Chapter 3 Affected Environment

3.1 Introduction

Chapter 3 describes the existing environment and resources potentially affected by the management alternatives described in Chapter 2. The information presented here builds upon the information presented in the 2001 Pelagics FEIS (NMFS, 2001), and the 2004 Pelagics SEIS (WPRFMC, 2004), supplemented by recent BiOps prepared by NOAA Fisheries and the USFWS, Council preliminary action documents and the BA prepared by the HLA and WPRFMC (2004). The information on seabird interactions in the Hawaii-based longline fishery incorporates the most recent available information from the NMFS observer program. The information about the Japanese squid jigging fishery was obtained from a Council-funded project to translate and summarize recent Japanese reports and scientific papers (Bower, 2004).

3.2 The Western Pacific Pelagic Environment

3.2.1 Oceanography

The descriptions of the physical and biological pelagic environment of the WCPO contained in the 2001 FEIS (NMFS, 2001) are complete and accurate accounts of that ecosystem and those descriptions are incorporated by reference here. Since the publication of the 2001 FEIS there has been an increasing awareness within the scientific community of the occurrence and importance of long-term (decadal-scale) oceanographic cycles (Chavez et al., 2003; SCBT 15, inter alia) and of their relationship to cycles in the population sizes of some species of fish such as California sardines and North Atlantic bluefin tuna. These naturally occurring cycles can either mitigate or accentuate the impact of fishing mortality on target species and, in general, the scientific community is becoming more aware of the need to recognize the possibility of large natural swings in the populations of exploited species and to incorporate this dynamism into management models. Meso-scale events such as *El Niño* and shorter term phenomena such as cyclonic eddies near the Hawaiian Islands (PFRP Newsletter 8(1), 2003) also impact the recruitment and fishing vulnerability of PMUS.

3.2.2 Essential Fish Habitat and Habitat Areas of Particular Concern

In considering the potential impacts of a proposed action on Essential Fish Habitat (EFH), all designated EFH must be considered. EFH was defined for PMUS in the Pelagics FEIS (NMFS, 2001) and updated for all of the Council's FMPs in the SEIS (WPRFMC, 2004). An update was necessary because of the approval of the CRE FMP and designation of CRE EFH and HAPC. The resulting list of EFH for all Council FMPs is shown in Table 3.2-1.

Table 3.2-1: Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for all Western Pacific FMPs

FMP	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Pelagics	Water column down to 1,000 m	Water column down to 200 m	Water column above seamounts and banks down to 1,000 m
Bottomfish and Seamount Groundfish	Bottomfish: Water column and bottom habitat down to 400 m Seamount Groundfish: (adults only) water column and bottom from 80 to 600 m, bounded by 29°-35°N and 171°E-179°W	Bottomfish: Water column down to 400 m Seamount Groundfish: (including juveniles) epipelagic zone (0-200m) bounded by 29°-35°N and 171°E-179°W	Bottomfish: All escarpments and slopes between 40-280 m, and three known areas of juvenile ʻō*pakapaka* habitat Seamount Groundfish: not identified
Precious Corals	Keāhole Point, Makapuʻu, Kaʻena Point, Westpac, Brooks Bank, 180 Fathom Bank deep water precious corals (gold and red) beds and Miloliʻl, Auʻau Channel and S. Kauaʻl black coral beds	Not applicable	Makapuʻu,Westpac, and Brooks Bank deep water precious corals beds and the Auʻau Channel black coral bed
Crustaceans	Bottom habitat from shoreline to a depth of 100 m	Water column down to 150 m	All banks within the NWHI with summits less than 30 m
Coral Reef Ecosystem	Water column and benthic substrate to a depth of 100 m	Water column and benthic substrate to a depth of 100 m	All MPAs identified in FMP, all PRIAs, many specific areas of coral reef habitat (see FMP)

Note: All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.

3.2.3 Contaminants in the Environment

Contaminants in the marine environment consist of dissolved, suspended or adsorbed chemical pollutants and solid debris. Contamination in the marine environment is not a focal point of this EIS, but Appendix A summarizes recent information regarding the nature, extent and risks associated with contaminants in the pelagic marine environment.

Laysan albatross chicks are susceptible to lead poisoning from deteriorating lead-based paint on buildings on Midway Atoll. This situation is described further in section 3.6.1.1.3.

3.3 Pelagic Management Unit Species

A thorough review of the descriptions of the biology and status of the stocks of the PMUS as described in the 2001 FEIS (NMFS, 2001) indicates that these are comprehensive and accurate reports and that by and large, no new data have emerged since that time that would invalidate or contradict those descriptions. Similarly, the 2004 SEIS also contains concise accounts of the status of the stocks of the various PMUS. Consequently, these sections of the 2001 FEIS and 2004 SEIS are incorporated by reference here. The salmon shark (*lamna ditropis*) has been added as a PMUS since the 2001 FEIS (NMFS, 2001) and a brief description of its biology is included in the current document. Deliberations of the SCTB in 2002 and 2003 (reported in SCTB Reports 15 and 16) indicate that generally, no significant changes in stock assessments for any of the PMUS have occurred since the 2001 FEIS. There have been some changes in perspective regarding the SCTB's assessment of bigeye tuna stock status and these are noted in the current document in the appropriate section (3.3.2.1). Much of the uncertainty regarding the status of bigeye stocks concerns whether recent large catches of juvenile bigeye are having an undue influence on estimates of recruitment (which are high) and whether these high levels of recruitment are sustainable. The most recent assessments of the SCTB (SCTB 16) concerning the status of PMUS stocks have been appended in the pertinent sections.

Of particular pertinence to the current EIS are results from ongoing studies of feeding habits of yellowfin and bigeye tuna in Hawaiian waters. Squid of the family Omnastrephidae are the second most common group of cephalopods found in the stomachs of these fish but cephalopods as a whole comprise less than 10% of the food taken by these tuna species (Holland, pers. comm.).

Claims made in recent publications (Worm and Meyers, 2003) that the abundance of top predators in the world's oceans has declined by 90% have been hotly contested within the scientific community but these publications have certainly served to energize the field of top predator population assessment. The claims of 90% reduction are in contrast with the fact that total tuna harvest in the WCPO is at record levels and recruitment of both bigeye and skipjack seems to be on an upward trend. Discussion of the Meyers and Worm article in Nature can be found on the Pelagic Fisheries Research Program web page www.soest.hawaii.edu/PFRP/large_pelagic_predators.html.

Since the 2001 FEIS (NMFS, 2001), research has continued in Hawaii to elucidate the impacts of FADs and seamounts on the feeding ecology of yellowfin and bigeye tuna (SCTB 15).

3.3.1 Status of Billfish Stocks

Concise definitions of the various criteria used to analyze current levels of harvest exploitation and the status of PMUS stocks can be found in Boggs et al. (2000). That document and the 2003 NMFS Report to the US Congress contain current best estimates of the status of PMUS stocks.

3.3.1.1 Swordfish (*Xiphias gladius)*

There is considerable debate concerning the stock structure of swordfish in the Pacific. Several studies have been unable to reject the hypothesis that there is a single, Pacific-wide stock while some recent evidence indicates that there may, in fact, be some delineation of separate stocks in different parts of the Pacific Ocean (Ward and Elscot, 2000). As reported by the thirteenth meeting of the Standing Committee on Tuna and Billfish, quantitative measures of the Pacific swordfish stock have yet to be completed (SCTB, 2000) but trends in overall catch and size composition of animals comprising Hawai‘i landings indicate that the swordfish population that supports the fishery within the Council's jurisdiction appears to be capable of sustaining current levels of effort (Kleiber and Yokawa 2002). This interpretation that the swordfish population is not overfished is congruent with that of Boggs et al. (2000) and the 2003 NMFS report to Congress (NMFS, 2004) and with most recent report (16th) of the Standing Committee on Tuna and Billfish (SCBT).

3.3.1.2 Black Marlin (*Makaira indica)*

The current status of the black marlin stock is unknown.

3.3.1.3 Blue Marlin (*Makaira mazara)*

Based on the assumption that there is a single, Pacific-wide stock, various recent analyses characterize the blue marlin population as stable and close to that required to support AMSY (Boggs et al, 2000; IATTC, 1999; PFRP, 1999; Hinton and Nakano, 1996). The most recent review by the thirteenth meeting of the Standing Committee on Tuna and Billfish (SCTB, 2000) indicates that current catches are below MSY and recent landings in Hawaii do not show any consistent trends in either CPUE or size composition. Recent catches fall within the decadal averages (WPFMC, 1998). However, blue marlin stocks are probably closer to MSY levels than other PMUS and consequently this species should continue to receive close scrutiny (Boggs et al., 2000). Kleiber et al (2003) used a multifan-CL analysis to conclude that, at worst, Pacific blue marlin are close to fully exploited and that this has been the case for the past 30 years even in the face of increased longline effort.

3.3.1.4 Striped Marlin (*Tetrapturus audax)*

Little is known about the overall status of the putative northern stock that supports the fishery in the management area although longline CPUE has demonstrated a declining trend in recent years (WPFMC,1999).

3.3.1.5 Shortbill spearfish (*Tetrapturus angustirostris)*

The current status of the shortbill spearfish stock is unknown.

3.3.1.6 Sailfish (*Istiophorus platypterus)*

The current status of the sailfish stock is unknown.

3.3.2 Status of Tuna Stocks

3.3.2.1 Bigeye Tuna (*Thunnus obesus)*

Genetic analyses indicate that there is a single pan-Pacific stock of bigeye (Grewe and Hampton, 1998). Most indicators suggest a reduction of bigeye tuna biomass in the past several years (PFRP, 1999) although biomass in the eastern Pacific seems to have stabilized (SCTB, 2000). There is ongoing debate concerning the status of bigeye stocks with assessments changing quite significantly from year to year. Significant sources of uncertainty in stock models is the possible misidentification of bigeye tuna (confused with yellowfin) in historical catch records and recent high catches of juvenile bigeye around FADs which may overestimate recruitment. Recruitment seems to be strong in recent years and rising. Although some analyses suggest that current levels of harvest may exceed MSY (Boggs et al., 2000) those same assessments found the stock to be well above MSST and is therefore not overfished (Boggs et al., 2000, NMFS 1999). The current population size is probably approximately at a level that can support AMSY, although the 2003 NMFS report to congress (NMFS, 2004) lists the bigeye stock as subject to overfishing. Recently, increased concern has arisen about the status of the stock in the face of large catches of sub-adult tuna being taken from around floating objects in the equatorial regions of the Pacific, but the most recent trends are for a decrease in FAD-associated purse seining (SCTB 16) which is seen as a positive development. Even the most recent assessments (SCTB 15 and 16) differ in their assessments of the stock. The pertinent section of SCBT 16 reads:

> *The bigeye assessment results of this year are both uncertain and for key management benchmarks, inconsistent with the bigeye assessment presented at SCTB 15. In particular, the SCTB 15 assessment concluded that overfishing was not occurring (Fcurrent<Fmsy), while this year's assessment concluded that overfishing is occurring (Fcurrent>Fmsy). Given that it is unlikely that the true status of the bigeye stock has changed so dramatically, as indicated by changes in the parameters in Table 2 since last year, the Group cannot discount last year's assessment. Consequently, caution should be exercised in using the bigeye assessment results for management purposes until such time that these issues can be resolved. The current stock status was assessed by the yield curve and a range of reference points. The analyses indicated that the current F is larger than FMSY. However, the current biomass remains higher than BMSY. In other words, overfishing is occurring, but the stock is not yet overfished because of the recent above-average recruitment. Overall, the longline fishery has had the largest impact on the stock, and later development of the purse seine fishery and increases in the Philippines and Indonesian catch have also had high impact on the stock. In this regard, the assessment results are consistent with those from a Pacific-wide assessment as well as the current status of the stock in the eastern Pacific. The current level of exploitation appears not to be sustainable in the long term, unless the high recent recruitment is continued in the future. Therefore, the Group believes that there should be no further increase in the fishing mortality rate for bigeye tuna, until the results is further confirmed.*
>
> *The Group noted, however, while recognizing the current uncertainty in the stock assessments, all the stock assessment results conducted this year were more pessimistic than the last year's. If further assessments confirm the concern derived from this year's results, the managers should consider practical management action to prevent further decline of stock.*

The issue of the interaction between the Cross sea mount fishery and the emergence of the use of private FADs (PFADs) has arisen in the deliberations of the WPFMC and in scoping sessions for this EIS. Hawaii DAR statistics indicate a reduction in harvest from the Cross seamount which may be due to redirection of effort to PFADs. Even if this redirection of effort has resulted in an increased harvest of bigeye tuna (there are insufficient data to confirm this), such an increase would not affect the overall stock status of bigeye tuna because the harvest of bigeye tuna in Hawaii is very small compared to the Pacific-wide harvest of this species. Recent analyses of tag-recapture data (Adam et al., 2003) indicate that sub-adult bigeye remain in the Hawaii region for two to three years which raises the possibility of local depletion but there are no data to indicate that this is occurring.

3.3.2.2 Albacore (*Thunnus alalunga)*

Albacore stocks appear to be in good condition and are experiencing moderate levels of exploitation. Neither the northern or southern stocks are regarded as overfished (Boggs et al 2000; NMFS 1999) and current catches are likely to be sustainable (SCTB, 2000). SCTB 16 states "[This year's] assessment gave similar results to last year's assessment, with a low impact of fishing on biomass, and indicated that the current biomass is at about 60% of unfished levels. It is therefore unlikely that the stock is being overfished or is in an overfished state."

3.3.2.3 Yellowfin Tuna (*Thunnus albacares)*

Some genetic analyses suggest that there may be several semi-independent yellowfin stocks in the Pacific including possible eastern and western stocks which may diverge around 150°W (Grewe and Hampton, 1998; Itano, 2000). On the other hand, tagging studies have shown individual animals are capable of large east - west movements that would suggests considerable pan-Pacific mixing of the stock. In fact, earlier mtDNA analysis failed to distinguish the presence of geographically distinct populations (Scoles and Graves, 1993; Ward et al., 1994). Boggs et al. (2000) chose to analyze eastern Pacific and western Pacific separately and determined that the eastern stock may be close to that required for MSY but that the western Pacific stock was in good condition.

Catch rates in the major industrial fleets (purse seine and longline) show "flat" trends and the Pacific and, in general, Pacific yellowfin stock appears to be in good condition and current catch levels are considered sustainable (PFRP, 1999). The report of SCTB 16 (2003) on status of the yellowfin stock states: "The assessment reviewed by SCTB16 reaffirms the result of the previous assessment that the yellowfin stock in the WCPO is presently not being overfished (ie. Ft/FMSY < 1) and that it is not in an overfished state (Bt/BMSY > 1). However, the stock is likely to be nearing full exploitation and any future increases in fishing mortality would not result in any long-term increase in yield and may move the yellowfin stock to an overfished state. While biomass-based reference points indicate that the long-term average biomass should remain above that capable of producing MSY if present catches are maintained, yield estimates indicate that there may be limited potential to expand long-term catches from the fishery at the current pattern of age-specific selectivity. The assessment also indicates that the equatorial regions are likely to be fully exploited, while the temperate regions are likely to be under-exploited. While these spatial patterns of exploitation remain uncertain, if true, this may indicate the potential need for different management in different regions. Furthermore, the attribution of depletion to various fisheries or groups of fisheries indicates that the Indonesian fishery has the greatest impact, particularly in its home region. The purse seine fishery also has high impact, particularly in the equatorial regions.

While recognizing continuing uncertainties associated with the present stock assessment, the SCTB reiterates the previous recommendation that there be no further increases in fishing mortality (particularly on juvenile yellowfin) in the WCPO. If future evidence supports a shift to a lower productivity regime, a decrease in total catch would be anticipated in order to maintain the stock at sustainable levels."

3.3.2.4 Bluefin Tuna (*Thunnus thynnus)*

Bluefin tuna are slower to become sexually mature than other species of tuna and this makes them more vulnerable to overfishing. Variability in CPUE in the eastern Pacific seems to be due to variability in the number of fish migrating from the western Pacific to the coast of north America. This variability may be driven by changes in the forage base available in the western Pacific. Conceivably, these variations in trans-Pacific movements could effect the catch rates of Hawaii based vessels. The number of year zero recruits in the nursery grounds of the western Pacific seems to be stable (IATTC, 1999). and evidence for overfishing of the stock is lacking (NMFS, 2004).

3.4.2.5 Skipjack Tuna (*Katsuwonus pelamis)*

It is believed that the skipjack tuna in the Pacific belong to a single population (Shomura et al., 1994). All recent analyses indicate that harvest ratios are appropriate for maintaining current catch levels and that overall the stocks are very healthy (Boggs et al., 2000). Although local depletions and variability may occur in response to local environmental conditions and fishing practices, the overall stock is healthy and can support existing levels of fishing (PFRP, 1999; SCTB, 2000). The most recent assessment of skipjack stock status by the SCTB (SCBT 16) states: "*Estimated biological reference points, particularly B-current/B-msy and F-current/F-msy, indicate that the skipjack tuna stock of the WCPO is not overfished owing to recent high levels ofrecruitment and a modest level of exploitation relative to the stock's biological potential. Continued catches at the 1.2 M mt level is sustainable with continued high levels of recruitment, which are believed to be determined by principally environmental factors and not owing to a strong spawner-recruit relationship."*

3.3.2.6 Kawakawa (*Euthynnus affinis)*

The status of the kawakawa stock is unknown.

3.3.3 Status of Shark Stocks

3.3.3.1 General Life History Characteristics of Sharks

Sharks are notable in that they produce relatively small numbers of young. Sharks are either oviparous (egg laying) or viviparous (where pups are hatched or are born fully developed). Viviparity reduces the susceptibility of young to predation but the production of comparatively few, well-developed offspring also makes sharks vulnerable to overfishing. Hoenig and Gruber (1990) state that, unlike teleost fish, they can be characterized as "K-selected species" and "the relationship between stock and recruitment in the elasmobranchs is quite direct, owing to the reproductive strategy of low fecundity combined with few, well-formed offspring." Many shark species give birth or lay eggs at specific nursery grounds, which are often habitats removed from the distribution of the adults. The main predators on juveniles appear to be other sharks (Castro, 1987). Thus, the availability of predator-free nursery grounds may be an important factor in regulating population (Springer, 1967).

Branstetter (1990) describes Atlantic Carcharhinid and Lamnid sharks' reproductive strategies in terms of various permutations of size at birth and growth rate. Slow growing species tend to utilize bays and estuarine areas as nursery grounds, where there are turbid waters and large predators are comparatively few. On the other hand, pelagic sharks tend to have quite large young that grow comparatively fast. These include some species found in the Council's management area.

The silky shark ©. *falciformis*) depends on rapid neonate growth for survival and also has relatively large neonates. According to Springer (1967) neonates are found on deep reef areas and move into the pelagic environment at about six months of age. Alopiids (thresher sharks) and some Lamnids (salmon sharks and mako sharks) have similar strategies, although *Isurus oxyrinchus* (shortfin mako) has smaller neonates but compensates with large litter sizes. Alopiids produce two to four young of intermediate size. Rapid growth in the young of these species allows greater swimming efficiency and speed in order to escape predators.

Sexual segregation in schools is often observed in sharks and may be related to reproduction. Strasburg (1958) discusses sexual segregation in blue sharks based on longline data (refer to the blue shark habitat description).

Blue sharks comprise approximately 95 percent of the sharks taken in the Hawai‘i pelagic fishery (Ito and Machado, 1999). Consequently, this is the only species that will be extensively covered here in terms of natural history. Other species that are taken very occasionally in the fishery will be covered comparatively briefly.

3.3.3.2 Blue shark (*Prionace glauca)*

The most current stock assessment of blue shark in the Pacific was conducted by Kleiber et al. (2001) using a Multifan-CL model. All outputs of the model indicated a decline in the blue shark population during the 1980s followed by some level of recovery during the 1990s. The decline in the 1980s coincided with the existence of an extensive small-mesh driftnet fishery in the North Pacific and recovery of the stock occurred following the banning of the driftnet fishery. On the basis of the most pessimistic estimate of stock size, maximum sustainable yield (MSY) is estimated to be approximately twice the current take (averaged between 1994 and 1998) by all fisheries in the North Pacific. Other plausible estimates indicate that the fishery could sustain an MSY up to four times the current level of harvest.

3.3.3.3 Miscellaneous Sharks (Families Carcharhinidae, Alopiidae, Sphyrnidae, and Laminidae)

Data from the NMFS longline observer program indicate that blue sharks comprise approximately 93% of the sharks caught on Hawaii vessels carrying observers. The remaining sharks fall into four families (Table 3.3-1). Within these families, only the thresher sharks, oceanic whitetip and mako occur as over 1% of the shark catch. All other species are taken in extremely low numbers. Table 3.3-1 is based on "raw" observer data and represents total sharks recorded between 1994 and 1997. Approximately 5% of trips made during that period had observer coverage, with about 500-600 sets observed. Because observer coverage was low, the data should be treated with caution. Nonetheless, these data give an indication of the relative frequency of capture for various sharks. For management purposes, some shark species (e.g., thresher sharks) are only identified at the family level.

Table 3.3-1 Observer data on sharks caught in the longline fishery. Source: NMFS Observer program

Species	Number	Percent
Alopiidae		
Pelagic thresher (*Alopias pelagicus*)	19	0.08%
Bigeye thresher (*A. superciliosus*)	356	1.46%
Common thresher (*A. vulpinus*)	35	0.14%
Unidentified thresher (*Alopias sp.*)	38	0.16%
Subtotal	448	1.84%
Lamnidae		
Great white (*Charcharodon carcharias*)	0	0.00%
Shortfin mako (*Isurus oxyrinchus*)	312	1.28%
Longfin mako (*I. paucus*)	5	0.02%
Unidentifed mako shark (*Isurus sp*.)	8	0.03%
Salmon shark (*Lamna ditropis*)	57	0.23%
Subtotal	383	1.57%
Charcharhinidae		
Bignose shark (*Carcharhinus altimus*)	9	0.04%
Silky shark (*C. falciformis*)	56	0.23%
Galapagoes shark (*C. galapagensis*)	4	0.02%
Oceanic whitetip (*C. longimanus*)	629	2.58%
Dusky shark (*C. obscurus*)	2	0.01%
Sandbar shark (*C. plumbeus*)	27	0.11%
Tiger shark (*Galeocerdo cuvier*)	5	0.02%
Blue shark (*Prionace glauca*)	21,917	89.90%
Subtotal	22,649	92.90%
Sphyrnidae		
Scalloped hammerhead (*Sphyrna lewini*)	0.01	%
Smooth hammerhead (*S. zygaena*)	8	0.03%
Unidentified hammerhead (*Sphyrna sp*.)	0.02%	
Subtotal	15	0.06%
Unidentified sharks	885	3.63%
Total	24,380	**100.00%**

3.3.3.3.1 Family Alopiidae

This family includes the thresher sharks.

In California, 94 percent of the total thresher shark commercial landings are taken in the driftnet ("drift gillnet") fishery for swordfish, where it is the second most valuable species landed. Catches peaked early in this fishery with approximately 1,000 mt taken in 1982 but declined sharply in 1986 (Hanan *et al.*, 1993). Since 1990, annual catches have averaged 200 mt (1990-1998 period) and appear stable (Holts et al., 1998). Catch per unit effort (CPUE) has also declined from initial levels.

Declines in CPUE indicate a reduction in the thresher shark population (K. Hill and D. Holts, unpub. data; Holts et al.,1998). However, the decline in the driftnet CPUE as a measure of the magnitude of the decline of the stock is confounded by the effects of the various area and time closures, the offshore expansion of the fishery, and the changed emphasis from shark to swordfish among most of the fishers. Based on the estimated rate of population increase (Smith et al., in press; Au et al., in press), the common thresher MSY is estimated to be as little as 4-7 percent of the standing population that existed at the beginning of the fishery.

3.3.3.3.2 Family Lamnidae

This family includes mako sharks and salmon sharks which have been recently added to the list of PMUS.

Salmon sharks (*Lamna ditropis*) are widely distributed across the entire width of the north Pacific between about 30˚ and 65˚ north. This species is abundant in water temperatures ranging from 5°C to 18°C, and high catches have been recorded in sea surface temperatures (SST) of 9°C-16°C (Nakano and Nagasawa 1996). Salmon sharks occur in both the nearshore and oceanic environments. Adult salmon sharks typically range in size from 180-210 cm PCL, and can weigh upwards of 220 kg. Length-at-maturity in the western North Pacific has been estimated to occur at approximately 140 cm PCL (age five) for males and between 170-180 cm PCL (ages eight to ten) for females. Salmon sharks are opportunistic feeders, sharing the highest trophic level of the food web in subarctic Pacific waters with marine mammals and seabirds. They feed on a wide variety of prey including salmon and other fishes (Goldman and Musick, in press).

Nothing is known about the stock structure or population status of salmon sharks although, as with most shark species, there is concern over its ability to sustain high levels of exploitation due to its low reproductive potential.

Mako sharks are also taken primarily by the California driftnet fishery for swordfish. Although current catches are only about 80 mt/yr in the California fishery, the mako shark is still the second most valuable species taken in the fishery. Like the common thresher, shortfin mako catches have been affected by the changes that occurred in the driftnet fishery. Catches peaked soon after the fishery started (240 mt in 1982) and then declined. Makos are also taken in smaller amounts (<10 mt/yr) by California-based longliners operating beyond the EEZ (Vojkovich and Barsky, 1998). This fishery takes primarily juveniles and subadults, probably because the area serves as a nursery and feeding area for immature stages (Hanan et al., 1993). The mako shark distribution is affected by temperature, with warmer years being associated with more northward movement. According to the PRFMC (2003) west coast stocks are thought to be not overfished.

Crocodile sharks *(Pseudocarcharius kamoharia*) are also regarded as a PMUS and are occasionally taken in pelagic fisheries. Very little is known about this small, cylindrical shark with very large eyes. Males mature at about 74 cm and females between 89 cm and 102 cm. Pups (four per litter) are born at a length of 41 cm; maximum size is 110 cm, making it the smallest of the Lamnid sharks. It ranges to a depth of 300 meters (Compagno, 1984). Captured specimens have small fishes, squid and shrimps in their gut.

3.3.3.3.3 Family Carcharhinidae

This is one of the largest and most important families of sharks, with many common and wide-ranging species found in all warm and temperate seas. The silky (*Carcharinus falciformis*) and oceanic whitetip ©. *longimanus*) are the most important as far as Hawaii's fisheries are concerned and there have been no published quantitative estimates of the population status of either of these species.

3.3.4 Stock Status of Miscellaneous PMUS

3.3.4.1 Mahimahi *(Coryphaena hippurus)* and Wahoo (Ono) (*Acanthocybium solandri*

Stock characteristics for *C. Hippurus* and *Acanthocybium solandri* are not known and catch rates are variable. However, the average size of these species has remained stable over the past two decades (NMFS, 2004) suggesting that the resource is being exploited at sustainable levels.

3.3.4.2 Moonfish (*Lampris guttatus*): Opah or Moonfish

Stock status is unknown.

3.3.4.3 Pomfret (*Eumegistus illustris)*

Stock status is unknown.

3.3.4.4 Snake Mackerels (Family Gempylidae)

Stock status is unknown.

3.4 Potential Squid PMUS

Synopses of the biology and ecology of the three species of squids with commercial value in the Western Pacific Region are presented in this section. More extensive accounts, with additional documentation, are found in Appendix B. Following the descriptions of potential squid PMUS is a brief summary of other cephalopods commonly encountered in the region, and rationale for their exclusion from consideration as PUMS. The section concludes with a description of squid bycatch.

3.4.1 Neon Flying Squid (*Ommastrephes bartramii* Lesueur, 1821)

3.4.1.1 General Description

O. bartramii occurs in mostly subtropical to temperate waters throughout the world's oceans. At the peak of its exploitation prior to 1993, over 300,000 metric tons of this squid were taken annually in the North Pacific. In the North Pacific females reach a larger size, over 56 cm mantle length (ML) and about 6 kg total weight, than males, 40 cm ML and about 1.5 kg. Females presumably spawn large egg masses with perhaps 100,000 or more eggs per egg mass with batch fecundity of about 1.5 milion eggs. Spawning occurs throughout the year mostly in subtropical waters with peaks in the fall-winter and winter-spring periods. Eggs are about 1 mm in diameter and the paralarva reaches a size of about 7 mm ML a month after hatching and over 100 mm ML at 3 months and nearly 300 mm ML by six months. Growth rates, however, are highly variable. Males mature at about 300 mm ML at about 6 months of age and females at a bit under 500 mm ML at nearly nine months of age. Growth presumably slows after maturity when energy must be spent on gametes although this has yet to be documented. Females appear to spawn repeatedly but the frequency is unknown. Maximum life span for both males and females appears to be about one year.

Squid appear to occupy the upper 50 m depths during the nighttime and about 150-300 m depths during the day at high latitudes, and the upper 100 m during the nighttime and 400-700m or deeper during the daytime in clearer subtropical waters. These squid are prey during various times in their life cycle for a large variety of seabirds, fishes and mammals. The squid feed mostly on crustaceans when small and fishes and squids when large. Subadult and adult squids are thought to occupy trophic levels between 4 and 5.

While spawning occurs year round mostly in subtropical waters (ca. 25-35°N), the peak fishing season is from June to December and occurs mostly in the Subarctic Frontal Zone (ca. 41-43°N). The squid, therefore undergo a south to north migration for feeding and a north to south migration for spawning. Details of the migrations, however, are poorly known. With year-round spawning, differential sizes between males and females, north-south migrations, highly variable growth rates, and the large size of the habitat, population structure and dynamics have been difficult to unravel. Females generally arrive on the fishing grounds before males and depart earlier and the commercial catch is dominated by females. Two major cohorts comprise most of the commercial catch: an autumn (period of hatching) cohort with females of larger size (> 55 mm ML) and a winter-spring cohort with smaller females (< 46 mm ML). Both cohorts contribute to the harvest across much of the North Pacific but the autumn cohort predominates in the Central and Eastern Pacific and the winter-spring cohort in the Western Pacific. The reasons for the size differences are thought to relate to the productivity of the waters at the time of hatching and subsequent growth. Much of the productivity of the spawning grounds varies with the seasonal movement of the Transition Zone Chlorophyll Front.

3.4.1.2 Status of the Stock

We are unaware of any estimates of potential productivity or natural mortality rates for *O. bartramii*. However, we expect that both of these attributes will be high. The squid grows rapidly, has a short life span and a relatively high reproductive potential (production of many small eggs) and there appears to be no shortage of predators. *O. bartramii'*s high position on the trophic pyramid (level 4-5), the rapid turnover time (short lifespan) suggest that its stock size is highly dependent on environmental conditions and, thus, subject to high inter-annual and longer-term variability. Its year-round spawning, however, can be considered a hedge against unfavorable environmental variability. Its high potential productivity suggests resilience in the face of fishery-related stock-depletion if natural mortality rates remain stable.

The standing stock of *O. bartramii* in the North Pacific has been estimated at about 0.5 - 1.5 million tons. The combined annual catch by the Japanese, Taiwanese and Korean fisheries for 1985-1990 ranged from 248,000-378,000 mt (328,000 mt ave.) (Murata and Nakamura, 1998). *O. bartramii* has been fished commercially in the North Pacific since 1974 (Yatsu, et al., 2000). An intense fishery for *O. bartramii* began in 1978 with the introduction of driftnet fishing, and driftnet fishing dominated the fishery until the end of 1992 when a moratorium on large-scale driftnet-fishing was instigated (Yatsu et al., 2000). Catch rates from driftnet fishing greatly exceeded those of jigging when fishing in the same area (1.5 - 3.8 times greater) (Murata, 1990) and driftnet catches represented about 87% of the Japanese total catch between 1985-1990 (Murata and Nakamura, 1998). Prior to the moratorium data were insufficient to assess the population size, but there was some indication from declines in the stock size index and the size of individual squid that the population in the eastern region might be declining (Murata, 1990). The CPUE for the Japanese driftnet fishery, however, showed a peak in 1990 and good values in 1991 and 1992 (Yatsu and Watanabe, 1996). The major fishery, before the moratorium, operated primarily from June through December with most fishing occurring in the Subarctic Frontal Zone (Araya, 1983; Murata, 1990; Murata and Hayase, 1993). The current jigging fishing grounds lie at about 40-42°N and 150-170°E (Yatsu et al., 1997). Research catches using jigging and small-size driftnets starting in 1980 show high catches beginning in 1994 indicating that the population recovered rapidly after the termination of commercial driftnet fishing (Yatsu et al., 2000). In the western region total catches in the jigging fishery ranged from 50 Kt to 80 Kt during 1994-1998 and fell to 30 Kt in 1999 and 2000 (Yatsu, 2003, cited in Bower, 2004). In the central region, beginning in 1996 the Japanese *O. bartramii* jigging fishery showed increasing catches to 1998 then declining catches (1997 - 12 Kt, 1998 - 21 Kt, 1999 - 12 Kt, 2000 - 5 Kt. Numerous Chinese jigging vessels, estimated to be about 400-600 in number with a catch equal to or greater than the Japanese catch), along with Korean and Taiwanese vessels operating in the general area of the Japanese fishing grounds may contribute to the declining catches (Ichii, 2003 and Yatsu, 2003, both cited in Bower 2004).

3.4.2 Diamondback Squid (*Thysanoteuthis rhombus*)

3.4.2.1 General Description

T. rhombus, the only member of its family, occurs in tropical and warm-temperate waters throughout the world's oceans but is rarely abundant; however, it supports small fisheries in the

Sea of Japan and in waters around Okinawa. The total annual Japanese fishery yield is about 6,000 tons. Males and females are nearly the same size with males reaching about 800 mm ML and females about 850 mm ML and weights up to 24 kg. Females spawn large sausage-shaped egg masses that float at the ocean surface with 24,000 to 180,000 eggs. Batch fecundity is about 140,000 eggs. Seasonal variation in spawning is uncertain. Eggs are about 1.7 mm in diameter. Growth rates of paralarvae are unknown. Juveniles reach 90 mm ML at three months. Maximum growth rates at ca. 300 - 400 mm ML reach 80-140 mm per month. Growth appears to slow after maturity. Females may spawn 8-12 egg masses over a three to four month period. Maximum lifespan for both males and females appears to be about one year.

T. rhombus is found during the day at depths between 300-600m and a night between depths of 0-150m. These squid are prey during various times in their life cycle for a large variety of fishes and mammals but the frequency of occurrence is usually low. Young squid are rarely found in the stomachs of seabirds. Large squid feed mostly on small fishes and squids. The trophic level of subadult and adult *T. rhombus* has not been calculated.

T. rhombus apparently migrates into the Sea of Japan from August to October where they are fished commercially. Details of their movements in the Sea of Japan are poorly known. The occasional captures in temperate waters around the world provides the only other evidence of extensive horizontal migrations for this species.

3.4.2.2 Status of the Stock

The world-wide standing stock of *T. rhombus* is unknown although Nigmatullin and Arkhipkin (1998), based on night-light observations and trawl catches, report an estimate of 1.5-2.5 million tons world-wide. This “educated guess” is, apparently, the only estimate that exists. We are unaware of any estimates of potential productivity or natural mortality rates for *T. rhombus*. However, we expect that productivity will be high and, perhaps, natural mortality also but we have little evidence for the latter. The squid grows rapidly, has a short life span and a relatively high reproductive potential (production of many small eggs) but differs from *O. bartramii* and *S. oualaniensis* in having somewhat larger eggs and a lower batch fecundity. Little is known about natural predators. The rather high position of *T. rhombus* on the trophic pyramid (probably comparable to *S. oualaniensis* even though *T. rhombus* is much larger), and its the rapid turnover time (short lifespan) suggest that its stock size is highly dependent on environmental conditions and, thus, subject to high inter-annual and longer variability. While spawning is seasonal around Okinawa, we suspect year-round spawning in more tropical waters which can provide a hedge against environmental variability and its predominately tropical habitat lessens some types of environmental variability. Its high potential productivity suggests resilience in the face of fishery-related stock-depletion if natural mortality rates remain stable. The large biomass of individuals and its high quality as a human food source make it an attractive fishery target. Its distribution in generally very small small groups over a broad geographical area suggest resilience to fishery mortality. However, the possible low local population mobility may indicate low resilience to fishery mortality at the local level.

The fishery off Okinawa, which started in 1989 and uses drop-line and long-line fishing methods, catches about 1600-2000 mt yr^{-1} (Kato, et al., 2001). The total Japanese fishery yield of *T.*

rhombus was nearly 6000 mt in 2001 (Bower, 2004). Experimental fishing in the South China Sea produced almost no results (Dickson, et al., 2000).

3.4.3 Purpleback Flying Squid (*Sthenoteuthis oualaniensis)*

3.4.3.1 General Description

S. oualaniensis, a member of the same family (Ommastrephidae) as *Ommastrephes bartramii*, occupies tropical and subtropical waters of the Indo-Pacific region. The population structure of *S. oualaniensis* is complex with a variety of forms that may or may not be genetically distinct. Although considered the most abundant large squid in these waters, the general lack of highly concentrated populations has prevent exploitation except for a few local fisheries (Taiwan and nearby islands, Hawaiian Islands). In the North Pacific, females reach a larger size, 335 mm ML and 1.6 kg total weight, than males, 210 mm ML and under 0.4 kg. Females presumably spawn large egg masses with perhaps 100,000 eggs per egg mass with batch fecundity of about 250,000 eggs. Spawning occurs throughout the year in tropical waters with an apparent peak in Hawaiian waters in late summer. Eggs are just under 1 mm in diameter and the paralarva apparently reaches a size of about 4 mm ML a month after hatching and about 100 mm ML at 3 months but strong disagreement exists in calculated growth rates. Males mature at about 140 mm ML and females about 200 mm ML. Growth presumably slows after maturity when energy must be spent on gametes although this has yet to be documented. Females appear to spawn repeatedly but the frequency is unknown. Maximum lifespan for both males and females appears to be about one year.

Squid occur in near-surface depths during the nighttime and are thought to descend to depths of over 600 m during the day. These squid are prey during various times in their life cycle for a large variety of seabirds, fishes and mammals. The squid feed mostly on crustaceans when small and fishes and squids when large. Subadult and adult squids are thought to occupy a lower trophic level than large *O. bartramii.*

Unlike *O. bartramii*, *S. oualaniensis* does not make major migrations from low to high latitudes and back although the habitat may expand somewhat with the season following the movement of the subtropical front. The squid, however, does exhibit distinct distribution patterns around islands that may involve local migration.

3.4.3.2 Status of the Stock

The world-wide standing stock of *O. oualaniensis* is unknown although it has been roughly estimated at about 3 to 4 million tons. The biomass of *S. oualaniensis* standing stock in the South China Sea Area III (west of the Philippines) was estimated from jigging surveys at 283,000 metric tons (Labe, 2000). Zuev et al. (2002) estimated, based mostly on visual survey methods, the total instantaneous stock size of *S. oualaniensis* at 3-4 million tons (1.9-2.4 million tons for the middle-sized form) and an annual production to biomass ratio for adult squids of 8.0-8.5.

We are unaware of any estimates of potential productivity or natural mortality rates for *S. oualaniensis*. However, we expect that both of these attributes will be high. The squid grows rapidly, has a short life span and a relatively high reproductive potential (production of many small eggs) and there appears to be no shortage of predators. *S. oualaniensis*'s rather high position on the trophic pyramid (probably one level below large *O. bartramii*), the rapid turnover time (short life span) suggest that its stock size is highly dependent on environmental conditions and, thus, subject to high inter-annual and longer-term variability. Its year-round spawning, however, can be considered a hedge against unfavorable environmental variability and its tropical habitat lessens some types of environmental variability. Its high potential productivity suggests resilience in the face of fishery-related stock-depletion if natural mortality rates remain stable. The relatively small size of individuals and its rather low quality as a human food make it less attractive as a fishery target. Its distribution in generally highly dispersed small groups over a broad geographical area suggest resilience to fishery mortality although the extent of population mobility between geographical areas is unknown.

S. oualaniensis has been commercially fished off Okinawa (in the Ryukyu chain), Taiwan and Hawaii. Fishing grounds existed on the southwestern coasts of Taiwan and beyond the 200 m bottom isobath of the Ryukyu chain (Okutani and Tung, 1978). The fishing season in Taiwan is from March to November with a peak in May-August. Fishing was most productive at SSTs of 26°-28°C. The annual landings of squid and cuttlefish in Taiwan and Okinawa from 1947-1969 averaged 325 tons with 70 percent being *S. oualaniensis* (Okutani and Tung, 1978). The *S. oualaniensis* catch is used for tuna bait and for human consumption (Okutani and Tung, 1978). According to Lu (pers. comm., 2003) the fishery never was very successful as the squid had low value for human consumption relative to other squid, due to its toughness. He states that at present there is no longer a targeted fishery for *S. oualaniensis* but fishers still take incidental catches of the squid. In Hawaii the fishery began with immigrants from Okinawa that fished off Hilo at night in small boats with handlines; however, it soon became apparent that they could also catch tuna and quickly tuna became the target of the fishery with squid being used as bait for the tuna or as incidental catch (Yuen, 1979). This nighttime handline fishery has become known as the *ika-shibi* (squid-tuna) fishery. Between 1973 and 1975 the annual squid catch varied between 0.5 and 5.0 tons (Yuen, 1979). Between 1976 and 1992 the annual squid landings in Hawaii varied from about 1-12 tons with large year-to-year fluctuations and no clear trends (unpublished data from the Hawaii Division of Aquatic Resources).

3.4.4 Other Pelagic Cephalopods of the Western Pacific Region

With the exception of Hawaiian waters the pelagic cephalopod species found in the Western Pacific Region are poorly known. In Hawaiian waters there are about 70 species of pelagic cephalopods, most of which are mesopelagic species. There are three additional species of squids in the family Ommastrephidae (*Eucleoteuthis luminosa*, occurring at the northern limits of the Hawaiian EEZ, and *Nototodarus hawaiiensis*, a demersal species found near the islands and *Hyaloteuthis pelagicus*, a small species, less than 100 mm ML. None of the three is common and none are fished commercially. There are three species of *Onychoteuthis* that are rather muscular and presumably edible but they are rather small (less than 200 mm ML) and infrequently encountered. Other squids are mostly very small or weakly muscled and none occur in commercial quantities. A large pelagic octopod, *Tremoctopus gracilis*, has a muscular mantle but the animal is rare in Hawaiian waters. Another large, muscular octopod, *Ocythoe tuberculata*, is found north of Hawaiian waters but is occasionally encountered by Hawaiian fishermen targeting

O. bartramii. Neither of these octopods appears to occur in commercial quantities and neither is fished anywhere in the world.

We can assume a similar cephalopod fauna, although with mostly different but related species, in the other areas of the Western Pacific Region. In these latter areas there are also neritic and often demersal cephalopods (loliginid squids and sepiid cuttlefishes) that may be fished for personal consumption.

3.4.5 Bycatch in the Squid Jigging Fishery

There is anecdotal information that bycatch in the U.S. pelagic squid jigging fishery is minor, and consists of shark (which break the line) and squid which drop off the lure as it is being lifted from the water (B. Endreson, pers. comm.). A similar fishery operates in the waters around southern Australia, and a draft Bycatch Action Plan has recently been prepared for this fishery by the Australian Fisheries Management Authority (AFMA, 2003). They report that a "global assessment of bycatch and discards across world fisheries found that squid jigging is a highly selective fishing method" (Alverson et al., 1992, cited in Harris and Ward, 1999). In the Australian fishery the most common bycatch species include small quantities of blue shark (*Prionace glauca*), garfish (*Hyporhamphus* spp.) and baracouta (*Thyrsites atun*). Seals sometimes follow the vessels in this fishery and take squid from the hooks, but there are no reports of entanglements. Because of the bright lights used on the vessels, there have been concerns about birds becoming disoriented. The AFMA observer program reported an interaction with a little penguin (hooked in the flipper), but none of the other birds (1 shy albatross and 2 short-tailed shearwaters) were observed to interact with either the boats or fishing gear.

3.5 Other Species, Including Non-Target, Associated, or Dependent Pelagics Species (NADS)

NMFS observers recorded more than 60 different species caught by the Hawaii-based longline fleet between 1994 and 1997. Non-PMUS species captured by the longline fleet are discarded and represent about six percent of the total number of fish caught. Based on NMFS observer data for 1994-1997, which amounts to between four and five percent of the annual total number of longline fishing trips, the discarded non-PMUS species include lancet fish, pelagic stingray, snake mackerel, escolar, remora, crocodile shark and *mola mola*, among others. Bycatch of these species in the Hawaii-based longline fishery and other Pacific fisheries is described in the 2001 FEIS (NMFS, 2001) and more information may be found there.

3.6 Protected Species

This section describes the biology, ecology and habitat of the seabirds, sea turtles and marine mammals present in the area fished by the Hawaii-based longline fleet.

3.6.1 Seabirds

NOAA Fisheries Observer records show that Hawaii-based pelagic longline fishing operations inadvertently hook and kill black-footed albatrosses (*Phoebastria nigripes*) and Laysan (*P.*

immutabilis) albatrosses. On rare occasions, wedge-tailed (*Puffinus pacificus*) and sooty (*Puffinus griseus*) shearwaters are also incidentally hooked. Only seven shearwaters of various species were observed hooked by Hawaii longline vessels between 1994 and 2004. NOAA Fisheries observers have also reported boobies hovering over baited hooks and that some birds may actually attempt a dive, however, no boobies have been reported hooked. The short-tailed albatross (*P. albatrus*) and Newell's shearwater (*Puffinus auricularis newelli*) are two seabird species listed under the Endangered Species Act present in the area where the Hawaii longline fishery operates. No short-tailed albatross or Newell's shearwater have been reported taken by the longline fishery. The only sighting of a short-tailed albatross near a Hawaii longline vessel was recorded on January 23, 2000, by a NOAA Fisheries observer at 33°09′N, 147°49′ W. The short-tailed albatross sighted was a juvenile bird. No sighting of a Newell's shearwater has been recorded for the fishery, and one is unlikely given the difficulty of distinguishing a Newell's shearwater from other shearwater species when in flight.

Between August 19, 2002 and October 28, 2002, NOAA Fisheries observers collected information onboard pelagic vessels operating out of American Samoa and reported no seabird interactions. No albatross species are present in American Samoa. There are some shearwater species present, such as the wedge-tailed shearwater, that have the potential to lethally interact with longline gear. No reports or observed information on seabird/fishery interactions is available from pelagic fisheries operating in other areas under the Pelagics FMP. Therefore, the focus of this assessment is on the seabird species that are observed to interact with the Hawaii-based longline fishery.

3.6.1.1 Albatrosses (Order Procellariiformes, Family Diomedeidae)

Three species of albatross breed and forage in the North Pacific: the short-tailed albatross, the black-footed albatross and the Laysan albatross (Table 3.6.1-1). NMFS observer data show that fishery-seabird interactions occur between the Hawaii-based longline fishery and two species of albatross: the black-footed albatross and the Laysan albatross. Neither the black-footed albatross nor the Laysan albatross are listed as endangered under ESA. Both seabirds are protected under the Migratory Bird Treaty Act (MBTA). Under the World Conservation Union (IUCN), the black-footed albatross is listed as "endangered" and the Laysan albatross as "vulnerable." The short-tailed albatross is listed as endangered under ESA and is considered "vulnerable" under IUCN. There have been no reports of interactions between the short-tailed albatross and the Hawaii-based longline fishery.

Albatross populations are particularly vulnerable to large-scale unnatural mortalities. Although albatrosses are long-lived (up to 60 years) they mature late (7-12 years) (Marchant and Higgins, 1990; Robertson, 1995; Bergin, 1997), produce only a single chick every one to three years (Marchant and Higgins, 1990) and both parents are typically required to successfully fledge their chick (Fisher, 1971; Fisher, 1975). Thus the loss of one parent may lead to the loss of the pair's chick as well as to the less successful mating of the remaining member of the pair for years to come (Richdale, 1950; Fisher, 1972; Cousins and Cooper, 2000). Albatrosses may return to the breeding colonies at two or three years of age but the average age at first breeding is seven or eight years (Rice and Keyon, 1962; Hasegawa and DeGange, 1982). Albatrosses fit the model of a "K-selected" species (MacArthur and Wilson, 1967; Pianka, 1970): slow development, late reproduction, large body size and a low potential rate of population. Populations of K-selected species do not bounce back rapidly from severe declines in population size and are therefore at greater risk of local, and inevitably global extinction from such declines.

Albatrosses are nest site specific and lay a single egg during a breeding season. But albatrosses may not breed every year. Albatrosses are dependent upon their flight feathers for foraging and must take time from breeding to molt and grow new flight feathers. As a consequence, it is estimated that at any one time approximately 25% of an albatross population may not return to breed (Cochrane and Starfield, 1999)

Table 3.6.1-1 Summation of current best available data for the numbers of breeding pairs of black-footed, Laysan and short-tailed albatrosses for each known breeding locality.

Breeding Locality	Black-footed Albatross	Laysan Albatross	Short-tailed Albatross
Kure Atoll	1,216[a] -1999	5,539[a] -1997	--
Midway Atoll	20,939 -2003	441,178 -2003	--
Pearl and Hermes Reef	6,949[a] -1998	11,429[a] -1997	--
Lisianski Island	3,737[a] -2002	26,500 -1982	--
Laysan Island	19,472 -2003	135,269 -2003	--
French Frigate Shoals	3,309 -2003	2,726 -2003	--
Necker Island	112[a] -1995	500[a] -1995	--
Nihoa Island	31[a] -1994	0 -1995	--
Kauai Island	0 -1995	100 -1995	--
Lehua Island	0.41667 -2002	0 -2002	--
Niihau Island	unknown	175 -1998	--
Kaula Island	0[b] -1998	63 -1993	--
Oahu Island	0 -2002	0.166667 -2002	--
Subtotal	55,775	623,495	--
Senkaku Islands (Kita-Kojima)	81 -2003	--	50 -2003
Bonin Island (Chichijima)	1,000 -1993	14	--
Izu Island (Torishima)	2,042[a] -2003	--	276 -2003
Subtotal	3,123	14	326
Guadalupe Island	--	100 -1998	--
Other Mexican Islands	--	13 -1998	--
World Total	58,898	623,622	326

[a] Indicates an extrapolation to total eggs from chicks counted later in the season (assumes 75% reproductive success. [b] Survey at Kaula was done 16-17 November 1998, which is slightly early to rule out that eggs were laid after this date. Nine birds were present on the island.

3.6.1.1.1 Short-tailed Albatross (*Phoebastria albatrus*)

On November 29, 2000, the USFWS issued a BiOp on the effects of the Hawaii-based longline fleet on the short-tailed albatross. That document contains detailed information on the species status, distribution, life history, population dynamics, threats, fisheries interactions and the Terms and Conditions imposed on the fleet in order to reduce the incidental take of the short-tailed albatross. In November 2002, the USFWS issued a revision of that BiOp with additional information. The following is a brief overview of the species.

The short-tailed albatross is the largest seabird in the North Pacific with a wingspan of more than 3 meters (9 ft) in length. The short-tailed albatross bill is larger than the bills of Laysan and black-footed albatrosses, and is characterized by a bright pink color with a light blue tip and defining black line extending around the base. The plumage of a young fledgling (i.e., a chick that has successfully flown from the colony for the first time) is brown and at this stage, except for the bird's pink bill and feet, the seabird can be easily mistaken for a black-footed albatross. As the juvenile short-tailed albatross matures, the face and underbody become white and the seabird begins to resemble a Laysan albatross. In flight, however, the short-tailed albatross is distinguished from the Laysan albatross by a white back and by white patches on the wings. As the short-tailed albatross continues to mature, the white plumage on the crown and nape changes to a golden-yellow.

The short-tailed albatross is known to breed only in the western North Pacific Ocean, south of the main islands of Japan. Although at one time there may have been more than ten breeding locations (Hasegawa 1979), today there are only two known active breeding colonies, Minami Tori Shima Island ("Torishima") (30º29´N, 140º19´E) and Minami-Kojima Island (25°56´N, 123°42´E). On December 14, 2000, one short-tailed albatross was discovered incubating an egg on Yomejima Island of the Ogasawara Islands (southernmost island among the Mukojima Islands).

A few short-tailed albatrosses have also been observed attempting to breed, although unsuccessfully, at Midway Atoll National Wildlife Refuge ("Midway")(28°12´N, 177°20´W) in the NWHI. Midway lies roughly 1,750 miles east and slightly to the north of Torishima. It is unknown if short-tailed albatrosses historically bred in the NWHI. Visits to the NWHI by short-tailed albatrosses were first recorded on Midway in 1938, when a female was seen incubating an infertile egg (Haden, 1941; Munro, 1944). Sighting and banding records (Table 3.6.1-2) show that between 1938 and 2003, at the most, 22 short-tailed albatrosses visited the NWHI, with only one or two sighted on the same island at any one time. The first time two short-tailed albatrosses were known to be present on Midway at the same time, although located at different locations, occurred in February 1981. Currently, it is estimated that up to seven short-tailed albatrosses may visit Midway during a breeding season. One of these birds, a female, has returned to midway each year since 1988, and has laid a total of four infertile eggs (Table 3.6.1-2).

Table 3.6.1-2 Short-tailed albatross observations in the NWHI.

Year	Month	Day	Location	Birds	Description
1938	Dec	--	Midway Atoll, Sand Is.	1	Immature
1939	Dec	--	Midway Atoll, Sand Is.	1	Injured then died
1940	Nov	28	Midway Atoll, Sand Is.	1	Immature
1962	Winter	--	Midway Atoll, Sand Is.	1	Adult
1965	Winter	--	Midway Atoll	1	Immature
1966	Mar	18	Midway Atoll, Eastern Is.	1	Banded[1]
1972	Nov	--	Midway Atoll, Sand Is.	1	Band 558-30754
1973	May	--	Midway Atoll, Sand Is	1	Band 558-30754
1973 - 1974	Fall - Winter	--	Midway Atoll, Sand Is	1	Band 558-30754
1974 - 1975	Fall - Winter	--	Midway Atoll, Sand Is	1	Band 558-30754
1976	Mar	--	Laysan Island	1	Immature-unbanded
1976	Winter	--	Tern Island	1	Immature-unbanded
1976	Winter	--	Midway Atoll, Sand Is.	1	Band 558-30754
1977	Dec	--	Midway Atoll, Sand Is.	1	Band 558-30754
1978	Oct	25	Midway Atoll	1	Band 558-30754
1979	Jan	16-20	Midway Atoll	1	--
1979	Nov	7	Midway Atoll, Sand Is.	1	Band 558-30754
1980	Jan	38335	Midway Atoll	1	Band 558-30754
1980	Jan	13	Tern Island	1	--
1980	Dec	12	Midway Atoll, Sand Is.	1	Band 558-30754
1981	Oct - Dec	--	Midway Atoll, Sand Is.	1	Band 558-30754
1982	Jan	25	Tern Island	1	--
1982	Nov	Mid-	Midway Atoll	1	Band 558-30754
1983	Feb	10	Midway Atoll	1	Band 558-30754
1984	Dec	15	Midway Atoll, Sand Is.	1	000 white[2]
1985	Nov	20	Midway Atoll, Sand Is.	1	000 white
1987	Feb - Mar	--	Midway Atoll, Sand Is.	1	000 white
1988	Dec	2	Midway Atoll, Sand Is.	1	000 white
1989	Dec Dec	8-12 14	Midway Atoll, Sand Is.	2	015 yellow[3]/000 white (at different locations)
1990 -1991	Fall – Winter	--	Midway Atoll, Sand Is.	2	000 white/015 yellow
1991 -1992	Dec - Mar	--	Midway Atoll, Sand Is.	2	000 white/015 yellow
1992 -1993	Dec - Jan	--	Midway Atoll, Sand Is.	2	000 white/015 yellow
19931994	Oct Jan Feb-Mar	2611	Midway Atoll, Sand Is. (First time birds seen together)	2	000 white/015 yellow sitting on infertile egg
1994	Feb - Mar Mar	924	French Frigate Shoals Kure Atoll, Green Is.	1	Band 043 yellow[4]
19941995	Nov Nov - April	3	Midway Atoll, Sand Is.	2	000 white/015 yellow
1995 -1996	Nov Jan Dec - Feb	8813	Midway Atoll, Sand Is. Midway Atoll, Eastern Is.	2	015 yellow sitting on infertile egg 051 red[5]
1996	Feb	13	Midway Atoll, Sand Is.	1	172 black[6]
1997-1998	Nov	4	Midway Atoll, Sand Is.	1	015 yellow sitting on infertile egg
1998-1999	Jan-Mar Oct Feb-May	-2015	Midway Atoll, Sand Is. Midway Atoll, Eastern Is.	2	015 Yellow 057 Blue[7]
1999-2000	Oct Nov	28 17	Midway Atoll, Sand Is. (057 Blue moved to female -	3	015 Yellow 057 Blue

Year	Month	Day	Location	Birds	Description
	Dec-Feb	--	10 min dance) Midway Atoll, Eastern Is.		051 Red
2000-2001	Oct-Apr Jan Oct-Apr Mar	-- 8-9 -- 28	Midway Atoll, Sand Is. Midway Atoll, Eastern Is.	4	057 Yellow/ 133 Black[8] 051 Red/ 057 Orange[9]
2001-2002	Oct-Apr Oct-Apr	-- --	Midway Atoll, Sand Is. Midway Atoll, Eastern Is.	2	015 Yellow sitting on infertile egg; colored band removed; metal band on left leg 051 Red
2002-2003	Oct-Mar Jan Nov-Mar	-- 3-13 --	Midway Atoll, Sand Is. Midway Atoll, Eastern Is.	3	Bird with metal band on left leg10 Unknown juvenile Unknown male wearing a metal band
2003-2004	Oct-Apr	--	Midway Atoll, Eastern Is.	1	Unknown adult male, metal wearing band 130-01319?[11]

[1] Chandler Robbins placed two USFSW bands (nos. 767-95701 and 767-95702) on the bird. [2] Bird was banded as a chick on Torishima March 20, 1979. [3] Bird was first banded as a chick on Torishima, March 24, 1982. [4] Bird was first banded as a chick on Torishma, April 19, 1989. [5] Bird was first banded as a chick on Torishma, April 14, 1987. [6] Bird was first banded as a chick on Torishima, April 4, 1993; Bird had all dark plumage. [7] Bird was first banded as a chick on Torishima, April 11, 1988. [8] Bird was first banded as a chick on Torishima, April 8, 1993. [9] Bird was first banded as a chick on Torishima, April 18, 1990. [10] Most likely 015 Yellow. [11] Most likely banded as a chick on Torishima, March 24, 1982.

Historically, the short-tailed albatross ranged along the coasts of the entire North Pacific Ocean from China, including the Japan Sea and the Okhotsk Sea (Sherburne, 1993), to the west coast of North America. Prior to the harvesting of the short-tailed albatross at their breeding colonies, this albatross was considered common year-round off the western coast of North America (Robertson, 1980). The short-tailed albatross ranges from approximately 66°N to 10°N latitude (King, 1981) and are known to occur near St. Lawrence Island, north to the Bering Strait, south to the Barren Islands in Lower Cook Inlet and in the Gulf of Alaska (DeGange, 1981). Other Bering Sea records include sightings around the Komandorskie Islands, Diomede Islands, and Norton Sound (AOU, 1961). Only one sighting of a short-tailed albatross has been reported in the waters surrounding the NWHI. On January 23, 2000, a sighting of a juvenile short-tailed albatross was made by a NMFS observer at 33.09°N latitude and 147.49°W longitude (approximately 1,800 nm northeast of Oahu).

Prior to the 1880s, the short-tailed albatross population was estimated to be in the millions and it was considered the most common albatross species ranging over the continental shelf of the United States (DeGange, 1981). Between 1885 and 1903, an estimated five million short-tailed albatrosses were harvested from the Japanese breeding colonies for the feather, fertilizer, and egg trade, and by 1947 only three birds remained. By 1949 the species was thought to be extinct (Austin, 1949). In 1950, ten short-tailed albatrosses were observed nesting on Torishima (Tickell, 1973).

In an effort to protect the short-tailed albatross from feather hunters, Torishima was declared a "Kinryoku" (no hunting area) in 1933, but the regulation was not enforced (Yamashina in Austin, 1949). In 1956 the Japanese government declared the short-tail albatross a protected species and declared Torishima a National Monument (Tickell, 1975). In 1972 Japan further designated the short-tailed albatross a special bird for protection (King, 1981). Currently, under the World Conservation Union (IUCN) criteria for identification of threatened species, the conservation status for the short-tail albatross is vulnerable (Croxall and Gales, 1998). The species is also listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; July 1, 1975) which protects the endangered species by prohibiting its commercial import or export or the trade of its parts across international borders. Currently, the short-tailed albatross is listed as an endangered species throughout its range under the Endangered Species Act 1973 (ESA) (65 FR 46643, July 31, 2000).

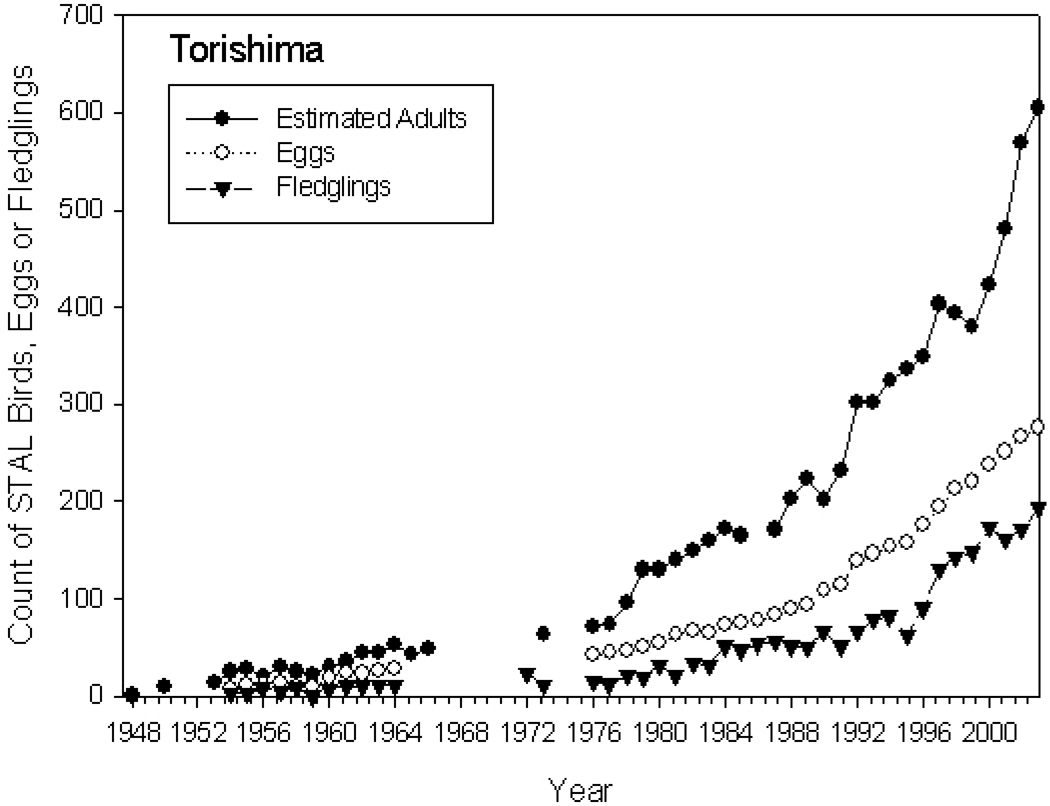
Today, the breeding population of the short-tailed albatross is estimated at approximately 326 breeding pairs: 276 pairs on Torishima (Table 3.6.1-3) and 50 pairs on Minami-Kojima (Figure 3.6.1-1). The short-tailed albatross have an annual survival rate of 96% and a population growth rate of 7.8% (65 FR 46643, July 31, 2000; Hasegawa, 1997). Because of the robust growth of the population at Torishima, and the fact that short-tailed albatrosses do not return to the colony until three or four years of age, a large number of these birds are dispersed at sea. At least 25% of the reproducing adults also remain at sea during each breeding season (Cochrane and Starfield, 1999). As a consequence, the exact number of individuals in the population is difficult to assess and at this time is unknown. The population size has been estimated at about 1,900 (P. Sievert, pers. comm.). This estimate is based on a deterministic model that was fit to observed numbers and incorporated age-specific survivorship data collected for short-tailed albatrosses on Torishima.

Table 3.6.1-3 Short-tailed albatross census counts at Torishima, Japan, between 1977 and 2004. (Source: Tickell, 1975; Sanger, 1972; Hasegawa, 1977. Sub-adults were not always differentiated from adults in some years.)

Breeding Season	Breeding Pairs	Adults	Sub-adults	Eggs	Chicks	Chicks Fledged
1977 – 1978	--	73	12	40	12*	12
1978 – 1979	--	96	12	--	--	22
1979 – 1980	--	130	32	50	20	20*
1980 – 1981	--	130	--	54	--	32
1981 – 1982	--	140	--	63	--	21
1982 – 1983	--	150	--	67	--	34
1983 – 1984	--	160	--	65	--	32
1984 – 1985	--	172	--	73	--	51
1985 – 1986	--	165	--	76	--	47
1986 – 1987	--	146*	--	77	64*	53
1987 – 1988		171	--	84	58*	57
1988 – 1989	--	203*	--	89	--	51
1989 – 1990	--	223	--	94	--	50
1990 – 1991	115*	202	--	108	66	66
1991 – 1992	--	232	--	115	--	51
1992 – 1993	--	302	--	139	--	66
1993 – 1994	--	301	--	146	--	79
1994 – 1995	--	324	--	153	--	82
1995 – 1996	--	337	--	158	--	62
1996 – 1997	--	349	--	176	--	90
1997 – 1998	--	388	--	194	--	130
1998 – 1999	--	426	--	213	--	143
1999 – 2000	--	440	--	220	–	148
2000 - 2001		476		238		173
2001 - 2002		502		251		161
2002 - 2003		534		267		171
2003 - 2004		552		276		193

*Values marked by an asterisk indicate there are uncertainties associated with the data (i.e., very few observations).

Figure 3.6.1-1 Counts of short-tailed albatross (STAL) adults, eggs and fledglings on Torishima between 1947 and 2003 (Sources: Tickell, 1975; Sanger, 1972; Hasegawa, 1977; H. Hasegawa and P. Sievert, pers. comm.).



3.6.1.1.2 Black-footed Albatross (*Phoebastria nigripes*)

The NWHI contain the primary breeding colonies of the black-footed albatross population (Table 3.6.1.1). A comparatively smaller population estimated at about 11,000 black-footed albatrosses breed on Torishima (P. Sievert, pers.comm.). Although the at-sea distributions of Hawaiian and Japanese black-footed albatrosses overlap both in the western Pacific and around the NWHI, these two populations have been reproductively separated (genetically distinct units) for no more than three quarters of a million years (Walsh and Edwards, in review). Due to an absence of any significant gene flow between Hawaiian and Japanese populations of black-footed albatrosses, Walsh and Edwards (in review) suggest that Hawaiian and Japanese black-footed albatrosses fulfill the criteria for separate phylogenetic species and should be designated full species (*P. nigripes* and *P. nihonus*, respectively).

Discriptively, the black-footed albatross has a dark bill, legs and feet at all stages of their development. The black-footed albatross is slightly larger and heavier than the Laysan albatross, (Harrison et al., 1983; Whittow, pers. comm.). The Japanese black-footed albatross is reported to be slightly smaller than its Hawaiian counterpart (H. Hasegawa, pers. comm.). The plumage colorations for both the immature and adult black-footed albatrosses are extremely similar; brown with a white band at the base of their bill and a white sweep defining their eyes. One of the distinguishing features between adult and juvenile (i.e., young-of-the-year) black-footed albatrosses are that the juveniles lack the white plumage at the base of their tail. The plumage of the immature birds can be, but is not always, slightly darker in coloration than the adult birds. Generally, as the juvenile black-footed albatrosses mature, they tend to become more gray or dusty in appearance (Miller, 1940).

The feather and egg trade in the early 1900s destroyed nesting colonies on Izu, Wake, Bonin and Marcus Islands, as well as colonies on Johnston and Taongi Atolls (Rice and Kenyon, 1962; McDermond and Morgan, 1993). However, a small population of approximately 1,106 - 1,206 black-footed albatrosses have recolonized the Japanese Islands of Torishima (Rice and Kenyon, 1962; Hasegawa, 1984; Ogi et al., 1994) and there have been recent observations of Black-footed albatrosses visiting Wake Island (Rauzon, 1988, unpubl. observ.) and two mated pairs have been sighted over Minami Iwo Jima in 1982 (E. Flint, pers.comm.). Since 1998, there have been no reports of visitations by black-footed albatross to Johnston Atoll or to Marcus Island (E. Flint, pers. comm.).

Black-footed and Laysan albatrosses range throughout the North Pacific between 20°N and 58°N. Knowledge of their distribution comes primarily from reports of encounters with banded birds, from scientific transects, and from observations. A few birds have been tracked over long distances by satellites (Anderson and Fernandez, 1998). Researchers used satellite telemetry to study the movements of a male black-footed albatross during its pelagic travels off the coast of California (Hyrenbach and Dotson, 2001). This albatross covered a distance of 5,067 km during 35 days, and moved over a broad range of ocean water temperatures (22–15°C). The rate of movement of the tracked albatross varied significantly during different periods of the day, and was influenced by ambient light levels during the night (Hyrenback and Dotson, 2001).

The black-footed albatross occurs regularly in large numbers off the west coast of Canada and the United States and off the East Coast of Japan. The Laysan is common in the Gulf of Alaska, the Aleutian Islands and Bering Sea.

The current world population of breeding black-footed albatrosses is estimated at 327,753 individuals, with 58,898 breeding pairs in 12 colonies (Table 3.6.1-1). Nine of the colonies are located in the NWHI comprising the majority of the breeding population (55,775 breeding pairs).

Seventy-five percent of the NWHI breeding pairs nest in three colonies that are routinely surveyed by the USFWS: Laysan Island, Midway Atoll and French Frigate Shoals (Figure 3.6.1-2). The two largest black-footed albatross colonies accounting for approximately 70% of world population are on Midway Atoll and Laysan Island. French Frigate Shoals accounts for about 6% of the world population. Three black-footed albatross colonies are also located in the Western Pacific (estimated 3,123 breeding pairs) accounting for 5% of the world population. On, Torishima, six black-footed albatross chicks were successfully reared in 1957, and since then the number of chicks reared has increased from 914 in 1998, to 1,170 in 2003 (H. Hasegawa, unpubl.

data). The black-footed albatross populations on Bonin and Senkaku Islands have also modestly increased (Table 3.6.1-1).

Analysis of the breeding pair counts for Midway Atoll, Laysan Island and French Frigate Shoals between 1992 and 2003, suggest that the black-footed albatross population is annually declining by about 1% (Figure 3.6.1-3). However, many albatrosses do not return to breed each year, taking time away from breeding to molt their flight feathers. Counts of returning albatrosses may also be affected by changes in oceanographic productivity (Polovina et al., 1994). Consequently, annual counts of breeding pairs may not be representative of the entire breeding population, and may not reflect population trends. Analysis of bird-banding data could yield important information on albatross breeding frequency, survival rates and juvenile recruitment.

Figure 3.6.1-2 Counts of black-footed albatross breeding pairs at French Frigate Shoals, Midway Atoll and Laysan Island, NWHI for years 1992 to 2003. Counts of breeding pairs for Laysan Island were extrapolated from plot counts of eggs for years 1992 to 2002. All other data points were obtained from direct counts of breeding birds.

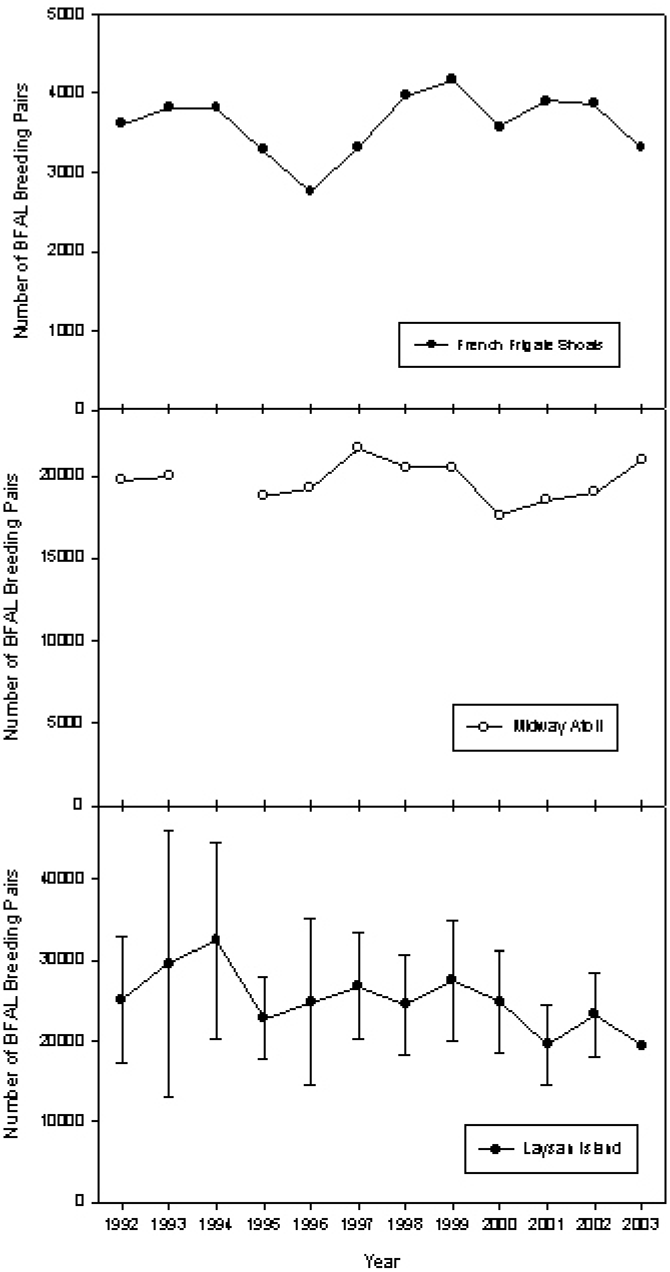
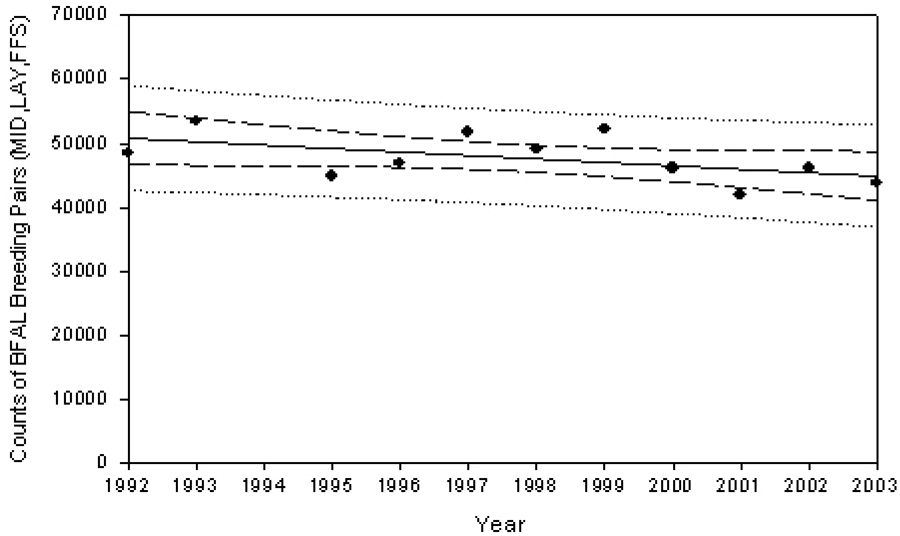


Figure 3.6.1-3 Combined counts of black-footed albatross (BFAL) breeding pairs on Midway Atoll (MID), Laysan Island (LAY) and French Frigate Shoals (FFS) plotted against year (1992 - 2003). Y = 50,746±26387 - 533±288x (r^2=0.3).



3.6.1.1.3 Laysan Albatross (*Phoebastria immutabilis*)

Laysan albatrosses are characterized by white plumage on their head, neck and chest, and sooty brown plumage on their upper wings, back and tail. The Laysan albatross underwings have variable patches of dark and white plumage and are distinguished by dark leading edges and wing tips. Laysan albatrosses have fleshy-pink colored legs and webbed feet, and in flight the feet project beyond the tail. The Laysan albatross eye is defined with gray and black plumage that extends to a thin line behind the eye. There are no distinguishing characteristics between sexes or between adult and immature phases.

Over the past century, the Laysan albatross population experienced several disturbances. It is estimated that before the feather hunters reached Marcus Island, the island had a population of one million Laysan albatrosses (Rice and Kenyon, 1962). Feather hunters also raided Laysan albatross colonies in the NWHI taking at least 300,000 birds from Laysan Island in 1909 (Dill and Bryan, 1912). To protect the colonies from further devastation, President Theodore Roosevelt established the Hawaiian Islands Bird Reservation on 3 February 1909 (Executive Order 1019). The Reservation initially included all of the NWHI except for Midway Islands, which were under the jurisdiction of the U.S. Navy Department (Clapp and Kridler, 1977). Jurisdiction over the Reservation was transferred to the Department of the Interior on 25 July 1940. However, tens of thousands of birds were killed during WWII, and then later thousands more were killed by the U.S. Navy in an attempt to reduce bird strike hazards to aircraft (Robbins, 1966). In 1996, Executive Order 13022 transferred the administration of Midway Atoll to the Department of Interior to be managed by the U.S. Fish and Wildlife Service as a National Wildlife Refuge. The current world population of breeding Laysan albatrosses has moderately recovered from past disturbances only to face new problems.

Today, it is estimated that the Laysan albatross population is 3.4 million individuals, with 623,622 breeding pairs in 15 colonies (Table 3.6.1-1). Twelve of the colonies are located in the NWHI comprising of the majority of the breeding population (623,495 breeding pairs). The largest Laysan albatross colony (71% of the world population) is on Midway Atoll (Figure 3.6.1-4). Laysan Island has the second largest colony (22% of the world population). A Laysan albatross colony located on Bonin Island is comprised of 14 breeding pairs while three other colonies (with a total of 113 breeding pairs) are located in the Eastern Pacific on Guadelupe (Dunlap, 1988), the San Benedicto Islands, and Isla Clarion, Mexico (Howell and Webb, 1992). Since 1998, there have been no reports of visitations by Laysan albatrosses to Johnston Atoll or to Marcus Island (E. Flint, pers. comm.). Like the black-footed albatross population, the Laysan albatross population also appears to be in decline, although the data are insufficient at this time to estimate the amount of the decline (Figure 3.6.1-5)

More Laysan sightings are being reported on the California coast, perhaps due to the colony in Mexico. It is unknown at this time if the colony is growing due to juvenile recruitment or to immigration from other colonies. The great majority of pelagic encounters of Laysan albatross have come from west of the 180° meridian (Robbins and Rice, 1974).

A serious problem for the Laysan albatross population is lead poisoning of chicks from weathering lead-based paint on old buildings on Midway Atoll. Chicks raised in nests close (< 5 meters) to buildings ingest deteriorating paint directly from the buildings or paint chips that have fallen in and around their nests. Blood lead concentrations in chicks near buildings average 440 µg/dL, compared to an average blood lead of 6 µg/dL in chicks nesting more than 100m from buildings. For comparison, the Centers for Disease Control's blood level of concern for children is 10 µg/dL. The chicks near buildings frequently exhibit a condition of peripheral neuropathy called "droopwing." These chicks cannot raise their wings, leading to broken bones and open sores. They die either as a direct result of lead poisoning or from starvation when their parents stop feeding them. It is estimated that chicks suffering significant detrimental effects from lead exposure on Midway's Sand Island could number in the thousands per year (Finkelstein, 2004).

Figure 3.6.1-4 Counts of Laysan albatross breeding pairs at French Frigate Shoals, Midway Atoll and Laysan Island, NWHI for years 1992 to 2003. Counts of breeding pairs for Laysan Island were extrapolated from plot counts of eggs for years 1992 to 2003. All other data points were obtained from direct counts of breeding birds.

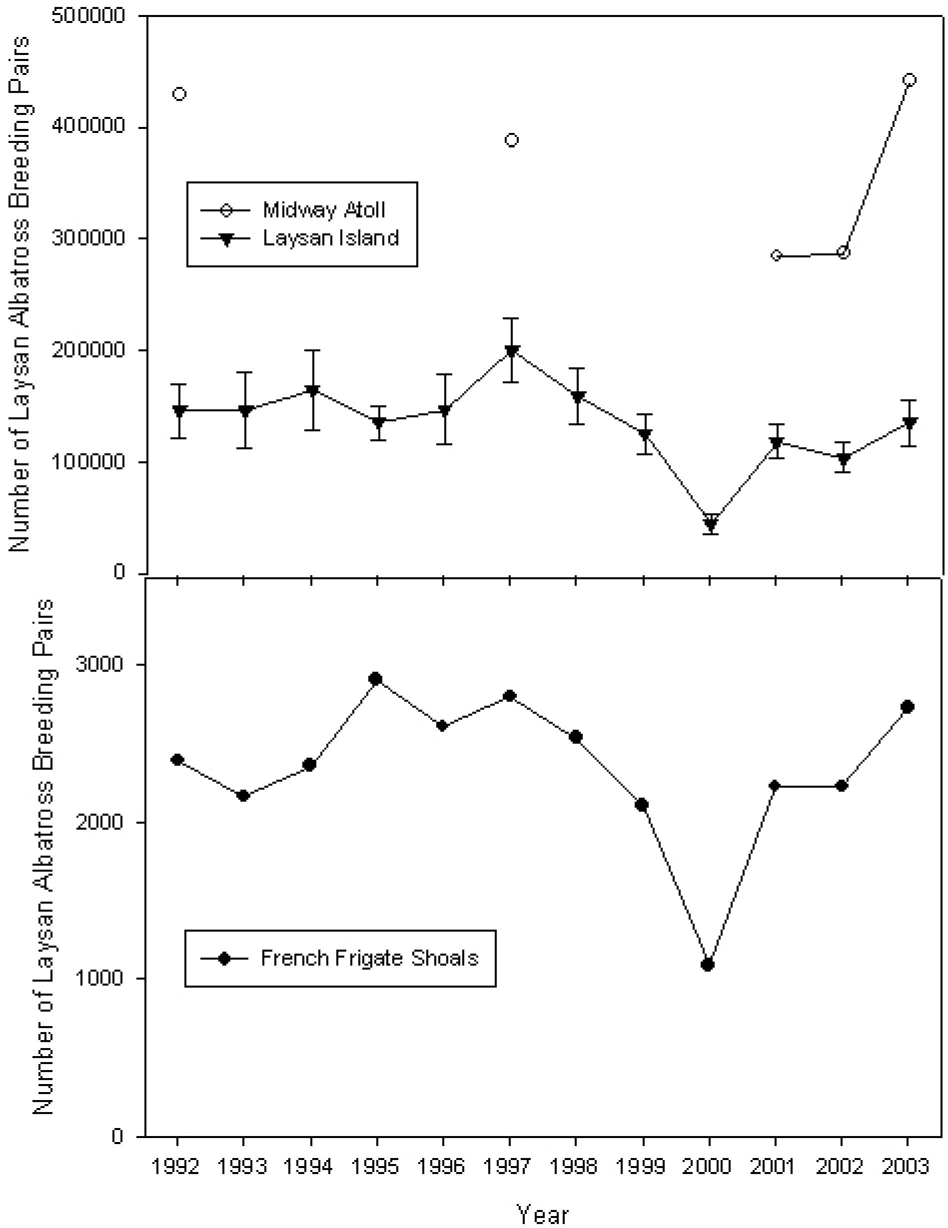
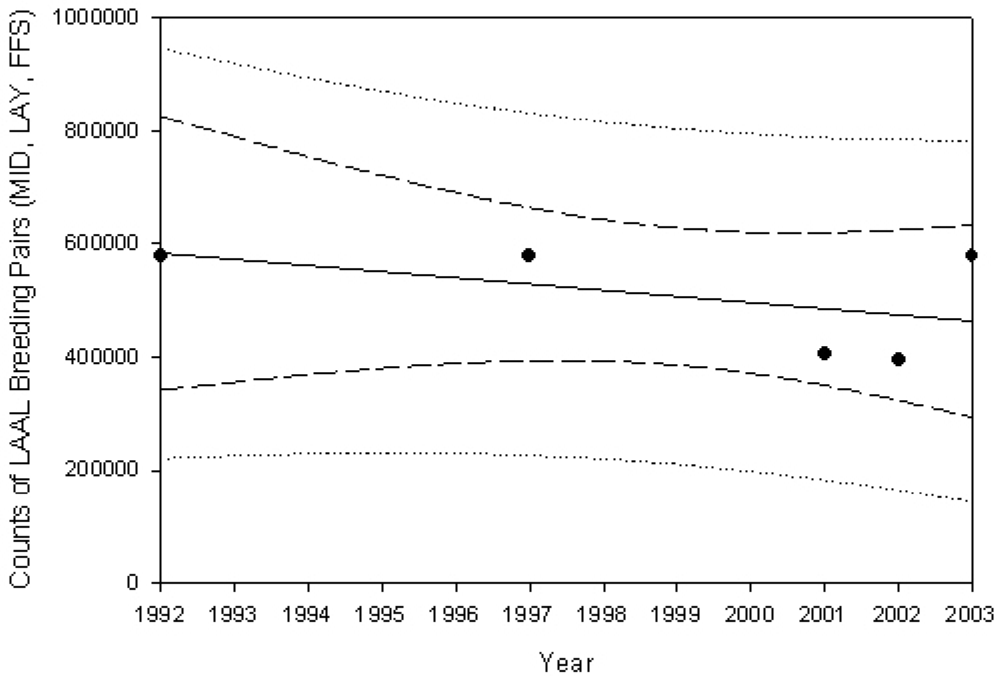


Figure 3.6.1-5 Combined counts of Laysan albatross (LAAL) breeding pairs on Midway Atoll (MID), Laysan Island (LAY) and French Frigate Shoals (FFS) plotted against year (1992 - 2003). Y = 22,310,829±21,680,891 - 10,908±10,846x (r^2=0.25). More information is needed to determine a population trend.



3.6.1.2 Shearwaters (Order Procellariiformes, Family Procellariidae)

Three species of shearwaters breed in the Hawaiian Islands and forage in the area in which the Hawaii longline fishery operates. These are the wedge-tailed shearwater (*Puffinus pacificus*), Christmas shearwater (*P. nativitatis*) and the Newell's shearwater (*P. auricularis newelli*). A fourth shearwater, the short-tailed shearwater (*P. tenuirostris*), breeds in Australia but migrates to foraging areas at Kotzebue Sound which is north of the Arctic Circle in Alaska. Short-tailed shearwaters may be present in Hawaiian waters between September and May during their annual migration.

The Newell's shearwater is listed as threatened under the U.S. Endangered Species Act and is considered vulnerable by the IUCN. The Newell's shearwater has been given this conservation status because of its small population size, approximately 14,600 breeding pairs, their isolated breeding colonies, and the numerous hazards affecting them at their breeding colonies including urban development and introduced predators like rats, cats, dogs and mongoose (Ainley et al., 1997). The conservation status of the Christmas shearwater to date is unknown. Harrison (1990) estimated that there were approximately 3,100 Christmas shearwaters nesting in the Hawaiian

Islands in the late 1980s. Given that the Hawaiian Islands are at the species most northern boundary, it is possible that the Christmas shearwater population is more abundant near breeding colonies located in the mid- and South Pacific. The wedge-tailed shearwater is one of the most abundant seabirds in the Hawaiian Islands with an estimated 1,330,000 birds (Harrison, 1990). Worldwide there is an estimated 5.2 million wedge-tailed shearwaters (Whittow, 1997).

Shearwaters are known to forage in the area where Hawaii longline vessels operate, but lethal interactions between shearwaters and the Hawaii-based longline fishery are rare events. Both the Newell's and wedge-tailed shearwaters are known to prefer foraging areas of either low water temperature, such as the cool upwelling waters of the North Pacific Transition Zone (NPTZ), or high salinity (Gould, 1983; Spear et al., 1999). Also, high densities of these birds are seen in the southeastern portion of the Hawaii longline fleet's area of operations (Spear et al., 1999). It is not unusual for a petrel to accidentally fly onto a vessel during rough weather and high seas. Usually, these birds remain on board for a brief period, or overnight, before they depart back to sea.

Shearwaters are most active in the day and skim the ocean surface while foraging. During the breeding season, shearwaters tend to forage within 50 - 62 miles (80 -100 km) of their nesting burrows (Harrison, 1990). Shearwaters also tend to be gregarious at sea and only the Newell's and short-tailed shearwaters are known to occasionally follow ships (Harrison, 1996). Shearwaters feed by surface-seizing and pursuit-plunging (Warham, 1990). Often shearwaters will dip their heads under the water to site their prey before submerging (Warham, 1990). Shearwaters are efficient swimmers as their pelvises are narrow and their legs are placed far back on their body, however, adaptions to swimming make shearwaters extremely awkward on land (Harrison, 1990).

Shearwaters are extremely difficult to identify at sea, as the species are characterized by mostly dark plumage, long and thin wings, a slender bill with a pair of flat and wide nasal tubes at the base, and dark legs and feet. Like the albatross, the nasal tubes at the base of the bill enhances the bird's sense of smell, assisting them to locate food while foraging. The wedge-tailed shearwater may be more distinct from the other species of shearwaters as it is slightly larger with flesh-colored legs and feet and has a long wedge-shaped tail (Harrison, 1990). The wedge-tailed shearwater is also polymorphic, meaning that there are dark, light and intermediate plumage forms (Whittow, 1997).

3.6.1.2.1 Newell's Shearwater (*Puffinus auricularis newelli*)

The Newell's shearwater was listed as a threatened species under the ESA on September 25, 1975 (40 FR 44149). The Newell's shearwater breeds only in colonies on the main Hawaiian Islands, such as on Molokai, Hawaii, and mainly on Kauai (Pratt et al., 1987; Harrison, 1990; Reynolds et al., 1997a,b). The Newell's shearwater (*Puffinus auricularis newelli*) was once widespread in the main Hawaiian Islands, but is reduced to a few remnant breeding colonies because of urbanization and predation by introduced mammals.

The species was thought to be extinct in the Hawaiian Islands by 1908, but was found to be breeding on Kauai in 1967 (King and Gould, 1967; Sincock and Swedberg, 1969). Historically, the bird was collected for food by the Polynesians who colonized the Hawaiian Islands. Since then much of the breeding habitat for the species has been converted to agricultural, military, commercial or residential land (Cuddily and Stone, 1990). The loss of nesting habitat for the species is considered one of the primary causes for the present decline of its populations (Ainley et al., 1997). Predation of adults and chicks by introduced predators, such as mongooses (*Herpestes auropunctatus*), rats (*Rattus* spp.), feral cats and barn owls (*Tyto alba*) (Byrd and Telfer, 1980; Harrison, 1990), is another factor in the species decline.

The Newell's shearwater is highly pelagic, occurring year-round in the tropical and subtropical waters mostly to the east and south of the Hawaiian Islands (Ainley et al., 1997). The bird especially frequents the Equatorial Countercurrent, from near the portion of the equator lying south of the Hawaiian Islands east to about 120°W and north to and around the main Hawaiian Islands (22°N). Isolated sightings of Newell's shearwater are recorded from central and south Pacific, west to the Commonwealth of the Northern Mariana Islands and Guam, Wake Island, and Johnston Atoll (King and Gould, 1967; Pratt et al., 1987), and south to the Marquesas Islands and Samoa (Pratt et al., 1987; Grant et al., 1994; Spear et al., 1995).

Newell's shearwaters breed in burrows or deep rock crevices between 160 and 1,200 m elevation (Reynolds and Ritchotte, 1997). Breeding pairs form in the years before mating. Mating usually begins at six years of age (Brooke, 1990). One smooth, white egg is laid by the female in a breeding season. Both parents attend to a chick which is irregularly until it fledges in October (Telfer et al., 1987). For unknown reasons, fledglings are attracted to lights which can lead to mortality in urban settings (Reed et al., 1985). The annual adult survivorship of a Newell's shearwater is estimated to be about 90% (Ainley et al., 1997).

3.6.1.2.2 Wedge-tailed Shearwater (*Puffinus pacificus*)

The wedge-tailed shearwater is one of the largest of the tropical shearwters with an overall length of 43 cm, and body mass of 390 g (Whittow, 1997). The bird has grayish brown plumage on its back and white on its belly and underparts except for dark edge to the wings and dark undertail coverts. The sexes are indistinguishable and there are a light and a dark morph to this species.

The wedge-tailed shearwater has migratory behaviors. From September to November, large flocks of the species gather offshore before migrating near the Hawaiian Islands (King, 1974). Often during this period there may be rafts of birds with up to 700 individuals. The wedge-tailed shearwater breeds between February and November in the Northern Hemisphere and August and October to May and June in the Southern Hemisphere.

The wedge-tailed shearwater breeds from Kure Island in the NWHI to Maui Island in the main Hawaiian Islands (Ainley et al., 1997). The wedge-tailed shearwater also breeds on other islands spread throughout the Northeast and South Pacific, including Johnston Atoll and Christmas, Bonin, Volcano, Marshall, and Caroline Islands, and the Indian Ocean where it is known to breed as far west as Madagascar (Whittow, 1997).

A female wedge-tailed shearwater lays a single white egg in a burrow at sea level. The bird may use ledges and rock piles on rocky islands such as Necker in the NWHI (Harrison, 1990), or use shell debris or crevices under coral ledges (Gallagher, 1960). Both adults share in the excavation of the burrow, incubation of the egg, and feeding of the young (Shallenberger, 1973; Shallenberger, 1984). First breeding is at four years of age (Floyd and Swanson, 1983), and a wedge-tailed shearwater may live as long as 29 years (E. Flint in Whittow, 1997).

3.6.1.2.3 Christmas Shearwater (*Puffinus nativitatis*)

Christmas shearwaters are slender-bodied with a length of 35-38 cm and body mass of 354 g. (Harrison,1983). Their plumage is dark brown with their underparts being lighter than their upperparts. The sexes are indistinguishable.

The Christmas shearwater breeds primarily in the tropical Pacific ranging as far north as the Hawaiian Islands to as far south as Easter Island (Harrison, 1996). The species usually breeds on remote, small, flat and sandy islands under dense vegetation such as naupaka (*Scaevola sericea*). Christmas shearwaters also breed on a steep grass covered slope on Motu Nui (Johnson et al., 1970).

Breeding adults return to the NWHI from early to late February (Naughton, 1982). A breeding pair will occupy a nest site in early to late March (Seto, 2001). The nest is a shallow scrape or depression in the ground, and usually located under vegetation. The female lays a single white egg each breeding season, and both parents share incubation of the egg and feeding of the chick (Seto, 2001). Chicks fledge between September and October on Midway Atoll The oldest record of a banded Christmas shearwater was 17 years on Laysan Island (K. Swift in Seto, 2001).

3.6.1.3 Boobies (Order Pelecaniformes, Family Sulidae)

Three species of boobies also breed in the NWHI and forage in the North Pacific: the masked booby (*Sula dactylatra*), the brown booby (*Sula leucogaster*) and the red-footed booby *(Sula sula*). Currently, the World Conservation Union classifies boobies as “not globally threatened.” Like the albatrosses, the boobies are also long-lived and have a delayed maturity. Unlike the albatrosses, which are primarily surface feeders, the boobies are plunge divers and also tend to take flying fish (*Cypselurus* spp.) just above or at the surface of the water.

To date, there have been no reports of lethal interactions between boobies and the Hawaii-based longline fishery, but boobies are reported to sit on vessel decks and watch the baited hooks as they are being set or hauled back. NOAA Fishery observers report boobies hovering over baited hooks and some birds may actually attempt a dive, however, no boobies have been reported hooked. Although the foraging behavior of boobies may differ from that of the albatrosses, such that they do not interact with longline fishing vessels or gear in the same manner, boobies are present during fishing operations and the potential for fatal interactions does exist.

Boobies breed throughout the Hawaiian Archipelago, and three localities have been routinely monitored by the USFWS in Honolulu (Table 3.6.1-4). Harrison (1990) reported breeding pair numbers from surveys of booby colonies completed between 1981 and 1988. From the surveys completed in the 1980s, it was estimated that there were about 14,000 masked boobies, 1,500 brown boobies and 11,000 red-footed boobies (Harrison, 1990).

Table 3.6.1-4 NWHI booby counts at Johnston Atoll, Midway Atoll and Tern Island, French Frigate Shoals, between 1979 and 1996.

Year	Johnston Atoll			Midway Atoll	Tern Island	
	Red-footed	Masked	Brown	Red-footed Booby	Red-footed	Masked
1979	--	--	--	--	385	--
1980	--	--	--	--	441	--
1981	40	--	92	--	394	--
1982	--	--	80	--	341	--
1983	35	--	56	--	500	--
1984	40	--	150	--	605	--
1985	57	--	135	178	727	--
1986	86	--	123	--	691	--
1987	84	1	169	--	735	--
1988	102	3	200	282	932	--
1989	116	3	189	410	1133	--
1990	119	9	217	427	888	--
1991	189	5	204	--	1267	--
1992	230	11	287	555	1348	18
1993	312	13	401	--	1579	23
1994	309	14	369	--	1040	29
1995	320	18	361	--	1561	32
1996	--	--	--	563	2194	35

Source: USFWS Refuges Office, Honolulu, Hawaii, unpubl. data.

The age at first breeding for boobies is usually four years (Woodward, 1972). Boobies tend to lay between one and two eggs each breeding season. Red-footed boobies only lay one egg each season while brown boobies lay one or two eggs (Nelson, 1978). Masked boobies lay two eggs and when both eggs hatch, the oldest hatchling ejects its sibling from the nest (Anderson, 1990). The ejected chick is not protected by the parents and dies (Anderson, 1990). Adult boobies are known to live at least 22 years, if not longer (Clapp et al., 1882; Anderson, 1993).

3.6.1.4 Fishery Seabird Interactions

3.6.1.4.1 Worldwide Longline Seabird Interactions

Brothers first quantified the magnitude of the incidental catch of albatrosses for the Japanese longline fishery in the Southern Ocean and found that by conservative calculation 44,000 albatrosses were killed annually (Brothers, 1991). Albatrosses are incidentally caught in longline operations when they attempt to take bait from baited hooks and are hooked in the process. Albatrosses forage around longline fishing vessels because they often provide the birds ample food in the form of bait, discarded bait and offal (unwanted body parts of fish catch) (Harrison et al., 1983). In many instances albatrosses successfully remove a bait or part thereof from a hook without being hooked. The incidental catch of albatrosses has since been estimated in a number of other fisheries (Murray et al., 1993; Moloney et al., 1994; Ashford et al., 1995; Klaer and Polacheck, 1995; Alexander et al., 1997; Klaer and Polacheck, 1997; Brothers et al., 1999a), including the Hawaii-based pelagic longline fishery in which an estimated 1,963 black-footed albatrosses and 1,479 Laysan albatrosses became incidental catch in 1998 (Kleiber, 1999).

Researchers began documenting declines in wandering albatross (*P. exulans*) populations on islands in the Southern Ocean in 1979 (Croxall, 1979; Tomkins, 1985; Weimerskirch et al., 1987; Weimerskirch and Jouventin, 1987; Croxall et al., 1990). The declines were attributed to the incidental catch of these birds by the tuna longline industry in the region (Gales, 1993; CCAMLR, 1994; Birdlife International, 1995; Kalmer et al., 1996; Gales et al., 1998; Klaer and Polacheck, 1995). By the early 1990s, at least six of the world's albatross species were known to have experienced recent declines in population size (Gales, 1993) and it was determined that the single greatest anthropogenic threat to these seabirds was the longline fishing industry (Birdlife International, 1995; Brothers et al., 1998; Gales, 1998; Cousins and Cooper, 2000). The Australian Government formally recognized this threat in 1995, when it listed the incidental catch of seabirds during oceanic longline fishing operations as a key threatening process on Schedule 3 of the *Endangered Species Protection Act 1992.* The United Nations Food and Agriculture Organization Committee on Fisheries formulated an initiative calling for longlining nations experiencing incidental seabird catch to voluntarily employ proven incidental seabird catch mitigation methods in their fisheries. The U.S. National Plan of Action (NPOA) to reduce the incidental catch of seabirds in U.S. fisheries was published in February 2001 (DOC, 2001). The goal of the NPOA is to reduce the incidental catch of seabirds in U.S. longline fisheries where it is determined by a regional fishery management council to be a problem.

The current worldwide albatross incidental catch-rate by longline vessels is believed to average 0.4 albatrosses per 1,000 hooks set (Alexander et al., 1997; Bergin, 1997) although there is variation around this number. For instance, Brothers (1991) reports a catch rate of 1-1.6 albatrosses per 1,000 hooks near New Zealand while Klaer and Polacheck (1997) estimate an incidental catch rate of 0.15 albatrosses per 1,000 hooks for Japanese longline vessels fishing in the Australian Fishing Zone. In comparision, between 1994 and 1998, the USFWS estimated 0.10 Laysan albatrosses and 0.12 black-footed albatrosses caught per 1,000 hooks in the Hawaii longline fishery (USFWS, 2000).

Data sources considered in this EIS primarily focus on the findings and observations made onboard Hawaii-based pelagic longline vessels and the seabird populations nesting in the NWHI. The Hawaii-based longline fleet encounters seabirds because the fleet operates in known foraging grounds for the seabirds that nest in the NWHI. At present, this fishery is the only fishery operating under the Pelagics FMP known to interact with seabirds. At-sea seabird observations for vessels operating in Guam and CNMI are absent and limited NOAA Fisheries observations of the American Samoa longline operations did not detect any interactions there.

3.6.1.4.2 Hawaii Longline Seabird Interactions

Hawaii-based pelagic longline fishing operations hook and kill black-footed albatrosses (*Phoebastria nigripes*) and Laysan albatrosses (*P. immutabilis*) that nest in the Northwestern

Hawaiian Islands (NWHI). The birds follow the longline vessels and dive on the baited longline hooks during setting or hauling of the longline, become hooked and subsequently drown. Besides the direct mortality to adult birds, fishing-related deaths may also have a negative influence on chick survival if one or both parent birds are killed. On rare occasions wedge-tailed and sooty shearwaters are also incidentally caught by these vessels. Although the endangered short-tailed albatross (*P. albatrus*) is seen in the areas where the fishery operates and is known to visit the NWHI, there are no reports of interactions between the fishery and the seabird. In the Hawaii-based longline fishery, the problem of incidental seabird catch occurs mainly among those fishing vessels targeting broadbill swordfish (*Xiphias gladius*) or a mixture of swordfish and bigeye tuna (*Thunnus obesus*), and fishing near known seabird foraging areas.

Although seabird interactions were known to occur in the Hawaii longline fishery prior to the inception of the NMFS observer program, the deployment of observers by the NMFS on longliners from1994 onwards provided data to quantify seabird interaction rates. It is unknown how many seabirds were incidentally caught by the fishery prior to the inception of the NMFS observer program, but it is likely that the pre-observer seabird interaction rates were similar to the rates collected by the NMFS observers. Still, management initiatives generated by the Western Pacific Regional Fishery Management Council (WPRFMC) in the early 1990s to regulate the Hawaii-based longline fishery may have inadvertently mitigated some of the incidental seabird catch. These included the limited entry program, the cap on fishing capacity (number and size of vessels), and the implementation of a 50 nautical mile protected species closed area around the NWHI. The observer data provided the spatial distribution of seabird interactions for the fleet, and when analyzed it showed that catches of black-footed albatrosses were found to be significantly related only to proximity to nesting colonies and longitude, while catches of Laysan albatrosses were significantly related only to proximity to nesting colonies and year. In addition, data collected by NMFS observers showed that vessels with a line-shooter targeting principally tunas had seabird catch rates one order of magnitude less than vessels employing no line-shooter and targeting swordfish (Table 3.6.1-5).

3.6.1.4.3 Previous Actions to Reduce Seabird Interactions in the Hawaii-based Longline Fishery

Measures taken by the Council in the early 1990s to manage the Hawaii-based longline fishery indirectly reduced the incidental catch of seabirds by the fleet. These measures included limiting the size of the longline fleet to 162 permits, and prohibiting longline fishing in a 50 nautical mile area (protected species zone) around the Northwestern Hawaiian Islands (NWHI). Specific actions by the Council to reduce the incidental catch of seabirds began in 1996, when the Council and the USFWS conducted a workshop in September of that year in Honolulu to inform longline fishermen of the problem and introduce to them various mitigation methods they could employ to reduce seabird interactions. The book *Catching Fish, Not Birds* by Nigel Brothers (1995) was translated into Vietnamese and Korean, and copies were sent to all holders of a NMFS Hawaii longline limited access permit. A second workshop informing fishermen of the problem was held in January 1997. At that time, the USFWS also distributed a laminated card showing various species of albatross and describing possible mitigation methods. The card was issued in both English and Vietnamese.

Assessments of the level of voluntarily adoption of mitigation methods by Hawaii longline fishermen indicated that the education program described above was only partially successful. Two dockside visits by Council and USFWS staff in mid-1997 to examine what mitigation methods, if any, were being employed revealed that, of the 12 longline vessels surveyed, five used weighted hooks, one used bait dyed blue to camouflage it in the water, three towed a trash bag or buoy, one scared birds with a horn, one distracted the birds by strategically discarding offal and two vessels employed no mitigation methods. A mail survey of 128 Hawaii-based longline vessels was conducted by the Environmental Defense Fund during the same period. Ten of the 18 fishermen that responded to a question regarding mitigation methods employed indicated that they were actively using some type of measure, such as reducing the use of deck lights at night, adding weights to increase the sink rate of the fishing line during setting, strategically discarding offal to distract birds, using a line-setting machine or setting the line underwater.

In October 1997, NMFS observers deployed on Hawaii-based longline vessels began recording which mitigation methods, if any, were being used voluntarily by fishermen. Information from the observer program for 1998 showed that nearly all vessels used some measure, the most common being to avoid setting the line in the vessel's wake. About 55% of the vessels thawed the bait before baiting hooks, 29% of the vessels set at night and 11% avoided discarding unused bait while setting the fishing line. Only two percent of the vessels used a towed deterrent or blue-dyed bait.

A Biological Assessment (BA) by the NMFS, Pacific Islands Area Office (now the Pacific Islands Regional Office) and incorporated into the 2000 BiOp estimated that 15 short-tailed albatrosses have visited the NWHI over the past 60 years (NMFS, 1999). The assessment noted that the historical range of the short-tailed albatross was known to include the waters and coastlines near China, Japan, Korea, Russia, West Coast of the U.S. and British Columbia, Canada. There is no evidence to indicate that short-tailed albatrosses once bred in the NWHI. Many mariners and a few naturalists (i.e., H. Palmer and G. Munro) visited Midway Atoll between 1859 to 1891 (i.e., prior to the species being harvested to near extinction by Japanese settlers between 1880 and 1932) with no reports of short-tailed albatrosses. It is possible that the bird did breed in the NWHI, but in recent years very few short-tailed albatross have returned to Midway or other islands in the NWHI each breeding season. The BA concluded that the chance of an interaction between a longline vessel and a short-tailed albatross was extremely low, but it would be reduced further if mitigation methods were employed by longline vessels in areas where the bird might be present. The BA also noted that the risk of interactions with fisheries could increase if the short-tailed albatross population grows and the range of the species expands to include its historical range along the west coast of North America.

In October 1998, a seabird population biology workshop was convened at the Council office in Honolulu to make a preliminary assessment of the impact of fishing by the Hawaii-based longline fleet on the black-footed albatross population in the NWHI (WPRFMC, 2000). The incidental catch of seabirds by fishing vessels was identified as a source of chronic or long term mortality. It was noted that the impact of the interactions would be more serious if the albatrosses killed were predominantly adult birds because this would result not only in the consequent loss of chicks they were caring for, but also the loss of many breeding seasons as the surviving mate must find another mate and establish a pair bond. However, banding data analyzed at the workshop suggested that it was predominantly immature juvenile birds that were interacting with longline boats. This finding is consistent with that of Brothers (1991), who observed that about four times as many juvenile as adult albatrosses are caught in the Southern Bluefin tuna (*Thunnus maccoyii*) longline fishery.

In anticipation that regulatory measures would be required to further reduce the incidental catch of seabirds in the Hawaii longline fishery, the Council in 1998, contracted Garcia and Associates to assess which mitigation methods would be most effective for local vessels under actual commercial fishing conditions. As reported in McNamara *et al*. (1999), the study assessed the effectiveness of various mitigation methods aboard Hawaii-based longline vessels under actual fishing conditions. The mitigation techniques evaluated included several of those identified by Alexander, Robertson and Gales (1997) as being effective in other fisheries, such as night setting, towed deterrents, modified offal discharge practices and thawed bait. In addition, Garcia and Associates evaluated blue-dyed squid bait, the effectiveness of which appeared promising based on limited use by Hawaii-based longline vessels, but which had not been scientifically assessed. Because data collected by NMFS observers showed that Hawaii-based longline vessels targeting swordfish had higher incidental catches of seabirds than did vessels targeting tuna, Garcia and Associates tested the effectiveness of mitigation methods primarily during swordfish trips. The criteria used by Garcia and Associates to evaluate the effectiveness of mitigation methods included the number of attempts on (chases, landings and dives) and interactions (physical contact) with fishing gear as well as actual hookings and mortalities.

In early 1999, NMFS' Honolulu Laboratory assessed the effectiveness of several seabird mitigation methods during a cruise on a NOAA research vessel in the waters around the NWHI (Boggs, 2001). This study was designed to supplement the field test of towed deterrents and blue-dyed bait conducted by Garcia and Associates, and to evaluate an additional measure: weighted branch lines. The advantage of using a research vessel to test the effectiveness of mitigation methods was that fishing operations could be controlled to improve the opportunities for observation, comparison and statistical analysis. For example, by setting gear in daylight researchers greatly increased the number of bird interactions with the gear in the presence and absence of each mitigation method. Easily regurgitated net pins were substituted for hooks in the research to avoid injuring seabirds.

Based on observer records from 1994 to 1998, the Honolulu Laboratory also assessed the mitigative effectiveness of a line-setting machine used in combination with weighted branch lines.

In October 1999, the Council recommended three measures to mitigate the harmful effects of fishing by vessels registered under Hawaii longline limited access permits on seabirds. The first measure required vessel operators fishing with longline gear north of 25°N to employ two or more of the following seabird deterrent techniques: 1) maintain adequate quantities of blue dye on board and use only completely thawed, blue-dyed bait; 2) discard offal while setting and hauling the line in a manner that distracts seabirds from hooks; 3) tow a NMFS-approved deterrent (such as a tori line or a buoy) while setting and hauling the line; 4) deploy line with a line-setting machine so that the line is set faster than the vessel's speed and, to promote rapid sinking of the bait; 5) attach weights equal to or greater than 45 grams to branch lines within one meter of each hook; and 6) begin setting the longline at least one hour after local sunset and complete the setting process no later than local sunrise, using only the minimum vessel's lights necessary for safety. The second measure directed vessel operators to make every reasonable effort to ensure that birds brought onboard alive are handled and released in a manner that maximizes the probability their long-term survival. The final measure required all vessel owners and operators to annually complete a protected species educational workshop conducted by the NMFS.

NMFS published a proposed rule for the Hawaii-based longline fishery based on the Council's recommended measures (65 FR 41424, July 5, 2000). However, the agency did not proceed with the publication of a final rule, as the USFWS was in the process of developing a BiOp for the fishery under section 7 of the Endangered Species Act (ESA) for the short-tailed albatross. This endangered species has been documented in small numbers in the NWHI, and the USFWS BiOp, published on November 28, 2000, concluded that the Hawaii-based longline fishery was not likely to jeopardize its continued existence.

The USFWS 2000 BiOp was based on the operations of the Hawaii-based longline fishery prior to December 1999, and anticipated that the fishery would take 15 short-tailed albatrosses during the seven-year period addressed in the consultation (2.2 short-tailed albatrosses annually from 2000-2006). The 2002 USFWS BiOp used (as did the 2000 USFWS BiOp) surrogate species interaction rates (i.e., black-footed albatross) to estimate the take of the short-tailed albatross by the Hawaii longline fishery. The BiOp considered a "take" to include not only injury or mortality to a short-tailed albatross caused by longline gear, but also any short-tailed albatross striking at the baited hooks or mainline gear during longline setting or haulback.[8]

The 2000 USFWS BiOp included several non-discretionary measures to be employed by the Hawaii-based longline fishery and implemented by NMFS. In contrast to the Council's recommendation requiring the use of any two of the six approved deterrents, the 2000 USFWS BiOp required that all Hawaii-based vessels operating with longline gear north of 23°N use thawed blue-dyed bait and discard offal strategically to distract birds during setting and hauling of longline gear. In addition, when making deep-sets (targeting tuna) north of 23°N, Hawaii-based vessel operators were required to employ a line-setting machine with weighted branch lines (minimum weight = 45 g). Under the terms and conditions of the BiOp, all longline vessel operators and crew were also required to follow certain handling techniques to ensure that short-tailed albatrosses would be handled and released in a manner that maximizes the probability of their long-term survival, and vessel operators were required to annually complete a protected species educational workshop conducted by NMFS. It was recommended that these guidelines be followed for all seabirds hooked but still alive. Optional mitigation methods include towed deterrents, or the use of weighted branch lines without a line-setting machine (in the case of swordfish or mixed target sets).[9] In addition, operators of vessels making shallow-sets (targeting

[8] The 2002 BiOp states "Because the Service defines take of short-tailed albatrosses to include injury or mortality resulting from physical interaction with longline gear, it is not necessary to have a dead bird in hand to document take. The record of a STAL physically interacting with gear and being hooked and/or obviously killed is sufficient."

[9] On October 18, 2001, the FWS amended the 2000 BiOp to include traditional basket-style, tarred mainline gear as an alternative to monofilament gear set with a line-setting machine and weighted branch lines.

swordfish) north of 23°N were required to begin the setting process at least one hour after sunset and complete the setting process by sunrise.

The emergency and final regulations implementing the above seabird mitigation measures for the Hawaii-based longline fishery were promulgated on June 12, 2001 and May 14, 2004, respectively. However, the 2000 USFWS BiOp requirements regarding shallow-set longlining north of 23°N were not implemented by NMFS. Instead, for the purpose of minimizing effects of the fishery on threatened and endangered sea turtle species, on March 31, 2001, by order of the court NMFS prohibited all shallow-set pelagic longline fishing north of the equator by Hawaii-based longline vessels.

The March 31, 2001 closure of the shallow-set longline component of the fishery led NMFS on August 15, 2001 to reinitiate consultation with the USFWS under the Endangered Species Act (ESA) to examine the impacts of the reduced fishery on short-tailed albatross. The subsequent 2002 BiOp was released November 18, 2002, and again concluded that the Hawaii-based longline fishery was not likely to jeopardize the continued existence of the short-tailed albatross. The 2002 USFWS BiOp also used surrogate species interaction rates (i.e., black-footed albatross) to estimate that one (1) short-tailed albatross per year may be taken in the reduced Hawaii-based longline fishery, or a total of four over the remaining four-year duration of that consultation (FWS, 2002).

In a ruling on August 31, 2003, the District Court vacated the 2002 sea turtle BiOp prepared by NMFS and the fishery regulations promulgated on June 12, 2002. This had the effect of removing the ban on shallow-setting by the Hawaii-based longline fishery, but also removed the protection afforded fishermen from prosecution under the ESA by the incidental take statement for listed sea turtles contained in the invalidated BiOp. This situation, combined with new information, experimental results and technological advances in longline gear design applicable to interactions between the fishery and sea turtles, prompted the Council to recommend new turtle interaction mitigation methods for the Hawaii-based fishery. As a result, current regulations allow a limited amount of shallow-set longline effort (2,120 sets annually) by Hawaii-based vessels using circle hooks with mackerel-type bait. Because this action allowed limited shallow-setting, it also implemented the 2000 USFWS BiOp requirement that any shallow-setting occurring north of 23°N be done at night. Final regulations implementing these recommendations were promulgated on April 2, 2004 (69 FR 17329).

A recent Biological Assessment (BA) concluded that the seasonal southern time/area closure during April and May (from the equator to 15°N and 145°W to 180°) poses a low likelihood of increased seabird interaction rates and that the fishery would not likely jeopardize the short-tailed albatross (HLA and WPRFMC, 2004). The BA also acknowledged that the greatest likelihood of interaction with seabirds may exist with the reopening of the swordfish component of the fishery, even though this component of the fishery will be markedly different than the historical fishery, such that vessels will employ all required seabird mitigation measures (including night setting above 23°N) as well as use circle hooks and mackerel bait (HLA and WPRFMC, 2004).

In 2001, the Council, NMFS, the Hawaii Longline Association, USFWS and the Blue Ocean Institute continued a collaborative research effort on seabird mitigation techniques using tuna gear. Of particular interest was the development of an underwater setting chute in New Zealand and Australia, and the potential for adapting this technology for Hawaii-based longline vessels.

A series of research trials with new mitigation methods were conducted between 2002 and 2003 using Hawaii-based longline vessels. The trials found that underwater setting chutes and side setting in conjunction with a bird curtain, where the longline is deployed laterally from amidships rather than directly over the stern, were also effective in minimizing interactions with seabirds.

3.6.1.4.4 Monitoring Seabird Interactions

The two major sources of information on albatross interactions with Hawaii-based longline vessels are the mandatory logbook and observer data collection programs administered by NOAA Fisheries. The longline logbook program requires operators of longline vessels to complete and submit to NOAA Fisheries a data form containing detailed catch and effort data on each set (50 CFR 660.14). Although the information is extensive, it does not compare to the completeness of the data collected by NOAA Fisheries observers. Furthermore, preliminary comparisons between logbook and observer data indicate under-reporting of protected species interactions by vessel operators in the logbooks (NMFS, 1996).

The Observer Program administered by NMFS was implemented in February, 1994 to collect data on protected species interactions (marine turtles have highest priority) which include: all sea turtles, especially green, leatherback, and loggerhead turtles; Hawaiian monk seals; selected whale and dolphin species; and seabirds, including the albatross species and the brown booby (*Sula leucogaster*). The NOAA Fisheries Observer Program achieved 5.3% coverage of all trips in the first year it was implemented, and then was unable to raise above 5% over the next five years (Table 3.6.1-5). The selection of trips to observe was based on a sampling design by DiNardo (1993) to monitor sea turtle interactions. Because most interactions with sea turtles tended to occur on vessels setting shallow and targeting swordfish, most trips observed tended to be those that fished above 23°N and targeted swordfish or a mixture of swordfish and tuna. As a consequence of regulatory changes, and with the prohibition of shallow-setting, a new sampling program was designed by M. McCracken where observers are randomly placed on vessels.

Although data collection on protected species is the primary purpose of the Observer Program, the observers also collect catch data on the fishery and in total record five different sets of data as follows: 1) incidental sea turtle take events; 2) fishing effort; 3) interactions with other protected species; 4) fishes kept and discarded, by species; and, 5) life history information, including biological specimens in some instances. The data from this program cover observed trips from February 25, 1994 (tail end of first quarter 1994), to the present, and provide the primary source of statistical information on seabird interaction rates for the Hawaii longline fishery.

Table 3.6.1-5 NOAA Fisheries Observer Program coverage of Hawaii-based longline fishing vessels between 1994 and 2003.

Year	Number of Trips	Observed Number of Trips	Average % Coverage
1994	1,031	55	5.3
1995	937	42	4.5
1996	1,062	52	4.9
1997	1,123	40	3.6
1998	1,180	48	4.1
1999	1,136	38	3.3
2000	1,134	118	10.4
2001	1,035	233	22.5
2002	1,193	294	24.6
2003	1,120	266	22.2

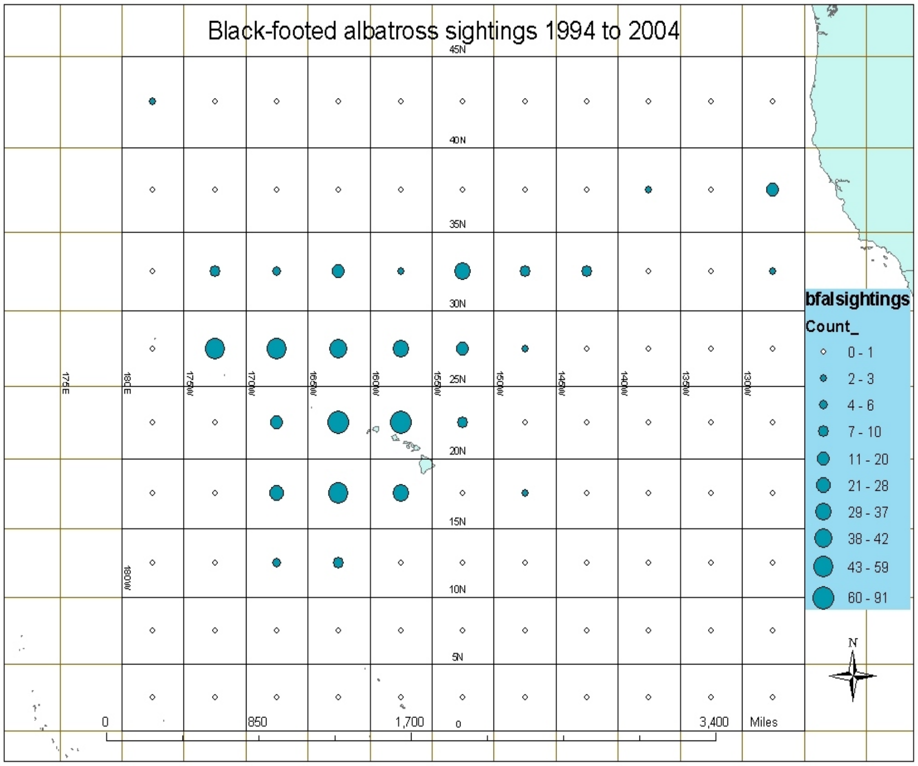
*Year 2000 was calculated as the time period between August 25, 2000 and March 31 2001. Year 2001 was calculated as the time period between July 1, 2001 and June 30, 2002.

NOAA observers record protected species data from three main types of events that include approaches, contacts and sightings. At sea seabird abundance around Hawaii longline fishing vessels is also collected (Figure 3.6.1-6). Sighting events are descriptions of seabird activity or behavior that do not involve approach or contact. An approach event is when a seabird is observed coming closer to the vessel or the gear and in some cases attempting to make contact. A contact event is when the seabird is observed to touch the gear. Any seabirds that become entangled or hooked in the gear are considered as incidental catch. A mortality is usually recorded by a NOAA observer when a seabird is retrieved during the haul. Dead seabirds retrieved on the haul-back are assumed to have been hooked during the set. Infrequently, albatrosses are incidentally caught during the haul, and if caught the birds usually survive.

The recording of approach and contact events are important in that these data could be used to estimate seabird incidental catch. For instance, seabird mitigation data collected on Hawaii longline fishing vessels during 1998 (McNamara et al.,1999) suggested that approach and contact events by albatrosses are correlated with hooking events (Figure 3.6.1-7). Further, contact events also appear to be linearly correlated with the number of seabirds present (Figure 3.6.1-7). Because seabird mortalities are statistically rare events (Brothers, 1991; Perkins and Edwards, 1996), gathering enough mortality data to show a statistically significant difference between mitigation methods may be difficult given that the seabird interaction rates for the Hawaii longline fishery are very low (Section 3.6.1.4.5). The gathering of more abundant data such as approaches and contacts may be one way to estimate possible seabird incidental catches in the fishery.

The relationship described in the second assumption supposes that albatross behavior is density independent, such that as bird abundance increases the number of approaches (or attempts to contact the gear) and contact events increase linearly. Since albatross abundance varies at sea, the data could be biased by inequalities in their abundance during the application of various mitigation methods. Albatross abundance data could be taken so that results could be presented in units of behaviors/mortality per bird (Grabowsky and Cousins, in prep.). This correction is successful only if the number of behaviors show a linear correlation with changes in abundance. The data from the McNamara et al. (1999) study and that of Gilman et al. (2002) suggest that the assumption that albatross attempt and contact events are correlated with a catch event, is valid. Thus, the more copious attempt and interaction data might be used as indicators of the potential for albatross catch on pelagic gear in the Hawaii-based longline fishery.

Figure 3.6.1-6 Abundance of black-footed albatrosses (top map) and Laysan albatrosses (bottom map) around Hawaii longline vessels during fishing operations (Source: NOAA Fisheries Observer Program, unpubl. info.).



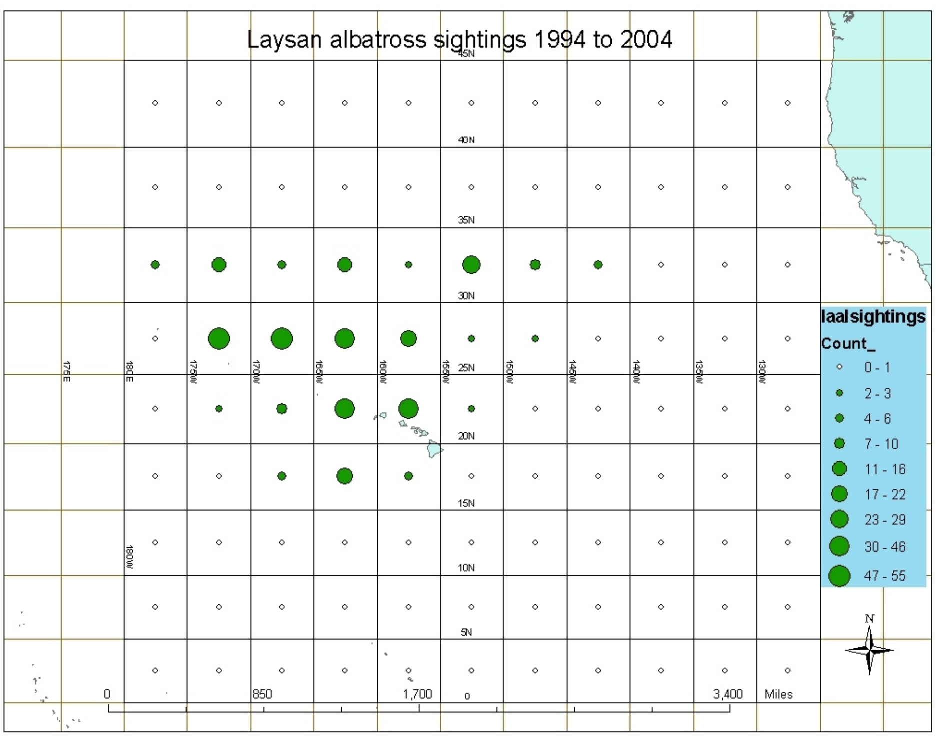


Figure 3.6.1-7 Relationships of albatross attempts, interactions and mortalities. Top - The relationship between the total number of albatross attempts and hooking events for all 21control observation periods during the set in which albatrosses were present. The product-moment correlation coefficient (*r*) between the number of attempts and the mortality is $r = 0.531$ (n = 21, $k = 1$, df = 19) which demonstrates that there is a significant ($P < 0.05$) relationship between attempts and hookings. Bottom - The relationship between the number of contact events or interactions and hooking events recorded over the same 21 control observation periods. The correlation coefficient for these data is $r = 0.641$ (n = 21, $k = 1$, df = 19) again demonstrating that there is a significant ($P < 0.05$) relationship between interactions and seabird hookings. (Source: Data obtained from McNamara et al., 1999.)

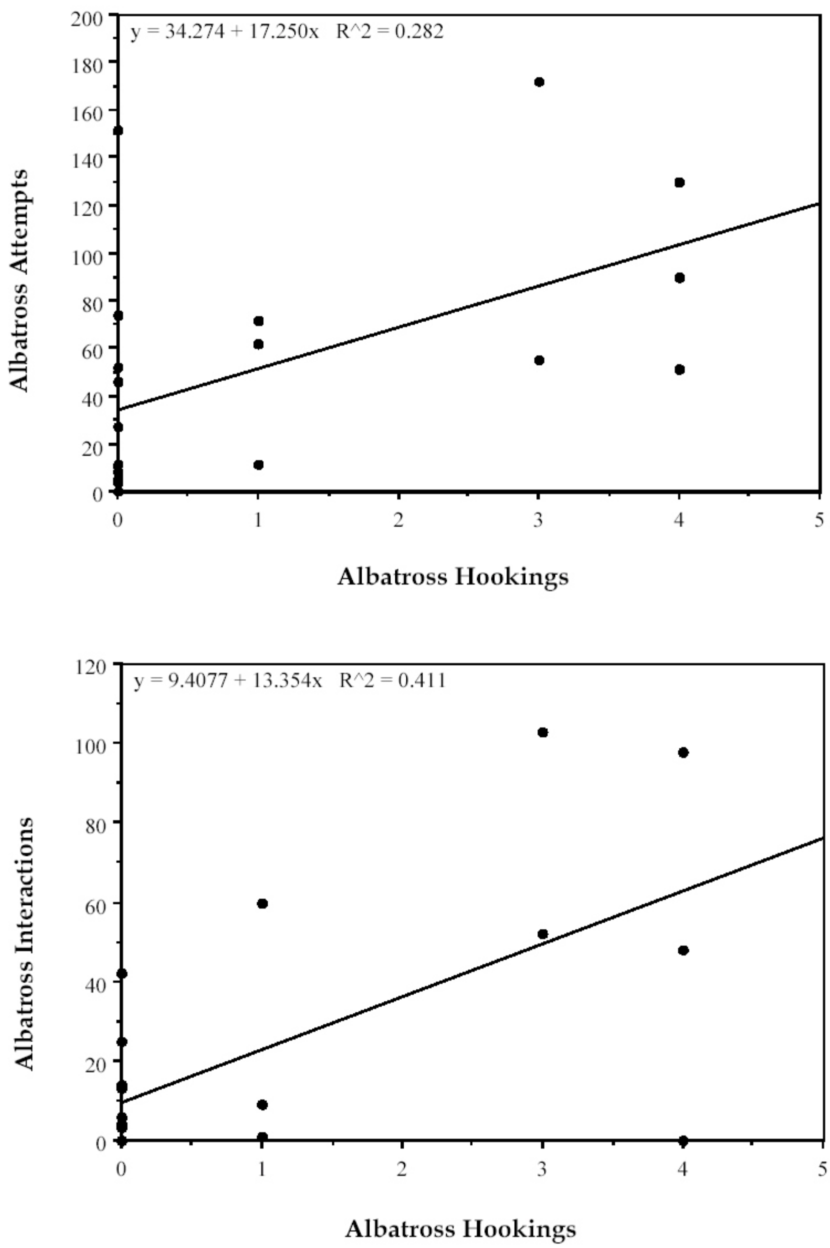


Figure 3.6.1-8 Relationships between albatross attempts, interactions and numbers present. Top - The relationship between the number of albatross attempts and the total number of albatrosses present for each of the 21 control observation periods on the set. The plot illustrates a correlation of $r = 0.760$ (n = 21, $k = 1$, df = 19) demonstrating that there is a significant ($P < 0.05$) linear relationship between the number of birds present and the number of attempts made towards baits on the set. Bottom - The relationship between the number of contact events or interactions and the number of albatrosses present during control observations on the set. The correlation coefficient for this plot is $r = 0.541$ (n = 21, $k = 1$, df = 19) which is significant ($P < 0.05$). (Source: Data obtained from McNamara et al., 1999.)