Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii Longline Fishery for 2007

ADMINISTRATIVE REPORT

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

June 2008

PACIFIC ISLANDS REGIONAL OFFICE

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Cover photo: Short-tailed albatross (*Phoebastria albatrus*), Laysan albatrosses (*Phoebastria immutablis*), and black-footed albatrosses (*Phoebastria nigripes*), Midway Atoll. Photo courtesy U.S. Fish and Wildlife Service.

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June 2008

Table of Contents

1.0	**Introduction**	**9**
2.0	**Description and Status: Short-tailed Albatross**	**10**
3.0	**Description and Status of Proxy Species**	**11**
4.0	**Description of the Hawaii Pelagic Longline Fishery**	**14**
5.0	**Seabird Deterrence Measures**	**19**
6.0	**Observer Coverage in 1994-2007**	**26**
7.0	**Protected Species Workshops in 2007**	**28**
8.0	**Seabird Interactions**	**30**
9.0	**Summary**	**38**
10.0	**Literature Cited**	**40**
11.0	**Acknowledgements**	**44**
12.0	**Appendices**	**45**
Appendix 1:	**Pelagic Management Unit Species and Common Catch Species**	**45**
Appendix 2:	**Interaction estimates with incidentally caught sea turtles, seabirds, and marine mammals in the Hawaii longline deep-set fishery.**	**48**

List of Tables

1) **Table 1. Characteristics of the Shallow-set (swordfish-targeting) and Deep-set (tuna-targeting) Components of the Hawaii Longline Fishery** **14**

2) **Table 2. Hawaii Longline Fishery effort data, 2000–2007** **17**

3) **Table 3. Summary of current seabird regulations for the Hawaii longline fleet, effective as of January 18, 2006** **21**

4) **Table 4. Hawaii Longline Observer Data Collection Requirements from 1994-Present** **27**

5) **Table 5. Types of Interactions between Albatrosses and Hawaii Longline Vessels in 2007** **33**

6) **Table 6. Release Condition for Albatrosses Captured Incidentally to Fishing Operation in the Hawaii Longline Fishery in 2007** **34**

7) **Table 7. Probable Time of Capture for Observed Albatross Interactions in the Hawaii Longline Fishery in 2007** **35**

8) **Table 8. Interaction estimates with incidentally caught albatrosses and corresponding 95% confidence intervals (C.I.) for the Hawaii Deep-set Longline Fishery in 2007** **36**

9) **Table 9. Short-tailed Albatross Sightings in 2007** **38**

List of Figures

Figure 1. Short-tailed albatross nesting pairs on Torishima Island, Japan, 1976-2007 **11**

Figure 2. Number of Albatross Breeding Pairs at Laysan Island 1992-2008 **12**

Figure 3. Number of Black-footed Albatross Breeding Pairs at Midway Atoll **13**

Figure 4. Number of Active Nests at Midway Atoll 1992-2008 **13**

Figure 5. Generalized depiction of shallow-set (swordfish) and deep-set (tuna) gear types **15**

Figure 6. Observed fishing effort in the shallow-set fishery, 1994-2007 **16**

Figure 7. Observed fishing effort in the deep-set fishery, 1994-2007 **16**

Figure 8. Catch per unit effort (CPUE) in the Hawaii longline fishery in fish per 1000 hooks from 1999-2007 **18**

Figure 9. Hooks set per year in the deep-set and shallow-set fisheries 2000-2007 in millions of hooks **18**

Figure 10. Depictions of side-setting and stern setting **22**

Figure 11. Bird curtain specifications and preferred design **23**

Figure 12. Preparing swordfish head for strategic offal discard **25**

Figure 13. Observer coverage on deep-setting vessels, 2000-2007 **28**

Figure 14. Observer coverage on deep-setting vessels north of 23° N latitude, 2000-2007 **28**

Figure 15. Protected Species Workshop certifications for Hawaii, Guam, and American Samoa longline fishermen, 2000-2007 **29**

Figure 16. Total estimated albatrosses incidentally taken by Hawaii longline vessels 2000-2007 **30**

Figure 17. Total observed black-footed and Laysan albatross interactions in the Hawaii pelagic longline fishery in 2007 **32**

List of Figures (Cont.)

Figure 18. Types of Interactions between Albatrosses and Hawaii longline vessels in 2007 **33**

Figure 19. Release condition for albatrosses captured incidentally to fishing operations in the Hawaii longline fishery in 2007 **34**

Figure 20. Time of capture for observed albatross interactions in the Hawaii longline fishery in 2007 **35**

Figure 21. Estimated fleet-wide incidental interactions with black-footed and Laysan albatrosses in the Hawaii longline fishery during, 1999-2007 **37**

Figure 22. Short-tailed albatross sightings by NMFS observers, 2007 **38**

List of Acronyms

BiOp	Biological Opinion
BFAL	Black-footed Albatross
CI	Confidence Interval
CMC	Center for Marine Conservation
CPUE	Catch Per Unit Effort
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FR	Federal Register
FMP	Fishery Management Plan
HLA	Hawaii Longline Association
LAAL	Laysan Albatross
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWHI	Northwestern Hawaiian Islands
OLE	Office for Law Enforcement
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PMUS	Pelagic Management Unit Species
PRIA	Pacific Remote Islands Area
SFD	Sustainable Fisheries Division
STAL	Short-tailed Albatross
USFWS	U.S. Fish and Wildlife Service
WPFMC	Western Pacific Fishery Management Council

Annual Report on Seabird Interactions and Mitigation Efforts in the Hawaii Longline Fishery for 2007

1.0 Introduction

In the western Pacific, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), through its Pacific Islands Regional Office (PIRO), is responsible for managing, protecting, and conserving living marine fishery resources in Federal waters of the U.S. Pacific islands areas.[1] PIRO accomplishes this aim through the implementation of regulations and policies designed to sustain healthy marine resources, prevent overfishing, rehabilitate depleted stocks, and promote the recovery of protected species. The NMFS Pacific Islands Fisheries Science Center (PIFSC) conducts fisheries research and provides scientific information and expertise on Pacific insular and pelagic marine resources and protected species. The Western Pacific Fishery Management Council (WPFMC) is responsible for developing domestic fishery policies and management plans for the region. The PIRO, PIFSC, WPFMC, and the U.S. Fish and Wildlife Service (USFWS) work cooperatively to prevent and mitigate the bycatch of protected resources, including seabirds, by U.S. domestic fisheries governed under fishery management plans.[2]

Seabird mitigation measures, authorized under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), are prescribed in fishery management plans governing fisheries operating in the U.S. Exclusive Economic Zone (EEZ) and international waters of the western Pacific region. To assess possible impacts of the Hawaii pelagic longline fishery on the endangered short-tailed albatross (*Phoebastria albatrus*) population NMFS consulted with USFWS under Section 7 of the Endangered Species Act (ESA). A "Biological Opinion on the effects of the Hawaiian Longline Fishery on the short-tailed albatross" (BiOp) was issued by USFWS on November 28, 2000 [FWS 1-2-1999-F-02; USFWS 2000], and subsequently revised November 18, 2002 [FWS 1-2-1999-F-02R; USFWS 2002]. The 2002 revision examined the effects of the deep-set fishery on the short-tailed albatross after a suspension of the shallow-set fishery was ordered by the U.S. Court in *Center for Marine Conservation (CMC)* v. *NMFS* on April 1, 2001. USFWS issued a supplement to the BiOp in October 2004 entitled "Biological Opinion on the Effects of the reopened shallow-set sector of the Hawaii Longline Fishery on the short-tailed albatross (*Phoebastria albatrus*)" [FWS 1-2-1999-F-02.2: USFWS 2004]. Prior to its suspension, the shallow-set sector of the Hawaii longline fishery accounted for the majority of seabird mortalities, so the October 2004 BiOp evaluated only the effects of the April 2004 reopening of the shallow-set longline fishery on the short-tailed albatross. From 2004-2007, no short-tailed albatross interactions were reported in

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

[2] Fishery management plans, if approved by the Secretary of Commerce, are implemented by regulations by NMFS at 50 CFR 665. Five fishery management plans governing western Pacific fisheries including pelagics, bottomfish/seamount groundfish, crustaceans, precious corals, and coral reef ecosystems.

the Hawaii shallow-set longline fishery which is required to have 100% observer coverage.[3] The BiOp issued on November 18, 2002, on the deep-set sector remains in effect.

The three BiOps (USFWS 2000, 2002, 2004) require NMFS to report annually any observed interactions and sightings of short-tailed albatrosses with the Hawaii longline fishery, and any observed and estimated total number of interactions with Laysan (*P. immutabilis*) and black-footed (*P. nigripes*) albatross by set type.[4] Because observed interactions between short-tailed albatrosses and Hawaii pelagic longline vessels are non-existent and are thought to be very rare, surrogate species are used to predict expected interaction rates. Black-footed and Laysan albatrosses are used as surrogate species to assess the effects of fishery interactions and the efficacy of mitigation measures on the short-tailed albatross population due to their relatedness, similar habitats, and likely similar foraging strategies. In addition, NMFS must report on the status of observer coverage, provide assessments of the effectiveness of required seabird deterrents including a review of the observer data from vessels choosing to side-set, and summarize the results of the Federally-mandated Protected Species Workshops conducted by NMFS. This report includes the reporting requirements under the Terms and Conditions of each BiOp for the Hawaii longline fishery operating during 2007.

2.0 Description and Status: Short-tailed Albatross

The short-tailed albatross (STAL) is the largest of the northern hemisphere albatross species (33-37 inches as compared with body lengths of 31-32 in for Laysan and 27-29 in for black-footed albatrosses, USFWS 2005). They are long-lived and reach breeding age around six years old (USFWS 2004). Their plumage varies in color as they mature. Shortly after fledging (leaving the nest), STALs develop a distinctive large pink bill with a gray tip and thin black line at its base which they have for the rest of their lives. The STAL's feet are pinkish. When STALs are one year old, their plumage may resemble a BFAL, but may be distinguished from BFALs primarily by their pink bills (the BFAL has a black beak). As the STAL matures, its stomach, and back become white in color. It is the only albatross in the North Pacific with a white back. The color on the upper surface of the wings is variable being proximally white and distally brown. A fully mature STAL has a golden head.

STALs once ranged throughout most of the North Pacific Ocean and Bering Sea, with known nesting colonies on western Pacific islands near Japan and Taiwan (Hasegawa 1979). During the early 20th century, the species was nearly extirpated due to overharvest for feathers and oil. Between 1880 and 1903 5 million STALs were harvested on Torishima alone (USFWS 2004). The species began to recover during the 1950s. Likely due to habitat management and habitat protection, the population is growing annually (Figure 1). Today, the only known currently-active breeding colonies of STALs are on Torishima south of Honshu Island, Japan, (30° 29' N 140° 18' E) and Minami-kojima in the Senkaku Islands just north of Taiwan (25° 43' N 123° 33' E) (USFWS 2004). It is estimated that 80-85% of the known breeding STAL use a single

[3] The shallow-set sector of the Hawaii longline fishery reopened with a final rule on April 2, 2004 (69 FR 17329).
[4] NMFS described tuna (deep-set) and/or swordfish (shallow-set) type.

colony at Tsudame-zaki, on Torishima, an active volcanic island (Suryan et al. 2007). The current worldwide STAL population is estimated to be approximately 2,000 individuals, with 382 nesting pairs observed on Torishima Island during the 2007-2008 breeding season (Hasagawa 2007b).

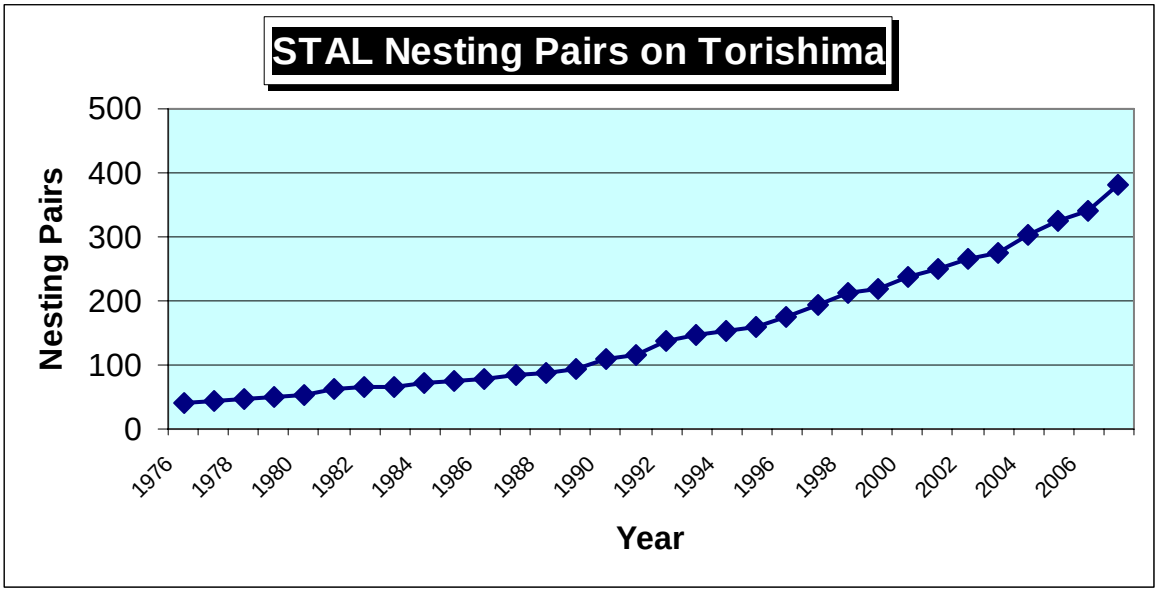

Figure 1. Short-tailed albatross nesting pairs on Torishima Island, Japan, 1976-2007.
(Sources: Sievert 2007, Hasegawa 2006, 2007a, 2007b)

In recent developments, Japanese wildlife managers began a translocation project to establish a new breeding colony on Muko-shima Island on February 19, 2008. Muko-shima is two hundred miles south of Torishima in the Bonin Archipelago (Kim 2008, Suryan 2008). In the Northwestern Hawaiian Islands, mating behavior was witnessed between two short-tailed albatrosses at Midway Atoll in January 2008. No offspring were produced (USFWS 2008).

3.0 Description and Status of Proxy Species

Laysan Albatross

The Laysan albatross (LAAL) is one of the most abundant albatross in the world (BirdLife International 2004). They are characterized by a white head, neck and under parts. There is dark plumage surrounding the eyes. Dorsally, the wings and back are dark brown. Ventrally, the wings are variably white and brown differing between individuals. The tail is dark brown.

Because variables such as population structure, mortality, and individual breeding frequency are not fully understood, a total world population estimate cannot be determined for LAAL. Instead, an estimate of total numbers of nesting pairs has been used to track LAAL populations. The worldwide breeding population of LAAL is estimated at 590,000 pairs in 2005 (Naughton 2007) and 99% of the world's LAAL breed in the Northwestern Hawaiian Islands (NWHI). Other breeding sites are in Japan and Mexico.

Black-footed Albatross
BFALs have black legs and black bills with a prominent ring of white at plumage at the base. Overall, the plumage is dark brownish gray. Birds older than two years have white plumage surrounding the vent. The world breeding population of BFAL was estimated to be 61,700 pairs in 2005 (Naughton 2007) and according to USFWS, approximately, 97% of BFALs breed in the NWHI (72 FR 57278). A smaller population of approximately 2000 breeding pairs nests in the Bonin Islands south of Japan. Walsh and Edwards (2005) have demonstrated that the Japanese sub-population is reproductively isolated from NWHI BFALs.

Population Status of Proxy Species
Assessing albatross populations is a daunting task. Because juvenile animals and not all birds return to the breeding colonies every year, direct counts of populations cannot be made. Instead, the number of *breeding pairs,* or *number of active nests,* is one measure used to assess the health of albatross populations. This proxy measurement can be used to assess long-term trends in populations. Environmental factors such as foraging success may influence how many albatrosses return to a colony to breed. During the 2007-08 breeding season, the usual nest counts for LAALs and BFALs could not completed due to exigent circumstances at French Frigate Shoals. The figures below illustrate trends in breeding pair numbers at Laysan Island and Midway Atoll from 1992-2008.

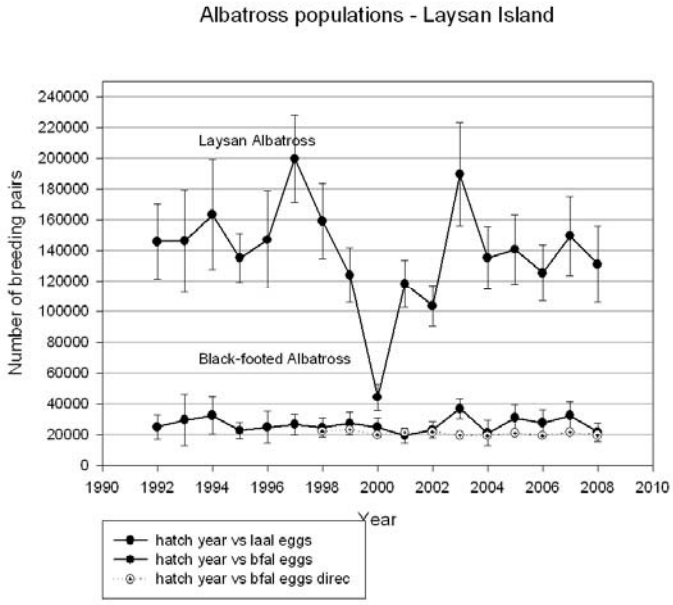

Figure 2. Number of Albatross Breeding Pairs at Laysan Island 1992-2008 (Source: USFWS 2008)

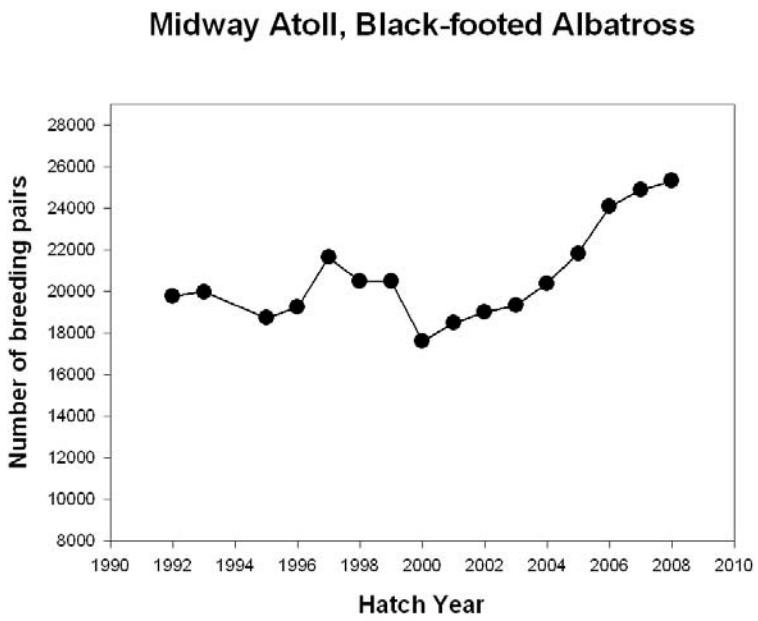

Figure 3. Number of Black-footed Albatross Breeding Pairs at Midway Atoll
(Source: USFWS 2008)

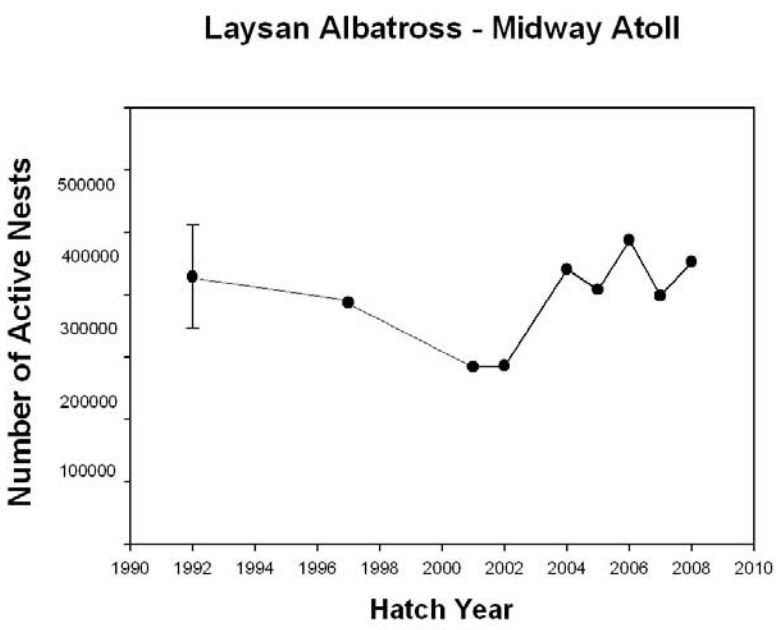

Figure 4. Number of Active Nests at Midway Atoll 1992-2008
(Source: USFWS 2008)

4.0 Description of the Hawaii Pelagic Longline Fishery

Background

Historically, the Hawaii-based longline fishery has had the greatest number of seabird interactions of any U.S. managed fishery in the tropical Pacific (NMFS 2001). The fishery began around 1917 employing techniques similar to those of Japan. Early Hawaii-based longliners used tarred braided rope and flagged marker buoys. A relatively small number of vessels continued targeting tuna using this gear until the late 1980s. At that time, the fleet expanded from 37 vessels in 1987 to 138 vessels in 1991 with the influx of longliners from the East Coast and Gulf of Mexico targeting swordfish with monofilament mainlines and radio buoys (NMFS 2007).

Today, the Hawaii longline fishery is comprised of two components: deep-set, targeting tuna, and shallow-set, targeting swordfish. While the deep-set fishery generally targets bigeye tuna (*Thunnus obesus*), the shallow-set fishery targets swordfish (*Xiphias gladius*). In addition to tunas and swordfish, a variety of other pelagic fish species are caught in both segments of the fishery. Some of these species are kept and considered catch, while others are discarded and considered bycatch[5]. Lists of Pelagic Management Unit Species that are specifically managed under the Pelagics FMP and other commonly encountered fish species can be found in Appendix 1.

The general characteristics of the two gear types are provided in Table 1 and Figure 5, illustrating the differences and similarities between them.

Table 1. Characteristics of the shallow-set (swordfish-targeting) and deep-set (tuna-targeting) components of the Hawaii longline fishery.

Characteristics	Swordfish-targeting	Tuna-targeting
Set depth	Shallow (~ 40 m)	Deep (~100-300 m)
Hook type	18/0 circle hook (maximum 10° offset)	3.6-3.8 mm tuna hooks or 14/0-16/0 circle hooks
Bait	Fusiform Fish	Saury
Lightsticks used?	Yes	No
Set deployment/retrieval	Night/Morning	Morning/Night
No. hooks between floats	4 - 6	15 - 30
Approx. no. hooks per set	800	2,000 to 3,000

[5] For the purpose of this report *bycatch* is defined as discards plus unseen mortality due to fishing operations. This includes incidental interactions with seabirds.

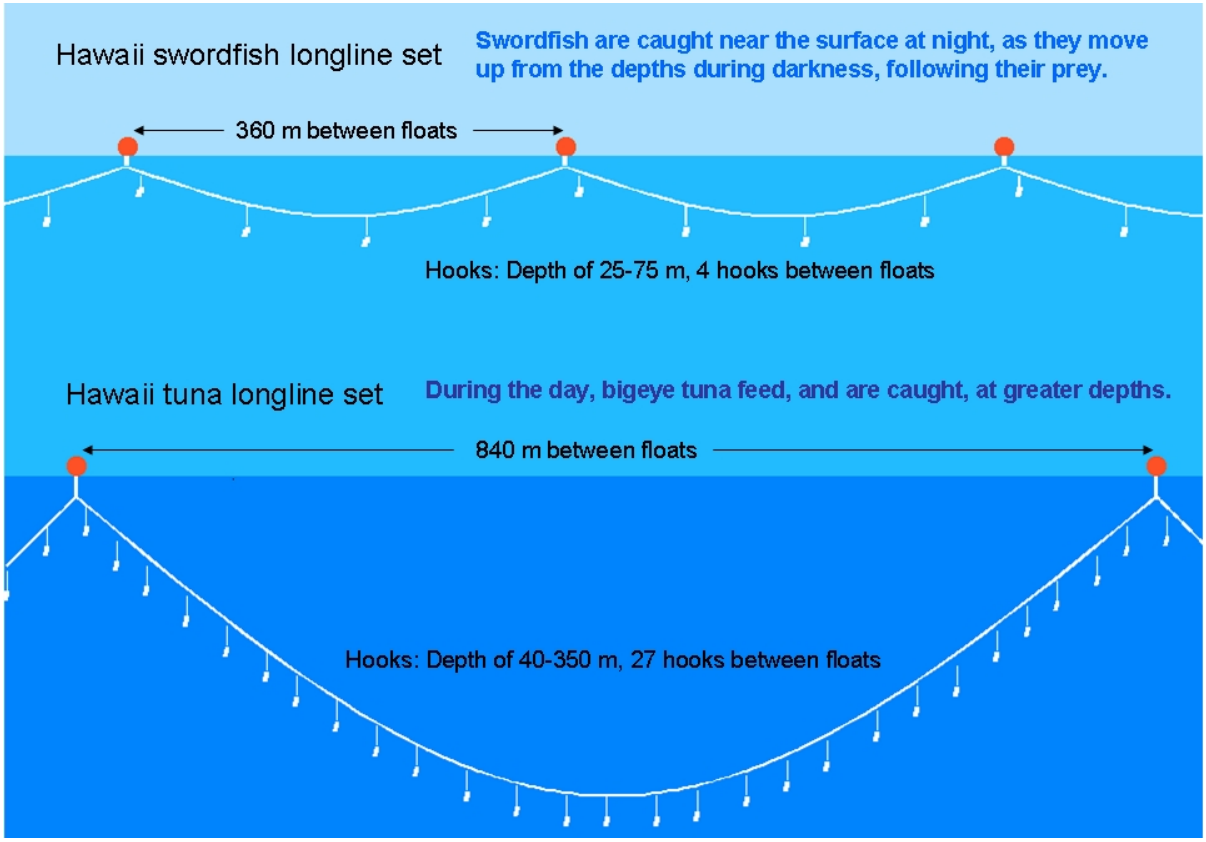

Figure 5. Generalized depiction of shallow-set (swordfish) and deep-set (tuna) gear types
(Source: PIFSC)

As seen in Figure 5, deep-set gear is intended to reach depths where bigeye tuna concentrations are highest. Matsumoto et al. (2007) have demonstrated through archival tagging studies that bigeye tuna tend to congregate at depths reached by the lower half of mainline in the deep-set fishery. The set configuration is achieved by use of a line shooter. The line shooter deploys the line faster than the vessel is moving forward, thus forming deep sags in the line. In contrast, shallow-set gear is usually deployed by simply allowing the mainline to spool off of the mainline reel as the vessel is underway. No line shooter is used. Additionally, fewer hooks are deployed between floats. This results in the line being set relatively shallow in the water column where swordfish tend to congregate. There are differences between the two segments of the fishery (Figures 6 and 7).

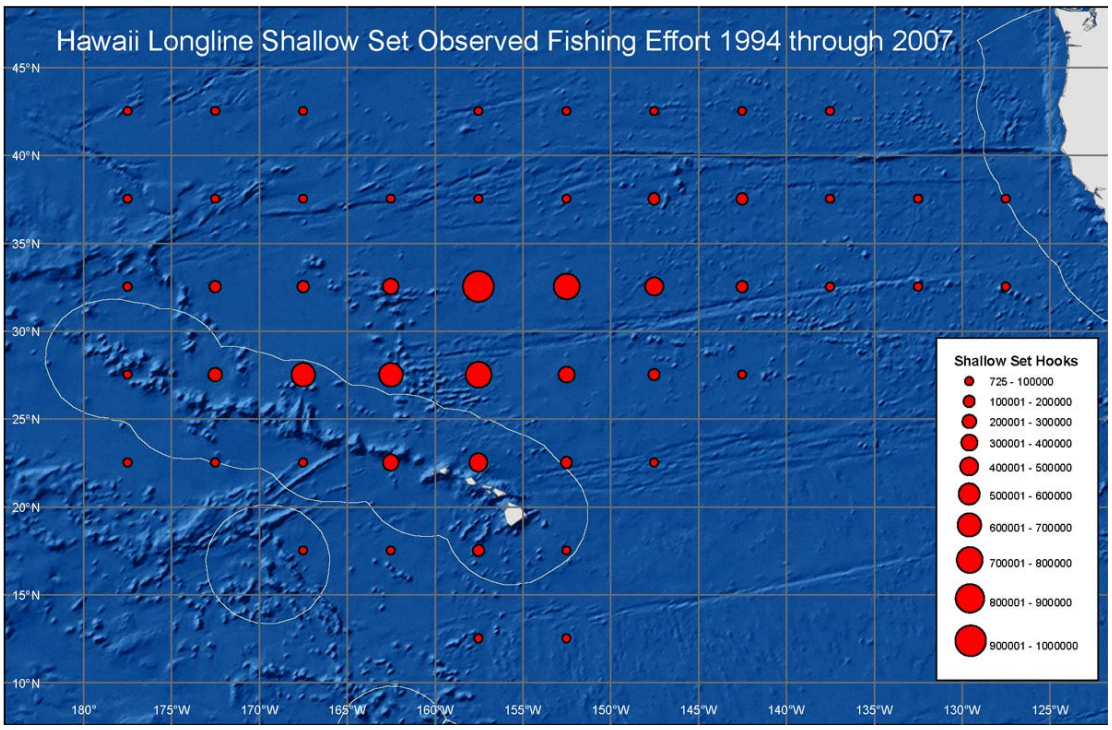

Figure 6. Observed fishing effort in the shallow-set fishery, 1994-2007.
(Source: PIRO)

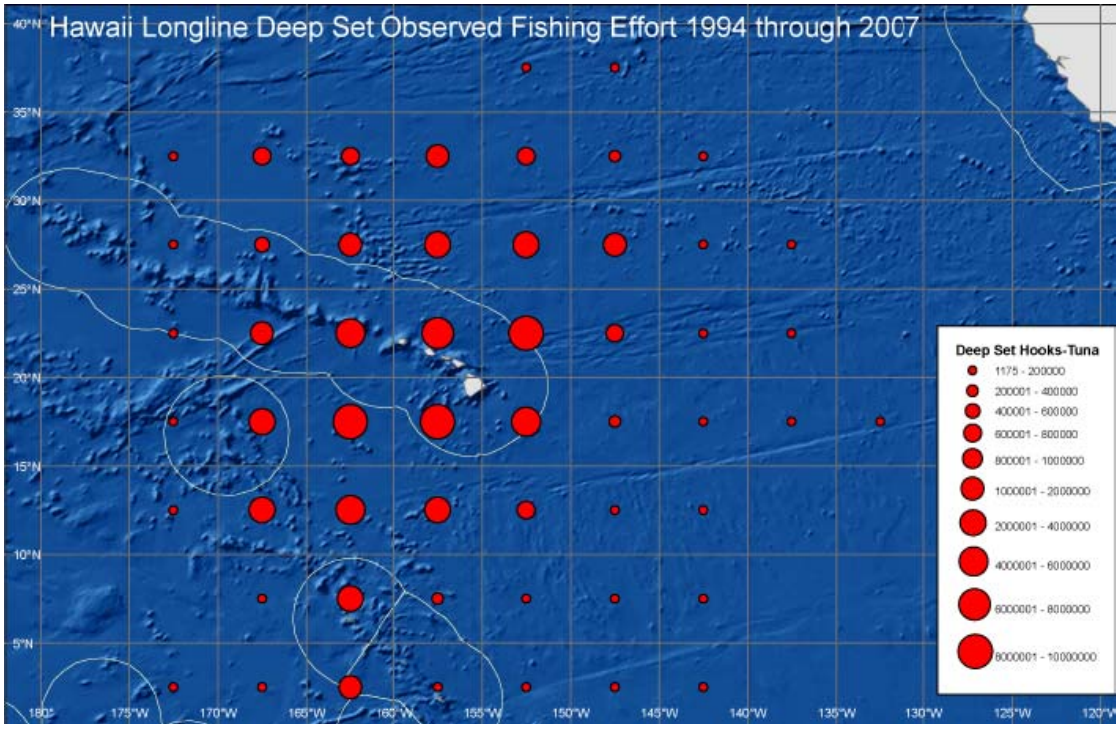

Figure 7. Observed fishing effort in the deep-set fishery, 1994-2007.
(Source: PIRO)

The majority of the fishing effort in the shallow-set component of the fishery has occurred to the north of the Hawaiian Archipelago, while the majority of deep-set effort has been distributed to the south of the islands.

Effort, as measured by number of vessels or number of trips, has been relatively stable from 2000 to 2007 for the combined fishery (both shallow- and deep-sets) (Table 2). The number of sets made and total number of hooks deployed for this combined fishery have increased during the 2000 to 2007 period. Even at its highest effort, the shallow-set fishery has always deployed far fewer hooks per year than the deep-set fishery. CPUEs for the major species – tunas, billfish, and sharks - decreased by about 50% from 1999-2005, but have remained relatively steady for the last three years (Figure 8).

Table 2. Hawaii longline fishery effort data, 2000–2007
(Sources: NMFS 2008, PIFSCS, WPFMC)

Year	#Vessels	#Trips	#Sets	#Hooks (Total)	#Hooks (Deep-set)	#Hooks[6] (Shallow-set)
2000	125	1,135	12,930	20,282,826	17,192826	3,090,000
2001	101	1,075	12,169	22,327,897	21,837897	490,000
2002	102	1,193	14,225	27,018,673	27,018,673	0
2003	110	1,215	14,560	29,297,813	29,297,813	0
2004	125	1,338	15,976	31,967,874	31,891,124	76,750
2005	124	1,533	18,083	34,895,229	33,566,423	1,328,806
2006	127	1437	17,247	35,192,344	34,486,898	705,446
2007	129	1515	19,379	40,197,926	38,825,977	1,371,949

[6] Hooked deployed in the shallow-set fishery for 2000 and 2001 include hooks reported deployed for swordfish and mixed species targeted trips. Mixed targeted trips were generally reported for smaller shallow-set vessels that would often target swordfish at the beginning of fishing trips and target tuna or marlins towards the end. Source: WPFMC.

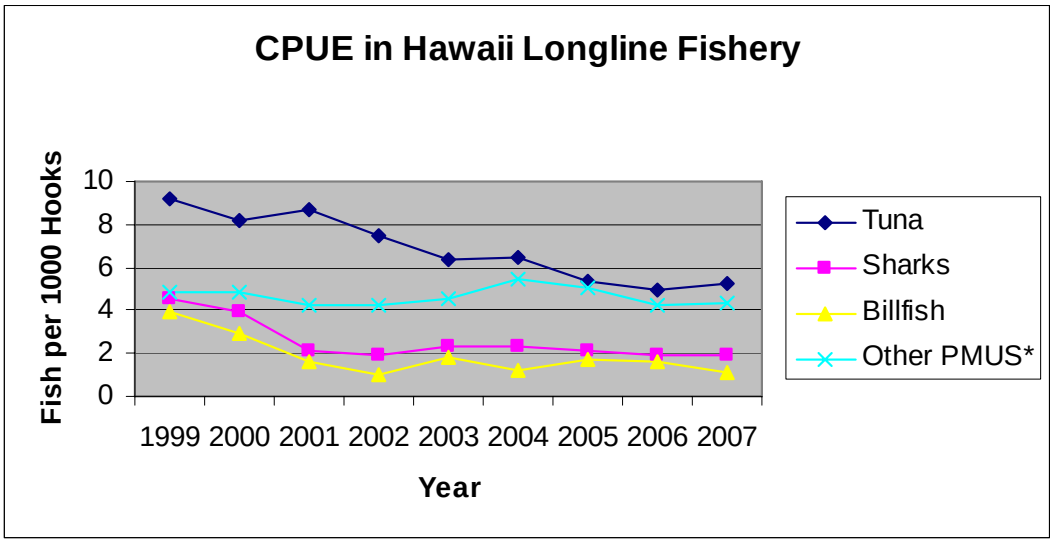

Figure 8. Catch per unit effort (CPUE) in the Hawaii longline fishery in fish per 1000 hooks from 1999-2007 (Source PIFSC)

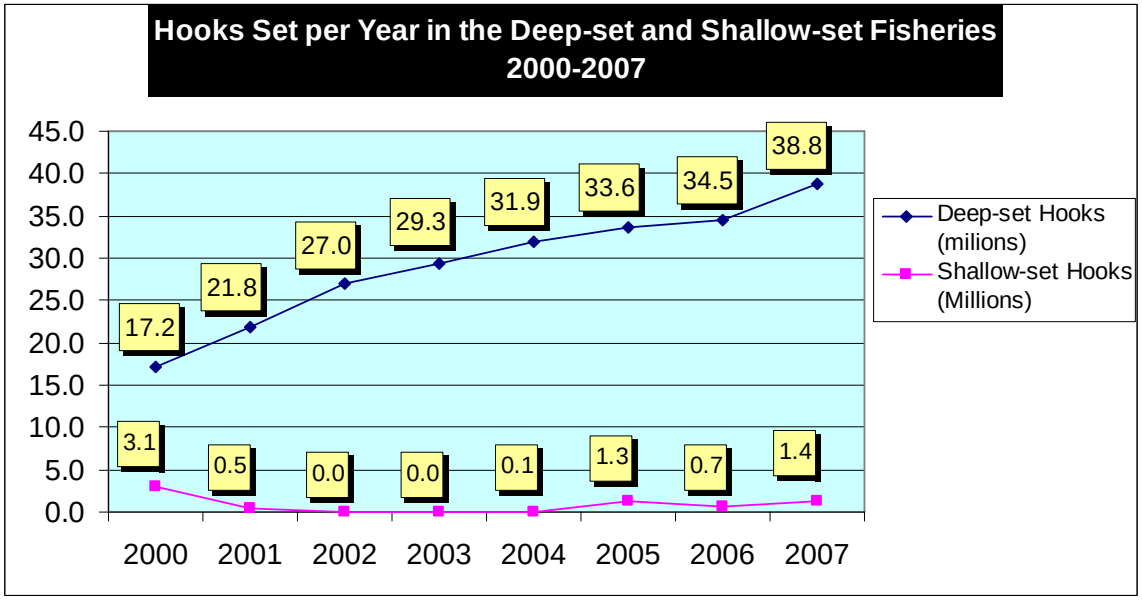

Figure 9. Hooks set per year in the deep-set and shallow-set fisheries 2000-2007 in millions of hooks. (Sources: PIFSC, WPFMC)

On June 12, 2001, NMFS issued an emergency rule that closed the shallow-set fishery and implemented the Terms and Conditions of the November 28, 2000 Short-tailed Albatross BiOp issued by USFWS (66 FR 31563). Some traditional swordfish vessels switched to targeting tunas further widening the disparity of the numbers of hooks deployed between the two fisheries. It is interesting to note that even with the reopening of the shallow-set fishery in 2004, the number of hooks deployed per year in the deep-set continues to increase (Figure 9). Over twice as many hooks were deployed in the deep-set fishery in 2006 and 2007 as were in 2000.

Conversely, the number of hooks deployed in the shallow-set fishery in 2007 and 2007 is less than half of the number deployed in 2000.

In April 2004, the shallow-set fishery was reopened under a suite of new management measures that required new gear configurations and specialized turtle dehooking equipment were put in place to reduce incidental captures of sea turtles and increase their post-hooking survival (69 FR 17329, May 19, 2004).

Requirements for the shallow-set fishery (69 FR 17354, April 2, 2004) include:

- 100% observer coverage
- a maximum of 2,120 sets are permitted annually
- 18/0 circle hooks with 10 degree offset
- Mackerel-type bait
- Sea turtle handling measures including dehooking equipment; and
- Annual attendance at mandatory Protected Species Workshops for vessel operators and owners
- Interaction Limits for Loggerhead sea turtles (n=17) and Leatherback sea turtles (n=16)

The seabird deterrents for both segments of the Hawaii longline fishery will be discussed separately in the next section.

Summary of 2007 Fishery Effort
In 2007, there were 129 active Hawaii longline vessels that made 1,515 trips in 2007 (Table 2). The trips targeted tunas (bigeye (*Thunnus obesus*), albacore (*Thunnus alalunga*), and yellowfin (*Thunnus albacares*)) and swordfish (*Xiphias gladius*). A total of 1426 tuna trips and 89 swordfish trips were made[7]. There were 8146 sets made at or above 23° N latitude. Of these, 6614 were deep sets and 1532 were shallow sets (PIFSC, unpubl.). Of 40,197,926 total hooks fished, the deep-set fishery deployed a reported 38,825,977 hooks in 17,809 sets and the shallow-set fishery deployed a reported 1,371,949 hooks on 1570 sets (PIFSC, unpubl.).

5.0 Seabird Mitigation Measures

Background
The emergency rule (66 FR 31563, June 12, 2001) that closed the shallow-set fishery also implemented non-discretionary terms and conditions of the BiOp issued by the USFWS on November 28, 2000 (USFWS 2000). A final rule (67 FR 34408, May 14, 2002) subsequently implemented the requirements contained in the emergency rule. The required suite of seabird mitigation techniques were as follows: when making deep sets north of 23° N., vessels must employ a line-setting machine with at least 45 g weights attached within 1 m of each hook, use thawed blue-dyed bait and strategic offal discards during the setting and hauling of longline gear.

[7] The shallow-set fishery was closed on March 20, 2006 after reaching the interaction limit for loggerhead sea turtles (17) on March 17, 2006. There is an interaction limit in this fishery of 16 leatherback turtles that has never been reached.

These measures were revised (70 FR 75075, December 19, 2005), to satisfy the terms and conditions of the 2004 BiOp. These current seabird mitigation requirements for Hawaii-based longline fishermen are listed in Table 6.

Description of Mitigation Measures

Vessel operators have the option of either using side-setting (as it's defined under the regulations) or an alternate suite of mitigation methods. A variety of seabird deterrence methods for longline fisheries have been tested and found to reduce interaction rates as well as mortality of seabirds (e.g., Brothers 1995; Brothers et al. 1999; McNamara et al. 1999; Gilman et al., 2003, 2005, and 2007). When employed effectively, seabird avoidance measures have the potential to nearly eliminate seabird interactions. To resolve the problem of seabird mortality in these fisheries, there is a need to identify deterrent methods that not only have the capacity to minimize seabird interactions, but are also practical and convenient to use by fishermen (Gilman et al. 2005).

The following seabird deterrent methods are explained in more detail:

- side-setting.
- strategic offal discarding;
- thawed blue-dyed bait;
- weighted branch lines; and
- night setting

Table 3. Summary of current seabird regulations for the Hawaii longline fleet, effective as of January 18, 2006.
(Source: NMFS PIRO)

X = Required Measure	Side-Setting			Stern- Setting		
	Shallow Set	Deep Set >23°N	Deep Set <23°N	Shallow Set	Deep Set >23°N	Deep Set <23°N
Weights (minimum 45 g) attached within 1 m of the hook	**X**	**X**			**X**	
Set from port or starboard side	**X**	**X**				
Setting station at least 1 m forward of stern corner	**X**	**X**				
Line shooter at least 1 m forward of stern corner (if used)	**X**	**X**				
Deploy gear so that hooks do not resurface	**X**	**X**				
Use bird curtain	**X**	**X**				
Use blue-dyed bait (thawed)				**X**	**X**	
Maintain at least 2 (1 lb) containers of blue dye on board the vessel				**X**	**X**	
Use line shooter					**X**	
Employ strategic offal discards				**X**	**X**	
Begin set 1 hr after sunset/complete before dawn				**X**		
Follow seabird handling procedures	**X**	**X**	**X**	**X**	**X**	**X**

Side-setting

Side-setting involves deploying the gear from the side of the vessel, as compared to the conventional approach of setting from the stern (Figure 10). The effect is that baited hooks are deployed closer to the side of the vessel's hull where seabirds are unable or unwilling to pursue them. With proper weighting, baited hooks deployed in this manner will sink to a depth where a North Pacific albatross species could not reach them. Additionally, deploying a bird curtain inhibits the ability of seabirds to land along the side of the vessel where baits are accessible; an ancillary benefit of this technique is reduced bait loss for fishermen.

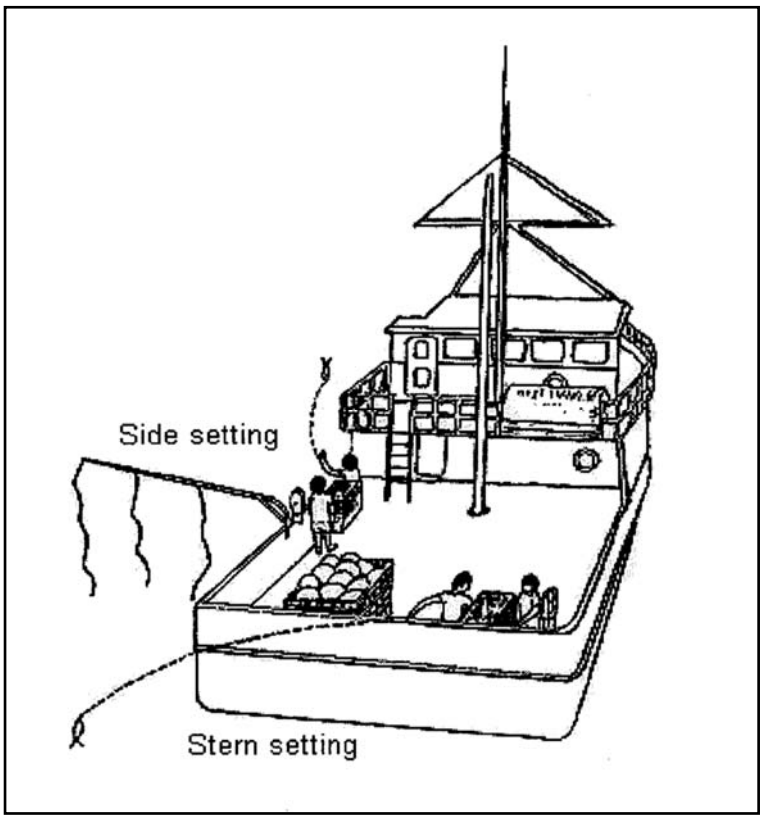

Figure 10. Depictions of side-setting and stern setting
(Source: Gilman et al. 2003)

Side-setting regulatory requirements are as follows:

1) Deploy the mainline as far forward on the vessel as practicable including mounting line shooters (if used) at least 1 m forward from the stern corner of the vessel;
2) Set the mainline and branch lines from the port or starboard side of the vessel;
3) Attach weights (45 g minimum) to branchline within one meter of the hook;
4) When seabirds are present, the longline gear must be deployed so that baited hooks remain submerged and do not rise to the sea surface; and
5) A bird curtain must be deployed, that consists of the following three components (See Figure 11):
   a) a pole that is fixed to the side of the vessel aft of the line shooter and that is at least 3 m long;
   b) at least three main streamers that are attached at regular intervals to the upper 2 m of the pole and each of which has a minimum diameter of 20 mm; and
   c) branch streamers attached to each main streamer at the end opposite from the pole, each of which is long enough to drag on the sea surface in the absence of wind, and each of which has a minimum diameter of 10 mm.

If the above conditions are not met by a vessel, it is not considered to be side-setting by NMFS.

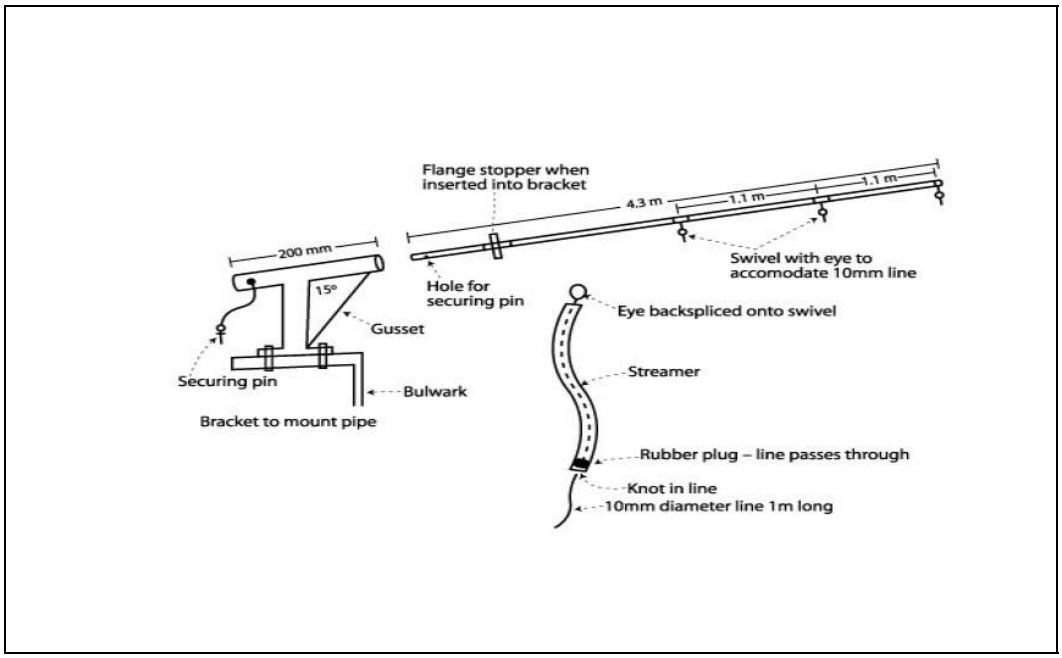

Figure 11. Bird curtain specifications and preferred design
(Source: Gilman et al. 2003)

Sea trials indicate that side-setting is the most effective of any single seabird mitigation method in reducing albatross mortality in the Hawaii longline fishery. Side-setting produced the lowest seabird interaction rates when compared to underwater setting chutes and blue-dyed bait in both deep-set and shallow-set fisheries (Gilman 2007). In 2005, observers did not record any seabird interactions on vessels employing side-setting. Out of 124 active Hawaii longline vessels, 44 converted their vessels to side-setting by December 2005. In 2006, 35 vessels were configured for side-setting. In 2007, 25 deep-setting vessels with observers used the technique when fishing above 23° N latitude. This represented 47.9% of all observed effort above that latitude for 2007 (PIRO unpub.). No shallow-setting vessels were observed using the technique in 2007. Some vessels that were outfitted for side-setting never used the measure and some vessels have reverted to stern-setting (Brothers and Gilman 2007). It is not known at this time how many vessels have reverted back to stern setting, but a survey of vessels is planned for the summer of 2008. Again, because of its effectiveness and the high likelihood of compliance, even in the absence of observers, it is the preferred seabird mitigation technique by NMFS for deep-set vessels. NMFS strongly encourages its use.

Vessel operators targeting swordfish are unlikely to switch to side-setting due to their unwillingness to place weights within one meter of the hook. Therefore, these vessels even if they set their gear from the side would not conform to the definition of side-setting under current regulations. While weights (≥45 g) are normally placed on shallow-set branchlines, they are usually situated far from the hook in the middle of the branchline. Safety considerations are usually cited by fishermen as the reason for placing weights in the middle of branchlines rather than closer to the hook. Experiments testing weight placement and weights designed to address

safety concerns are being conducted and the results of these experiments will be detailed in next year's report (see section on Weighted Branch Lines).

In 2007, there was some confusion regarding the use of bird curtains during fishing operations north of 23° N. Some fishermen understood that the bird curtain did not need to be used if seabirds were not present. Outreach efforts were undertaken to advise fishermen that regulations require the use of a bird curtain at all times when side-setting. Failure to deploy the bird curtain when fishing above 23° N Latitude is considered a violation of Federal regulations (50 CFR 665.35).

Strategic Offal Discards

Strategically discharging offal is a technique developed by *fishermen* to mitigate interactions with albatrosses attempting to steal baits from branchlines before they could be retrieved. Fishermen would throw swordfish heads and livers over the side of the vessel to distract albatrosses away from the baited hooks. It was noted by some NMFS observers in the mid-1990s that strategically discharging offal seemed to reduce incidental hookings and entanglements with albatrosses.

Strategic offal discards have been proven to be effective in reducing interactions with seabirds – if employed properly. Strategic offal discards reduced gear contacts with seabirds in the Hawaii longline shallow-set fishery by 51% and seabird interactions by 88% (McNamara et al 1999). However, over time, this practice is believed to attract birds to the vicinity of the vessel, increasing bird abundance, searching intensity, and interaction (Brothers et al. 1999) by reinforcing the association that birds make with specific longline vessels being a source of food. Brothers (1996) hypothesizes that seabirds learn to recognize by smell specific vessels that provide a source of food, implying that vessels that consistently discard offal and fish bycatch will attract more seabirds than vessels that do not discard offal and fish waste. NOAA Fisheries will continue to monitor the effectiveness of strategic offal discards and other mitigation measures.

Strategically discharging offal to reduce seabird interactions requires vessel operators to:

1) Retain sufficient quantities of spent bait and fish offal with hooks removed for use as strategic offal discards during fishing operations;
2) Retain swordfish heads and prepare them by removing the bill, cutting them length-wise between the eyes, and freezing them (See Figure12);
3) Retain swordfish livers and freeze them; and
4) Discharge all spent bait and fish parts on the opposite side of the vessel during gear deployment and retrieval, *if seabirds are present*.

Figure 12. Preparing swordfish head for strategic offal discard (Source: PIRO)

Traditionally in this longline fishery, only swordfish were gilled and gutted at sea. However, in December 2004, the Food and Drug Administration (FDA) regulations required all fish be gilled and gutted at sea. Results from an analysis of Hawaii longline fishery observer data indicate that only 18% of tuna-targeting sets employed strategic offal discards (Gilman 2004). This percentage increased to approximately 50%[8] in 2005, partially due to the new FDA regulations.

Thawed Blue-dyed Bait

Dying bait to a specific blue color is a means to reduce the visibility of baits by reducing their contrast with the sea surface. The bait is thawed in order to increase sink rates.

Almost all bait used in the Hawaii longline fisheries consists of fusiform fish. Using squid for bait is prohibited in the shallow-set fishery to reduce sea turtle interactions. While squid may still be used in the deep-set fishery, the cost is prohibitive. Several concerns have been noted by fishermen regarding the required bait treatments of thawing and dyeing and bait type: 1) blue dye is absorbed less readily by fish than by squid, 2) baits must be thoroughly thawed in order to ensure maximum dye absorption, 3) it is difficult to achieve the NMFS-required color intensity due to scale loss by fish baits, 4) thawing the bait results in its lower retention because thawed bait falls off the hook more easily than partially frozen bait, 5) thawed blue-dyed bait results in slower hook setting rates because of the time spent thawing and dying the bait blue during the setting of longline gear, 6) dye can be messy, dyeing the hands and clothes of the crew and the deck of the vessel. While fishermen must (and do) comply with blue dyed bait requirements and the benefits have been experimentally proven, they do not favor the technique. Gilman et al. (2007) suggest most of the practicality and convenience problems could be addressed if pre-blue-dyed bait were commercially available.

[8] This percentage is an estimated value, as observer data was recorded differently beginning in June of 2005 when the regulation for "strategic offal discards" changed to be recorded only when seabirds are present (NMFS 2006).

Weighted Branch Lines
Weights placed close to the hook on branch lines are intended to quickly sink baited hooks, before foraging seabirds can take the baits and subsequently become hooked or entangled in longline gear. Hawaii longline vessels use 45 g, 60 g, and/or 80 g weights within 1 m of the hook to quickly sink their branchlines to desired target depths. A recent study comparing the effective sink rates of 45 g (1.2 m/s) and 60 g (1.3 m/s) weighted branch lines concluded the difference in sink rates to be negligible (Brothers and Gilman 2005). Thus, 45 g weights are the current minimum weight requirement for deep-setting vessels fishing north of 23° N and for side-setting vessels, wherever they fish.

As noted previously, some fishermen in the shallow-set fishery are concerned that placing weights close to the hook may be dangerous if branchlines break while setting gear. Because using weights to increase sink rates has been proven effective in reducing seabird incidental interactions, NOAA Fisheries is funding a study to evaluate the use of "safe-leads" to address safety concerns. Safe-leads are designed to release from branchlines if they break while under tension.

Night Setting
The use of night setting as a seabird mitigation measure requires that fishermen must set their gear no earlier than one hour after local sunset, and completing the set no later than sunrise, using only the minimum number of lights necessary to conform to navigation rules and best safety practices. It is based on the premise that seabirds cannot see baited hooks in the dark and thus do not attack them. The effectiveness of this measure may potentially be affected by moon phase and cloud cover, vessel lighting, and the use of light sticks to illuminate baits making them more conspicuous[9]. Night-setting has been identified as an effective seabird mitigation measure, reducing seabird interactions by 73% (McNamara et al 1999) and even by as much as 98% (Boggs 2001). In the past, shallow-set vessels were able to set before sunset and correspondingly high sea bird interaction rates occurred. Interaction rates have remained low in the shallow-set fishery with the inception of this mitigation requirement.

Because the time at sunset changes with longitude and Hawaii-based longline vessels operate over a wide geographical area, NMFS observers aid fishermen to determine when it is legal for them to begin dear deployment. NMFS observers are trained to use issued Global Positioning System units to determine the exact time of sunset for their vessel's longitude. This has proven to be very helpful, especially on cloudy evenings.

6.0 Observer Coverage from 1994-2007

Background
The two major sources of information regarding albatross interactions with the Hawaii longline fishery are mandatory logbooks and observer data collection programs, both administered by NMFS. The longline logbook program requires longline vessel operators to complete and submit

[9] Lightsticks are used to make baits more conspicuous to swordfish feeding at night.

to NMFS a daily log sheet containing detailed catch and effort information about each set, including interactions with protected species (50 CFR 665.14).

NMFS observers have been deployed aboard Hawaii longline vessels since 1994 to document protected species interactions, collect fishery-related information, and perform other biological work as requested by PIRO. The terms and conditions of the 2004 Pelagics BiOp (NMFS 2004) required 100% observer coverage on shallow-setting vessels, whereas the 2005 BiOp on the deep-set fishery (NMFS 2005a) directs NMFS to maintain an annual level of at least 20% observer coverage on deep-setting vessels.

Table 4 provides a brief history of seabird data collection requirements for the Hawaii Longline Observer Program under program protocols and the terms and conditions of applicable biological opinions.

Table 4. Hawaii longline observer data collection requirements from 1994-Present

Time Period	Authorities	Observer Data Collection Requirements
1994-2001	Observer Program Protocols (NMFS 1999)	1) Record all STAL interactions with fishing gear
2001-2002	November 2000 STAL BiOp (USFWS 2000)	1) Record all interactions with fishing gear 2) Record all STAL sightings 3) Return all dead STAL specimens to port
2002-2004	November 2001 Revision to November 2000 STAL BiOp (USFWS 2002)	1) Record all STAL interactions with fishing gear 2) Record all STAL sightings 3) Record sightings and behavior of *albatrosses* during the set and haulback of the mainline 4) Record *seabird* sightings in the vicinity of the longline gear during setting and haulback operations 5) Return all dead STAL specimens to port
2004-Present	1) November 2002 Revision to November 2000 STAL BiOp (USFWS 2002) 2) October 2004 STAL BiOp on Shallow-set Fishery (USFWS 2004)	1) Record all STAL interactions with fishing gear 2) Record all STAL sightings 3) Record sightings and behavior of *albatrosses* during the set and haulback of the mainline 4) Record *seabird* sightings in the vicinity of the longline gear during setting and haulback operations 5) Conduct two (2) five-minute scan counts for seabird abundance on *shallow-set*s during the first hour of setting operations as daylight permits and every two hours during haulback operations 6) Return all dead STAL specimens to port

Observer Coverage in 2007

In 2007, NMFS maintained an observer coverage rate of 20.1% for the deep-set fishery (Figure13). As per the Terms and Conditions of the 2002 BiOp, NMFS maintained a 16.2%

annual observer coverage rate on deep-set vessels fishing above 23° N. latitude observing 1069 out of 6614 sets (Figure 14). All shallow-sets above 23° N. latitude were observed in 2007.

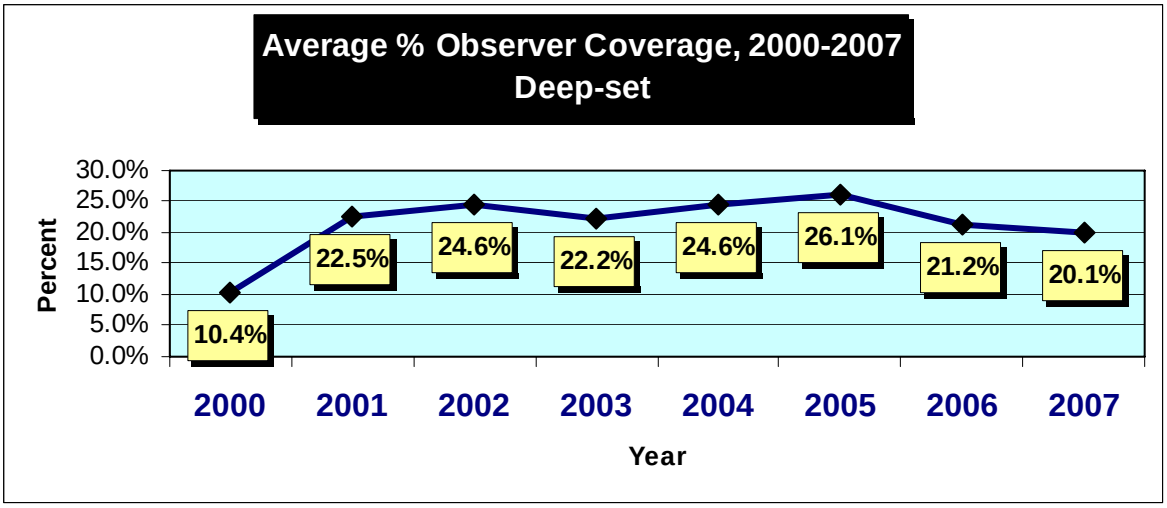

Figure 13. Observer coverage on deep-setting vessels, 2000-2007.
(Source: PIRO)

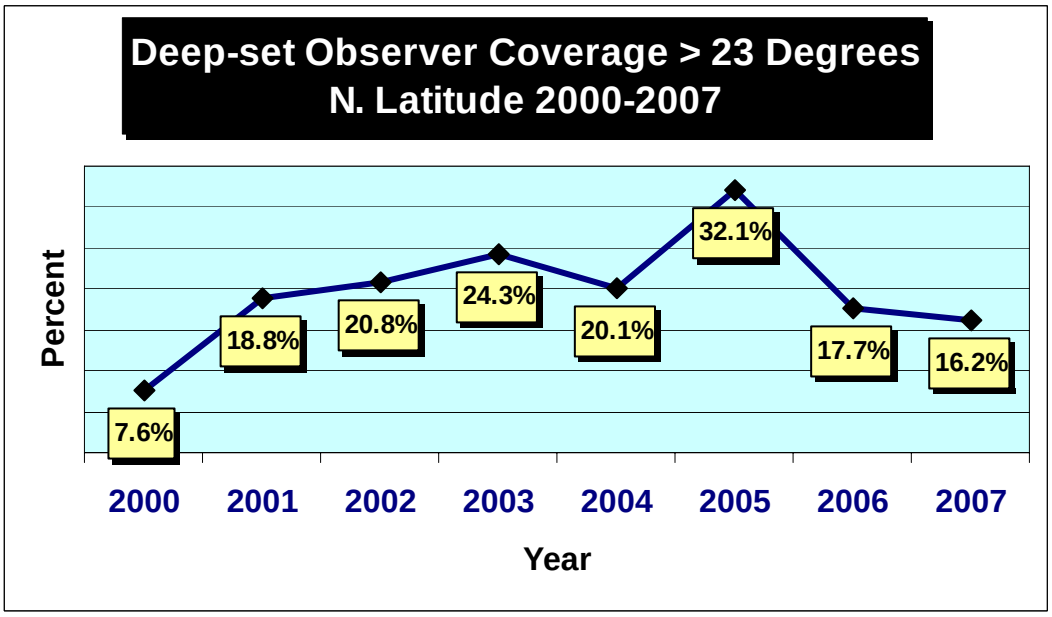

Figure 14. Observer coverage on deep-setting vessels north of 23° N latitude, 2000-2007(Source: PIRO)

7.0 Protected Species Workshops in 2007

The Protected Species Workshops have been conducted by PIRO, Sustainable Fisheries Division (PIRO SFD) annually since 2000. Workshops are mandatory for all operators and owners of

vessels permitted for use with a limited entry permit issued by PIRO (50 CFR 665.21). Participants receive a certification card upon completion of the workshop, and the card must be carried on board the vessel during fishing operations. PIRO SFD collaborates with USFWS, PIFSC, and NMFS Office for Law Enforcement (OLE), and the PIRO Observer Program and PIRO's Protected Resources Division in the development of content material for the workshops. This collaborative approach has resulted in informative and successful Protected Species Workshops.

The workshops present information on seabird, sea turtle, and marine mammal identification and life history, mitigation techniques, current regulations, and any updates on current research pertinent to the fishery. Participants receive workbooks containing current regulations, copies of presentations, and information placards. Written materials and video presentations are provided in English, Vietnamese, and Korean, which are the predominant languages of captains of Hawaii longline vessels. In recent years, crews have been recruited from various parts of Micronesia, the Philippines, and Indonesia to work on Hawaii longline vessels. The majority of materials have been translated into Tagalog to accommodate crews from the Philippines. The introduction of Indonesian workers is fairly recent, and outreach materials have not yet been prepared for this group. Additionally, all outreach materials have been translated into Samoan for use in the American Samoa-based longline fishery.

In 2007, NMFS presented the Protected Species Workshops to 346 longline vessel operators and owners in Hawaii, American Samoa, and Guam (Figure 15).

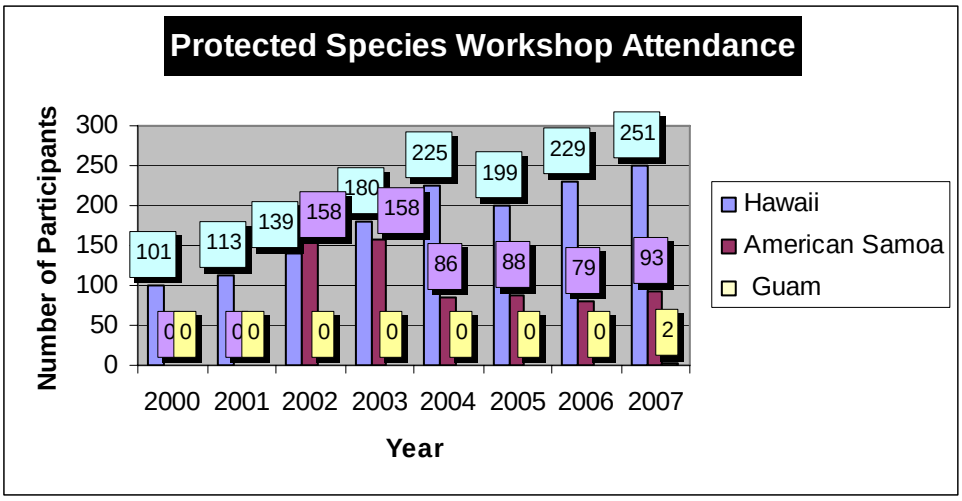

Figure 15. Protected Species Workshop certifications for Hawaii, Guam, and American Samoa longline fishermen, 2000-2007 (Source: PIRO)

PIRO SFD began beta testing an interactive version of the workshops in 2007. Twenty-five fishermen participated in the tests and provided valuable feedback. The on-line course was well-received in regard to content and ease of use. Additionally, the system was successfully tested from sites on the mainland U.S., Guam, Hawaii, and on board fishing vessels. Currently, guidelines to use the interactive course are in the last stages of review. The interactive course is

expected to become an integral part of the Protected Species Workshop program before the end of 2008. An option for the more traditional classroom-style workshop will continue to be available.

8.0 Seabird Interactions

Background
Since 2001, the estimated number of seabirds incidentally taken in Hawaii pelagic longline fisheries has dramatically decreased (Figure 16).

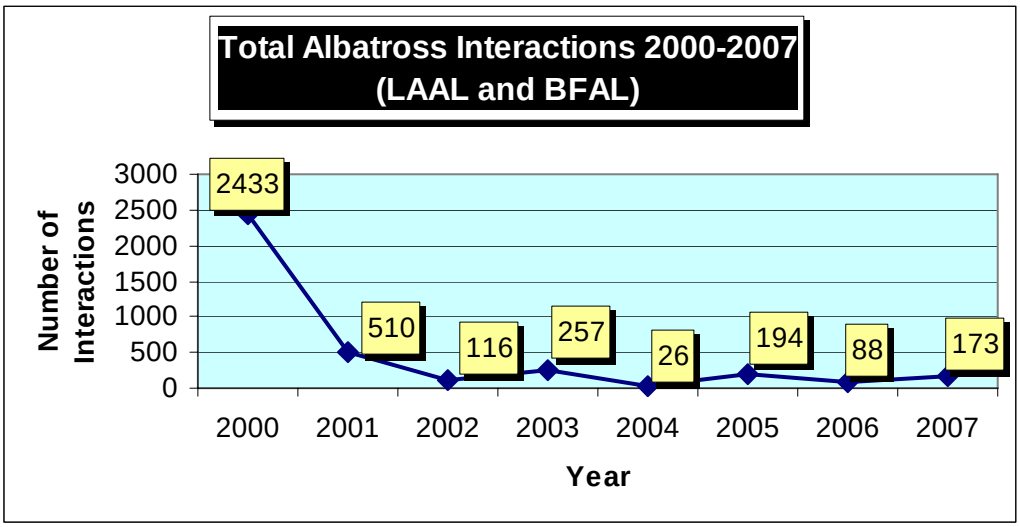

Figure 16 Total estimated albatrosses (LAAL and BFAL) incidentally taken by Hawaii longline vessels 2000-2007 (Source PIRO)

In 2000, an estimated 2,433 seabirds were captured. In 2001, an estimated 510 seabirds were incidentally taken in Hawaii longline fisheries. This reduction can be primarily attributed to the curtailment and eventual closure of the shallow-set fishery in 2001 due to sea turtle interactions. The swordfish fishery remained completely closed throughout 2002 and 2003. During this period, the deep-set fishery had an estimated 373 incidental interactions with seabirds (116 in 2002 and 257 in 2003).

In April 2004, the swordfish fishery re-opened under a new management program that limited effort in the fishery to a maximum of 2180 sets annually (69 FR 17330). During 2004, 26 albatrosses were estimated to have been captured in the shallow-set and deep-set components combined. It should be noted that the shallow-set component was only open from October through December in 2004. In 2005, NMFS estimated that 194 seabirds were captured by the entire fishery. Even with the shallow-set fishery open for the entire year, the fishery did not experience the high interaction rates that occurred in prior years (e.g. 2000). While the shallow-set fishery was curtailed in 2006 because it reached the loggerhead sea turtle interaction limit,

both the total numbers of birds taken (as would be expected) and the seabird interaction rate (0.015 seabirds per 1000 hooks) remained low compared to years prior to the shallow-set closure.

A key factor contributing to the decrease in estimates of seabird interactions over the years is the implementation of seabird deterrence measures. In June 2001, a suite of seabird measures became mandatory in the Hawaii longline fishery with the implementation of an emergency rule (66 FR 31561). The final rule for this suite of seabird deterrence techniques was published in May 2002 (67 FR 34408). Since then, the number of seabirds incidentally taken in the Hawaii longline fishery has remained low. The seabird interactions have remained low under more recent mitigation measures implemented on January 18, 2006 (70 FR 75075).

Efforts were made to analyze observer data to determine the effectiveness of three treatments: 1) side setting with plain baits; 2) stern setting with plain baits; and 3) stern setting with blue-dyed baits using observer data from the deep-set fishery (Gilman 2006). The results were inconclusive due to the small number of albatross interactions (n=6). Because albatross interactions in the deep-set fishery are such rare events the sample size of 323 sets was not adequate to make any solid conclusions. An analysis with a larger sample size determined that the current regulations reduced the observed *rate* of incidental seabird interactions in the deep-set fishery by about 83% (Gilman and Kobayashi 2007). The only treatment that showed a significant difference in efficacy above side-setting for stern setting vessels was when heavier ($\geq$ 60 g) weights were used with thawed blue-dyed baits.

Spatial and temporal placement of fishing operations and the localized seabird abundance around vessels likely influence interaction rates and thus the efficacy of seabird mitigation measures. The NMFS observer program records relative seabird abundance during fishing operations. Including relative seabird abundance into analyses will improve the understanding of the relative success of seabird mitigation measures and enable the calculation of more precise interaction rates. For instance, it is possible that observed reductions in seabird interaction rates result from fewer albatrosses in the vicinity of observed fishing vessels due changes in fishing patterns. However, it was found that there were no discernable spatial differences in fishing effort since the reopening of the swordfish fishery in 2004 compared to historic fishing effort for either the deep-set fishery or the shallow-set fishery (Figs. 6 and 7) (NMFS 2006). Therefore, if albatross abundances in the vicinity of Hawaii longline vessels have also not changed, then differences in seabird interaction rates must be a result of something besides differences in spatial-temporal patterns of fishing effort and seabird abundance proximal to fishing operations.

NMFS's efforts to gather ship-board estimates of relative seabird abundance are continuing. These observations will likely prove valuable when combined with on-going tracking studies of all three species of North Pacific albatrosses. Even with no changes in temporal-spatial effort over time and seabird abundance, it is difficult to gauge the effectiveness of mitigation measures in Hawaii longline fisheries - especially, in the shallow-set fishery. Regulations designed to protect sea turtles in the shallow set fishery (large circle hooks, mackerel-type bait, sea turtle interaction limits) likely provided an ancillary benefit to reduce seabird interactions. For instance, the shallow-set fishery was closed in March 2006 because the interaction limit on loggerheads

was reached. Obviously, the closure meant that fewer incidental interactions with seabirds occurred that year.

Seabird Interactions 2007

Incidental interactions with seabirds are usually recorded during the haulback of longline gear, but on rare occasions they may be recorded by observers during the setting of gear. Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species without special exemption. Take is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." An incidental take of one STAL is allowed per year for the shallow-set fishery under the 2004 BiOp (USFWS 2004) and 15 over a seven year period for the deep-set fishery (USFWS 2002).

Observed Interactions

There were no observed interactions with STALs in either the deep-set or shallow-set components of the Hawaii longline fishery during 2007. However, NMFS observers recorded interactions with 18 BFAL and 7 LAAL in the deep-set fishery with a 20.1 % observer coverage rate for trips returning in 2007 (0.003 seabirds per 1,000 hooks). Interactions with 8 BFAL and 40 LAAL were observed in the shallow-set component of the fishery in 2007 with a 100% observer coverage rate (0.035 seabirds per 1,000 hooks) (Figure 17). While the observed interaction rate for the deep-set component remained roughly the same, the interaction rate for the shallow-set component roughly doubled from 2006 to 2007. Only albatrosses were observed taken incidentally to fishing operations in 2007.

Observed Interaction Statistics

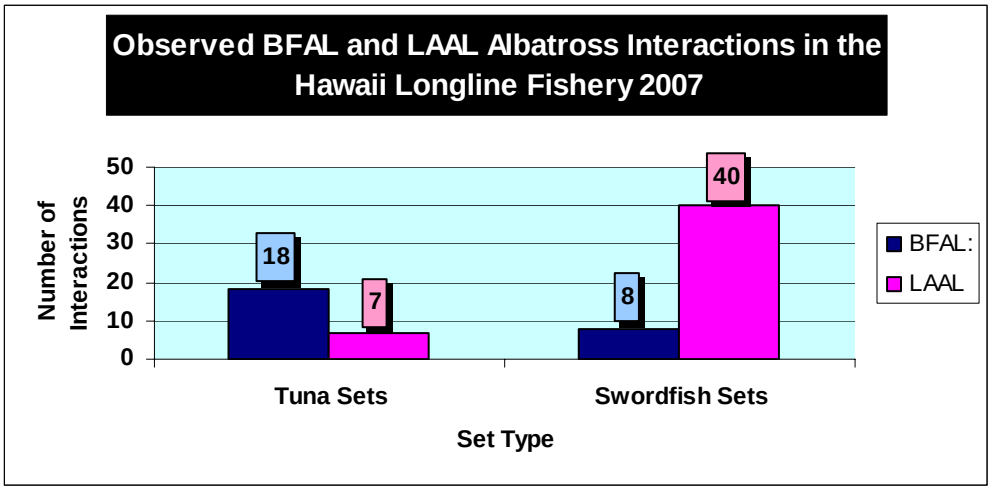

Figure 17. Total observed black-footed and Laysan albatross interactions in the Hawaii pelagic longline fishery in 2007 (Source: PIRO)

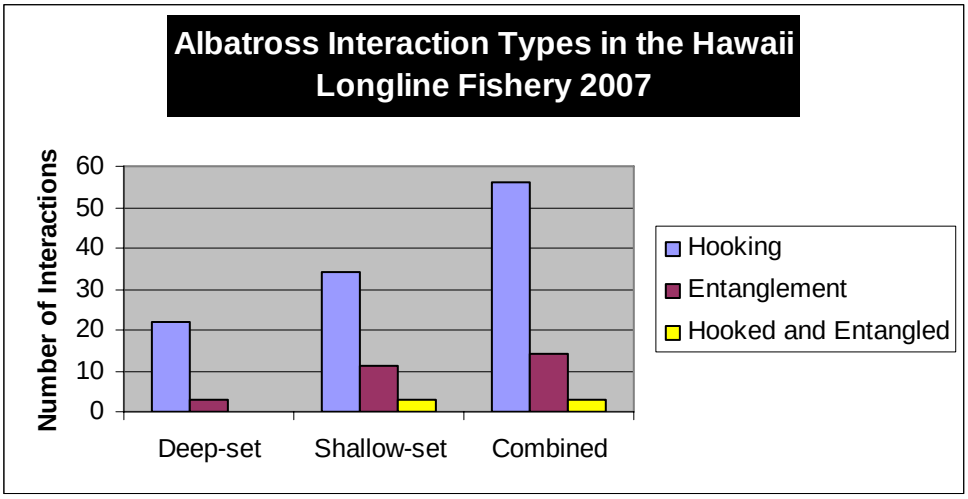

Figure 18. Types of observed interactions between albatrosses and Hawaii longline vessels in 2007 (Source: PIRO)

Table 5. Types of Interactions between Albatrosses and Hawaii Longline Vessels in 2007

	Deep-set (25 Total)	**Shallow-set (48 Total)**	**Combined (73 Total)**
Hooking	22 (88%)	34 (71%)	56 (77%)
Entanglement	3 (12%)	11 (23%)	14 (19%)
Hooked and Entangled	0 (0%)	3 (6%)	3 (4%)

The types of interactions in 2007 occurred in roughly the same proportions in the deep-set and shallows-set fishery with hookings accounting for the majority of observed interactions. A smaller proportion of albatrosses were entangled. There were three (3) albatrosses observed hooked and entangled in the shallow-set component. No seabirds were observed hooked and entangled in the deep-set component (Figure 18 and Table 5).

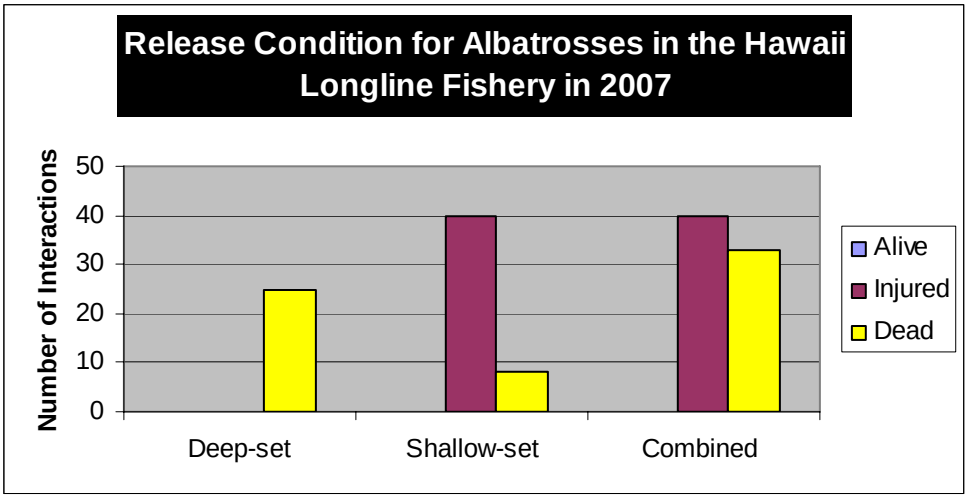

Figure 19. Release condition for albatrosses captured incidentally to fishing operations in the Hawaii longline fishery in 2007 (Source PIRO)

	Deep-set (25 Total)	**Shallow-set (48 Total)**	**Combined (73 Total)**
Alive	0 (0%)	0 (0%)	0 (0%)
Injured	0 (0%)	40 (83%)	40 (55%)
Dead	25 (100%)	8 (17%)	33 (45%)

Table 6. Release condition for albatrosses captured incidentally to fishing operations in the Hawaii longline fishery in 2007 (Source PIRO)

In 2007, all albatrosses that were observed captured in the deep-set component were dead when recovered. In contrast, the majority (83%) of albatrosses observed captured in the shallow-set component were released injured. The remaining incidental interactions in the shallow-set fishery resulted in mortalities. No albatrosses were observed released alive (Figure 19 and Table 6). According to observer program staff, seabirds are seldom given an "Alive" release code. This could only happen if a seabird were to become lightly entangled and free itself without the aid of the observer (pers. comm. Jeremy Willson, April 2007). There is a strong correlation between the release condition and the phase of fishing operations in which seabirds are captured. If seabirds are caught during gear deployment, they are unlikely to survive gear interactions. In contrast, the majority of seabirds caught during gear retrieval are usually released injured.

Based on 2007 observer data, it can be determined whether an albatross was captured during gear deployment and the soak period or gear retrieval. Data were analyzed and most probable time of capture was determined. No albatrosses were observed captured in the deep-set component during the gear retrieval phase of fishing operations (Figure 20 and Table 7). The observer narratives are consistent with the interpretation that all captures occurred during gear deployment in the deep-set component of the fishery. In contrast, the majority (83%) of interactions in the shallow-set component were directly observed occurring during the gear retrieval operations (haul). Most interactions that occurred during the haul happened when albatrosses were

attempting to steal baits from branchlines that were being retrieved. The rest of the interactions (17%) appear to have occurred during gear deployment or when the gear was soaking.

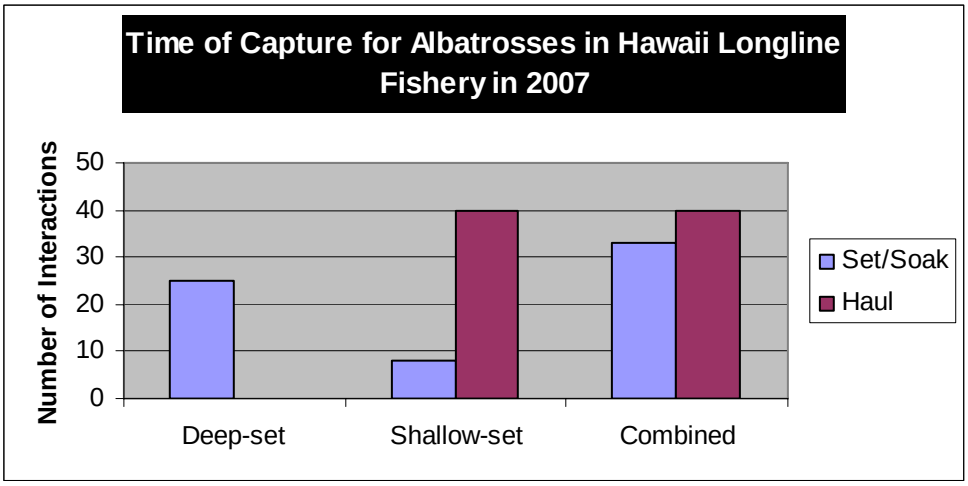

Figure 20. Time of capture for observed albatross interactions in the Hawaii longline fishery in 2007 (Source PIRO)

	Deep-set	Shallow-set	Combined
Set/Soak	25 (100%)	8 (17%)	33 (45%)
Haul	0 (0%)	40 (83%)	40 (55%)

Table 7. Probable time of capture for observed albatross interactions in the Hawaii longline fishery in 2007 (Source PIRO)

All of the albatrosses in both components of the fishery that were determined to have been caught during gear deployment/soak were also recovered dead.

Estimated Interactions

Interaction estimates are calculated for the deep-set fishery in which ≥20% observer coverage is maintained annually (NMFS 2005a). In the shallow-set fishery, 100% observer coverage is required; therefore, all *observed* interactions are assumed to equal *total* interactions.

Because of fluctuations in the deep-set fleet's activity levels and observer availability, coverage levels vary throughout the year. These fluctuations make it impractical to sample trips so that each trip has an equal chance of being sampled (*simple random sample*). Furthermore, it is inappropriate to estimate the total number of incidental interactions by simply raising the average observed catch rate by the total amount of effort as this estimator assumes a simple random sample.

The Horvitz-Thompson estimator methodology used for the deep-set fishery is an unbiased estimator based on the sampling design (McCracken 2006). The sampling design uses a

systematic sample as the primary sample and a daily random sample as a secondary sample. The systematic component uses a random number generator to select trips based on the order in which they are called in. This systematic schedule is usually designed to provide a 15% sampling rate. The daily sample selects trips randomly from vessel notifications at the end of a business day when observers are available. This hybrid approach to sampling is necessary to address the needs of fishing vessels to be able to fish, the ability of the NMFS Observer Program to place observers on vessels as observer availability varies, and the need to maintain a minimum 20% annual observer coverage rate for deep-set vessels. For instance, right after an observer training class there may be more than an adequate number of observers available to cover 20% of deep-set trips. Sampling can easily follow the systematic schedule. Often during these periods the coverage rate is above 20% and vessels have a greater chance of being sampled. Conversely, if there are other demands on observers, like when trying to cover 100% of shallow-set trips, NMFS cannot simply prevent deep-set vessels from fishing. This leads to periods of low observer coverage and lower probabilities that a particular vessel will be sampled. The Horvitz-Thompson estimator used by McCracken accounts for the interplay between observer availability and fleet activity which, in turn, influences the *probability* of whether a trip is sampled, or not.

While point estimates derived through the Horvitz-Thompson estimator are considered reliable, periods of low observer coverage (i.e., small sample size) lead to wider confidence intervals. Because seabird interactions are relatively rare events, confidence intervals were computed using accepted methods for estimating confidence intervals for rare events (Poissant variants). Confidence intervals for the yearly total were not computed because it is unreasonable to assume the interaction rates are constant throughout the year (McCracken 2006).

Table 8. Interaction estimates with incidentally caught albatrosses and corresponding 95% confidence intervals (C.I.) for the Hawaii deep-set longline fishery in 2007.
(Source: PIFSC)

	Quarter 1	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual Total**
Species	Point Estimate, C.I.	Point Estimate, C.I.	Point Estimate, C.I.	Point Estimate, C.I.	
Black-footed Albatross	33, [4,98]	25, [5,62]	7, [1,30]	12, [4,28]	77
Laysan Albatross	30, [3,98]	5, [1,27]	0, [0,23]	9, [0,10]	44

In 2007, the Hawaii deep-set longline fishery was estimated to have incidentally interacted with 77 BFAL and 44 LAAL. The estimated interaction rates for 2007 in the deep-set fishery by species are 0.002 BFAL per 1000 hooks and 0.001 LAAL per 1000 hooks. The overall deep-set fishery interaction rate was 0.003 albatrosses per 1000 hooks.

In 2007, there were an estimated 85 total interactions with BFAL and 88 total interactions with LAAL (173 total). Total estimates for the entire fishery were determined by combining the

estimated interactions (e.g. point estimates) with the total number observed in the shallow-set (swordfish) fishery (Figure 17). Fleet-wide seabird interactions for both components of the Hawaii longline fishery (estimated deep-set plus observed shallow-set) from 2000 through 2007 are depicted in Figure 21. It should be taken into account that the shallow-set fishery closed in April 2001, and re-opened in October 2004.

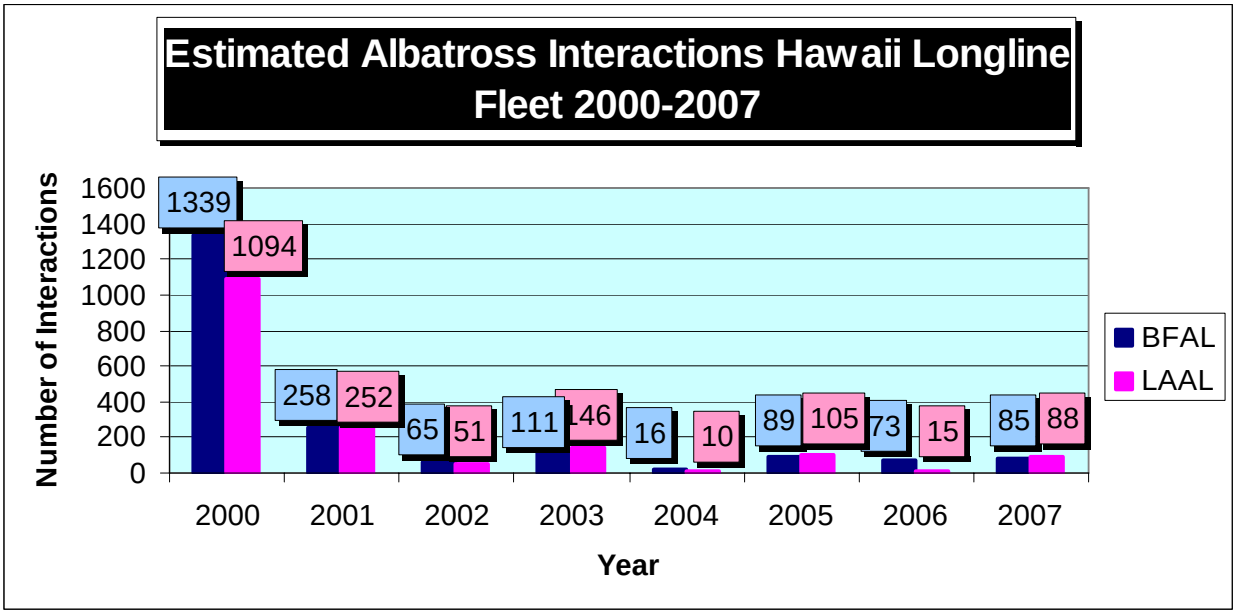

Figure 21. Estimated fleet-wide incidental interactions with black-footed and Laysan albatrosses in the Hawaii longline fishery during, 1999-2007 (Source: PIRO)

Relatively more BFALs are taken compared to their population size (recall that the BFAL nesting pair population is about one tenth that of LAALs) than are LAALs since they are taken in about even total numbers. This trend seems to be consistent over the years (Figure 21). Fernandez et. al. (2001) note that this species is commonly seen following ships, and the results of a satellite telemetry study by Hyrenbach et. al. (2002) suggests that BFALs may selectively forage during the breeding season in the same areas that are fished by Hawaii-based longline vessels. Both studies show that during the early breeding period (January and February) both species may make short foraging trips to areas that are often fished by Hawaii-based longline vessels close to the NWHI. The Hyrenbach study also demonstrates a preference by LAALs for boreal and sub-arctic waters away from pelagic longline fishing grounds later in the breeding season (March and April). The differences in behavior and preferred foraging areas during the breeding season between the two species may have some influence on why BFALs are caught in disproportionate numbers relative to their population. Research into the feeding behaviors, monitoring of albatross abundance and interactions on fishing grounds, and telemetry studies should continue in order to help clarify why BFALs are taken more often in pelagic longline fishing operations relative to their population size.

Short-tailed Albatross Sightings in 2007
There were four short-tailed albatross sightings in 2007 by NMFS observers aboard Hawaii-based longliners (Table 9). All details of the sightings were provided to USFWS.

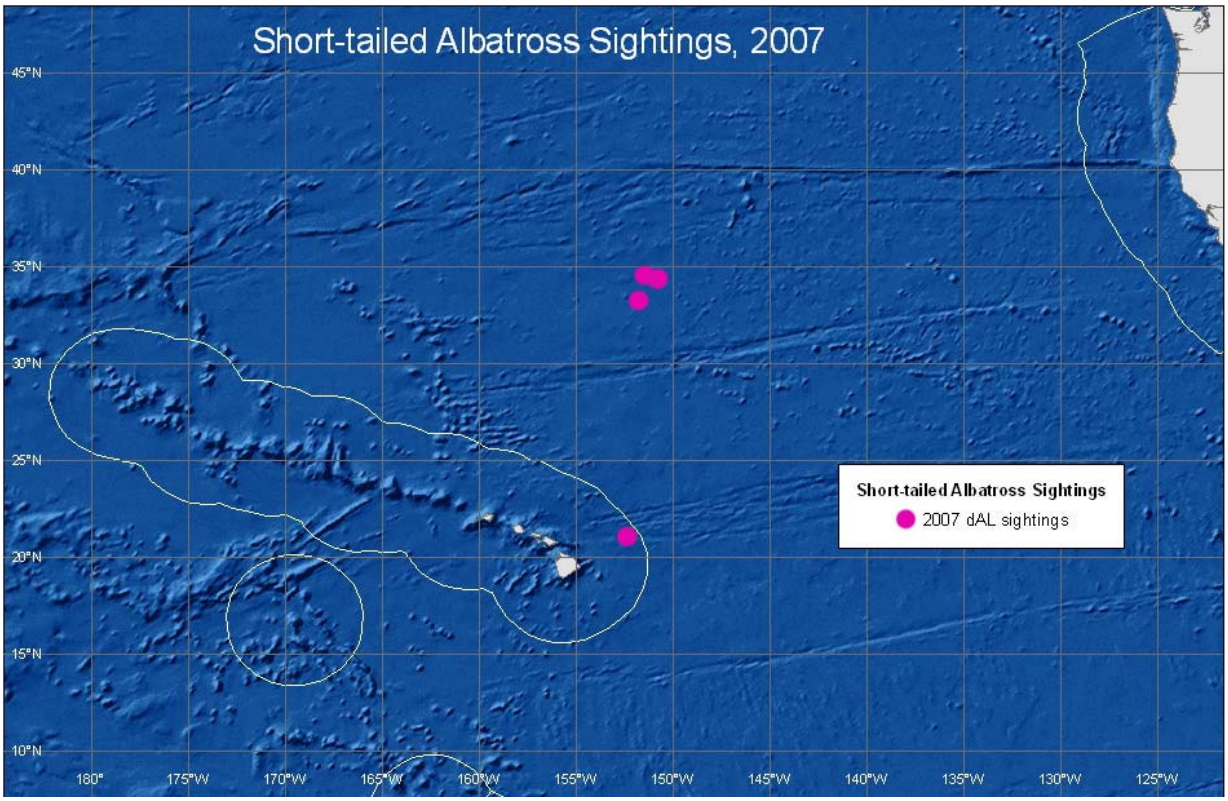

Figure 22. Short-tailed albatross sightings by NMFS observers, 2007 (Source: PIRO)

Table 9. Short-tailed albatross sightings in 2007

Date	Trip Type	Comments
January 4, 2007	Shallow-set	No gear contact. Bird sighted resting on the water.
January 14, 2007	Shallow-set	No gear contact.
January 14, 2007	Shallow-set	No gear contact. (Same trip and day).
December 11, 2007	Deep-set	No gear contact. Bird sighted resting on the water 20 – 30 m from vessel.

9.0 Summary

In 2007, total observer coverage averaged 25.6% (20.1% for deep-setting vessels and 100% for shallow-setting vessels; 4,964 of 19,385 total sets) based on trips arriving in 2007. Additionally, NMFS observers monitored 31.9% of all longline sets north of 23° N and 16.2% of deep-sets north of 23° N that were hauled in 2007 (NMFS unpubl. 2008).

Of 40,197,926 total hooks fished, the deep-set fishery deployed about 39 million hooks in 17,809 sets, and the shallow-set fishery deployed a reported a little more than1.3 hooks in 1,570 sets (NMFS 2008).

No interaction was observed or reported with a STAL in the Hawaii longline fishery, either by deep-setting or shallow-setting vessels. However, there were four sightings of STALs by NMFS observers aboard Hawaii-based longline vessels. In 2007, the shallow-set fishery was observed to interact with 8 BFALs and 40 LAALs, an interaction rate of 0.035 albatross per 1000 hooks. It was estimated that there were 77 BFAL and 44 LAAL interactions in the deep-set fishery in 2007. Overall, the deep-set fishery had an estimated interaction rate of 0.003 albatrosses per 1000 hooks. Since 2004, the estimated number of albatrosses taken incidentally to fishing operations by Hawaii pelagic longline fisheries has been reduced by 92-99% compared to the 2000 estimates. No other species besides albatrosses were reported caught incidentally to fishing operations in the Hawaii-based longline fishery in 2007.

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11.0 Acknowledgements

Dr. Marti McCracken of the Pacific Islands Fisheries Science Center provided the 2006 interaction estimates for protected species incidentally caught in the Hawaii longline fishery. Eric Gilman of the Blue Ocean Institute provided input on the effectiveness of seabird deterrence measures. Lesley Jantz of the Pacific Islands Region Hawaii Longline Observer Program provided the Hawaii longline effort plots and general data requests. Jeremy Willson and Eric Forney were essential in gathering data for the report. Dr. Beth Flint of the U.S. Fish and Wildlife Service provided the current status of albatross populations. Dr. Scott Schaffer and Dr. Robert Suryan provided guidance and papers on understanding albatross movements. Kim Rivera, National Seabird Coordinator, NOAA Fisheries, and Brett Wiedoff (SFD) for reviewing the document prior to distribution.

12.0 Appendices

Appendix 1. Pelagic Management Unit Species and Common Catch Species

Table 1. Pelagic Management Unit Species (Source: WPFMC)

Common name	Scientific name
Mahimahi (dolphinfish)	*Coryphaena spp.*
Indo-Pacific blue marlin	*Makaira mazara*
Black marlin	*M. indica*
Striped marlin	*Tetrapturus audax*
Shortbill spearfish	*T. angustirostris*
Swordfish	*Xiphias gladius*
Sailfish	*Istiophorus platypterus*
Pelagic thresher shark	*Alapias pelagicus*
Bigeye thresher shark	*Alopias*
Common thresher shark	*Alopias vulpinus*
Silky shark	*Carcharhinus falciformis*
Oceanic whitetip shark	*Carcharhinus longimanus*
Blue shark	*Prionace glauca*
Shortfin mako shark	*Isurus oxyrinchus*
Longfin mako shark	*Isurus paucus*
Salmon shark	*Lamna ditropis*
Albacore	*Thunnus alalunga*
Bigeye tuna	*T. obesus*
Yellowfin tuna	*T. albacore*
Northern bluefin tuna	*T. thynnus*
Skipjack tuna	*Katsuwonus pelamis*
Kawakawa	*Euthynnus affinis*
Wahoo	*Acanthocybium solandri*
Moonfish	*Lampris spp.*
Oilfish family	*Gempylidae*
Pomfret	*family Bramidae*
Other tuna relatives	*Auxis spp., Scomber spp.;* Allothunus spp.

Table 2. **Common Fish Species Encountered in the Hawaii-based Pelagic Longline Fishery**
(Source: PIFSC)

Black Mackerel	*Scombrolabrax heterolepis*
Bony Fishes, Unidentified	*Osteichthys*
Crestfish	*Lophotus lacepede*
Dolphinfish	*Coryphaena hippurus*
Dolphinfish, Pompano	*Coryphaena equiselis*
Driftfish	*Cubiceps*
Escolar, Oilfish	*Ruvettus pretiosus*
Escolar, Roudi	*Promethichthys prometheus*
Escolar, Smith's	*Lepidocybium flavobrunneum*
Great Barracuda	*Sphyraena barracuda*
Jack, Cottonmouth (Unidentified)	*Uraspis spp.*
Jack, Rainbow Runner	*Elagatis bipinnulatus*
Jack, Yellowtail	*Seriola lalandi*
King-of-Salmon	*Trachipterus altivelis*
Lancetfish, Longnose	*Alepisaurus ferox*
Louvar	*Luvarus imperialis*
Mackerel, Pacific (Chub)	*Scomber japonicus*
Manta, Atlantic	*Manta birostris*
Manta-Mobula (Unidentified)	*Mobulidae*
Marlin, Black	*Makaira indica*
Marlin, Indo-Pacific Blue	*Makaira mazara*
Marlin, Striped	*Tetrapturus audax*
Mola, Common (Ocean Sunfish)	*Mola mola*
Mola, Sharptail	*Masturus lanceolatus*
Mola, Slender	*Ranzania laevis*
Oarfish	*Regalecus glesne*
Omosudid (Hammerjaw)	*Omosudis lowei*
Opah	*Lampris guttatus*
Pelagic Puffer	*Lagocephalus lagocephalus*
Pelagic Stingray	*Dasyatis violacea*
Pomfret, Brilliant	*Eumegistus illustris*
Pomfret, Knifetail	*Taractes rubescens*
Pomfret, Rough	*Taractes asper*
Pomfret, Sickle	*Taractichthys steindachneri*
Pomfrets, Unidentified	*Bramidae*
Ray (Other)	*Rajiformes*
Ray (Unidentified)	*Rajiformes*
Razorback Scabbardfish	*Assurger anzac*
Rough Triggerfish	*Canthidermis maculata*
Sailfish	*Istiophorus platypterus*

Scalloped Hammerhead Shark	*Sphyrna lewini*
Scalloped Ribbonfish	*Zu cristatus*
Shark (Other)	
Shark, Bigeye Thresher	*Alopias superciliosus*
Shark, Bignose	*Carcharhinus altimus*
Shark, Blacktip	*Carcharhinus limbatus*
Shark, Blue	*Prionace glauca*
Shark, Cookie Cutter	*Isistius brasiliensis*
Shark, Crocodile	*Pseudocarcharias kamoharai*
Shark, Galapagos	*Carcharhinus galapagensis*
Shark, Grey Reef	*Carcharhinus amblyrhynchos*
Shark, Longfin Mako	*Isurus paucus*
Shark, Oceanic Whitetip	*Carcharhinus longimanus*
Shark, Pelagic Thresher	*Alopias pelagicus*
Shark, Salmon	*Lamna ditropis*
Shark, Sandbar	*Carcharhinus plumbeus*
Shark, Shortfin Mako	*Isurus oxyrinchus*
Shark, Silky	*Carcharhinus falciformis*
Shark, Smooth Hammerhead	*Sphyrna zygaena*
Shark, Thresher	*Alopias vulpinus*
Shark, Tiger	*Galeocerdo cuvieri*
Shark, Unidentified	*Chondrichthyes*
Shark, Velvet Dogfish	*Scymnodon squamulosus*
Shark, White	*Carcharodon carcharias*
Sharks, Hammerhead	*Sphyrna*
Sharks, Thresher (Unidentified)	*Alopiidae*
Shortbill Spearfish	*Tetrapturus angustirostris*
Snake Mackerel	*Gempylus serpens*
Swordfish	*Xiphias gladius*
Tapertail Ribbonfish	*Trachipterus fukuzakii*
Triggerfish, Unidentified	*Balistidae*
Tuna, Albacore	*Thunnus alalunga*
Tuna Bigeye	*Thunnus obesus*
Tuna, Kawakawa	*Euthynnus affinis*
Tuna, Pacific Bluefin	*Thunnus orientalis*
Tuna, Pacific Bonito	*Sarda chiliensis*
Tuna, Skipjack	*Katsuwonus pelamis*
Tuna, Yellowfin	*Thunnus albacares*
Wahoo	*Acanthocybium solandri*

Appendix 2: Interaction estimates with incidentally caught sea turtles, seabirds, and marine mammals in the Hawaii longline deep-set fishery.

Estimation of Incidental Interactions with Sea Turtles and Seabirds in the 2007 Hawaii Longline Deep Set Fishery

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This report provides estimates of the number of incidental interactions with protected species by the Hawaii longline deep set fishery in the year 2007 (Table 1). Within this report, an incidental interaction means an event during a longline fishing operation in which a protected animal is hooked or entangled by the fishing gear. An incidental interaction estimate refers to the estimated total number of incidental interactions for all longline deep set fishing trips landing in the specified time period. A longline deep set fishing trip is defined as any commercial fishing trip by a vessel with a Hawaii longline permit that departs or returns at a Hawaii port, excluding those trips using a certificate for swordfish fishing.

The interaction estimates are based on a random sample of longline trips on which scientific observers are deployed. In 2007, observed trips were selected using two sampling schemes to accommodate fluctuating coverage levels and utilize observers efficiently. Coverage levels vary throughout the year because of fluctuation in the fleet's activity level, demands of 100% coverage in the Hawaii longline shallow set fishery for swordfish, and an influx of observers after completion of NMFS observer training. Because observers are not paid while waiting to be deployed, they must be assigned with minimal delay when available. The alternative of paying them while they are waiting to be deployed would increase the cost of the observer program. The two sampling schemes attempt to reach a balance between obtaining a probability sample and being cost effective. A probability sample implies that all trips have a probability of being sampled and the sampling probabilities are known. These sampling probabilities form the basis of design-based estimators. An unbiased design-based estimator has the merit that it is unbiased regardless of the characteristics of the population being surveyed.

The primary scheme was a systematic sample. Before departing on a fishing trip, longline vessels were required to call the NOAA Fisheries Pacific Islands Regional Office (PIRO) observer program contractor at least 72 hours prior to their intended departure date. To enable sample selection, the PIRO contractor numbered calls sequentially in the order in which they were received. Herein, this assigned number is referred to as the call number. Prior to the beginning of a quarter, a systematic sample of call numbers was drawn by PIFSC and supplied to the contractor. The trips associated with these selected call numbers were designated to be sampled. Although every reasonable effort was made to sample selected trips, there were some selected trips that departed without an observer. In this situation, the PIRO contractor recorded that the trip was not sampled along with a short explanation of why it was not sampled. If a trip was selected but the vessel did not leave within a reasonable amount of time, usually the observer was reassigned to a different vessel trip. When the selected vessel was ready to depart a different observer was assigned to it.

The systematic sample requires having an observer available to be deployed whenever a selected trip is ready to depart. To achieve this requirement under full targeted coverage throughout the year requires increasing the current number of observers on contract and paying them when they are not deployed on a vessel. These requirements frequently cannot be met under the current level of funding; therefore, the quarterly sample selected under the systematic design was usually slightly smaller than the targeted coverage, typically 5% less. When this occurred, the additional trips needed to reach the full targeted level were selected using a secondary sampling scheme. This secondary scheme was used when all trips selected by the systematic sample were already covered and an observer was ready to be deployed. In this instance, a trip was randomly selected with equal probability from the calls received that day that had not already been selected. If more than one observer needed to be assigned, the appropriate number of trips was sampled with equal probability from this pool of call-ins. The coverage obtained by this secondary sampling scheme was flexible and dependent on the need to deploy observers. The additional samples drawn under the secondary sampling scheme depart from traditional probability samples because the days when additional samples were drawn were not randomly selected but determined by the need to deploy observers.

Because the systematic sample was selected quarterly, point estimates of incidental interactions were computed on a quarterly basis and then summed to estimate the year's total interactions. All observed incidental interactions on a trip were assigned to the quarter when the vessel returned to port after completing the trip. Some quarterly estimates of interactions therefore involve interactions that occurred during an earlier quarter. Accordingly, these estimates are not the best source of information on seasonality of interactions.

The contractor's sampling records were used to approximate sampling probabilities. The sampling probabilities during the periods when additional (secondary) samples were drawn were computed by enumerating the number of call-ins during consecutive periods of comparable coverage. It was then assumed that the additional trips were selected with equal probability from those trips that had not been selected as part of the systematic sample. When coverage was below that of the anticipated systematic sample, the sampling probabilities were computed by enumerating all call-ins during this period and assuming that the trips sampled were selected with equal probability.

Because the coverage level changed with the fluctuations in observer availability and fishing activity, the observed trips were not selected with equal probability. Therefore, the Horvitz-Thompson estimator was used to estimate total interactions, as it takes into account unequal sampling probabilities. The incidental interaction records used to compute the Horvitz-Thompson estimator were those available in the Longline Observer Database System on 2 April 2008.

Confidence intervals for the quarterly incidental interactions were estimated using the approximated sampling probabilities and assuming that the number of incidental interactions per trip for a given species was an independent Poisson variate with a constant mean value. The

assumption that the average rate of incidental interactions was constant throughout a quarter is questionable but necessary to compute confidence intervals. Confidence intervals for the yearly total were not computed, as it seems unreasonable to assume that incidental interaction rates were constant throughout the entire year. A quarter's confidence interval does not incorporate information beyond the quarter's data. Therefore, for some species the upper bound of the confidence interval may seem high given historical records. For example, there has not been an observed incidental interaction with a short-tailed albatross during the history of the observer program and based on this information it seems highly improbable that the incidental interaction levels would be as high as the upper bounds of the confidence intervals for this species.

Table 1. Point estimates of the number of incidental interactions by species and corresponding 95% confidence intervals (C.I.) for the Hawaii deep set longline fishery in 2007. All protected species of sea turtles and seabirds with an observed interaction are listed as well as species that most commonly interact with the fishery or are of special concern because of their endangered species status.

	Quarter								Annual Total
	Number of Incidental Interactions								
Species	Point Estimate	C.I.	Point Estimate	C.I.	Point Estimate	C.I.	Point Estimate	C.I.	Point Estimate
Turtles									
Loggerhead	0	[0,38]	0	[0,17]	7	[1,30]	0	[0,10]	7
Leatherback	0	[0,38]	2	[1,22]	0	[0,23]	2	[1,12]	4
Olive Ridley	0	[0,38]	11	[2,38]	0	[0,23]	15	[5,32]	26
Green	0	[0,38]	0	[0,17]	0	[0,23]	0	[0,10]	0
Albatrosses									
Black-Footed	33	[4,98]	25	[5,62]	7	[1,30]	12	[4,28]	77
Laysan	30	[3,93]	5	[1,27]	0	[0,23]	9	[3,23]	44
Short-tailed	0	[0,38]	0	[0,17]	0	[0,23]	0	[0,10]	0