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Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Year 2002

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for

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Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Year 2002

1. Introduction

In the western Pacific region, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries), through its Pacific Islands Regional Office (PIRO) has the lead responsibility 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 Fisheries Management Council (WPFMC) is responsible for developing fishery management plans for this region. Together PIRO, PIFSC, and U.S. Fish and Wildlife Service (FWS) work cooperatively with the WPFMC to prevent and mitigate the bycatch of protected species, 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 finalized November 28, 2000 [FWS 1-2-1999-F-02; Service, 2000] with one revision submitted November 18, 2002 [FWS 1-2-1999-F-02R; Service, 2002].

As per the requirements of the BiOps (Service, 2000; 2002), NMFS/PIRO must annually report any observed interactions of Short-tailed albatross with the Hawaii-based pelagic longline fishery, and any observed and estimated total number of interactions with Laysan (*Phoebastria immutabilis*) and black-footed (*Phoebastria nigripes*) albatross by set type[3]. In addition, NOAA Fisheries must report on the status of observer coverage, provide assessments of the effectiveness of required seabird deterrents, and summarize the results of the Protected Species Workshops. This report includes the reporting

[1] American Samoa, Guam, Hawaii, Northern Mariana Islands, and the U.S. Pacific remote island area 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 as final regulations by NOAA Fisheries/PIRO. At present there are five fishery management plans governing western Pacific fisheries: pelagics, bottomfish/seamount groundfish, crustaceans, precious corals, and coral reef ecosystems.

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

requirement for the Hawaii-based pelagic longline fishery operating during calendar year 2002.

2. Species of Concern: Short-tailed Albatross

The short-tailed albatross (STAL) is the largest of the Northern Hemisphere albatross species. They are long-lived, slow to mature, acquire adult plumage with maturity, and may be identified by distinctive pink bills. 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 recovering 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, Japan. The current worldwide STAL population is approximately 1,700 individuals with over 1,500 at Torishima and 200-250 at Minami-kojima (Hasegawa, pers. comm. 2003).

3. The Hawaii-based Pelagic Longline Fishery

The Hawaii-based pelagic 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 component 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 accidentally in the fishery.

The Hawaii-based pelagic longline fishery of 2002 operated under the turtle and seabird mitigation measures that were promulgated as emergency rules (67 FR 40232, June 12, 2001) that subsequently became final June 12, 2002. The fishery operating during calendar year 2002 was exclusively a deep-set longline, "tuna-targeting" fishery. Key conservation measures (67 FR 40232, June 12, 2002) include:

- Seasonal longline area closures during April and May (from the equator to 15°N and 145°W to 180°);
- A prohibition on swordfish-targeted longline fishing north of the equator;
- A trip-limit of 10 on the number of swordfish that can be taken by a Hawaii-based longline vessel fishing north of the equator;
- A ban on the possession of light sticks or other light emitting devices used as lures to attract swordfish on boats operating north of the equator;
- Gear restrictions and gear configurations:

a) deploy longline gear such that the "sag" (deepest point) between any two floats is at least 100 m (328 ft) below the surface of the water at its deepest point;
b) a minimum of 15 branch lines deployed between any two floats; and
c) each float line (one length) must be at least 20 m (65.6 ft) long;

- Sea turtle handling measures; and
- Annual attendance at mandatory protected species workshops for vessel operators.

With respect to albatross, the most important change to the fishery resulting from the sea turtle mitigation measures, is the suspension of all swordfish-target or shallow-set longline operations by Hawaii-based longline vessels. In addition to sea turtles, the historic (pre-2000) swordfish fishery accounted for a majority of the accidental take of seabirds. The fishery employed a shallow-set longline gear configuration with baited hooks typically deployed at dusk and retrieved at dawn. In general, these are the times when albatrosses are actively engaged in foraging and feeding (Service 2000). This characteristic (in combination with other factors, Appendix 3) may have led to higher levels of interactions with longline gear.

4. Hawaii-based Pelagic Longline Fishery Activity in 2002

In 2002, the fishery yielded pelagic landings of 17 million pounds and generated ex-vessel revenues estimated at $37.5 million with tuna (*Thunnus* spp.) the dominant components of longline landings (Table 1).

Table 1. Hawaii-based Longline Fishery during 2002, 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	3.90	4.80
2000	8.18	3.91	2.88	4.80
2001	8.64	2.10	1.61	4.21
2002	7.48	1.87	0.98	4.27

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

In 2002, there were 102 active Hawaii-based longline vessels which made 1,193 trips (Table 2); almost all of which targeted tunas (Bigeye, Albacore and Yellowfin tuna). Of these trips, 510 trips occurred above 23 degrees N. Latitude (PIRO unpublished data).

Table 2. Hawaii-based Longline Fishery 1999 to 2002. 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

* Lightsticks used only by vessels operating south of the equator (i.e., restrictions only for vessels operating north of the equator).

5. Seabird Deterrent Methods

Numerous seabird deterrent mitigation methods have been tested and found to reduce interaction rates and/or incidental mortality of seabirds with longline fisheries (Brothers 1995; Brothers *et al.* 1999; McNamara *et al.* 1999). Although limited information exists about the effectiveness of seabird deterrents, research by McNamara *et al.*, (1999), Boggs (2001) and the PIFSC tested the deterrents in Table 3 and found them to be effective mitigation measures for use by the fishery. These deterrents were required by the Terms and Conditions in the 2000 STAL BiOp, and were initially required by the *emergency rule*s of June 2001 (Service, 2000; 66 FR 31561) and were finalized on May 12, 2002 (67 FR 34408).

Table 3. Summary of seabird deterrent measures (Service, 2000).	
Seabird Deterrent Measure	Tuna (deep) Set
Thawed Bait	Required
Blue Dyed Baits	Required for all baits except control sets in accordance with design of experiment described under "Description of Proposed Action"
Strategic Offal Discharge	Required
Line Setting Machine with weighted branch lines (= 45gm) within one meter of the hook, or use of tarred mainline, basket-style gear deployed slack	Required
Night Sets	Optional
Towed Deterrent	Optional

These *final rules,* recommended by the WPFMC and promulgated by NOAA Fisheries, includes the following seabird mitigation measures for all vessels fishing north of 23°N. latitude (WPFMC, 2002):

- 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;
- Mandatory attendance at annual Protected Species Workshops for vessel owners and operators;
- Handle **all** seabirds in a manner that maximizes the probability of their long-term survival;
- Notify NOAA FISHERIES immediately if a STAL is hooked or entangled; and
- Retain all dead STAL and submit the carcass upon return to port.

6. Observer Coverage

The two major sources of information regarding albatross interactions with the Hawaii-based pelagic longline fishery are mandatory logbooks and observer data collection programs administered by NOAA Fisheries. The longline logbook program requires longline vessel operators to complete and submit to NOAA Fisheries a daily log sheet containing detailed catch and effort data on each set, including information on interactions with protected species (50 CFR §660.14). Although the information is extensive, it does not compare to the completeness of the data collected by fishery observers placed onboard the longline fishing vessels.

NOAA Fisheries observers have been deployed aboard Hawaii-based longline fishing vessels since 1994 primarily to collect fishery-related information, document protected species interactions and collect other information as requested by the PIFSC. The March 30, 2001 court decision required increased observer coverage to 20% of all Hawaii longline vessels, and gradual observer coverage to 5% for all trips operating north of 23°N. latitude[4].

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). As of October 22, 2002, observers on vessels operating north of 23°N. latitude are required to document the setting and haulback of longline gear and record **all** seabird species present, behavior towards fishing gear and interactions (if any) with gear. In order to focus on seabird observations, observers are instructed to discontinue any other duties if seabirds

[4] Beginning in 2001, at least 1% of all longline trips operating in waters north of 23°N. latitude will have an observer. By 2002, at least 3% of all trips will have observers and by 2003, 5% of all trips operating north of 23°N latitude will have a NMFS observer (Service, 2000).

are present during the haulback of the longline gear (PIRO Circular Update 55, Oct. 22, 2002).

During 2002, the observer program maintained average observer coverage of 24.6% (Table 4), and exceeded the required 5% coverage (i.e., 20.8%) for vessels operating north of 23° N. latitude (Table 5).

Table 4: Selected Performance Measures for the Hawaii Longline Observer Program, 1994-2002 (NMFS unpublished data)

Year	Number of Trips	Observed Number of Trips	Average % coverage
1994	1031	55	5.3%
1995	937	42	4.5%
1996	1062	52	4.9%
1997	1123	40	3.6%
1998	1180	48	4.1%
1999	1136	38	3.3%
2000	1134	118	10.4%
2001	1035	233	22.5%
2002	1,193	294	24.6%

Table 5. Observer coverage of vessels operating North of 23° North latitude. Source: Logbook data (NMFS/PIRO).

Year	2000	2001	2002
Sets	4,265	2,856	3,594
Sets Observed (% observed)	356 (8.3)	567 (19.8)	970 (26.9)
Trips	393	352	510
Trips Observed (% observed)	30 (7.6)	66 (18.8)	106 (20.8)

7. Seabird Interactions: 2002

The following information provides the Laysan (LAAL) and black-footed albatross (BFAL), observed and estimated fleet-wide interactions with the Hawaii-based pelagic longline fishery based on observer data for calendar year 2002. In this report, as per the 2000 BiOp, a seabird interaction is any contact between a seabird and fishing activity, implying that the seabird became entangled in the line or was caught on a hook (Service, 2000). Seabird "takes" are recorded at the end of a set, during retrieval or "haul-in."

Observed

During calendar year 2002, there were 3 BFAL and 1 LAAL total observed takes during swordfish sets, and 14 BFAL and 14 LAAL interactions occurred during tuna sets (Table 6). *Emergency rules* [and subsequently *final rules*] restricted swordfish targeting above the equator and thus swordfish sets which interacted with seabirds are those that operated below the equator. There were no observed or recorded Short-tailed albatross interaction with a Hawaii-based pelagic longline vessel during tuna and/or swordfish sets. There have been, however, at sea sightings of individual Short-tailed albatross from such vessels[5], and one reported observation of a Short-tailed albatross occurred February 2, 2002 at French Frigate Shoals, North Western Hawaiian Islands (NWHI)[6].

Table 6. Total observed black-footed (BFAL) and Laysan (LAAL) albatross takes for calendar year 2000 in the Hawaii-based pelagic longline fishery. Source: NMFS/PIRO observer data.

Species	Condition	Swordfish Sets	Tuna Sets
BFAL:	Dead	2	14
	Injured*	1	0
LAAL	Dead	0	13
	Injured	1	1

* Injured birds released alive

Estimated

The following results are summarized from unpublished results provided by the PISFC (M. McCracken). See Appendix 1 for a complete description of the methods and applied statistical techniques. During 2002, the Hawaii-based pelagic longline fleet was estimated to have accidentally interacted with 65 BFAL and 51 LAAL (Table 7). Standard errors rather than prediction intervals (as in other years) are provided because sea bird interaction rates were too low for statistical significance, and thus confidence intervals and fleet wide estimates were difficult to obtain.

[5] As reported in the 2000 BiOp, two Short-tailed albatross sightings occurred, one in March 1997, and one in February 2000 (Service, 2000). In addition, in a meeting to review the protected species workshops held November 4, 2001 by NOAA Fisheries, NOAA staff stated that "two or three" fishermen said they had seen a Short-tailed albatross during longline trips, but whether these fishermen had correctly identified Short-tailed albatrosses is not clear (Karla Gore, NMFS, pers. comm., in Service, 2002).

[6] On February 2, 2002, one adult Short-tailed albatross was observed flying over the north side of Tern Island, French Frigate Shoals, NWHI by three members of the Hawaiian Islands National Wildlife Refuge staff (Debra Henry, Service, pers. comm. in Service, 2002).

Table 7. Estimates of the total incidental take of black-footed (BFAL) and Laysan albatross (LAAL) in the Hawaii-based longline fishery during the four Quarters of 2002. Source: PIFSC, Unpublished Data.

	Takes per Quarter				
Species	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total Takes
BFAL	51	3	0	11	65
(s.e.)	(13.8)	(2.3)	(5.0)	(10.8)	
LAAL	48	3	0	0	51
(s.e.)	(16.0)	(2.8)	(5.0)	(4.5)	

In addition, take rates were not consistent throughout all four quarters of 2002; this further complicated efforts to estimate fleet-wide take. There were no observed takes of seabirds during the 3rd Quarter, and only three black-footed and two Laysan albatross interactions during the 2nd Quarter (see Table 7). Statistically, the associated estimated standard error for the 3rd Quarter is zero. However, although this standard error may be zero, there is uncertainty in the estimate and is likely biased (see Appendix 1).

The fleet-wide estimated seabird takes by the Hawaii-based pelagic longline fishery during years 1999 (included for comparison purposes) through 2002 is depicted in Figure 1. Management regulations are similar for periods 2000b and 2001a (see Appendix 2 for a summary of regulatory restriction). The regulatory period 2001b demarcates the closure of the swordfish component and the beginning of *emergency regulations* for the Hawaii-based pelagic longline fishery. Regulations in 2002 remained unchanged.

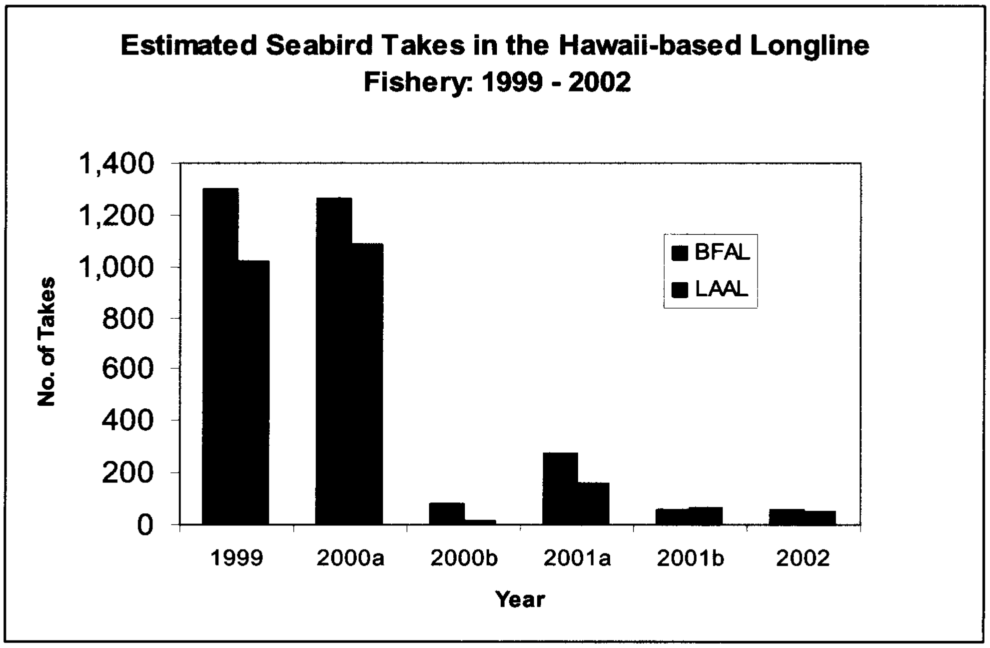

Figure 1. Estimated fleet-wide incidental take of black-footed (BFAL) and Laysan (LAAL) albatross in the Hawaii-based longline fishery during 1999 through 2002. 1999 = No relevant fishery restrictions; 2000a = Regime period 1/1 – 8/24; 2000b = Regime period 8/25 – 12/31; 2001a = Regime period 1/1 – 3/31; 2001b = Regime period 4/1 – 6/30 (emergency rule implemented); 2002 = final rule, unchanged.

8. Protected Species Workshops

The Protected Species Workshops have been held by PIRO every year since 2000 and are expected to continue into the future. Workshops are mandatory for all longline vessel operators and owners with a Hawaii limited entry permit, and for all vessel operators operating with a general longline permit. Participants receive a certification card upon attendance and completion of the workshop. The card must be carried aboard the vessel during fishing operations. PIRO makes a strong effort to collaborate with other agencies and groups involved with the Hawaii-based longline fishery. This collaborative effort between agencies has led to informative and successful Protected Species Workshops.

In 2002, Protected Species Workshops were also conducted in America Samoa where 158 American Samoa-based longline fishermen received certification in addition to 139 Hawaii-based longline vessel operators and owners (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

In general, workshops consist of presentations on seabird and sea turtle identification and life history, albatross and sea turtle handling techniques, marine mammal identifications, 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, and Samoan. In addition, efforts are being made to translate the turtle and seabird handling videos into Tagalog, the predominant language of some of the crews of Hawaii-based longline vessels.

9. Effectiveness of Mitigation Measures

Studies by McNamara *et. al.* (1999), Boggs (2001) and the PIFSC regarding the effectiveness of sea bird mitigation measures suggest that numerous measures have the potential to significantly reduce the incidental catch of albatrosses in the Hawaii-based pelagic longline fishery (see, Table 3). On the other hand, no mitigation measure is exclusively effective on its own (NMFS 2001a). 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 measures is likely to improve overall mitigation effectiveness, although it is uncertain by how much (NMFS 2001a).

The Hawaii-based longline fishery has been required to employ seabird mitigation measures since June 2001. These measures are part of a "mitigation measures package" which includes the 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 bycatch observed in the Hawaii-based longline fishery since 2000 cannot be quantified (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, nor were they tested independently of changing fishery management strategies.

In general, the suspension of swordfish targeting for vessels operating north of the equator and/or other characteristics associated with swordfish style fishing (Appendix 3) may be the primary influence(s) on the low interaction rates of albatrosses with the Hawaii-based pelagic longline fishery, and not the required deterrent measures.

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. The zero takes observed during the third Quarter of 2002 (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, 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, and provide crew with an incentive to employ them consistently and effectively (Gilman *et al.*, 2002).

Two research fishing trips were conducted between 1 April and May 17, 2003 on the Hawaii-based pelagic longline vessel, F.V. *Katy Mary* at grounds south of Laysan Island, Northwestern Hawaiian Islands (Gilman *et al.*, 2003). The study area was selected to ensure sufficient albatross abundance to demonstrate statistically significant differences between seabird deterrent treatments' effectiveness at avoiding seabird interactions[7]. Assessments were made of each deterrent method's effectiveness at avoiding seabird interactions, practicability and convenience, effect on fishing efficiency, cost to employ, and enforceability when limited resources for enforcement are available.

Three deterrent methods, but four experiments, were tested in swordfish and tuna sets. They include Side Setting, Underwater Bait Setting Chutes (both 9m and 6.5m in length), and Blue-dyed Bait. See Appendix 4 for a summary of research activities (Table 15) and summary of results (Table 16). The following information is summarized from the executive summary of the most recent seabird mitigation experiments (Gilman *et al.*, 2003, in review). For full description of the methods, results and analysis of these experiments please refer to the complete paper.

Side Setting

Side setting is a seabird deterrent method which entails setting gear from the side of the vessel, with other gear design the same as conventional approaches when 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, they will have sunk to a depth where seabirds cannot locate it or cannot dive to the depth needed to reach it.

This deterrent showed the highest promise of the four tested deterrent treatments. Side setting had the lowest mean seabird contact and capture rates of the deterrents tested when used with both Hawaii-based longline tuna and swordfish gear. Side setting provided a large operational benefit for certain types of vessels, and was perceived to be practicable for use by crew. Side setting resulted in high fishing efficiency relative to the other treatments, based on bait retention and hook setting rates. Side setting requires a nominal amount of initial expense to employ and can be effectively enforced via simple dockside inspections. 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.

Underwater bait setting chute

Underwater setting chutes release baited hooks underwater, out of sight and reach of diving seabirds. Results from the 2002 preliminary trials conducted in Hawaii suggested that the chute showed great a deal of promise, eliminating seabird captures, reducing contacts by 95%, and reducing the birds' interest in the vessel by 39% (Gilman *et. al.*, 2002). In these recent experiments, two lengths of an underwater setting chute were tested, one 9m long and one 6.5m long, which deployed baited hooks 5.4m and 2.9m underwater, respectively.

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[7] Breeding Laysan and black-footed albatrosses were in the latter half of their chick-rearing period during this period.

The chutes were found to be relatively effective at reducing bird interactions but performed inconsistently and were inconvenient due to design problems. Design improvements are needed and are feasible through additional research. For instance, integrating the chute into the deck hull could address the design and consistency problems currently encountered with the chute. After side setting, the 9m chute had the next lowest mean seabird interaction rates when used with swordfish gear, while after side setting, the 6.5m chute had the next lowest mean seabird interaction rates when used with tuna gear. The underwater setting chute is a relatively expensive deterrent, costing U.S.$5,000 for the hardware, however, the chute is not commercially available for pelagic longline fisheries. Use of the underwater setting chute may be effectively enforced if combined with relevant technology such as hook counters. The chute is not yet suitable for broad commercial use, but holds high promise to minimize seabird mortality in longline fisheries.

Blue-dyed Fish Bait

A part of the proposed action described in the 2002 revised BiOp is an experiment to test the efficacy of blue-dyed saury and other fish bait as a seabird deterrent in the Hawaii-based longline fishery (Service, 2002). The fishery presently incorporates the use of line shooters and weighted branch lines in its standard gear configuration. The recent experiments were designed to quantify any added benefits of using blue-dyed bait. The two previous blue-dyed bait studies (McNamara *et. al.*, 1999; Boggs, 2001) were controls for these experiments.

Thawing and dying bait blue is an attempt to reduce a seabirds 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. It was found that blue-dyed bait was generally less effective at preventing seabird interactions than side setting and the underwater chute. Dyeing bait was impractical and inconvenient for crew, and is not employed consistently by different crew. Blue-dyed bait resulted in a relatively low fishing efficiency based on bait retention and hook setting rates. Blue-dyed bait 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 holds less promise of tested methods to minimize seabird mortality in longline fisheries.

11. Conclusion

In summary no Short-tailed albatross was observed in the Hawaii-based pelagic longline fishery or reported taken by either swordfish or tuna sets during calendar year 2002. However, during this period the fishery incidentally captured approximately 65 black-footed and 51 Laysan albatross. Total observer coverage averaged 24.6% (3,523 of 14,225 sets), and 26.9% of the longline vessels operating north of 23° N. latitude (970 of

3,594 sets). Gilman *et al.* (2003) found that approximately 28% fewer seabirds are hauled aboard than caught during gear deployment. Therefore mortality rates for this annual report are considered conservative estimates, since they are based on observing the haul.

NOAA Fisheries observer and logbook data reflect that the fleet was in compliance with required seabird mitigation regulations, however, a definitive statement regarding the effectiveness of the required seabird deterrents cannot be made at this time. Numerous regulatory regimes influenced the Hawaii-based pelagic longline fishery during years 2000 and 2001. However, the suspension of the swordfish component of the fishery appears to have had the most relevant effect in reducing seabird interaction rates. These regulatory changes significantly changed the fleet's effort, spatial distribution of effort, and the amount and composition of incidental bycatch.

Beginning in 2001, the Hawaii-based pelagic longline fishery operated under sea turtle and seabird *emergency regulations* that subsequently became *final* in 2002. In 2001, seabird interaction rates with the fishery were expected to remain low (Kinan 2003, in review). In 2002, as expected albatross interaction rates were low.

APPENDICIES

12.1 APPENDIX 1: The following information was supplied by the PIFSC (M. McCraken) and provides a detail description of how year 2002 seabird interaction estimates were obtained and the analyses supporting subsequent results.

Despite higher observer coverage in 2002 compared to previous years (1994-2001) the paucity of interactions with protected species required a different statistical approach to estimating take than the modeling approach used in previous years. To estimate takes for year 2002, the estimators were based on sampling probabilities (i.e., the probability a trip was included in the sample). To improve the accuracy of the sample-based estimators, the sampling protocol for selecting trips changed during the second quarter of 2002. Because this change took place mid-quarter, take estimates for the first two quarters were estimated differently than for the last two quarters. Although trips were typically selected by a random scheme during the first two quarters, the sampling probabilities were unknown. When modeling the probability that a trip had an observer onboard, a reasonable model suggested that the sampling probabilities were fairly constant during the first quarter. Therefore, a simple random sample without replacement was assumed when estimating the first quarter's takes. The second quarter was split into two temporal strata, as it appeared that coverage was fairly constant within each time stratum but different between strata. Therefore, when estimating the second quarter's takes a stratified sample was assumed, with simple random sampling without replacement within each stratum. Although the estimators used are unbiased under the stated assumptions, we have approximated the sampling probabilities and are not under the pretense that our estimators are unbiased.

During the second and third quarters, trips were selected using a systematic design with additional trips being selected when needed. These additional trips were selected with equal probability from a pool of vessels that had recently called in to NMFS, as required, to report their intended departure. Coverage is not always constant throughout the quarter as the number of observers available and the level of fishing activity can fluctuate. Observers are not paid when on land waiting for assignment, and it is desirable to keep them fully employed if vessels are available. Therefore, additional vessel trips may be drawn from the available pool to accommodate an observer. This "systematic-plus" design permits the coverage level to be adjusted as needed. However, the additional sampling does depart from a probability sample since the day when additional samples are drawn is not randomly selected but determined by the need to draw additional samples on that day. The sampling probabilities during the periods when additional samples were drawn were computed by enumerating the number of trips calling in during the period of higher coverage and assuming that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample.

During the third and fourth quarters there were also short periods when coverage was below that of the anticipated systematic sample and several systematic samples were missed. In this situation, the sampling probabilities were computed by enumerating all trips that called in during this period and assuming that the trips sampled were selected with equal probability. Because of the additional sampling and periods of lower coverage, the trips in the third and fourth quarter were not selected with equal probability. Therefore, the Horvitz-Thompson estimator was used to estimate total take. A more detailed explanation of the systematic-plus sampling protocol and the formulas for computing the sampling probabilities required by the Horvitz-Thompson estimator will be forthcoming in a technical report. Confidence intervals have not been provided as an appropriate method for approximating them has not been verified.

When there were no observed takes of a species during a quarter, the Horvitz-Thompson estimate of total take and the estimated standard error of this take estimate was zero. Although the estimate of the standard error was zero, there is uncertainty in the estimate of total take. To provide an indication of the level of uncertainty, it was assumed that the takes per trip for the species of concern were independent Poisson variates with a constant mean value (Poisson parameter). This constant mean was defined as the parameter value consistent with a specified chance of observing zero takes in the observed longline sets. The parameter value was estimated corresponding to a 50% chance of observing no takes in the observed sets. This value was then used to estimate the standard error of the sample-base take estimate for that quarter. This estimate is likely biased.

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

Calendar Year 2000

During 2000, fishery data were separated into two periods, which reflect changes in fishery regulations that took place in August 2000. The actual and estimated black-footed and Laysan albatross takes in the Hawaii longline fishery are reported separately for these periods.

- Period One - January 1 to August 24, 2000 - the fleet was prohibited from fishing within the area bounded by 28° N and 44° N, 150° W and 168° W (termed "Area A"; see Figure 1).

- Period Two - August 25 to December 31, 2000 - the fleet continued to be prohibited from fishing within Area A, but was also limited to no more than 154 sets (with 100% observer coverage) within the area on either side of Area A and bounded by 28° N and 44° N and 173° E to 168° W (termed "Area B", see Figure 1). And targeting of swordfish (i.e., shallow setting) was prohibited in waters between the equator and 28° N, from 173° E to 137° W ("Area C").

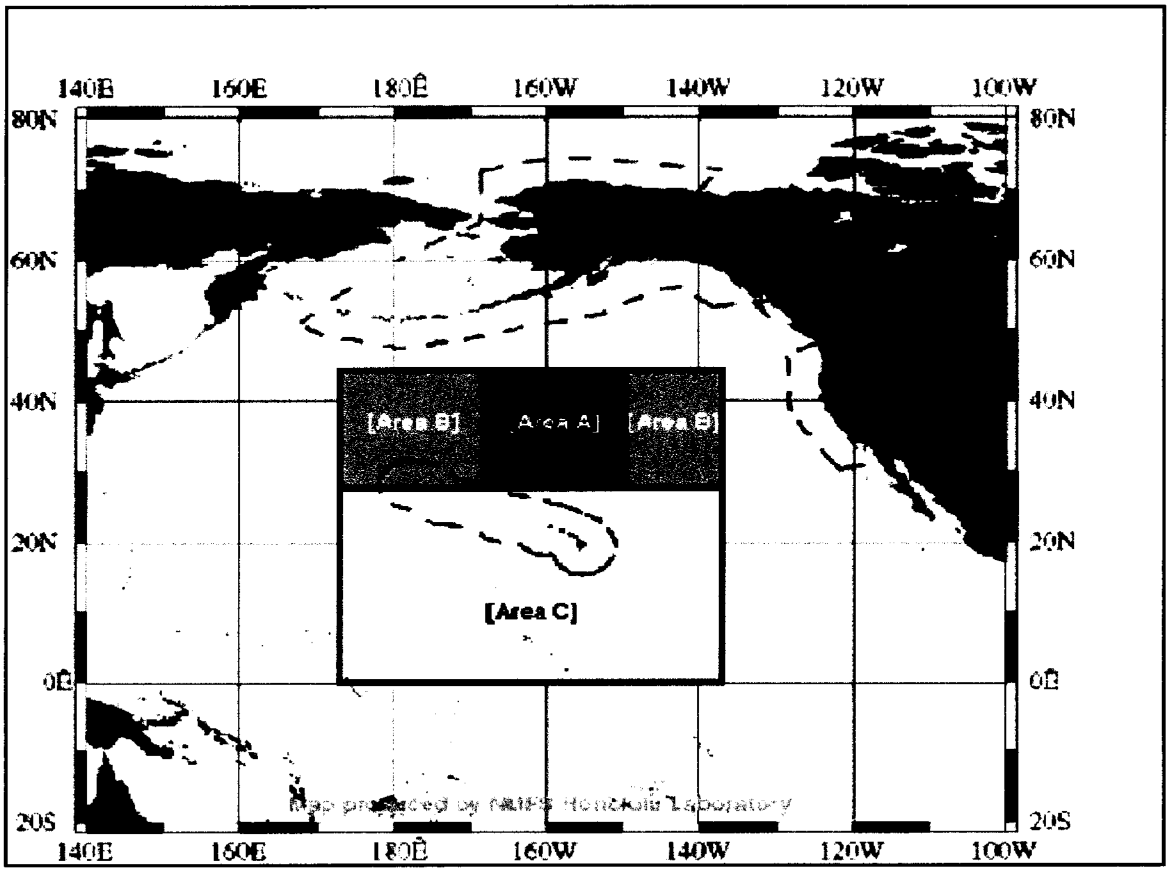

Figure 2. Map of area fishing restrictions applied to the Hawaii-based longline fishery during calendar year 2000.

Calendar Year 2001

Further fishery regulatory changes occurred in calendar year 2001. Of most relevance to seabird interactions was a prohibition on shallow-setting (i.e., targeting swordfish) for all Hawaii-based longline vessels fishing north of the equator. In addition, requirements were implemented that any vessel fishing above 23° North latitude must dye all bait blue, discard offal strategically, used weighted branch lines and either use a line setting machine or basket style longline gear to mitigate seabird interactions.

In 2001, the fishing grounds were divided into two regulatory regimes. The first regime governed the Hawaii-based longline fishery from August 25, 2000 - March 31, 2001 and therefore was applicable during the first quarter of 2001. The second regulatory regime beginning April 1, 2001 was applicable during the last three quarters of 2001 and has continued into the present.

- Regime One - The fishing grounds were split into the three management areas (A, B and C) such as during year 2000 (see Figure 2); each with different restrictions.

All vessels operating in Area B were required to carry a NMFS observer (i.e., 100% observer coverage).

- Regime Two - Fishing was regulated by a NMFS final rule implementing the March 30, 2001 court order (66FR 18243). The fishery management areas (A, B & C) were no longer applicable. Instead, the rule implemented restrictions, closures and gear prohibitions/configurations listed in section "The Hawaii-based Pelagic Longline Fishery" (pg. 4, this document).

12.3 APPENDIX 3: Characteristics of swordfish versus tuna fishing

General characteristics of swordfish versus tuna fishing.

Characteristics	Swordfish targeting	Tuna targeting
Set depth	Shallow (~40m)	Deep (~100-300m)
Hook type	J hook	Circle hook
Bait	Squid	Saury
Lightsticks	Yes	No
Set deployment/retrieval	Dusk/Dawn	Morning/Night
General Location	North of 25° N. lat.	South of 15° N. lat.
No. hooks between floats	4 - 6	15 - 30
Approx. No. hooks per set	800	2,000 to 3,000

12.4 APPENDIX 4: Fishing Experiments

Table 15 provides a summary of the dates of the two research fishing trips, and the order of replicates by tote (also called snood bins, line boxes, or hook boxes) for each set. Four seabird deterrent experimental treatments were employed using Hawaii pelagic longline tuna and swordfish gear.

Table 15. Summary of research activities in the longline experiments.

Trip 1

Set	Date 2003	Treatment and fishing method per tote[a]				
		A	B	C	D	E
1	6 April	B sword	9 sword	S sword	S sword	S tuna
2	7 April	S sword	9 sword	B sword	9 sword	9 tuna
3	8 April	9 sword	B sword	9 sword	S sword	S tuna
4	9 April	S sword	S tuna	B sword	B tuna	B tuna
5	10 April	B sword	B tuna	S sword	S tuna	S tuna
6	11 April	S tuna	S sword	S tuna	B tuna	B sword
7	12 April	B tuna	B sword	B tuna	S sword	S tuna
8	13 April	S tuna	S sword	S tuna	B sword	B tuna
9	14 April	B tuna	B sword	B tuna	S sword	S tuna
10	15 April	B sword	B tuna	S tuna	S sword	S tuna
11	16 April	S tuna	S sword	S tuna	B sword	B tuna
12	17 April	S tuna	S tuna	S tuna	S tuna	S tuna

Set	Date 2003	Trip 2: Treatments per tote (all sets use tuna gear)[a]				
		A	B	C	D	E
1	1 May	B	9	6.5	S	6.5
2	2 May	B	6.5	9	B	9
3	3 May	6.5	S	B	S	9
4	4 May	9	Ss	6.5	S	B
5	5 May	9	B	S	S	6.5
6	6 May	6.5	S	B	S	[b]
7	7 May	6.5	9	B	S	B
8	9 May	S	B	9	6.5	S
9	10 May	9	6.5	S	B	S
10	11 May	S	S	S	B	S
11	13 May	S	B	S	S	S

[a] 6.5 = 6.5m long underwater setting chute (deploys baited hooks 2.9m underwater)
9 = 9m long underwater setting chute (deploys baited hooks 5.4m underwater)
B = Blue-dyed bait
S = side setting
"tuna" = tuna fishing gear
"sword" = swordfish fishing gear
[b] Only 4 totes deployed in this set

Table 16. Summary of average albatross abundance, total seabird contacts, total seabird captures on the set, and total seabirds hauled aboard, by deterrent treatment.

			Mean albatross abundance[a]		Total contacts		Total birds caught/set		Total birds hauled aboard			
Treatment	No.	Hooks	LA	BF	LA	BF	LA	BF	LA	BF	STS	SS
Blue-dyed bait sword gear	11	3896	19.5	8.3	223	30	15	6	6	1	0	0
Blue-dyed bait tuna gear	23	11754	27.4	7.0	265	15	19	3	12	0	1	1
Side set swordfish gear	11	4322	17.1	8.4	8	0	1	0	1	0	0	0
Side set tuna gear	32	20133	21.4	5.7	3	0	0	0	1	0	0	0
9m chute swordfish gear	5	1805	7.4	8.4	8	1	0	1	0	1	0	0
9m chute tuna gear	10	4092	22.5	6.7	42	0	0	0	7	0	0	0
6.5m chute tuna gear	10	4263	24.4	6.4	24	0	1	0	2	0	0	0

[a] LA = Laysan albatross; BF = black-footed albatross, STS = short-tailed shearwater, SS = sooty shearwater

14. Literature Cited

Boggs, C.H. 2001. Deterring albatrosses from contacting baits during swordfish longline sets. Proceedings of the Symposium on Seabird Bycatch: Trends, Roadblocks and Solutions. Pacific Seabird Group, University of Alaska Sea Grant Program.AK-SG-01-01.

Brothers, N.P. 1995. Catching fish not birds: A guide to improving your longline fishing efficiency. Australian Longline Version. Hobard, Australia: Australia Parks and Wildlife Service. 70pp.

Brothers, N.P., Cooper, J., and S. Lokkebord. 1999. The Incidental Catch of Seabirds by Longline Fisheries: Worldwide Review and Technical Guidelines for Mitigation. FAO Fisheries Circular No. 937. Food and agriculture Organization of the United Nations: Rome. 100pp.

Cochrane, J.F. and A.M. Starfield. *In press.* A simulated assessment of incidental take effects on Short-tailed albatrosses. For U.S. Fish and Wildlife Service. 22pp.

Garcia and Associates. 1999. Final report: Hawaiian longline seabird mortality mitigation project. Prepared for Western Pacific Regional Fisheries Management Council, Honolulu, HI, September 1999. 93pp. + appendices.

Gilman E., Brothers N., Kobayashi D., Martin S., Cook J., Ray J., Ching G., Woods B. 2003. Performance Assessment of Underwater Setting Chutes, Side Setting, and Blue-Dyed Bait to Minimize Seabird Mortality in Hawaii Pelagic Longline Tuna and Swordfish Fisheries. Final Report. National Audubon Society, Hawaii Longline Association, U.S. National Marine Fisheries Service Pacific Islands Science Center, U.S. Western Pacific Regional Fishery Management Council: Honolulu, HI, USA. vi+49 pp.

Gilman, E., C. Boggs, N. Brothers, J. Ray, B. Woods, K. Ching, J. Cook, S. Martin, and D. Chaffey. 2002. Performance Assessment of an Underwater Setting Chute to Minimize Seabird Mortality in the Hawaii Pelagic Longline Tuna Fishery. Draft Final Report--Peer Review Version. To be submitted to U.S. Fish and Wildlife Service in fulfillment of Endangered Species Act and Migratory Bird Treaty Act permit conditions. Honolulu, HI, USA. 54 pp.

Hasegawa pers. comm. 2003. START meeting in Hawaii, November 2002.

Hasegawa, H. 1979. Status of the Short-tailed albatross of Torishima and in the Senkaku Retto in 1978/79. *Pacific Seabird Group Bull.* 6(1):806-814.

Kinan, I. 2003 (in review). Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Years 2000 – 2001. NMFS Technical Report.

King, W.B. 1981. Endangered Birds of the World: the ICBP Bird Red Data Book. Smithsonian Institute Press and International Council for Bird Preservation, Washington, DC. 13pp.

McCracken, M. L. 2001. Estimation of albatross take in the Hawaiian longline fisheries. Honolulu Lab., Southwest Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI. Southwest Fish. Sci. Center Admin. Rep. H-01-02. 29 p.

McNamara, B., Torre, L., and K.H. Morgan. 1999. Final report: Hawaii longline seabird mortality mitigation project. Report prepared by Garcia and Associates for the Western Pacific Fishery Management Council. 93pp + appendixes.

National Marine Fisheries Service (NMFS). 2001(a). Final Environmental Statement: Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region. March 30, 2001.

_____. 2001(b). Hawaii Longline Observer Program Field Manual. Southwest Region, Pacific Islands Area Office, Honolulu, Hawaii.

U.S. Fish and Wildlife Service (Service). 2000. Biological Opinion of the U.S. Fish and Wildlife Service for the effects of the Hawaii-based Domestic Longline Fleet on the Short-tailed Albatross (Phoebastria albatrus), November 2000. Honolulu, HI. 96 pp. FWS 1-2-1999-F-02.

_____. 2002. Revised Biological Opinion of the U.S. Fish and Wildlife Service for the effects of the Hawaii-based Domestic Longline Fleet on the Short-tailed Albatross (Phoebastria albatrus), November 2002. Honolulu, HI. 30 pp. FWS 1-2-1999-F-02R.

Western Pacific Regional Fishery Management Council (WPRFMC). April 2002. Pelagic fisheries of the Western Pacific region, 2000 Annual report. Honolulu, HI.

_____. April 2003. Pelagic fisheries of the Western Pacific Region, 2001 Annual report. Honolulu, HI.