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Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Year 2004

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Cover photo: Black-footed albatross (*Phoebastria nigripes*) flying over Hawaiian waters. Photo courtesy of Adam Bailey, Hawaii Longline Observer Program.

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Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Year 2004

1. Introduction

In the western Pacific region, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries Service), through its Pacific Islands Regional Office (PIRO) is responsible for managing, protecting and conserving living marine fishery resources in federal waters of the U.S. Pacific islands areas[1]. In addition to ensuring that federally-managed fisheries do not adversely affect essential fish habitat, PIRO also works to protect and recover endangered and threatened species. The Pacific Islands Fisheries Science Center (PIFSC) conducts fisheries research and provides scientific information and expertise on Pacific insular and pelagic marine resources and protected species. The Western Pacific Fishery Management Council (WPFMC) is responsible for developing fishery management plans for this region. Together PIRO, PIFSC, WPFMC, and the U.S. Fish and Wildlife Service (FWS) work cooperatively to prevent and mitigate the bycatch of protected resources, including seabirds, by U.S. domestic fisheries governed under the fishery management plans[2].

Seabird mitigation measures, authorized under the Magnuson-Stevens Fishery Conservation and Management Act, are prescribed in fishery management plans governing fisheries operating in the U.S. exclusive economic zone (EEZ) and international waters of the U.S. Pacific Islands region. To assess possible impacts of the Hawaii-based pelagic longline fishery to the endangered short-tailed albatross (*Phoebastria albatrus*) population, a "Biological Opinion (BiOp) on the effects of the Hawaiian Longline Fishery on the Short-tailed Albatross" was issued by FWS on November 28, 2000 [FWS 1-2-1999-F-02; Service, 2000] and subsequently revised November 18, 2002 [FWS 1-2-1999-F-02R; Service, 2002]. The November 2002 revision examined the effects of the deep-set fishery on the short-tailed albatross after the court ordered a suspension of the shallow-set fishery in April 2001. FWS most recently issued a supplement to the BiOp on October 2004, "Biological Opinion on the Effects of the reopened shallow-set sector of the Hawaii-Based Longline Fishery on the Short-tailed Albatross" [FWS 1-2-1999-F-02.2: Service 2004]. Prior to its suspension, the shallow-set sector of the Hawaii longline fishery accounted for the majority of seabird mortalities, therefore the October 2004 BiOp evaluates only the effects of the April 2004 re-opening of the shallow-set sector on the short-tailed albatross. During the 2004 calendar year, however, no short-tailed albatross takes were reported in the shallow-set sector of the Hawaii longline fishery.[3] The biological opinion issued on November 18, 2002 on the deep-set sector still remains in effect.

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[1] American Samoa, Guam, Hawaii, Northern Mariana Islands, and the U.S. Pacific remote islands, consisting of Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island as well as the high seas.

[2] Fishery management plans are developed by the WPFMC and, if approved by the Secretary of Commerce, implemented by regulation by NOAA Fisheries Service/PIRO. At present there are five fishery management plans governing western Pacific fisheries covering pelagics, bottomfish/seamount groundfish, crustaceans, precious corals, and coral reef ecosystems.

[3] The shallow-set sector of the Hawaii longline fishery reopened with a final rule on April 2, 2004 (69 FR 17329).

As per the requirements of the BiOps (Service, 2000; 2002: 2004), NOAA Fisheries Service must annually report any observed interaction of short-tailed albatross with the Hawaii longline fishery, and any observed and estimated total number of interactions with Laysan (*Phoebastria immutabilis*) and black-footed (*Phoebastria nigripes*) albatross by set type[4]. In addition, NOAA Fisheries Service must report on the status of observer coverage, provide assessments of the effectiveness of required seabird deterrents, including reporting information on the current voluntary implementation of side setting and review of the observer data from these vessels, and summarize the results of the Protected Species Workshops. This report includes the reporting requirement for the Hawaii longline fishery operating during calendar year 2004.

2. Status of the Species: Short-tailed Albatross

The short-tailed albatross is the largest of the Northern Hemisphere albatross species. They are long-lived, slow to mature, and may be identified by distinctive pink bills. The plumage of a short-tailed albatross varies in color at different stages of its life. Short-tailed albatross once ranged throughout most of the North Pacific Ocean and Bering Sea, with known nesting colonies on numerous western Pacific Islands in Japan and Taiwan (Hasegawa 1979, King 1981). During the beginning of the 20th century, the species declined in numbers to near extinction, resulting primarily from direct harvest at breeding colonies in Japan. They began to recover during the 1950's and since then, due to habitat management and stringent protection, the population has gradually increased approximately 6% per year (Service, 2000). Today the only known, currently active breeding colonies of short-tailed albatross are on Torishima and Minami-kojima islands, off the coast of Japan. The current worldwide short-tailed albatross population is estimated to be approximately 1,990 individuals (P. Sievert, 2004).

3. The Hawaii-based Pelagic Longline Fishery

The Hawaii longline fishery is the largest commercial fishery managed under the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (FMP) (NMFS 2001a). Prior to 1999, broadbill swordfish was one of the major target species and important components of the Hawaii longline fishery. Beginning in late 1999 and into 2001, the fishery, especially the swordfish component, was restricted by Federal Court orders that were intended to protect threatened and endangered sea turtles taken incidentally in the fishery. In April 2004, the swordfish component of the Hawaii-based longline fishery was reopened under a suite of management measures that required new gear configurations and specialized dehooking equipment to prevent the incidental capture of and to increase the post hooking survival of sea turtles.

For this report, the Hawaii longline fishery operating in calendar year 2004 was divided into two regulatory regimes. One regime was in place from January 2004 to April 1, 2004 (2004a regime) and the other from April 2, 2004 to December 31, 2004 (2004b regime). The fishery operating

[4] NOAA Fisheries Service described tuna and/or swordfish set type.

during the 2004a regime was exclusively a deep-set longline, "tuna-targeting" fishery. From April 2, 2004, the shallow-set fishery was reopened. Therefore the 2004b regime includes the "swordfish-targeting" fishery in addition to the deep-set fishery. Key conservation measures for the re-opened shallow-set sector (69 FR 17329, April 2 and May 3, 2004) include:

- 100% observer coverage
- 2,120 shallow set certificates for the entire fleet for the year
- 18/0 circle hooks with a 10 degree offset
- Mackerel-type bait, thawed and dyed blue
- Sea turtle handling measures including dehooking equipment; and
- Annual attendance at mandatory protected species workshops for vessel operators and owners.

(See Appendix 2 for summary of regulatory changes in 2004 for deep-sets, shallow-sets, and above 23° N)

4. Hawaii-based Pelagic Longline Fishery Activity in 2004

Preliminary results show that in 2004, the fishery yielded pelagic landings of 18.5 million pounds and generated ex-vessel revenues estimated at $42.6 million with tuna (*Thunnus* spp.) the dominant components of longline landings (PIFSC, R. Ito unpublished data). Table 1 gives the catch per unit effort (CPUE) of the species caught.

Table 1. Hawaii-based Longline Fishery during 2004, catch per unit effort (CPUE), number of species caught per 1,000 hooks. Source: PIFSC unpublished data.

Year	# Tuna	# Sharks	# Billfish	# PMUS*
1999	9.21	4.59	3.9	4.8
2000	8.18	3.91	2.88	4.8
2001	8.64	2.1	1.61	4.21
2002	7.48	1.87	0.98	4.27
2003	6.33	2.32	1.77	4.58
2004	6.42	2.34	1.24	5.49

* Pelagic Management Unit Species: mahimahi, moonfish, oilfish, pomfret, wahoo

In 2004, there were 125 active Hawaii longline vessels that made 1,338 trips (Table 2). The trips targeted tunas (bigeye, albacore and yellowfin tuna) and swordfish. 1, 332 tuna trips and 6 swordfish trips were made in 2004. 5 of the vessels made swordfish trips. Of the total number of trips made, 338 trips fished above 23 degrees N. latitude (PIRO unpublished data).

Table 2. Hawaii-based Longline Fishery 1999 to 2004. Source: PIFSC unpublished data.

Year	No. Vessels	No. Trips	No. Sets	No Hooks	No. Lightsticks
1999	122	1,165	12,805	19,145,304	818,149
2000	125	1,135	12,930	20,282,826	715,975
2001	101	1,075	12,169	22,327,897	26,519
2002	102	1,193	14,225	27,018,673	1,569
2003	110	1,215	14,560	29,297,813	0
2004	125	1,338	15,976	31,967,874	36,625

5. Seabird Deterrent Methods

A variety of seabird deterrent mitigation methods have been tested and found to reduce interaction rates and/or mortality of seabirds with longline fisheries (Brothers 1995; Brothers *et al.* 1999; McNamara *et al.* 1999). Although limited information exists regarding the effectiveness of seabird deterrents, research by McNamara *et al.* (1999), Boggs (2001), Gilman *et al.* (2003) and the PIFSC found all deterrents tested to be effective mitigation measures for use by the fishery (Table 3).

Table 3. Summary of seabird deterrent methods when deep setting north of 23N or when shallow setting anywhere

Seabird Deterrent Measure:	Tuna (deep) Set:	Swordfish (shallow) Set:
Thawed, Blue-dyed Bait	Required	Required
Strategic Offal Discharge	Required	Required
Line Setting Machine with weighted branch lines (= 45g) within one meter of the hook, or use of tarred mainline, basket-style gear deployed slack	Required	Optional
Night Setting	Optional	Required
Side setting	Optional	Optional
Tori Line	Optional	Optional
Towed Buoy	Optional	Optional

The *final rule* [67 FR 34412, May 14, 2002] promulgated by NOAA Fisheries Service, required all Hawaii longliners fishing north of 23° N. latitude to comply with the following seabird mitigation measures (WPFMC, 2002)[5]:

- Use of thawed, blue dyed bait;
- Discard offal strategically;
- Use at least 45g weights within one meter of each hook;
- Use a line shooter or basket gear;
- Attend annual Protected Species Workshops (vessel owners and operators);
- Handle **all** seabirds in a manner that maximizes the probability of their long-term survival;
- Notify NOAA Fisheries Service immediately if a short-tailed albatross is hooked or entangled; and
- Retain all dead short-tailed albatross and submit the carcass upon return to port

6. Observer Coverage

The two major sources of information regarding albatross interactions with the HI longline fishery are mandatory logbooks and observer data collection programs administered by NOAA Fisheries Service. The longline logbook program requires longline vessel operators to complete and submit to NOAA Fisheries Service a daily log sheet containing detailed catch and effort data on each set, including information on interactions with protected species (50 CFR §660.14).

NOAA Fisheries Service observers have been deployed aboard Hawaii longliners since 1994 primarily to document protected species interactions, collect fishery-related information, and collect other information as requested by PIFSC. A March 30, 2001, court order required increased observer coverage to 20% of all Hawaii longliners. The required 20% observer coverage remains in effect for the deep-set sector, but the reopened shallow-set sector requires 100% observer coverage.

Until 2001, NMFS Hawaii Longline Observer Program Field Manual specifically instructed observers not to record seabird sightings unless birds interacted with the fishing gear (NMFS 1999). In the June 2001 revised manual, observers were instructed to not record general seabird sightings **except for** sightings of short-tailed albatrosses although interactions with other species were to be recorded (NMFS 2001b). From October 2002 to November 2004, observers on vessels operating north of 23°N. latitude were required to document the setting and haul of longline gear and record **all** seabird species present, behavior towards fishing gear and

[5] At its 125th meeting, October 12-15, 2004, the WPFMC recommended adjustments to the current seabird mitigation measures. These recommendations include using either side setting or a suite of measures that include thawed, blue dyed bait, strategic offal discharge and deploying a tori line. A modification to use strategic offal discards only when seabirds are present was also recommended. If approved by NOAA Fisheries Service, these recommended measures are expected to take effect in August 2005.

interactions (if any) with gear. As of November 2, 2004, in order to comply with the short-tailed albatross BiOp, observers are directed to focus their seabird observations on short-tailed, Laysan, and black-footed albatross north of 23 degrees latitude. Observers are instructed to record details of any short-tailed albatross sighting and to photograph it (Service, 2004). Observers are asked to observe the entire first hour of setting operations for seabirds, conducting scan counts at the beginning of the hour and after the first half hour. Scan counts are five minutes in duration, and include surveying the area around the vessel in a 360 degree radius, and 200m out from the vessel. During the haul, observers are directed to conduct scan counts at the beginning of each hour of the haul. During the haul, only sightings during scan counts are recorded. (PIRO Circular Update 55B, Nov. 02, 2004)

During 2004, the observer program maintained an average of 24.6% observer coverage on deep-setting vessels and 100% observer coverage on shallow-setting vessels (Table 4), and exceeded the required 5% coverage (20.1%) for vessels operating north of 23˚ N. latitude (Table 5).

Table 4: Performance Measures for the Hawaii Longline Observer Program on Deep set trips, 1994-2003. Source: NMFS, unpublished data

Year	Number of Sets	Observed Number of Trips	Average % coverage
1994	1031	55	5.30%
1995	937	42	4.50%
1996	1062	52	4.90%
1997	1123	40	3.60%
1998	1180	48	4.10%
1999	1136	38	3.30%
2000	1134	118	10.40%
2001	1035	233	22.50%
2002	1,193	294	24.60%
2003	1,215	266	22.20%
2004	1,344	330	24.60%

Table 5. Observer coverage of vessels operating at or above 23° North latitude. Source: NMFS, PIFSC logbook data

	Year				
	2000	**2001**	**2002**	**2003**	**2004**
Total number of sets	4,265	2,856	3,594	3,776	3,082
Number of sets with observers	356	567	970	834	716
% of sets above 23°N with observers	8.3	19.8	26.9	22.1	23.2
Total number of trips above 23°N	393	352	510	404	338
Number of trips with observers	30	66	106	98	68
% of trips with observers	7.6	18.8	20.8	24.3	20.1

7. Seabird Interactions: 2004

In this report, a seabird interaction is any contact between a seabird and fishing activity, implying that the seabird became entangled or was hooked, usually resulting in mortality to the seabird. Seabird "takes" or "captures" are usually recorded during haulback of the longline but may be recorded by observers during setting of the longline. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. The ITS (incidental take statement) is one short-tailed albatross per year for the shallow-set fishery as stated in the 2004 BiOp (Service, 2004).

Observed Interactions

During calendar year 2004, there were 4 black-footed albatross (BFAL) and 3 Laysan albatross (LAAL) total observed takes during 1,344 observed sets. There were no observed or recorded short-tailed albatross interaction in the Hawaii longline fishery. Two sightings of short-tailed albatross occurred in the calendar year, both on shallow setting vessels fishing north of 36N (on November 18, 2004 and December 23, 2004).

Table 6. Total observed black-footed (BFAL) and Laysan (LAAL) albatross takes for calendar year 2004 in the Hawaii-based pelagic longline fishery. Source: NMFS/PIRO observer data.			
Species	Condition	Swordfish Sets	Tuna Sets
BFAL:	Dead	0	4
	Injured*	0	0
LAAL:	Dead	0	2
	Injured	1	0
	* Injured birds released alive		

Estimated Interactions

During 2004, the Hawaii-based pelagic tuna longline fleet was estimated to have incidentally interacted with 16 BFAL and 10 LAAL (Table 7). Confidence intervals for the quarterly estimates were computed using the approximated sampling probabilities and assuming that a species' takes per trip were independent Poisson variates with a constant mean value. The assumption that the average take rate is constant throughout a quarter is questionable , as these are migratory birds, but necessary to compute confidence intervals. Confidence intervals for the yearly total were not computed because it seemed unreasonable to assume the take rates were constant throughout the year (PIFSC, M. McCracken unpublished data)[6]. The total take in the Hawaii-based longline swordfish fishery was zero black-footed and one Laysan albatross.

Table 7. Estimates of the total incidental take of black-footed (BFAL) and Laysan (LAAL) albatross in the Hawaii-based longline deep-set fishery during the four Quarters of 2004 and corresponding 95% confidence intervals (c.i.). Source: PIFSC, Unpublished Data.					
	Takes per Quarter				
Species	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total Takes
BFAL	16	0	0	0	16
(c.i.)	(4, 36)	(0, 12)	(1, 13)	(0, 12)	
LAAL	10	0	0	0	10
(c.i.)	(2, 28)	(0, 12)	(0, 13)	(0, 12)	

The fleet-wide estimated seabird takes by the Hawaii longline fishery during years 1999 (included for comparison purposes) through 2004 is depicted in Figure 1. Management

[6] See Appendix 1 for a complete description of the methods and applied statistical techniques (M. McCracken).

regulations are similar for regimes 2000b and 2001a. The 2001b regime demarcates the closure of the swordfish component and the beginning of *emergency regulations* for the Hawaii longline fishery. The 2004a regime has similar management measures as 2003, and as stated earlier, the 2004b regime depicts the reopening of the shallow-set sector April 2, 2004.

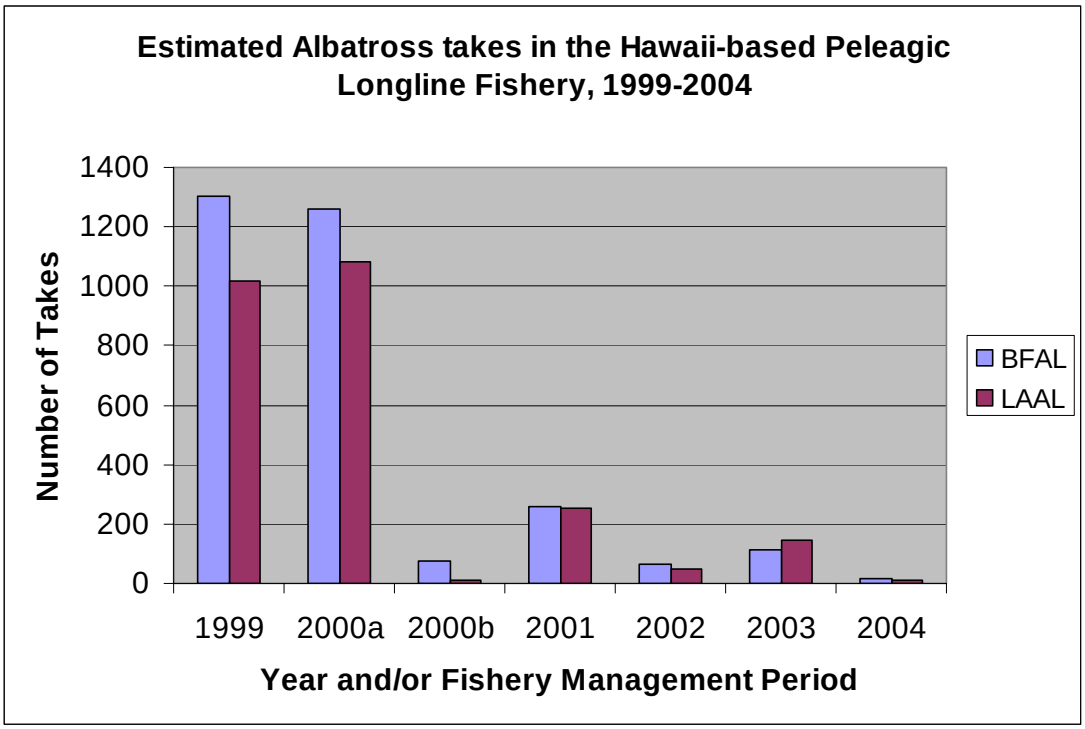

Figure 1: Estimated fleet-wide incidental take of BFAL and LAAL in the Hawaii based longline fishery during 1999-2004 (2000a=regime period 1/1-8/24 2000; 2000b = regime period 8/25-12/31 2000).

8. Protected Species Workshops

The Protected Species Workshops have been conducted by PIRO, Sustainable Fisheries Division every year since 2000. Workshops are mandatory for all longline vessel operators and owners with a Hawaii longline limited entry permit, and recommended for all vessel operators operating with a general longline permit. Participants receive a certification card upon completion of the workshop. The card must be carried on board the vessel during fishing operations. PIRO, Sustainable Fisheries Division collaborates with other agencies, as well as other PIRO divisions, involved with the Hawaii longline fishery, including US FWS, PIFSC, the PIRO Observer Program and the Office of Law Enforcement (OLE). This collaborative effort between the agencies other PIRO groups has led to informative and successful Protected Species Workshops.

In general, the workshops consist of presentations on seabird and sea turtle identification and life history, albatross and sea turtle handling techniques which include dehooking procedures, marine mammal identification, current regulations, and current sea turtle research including satellite tagging and gear modification experiments. Workbooks containing all current regulations, copies of presentations, and informational placards are provided to all participants. Written materials and video presentations have also been translated in Vietnamese, Korean, Samoan and Tagalog, which are the predominant languages of crews aboard Hawaii-based longline vessels.

225 Hawaii-based longline vessel operators and owners received certification in 2004 (Table 8).

Table 8. Protected Species Workshops Certifications.

Year	No. Fishers Certified
2000	101 Hawaii-based
2001	113 Hawaii-based
2002	• 158 Am. Samoa-based • 139 Hawaii-based
2003	• 158 Am. Samoa based • 180 Hawaiian-based
2004	• 86 Am. Samoa-based • 225 Hawaiian-based

9. Effectiveness of Mitigation Measures

Studies by McNamara *et. al.* (1999), Boggs (2001) and the PIFSC on the effectiveness of seabird mitigation measures suggest that numerous measures have the potential to significantly reduce the incidental catch of albatrosses in the Hawaii longline fishery (see, Table 3). Combining the use of mitigation measures is necessary if any single measure significantly loses its effectiveness under certain circumstances (e.g., night setting during a full moon or use of tori line in rough seas) or gradually loses its effectiveness (e.g., if seabirds become habituated to a particular towed deterrent or blue-dyed bait). Combining the use of two or more mitigation measures is likely to improve overall mitigation effectiveness, although the measure of improvement is uncertain (NMFS 2001a). However, as more information becomes available on side setting as a seabird deterrent, using this method as a stand alone mitigation technique appears to be feasible.

The Hawaii-based longline fishery has been required to employ seabird mitigation measures since June 2001. These measures include a suite of mitigation techniques: use of a line shooter (or basket style gear), weighted branch lines, thawed and dyed blue bait, and strategic offal discard. Although research indicates that use of these seabird deterrents may reduce the incidental catch of albatrosses, the relative effects of these measures on the reduction in seabird bycatch observed in the Hawaii-based longline fishery since 2000 are difficult to quantify (e.g. blue-dyed bait and line shooters). Fishery operations were not designed to experimentally test deterrents. Deterrents were not utilized independently of other measures, there were no "control" sets, neither were they tested independently of changing fishery management strategies.

In the past years, the suspension of swordfish targeting vessels operating north of the equator and/or other characteristics associated with swordfish style fishing (Appendix 3) were some of the primary influences on the low interaction rates of albatrosses with the Hawaii longline fishery. However, with new mitigation measures in place, and new regulations likely to take effect in August 2005, it is projected that lower interaction rates will largely be a result of the required deterrent measures, and not of fishery or area closures.

Another confounding factor in assessing the effects of seabird deterrents is the seasonal movements of albatross at sea. Rates cannot be directly extrapolated on an annual basis because seabird interaction rates change throughout the year as a function of their breeding biology and behavior. No takes observed during the third and fourth Quarter of 2004 (Table 7) may be reflective of seabirds migrating northwest during post-nesting season, rather than due to implemented deterrent measures or fishery management regimes. Despite 24.6 % observer coverage on deep set vessels and 100% coverage on shallow set vessels during the 2004b regime, seabird interaction rates were too low for statistical significance because there were not enough observed takes to model seasonal and/or spatial trends corresponding to the nesting season and distribution of seabirds with the distribution of fishery effort.

10. Seabird Mitigation Methods and Research

A number of seabird deterrent methods have the capacity to nearly eliminate bird captures when employed effectively. However, to resolve the problem of seabird mortality in longline fisheries, there is a need to identify deterrent methods that not only have the capacity to minimize seabird interactions, but are also practical and convenient for use by the fishermen. In 2004, strategic offal discards and thawed blue-dyed bait were used in conjunction with a line-shooter (for deep-setting vessels) and with night setting (for shallow-setting vessels) as required mitigation measures for the Hawaii longline fleet (69 FR 17329). Side setting was the new mitigation method used to avoid seabird bycatch, showing great promise as an effective stand alone mitigation measure. This method is currently being used by a number of vessels in the Hawaii longline fleet that have voluntarily converted to side setting. In the new proposed regulations for additional seabird deterrents, the tori line will be an added measure when deep-setting north of 23°N or when shallow-setting, if the vessels don't choose side-setting. The tori line is a bird scaring system that involves suspending a line from a high pole at the stern of the vessel and

deploying streamer lines to deter birds from diving for baited hooks. The tori line has also undergone experimentation in the Hawaii longline fleet and will likely be effective in combination with other seabird mitigation measures.

Strategic Offal Discards

Strategic offal discards is a technique that involves discharging fish offal while setting or hauling gear, on the opposite side of the vessel from where the longline gear is being set or hauled. Swordfish heads must be removed, and without bills, cut in half vertically before discharging. Livers must be removed and discharged. In the past, offal discards were easier to implement on vessels targeting swordfish than tuna, because the swordfish were dressed at sea (carcasses were headed and gutted before being packed on ice in the vessel's hold) unlike tuna. However, recently vessels have started making longer trips in order to find enough fish and these vessels are dressing their tuna at sea to keep them from spoiling. A supply of offal can be routinely generated for the next set now on both swordfish and tuna targeting vessels. Tuna that are dressed at sea, however, are usually not as fresh in quality and are more difficult to market in Hawaii. There will continue to be vessels that will not dress tuna at sea. For these fishermen, strategic offal discards consist of spent bait and valueless bycatch species retained during the haul to use for the next set when strategic offal discards are required. Strategic offal discards are very difficult to monitor when observers are not onboard, making compliance with this technique very difficult. Fishermen may be willing to use this measure because it has no cost associated with it, particularly for swordfish-targeting vessels which routinely generate large quantities of offal. For tuna-targeting vessels, the availability of offal and the convenience to comply is still problematic. Gilman (2004), in his analysis of recent Hawaii longline observer data, found that only 18% of tuna-targeting sets employed strategic offal discards.

This mitigation method has shown to be effective in reducing interactions with seabirds. Offal discards were shown to reduce gear contacts by 51% and captures by 88% in tests by McNamara et al. (1999) with Hawaii longline swordfish gear. However, there are also mixed evaluations of the effectiveness of strategic offal discharge (Cherel et al. 1996, Brothers 1995 and 1996, McNamara et al. 1999). Although discharging offal and fish bycatch during setting can distract birds from baited hooks (Cherel et al. 1996, McNamara et al. 1999), this practice is believed to have the disadvantage of attracting birds to the vicinity of the vessel, increasing bird abundance, searching intensity, and capture (Brothers et al. 1999). In the long-term, strategic offal discharge may reinforce the association that birds make with specific longline vessels being a source of food. Brothers (1996) hypothesizes that seabirds learn to recognize by smell specific vessels that provide a source of food, implying that vessels that consistently discharge offal and fish bycatch will have higher seabird abundance and capture rates than vessels that do not discharge offal and fish waste. Nevertheless, vessels that practice strategic offal discards have shown lower bird capture rates versus those that do not employ strategic offal discarding at all. The regulations on strategic offal discards coming into effect in August 2005 will modify the use of strategic offal discards to be used only when seabirds are present.

Thawed Blue-dyed Bait

Thawing and dying bait blue is an attempt to reduce a seabird's ability to see the bait by reducing the bait's contrast with the sea surface. The bait is thawed, separated, and soaked in a mixture of blue food coloring additive and sea water in an attempt to make the bait the same hue as the sea surface. Dyeing bait is most often impractical and inconvenient for crew, and is not employed consistently by different crew. Blue-dyed bait shows a relatively low fishing efficiency based on bait retention and hook setting rates. It is a relatively inexpensive deterrent method, costing about U.S. $14 per set, but does not facilitate effective enforcement. Most of the practicality, convenience, and enforceability problems could be addressed if pre-blue-dyed bait were commercially available. Currently this seabird deterrent method is a required mitigation method alongside strategic offal discards.

Side Setting

Side setting is a seabird deterrent method which entails setting the gear from the side of the vessel as opposed to the conventional approach of setting from the stern. The hypothesis is that when side setting, baited hooks will be set close to the side of the vessel hull where seabirds will be unable or unwilling to attempt to pursue the hooks alongside the vessel, and by the time the hooks reach the stern, the baits will have sunk to a depth where seabirds cannot locate them or cannot dive to the depth needed to reach them.

This deterrent shows the highest promise of any seabird mitigation method to date in terms of effectiveness. Side setting has the lowest mean seabird contact and capture rates of the deterrents when used with both Hawaii longline tuna and swordfish gear. In deep-set and shallow-set trials conducted by Gilman et al. (2003), side-setting was shown to perform significantly better at reducing interactions and mortalities than sets with the two lengths of underwater setting chutes or with blue-dyed bait. More recently, observer data (August 2003 – October 2004) analyzed by Gilman (2004) indicate that vessels employing side-setting did not record a single seabird capture. However, caution must be exercised when looking at observer data which, until recently, merely recorded the presence or absence of seabirds and did not normalize the data for bird abundance. Observer data now do include seabird abundance, as observers are directed to conduct scan counts at the beginning of each set and throughout the entire haul, thus enabling the analysis of data to be normalized for seabird abundance (see section 6: Observer Coverage for a description of scan counts). In addition, it must be pointed out that side-setting has been subject to relatively little experimentation and virtually no observations on commercial vessels. The expected efficacy in fishing operations is still relatively uncertain. Also, it is possible that birds will become habituated to the technique and over time learn to attack baits near a vessel's hull.

Side setting provides a large operational benefit for certain types of vessels, and is perceived to be practicable for use by crew. Side setting results in high fishing efficiency relative to the other treatments, based on bait retention and hook setting rates. Side setting requires an initial expense to employ, including adjusting the vessel deck design, fabricating or purchasing a bird curtain, and switching from 45 g to 60 g weighted swivels is estimated to be at least $1,550, with little or

no additional costs thereafter. It is estimated that about 70% of the vessels currently fishing in Hawaii already use 60 g weighted swivels (Sean Martin, HLA, pers. comm.), while other vessels are using the currently required 45 g weights when deep-set fishing north of 23°N. The safety concerns associated with the heavier weights could have associated indirect costs in the event of injury. Assessment of the feasibility of adjusting the gear to side set from various deck positions, the location of deployment of baited hooks from various side setting positions, sink rates of a range of types of baited hooks, and aspects of vessel conversion to side setting, indicates that side setting would be both feasible and effective at reducing seabird interactions on a wide range of longline vessel deck designs. Side-setting is relatively easy to enforce as the orientation of the gear on deck can be checked through dockside inspection, and vessel operations can be readily observed at sea.

As of March 2005, fifteen Hawaii longliners have voluntarily converted their vessels to side setting (Sean Martin, HLA, pers. comm.).

11. Conclusion

In summary, no short-tailed albatross was reported taken in the Hawaii longline fishery (either swordfish or tuna sets) during calendar year 2004. However, during this period the fishery incidentally caught an estimated 16 black-footed and 10 Laysan albatrosses. Total observer coverage averaged 24.6% (3,958 of 15,976 sets), and 23.2% of the longline vessels operating north of 23˚ N. latitude (716 of 3,082 sets). Gilman *et al*. (2003) found that approximately 28% fewer seabirds are hauled aboard than caught during gear deployment. Therefore estimated mortality rates for this annual report are considered conservative, since they are based on observing the haul.

NOAA Fisheries Service observer and logbook data indicate that the fleet was in compliance with required seabird mitigation regulations. However, the WPFMC took action on a new proposed rule which will change the required seabird mitigation regulations in August 2005. Two regulatory regimes (2004a and b) influenced the Hawaii longline fishery during the 2004 calendar year. Between January and April 2004, seabird mitigation measures were required for the deep-set sector of the fishery only, whereas between April 2 and December 2004, the fishery was regulated under seabird measures for the deep-set as well as the shallow-set sectors of the fishery. The reopening of the swordfish component of the fishery, however, appears not to have had a significant impact on seabird interaction rates. No seabirds were reported taken by shallow-setting vessels in 2004. It appears that the regulatory changes significantly change the fleet's effort, spatial distribution of fishing grounds, and the amount and composition of incidental bycatch.

APPENDICIES

12.1 APPENDIX 1: Estimation of Year 2004 Incidental Interactions of Sea Turtles, Seabirds, and Marine Mammals in the Hawaii Longline Deep Set Fishery

The following information was supplied by the PIFSC (M. McCracken) and provides a detail description of how year 2004 seabird interaction estimates were obtained and the analyses supporting subsequent results.

This report provides year 2004 estimates of the incidental interactions of protected species by the Hawaii longline deep set fishery. Incidental interactions estimates are provided for all protected species where there exist at least one recorded of an incidental interaction in the Hawaii Longline Observer Database System. This database includes all verified observed trips from February 1994 through December 2004. An incidental interaction refers to an animal that was observed hooked or entangled. The incidental interaction estimate is the estimated total number of incidental interactions for all trips landing in the specified time period by the Hawaiian longline deep set fishery. The longline deep set fishery is defined as any commercial fishing trip by a vessel with a Hawaii longline permit that departs or returns at a Hawaiian port, excluding those trips using a certificate for swordfishing.

The estimates of interactions are based on a random sample. For year 2004, observed trips were drawn using two sampling schemes. The primary scheme was a systematic sample. Before departing on a fishing operation, longline vessels were required to call the NOAA Fisheries contractor at least 72 hours prior to their intended departure date. To select a sample, calls were ordered and numbered sequentially in the order they were accepted. From herein, this number is referred to as the call number. Prior to the beginning of a quarter, a systematic sample of call numbers was drawn by PIFSC and supplied to the current contractor. The trips associated with these selected call numbers were to be sampled. Although every reasonable effort was made to sample selected trips, there were some selected trips that departed without an observer. In this situation, it was recorded that the trip was not sampled and a short explanation of why it was not sampled was given. If a trip was selected but did not leave within a reasonable amount of time, the observer was usually reassigned to a different trip. When the vessel was ready to depart an observer was assigned to it. Because the number of observers was limited it was impractical to obtain the full targeted coverage under the systematic design. Therefore, the systematic sample was designed to be slightly under the targeted coverage, typically 5% under. The additional trips were then selected using a secondary sampling scheme. This secondary scheme was used when all trips selected by the systematic sample were covered and an observer needed to be assigned to a trip. In this instance, a trip was randomly selected with equal probability from the calls received that day that were not previously selected. If more than one observer needed to be assigned to a vessel, the appropriate number of trips was sampled with equal probability from this pool of call-ins. The coverage obtained by the day scheme was flexible and dependent on the need to accommodate observers. This additional sampling does depart from a traditional probability sample since the day when additional samples were drawn was not randomly selected but determined by the need to draw additional samples. After each quarter the contractor sent a record of the sampling of trips to PIFSC.

Because the systematic sample was selected quarterly, incidental interaction estimates were estimated on a quarterly basis and then summed for the year's total estimate. A trip's incidental interactions were assigned to the quarter when the vessel returned to port after completing the trip. The contractors sampling records were used to approximate sampling probabilities. The sampling probabilities during the periods when additional samples were drawn were computed by enumerating the number of call-ins during consecutive periods of comparable coverage. It was then assumed that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. When coverage was below that of the anticipated systematic sample, the sampling probabilities were computed by enumerating all call-ins during this period and assuming that the trips sampled were selected with equal probability. Because the coverage level changed with the fluctuations in observer availability and fishing activity, trips were not selected with equal probability. Therefore, the Horvitz-Thompson estimator was used to estimate total interactions as it takes into account unequal sampling probabilities. The incidental interaction records used to compute the Horvitz-Thompson estimator were those available in the Longline Observer Database System on 2 February 2005.

Confidence intervals for the quarterly interaction estimates were computed using the approximated sampling probabilities and assuming that a species' interactions per trip were independent Poisson variates with a constant mean value. The assumption that the average interaction rate was constant throughout a quarter is questionable, as some of these animals are migratory, but necessary to compute confidence intervals. Confidence intervals for the yearly total were not computed as it seems unreasonable to assume interaction rates were constant throughout the year.

Table 1. Year 2004 estimated incidental interactions (est.) and corresponding 95% confidence intervals (c.i.) for the Hawaii deep set longline fishery.

	Quarter								
	1		2		3		4		Total
Species	**Est.**	**c.i.**	**Est.**	**c.i.**	**Est.**	**c.i.**	**Est.**	**c.i.**	**Est.**
Turtles									
Loggerhead	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Leatherback	10	[2,28]	0	[0,12]	0	[0,13]	5	[1,19]	15
Olive Ridley	5	[1,23]	11	[3,27]	19	[6,45]	11	[3,29]	46
Green	0	[0,14]	5	[1,19]	0	[0,13]	0	[0,12]	5
Albatrosses									
Black-footed	16	[4,36]	0	[0,12]	0	[0,13]	0	[0,12]	16
Laysan	10	[2,28]	0	[0,12]	0	[0,13]	0	[0,12]	10
Dolphins									
Spotter	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Spinner	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Bottlenose	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Risso	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Whales									
Pilot	0	[0,14]	3	[1,15]	0	[0,13]	0	[0,12]	3
Humpback	6	[1,23]	0	[0,12]	0	[0,13]	0	[0,12]	6
False	15	[3,35]	5	[1,19]	8	[2,25]	0	[0,12]	28
Sperm	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0
Beaked	0	[0,14]	0	[0,12]	0	[0,13]	0	[0,12]	0

12.2 APPENDIX 2: Summary of regulatory changes for years 2004. For a complete analysis of results for previous years, please refer to the *Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Year 1999, 2000 – 2001, 2002, and 2003* (Kinan, I. 2003).

Calendar Year 2004

During 2004, the fishery was separated into two periods, which reflect changes in fishery regulations that took place in April 2004. The actual and estimated black-footed and Laysan albatross takes in the Hawaii longline fishery are reported together for these periods.

- Period One 2004a - January 1 to April 1, 2000 - the fleet was prohibited from targeting swordfish (i.e., shallow setting)
- Period Two 2004b – April 2 to December 31, 2004 - the fleet was permitted to target swordfish (i.e., shallow setting), 2120 sets total (with 100% observer coverage)

Regulatory changes occurred in the Hawaii-based longline fishery in calendar year 2004. April 2, 2004 the shallow-sector (i.e. targeting swordfish) was re-opened for the Hawaii-based longline fleet.

Requirements were implemented for any vessel switching over to shallow-setting:

- 100% observer coverage
- provide a valid shallow-set certificate for each set,
- change their hooks to 18/0 circle hooks that are 10 degrees off set,
- use mackerel type bait

Requirements for deep-setting:

- 20% observer coverage
- Cannot possess or land more than 10 swordfish per trip
- Mainline must be 100 meters between any two floats
- Cannot possess lightsticks
- Float lines must be at least 20 meters
- There must be at least 15 branch lines between any two floats

Requirements for ALL trips:

- No switching set types once set type is declared.
- Carry and use specified dehooking equipment

Additional requirements for ALL trips north of 23°:

- Use thawed, blue dyed bait (must match NMFS issued color card)
- Must strategically discard offal off the opposite side of the vessel when setting and hauling

12.3 APPENDIX 3: Characteristics of the reopened swordfish fishery versus tuna fishery

Characteristics of the reopened swordfish versus tuna fishing.		
Characteristics	Swordfish targeting	Tuna targeting
Set depth	Shallow (~40m)	Deep (~100-300m)
Hook type	18° Circle hook with a 10 degree offset	Tuna hook (3.6 or 3.8 mm)
Bait	Mackerel type bait	Saury
Lightsticks	Yes	No
Set deployment/retrieval	Dusk/Dawn	Morning/Night
No. hooks between floats	4 - 6	15 - 30
Approx. No. hooks per set	800	2,000 to 3,000

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