# Summary of seabird bycatch rates recorded in the Western and Central Pacific

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**Abstract**
This paper summarises data on seabird bycatch rates in pelagic longline fisheries within the Western and Central Pacific, including data from vessels using seabird bycatch mitigation measures.

**Seabird bycatch data**
Table 1 summarises seabird bycatch data from observer programs on pelagic longline fisheries in the Western and Central Pacific. This table represents a work in progress: some data are not yet included.

The data highlight four key points:

1. Seabird bycatch rates are highly variable, but high levels have been recorded on vessels where no seabird bycatch mitigation measures are being used (Table 1a).

2. Data highlight the effectiveness of a range of seabird bycatch mitigation measures in reducing seabird bycatch (Table 1b). Comparisons of the effectiveness of seabird bycatch mitigation measures are best obtained from experimental designs (e.g. Table 2). Such experiments have recorded an 80-100% reduction in seabird bycatch rates using mitigation measures such as setting hooks at night, streamer (tori) lines, weighted branch lines, blue-dyed bait and strategic discharge of offal. Side setting is a measure which is still in development, but which has also proven effective in trials in Hawaii.

3. The variability of seabird bycatch rates in part reflects the stochastic nature of seabird bycatch, but also the seasonal and spatial clustering of seabird abundance, environmental variability, the significant effect of small differences in fishing gear configuration, and differences in methods of data collection by observers. The development of standardized methods for recording seabird bycatch within WCPFC's regional observer program for longline fisheries will be highly important in helping to reduce this variability and/or understand the factors that cause it. A high initial % coverage by observer programs is necessary if statistically rare events such as bycatch of seabirds and turtles are to be adequately recorded. The experience from CCAMLR has demonstrated that a good approach may be a coverage of c.20% over a limited period (e.g. 2 years), in order to assess bycatch levels.

4. The majority of the data presented here are from the Australian and New Zealand EEZs or from Hawaiian fleets. There are currently few seabird bycatch data available from high seas areas.

**Issues for consideration by the Ecosystem and Bycatch SWG**
Bycatch mitigation measures exist which can dramatically reduce seabird bycatch rates in demersal longline fisheries (as demonstrated by CCAMLR), and which are also effective in pelagic longline fisheries. However, the nature of pelagic longline gear (e.g. long branch lines, less line weighting) means that it has an inherently slower sink rate than demersal gear. Vessels targeting swordfish will also often use squid bait and light sticks which increase buoyancy further. These characteristics must be taken into account in order to design effective seabird bycatch mitigation strategies.

Research into seabird bycatch mitigation measures for pelagic longline fisheries is still underway. Measures currently under development include side setting (Gilman 2004; Yokota & Kiyota 2006), bait capsules (Graham Robertson pers comm.), bait pods (Ben Sullivan pers comm), and refinement of tori line designs for pelagic systems (Ed Melvin pers comm). Fisheries (e.g. swordfish, tuna) also differ in the measures that are best-suited for bycatch reduction (for example, night setting being a feasible measure within swordfish fisheries which fish at night).

WCPFC will be best placed for establishing requirements for seabird bycatch mitigation measures once results are available from the research that is currently underway. However, seabird bycatch data clearly demonstrate that bycatch mitigation measures can be significantly reduced using measures which are already available. The US, Australia and Japan have already adopted requirements for their fisheries that require vessels to use a combination of seabird bycatch mitigation measures. Until results are obtained from current research, the best approach for WCPFC is likely be a requirement for longline vessels fishing in areas north of 15ºN and south of 25ºS to use a tori line of explicit design, or side setting, combined with one other mitigation measure such as night setting, weighted branch lines or dyed bait, coupled with recommendations on, for example, offal discharge and thawing of bait. Further results from mitigation experiments should be available in 2007-2008.

In the WCPFC, the role of observer programmes using standardised data collection protocols will be critical to understanding the nature and scale of seabird bycatch and the effectiveness of mitigation measures.

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**Table 1. Seabird bycatch data collected by observer programs on pelagic longline fisheries in the Western and Central Pacific**

**Table 1a. Seabird bycatch rates on vessels with no seabird bycatch mitigation measures**

| **Region** | **Fishery** | **Target** | **Gear type** | **Bait** | **Mitigation measures** | **Time of set** | **Depth** | **Date** | **Seabird bycatch per 1000 hooks** | **Hooks observed** | **Notes** | **Reference** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia EEZ | Japanese pelagic longline | SBT | 40m branch lines, unweighted. | Squid or fish | None | Usually early AM | 60-150m | 1988 | **0.43** | 76,178 | During winter, near Tasmania | Brothers 1991 |
| New Zealand EEZ | Japanese pelagic longline | SBT | Branch lines usually 35m | | | | 60-180m | 1988-1990 | **0.32** | Approx 822,795 | Observations during winter. 2.7% of hooks observed | Murray et al 1993 |
| US | US pelagic longline fleet based in Hawaii | SWO | Monofilament American Longline system. 4-6 hooks between floats. Light sticks. | Squid | None | 'Night' | 30-90m | 1994-2002 | **0.26** | 406,266 | Data from NMFS observers | NMFS Southwest Fisheries Science Center. Cousins *et al* 2000 |
| Australia EEZ | Domestic Eastern Tuna & Billfish | Tuna & billfish | Day setting | | | | | 2001-2003 | **0.945** | 92,533 | Experimental trials. 28-37ºS. .Most of bycatch was flesh footed shearwater | Baker & Wise 2005 |

**Table 1b. Seabird bycatch rates on vessels using seabird bycatch mitigation measures**

| Region | Fishery | Target | Gear type | Bait | Mitigation measures | Time of set | Depth | Date | Birds/ '000 hooks | Hooks observed | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| US | US pelagic fleet based in California | SWO | Monofilament American model. 4-5 hooks between floats, 60-80g weights on branch lines. Light sticks. | Squid | Weighted branch lines (No line casting machine). Dyed baits on most vessels. Offal discharged on opposite side from setting. | Late PM or twilight | 5-60m | 2001-2003 | **0.29** | 210,360 | Data from NMFS observers. Data collected mid-September to June | NMFS Southwest Fisheries Science Center |
| US | Pelagic | Tuna | Day sets, 15+ hooks between floats, 45-60g weights on branch lines and line shooter | | Side set and bird curtain, weights on branch lines | | | 2002-2003 | **0** | 38,266 | Most south of 23ºN | Gilman 2004 |
| US | Pelagic | Tuna | As above, | | Dyed bait and weights on branch lines, offal management | | | 2002-2003 | **0.0043** | 234,255 | All north of 23ºN | Gilman 2004 |
| US | Pelagic | Tuna | As above. | | Line shooter, weights on branch lines | | | 2002-2003 | **0.013** | 384,098 | Mostly south of 23ºN | Gilman 2004 |
| New Zealand EEZ | Japanese pelagic longline | SBT | Branch lines usually 35m | | Increased use of night setting and tori lines | | 60- 180 m | 1991-1992 | **0.04** | Approx 1,464,607 | Observations during winter. 2.7% of hooks observed | Murray et al 1993 |
| New Zealand EEZ | Japanese pelagic longline | Tuna | Kuralon main line, monofilament branch line | | Increased use of night setting and tori lines? | | | 1991-1996 | **0.027-0.315** | 4,313,000 | | Manly et al 2002 |
| Australia EEZ | Japanese pelagic longline | SBT | 40m branch lines, unweighted. | Squid or fish | Tori line | Usually early AM | 60-150m | 1988 | **0.37** | 32,484 | During winter, near Tasmania | Brothers 1991 |
| Australia EEZ | Japanese pelagic longline | SBT | | | Most used night setting and tori lines | | | 1992-1995 | **0.16** | Approx 6,722,000 | Higher bycatch rates in southern areas. In 1993,2 vessels used monofilament, and had higher seabird batch. | Klaer & Polachek 1997 |

| Region | Fishery | Target | Gear type | Bait | Mitigation measures | Time of set | Depth | Date | Birds/ '000 hooks | Hooks observed | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia EEZ | Japanese longline | SBT | 40m branch lines | | Yes, including tori lines. Others undefined. | | 60-150m | 1988-1995 | **0.15** (0.1 in winter, 0.43 in summer) | | Rates highest during summer. Up to 95% higher seabird bycatch rates recorded when observer had dedicated time period to observe seabird bycatch. Fewer birds caught at night. | Gales et al 1998 |
| Australia EEZ | Japanese pelagic longline | SBT | 40m branch lines. Some vessels used weighted branch lines, bait casters, night setting. | | 90% observed sets used tori lines. Vessels using weighted branch lines and bait casters had lower seabird bycatch. 20% boats used night setting | | 60-150m | 1997 | **0.02 night sets**<br>**0.05 day sets** | 720,261 | AFMA & TASPAWS observers. Bycatch rate was lowest recorded since 1988. Could also be due to lack of fishing in summer. 59% birds killed in 6% observations. | Brothers et al 1997 |
| Australia EEZ | Domestic Eastern Tuna & Billfish | Tuna & billfish | Night setting | | Night setting | | | 2001-2003 | **0.378** | 223,342 | Experimental trials 28-37ºS. Also used underwater chute & weighted branch lines, but these did not significantly reduce seabird bycatch. Most of bycatch was flesh footed shearwater | Baker & Wise 2005 |
| Tasmania | Japanese pelagic longine | SBT | | | Tori line. Many vessels have line casting machines. | | | 2001-2002 | **0.04** | 120, 680 | Real Time Monitoring Program | Kiyota & Takeuchi 2004 |

**Table 2. Albatross interaction rates for seabird avoidance methods tested in North Pacific Ocean pelagic longline swordfish and tuna fisheries. Table reproduced from Gilman *et al* 2005.**

Interaction rates are expressed normalized for seabird abundance (expressed as contacts or captures per 1000 hooks per bird) and without normalizing for bird abundance (expressed in parentheses as contacts or captures per 1000 hooks). Percent reductions are based on the normalized rates unless noted otherwise.

| Study[1] | Treatment | Contact rate | Contact reduction (%) | Capture rate | Capture reduction (%) |
|---|---|---|---|---|---|
| McNamara *et al.* (1999) | Control[2] | 32.8 (265.7)[3] | | 2.23 (18.0) | |
| Hawaii longline swordfish gear | Blue-dyed bait | 7.6 (61.6) | 77 | 0.12 (17.5) | 95 |
| | Towed buoy | 16.1 (130.4) | 51 | 0.26 (6.8) | 88 |
| | Offal discards | 15.7 (124.7) | 53 | 0.32 (2.3) | 86 |
| | Streamer line | 15.7 (127.2) | 52 | 0.47 (6.6) | 79 |
| | Night setting | | | (0.60)[4] | 97[4] |
| Boggs (2001) | Control[2] | 7.60 (313.5)[3,5] | | | |
| Hawaii longline swordfish gear | Blue-dyed bait | 0.43 (20.5)[5] | 94 | | |
| | Streamer line | 1.82 (93.4)[5] | 76 | | |
| | Additional 60 g weight at bait | 0.61 (25.0)[5] | 92 | | |
| Gilman *et al.* (2003a) | Control[2] | 0.61 (75.93) | | 0.06 (4.24) | |
| Hawaii longline tuna gear | Underwater setting chute 9 m | 0.03 (1.85) | 95 | 0.00 (0.00) | 100 |
| Boggs (2003) | Control[2] | 0.78 (27.1) | | 0.058 (2.0) | |
| Hawaii longline swordfish gear | Night setting | 0.053 (4.8) | 93 | 0.0013 (0.11) | 98 |
| | Night setting and blue-dyed bait | 0.01 (0.98) | 99 | 0.00 (0.00) | 100 |
| Gilman *et al.* (2003b), | Underwater setting chute 9 m | 0.30 (5.0) | | 0.03 (0.6) | |
| Hawaii longline swordfish gear | Blue-dyed bait | 2.37 (64.9) | | 0.08 (1.8) | |
| | Side-setting | 0.08 (1.9) | | 0.01 (0.2) | |
| Gilman *et al.* (2003b), | Underwater setting chute 9 m | 0.28 (10.3) | 82[6] | 0.05 (1.7) | 38[6] |
| Hawaii longline tuna gear | Underwater setting chute 6.5 m | 0.20 (5.6) | 87[6] | 0.01 (0.5) | 88[6] |
| | Blue-dyed bait | 0.61 (23.8) | 60[6] | 0.03 (1.2) | 63[6] |
| | Side-setting | 0.01 (0.1) | 99[6] | 0.00 (0.0) | 100[6] |

1 Research has also been conducted by the Japan Fisheries Research Agency on the effectiveness of blue-dyed bait on reducing seabird interactions in Japan's longline tuna fishery in the western North Pacific Ocean (Minami and Kiyota 2002). Results were not published in a format that provides seabird interaction rates expressed as contact or capture per number of hooks or normalized rates for seabird abundance.

2 Control treatments in McNamara et al. (1999); Boggs (2001), Gilman et al. (2003a) and Boggs (2003) entailed conventional fishing operations with no seabird avoidance methods. Experiment conducted by Boggs (2003) set hooks during daylight hours.

3 The different contact rates observed by Boggs (2001) and McNamara et al. (1999) may be explained by the use of different definitions of what constituted a seabird contact. McNamara et al. (1999) counted the total number of times a seabird came into contact with gear near the hook, even if the same bird contacted the gear multiple times, while Boggs (2001) defined a contact where only one contact per bait was recorded as a contact regardless of whether a single bird contacted a bait multiple times.

4 This rate is not normalized for albatross abundance. McNamara et al. (1999) could not estimate seabird abundance during night setting. McNamara et al.'s (1999) control capture rate when not normalized for albatross abundance was 18.0 captures per 1000 hooks. Night setting reduced this control capture rate by 97%.

5 Contact rates are averages of rates reported by Boggs (2001) for Laysan and black-footed albatrosses.

6 Percent reductions use the control treatment contact and capture rates of Gilman et al. (2003a).