coverage**
China	• Chinese industrial pelagic longline tuna fishery. 304,390 hooks observed in 2003. Equates to **0.7%** of fishery.
Ecuador	• Ecuador's industrial pelagic longline fishery has no reported observer programme.
Japan	• Japanese industrial pelagic longline fishery has no reported observer programme in IATTC region.
Korea	• 51,533 hooks observed in 37 days from Dec 2004 to Jan 2005. Equates to **0.14%** of fishery.
Peru	• In the Peruvian industrial longline dolphinfish fishery, 310,921 hooks were observed from Nov 2007 to Feb 2008.
Spain	• 2,153,000 hooks observed predominantly between 1998-2005, although some from 1990. Equates to c. 269,125 hooks observed per annum (provided equal effort in each year). Annual fishing effort 6,496,008 (average for 2002 and 2003). Equates to c. **4%** of fishery.
Taiwan	• 23 trips between 2002-05. Average fishing effort is 5,387 thousand hooks. Average observer effort is 722 thousand hooks. Equates to c. **0.6%** of fishery (both eastern and western Pacific areas combined).
USA (West coast)	• The USA (West coast) longline fishery currently has only one 'deep-set' tuna vessel in its fleet and this vessel has **100%** observer coverage.
USA (Hawaii)	• Hawaiian 'shallow-set' swordfish longline fisheries require **100%** observer coverage. • Hawaiian 'deep-set' tuna longline fisheries maintain at least **20%** observer coverage.
Chile*	• Observer programme run by Instituto de Fomento Pesquero (IFOP) on Chilean industrial pelagic longline fleet since 2001. Since 2008, **100%** observer coverage required to report seabird bycatch.

*****Not a signatory to IATTC, but country with fisheries and seabird bycatch within the IATTC region.

3.2.1 NORTH-EASTERN PACIFIC

USA West Coast

The fleet of industrial pelagic longline vessels, based primarily out of California, fish for both tuna and swordfish. These vessels comprise a smaller fleet than that based out of Hawaii, with only one vessel fishing pelagic longline gear out of California since April 2004 when the new regulatory requirements came into force (i.e. prohibiting both shallow and deep sets in the US EEZ) (Rivera, 2006). Data from observer trips between October 2001 and February 2004 recorded 79 incidents of bycatch across 348,914 hooks observed. This equates to a bycatch rate of 0.23 birds/1,000 hooks (L. Enriquez, cited in Rivera, 2006). More recent bycatch rates (since the fishery reduced to one vessel) are likely to show reduced numbers of birds being caught due to the reduction in the size of the fishery.

3.2.2 CENTRAL-EASTERN PACIFIC

Hawaii

Some of the most comprehensive observer coverage, and therefore seabird bycatch data, occurs in the Hawaiian pelagic longline fisheries that operate predominantly in waters between 3-37ºN and 132-173ºW (tuna vessels), and between 12-43ºN and 127-178ºW (swordfish vessels). Vessels targeting swordfish (shallow-set) are required by US law to have 100% observer coverage. Those vessels targeting tuna (deep-set), and which operate north of 23ºN, are required to have 5% observer coverage, but usually the true coverage well exceeds this minimum and is typically c. 20%. Following the adoption of mandatory mitigation measures, seabird bycatch rates have declined from c. 2,300 albatrosses per year in the late 1990s to less than 200 in 2005 (Clemens, 2006). During 2005, the total estimate take of albatrosses in the deep-set fishery was 125 (c. 0.004 birds/1,000 hooks) and 69 in the shallow-set fishery (c. 0.04 birds/1,000 hooks). As this fishery has 100% observer coverage, this estimated total bycatch figure also represents the true total bycatch for the fishery for the year (Rivera, 2008).

Taiwan

The Taiwanese industrial pelagic longline fleet operates in eastern, central, and western Pacific regions. Huang et al. (2008) report seabird bycatch rates to be highest in the areas between 25-40°N and 165°W-165°E, and between 25-35°S and 165-180°W. Taiwan commenced its observer programme in 2002 in the Pacific Ocean. Observer effort averaged 722,000 hooks per year between 2002-05 (see Chang et al. 2007). This equates to c. 0.6% observer coverage for the entire pelagic longline fleet, which had an average fishing effort of 118,206,000 hooks per year for the Pacific Ocean (Huang et al. 2008). Unfortunately, observer coverage rates within IATTC alone were not available. Hence, levels of observer coverage in this area have been assumed comparable to those of the entire Taiwanese Pacific fleet (0.6%). However, bycatch rates are reported specifically for the Eastern Pacific Ocean (EPO), and hence provide bycatch data for Taiwanese pelagic longline vessels operating in IATTC waters. Bycatch rates for the EPO in 2005 were 0.016 birds/1,000 hooks (Chang et al. 2007). Fishing effort data for the Taiwanese pelagic longline fleet operating in the EPO is reported to be 38,345,000 hooks in 2005 (IATTC-75-06). This equates to an estimated total seabird bycatch for 2005 of 614 birds (see Table 2).

Korea

Korea began to develop an observer programme within their distant-water fleet in 2002, but have only recently began to place observers on their pelagic longline vessels (Moon et al. 2005). Thus far, this has predominantly focused on vessels fishing within WCPFC waters, however one observer was deployed on a Korean longline vessel fishing in the EPO (between 5°42'-11°23'S and 123°39'-146°43'W). Between December 2004 and January 2005 51,533 hooks were observed (Moon et al. 2005), representing c. 0.14% of the Korean fishery within IATTC (calculated as a percentage of average effort from 2004-05, i.e. 36,345,000 hooks as reported in IATTC-75-06). A bycatch rate was calculated based on the number of birds caught compared to the total number of hooks observed in the study (0.02 birds/1,000 hooks), which equates to total seabird bycatch estimate of 727 birds per year (see Table 2). As only one albatross was caught during the observer study, this extrapolation may prove questionable. However, it should be noted that this bycatch rate is comparable to other longline fleets operating in IATTC waters (e.g. Taiwan). Further data, resulting from greater levels of observer coverage, would be useful in refining this bycatch rate for the Korean pelagic longline fleet operating in IATTC waters.

China

China commenced its observer programme in the EPO in 2003. Data were collected for the period July-November 2003 within an area covered by IATTC, i.e. 03-17°S, 96-146°W (Dai et al. 2006). Six seabirds were caught incidentally during 304,390 hooks observed in 110 fishing days. This equates to a seabird bycatch rate of 0.02 birds/1,000 hooks for the Chinese pelagic longline fishery operating in IATTC waters. Fishing effort for the same year as this observer study (2003) was 43,289,000 (IATTC-75-06). Based on the available data, a multiplication of bycatch rate by fishing effort data gave a provisional bycatch estimate of 866 birds per year.

Japan

Seabird bycatch rates for the Japanese pelagic longline fleet operating within IATTC are difficult to determine, given that no targeted observer programme is currently in place for this fleet. One possible way to obtain a rough estimate of seabird bycatch within this fishery, (and one that we have used in this instance), is to take bycatch rates from a similar longline fishery operating in IATTC waters (both Chinese and Korean fleets report bycatch rates of 0.02 birds/1,000 hooks) and extrapolate an estimate for the Japanese fleet. This is clearly not an optimal method, and we would suggest that observer coverage been increased in this fleet as soon as possible, in order to provide more accurate bycatch figures for the fleet. However,

based on such an extrapolation, a potential 'guesstimate' of bycatch for this fishery for 2005 would be c. 1,434 birds. This was calculated using a likely bycatch rate of 0.02 birds/1,000 hooks multiplied by total fishing effort for the Japanese longline fleet in the EPO (71,679,000 hooks, taken from IATTC-75-06). However, as mentioned, this figure should only be treated as a rough proxy, and should be revised as soon as updated bycatch data are available.

3.2.3 SOUTH-EASTERN PACIFIC

Peru

Peru has both artisanal and industrial pelagic longline fleets operating in IATTC waters. For the purposes of this study, we have focused solely on bycatch in industrial longline operations, hence the data presented here related purely to this type of fishery. Ayala et al. (2008) placed observers on Peruvian industrial pelagic longline vessels from November 2007 to February 2008. Observers were deployed on 13 trips (departing from the port of Paita, Peru) and observed 310,921 hooks across 128 sets. This fishery predominantly targets dolphin fish (*Coryphaena hippurus*) and operates between 3-10°S and 80-86°W. No seabirds were caught as bycatch throughout the duration of this study. However, observers do report *Procellaria* sp. attempting to take bait from hooks, and so some degree of bycatch remains a possibility within this fishery. Total fishing effort for this fishery is currently not available through IATTC records, as Peruvian industrial and artisanal fishing effort are not reported separately (this is also the case for Chile, Ecuador, and a number of other countries that fish in IATTC waters).

Chile

While Chile is not a signatory member under IATTC, Chile does have both artisanal and industrial pelagic fisheries operating in IATTC waters. Fishing effort for the industrial longline fleet (which predominantly targets swordfish) in 2007 was 2,500,000 hooks over 1,118 sets in 46 trips (Moreno et al. 2007). This study also estimated a minimum and maximum bycatch per annum of 517-923 birds for the fishery (Moreno et al. 2007), which equates to a bycatch rate of 0.21-0.37 birds/1,000 hooks. The ATF study observed 90,000 hooks, which equates to c. 3.6% of the total fishery at that time. They reported albatrosses made up 79% of birds hooked with petrels making up the remaining 21%. They also noted wandering albatrosses (*Diomedea exulans*) were the species most frequently caught. The fleet does have a national observer programme, which commenced in 2001 and is operated by the Instituto de Fomento Pesquero (IFOP). From 2008, the IFOP observer programme has collected data on seabird bycatch rates and achieved 100% observer coverage across the

Chilean industrial pelagic longline fleet. However, data from this period are not yet available (Yates, pers comm.).

Ecuador

Ecuador is listed under the 'other' category for IATTC longline effort data (IATTC-75-06), and so it is not possible from this to extract effort data solely for the Ecuadorian industrial longline fleet. Equally, there are no known observer programmes currently operating in this fleet, and hence no known bycatch data specific to this fleet. There are some data on seabird bycatch rates from the Ecuadorian artisanal longline fleet, however without greater levels of observer coverage it would not be appropriate to draw conclusions on bycatch rates between the two.

Spain

Data are available for the Spanish industrial longline fleet that predominantly fish for swordfish in IATTC. Mejuto et al. (2007) report an interaction (and mortality) rate of 0.04 birds/1,000 hooks. They also report observer effort for 1990 and for the 1998-2005 period. 2.153 million hooks were observed within IATTC for these two periods, but observer effort was not listed by annual totals. The reportage of observer and bycatch rates by year and by 1,000 hooks would greatly increase the ease of comparisons between different fleets within IATTC and other RFMOs. Mejuto and Garcia-Cortes (2005) report fishing effort data for the Spanish longline fleet in the Pacific for 2002 and 2003. The average fishing effort over these two years for the entire Pacific was 6,496,008 hooks, however maps supplied of Spanish fishing effort in the Pacific demonstrate that activity occurs exclusively within the IATTC area, and so total fishing effort for the Pacific is actually total fishing effort for IATTC at this time. Fishing effort for this fleet expanded westward considerably in 2004 and 2005 (see Mejuto et al. 2007), and so after 2003 total fishing effort for the Pacific should not be considered to represent exclusively fishing effort for the Spanish fleet within IATTC alone. Using the seabird bycatch rate of 0.04 birds/1,000 hooks reported for this fishery, combined with an average of fishing effort data for 2002 and 2003, we calculate that c. 260 birds are killed annually through interactions with the Spanish industrial longline fleet operating in IATTC.

4. DISCUSSION

4.1 Data gaps

Given the remaining data gaps highlighted by this review, (e.g. Chile, Ecuador, Peru, and Japan) it is not appropriate to estimate a total seabird bycatch figure for all industrial longline fisheries operating within IATTC. However, broadly speaking these results indicate that upwards of 4,000 seabirds are killed annually within those fisheries that already report bycatch data to some degree (see Table 1). These estimates are **provisional** and are intended to highlight data gaps, rather than be relied on for accurate estimates of seabird mortality within particular fisheries. We have tried to avoid estimating seabird bycatch for those fisheries/effort for which we have no data. However, it is possible that bycatch does occur within these fisheries to some degree, despite the lack of reportage. Despite the obvious caveats, these provisional estimates would seem to suggest a significant bycatch problem within IATTC, particularly given that a considerable proportion of the birds being caught are long-lived, slow reproducing albatrosses, such as the Critically Endangered Waved Albatross.

4.2 Seabird bycatch within artisanal longline and gillnet fisheries

This report has focused specifically on seabird bycatch associated with industrial longline fisheries operating in the IATTC area. This is largely because of a lack of consensus on seabird bycatch rates associated with artisanal longline fisheries operating in IATTC waters combined with a lack of reliable data, although a number of (albeit small) studies do exist. Several of these studies point to considerable numbers of seabirds being caught as bycatch. Equally, levels of bycatch in artisanal gillnet fisheries are also highly variable and/or unknown, as few comprehensive surveys exist. Often data are reliant on fisher interviews from small subsets of communities. Hence, levels may be under or over represented depending on the particular regions included in the surveys. Again, some data do suggest the potential for seabird bycatch to occur among artisanal gillnet fisheries operating in IATTC. Hence, there is likely a need for increased research and observer coverage targeted at examining the issue of seabird bycatch within both artisanal longline and gillnet fisheries.

4.3 Seabird bycatch within illegal, unregulated and unreported fisheries

Currently, there are 22 vessels listed as falling under the Illegal, Unregulated or Unreported (IUU) category on IATTC records[4]. However, the true number of IUU vessels operating in IATTC waters is likely to be far higher, given the nature of IUU activity. The vessels currently listed are predominantly longline vessels, and so are likely to have equal (or higher) rates of bycatch than those regulated industrial longline vessels already fishing within IATTC waters. A typical bycatch rate for IATTC would seem to be c. 0.02 birds/1,000 hooks (see Table 1). Working with a likely underestimate of IUU vessels operating in IATTC waters (22 vessels) and assuming a bycatch rate of 0.02 (as reported for number of other regulated fisheries in the region) we estimate a fishing effort from IUU of upwards of c. 4 million hooks[5]. This equates to a minimum of c. 80 birds caught from IUU vessels per annum, although true numbers are likely to be considerably higher.

4.4 CONCLUSIONS

(1) Available bycatch data indicate that **seabird bycatch does occur** within **IATTC industrial longline fisheries**, including those operating in tropical regions.

(2) A crude examination of fisheries for which some level of bycatch data are collected and reported, indicates that **upwards of 4,000 birds** are killed annually within IATTC industrial longline fisheries. However, without a systematic approach to data collection, it is impossible to say how far this likely minimum is from the true total bycatch for IATTC as a whole.

(3) The review also demonstrates the need for all CPCs to **report fishing effort** (1,000 hooks/yr), **observer coverage** (1,000 hooks/yr), and **bycatch rates** (birds/1,000 hooks) on a **consistent basis**.

(4) It highlights the importance of CPCs **reporting data** exclusively for the **IATTC region**, and not (as is currently often the case) for the whole of the Pacific or large sections of the Eastern Pacific Ocean, which include regions not covered by IATTC. Such methods of reporting make it extremely difficult to assess the impacts of a particular fishery on seabirds within the IATTC area on an annual basis.

(5) Without a systematic framework in place to **collect standardised data** on seabird bycatch rates, it is difficult to effectively assess the true impact of particular fisheries within IATTC on seabird populations.

[4] http://www.iattc.org/VesselRegister/IUU.aspx?Lang=en
[5] Extrapolated from Korean effort of 36,345 thousand hooks across 202 registered longline vessels.

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