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Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Years 2000 and 2001

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Islands Regional Office

Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii-based Longline Fishery for Calendar Years 2000 and 2001

for

National Marine Fisheries Service

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1. Introduction

In the western Pacific region, the National Oceanic and Atmospheric Administration's(NOAA) National Marine Fisheries Service (NMFS or 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 marine resources and protected species. The Western Pacific Regional Fisheries Management Council is responsible for developing fishery management plans for the western pacific region. Together PIRO, PIFSC, and U.S. Fish and Wildlife Service (FWS) work cooperatively with the Western Pacific Fishery Management Council (WPFMC) to prevent and mitigate the bycatch of protected species, including seabirds, by U.S. domestic fisheries governed under the fishery management plans.

Seabird mitigation measures, authorized under the Magnuson-Stevens Fishery Conservation and Management Act, are prescribed in fishery management plans[2] governing fisheries operating in the waters of 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 made on November 18, 2002 [FWS 1-2-1999-F-02R; Service, 2002].

As specified by the BiOp, NOAA Fisheries must annually report any observed interactions of Short-tailed albatross with the Hawaii-based pelagic longline fishery, and 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 implementation timeframe of promulgated regulations (i.e., seabird mitigation measures and observer coverage), provide assessments of the effectiveness of seabird deterrents, and summarize the results of the

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[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.

[2] Fishery management plans are developed by the WPRFMC and when approved by the Secretary of Commerce are implemented as final regulations by NMFS/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] NMFS described tuna and swordfish set type.

Protected Species Workshops. This report includes the reporting requirement for the Hawaii-based pelagic longline fishery operating during calendar years 2000 and 2001[4].

2. Species of Concern: Short-tailed Albatross

The Short-tailed albatross 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 population of the endangered albatross is approximately 1,700 individuals with over 1,500 at Torishima and 200-250 at Minami-kojima (Hasegawa, pers. comm. 2003).

Additional background information regarding the Short-tailed albatross, including life history, population dynamics, environmental baselines and seabird interactions with fishery activity, is located in Appendix 5 (section 13.5) of this report.

3. The Hawaii-based Pelagic Longline Fishery: Historic Activity [5]

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). Between 1994 and 1999, this fishery was comprised of about 110 - 125 active longline vessels and accidentally caught annually, on average, an estimated 1,369 black-footed albatross (BFAL) and 1,175 Laysan albatross (LAAL) (NMFS 2001). No take (injury or mortality) of a Short-tailed albatross has been reported by a Hawaii-based longline vessel, but sightings of individual Short-tailed albatross from such vessels have occurred at sea on two occasions, in March 1997 and February 2000[6].

Prior to 1999, broadbill swordfish *(Xiphias gladius)* was one of the major target species and an important component of the Hawaii-based pelagic longline fishery. Beginning in late 1999 and into 2001, the fishery, especially the swordfish component

[4] Reporting requirements for calendar year 2002 will follow in a separate report.
[5] The Hawaii-based longline fishery as it operated until March 2001 is described in great detail in the March 2001 Final EIS (Section 3.10.3.1, pages 195 to 256; NMFS, 2001a).
[6] As reported in the 2000 BiOp (Service, 2000).

was severely restricted by Federal Court orders that were intended to protect threatened and endangered sea turtles taken accidentally in the fishery[7] (Service, 2002).

4. Hawaii-based Pelagic Longline Fishery: 2000 and 2001

In 2000, the Hawaii-based pelagic longline fishery yielded pelagic landings of 24 million pound and generated ex-vessel revenues estimated at $50 million with tuna (*Thunnus* spp.) and broadbill swordfish the commercially valuable components of longline landings[8] (Table 1). In 2001, longline landings and revenue fell by approximately 35% to 15.4 million pounds ($33 million). This decrease resulted from the suspension of the swordfish fishery and decrease in shark landings due to State and federal laws prohibiting shark finning (WPRFMC, 2002).

Table 1. Hawaii-based Longline Fishery 1999 to 2001, catch per unit effort (CPUE), number of species caught per 1,000 hooks. Source: PIFSC unpublished data.

Year	No. Tuna	No. Sharks	No. Billfish	No. Other 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

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

In 2001, there were 101 active Hawaii-based longline vessels, 24 fewer vessels than the previous year (Table 2). In 2000 and 2001, Hawaii-based longline vessels made 1,135 and 1,075 trips respectively; almost all of which targeted tunas (bigeye, albacore and yellowfin tuna).

[7] A lawsuit filed by the Earthjustice Legal Defense Fund in February 1999, on behalf of the Center for Marine Conservation and the Turtle Island Restoration Network, alleged that NMFS had failed to follow the prescribed National Environmental Policy Act (NEPA) process and challenged NMFS's determinations under the Endangered Species Act (ESA) that the continued conduct of the Hawaii-based pelagic longline fishery was likely to jeopardize the long-term existence of leatherback, loggerhead, olive ridley, and green sea turtles (Center for Marine Conservation v. NMFS (D. Haw.) Civ. No. 99-00152 DAE (CMC v. NMFS).

[8] Detailed information on the Hawaii-based longline fishery can be found in the 2000 and 2001 Annual Reports, Western Pacific Regional Fishery Management Council, Honolulu, HI (WPRFMC, 2001; 2002).

Table 2. Hawaii-based Longline Fishery 1999 to 2001. 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

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

4.1 Summary of Regulatory Changes for 2000

On November 23, 1999, the Federal Court for the District of Hawaii issued an injunction that led to the temporary closure (via *interim emergency rule*, 64 FR 72290; December 27, 1999) of certain waters north of Hawaii to fishing by Hawaii-based longline vessels. These measures became effective on April 27, 2000, under the *emergency rules* promulgated by NMFS (65 FR 16346; March 28, 2000). Subsequent Court orders, including one on June 23, 2000, required NMFS to suspend longline fishing for swordfish, and increase observer coverage to 20% of all longline trips (65 FR 51992; August 25, 2000). These regulatory changes led to the following two fishery management periods during 2000:

- 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). In addition, 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").

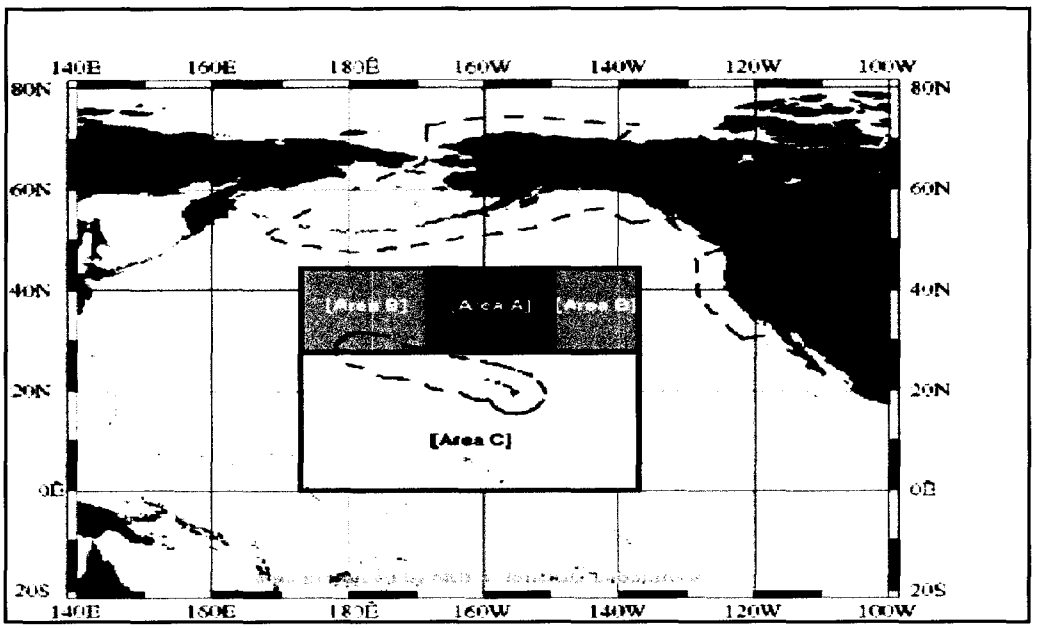

Figure 1. Map of area fishing area regulations applied to the Hawaii-based pelagic longline fishery during calendar year 2000.

4.2 Summary of Regulatory Changes for 2001

In 2001, the fishing grounds were once again divided into two regulatory periods, or regimes. Court orders requiring NMFS to complete an Environmental Impact Statement (EIS) on the conduct of the fishery under the FMP, resulted in subsequent promulgation of another *emergency rule* (66 FR 31561; June 12, 2001). This 2001 *emergency rule* included both seabird and sea turtle conservation measures consistent with the Terms and Conditions of the 2002 STAL BiOp and Pelagic Fishery FMP, Final EIS (FEIS) (Service, 2002; WPFMC, 2002).

The resulting fishery regime for the first period was a continuation from the previous year, and 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 (August 25, 2000 - March 31, 2001) - The fishing grounds were split into the three management areas (A, B and C) such as during the last half of the year 2000 (see Figure 1). Each area had different restrictions and all vessels operating in Area B were required to carry a NMFS observer (i.e., 100% observer coverage).

- Regime Two (April 1, 2001 to present) - 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 the following section, "The Current Hawaii-based Pelagic Longline Fishery."

5. The Current Hawaii-based Pelagic Longline Fishery

The Hawaii-based pelagic longline fishery essentially continues to operate under the turtle and seabird mitigation measures that were promulgated as *emergency rules* (66FR 31561) described in the *preferred alternative* of the FEIS (March 30, 2001) on the Pelagic Fisheries FMP (NMFS 2001a) and subsequently became final June 9, 2002 (67FR 40232). The Hawaii-based pelagic longline fishery is now exclusively a deep-set longline "tuna-targeting" fishery. Key conservation measures 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
- Mandatory attendance at 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, Table 3) may have facilitated higher levels of interactions with longline gear.

Table 3. 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	Sanma
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

6. 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). During the 101st WPRFMC Meeting (October 1999), the WPRFMC adopted measures to mitigate interaction between the Hawaii-based longline fishery and albatrosses. These measures were placed on hold until conclusion of the USFWS, STAL BiOp. 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 4 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 subsequently required by the *emergency rule*s of June 2001 (Service, 2000; see Appendix 3 for a summary of estimated effectiveness).

Table 4. 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

The seabird *emergency rules* (of June 2001) became *final* May 12, 2002 (67FR 34408). These *final rules,* promulgated by NMFS includes the following seabird mitigation measures for all vessels fishing north of 23°N. latitude (WPRFMC, 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 the 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 NMFS 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.

7. 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 NMFS. The longline logbook program requires longline vessel operators to complete and submit to NMFS a daily log sheet containing detailed catch and effort data on each set, including information on interactions with protected species (50 CFR 66014). 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.

NMFS observers have been deployed aboard Hawaii-based pelagic longline fishing vessels since 1994 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-based longline vessels, and gradual observer coverage to 5% for all trips operating north of 23°N. latitude[9].

Table 5: Selected Performance Measures for the Hawaii Longline Observer Program, 1994-2001 (NMFS unpublished data)

Year	No. Trips	No. Trip Observed	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%

Until 2001, the 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

[9] 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).

revised manual, observers were instructed to not record general seabird sightings **except for** sightings of Short-tailed albatrosses (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 discontinue any other duties.

The percentage of vessels carrying fishery observers increased to 10% by September 21, 2000, and increased to 20% by November 7, 2000. During 2000 and 2001, the observer program maintained average observer coverage of 10.4% and 22.5% respectively (Table 5), and exceeded the required 5% coverage for vessels operating north of 23°N. latitude (Table 6).

Table 6. Fishery observer coverage north of 23° N. latitude. Source: Logbook data (NOAA/PIRO).

Year	2000	2001
Sets	4,265	2,856
Sets Observed (% coverage)	356 (8.3)	567 (19.8)
Trips	393	352
Trips Observed (% coverage)	30 (7.6)	66 (18.8)

8. Seabird Interactions: 2000 and 2001

The following information is 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 years 2000 and 2001. In this report, as per the 2000 BiOp, a seabird interaction (or take) is defined as an event that resulted in a hooking or entanglement in longline gear but does not necessarily indicate a mortality (Service, 2000). During 2000 and 2001, there were no observed or recorded Short-tailed albatross interactions with the fishery. This includes no observations during tuna or swordfish sets. There was, however, one reported observation of a Short-tailed albatross which occurred during a time other than during fishery operations[10].

[10] In a meeting to review the protected species workshops held November 4, 2001, 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).

8.1 Calendar Year 2000

Observed

Seabird "takes" are recorded at the end of a set, during retrieval or "haul-in." During calendar year 2000, there were 124 BFAL and 77 LAAL total observed takes during swordfish sets, and 35 BFAL and 7 LAAL interactions during tuna sets (Table 7). Of these total takes, 21 BFAL and 3 LAAL occurred only during the second management period (during tuna sets).

Table 7. 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	101	30
	Injured*	23	5
LAAL	Dead	47	7
	Injured	30	0

* Injured birds released alive

Estimated

The fleet-wide estimated seabird interaction rates are separated into two periods, which reflect changes in fishery regulations that took place in August 2000. The following information is a summary of unpublished data provided by the PISFC (M. McCracken). See Appendix 1 for a complete description of the methods and applied statistical techniques.

During the first fishery management period (January 1 to August 24, 2000), the fleet-wide estimated takes was approximately 1,262 BFAL and 1,081 LAAL, with an estimated take per set of 14 BFAL and 12 LAAL (Table 8).

Table 8. Estimated fleet-wide interactions for year 2000, time period one (1/1 - 8/24). Area A closed to longline fishing. Average percent of trips observed = 4.4%; Total fleet wide effort = 9,156 sets.

Species	Estimated total fleet wide take (95% prediction interval)	Estimated fleet wide take rate (take per set)
BFAL	1,262 (1,060-1,487)	0.1378 (.1157-.1625)
LAAL	1,081 (751-1,398)	0.1181 (.0820-.1527)

The estimated fleet-wide take rate for the second period (August 25 to December 31, 2000) was statistically more complex since there were not enough takes to build a prediction model. No fishing was allowed in area A (i.e., no estimated take rate), 100% observer coverage in area B (take rate is assumed known), and in Area C where

swordfishing was not allowed, only 16 BFAL and 3 LAAL takes were recorded during tuna sets (Table 9).

Table 9. Estimated fleet-wide interactions for year 2000, time period two (8/25 - 12/31). Area A closed; Area B limited to 154 sets; Area C no swordfish targeting

Fishery Management Area	Observer Coverage	Species	
		BFAL	LAAL
Area A (closed to fishing)	0%	--	--
Area B interactions	100%	5	0
Area B interactions per set	100%	.0610	0
Estimated Area C interactions (95% prediction interval)	21.3%	72 (16-212)	13 (3-43)
Estimated Area C interactions per set (95% prediction interval)	21.3%	0.0192 (.0042-.0567)	0.0035 (.0008-.0115)

Based on similar analysis used to estimate the 1999 seabird interaction rates in the NMFS SWFSC Administrative Report H-01-02 (McCracken, 2001), the estimated total fleet-wide albatross take for the Hawaii-based pelagic longline fishery during calendar year 2000 was 1,339 BFAL and 1,094 LAAL (Table 10).

Table 10. Year 2000 total, estimated fleet-wide albatross takes. Average observer coverage = 10.4%; Total fleet wide effort = 12, 983 sets.

Species	BFAL	LAAL
Estimated total fleet-wide take	1,339	1,094
Estimated fleet-wide take rate (take per set)	0.1031	0.0843

For perspective, Figure 2 depicts the estimated takes of black-footed and Laysan albatross per longline set during the three time categories that represent the changing management regimes between 1999 and 2000.

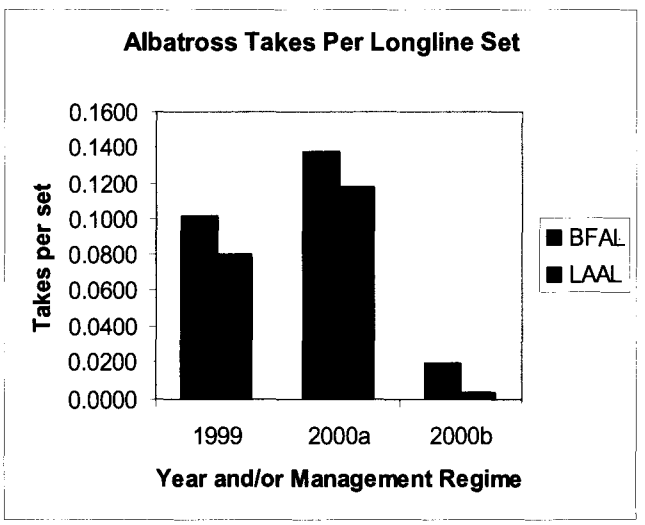

Figure 2. Estimated Albatross takes per longline set, based on observer data, in the Hawaii-based longline fishery during 1999 and 2000. 1999 = 12,776 sets; 2000a = 9,156 sets; 2000b = 3,827 sets.

8.2 Calendar Year 2001

Observed

Further fishery regulatory changes occurred in calendar year 2001, including closure of the swordfish component of the fishery on March 30, 2001. Of swordfish sets which occurred only during the first Quarter of 2001, 15 BFAL and 19 LAAL total takes were observed. Of tuna sets (all four Quarters), 63 BFAL and 58 LAAL interactions were observed (Table 11).

Table 11. Total observed black-footed (BFAL) and Laysan (LAAL) albatross takes for calendar year 2001 in the Hawaii-based pelagic longline fishery. Source: NMFS/PIRO observer data.

Species	Condition	Swordfish Sets*	Tuna Sets
BFAL:	Dead	12	60
	Injured**	3	3
LAAL	Dead	7	57
	Injured	12	1

* Swordfish targeting allowed only during 1st Quarter.
** Injured birds released alive

Estimated

The fleet-wide estimated seabird interaction rates are separated into two regimes, which reflect changes in fishery regulations that took place on April 1, 2001. The following information is a summary of unpublished data provided by the PISFC (M. McCracken). See Appendix 2 for a complete description of the methods and applied statistical techniques.

The two regulatory periods (Regime One & Two) represent two distinct phases of management in the fishery. Conveniently, Regime One occurs during the first Quarter of 2001 and Regime Two marks the beginning of the second Quarter, and thus the estimated take rate for the fishery is treated separately by Quarters.

Quarter 1 estimates for year 2001, based on observer data, for BFAL and LAAL were 215 and 145 respectively (Table 12). Regime 2, which began March 30, 2001, and marks the closure of the swordfish component of the fishery, was applicable to Quarters 2, 3 and 4. During these three Quarters combined, the seabird fleet-wide estimates were 43 BFAL and 107 LAAL (Table 12).

Table 12. Fleet-wide estimated take rates of black-footed (BFAL) and Laysan (LAAL) albatross in the Hawaii-based longline fishery during 2001.

Species	Quarter 1 Take	Quarter 2, 3 & 4 Takes
BFAL	215 (s.e.=26.08)	43 (s.e.=18.34)
LAAL	145 (s.e.=21.30)	107 (s.e.=90.68)

The fleet-wide estimated seabird takes by the Hawaii-based pelagic longline fishery during years 1999 (included for comparison purposes) through 2001 is depicted in Figure 3. Management regulations are similar for periods 2000b and 2001a. The

regulatory period 2001b demarcates the closure of the swordfish component and the beginning of final regulations for the Hawaii-based pelagic longline fishery.

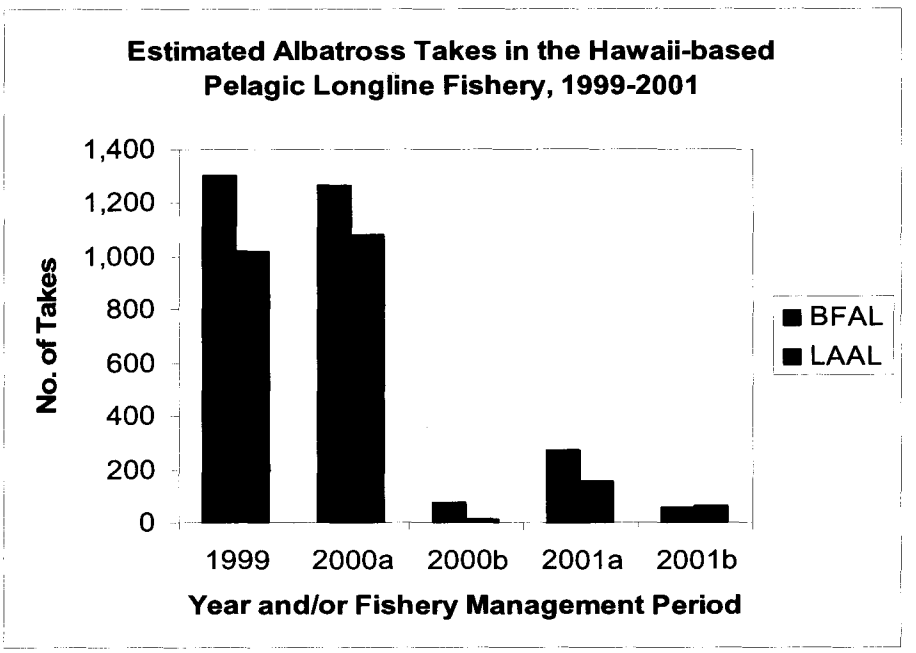

Figure 3. Estimated fleet-wide incidental take of black-footed (BFAL) and Laysan (LAAL) albatross in the Hawaii-based longline fishery during 1999 through 2001. 1999 = No relevant fishery restrictions; 2000a = Regime period 1/1 – 8/24; 2000b = Regime period 8/25 – 12/31; 2001a = Regime period 1/1 – 3/31;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

9. Protected Species Workshops

The Protected Species Workshops were held in 2000 and 2001 [and continue into the present]. Annual attendance at the workshops is 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 which 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 general, workshops consist of presentations on seabird and sea turtle identification and life history, Short-tailed albatross and sea turtle handling techniques, marine mammal identification, current regulations, and current sea turtle research including satellite tagging and gear modification experiments. Workbooks are provided to participants that contain all current regulations, copies of presentations, and informational placards. Written materials and video presentations have 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 many of the crews of Hawaii-based longline vessels.

The first series of Protected Species Workshops were held in Honolulu, Hawaii August 16, 27, and 30 and September 13, 2000. Through the course of those first workshops, 101 captains were certified. In 2001, the workshops were again held in Hawaii and certified 113 attendees (representing 89 vessels).

10. Effectiveness of Seabird Mitigation Measures

Studies of the effectiveness of mitigation measures suggest that measures described in Table 4 and Appendix 3 have the potential to significantly reduce the incidental catch of albatrosses in the Hawaii-based pelagic longline fishery (Service 2000). 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, by *emergency rule*, to use 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. The whole picture is compounded by changing management regimes (e.g., seasonal/area closures, gear restrictions, gear configurations, cessation of the swordfish fishery and bans on the possession of light sticks on vessels operating north of the equator) during the same period that seabird mitigation measures were required.

Furthermore, the assorted changes in management regimes and fleet effort since 1999 are difficult to assess statistically. Decreased fishery effort in the later half of 2000, and low catch rates in the second period of 2000 and all of 2001 make it difficult to generate meaningful, quantitative results that address the effectiveness of seabird mitigation measures. In general, the suspension of swordfish targeting and characteristics associated with swordfish style fishing (Table 3) may be the primary influence(s) on the

decreased take of albatrosses in the Hawaii-based pelagic longline fishery and not the required deterrent measures.

A comparison of seabird interaction rates between 1999 (see Appendix 1), and Periods One and Two of 2000, reveals that Period One's area closures (implemented to afford protection to sea turtles) may have resulted in increased interaction rates with seabirds (see Table 8). On the other hand, Period Two's area closures in combination with the prohibition on shallow-setting appeared to facilitate the reduction of seabird interaction rates (Figure 2). However, decreased fishery effort for this period (i.e., 3,825 sets versus 9,156 sets of the first period of 2000), further complicates statistical predictions.

Another confounding factor in assessing the effects of changing management and 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. If compared to 1999, the estimated take rates for 2000 were higher (Table 10). However, this may be due to more trips operating west of the closed area (west of 173°E. and north of 28°N.) in Period One than in years past (i.e., forcing the fishery to operate closer to the breeding colonies of the NWHI). On the other hand, the reduction of takes observed during the second period of 2000 may be reflective of seabirds migrating to the northwest (out of the fisheries range) post-nesting season, rather than due to implemented deterrent measures or fishery management regimes[11]. Despite increasing observer coverage in 2000 (10.4%) and higher observer coverage in 2001 (22.5%) than 1999 (3.3%), 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.

It is important to note that during these same years, 2000 and 2001, fishermen attended the required Protected Species Workshops. It cannot be discounted, yet difficult to quantify, if education and increased awareness regarding seabird mitigation measures were effective in facilitating reduced interactions.

11. Seabird Mitigation 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 bird 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. The study area was selected to ensure sufficient albatross abundance to demonstrate statistically significant differences between seabird

[11] It is during this time, at the end of the year, when the take rate typically starts to decrease.

deterrent treatments' effectiveness at avoiding seabird interactions[12]. 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

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

were tested, one 9m long and one 6.5m long, which deployed baited hooks 5.4m and 2.9m underwater, respectively.

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 sanma 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 baits 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 avoiding bird interactions than side setting and the underwater chute. Dying 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.

12. Conclusion & Recommendations

Numerous regulatory regimes were imposed on the Hawaii-based pelagic longline fishery during years 2000 and 2001. These regimes and fishery management strategies affected the interaction rates of Black footed and Laysan albatross during these years. Compared to 1999, there were increased interactions with black-footed and Laysan

albatross in year 2000. This was likely a result of the fishery operating closer to the NWHI due to sea turtle mitigation measures promulgated by NOAA Fisheries under court order in late 2000 (i.e., closure of Area A). Albatross interaction rates decreased during the second regulatory period of 2000, however, this period coincided with the period when interaction rates typically decrease.

In summary, NOAA Fisheries complied with the required regulatory timeframe to increase observer coverage of the Hawaii-based pelagic longline fleet. Averaged observer coverage increased from 3.3% in 1999, to 20% by November of 2000, to 22.5% during 2001, and is expected to remain at or over the required 20% in the future.[13] The fishery exceeded the required 5% coverage for vessels operating north of 23 °N. latitude for both 2000 and 2001. Observer and logbook data indicate 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 given at this time. In addition, with the closure of the swordfish component of the fishery beginning in April 2001 by court order and subsequent promulgation of *emergency and final rule;* the fishery never had the opportunity to "test" mitigation measures with a significant number of swordfish sets.

In 1999, absent sea turtle and seabird mitigation regulations, 1,301 black-footed and 1,019 Laysan albatross were estimated to have been accidentally caught during fleet-wide operations (see Appendix 1, Table 13). Two years later in 2001, with multiple regulatory management strategies, the fleet was estimated to have caught 258 black-footed and 252 Laysan albatross (see Table 12). This constitutes an approximate 80% black-footed and 75% Laysan albatross reduction in estimated interactions. The number of interactions are to be considered "worst-case scenarios" (mortalities). Gilman *et al.* (2003 in review) found that approximately 28% fewer seabirds are hauled aboard than caught during gear deployment, and thus mortality rates for this annual report are considered conservative estimates. No Short-tailed albatross takes were observed or reported in 2000 or 2001 for either swordfish or tuna sets.

With respect to albatross, the fishery management *emergency rules* implemented June 2001 (i.e., closure of the swordfish component of the fishery) appeared to have the most relevant effect in reducing seabird interaction rates. These regulatory changes have significantly changed the fleet's effort, spatial distribution of effort, and amount and composition of incidental catch. Since the Hawaii-based pelagic longline fishery now operates under sea turtle and seabird *final rules* (June 9, 2002; 67 FR 40232 & May 14, 2002; 67 FR 34408), seabird interaction rates are expected to remain low.

Recommendations

The following recommended conservation measures are summarized from the 2000 and 2002 revised BiOp, to help reduce the risk of interactions between Laysan, Black-footed and Short-tailed albatross and the Hawaii-based Pelagic Longline fishery:

[13] November 2001, Sea Turtle Biological Opinion

- Coordinate with the governments of Japan, Korea and Taiwan on the collection of fishery effort and seabird bycatch information.
- Conduct a study to determine whether "C" hooks reduce hooking related injuries to seabirds, as opposed to the commonly used "J" hooks.
- Continue to encourage and support research into effective seabird deterrent devices and strategies that reduce the risk of interaction between seabirds and Hawaii longline gear (i.e., side setting and underwater setting chutes).
- Investigate the rate at which Laysan and black-footed albatross "fall-off" longline gear due to injury, hooking or entanglement during the set.
- Support and increase industry incentives to voluntarily use seabird deterrent methods, including those not currently mandated such as underwater setting chutes or chute replacement.
- Consider promulgating regulations to require additional mitigation measures to be use in all Hawaii-based longline operations (e.g., side setting).
- Make any necessary amendments to the Biological Opinion to reflect any new seabird deterrent devices, strategies or results from experiments.

APPEDICIES

13.1 APENDIX 1: Methods Calendar Year 2000 (M. McCracken, PIFSC)

The following methods and data concern the interactions between seabirds and the Hawaii-based pelagic longline fishery during calendar year 2000. Results are separated into two time periods based on changes in fishery regulations that took place in August, 2000, and are based on information received from the National Marine Fisheries Service's Honolulu Laboratory.

- 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). In addition, 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").

In this report, as per the 2000 BiOp (Service, 2000), a seabird interaction is defined as an event that resulted in a hooking or entanglement in longline gear but does not necessarily indicate a mortality. Total fleet-wide effort represents the total number of sets made by the Hawaii-based longline fleet during the period and area specified.

Total fleet wide takes were estimated using a prediction model that related observer recorded take to ancillary (predictor) variables recorded in vessel logbooks. Interactions for unobserved trips were predicted by applying the model to the predictor variables recorded in the vessel logbooks for those trips. The analysis was very similar to that used for estimating 1999 seabird interactions in the NMFS SWFSC Administrative Report H-01-02 (McCracken, 2001). Interaction rates were then calculated as the interactions per set (fleet wide interactions/fleet wide effort).

To estimate take for period one, a prediction model that related observer recorded take to ancillary variables recorded in logbooks was developed. The take for unobserved trips was predicted by applying the model to predictor variables recorded in logbooks for those trips. Total takes were computed by adding the sum of the predicted takes for unobserved trips to the total takes recorded on observed trips. The final predictive model was a generalized additive model. We did evaluate if year, especially year 2000, was associated with albatross takes. The low coverage each year makes it difficult to know if differences between years were due to an occasional trip with high takes or a real yearly component. We did not feel there was an adequate sample in 2000 to build a good approximating model for 2000 separately, as would have been preferred. By combining the data we take the risk that our estimates could be misleading if fishing patterns outside the closed areas changed due to the closure.

Prediction intervals were approximated using a bootstrapping algorithm similar to that described in McCracken (2001). Since a generalized additive model was used, in order to avoid bias, the bootstrapping algorithm was changed so that residuals from an undersmoothed curve were added to an oversmoothed curve. As before, the prediction intervals do not take into account the uncertainty in model selection. Point estimates of take adjusted for bias and approximated prediction intervals for estimated takes are given in Table 9.

Total take for Period two was estimated using data collected during this period. We truncated the data to include only the northern latitudes (above 16°N for black-footed and 15°N for Laysan) since no takes have been recorded by observers in the southern latitudes since 1994. Area B had 100% observer coverage so the take was assumed to be known. The recorded take for Area B is given in Table 9. In Area C, where swordfishing was not allowed, only 16 black-footed albatross and 3 Laysan albatross takes were recorded. This did not provide use with enough information to build a prediction model. Since we do not have a probability sample with known probabilities, we used a simple model that assumed the take rate was constant over time and space. Previous analysis suggest this is an incorrect assumption.

The majority of recorded takes in 2000 were observed at the end of this year when the take rate typically starts to increase. We estimated the constant take rate in the same manner as for a Poisson distribution. Prediction intervals were approximated using a similar resampling algorithm as described in McCracken (2001). Due to the frequency of zero takes the standardized statistic was inappropriate and we used the percentile method for estimating the lower and upper prediction bounds. Due to the sparseness of the data, the reported prediction intervals are probably poor approximations. Because our model is likely inappropriate, we would expect model bias. Hence, our estimates and prediction intervals for Area C should be considered unreliable. However, since albatross takes were only recorded in 5 trips, we would not expect the total take during Period Two to be large.

If compared to the take estimates from 1994 through 1999 (Table 13), the estimated take for 2000 was higher than recent years. This may be due to more trips west of the closed area in Period One than in years past, i.e. there were more fishing trips closer to the NWHI.

Table 13. Year 1999 estimated fleet-wide take (for comparison purposes) - No relevant fishery restrictions. Average observer coverage (% of trips) = 3.2%; Total fleet wide effort = 12,776 sets.

Species	Estimated total fleet wide take (95% prediction interval)	Estimated fleet wide take rate (take per set)
BFAL	1,301 (1,021-1,600)	0.1018 (.0799-.1253)
LAAL	1,019 (688-1,435)	0.0798 (.0538-.1124)

13.2 APPENDIX 2: Methods Calendar Year 2001

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 1); 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 Current Hawaii-based Longline Fishery" (pg. 8 this document).

During calendar year 2001, the two periods (Regime One & Two) represented two distinct phases of management in the fishery. Conveniently, Regime One occurs during the first Quarter of 2001 and Regime Two marks the beginning of the second Quarter, and thus the data are treated separately by Quarters. For the first Quarter, take estimates were derived using the modeling approached used in previous years (McCracken 2001).

Despite higher observer coverage in 2001 and 2002 than in previous years, the paucity of interactions with seabirds during the second regulatory regime required a different statistical approach than the modeling approach to estimate total take. The number of seabirds taken on a longline set is expected to show a seasonal and spatial trend corresponding to the nesting season and distribution of seabirds; however, there are not enough observed takes to model these trends.

An alternative method for estimating total take is to base the estimator on the sampling probabilities that a trip was sampled. Strictly speaking, a probability sample does not exist because not all trips during this period had a probability greater than zero of being sampled. Although trips were typically selected by a random scheme, it is unrealistic to assume that each trip had an equal probability of being sampled. When modeling the probability a trip had an observer on board, a reasonable model suggested splitting the period into four strata and assuming equal probability within each stratum. Therefore, the total take during the second regime (i.e., Quarters 2, 3 and 4) were calculated assuming a stratified random sample with simple random sampling without replacement in each of the four strata. Although the estimators used are unbiased, the approximated sampling probabilities are not under the pretense that estimators are unbiased. Confidence intervals are thus unclear due to the rarity and distribution of

bycatch. Therefore, only standard errors are provided. For practical reasons, it is difficult to draw a sample of fishing trips with known sampling.

13.3 APPENDIX 3: Estimated effectiveness of mitigation measures.

Table 14. Summary of estimated effectiveness of mitigation measures in reducing the incidental catch of black footed (BF) and Laysan (LA) albatrosses in the Hawaii-based pelagic longline fishery (Service 2000).

Mitigation Measure	Species	% Reduction in Bycatch
Discharge of offal strategically[1]	BF	83
	LA	91
Night setting[1]	BF	95
	LA	40
Blue-dyed bait [1,2]	BF	95
	LA	90
Towed deterrent[1]	BF	86
	LA	71
Weighted branch lines[2,3]	BF	93
	LA	91
Line setting machines with weighted branch lines[3]	BF	98
	LA	97

Source: McNamara *et. al.* 1999[1]; Boggs 2001[2]; PIFSC[3]

13.4 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						
		Treatment and fishing method per tote[a]				
Set	Date 2003	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
Trip 2						
		Treatments per tote (all sets use tuna gear)[a]				
Set	Date 2003	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

13.5 APPENDIX 5: Short-tailed Albatross Biology & Environmental Baselines

The information and sections contained in this Appendix 2 (Species Description, Life History, Population Dynamics, Distribution and Population Status, Breeding Habitat, Disease and Parasites, Predation, Contaminants, Pacific (Non-Hawaiian) Fisheries, Air Strikes, Recreational Fishery Bycatch, Foraging Behavior, Analysis of Seabird Interactions with Fishery Activity, Temporal and Spatial Overlap) are adopted and/or summarized from the 2000 BiOp (Service, 2000) and 2002 Revised BiOp (Service, 2002).

Species Description

The first record of the short-tailed albatross was provided by George Steller in the 1740s. The type specimen for the species was collected offshore of Kamchatka, Russia, and was described in 1769 by P.S. Pallas in Specilegia Zoologica (AOU 1998). In the order of tubenose marine birds, Procellariiformes, the short-tailed albatross is classified within the family Diomedeidae. Until recently, it was assigned to the genus *Diomedea*. Following results of the genetic studies by Nunn *et. al.* (1996), the family Diomedeidae was arranged in four genera. The genus *Phoebastria*, North Pacific albatrosses, now includes the Short-tailed albatross (*P. albatrus*), the Laysan albatross (*P. immutabilis*), the black-footed albatross (*P. nigripes*), and the waved albatross (*P. irrorata*) (AOU 1998).

The short-tailed albatross is a large pelagic bird with long narrow wings adapted for soaring just above the water surface. The bill is disproportionately large compared to other northern hemisphere albatrosses; it is pink and hooked with a bluish tip, has external tubular nostrils, and has a thin but conspicuous black line extending around the base. Adult short-tailed albatrosses are the only northern Pacific albatross with an entirely white back. The white head develops a yellow-gold crown and nape over several years. Newly fledged birds are dark brown-black, but soon obtain pale bills and legs that distinguish them from black-footed albatross (Tuck 1978, Robertson 1980). Subadult

birds have mixed white and brown-black areas of plumage, gradually getting more white feathers at each molt until reaching fully mature plumage.

Life History

Available evidence from historical accounts and from current breeding sites indicates that short-tailed albatross nesting habitat is characterized by flat or sloped sites with sparse or full vegetation on isolated windswept offshore islands with restricted human access (Arnoff 1960, Sherburne 1993, DeGange 1981). The only known, currently active breeding colonies of short-tailed albatross are on Torishima and Minami-kojima islands, Japan.

Short-tailed albatrosses are long-lived and slow to mature; the average age at first breeding is about 6 years (Service, 1999). As many as 25 percent of breeding age adults may not return to the colony in a given year (Service, 1999; Cochrane and Starfield, in press.). Females lay a single egg each year, which is not replaced if destroyed (Austin 1949). Adult and juvenile survival rates are high (96%), and an average of 0.24 chicks per adult bird in the colony survive to fledge at six months of age (Cochrane and Starfield, in press.). However, chick survival can be reduced severely in years when catastrophic volcanic or weather events occur during the breeding season.

At Torishima, birds arrive at the breeding colony in October and begin nest building. Egg-laying begins in late October and continues through late November. The female lays a single egg; incubation involves both parents and lasts for 64-65 days. Eggs hatch in late December and January, and by late May or early June, the chicks are almost fully grown and the adults begin abandoning their nests (Service, 1999; Hasegawa and DeGange 1982). The chicks fledge soon after the adults leave the colony, and by mid-July, the colony is deserted (Austin 1949). Non-breeders and failed breeders disperse from the breeding colony in late winter through spring (Hasegawa and DeGange 1982). There is no detailed information on phenology on Minami-kojima, but it is believed to be similar to that on Torishima.

Short-tailed albatrosses are monogamous and highly philopatric to breeding sites. Chicks hatched at Torishima return there to breed. However, young birds may occasionally disperse from their natal colonies to breed, as evidenced by the appearance of adult birds displaying courtship behavior on Midway Atoll that were banded as chicks on Torishima (Service, 1999, Richardson 1994). Observed population growth rates, as indicated by annual increases in adults observed, eggs laid, and chicks fledged on Torishima Island are presented in Table 17. The population at Torishima is estimated to be growing at a rate of between 6.5 and 8.0% per year (Service, 1999).

Table 17. Observed population growth rates at the Torishima Island Short-tailed albatross colony. Source: Hasegawa in 2000 BiOp (Service, 2000).

	Average Annual Increase: 1955-1998	Average Annual Increase: 1980-1998
Birds Observed	6.86%	6.47%
Eggs Laid	6.76%	7.59%
Chicks Fledged	7.86%	8.04%

Population Dynamics

Breeding-age population estimates come primarily from egg counts and breeding bird observations. There were 440 breeding adults present at the beginning of the 1999-2000 breeding season on Torishima, assuming two adults are present for each of the 220 eggs counted (Hasegawa, pers. comm. in Service, 2000). The most recent population estimate on Minami-kojima is 25 breeding pairs, or 50 breeding adults. Therefore, the unadjusted total worldwide estimate is 490. It has been noted that an average of approximately 25 percent of breeding adults may not return to breed each year. It is reasonable, therefore, to estimate that approximately 122 additional breeding-aged birds may not be observed on the breeding grounds. Therefore, 612 birds is the adjusted worldwide estimate of breeding age birds.

Numbers of immature birds are more difficult to estimate because these individuals do not congregate between fledging and returning to breed at approximately 6 years of age. An estimate can be calculated by totaling the number of known fledged chicks in the last 6 years, and the average juvenile survival rate of 96 percent (Service, 1999; Cochrane and Starfield, in press). Dr. Hiroshi Hasegawa of Toho University, Japan, reported that 655 chicks were fledged from the Tsubamesaki colony on Torishima between 1994 and 2000 (H. Hasegawa, pers. comm. in Service, 2000). Based on an average juvenile survival rate of 96 percent, there are an estimated 629 birds in the immature population from Torishima Island. In 1998, Hasegawa estimated the total population at Minami-kojima to be 150 birds, containing an estimate of 100 immature birds. Combining the estimated number of immature birds from Torishima Island and the estimated number of immature birds from Minami-kojima yields a worldwide immature population estimate of about 729 individuals (based on data through the 1999-2000 breeding season at Torishima and 1997-98 breeding season at Minami-kojima).

In 2002, the total short-tailed albatross population on Torishima was estimated at 1,415, including chicks fledged in 2002 (Hasegawa, pers. comm. in Service, 2002). 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). No measures of uncertainty are available for this estimate.

Distribution and Population Status

The species 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). Though other undocumented nesting colonies may have existed, there is no conclusive proof that short-tailed albatross once nested at locations beyond the Japanese and Taiwanese colonies. Short-tailed albatross courtship behavior and reproductive activities have been observed at Midway Atoll National Wildlife Refuge (NWR). The question of the future potential of Midway Atoll NWR to serve as a successful nesting colony, through either natural colonization or propagation efforts, remains unknown (Service, 1999).

At the beginning of the 20th century, the species declined in population numbers to near extinction, primarily resulting from direct harvest at breeding colonies in Japan. Pre-exploration worldwide population estimates of short-tailed albatrosses are not known, but estimates can be made from the total number of known harvest. By 1949, there were no short-tailed albatrosses breeding at any of the historically known breeding sites, including Torishima, and the species was thought to be extinct (Austin 1949).

In 1950, a few nesting short-tailed albatross were reported (Tickell 1973, 1975), and by 1954 there were 25 birds and at least six breeding pairs present on Torishima (Ono 1955). These were presumably juvenile birds that had been wandering the northern Pacific during the final several years of slaughter. Since then, due to habitat management, stringent protection, and the absence of any significant volcanic eruption events, the population has gradually increased. The average growth of the colony on Torishima Island (the colony is called "Tsubamesaki") between 1950 and 1977 was 2.5 adults per year; between 1978 and 1991 the average population growth was 11 adults per year. An average annual population growth of at least 6 percent per year (Hasegawa 1982; Cochrane and Starfield, in press) has resulted in a continuing increase in the breeding population to an estimated 440 breeding birds on Torishima in 1999 (Service, 1999). Torishima Island is under Japanese government ownership and management and is managed for the conservation of wildlife. There is no evidence that the breeding population on Torishima is nest site-limited at this point; therefore, ongoing management efforts focus on maintaining high rates of breeding success.

In 1971, 12 adult short-tailed albatrosses were discovered on Minami-kojima in the Senkaku Islands, one of the former breeding colony sites (Hasegawa 1984). Aerial surveys in 1979 and 1980 resulted in observations of between 16 and 35 adults. In April 1988, the first confirmed chicks on Minami-kojima were observed, and in March 1991, 10 chicks were observed. In 1991, the estimate for the population on Minami-kojima was 75 birds, including 15 breeding pairs (Hasegawa 1991).

At-sea sightings since the 1940s indicate that the short-tailed albatross, while very few in number today, are distributed widely throughout its historical foraging range of the temperate and subarctic North Pacific Ocean with observations concentrated in the northern Gulf of Alaska, Aleutian Islands, and Bering Sea (McDermond and Morgan

1993; Sherburne 1993; Sanger 1972). Individuals have been recorded along the west coast of North America as far south as the Baja Peninsula, Mexico and as far south as Kauai in the Central Pacific (Palmer 1962; Service, 2000). Recent satellite tracking of black-footed and Laysan albatrosses revealed that individuals of these species travel hundreds of miles from breeding colonies during the breeding season (Service, 1999). If short-tailed albatrosses are similar in behavior to black-footed and Laysan albatrosses, short-tailed albatross foraging trips may extend hundreds of miles or more from colony sites (Service, 2000).

Population Status

Between the 1950s and 1970, there were few records of the species away from the breeding grounds, according to the AOU Handbooks of North American Birds (Vol. 1, 1962) and the Red Data Book (Vol. 2, Aves, International Union for the Conservation of Nature, Morges, Switzerland, 1966) (Tramontano 1970). In the northern Pacific, there were 12 reported marine sightings in the 1970s, 55 sightings in the 1980s, and over 250 sightings reported in the 1990s to date (Sanger 1972; Hasegawa and DeGange 1982, unpublished data). This observed increase in opportunistic sightings should be interpreted cautiously, however, because of the potential temporal, spatial, and numerical biases introduced by opportunistic shipboard observations. Observation effort, total number of vessels present, and location of vessels may have affected the number of observations independent of an increase in total numbers of birds present.

The Japanese government designated the short-tailed albatross as a protected species in 1958, as a Special National Monument in 1962 (Hasegawa and DeGange 1982), and as a Special Bird for Protection in 1972 (King 1981). Torishima was declared a National Monument in 1965 (King 1981). These designations have resulted in tight restrictions on human activities and disturbance on Torishima (Service, 1999). In 1992, the species was classified as "endangered" under the then-newly implemented "Species Preservation Act" in Japan, which makes Federal funds available for conservation programs and requires that a 10-year plan be in place, which sets forth conservation goals for the species. The current Japanese "Short-tailed albatross Conservation and Management Master Plan" outlines general goals for continuing management and monitoring of the species, and future conservation needs (Environment Agency 1996). The principal management strategies used on Torishima is legal protection, habitat enhancement, and population monitoring. Since 1976, Hasegawa has systematically monitored the breeding success and population numbers of short-tailed albatrosses breeding on Torishima (Service, 2000).

Due to an oversight in administrative procedures, because available data were not interpreted to support resident status for the species, short-tailed albatross were excluded from U.S. range (Alaska, California, Hawaii, Oregon and Washington) and were not protected by the Endangered Species Conservation Act of 1969. On July 25, 1979, the Service published a notice (44 FR 43705) acknowledging this oversight. On July 25, 1980, the Service published a proposed rule (45 FR 49844) to list the short-tailed albatross in the U.S. No action was taken until September 19, 1997, when the Service

officially designated the species as a candidate for listing in the U.S. (62 FR 49398). The proposal to list the short-tailed albatross as endangered in the U.S. was published on November 2, 1998 (63 FR 58692), and a final rule was published on July 31, 2000 (65 FR 46643) listing the species as endangered throughout its range (Service, 2000).

Breeding Habitat

Short-tailed albatross face a significant threat at the primary breeding colony on Torishima due to the potential for habitat destruction from volcanic eruptions on the island. The threat is not predictable in time or in magnitude. Eruptions could be catastrophic or minor, and could occur at any time of year. A catastrophic eruption during the breeding season could result in chick and adult mortalities as well as destruction of nesting habitat. Significant loss of currently occupied breeding habitat or breeding adults at Torishima would delay and possibly preclude recovery of the species (Service, 2000).

In 1981, a project was supported by the Environment Agency of Japan and the Tokyo Metropolitan Government to improve nesting habitat by transplanting grass and stabilizing the loose volcanic soils (Hasegawa 1991). Breeding success at the Tsubamezaki colony has increased following habitat enhancement (Service, 1999). Current population enhancement efforts in Japan are concentrated on attracting breeding birds to an alternate, well-vegetated colony site on Torishima which is less likely to be affected by lava flow, mud slides, or erosion than the Tsubamezaki colony site (Service, 1999). Japan's "Short-tailed albatross Conservation and Management Master Plan" (Environment Agency 1996) identifies a possible long-term goal of establishing additional breeding grounds away from Torishima once there are at least 1,000 birds on Torishima. Midway Atoll has been identified as a possible site for establishing an additional breeding colony (Service, 1999). Midway Atoll NWR is a logical candidate because it is visited by short-tailed albatross that have displayed reproductive capacity (e.g., courtship dances and egg laying). Until other safe breeding sites are established, short-tailed albatross survival will continue to be at risk due to the possibility of significant habitat loss and mortality from unpredictable natural catastrophic volcanic eruptions and land or mud slides caused by monsoon rains (Service, 2000).

It should be noted that the risk of extinction caused by a catastrophic event at the breeding colony is buffered by adult and immature non-breeding birds. An average of 25 percent of breeding age adults do not return to breed each year (Service, 1999), and immature birds do not return to the colony to breed until at least 6 years after fledging (Service, 1999). As much as 50 percent of the current total worldwide population may be immature birds. If suitable habitat were still available on Torishima, it is possible that these birds could recolonize in years following a catastrophic event.

The active volcano on Torishima began erupting on August 12, 2002. Although the albatrosses' breeding season was over, the effects of this eruption on the colony site,

on the next breeding season, and on the abundance and distribution of short-tailed albatrosses in the action area are not yet clear (Service, 2000).

Disease and Parasites

There are no known diseases affecting short-tailed albatrosses on Torishima or Minami-kojima today (Service, 2000). However, the world population is vulnerable to the effects of disease because of the small population size, the extremely limited number of breeding sites, and the genetic consequences of going through a severe population bottleneck within the last century. Hasegawa (Service, 1999) reports that he has observed a wing-disabled bird every few years on Torishima, but the cause of the disability is not known. An avian pox has been observed in chicks of albatross species on Midway Atoll, but it is unknown whether this pox infects short-tailed albatross or whether there is an effect on survivorship of any albatross species (Service, 1999).

Predation

Sharks may take fledgling short-tailed albatrosses as they desert the colony and take to the surrounding waters (Harrison 1979). Shark predation is well-documented among other albatross species, but has not been documented for short-tailed albatross. The crow, *Corvus* sp., is the only historically known avian predator of chicks on Torishima. Hattori (in Austin 1949) reported that one-third of the chicks on Torishima were killed by crows, but crows are not present on the island today (Service, 1999). Black, or ship, rats (*Rattus rattus*) were introduced to Torishima at some point during human occupation; their effect on short-tailed albatross is unknown. Cats (*Felis cattus*) were also present, and were most likely introduced during the feather-hunting period. They have caused damage to other seabirds on the island (Ono 1955), but there is no evidence to indicate an adverse effect to short-tailed albatrosses. Cats were present on Torishima in 1973 (Tickell 1975), but Hasegawa (1982) did not find any evidence of cats on the island in 1979-1981 (Service, 2000).

Contaminants

A potential threat to Short-tailed albatross is damage or injury due to oil contamination, which could cause physiological problems from petroleum toxicity and by interfering with the bird's ability to thermoregulate (Service, 2000). Oil spills can occur in many parts of the short-tailed albatross' marine range. Oil development has been considered in the past near the Senkaku Islands (Hasegawa 1981). This industrial development would introduce the risk of local marine contamination, or pollution due to blow-outs, spills, and leaks related to oil extraction, transfer and transportation. Historically, short-tailed albatrosses rafted together in the waters around Torishima (Austin 1949) and small groups of individuals have occasionally been observed at sea

(Service, 2000). An oil spill in an area where individuals are rafting could affect the population significantly. The species' habit of feeding at the surface of the sea makes them vulnerable to oil contamination. Hasegawa (Service, 1999) has observed some birds on Torishima with oil spots on their plumage.

Consumption of plastics may also be a factor affecting the species' survival. Albatrosses often consume plastics at sea, presumably mistaking the plastics for food items, or in consuming marine life such as flying fish eggs which are attached to floating objects (Service, 2000). Hasegawa (Service, 1999) reports that short-tailed albatross on Torishima commonly regurgitate large amounts of plastic debris. Plastics ingestion can result in injury or mortality to albatross if sharp plastic pieces cause internal injuries, or through reduction in ingested food volumes and dehydration (Sibert and Sileo 1993). Young birds may be particularly vulnerable to potential effects of plastic ingestion prior to developing the ability to regurgitate (Fefer 1989). Auman (1994) found that Laysan albatross chicks found dead in the colony had significantly greater plastic loads than chicks injured by vehicles, a sampling method presumably unrelated to plastic ingestion, and therefore representative of the population. Hasegawa has observed a large increase in the occurrence of plastics in birds on Torishima over the last 10 years (Service, 1999), but the effect on survival and population growth is not known.

Pacific (Non-Hawaiian) Fisheries

Distant water longline fleets, such as those from Japan, Russia (minor fishery), Korea, and Taiwan, traverse the waters of the North Pacific Ocean in search of swordfish and tuna (Service, 2000). Swordfish can be found at frontal zones: where the Kuroshiro Current converges with the coastal waters of Taiwan and Japan; where the Kuroshiro Extension Current converges with the Oyashio Current; where the Equatorial Counter Current converges with the Peru Current; and along Baja California (Mexico) and California (Sakagawa 1989). Bigeye tuna, which commands among the highest prices per pound for tuna species, are distributed from 40° north latitude and south of the equator, from Japan east to the United States and Mexico (Hampton *et. al.* 1998).

Understanding foreign fishing fleet effort, that in many instances overlaps with the currently known foraging range of the short-tailed albatross, is an integral part of analyzing the threat of foreign longline fishing activities to short-tailed albatross (Service, 2000). However, in many fisheries, fishers may not be required to report seabird bycatch, may not be able to identify seabirds, or may have significant disincentives to do so for fear of consequences to the future of the fishery. To our knowledge, reporting seabird bycatch and the rates at which seabirds are caught is not reported by foreign fishing nations (Service, 2000).

Hasegawa (Service, 1999) reported that 3-4 birds come ashore on Torishima Island per year entangled in fishing gear, and that some may have died as a result. He also stated that some take by Japanese handliners may occur near the nesting colonies,

although no such take has been reported. There is no additional information on the potential effects of fisheries near Torishima on the species (Service, 2000).

Air Strikes

Seabird collisions with airplanes have been documented by the Service on Midway Atoll NWR since operation of the airfield was transferred from the Department of Defense to the Department of Interior in July 1997. Since acquiring the airfield, the Service has implemented several precautionary mechanisms to reduce and document seabird collisions. Transient aircraft (primarily U.S. Military or U.S. Coast Guard C-130s) are required to obtain Prior Permission before landing at Midway Atoll NWR. Aircraft are advised to land within the parameters provided by airfield operations to reduce air collisions with seabirds. Because of the current changes in visitor use at Midway Atoll NWR, at present air traffic is significantly reduced, and the risk of seabird collision with aircraft is reduced commensurately (see, Service 2002).

Recreational Fishery Bycatch

The Service has authorized a recreational rod and reel fishery at Midway Atoll NWR. In 1999, nine Laysan albatross were reported to have been accidentally caught on recreational lines by fishing vessels operated by Midway Sport Fishing (see Service 2002). However, due to current changes in visitor use at Midway, and the cessation of the recreational fishery in the atoll, at present there is no threat to seabirds from this source.

Foraging Behavior

Similar to Laysan and black-footed albatross, short-tailed albatross are able to locate food using well-developed eyesight and sense of smell. All three species of albatross feed at the ocean surface or within the upper three feet (one meter) by seizing, dipping or scavenging (Austin 1949, Harrison *et. al.* 1983). Albatross diet consists primarily of squid, fish and flying fish eggs (Harrison *et. al.*, 1983 and Austin 1949).

Current knowledge of the foraging behavior of the three species of *Phoebastria* albatross that occur in the North Pacific (which includes the action area), and the existing data collected by NMFS and Garcia and Associates (1999), suggest that: 1) these species behave similarly with respect to longline fishing, and 2) a deterrent that is effective for one species is likely to be effective for all three.

In short, foraging seabirds may interact with fishing gear, which may result in mortality if birds attempting to steal bait. Birds may become hooked as the mainline is set, are pulled underwater, and drowned. In addition, birds may sustain injuries from interactions with baited hooks during the process of setting and hauling back the main line, which could seriously impair them and result in mortality.

Analysis of Seabird Interactions with Fishery Activity

The probability of short-tailed albatross being taken on longline gear and reported is a function of many factors, including: 1) temporal and spatial overlap of the distribution of short-tailed albatross at sea and the distribution of longline vessels' fishing activity, 2) albatross foraging behavior, 3) observer coverage, 4) total number of baited hooks set per unit time, and the species targeted by the longline fishing vessels (i.e., swordfish set, mixed set or tuna set), and 5) use and effectiveness of seabird deterrent devices (Service, 2000).

In addition, numerous other factors may contribute to the probability that individual birds will be hooked, including: 1) type of fishing operation and gear used, 2) length of time longline gear is at or near the surface of the water during the set, and to a lesser degree during the haulback, 3) behavior of the individual bird, 4) water and weather conditions (e.g., sea state), 5) availability of food (including bait and offal), and 6) physical condition of the bird (Service, 2000). The number of birds affected by longline fishing is also a function of population size; as the short-tailed albatross population increases, an increase in number of birds killed on longlines may likely occur.

There are no documented instances of short-tailed albatrosses being killed in the Hawaii-based pelagic longline fishery. This may be a result of a combination of factors, including: low observer coverage in the fishery (1994-1999 average coverage less than 5%), the allocation of observers' duties during that period, and the fact that short-tailed albatross occurrences are likely to be relatively rare because of their low population numbers world-wide.

Few short-tailed albatrosses exist today (approx. 1,700), even fewer have been observed in the Hawaiian region, and historical information is lacking on which to base an estimate of Short-tailed albatrosses takes in the Hawaii longline fishery. Therefore, the level of risk this species may experience resulting from Hawaii longline fishery activity is difficult to determine. To assess interaction rates and fishery effects, a surrogate species, Laysan and/or black-footed albatross are used. Short-tailed albatross are best compared with black-footed albatross because both species are larger than Laysan albatross, and they may out compete Laysan albatrosses for food due to their size and behavior. Furthermore, two NMFS observations of short-tailed albatrosses (March 1997 and February 2000) indicate that they were flying primarily in the company of black-footed albatrosses[14] (Service, 2000).

By use of surrogate species interaction rates (i.e., black-footed albatross) and as per the revised 2002 BiOp, it is estimated that one (1) short-tailed albatross per year may be taken in the Hawaii-based longline fishery, or a total of four over the remaining four-year duration of this consultation (see Service, 2002). The Service defines take of short-

[14] In March 1997, a juvenile short-tailed albatross was observed in the company of about 30 black-footed albatrosses by a NMFS fishery biologist from the R/V Townsend Cromwell; in January 2000, a juvenile short-tailed albatross was observed in the company of about 10 - 15 black-footed albatrosses by a NMFS fishery observer from a Hawaii-based longline fishing vessel (Service, 2000).

tailed albatrosses to include injury or mortality resulting from interaction with longline gear. Thus, to document take it is not necessary to have a dead bird in hand. The record of a Short-tailed albatross interacting with gear and being obviously hooked or killed is sufficient.

Temporal and Spatial Overlap with the Hawaii-based Longline fishery

Short-tailed albatrosses have been observed in the vicinity of the NWHI between November and March and have been observed as far south as Kauai (Service, 2000). In 2000, it was estimated that throughout the course of one year, about 347 short-tailed albatross (or 24.5% of the then estimated 1,415 of the worldwide population) [Service, 2002] may have been present within the area where the range of the bird overlaps with the Hawaii-based longline fishery (Figure 4). This map depicts approximately 989,651,000 hectares (or 24.5%) of the seabirds' range may overlap with the Hawaii-based longline fleet operations (Service, 2000). However, this range was estimated based on the characteristics of the pre 2000 longline fishery. The fishery since then has undergone many changes, primarily associated with targeting tuna (south of 15°N. lat) rather than swordfish (north of 25° N. lat).

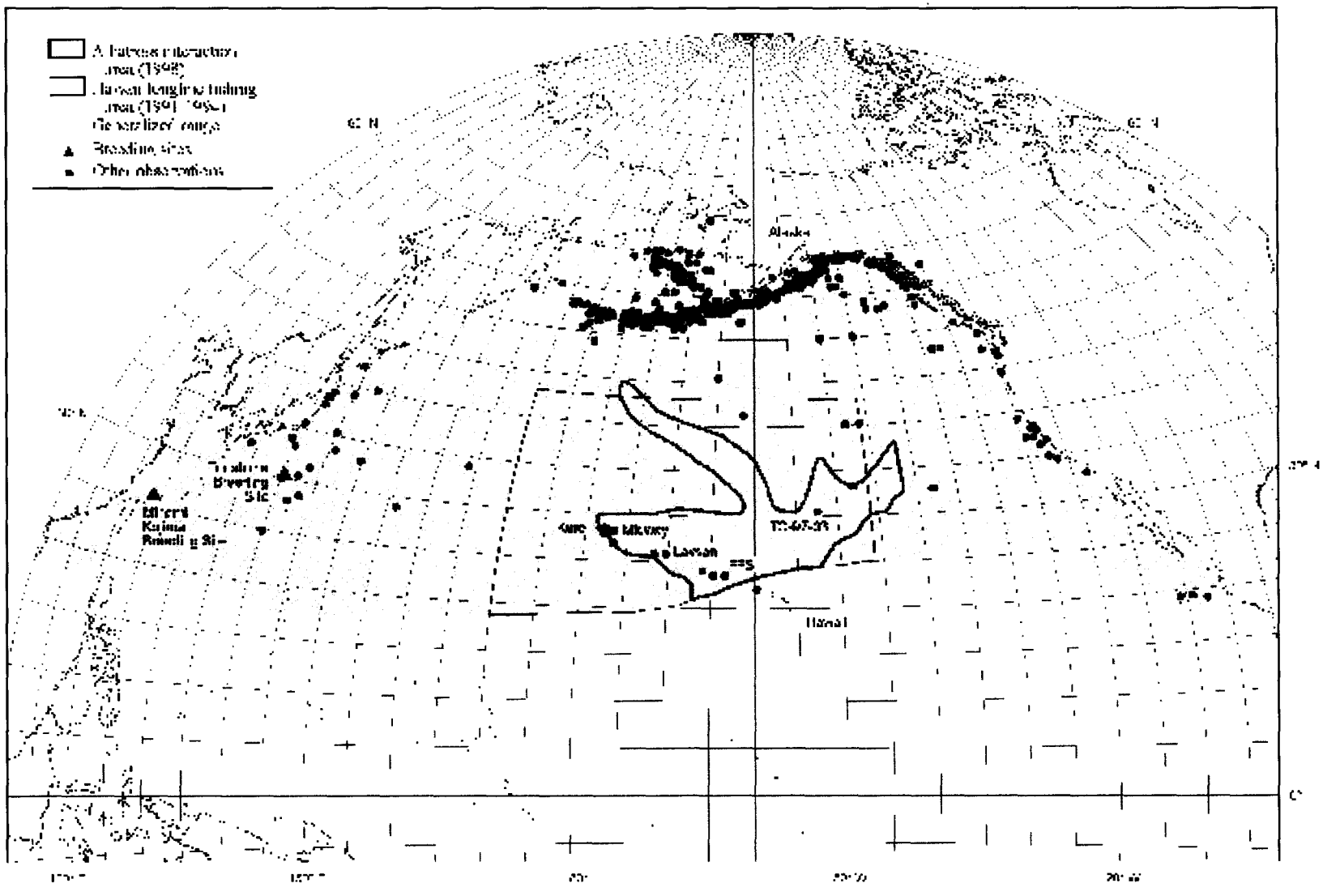

Figure 4. Short-tailed albatross range (shaded) overlapping with the Hawaii-based pelagic longline fishery (enclosed area). Dots represent short-tailed albatross documented sightings. Triangles denote nesting sites.

14. Literature Cited

American Ornithologists' Union (AOU). 1998. Checklist for North American birds. 7th ed. Allen Press: Lawrence, KS.

Arnoff, A.E. 1960. Some observations on birds at Torishima. *Tori* 15(76):269-279.

Auman, H.J. 1994. Plastic ingestion, biomarkers of health, PCBs and DDE in two species of albatrosses on Sand Island, Midway Atoll. M.S. Thesis. Michigan St. Univ., Department of Fisheries and Wildlife.

Austin, O.L., Jr. 1949. The status of Steller's albatross. *Pacific Science* 3:283-295.

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.

DeGange, A.R. 1981. The short-tailed albatross, *Diomedea albatrus,* its status, distribution and natural history. U.S. FWS unpubl. rep. 36pp.

Environment Agency, Japan. 1996. Short-tailed albatross conservation and management master plan. Environment Agency, Japan.

Fefer, S.I. 1989. Letter to Dr. Hiroshi Hasegawa, Biology Department, Toho University on April 26, from Stewart Fefer, U.S. Fish and Wildlife Service, Honolulu HI, regarding short-tailed albatross sightings on Midway Island and ingestion of plastics by birds. 2pp.

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.

Hampton, J., K. Bigelow, and M. Labelle. 1998. A summary of current information on the biology, fisheries, and stock assessment of bigeye tuna (*Thunnus obesus*) in the Pacific Ocean, with recommendations for data requirements and future research. Secretariat of the Pacific Community. Oceanic Fisheries Programme Tech. Rep. No. 36. Noumea, New Caledonia. 46pp.

Harrison, C.S. 1979. Short-tailed albatross, vigil over Torishima Island. *Oceans* 12(5):24-26.

_____ . Hida, T.S. and M.P. Seki. 1983. Hawaiian seabird feeding ecology. *Wildl. Monogr.* 85:1-71.

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.

_____. 1981. Letter of 27 July to U.S. Fish and Wildlife Service from Biology Department, Toho University, Japan. 4pp.

_____. 1982. The breeding status of the short-tailed albatross *Diomedea albatrus,* on Torishima, 1979/80-1980/81. J. Yamashina Inst. Ornithol.14:16-24.

_____. 1991. Red Data Bird: Short-tailed albatross. *World Birdwatch* 13(2):10.

_____. 2000. Toho University, Japan. Personal communication in 2000 BiOp (FWS 1-2-1999-F02)

_____ and A. DeGange. 1982. The short-tailed albatross *Diomedea albatrus,* its status, distribution and natural history. *Am. Birds* 6(5):806-814.

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). 1999. Hawaii Longline Observer Program Field Manual. Southwest Region, Pacific Islands Area Office, Honolulu, Hawaii.

_____. 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.

Nunn, G.B., J. Cooper, P. Jouventin, C.J.R. Robertson, and G.G. Robertson. 1996. Evolutionary relationships among extant albatrosses (Procellariiformes: Diomedeiadae) established from complete cytochrome-B gene sequences. *Auk* 113(4):784-801.

Ono, Y. 1955. The status of birds on Torishima; particularly of Steller's Albatross. *Tori* 14: pgs. 24-32.

Richardson, S. 1994. Status of the short-tailed albatross on Midway Atoll. *Elepaio* 54:35-37.

Robertson, D. 1980. Rare birds of the west coast of North America. Woodcock Publications, Pacific Grove, CA. Pp. 6-9.

Sakagawa, G.T. 1989. Trends in fisheries for swordfish in the Pacific Ocean. In Planning the Future of Billfishes - Research and Management in the 90s and Beyond, (Marine Recreational Fisheries 13) Proceedings of the Second International Billfish Symposium, Kailua-Kona, Hawaii (August 1 - 5, 1988), Part 1: Fishery and Stock Synopses, Data Needs and Management, Richard H. Stroud, (Ed.). Published by the National Coalition for Marine Conservation, Inc. Savannah, GA.

Sanger, G.A. 1972. The recent pelagic status of the short-tailed albatross (*Diomedea albatrus)*. Pacific Grove, CA. Pp.6-9.

Sherburne, J. 1993. Status report the of short-tailed albatross *Diomedea albatrus*. U.S. Fish and Wildlife Service unpubl. rep., Alaska Natural Heritage Program. 33pp.

Sibert, P.R. and L. Sileo. 1993. The effects of ingested plastic on growth and survival of albatross chicks in Veermeer, K. et al, eds. The status, ecology and conservation of marine birds of the North Pacific. Can. Wildl. Serv. Spec. Publ., Ottawa.

Tickell, W.L.N. 1975. Observations on the status of Steller's albatross (*Diomedea albatrus)* 1973. Bulletin of the International Council for Bird Preservation XII: 125-131.

Tramontano, J.P. 1970. Winter observations of the short-tailed albatross in the western Pacific Ocean. *Condor* 72(1):122.

Tuck, G.S. 1978. A field guide to the seabirds of Britain and the world. Collins Co. Ltd., London. 17pp.

U.S. Fish and Wildlife Service (Service). 1999. Biological Opinion on the effects of hook-and-line groundfish fisheries in the Gulf of Alaska and Bering Sea/Aleutian Islands areas on short-tailed albatrosses (*Phoebastria albatrus*).

____. 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 (Pheebastria 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 (Pheebastria albatrus), November 2002. Honolulu, HI. 30 pp. FWS 1-2-1999-F-02R.

Western Pacific Regional Fishery Management Council (WPRFMC). March 23, 1987. Fishery management plan for pelagic fisheries of the western Pacific region. 1164 Bishop Street, Suite 1405. Honolulu, HI.

_____. November 21, 1990. Amendment 1 and environmental assessment - fishery management plan for pelagic fisheries of the western Pacific region.

_____. February, 1991. Amendment 2 and environmental assessment, fishery management plan for pelagic fisheries of the western Pacific region.

_____. June 4, 1991. Amendment 3, regulatory impact review and proposed regulations, fishery management plan for pelagic fisheries of the western Pacific region.

_____. June, 1991. Amendment 4, extend the Hawaii longline moratorium for a total of 3 years - environmental assessment and regulatory impact review, fishery management plan for pelagic fisheries of the western Pacific region.

_____. October 7, 1991. Amendment 5, fishery management plan for pelagic fisheries of the Western Pacific region.

_____. April 30, 1992. Amendment 6, fishery management plan for pelagic fisheries of the western Pacific region.

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.

_____. March 2002. Measures to reduce the incidental catch of seabirds in the Hawaii longline fishery. A framework adjustment to the Western Pacific Pelagic Fisheries Management Plan.