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Protected Species Conservation

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INTRODUCTION

There is a saying at the Western Pacific Regional Fishery Management Council (WPRFMC, or the Council) that goes like this: “Seabirds are so 1990s, sea turtles are so 2000s and now it’s marine mammals.” This highlights the main decades in which the Council addressed interactions of seabirds, sea turtles and marine mammals in the Hawai‘i-based longline fishery. In reality, the Council’s efforts to prevent and minimize protected species interactions extend back another 15 years, starting with the early years of the Council’s history.

The Council is one of the eight regional fishery management councils under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976. The MSA is the principal law governing fisheries management in US federal waters. The WPRFMC has authority over fisheries in the Pacific Ocean seaward of the state/territorial waters around Hawai‘i, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI) and the Pacific Remote Islands Area (PRIAs).

The primary role of the Council is to develop and amend fishery management plans (FMPs) through a transparent, bottom-up process. Management policies developed by the Council and approved by the Secretary of Commerce are implemented by the National Marine Fisheries Service (NMFS) and enforced by the NOAA Office of Law Enforcement, the US Coast Guard and local enforcement agencies.

Monitoring and mitigating protected species interactions is an integral component of managing fisheries under the MSA. For example, one of MSA’s National Standards requires that conservation and management

measures in FMPs minimize bycatch and bycatch mortality to the extent practicable. The MSA additionally requires FMPs to be consistent with laws such as the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA) and the National Environmental Policy Act (NEPA). Balancing the needs of fisheries and fishing communities with protected species conservation is also central to the ecosystem-based management approach implemented by the Council through its current Fishery Ecosystem Plans (FEPs).

This monograph is an overview of the many actions that the Council has taken since its establishment in 1976 to minimize fishery impacts on protected species. These actions are results of collaboration with fishermen, seafood industry members, researchers, managers and others who have contributed to finding solutions to each emerging issue. Part I of this monograph traces the history of the various management measures that have contributed to the conservation of protected species. Part II provides a summary of the Council’s Sea Turtle Conservation Program, established in 2002.

A monk seal rests near a green sea turtle hatchling on the northwest Pacific island of French Frigate Shoals. (Photo: Mark Sullivan/NOAA)

PART 1 HISTORY OF PROTECTED SPECIES CONSERVATION BY THE WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL



Top left: Original members of the Western Pacific Regional Fishery Management Council in 1976. Top right: Bottomfish fisherman with onaga (longtail snapper). Above: Ahi (bigeye tuna) at the Honolulu fish auction.

WHEN THE MSA was enacted in 1976, the Council began the task of developing plans for the conservation and management of fishery resources within the 200 nautical mile zone that would later become the exclusive economic zone (EEZ). Each of the FMPs established a management framework and measures to prevent overfishing while achieving optimum yield for target stocks. Notably, each FMP included conservation measures that directly or indirectly contributed to the protection of non-target species such as marine mammals, sea turtles and seabirds.

Since the first FMPs were implemented in the early 1980s, the Council prohibited various fishing gear to prevent protected species interaction and habitat degradation. The first two plans implemented in 1983 were the *Fishery Management Plans for Precious Coral Fisheries of the Western Pacific Region* (Precious Coral FMP) and the *Fishery Management Plan for Crustacean Fisheries of the Western Pacific Region* (Crustacean FMP). The Precious Coral FMP prohibited the use of bottom trawling and other potentially

destructive and non-selective gear to harvest species managed under the plan. The Crustacean FMP included measures to minimize potential impacts to Hawaiian monk seals, such as specification of trap gear design and prohibition of nets.

The *Fishery Management Plan for Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region* (Bottomfish FMP) was implemented next in 1986. The plan included a prohibition on destructive fishing techniques, such as explosives, poisons, trawl nets, and bottom-set gillnets. The following year in 1987, the *Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region* (Pelagic FMP) was implemented and prohibited foreign and domestic drift gillnet fishing within the EEZ. The drift gillnet ban under the Pelagic FMP covered the entire 1.5 million square miles of US EEZ waters throughout the Western Pacific Region and was implemented ahead of the 1991 United Nations ban on large-scale drift gillnets on the high seas. In 2001, the *Fishery Management Plan for Coral Reef Ecosystems of the Western Pacific Region* (Coral Reef

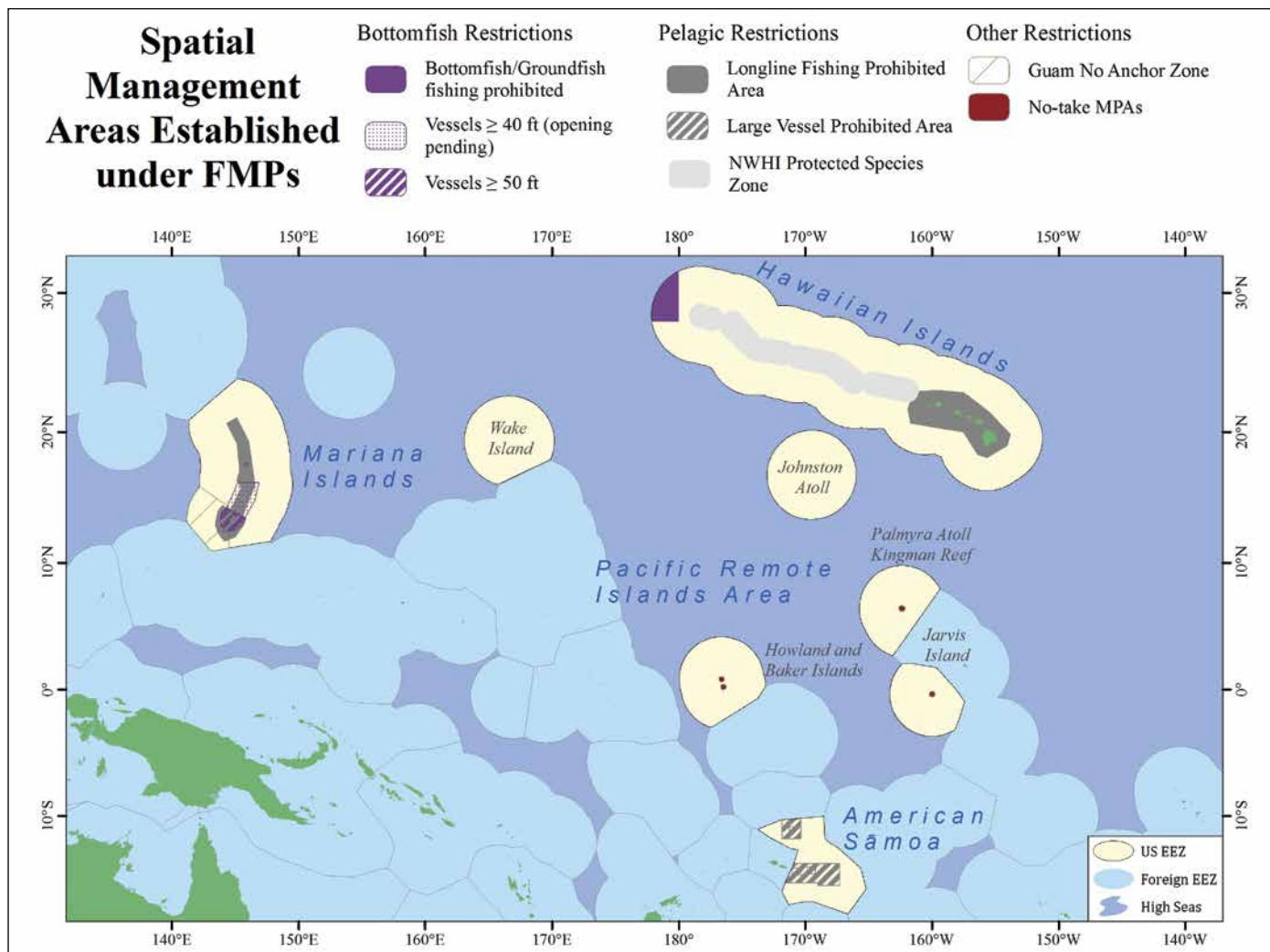
Ecosystem FMP) was implemented, prohibiting the use of destructive and non-selective fishing gears to harvest coral reef ecosystem management unit species.

Another aspect of FMP management measures that contributes to protected species conservation is the mechanism to collect information and monitor impacts if concerns arise. The Bottomfish, Crustacean and Pelagic FMPs included either in their original plans or subsequent amendments a mechanism for establishing a mandatory observer program to collect information on protected species interactions. An observer program was implemented for the Northwestern Hawaiian Islands (NWHI) bottomfish fishery from 2003 to 2005, and continuous observer programs have been implemented in the Hawai'i longline fishery since 1994 and the American Samoa longline fishery since 2006.

The Council has also developed spatial measures as a management tool. For example, the 1983 Crustacean FMP established a 20-nautical-mile closure around Laysan Island and all waters shallower than 10 fathoms, and the 2001 Coral Reef Ecosystem FMP designated no-take and low-use marine protected areas in the NWHI and American Samoa. A 50-nautical-mile protected species zone around the NWHI was established under the Pelagic FMP in 1991 to prevent longline fishery interactions with the endangered Hawaiian monk seals. This was followed by a 25- to 75-nautical-mile longline exclusion zone around the main Hawaiian Islands (MHI) in 1992 to prevent gear conflicts between longline vessels and other smaller fishing boats. The MHI longline exclusion zone also eliminated any potential interactions between the longline fishery and nearshore

populations of sea turtles and marine mammals. Vessel monitoring system requirements were implemented in the Hawai'i longline fishery to monitor compliance with area closures.

These proactive conservation and management measures implemented under the original FMPs prevented the use of destructive fishing gear and established mechanisms for monitoring, gathering information and mitigating protected species interactions. The FMPs also implemented limited entry programs and, in some fisheries, maximum vessel sizes to manage the scale of fishery participation. These mechanisms paved an important path forward in addressing seabird, sea turtle and marine mammal interactions that began to surface in the 1990s, particularly in the longline fisheries managed under the Pelagic FMP.



Spatial management measures implemented under the Council's FEPs provide conservation benefit to protected species.

Seabird Mitigation in the Hawai'i Longline Fishery

In the mid-1990s, the Council began addressing seabird interactions in the Hawai'i-based longline fishery after the fishery expanded and the mandatory observer program began reporting high catch rates of Laysan and black-footed albatrosses that nest in the NWHI. The albatross species followed the longline vessel, foraged on baited longline hooks as the vessels deployed their fishing lines and inadvertently became hooked or entangled in the process. By the time the Council began addressing the issue, some simple mitigation measures had been devised for longline fisheries outside of the United States.



Laysan albatross with chick.

In an effort to encourage voluntary adoption of mitigation measures, the Council and the US Fish and Wildlife Service (USFWS) held two workshops in 1996 and 1997 to inform fishermen of the problem and various mitigation measures. Outreach materials describing possible mitigation measures were also distributed at the workshops and sent to all Hawai'i longline limited access permit holders. Two separate surveys conducted in 1997 and data collected by the observer program showed that the initial outreach efforts led to nearly all of the longline vessels using some form of mitigation measure to keep seabirds away from their vessels and baited hooks. These measures included 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 and using bait dyed blue to camouflage it in the water.

In 1998, the Council convened the Black-footed Albatross Population Biology Workshop to make a preliminary assessment of the impact of fishing by the Hawai'i-based longline fleet on the black-footed albatross population in the NWHI.



Blue-dyed bait camouflages it in the water, reducing the chance that seabirds will spot the bait.

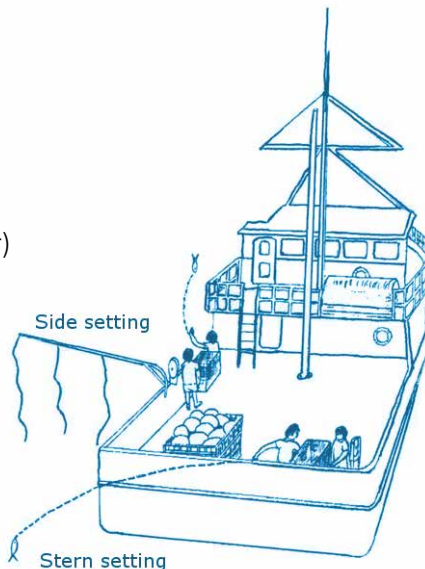
The workshop identified the incidental catch of seabirds by fishing vessels as a source of long-term mortality and showed that the interactions were occurring predominantly with immature juvenile birds (Cousins and Cooper 2000). This suggested that the impacts were not as severe as having an equal amount of adult mortalities.

Seabird Mitigation Measure Requirements for the Hawai'i-based Longline Fishery

Applies to tuna-targeting deep-set longline vessels operating at latitudes higher than 23 degrees north and all swordfish-targeting shallow-set longline vessels

When **side-setting**, vessels are also required to:

- Use bird curtain aft of the setting station
- Attach weights (45 grams or heavier) within 1 meter of each hook
- If using a line shooter, mount at least 1 meter forward from stern corner
- Deploy gear so hooks do not resurface



When **stern-setting**, vessels are also required to:

- Use blue-dyed bait
- Use fish parts and spent bait for strategic offal discard
- Night set—begin set 1 hour after sunset and finish 1 hour before next sunrise (if shallow-setting)
- Use a line shooter and weighted hooks (if deep-set setting)

Figure 1. Summary of seabird mitigation measures in the Hawai'i-based longline fishery (image source: Gilman and Others 2003)

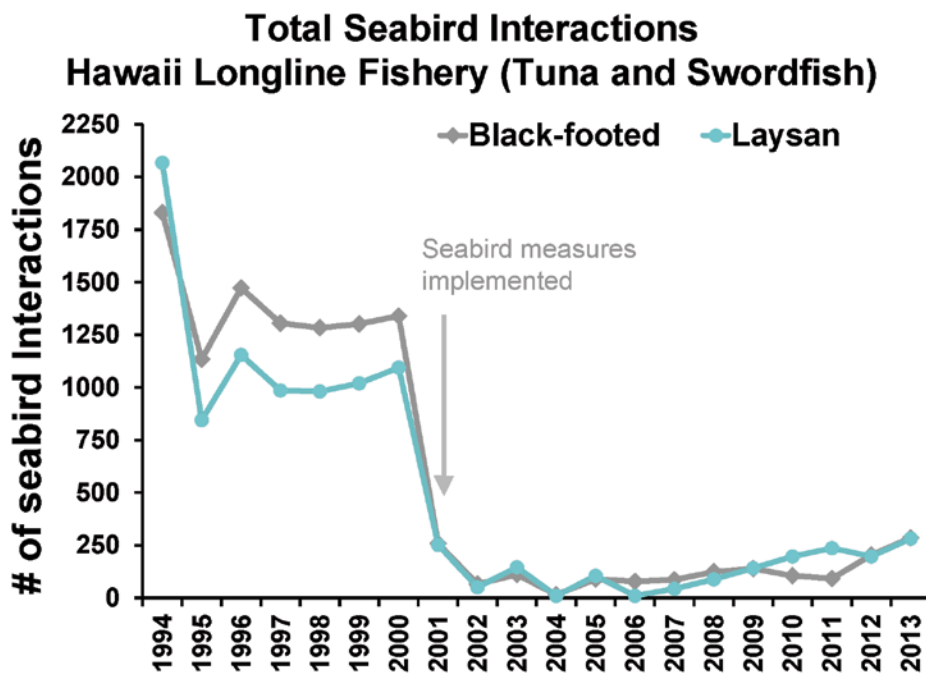


Figure 2. Total seabird interactions in the Hawai'i-based tuna and swordfish longline fisheries, 1994–2013.

The same year, the Council contracted a study to assess which mitigation methods would be most effective in reducing seabird interactions for Hawai'i-based longline vessels under actual commercial fishing conditions (McNamara and Others 1999). The study evaluated the effectiveness of mitigation methods known to reduce seabird interactions in other fisheries, such as night setting, towed deterrents, and modified offal discharge practices. The study also tested blue-dyed bait, the effectiveness of which appeared to be promising based on limited use by Hawai'i-based longline vessels but which had not been scientifically assessed. Additional research was conducted by the NMFS Southwest Fisheries Science Center Honolulu Laboratory (now called the Pacific Islands Fisheries Science Center) to evaluate the effectiveness of weighted branch lines and to assess the effectiveness of a line-setting machine in combination with weighted branch lines.

Results from the studies suggested that no single mitigation method would entirely eliminate mortalities of seabirds in the longline fishery. As a result, a combination of mitigation measures and simple modifications to

common fishing practices were considered to provide the most effective approach for reducing seabird interactions.

In 1999, the Council recommended three measures to mitigate incidental interactions with seabirds by vessels registered under the Hawai'i longline limited access permits. The first measure required vessel operators to use two or more seabird deterrent techniques when fishing with longline gear in higher latitudes prone to seabird interactions. The recommended techniques included blue-dyed bait, strategic offal discard, towed deterrents, line-setting machine, weighted hooks and night setting. 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 their long-term survival. The final measure required all vessel owners and operators to annually complete a protected species educational workshop conducted by NMFS.

Most of the measures recommended by the Council were first implemented through an emergency rule in June

2001, which was later extended to June 2002. The full set of measures was implemented through a Framework Adjustment to the Pelagic FMP that became effective in 2002.

The seabird measures implemented in 2001, combined with the temporary closure of the Hawai'i-based swordfish longline fishery that same year due to sea turtle interactions resulted in a significant reduction in seabird interactions. Seabird interactions remained low even after the reopening of the swordfish fishery in 2004, as fishermen were required to use a combination of mitigation measures at all times.

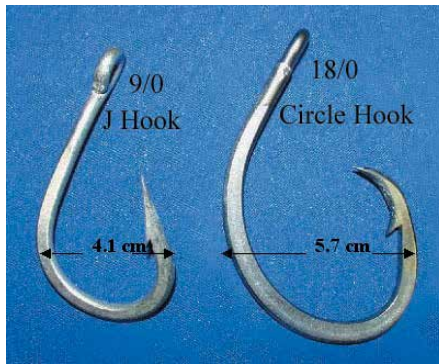
Additional seabird mitigation research later revealed that conducting the longline gear deployment from the side of the vessel rather than the stern, when combined with weighted hooks, was effective in reducing interactions even further (Gilman and Others 2007). Based on these results, the Council recommended a modification to the seabird measures that provided fishermen with the option to side-set in combination with weighted hooks or use a combination of the original mitigation measures such as blue-dyed bait. The side-setting rule was implemented in 2006 and remains in place today.

The decade-long effort to reduce seabird interactions is an example of successful collaboration between the Council, industry, researchers, managers and environmental non-governmental organizations (ENGOS). These efforts resulted in more than a 90-percent reduction in total seabird captures in the Hawai'i-based longline fishery by 2006 (Van Fossen 2007) and a 67-percent reduction in seabird bycatch rate in the tuna-targeting deep-set longline fishery (Gilman and Others 2008).

Sea Turtle Mitigation in the Longline Fisheries

Sea turtle bycatch in the Hawai'i-based longline fishery became a concern in the early 1990s with increased swordfish fishery effort in the region. At the time, annual loggerhead interactions were estimated to be around 400 individuals with an estimated mortality between 64 and 88 individuals annually. Leatherback interactions were estimated to be around 100 individuals annually with an estimated mortality of approximately 10 individuals. In response, the Council encouraged the establishment of a volunteer observer program to monitor the extent of bycatch in the fishery, and NMFS convened a number of workshops between 1993 and 1998 to discuss ways to reduce sea turtle bycatch. Despite increasing concerns about the potential impacts of the fishery on these sea turtle populations, a requirement under NEPA to prepare an environmental impacts statement (EIS) for the longline fishery had not been fulfilled by NMFS. Eventually, the absence of an EIS for the fishery became a target for ENGOs that had concerns over the high number of sea turtle bycatch.

A lawsuit was filed against the federal government in 1999 by several ENGOs claiming that the Hawai'i longline fishery was operating in violation of NEPA and ESA. Over the subsequent five years, the Hawai'i longline fishery was subject to a number of management measures stemming from lawsuits, emergency rules, longline closures, ESA consultations, and FMP amendments. Several time-area closures of the swordfish fishery were implemented after 1999, and a full closure of the swordfish sector of the Hawai'i-based longline fishery went into effect in 2001. The closure lasted until April 2004, during which time bycatch experiments were conducted in the US Atlantic longline fishery. The experiments found that a combination of circle hooks with mackerel-type bait reduced interactions with loggerhead and leatherback turtles by 92 percent and 67 percent, respectively (Watson and Others 2005).



Large circle hooks and mackerel bait replaced J-hooks and squid bait when the Hawai'i-based swordfish longline fishery reopened in 2004, reducing interactions and minimizing injury

The 2004 amendment to the Pelagic FMP that reopened the Hawai'i-based swordfish fishery included a number of requirements to reduce sea turtle interactions with this fishery: mandatory uses of circle hooks and mackerel-type bait, 100-percent observer coverage, sea turtle safe handling requirements and mandatory annual attendance of a protected species workshop by longline vessel operators.

In addition to these measures, the swordfish fishery reopened under an annual set effort limit of 2,120 sets (approximately 50 percent of the 1994–1999 annual average number of sets).



Examples of sea turtle safe handling gear required for Hawai'i-based longline vessels. These gear help remove hooks and other gear from sea turtles before release.

Further, based on ESA consultation of the fishery by NMFS containing an incidental take statement, the swordfish fishery was given annual allowable takes (hooking or entanglement) of 17 loggerheads and 16 leatherbacks, after which the swordfish fishery would close for the remainder of the year. A subsequent regulatory amendment in 2010 removed the swordfish fishery



set-limit, and the allowable take levels were changed to 34 loggerheads and 26 leatherbacks in 2012.

The Hawai'i-based swordfish longline fishery has now been operating for more than 10 years with management measures to reduce sea turtle interactions. As a result of these measures, sea turtle interactions have been significantly reduced. An analysis of the swordfish longline fishery observer data for the period of 2004–2007 showed that interaction rates of leatherback and loggerhead turtles declined by 83 percent and 90 percent, respectively, compared to pre-regulation interaction rates (Gilman and Others 2007). During the period 2004–2011, the swordfish fishery reached the loggerhead hard cap only once in 2006 and the leatherback hard cap only once in 2011. Since the revision of the allowable take limit in 2012, the fishery has not triggered the hard cap.

Effects of the Swordfish Longline Closure

The closure of the swordfish fishery in Hawai'i was intended to reduce sea turtle interactions and reduce the impacts of the fishery to endangered and threatened sea turtle populations. While sea turtle interactions within the US EEZ may have been reduced during the closure, the closure only applied to Hawai'i-based longline vessels and did not affect foreign flag vessels fishing outside of the US EEZ. In addition, US demand for swordfish did not decrease in response to the closure, and foreign imports of swordfish increased during that time. Analyses show that much of the imports came

from fisheries that were less regulated and had greater impacts to sea turtle population. The closure may have contributed to an additional 2,800 sea turtle interactions in the four-year period (Rausser and Others 2009). The closure of the swordfish fishery accelerated the Hawai'i-based fishery's efforts to reduce sea turtle interactions in the long run; however, it is likely to have resulted in a short-term negative impact to sea turtle populations on a global scale.

Additional Contribution to Sea Turtle Conservation by the Western Pacific Regional Fishery Management Council

In a resolution adopted at its 104th meeting in June 2000, the Council recognized that the impacts from Hawaii's fisheries to the overall sea turtle population were limited. The Council pointed to the extremely small fishing effort of the Hawai'i-based longline fishery compared to the Pacific-wide longline fishing effort (less than 5 percent), the high survival rate of sea turtles interacting with the swordfish longline fishery, and the significant threats sea turtle populations encounter in their nesting habitat. The resolution called for international cooperation to mitigate fishery impacts throughout the Pacific and for the conservation of sea turtle nesting beaches. Acting upon its

resolution, the Council established its Sea Turtle Conservation Program in 2002 to ensure the sustainability of Hawai'i-based longline fisheries, contribute to the international transfer of sustainable fisheries technology and knowledge, and aid in the recovery of Pacific sea turtle populations. The Council also formed a Sea Turtle Advisory Committee in 2003 to direct and advise the Council in its activities related to sea turtle conservation and fishery management initiatives. A summary of this program's history is presented in Part 2.

Mitigating Green Turtle Interactions in the American Samoa Longline Fishery

The American Samoa longline fishery began in 1995 with one vessel targeting albacore tuna to be delivered to the local canneries. The fishery soon expanded, increasing from approximately 21 mostly small vessels in 1997 to 75 vessels of a variety of sizes in 2002. In response to the developing fishery, the Council began managing the fishery under the Pelagic FMP, establishing a longline prohibited area for large vessels and a limited entry system for pelagic longline vessels fishing in the US EEZ waters around American Samoa. Monitoring mechanisms were also put in place, requiring American Samoa longline vessel operators to complete federal logbooks, use vessel

monitoring systems and carry federal observers if requested by NMFS.

When the federal observer program for the American Samoa longline fishery started in 2006, it was discovered that the fishery had occasional green turtle interactions. During the first few years, the fishery had one to three observed interactions with green turtles annually, with an estimated total of approximately 30 per year for the entire fishery. The Council considered this interaction level low compared to other foreign fisheries operating in the Pacific. Nonetheless, it began developing mitigation measures upon receiving advice from NMFS in 2008.



Safe handling of sea turtles is an essential component of the mitigation measures to ensure turtles survive after release.

The American Samoa longline fishery was already using circle hooks and fish bait, which were the main measures that resulted in significant sea turtle bycatch reductions in the Hawai'i-based swordfish longline fishery. The focus of developing mitigation measures was placed on the depth of the fishing gear, given that available observer data showed that most of the green turtle interactions occurred on the shallowest hooks.

In 2009, the Council recommended a measure to mitigate green turtle interactions by requiring longline gear configuration in such a way that all hooks are set deeper than 100 meters. Since the measure became effective in 2011, the estimated total interactions have been about seven green turtles per year, a substantial reduction compared to the estimated 30 per year before the implementation.

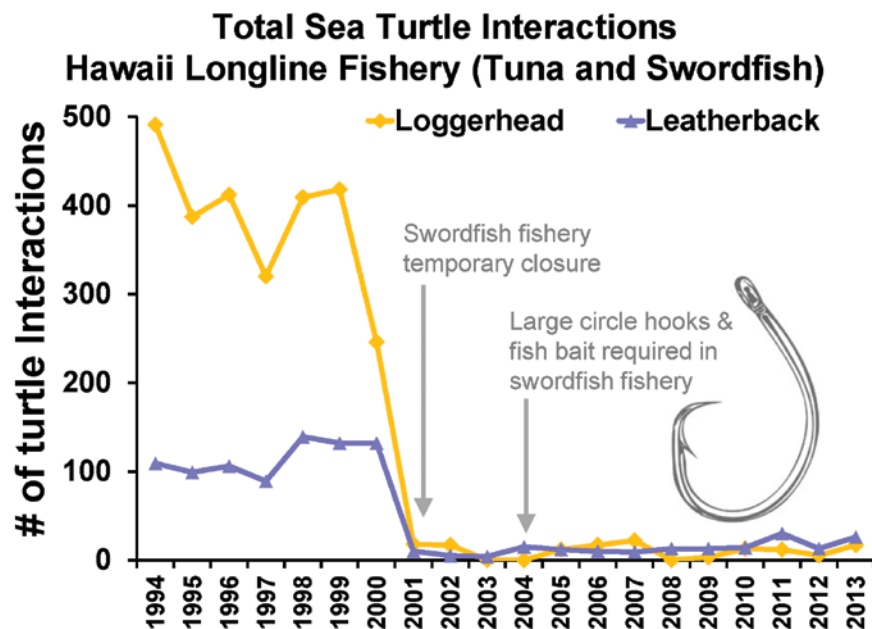


Figure 3. Total sea turtle interactions in the Hawai'i-based tuna and swordfish longline fisheries, 1994–2013.



False killer whales are toothed whales found in all tropical and temperate oceans worldwide. (Photo by Southwest Fisheries Science Center, NOAA Fisheries Service)

New Challenges: Marine Mammals and Beyond

After the Hawai'i-based longline fishery's success with seabird and sea turtle bycatch mitigation efforts, the Council turned its attention to another protected species issue. This time, it was false killer whales in the Hawai'i-based deep-set longline fishery, which primarily targets bigeye tuna.

False killer whales and other toothed whales are known to eat catch and bait off of longline hooks in many parts of the world. These depredation events can be costly to fishermen, as false killer whales will leave only the head of the tuna and other valuable fish. In rare instances, false killer whales may become accidentally hooked or entangled in the process.

Since the observer coverage rate for the deep-set longline fishery increased to more than 20 percent in 2001, the number of observed false killer whale hookings and entanglements has been less than five in most years. This level of interaction is considered very rare

in the fishery, and most interactions resulted in the animal being released alive. Yet, it was estimated that the false killer whale interactions were occurring at an unsustainable levels according to the assessments conducted under the MMPA.

When marine mammal interaction levels are found to be unsustainable under the MMPA, NMFS is required to

convene a Take Reduction Team (TRT) to develop recommendations for mitigating the impacts. However, in the case of false killer whale interactions in the Hawai'i longline fishery, NMFS delayed the convening of the TRT due to funding limitations. In the interim, the Council stepped in and formed the Marine Mammal Advisory Committee (MMAC) in 2005.



Tuna and other fish depredated by false killer whales are typically brought up with only the head remaining on the hook. (Photo by NMFS PIRO Observer Program)

Three meetings of the MMAC highlighted the challenges of mitigating false killer whale depredations and interactions, as these rare events appeared to be occurring randomly in time and space. Information on false killer whale stocks around Hawai'i was also limited, and studies aimed at deterring false killer whales from eating bait and catch had not resulted in any effective solutions. As a result, the MMAC generated recommendations aimed at addressing these challenges and data gaps.

NMFS eventually formed a TRT in 2010, and the TRT was tasked to develop a draft Take Reduction Plan (TRP) within six months. Due to the lack of technological solutions to reduce interactions, the TRT focused its deliberations on ways to minimize the injury if a false killer whale is hooked. The final TRP was implemented in late 2012, requiring the deep-set longline fishery to use "weak" hooks intended to straighten on the weight of a false killer whale but withstand the weight of a large bigeye tuna.

Monitoring of the TRP is ongoing, but the effectiveness of the measures

intended to minimize injuries has yet to be determined as of 2015. Indeed, the low level of interactions may mean that it may take many years to determine whether measures are working, unlike the significant bycatch reductions seen after the implementation of the Council's seabird and sea turtle measures.

The Council continues to work with the industry and NMFS to search for long-term solutions to the false killer whale depredation and incidental interaction issues. In 2015, the Council supported the industry in their fleet-wide outreach effort to increase awareness of the importance of straightening a weak hook if fishermen encounter a false killer whale hooking. The Council is also working with the industry to test the commercial viability of a device designed to deter false killer whales from depredating on tuna and other catch.

Future of Protected Species Conservation in Fishery Management

Efforts to monitor, assess and mitigate fishery impacts to protected species will continue to be a high priority for the Council in the future. These initiatives

are integral to managing fisheries under the MSA, especially in light of Council's transition in 2009 from species-based management approach under the former FMPs to ecosystem-based management approach under the new Fishery Ecosystem Plans.

The Council's focus on protected species will evolve as new issues emerge. Listing of new species groups under the ESA in recent years, such as reef-building corals and sharks, prompted the Council to establish a Protected Species Advisory Committee in 2013 to bring together a broad range of experts to advise on priorities for research, conservation and management. Climate change brings to light new challenges in understanding and mitigating fishery impacts on protected species populations, while rebounding populations of certain ESA-listed species may lead to more frequent fishery interactions. Regardless of what the future holds, the Council's bottom-up process to adaptive management will serve as a mechanism to address each new issue that arises in fisheries across the US Western Pacific region.



Hawaii longline fishery vessel at Honolulu Harbor.

History of Protected Species Conservation and Management by the Western Pacific Regional Fishery Management Council



The Western Pacific Regional Fishery Management Council (WPRFMC) has been at the forefront of protected species management. Through the bottom-up process established under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Council has developed numerous measures that directly and indirectly benefit protected species.



1976 MSA

Congress approves the MSA, which establishes the WPRFMC along with seven other regional Councils. The original MSA did not include tuna species under its management authority.

1983

Precious Coral FMP

Fishery Management Plan for Precious Coral Fisheries of the Western Pacific Region (*Precious Corals FMP*) implemented and prohibited bottom trawling and other potentially destructive and non-selective gear.



1987

Pelagic FMP

Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (*Pelagic FMP*) implemented and prohibited the use of drift gillnet gear within the EEZ unless authorized by an experimental fishing permit.



1991-1994

Hawaii Longline Fishery

A number of amendments to the MSA, including the establishment of a 50-mile species zone in the NWHI and 25-mile exclusion zone around the main Hawaiian Islands and reporting requirements, limited mandatory vessel monitoring program.



1990 Tuna

Congress amends the MSA to include highly migratory tuna species in the Pacific under management authority of WPRFMC.



SETTING UP THE MANAGEMENT SYSTEM

FOCUS ON DATA COLLECTION



1983

Crustaceans FMP

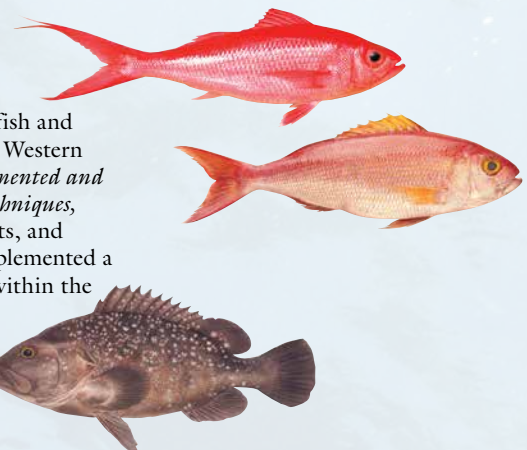
Fishery Management Plan for Crustacean Fisheries of the Western Pacific Region (*Crustacean FMP*) implemented and established gear restrictions such as trap design specifications and prohibition of certain gear to minimize risk to Hawaiian monk seals.

The FMP also established measures for the Northwestern Hawaiian Islands (NWHI) management area, including federal permit requirements and area closures of waters within 20 nautical miles of Laysan Islands and all waters shallower than 10 fathoms.



1986 Bottomfish FMP

Fishery Management Plan for Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region (*Bottomfish FMP*) implemented and prohibited certain destructive fishing techniques, including explosives, poisons, trawl nets, and bottom-set gillnets. The FMP also implemented a permit system for bottomfish fishing within the EEZ around the NWHI.



1988 Limited Access

Limited access system and a requirement to complete a protected species workshop established under the Bottomfish FMP for the distant Ho'omalū Zone of the NWHI bottomfish fishery. Both provisions were later expanded to the closer Mau Zone of the NWHI bottomfish fishery in 1999.



1992

Limited Access

Limited access system established for the NWHI under the Crustacean FMP.

Western Pacific Regional Fishery Management Council

of protected species conservation and
Conservation and Management Act
ected species.

Fishery Management

Pelagic FMP implemented,
0 nautical mile *protected*
75 nautical mile *longline*
Hawaiian Islands, permit
ed entry program, and a
ram.



2000

Sea Turtle

WPRFMC adopts
international sea
turtle research
and mitigation
resolution.

2001 Coral Reef Ecosystem FMP

Fishery Management Plan for
Coral Reef Ecosystems of the
Western Pacific Region (*Coral
Reef Ecosystem FMP*) *implemen-
ted and prohibited the use of
destructive and non-selective
fishing gears.*



2004

Sea Turtle

*Sea turtle bycatch
mitigation measures
implemented* for
the Hawaii-based
longline fishery under
the Pelagic FMP,
reducing interactions
by nearly 90%.



2005

American Samoa Longline Fishery Management

Limited access system for the American Samoa
longline fishery established under the Pelagic FMP.
Additional new requirements implemented this
year include federal permits, logbooks and vessel
monitoring systems.

2006

Observer Program

Mandatory federal
observer program
initiated for the
American Samoa
longline fishery.

2011

Sea Turtle

*Sea turtle mitigation
measure implemented*
in the American Samoa
longline fishery under
the Pelagic FEP to
minimize interactions
with green turtles.

COLLECTION



Access

ss system
for the
er the
FMP.

1996

Seabird

WPRFMC
initiates
program
to reduce
albatross
interactions
with longline
fisheries.



2002 Seabird

*Seabird bycatch mitigation
measures implemented* for
the Hawaii-based longline
fishery under the Pelagic FMP,
reducing interactions by over
90%. Additional measures
implemented in 2006.

1994

Observer Program

Mandatory federal observer
program initiated for the
Hawaii longline fishery.



2003

Observer Program

Federal observer program
initiated for the NWHI
bottomfish fishery. No
interactions were observed
with sea turtles or marine
mammals, and the federal
observer coverage ended
in 2005.

2005

Marine Mammal

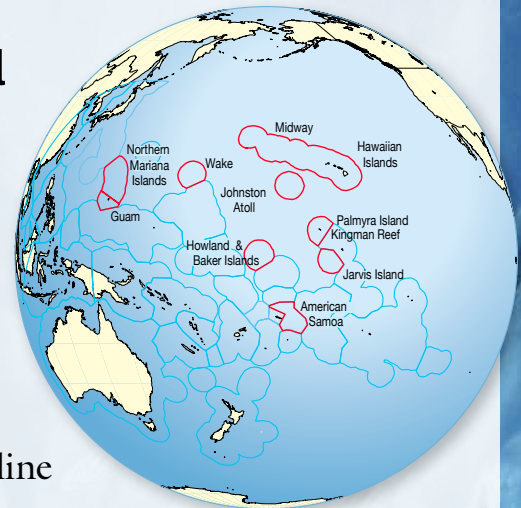
WPRFMC establishes the
Marine Mammal Advisory
Committee (MMAC) to
recommend measures to
minimize marine mammal
interactions in pelagic longlines.
MMAC generated a number
of research and data collection
recommendations necessary
for developing bycatch
mitigation solutions.



2009

Ecosystem-based Fishery Management

FMPs restructured as four
Archipelagic Fishery Ecosystem
Plans (FEP) for Hawaii, Marianas,
American Samoa and the Pacific
Remote Island Areas (PRIA), and
one Pacific Pelagic FEP, shifting
WPRFMC's management focus
from a species-based to ecosystem-
based conservation approach.



SOLVING BYCATCH ISSUES & SHIFT TO ECOSYSTEM-BASED MANAGEMENT

PART 2 COUNCIL'S SEA TURTLE CONSERVATION PROGRAM



A leatherback hatchling emerges from a nest and through a bamboo grid designed to keep predators away from the nests.
(Photo by Nicolas Pilcher, Marine Research Foundation)

Overview of the Council's Sea Turtle Conservation Program

The Council established the Sea Turtle Conservation Program in 2002 to ensure the sustainability of Hawai'i-based longline fisheries, contribute to the international transfer of sustainable fisheries technology and knowledge, and aid in the recovery of Pacific sea turtle populations. Since then, the Council has played an instrumental role in fostering collaboration, transferring bycatch mitigation technology, and advancing the sustainability of fisheries by convening a number of international meetings. The Council has also played a key role in encouraging sea turtle research, monitoring, and conservation projects in the Pacific where funding may not have been otherwise available.

Prior to 2001, the Hawai'i-based longline fishery had annual interaction levels of approximately 400 loggerhead turtles and 100 leatherback turtles. The temporary closure of the shallow-set swordfish fishery over concerns of turtle interactions brought about the immediate need to develop effective solutions to reduce turtle interactions while maintaining the viability of the industry. Since the reopening of the swordfish sector in 2004, the fishery has operated under strict management measures, including the use of

large circle hooks and fish bait, restricted annual effort, caps of turtle interactions, and 100% onboard observer coverage. As a result of these measures, sea turtle interactions in the swordfish fishery were reduced by nearly 90% (Gillman et al. 2007).

Recognizing that reducing sea turtle interactions in Hawai'i-based fisheries alone will not be sufficient to recovering sea turtle populations in the Pacific, the Council has played an active role in transferring mitigation technology to international fisheries through establishing collaborations, hosting international meetings, and participating in Regional Fishery Management Organization (RFMO) meetings. In addition, the Council has supported nesting beach and foraging ground conservation projects across the Pacific to aid in the recovery of sea turtle populations that interact with Hawai'i-based fisheries. These projects have not only provided substantial conservation benefits by increasing hatchling production and reducing mortality, but data obtained from the projects have also contributed to providing improved population baseline data for the Biological Opinions under the ESA Section 7 consultation process.

The following sections highlight Council efforts to contribute to the recovery of sea turtle populations through its Sea Turtle Conservation Program.

International Transfer of Mitigation Technologies

Recognizing that the impacts to sea turtle populations from the Hawai'i-based longline fishery are a small component of threats that these highly migratory megafauna face, the Council in 2000 adopted a resolution calling for international cooperation to assess fishery takes and to develop mitigation programs to reduce interactions Pacific-wide. This prompted a decade-long effort to encourage information exchange and technology transfer on an international scale.

International Fishers Forum

The mission of the International Fishers Forum (IFF) series is to convene an international meeting of fishermen, management authorities, seafood retailer industry, experts in fishing technology, marine ecology and fisheries science, and other interested parties to facilitate the sharing of information and experiences on (i) sustainable fishery practices; and (ii) approaches to minimize problematic interactions with sea turtles, seabirds, sharks and cetaceans primarily in pelagic and demersal longline fisheries, but with an increasing focus on static fishing gears such as gill nets and pound-nets.

The first IFF was held in November 2000 in Auckland, New Zealand, followed by the second IFF held in

November 2002 in Honolulu, Hawai'i, United States; the third, September 2005 in Yokohama, Japan; the fourth, November 2007 in Puntarenas, Costa Rica; and the fifth, August 2010 in Taipei, Taiwan. The Council has played a significant role in the IFF series since the second meeting in Honolulu. Through these meetings, various countries have adopted measures to reduce protected species interactions, such as those first widely utilized by the Hawai'i-based longline fisheries. The number of participants and publications resulting from Council-supported IFF are as follows:

IFF2—November 2002 (Honolulu, Hawai'i, United States)

Participants: 263 participants from 28 countries.

Publication: Parks NM, editor. 2003. Proceedings of the Second International Fishers Forum; 2002 Nov 19–22; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.

IFF3—July 2005 (Yokohama, Japan)

Participants: More than 80 fishermen and 170 researchers, government officials and non-governmental organization representatives from 26 countries.

Publication: WPRFMC. 2006. Proceedings of the International Tuna Fishers Conference on Responsible Fisheries & Third International Fishers Forum;

2005 June 25–29; Yokohama, Japan. Honolulu (HI): Western Pacific Regional Fishery Management Council.

IFF4—November 2007 (Puntarenas, Costa Rica)

Participants: Approximately 250 fishermen, management authorities, seafood retail industry representatives, fishing technology experts, marine ecologists and fisheries scientists from more than 40 countries.

Publication: WPRFMC. 2009. Proceedings of the Fourth International Fishers Forum; 2007 Nov 12–14; Puntarenas, Costa Rica. Honolulu (HI): Western Pacific Regional Fishery Management Council.

IFF5—August 2010 (Taipei, Taiwan)

Participants: Approximately 300 fishermen, management authorities, seafood retail industry representatives, fishing technology experts, marine ecologists and fisheries scientists from 28 countries and territories.

Publication: Gilman E, Ishizaki A, Chang D, Liu WY, Dalzell P, editors. 2011. Proceedings of the Fifth International Fishers Forum on Marine Spatial Planning and Bycatch Mitigation; 2010 Aug 3–5; Taipei, Taiwan. Honolulu (HI): Western Pacific Regional Fishery Management Council.



IFF5 was held in Taipei in 2010 with a focus on bycatch mitigation and marine spatial planning. (Photo by the Overseas Fisheries Development Council, Taiwan)

Latin American Gear Technology Exchange

The Council supported the Inter American Tropical Tuna Commission from 2004 to 2007 to coordinate, design and implement a circle hook exchange program and associated research to test and introduce mitigation measures to reduce sea turtle bycatch by mahimahi (dolphinfish) and tuna/billfish artisanal longline fisheries. The project started with a focus on the Ecuadorian fleet and was later expanded to other Latin American countries including Peru, Panama, Costa Rica, Guatemala and El Salvador.

Most of the sea turtle interactions in fisheries identified by this program are with green and olive ridley turtles. By the end of 2006, more than 1.5 million J hooks on approximately 100 boats were exchanged for circle hooks, which have been shown to reduce sea turtle bycatch without reducing target catch in other fisheries such as the Hawai'i-based longline fishery. Under this

project, circle hooks were also shown to effectively reduce bycatch and reduce serious injuries of hooked turtles in small-scale fisheries. Proper sea turtle handling and release protocols were also promoted during this project, improving the post-release survival rates of hooked and entangled turtles.

Technical Workshop on Mitigating Sea Turtle Bycatch in Coastal Net Fisheries

Recognizing the growing evidence indicating that small-scale artisanal fisheries may be one of the major threats to some sea turtle populations, the Council co-hosted a technical workshop in January 2009 in Honolulu, Hawai'i to address bycatch issues specifically in coastal net fisheries. The workshop provided the first opportunity for experts from multiple relevant disciplines to share information from 20 gillnet and pound-net fisheries worldwide. Participants reviewed the assessment status and mitigation

activities of the fisheries; shared information on effective, affordable gear to mitigate sea turtle capture and injury in coastal net fisheries; identified research priorities to advance turtle-friendly gear and fishing methods; and explored the range of tools available to assess, mitigate and manage sea turtle bycatch in artisanal fisheries. The workshop fostered new partnerships and advanced the transfer of best available information and practices for bycatch mitigation in fisheries that have been mostly overlooked.

Participants: 49 experts from 17 countries.

Publication: Gillman E, editor. 2009. Proceedings of the technical workshop on mitigating sea turtle bycatch in coastal net fisheries; 2009 Jan 20–22; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.

Nesting Beach Monitoring, Management and Conservation

Leatherback Turtle Conservation at Wermon Beach, Papua, Indonesia (2003–2009)

The Council provided support to the World Wildlife Fund-Indonesia (WWF-Indonesia) from November 2003 to December 2009 to hire village rangers to protect the Wermon nesting beach

at Bird's Head Peninsula in Papua, Indonesia. This project built on an existing program established by WWF-Indonesia since 1990 at the neighboring Jamursba-Medi Beach, the largest known leatherback nesting site in Indonesia and in the Western Pacific. Prior to project implementation, poaching and predation impacted majority of the nests.

Impacts from predation were reduced by 90 percent during the project period, and Wermon Beach

earned recognition as being far more important for leatherback nesting than previously assumed. The project also provided a research platform for Western Pacific leatherbacks, including aerial surveys, genetic sampling, hatching success surveys and nest relocation studies. Approximately 8,907 nests and 226,302 hatchlings were conserved by this project over the Council's funding period (Table 1). Council funding for this project was completed in 2009, as other funding sources became available to conduct basic monitoring and research of nesting activity at Wermon Beach.

Leatherback Turtle Conservation at Huon Coast, Papua New Guinea (2003–2014)

The Huon Coast Leatherback Turtle Conservation Project (HCLTCP) began at the Kamiali Wildlife Management Area in November 2003, initially managed by the Kamiali Integrated Conservation Development Group and later coordinated by the Marine Research Foundation. By late 2005, the project area expanded to incorporate

Table 1. Estimated number of hatchlings produced at Wermon Beach in Indonesia.

Year	Nests laid	Nests conserved	Est. eggs conserved	Est. hatchlings produced ^a
2003–2004	2,881	2,039	154,964	72,833
2004–2005	2,080	1,160	88,160	41,452
2005–2006	1,346	1,198	91,048	42,792
2006–2007	1,319	1,096	83,296	39,149
2008–2009	1,281	842	63,992	30,076
Total¹	8,907	6,335	481,460	226,302

^a Estimated using 76 eggs per clutch and 47% hatching success rate (Tapilatu and Tiwari 2007)
Source: WWF-Indonesia project reports to WPRFMC 2004–2007, 2009



STAJ project members prepare a loggerhead turtle nest for relocation as an approaching typhoon brings high tides to this nesting beach on Yakushima Island. (Photo by STAJ)

Table 2. Estimated number of hatchlings produced by the Huon Coast Leatherback Turtle Conservation Project in Papua New Guinea.

Year	Nests laid eggs laid	Estimated produced	Est. hatchlings
2003–2004	Unknown	Unknown	Unknown
2004–2005	197	Unknown	Unknown
2005–2006 ^a	249	22,434	11,330
2006–2007	236	23,863	10,394
2007–2008	270	28,701	19,660
2008–2009	210	20,664	12,234
2009–2010	243	23,668	11,445
2010–2011	527	49,590	21,820
2011–2012	193 ^b	19,184	8,746
2012–2013	199 ^b	15,780	7,075
Total	2,324	203,884	102,704

^a First year that predator mitigation (bamboo grids) was implemented to address nest predation

^b Incomplete monitoring due to community issues unrelated to the project

Source: Pilcher N (Marine Research Foundation). 2006–2013. Project reports to WPRFMC.

three additional communities that were identified as having significant leatherback nesting activity through aerial surveys, historical accounts and community leaders. During the 2006–2007 nesting season, three more communities were incorporated into the project, bringing the total number of participating communities to seven. The HCLTCP project sites are located 20 to 60 kilometers (km) southeast of Lae, Papua New Guinea (PNG), and in total resulted in approximately 20 km of monitored beach. This project also involved a socioeconomic

assessment of the region to better understand the impacts of leatherback turtle conservation activities on local communities.

Prior to the implementation of the project, a high proportion of nests were lost to predation by feral and domestic dogs as well as inundation. Hatching success was dramatically improved since deployment of bamboo grids to protect nests from predation began in 2006. Between 2003 and 2013, the project produced more than 100,000 hatchlings that would otherwise not have survived (Table 2). A portion

of the funding also contributed to community development projects to provide incentives for supporting sea turtle conservation.

Loggerhead Turtle Conservation in Japan (2004–2013)

The Council supported the Sea Turtle Association of Japan (STAJ) from 2004 to 2013 to conduct nesting beach management activities at several loggerhead nesting beaches in Japan. STAJ implemented conservation actions at Minabe-Senri Beach in Wakayama Prefecture, Myojinyama-Oida Beach in Miyazaki Prefecture and Inakahama and Maehama Beaches of Yakushima Island, Kagoshima Prefecture. Yakushima Island is the most significant loggerhead nesting location in the North Pacific and is where nearly half of all nesting activity takes place. The project involved nightly and daily patrols of nesting beaches, relocating nests from erosion prone areas, keeping foot traffic away from nests to prevent crushing and cooling the nests with water to prevent overheating during incubation.

The project was initially implemented with the expectation of conserving approximately 6,000 hatchlings per year. However, management activities successfully exceeded the initial expectation with more than 260,000 hatchlings conserved and released from relocation efforts over the nine-year period (Table 3).

Table 3. Estimated number of hatchlings conserved from nest relocation efforts at Yakushima Island beaches in Japan.

Year	Nests laid	Nests relocated	Percent relocated	Eggs relocated	Hatchlings conserved
2004	2,120	238	11.2%	24,900	14,994
2005	2,091	470	22.5%	49,350	29,610
2006	1,315	600	45.6%	63,000	37,800
2007	1,424	463	32.5%	48,615	29,169
2008	4,469	771	17.3%	80,955	48,573
2009	2,813	608	21.6%	63,840	38,304
2010	3,897	483	12.4%	50,715	30,429
2011 ^a	2,711	268	9.9%	28,140	16,884
2012	5,143	376	7.3%	39,480	23,688
Total	25,983	4,277	20.0%	448,995	269,451

^a *Inakahama Beach only.* Note: Number of hatchlings conserved does not include hatchlings produced from in situ (non-relocated) nests. Source: STAJ Reports to WPRFMC 2004-2013

Leatherback Turtle Conservation in Manokwari Region, Papua, Indonesia (2010–2012)

The Council supported the Everlasting Nature of Asia (ELNA) to implement a leatherback nesting beach monitoring and conservation project from 2010 to 2012 in a lesser-known region in Papua, Indonesia. Past aerial surveys had confirmed some level of leatherback nesting activity in the Manokwari Region, located further east of the two major Western Pacific leatherback nesting areas of Jamursba-Medi and Wermon. However, no ground-truth surveys had been conducted until ELNA entered the region in 2006 to gather information from local communities. Surveys conducted prior to 2010 have confirmed low-level but year-round leatherback nesting in the region.

During the 2010–2012 project period, 184 leatherback nests were confirmed in the survey area. Actual number of nests during this period was likely higher, given that the monitoring system was still in development. The project confirmed a low-level but steady year-round nesting in the region with high hatch success rates despite frequent inundation from high tides. The Manokwari region is remote, and establishment of a reliable monitoring system is expected to take a number of years of collaboration with the local communities.

Socioeconomic Research and Capacity-Building to Strengthen Conservation of Western Pacific Leatherback Turtles in Papua Barat, Indonesia (2010–2012)

The Council worked with a social scientist Heidi Gjertsen from 2010 to 2012 to support and strengthen Papua State University's existing leatherback conservation efforts at Jamursba-Medi and Wermon nesting beaches by attending to community needs and interests and the socioeconomic factors related to conservation. The first phase of the project implemented surveys with local communities at three villages bordering Jamursba-Medi and Wermon, where approximately 75

percent of all leatherback nesting in the Western Pacific occur.

Socioeconomic surveys indicated that many improvements had been made in the villages since 2008 (mostly from government) and nearly all respondents felt their economic status was improving. A majority of households continued to live at a basic subsistence level. The surveys identified the top five things respondents thought would improve household well-being, which were scholarships, housing, transportation, agriculture support and business support. The surveys showed that the communities were remained somewhat supportive of leatherback conservation, despite the continued belief that it did not benefit the community in a substantial way. At the same time, a mining company in the area provided a number of incentives to the communities for the use of their land.

The second phase of the project focused on building community capacity to take on more responsibility in conservation in their villages. Project members conducted a series of workshops on agriculture assistance, small business finance, and predator control, with substantial participation and support from the local communities and increased awareness of the community benefits gained through the leatherback conservation program.



Community workshops were held in villages adjacent to the largest remaining leatherback nesting area in the Western Pacific to build community capacity and support for leatherback turtle conservation. (Photo by Fitry Pakiding)

Fisheries Impacts Mitigation

Loggerhead Bycatch Reduction, Baja California Sur, Mexico (2004–2012)

The Council supported sea turtle bycatch reduction activities in Baja California Sur (BCS), Mexico, from 2004 to 2012. Council funding supported a portion of activities carried out by Proyecto Caguama (implemented by ProPeninsula), which aimed to raise awareness of sea turtle bycatch, harvest and mortality issues among Mexican fishers and to work with fishers and communities to develop mortality reduction solutions in coastal small-scale fisheries. Specifically, Council funding supported systematic shoreline surveys to quantify stranded dead turtles, bycatch mitigation gear research, education and outreach (Table 6). Additional support was provided to The Ocean Foundation to conduct a study to determine stranding probabilities of loggerhead turtles that are killed in fisheries along the coast.

Research and monitoring conducted under this project have shown the high bycatch rates in small-scale longline (29 loggerheads per 1,000 hooks) and gillnet (1 loggerhead per 1km of net) fisheries in BCS. Outreach efforts



Project team members of ProCaguama implemented conservation activities aimed at reducing loggerhead turtle bycatch in coastal fisheries in Baja California Sur, Mexico.

have resulted in a bottom-set longline fleet to retire the high-impact gear, which is estimated to have saved 700 loggerheads from bycatch mortality. Buoy-less gillnet experimental trials supported in 2009 showed that these modified gillnets reduced turtle bycatch by 55%.

American Samoa Longline Fishery Circle-Hook Study (2010)

The American Samoa longline fishery uses fish bait but does not use large (16/0) circle hooks. Large circle hooks are considered to be a viable method in reducing sea turtle bycatch in longline fishery and have been adopted as a mitigation measure in the Hawai'i-based longline fishery. When developing green turtle bycatch mitigation measures for the American Samoa longline fishery, the Council considered the use of 16/0 or larger circle hooks as an alternative. However, the option was not adopted because the impacts on target catch specific to American Samoa were unknown. The Council funded a study by the Secretariat of the Pacific Community in 2010 to examine the target albacore catch rate using 16/0 circle hooks in the American Samoa longline albacore fishery."

Using a commercial longline vessel fishing out of Pago Pago, American Samoa, investigators undertook 43 sets comparing 14/0 (control) with 16/0 (experimental) circle hooks. A total of 108,036 hooks were set, equally divided between the two hook sizes. For albacore, there was no significant difference in catch rates, the life

Table 4. Summary of Loggerhead Bycatch Reduction Projects in Baja California Sur, Mexico

Year	Nests
2004	Gillnet fishery mitigation research, education and outreach, social networking; Poaching reduction patrols and enforcement implemented at hunting hotspots
2005	Gillnet fishery mitigation research, habitat use research and satellite tracking, education and outreach, social networking, poaching patrols • 150–200 loggerheads/year saved (estimated)
2006	Loggerhead Reserve and ecotourism alternatives identified, habitat use research and satellite tracking, education and outreach, social networking • 150–200 loggerheads/year saved (estimated)
2007	Loggerhead Reserve implementation focus • A minimum of 700 loggerheads saved due to a fisherman's declaration to retire his fleet's bottom set longlines during the Tri-national fisherman exchange held in Honolulu
2009	Fisheries observations to determine 2009 baseline and Buoy-less gillnet experimental trials
2010–12	Assessment of loggerhead strandings on the Pacific Coast of BCS, and estimate of stranding probabilities for loggerhead turtles



loggerhead turtle (Photo: NOAA)

status of fish on capture or the size composition of the catch. Statistically significant differences were found in the catch rates of escolar, skipjack and wahoo with higher catch rates on the 14/0 hooks and in the size composition of bigeye and yellowfin tuna with larger fish taken on the 16/0 hooks. The results suggest that the adoption of larger circle hooks in the fishery will not have an impact on albacore catch rates, but there will be some potential losses (reduced catch rates of skipjack and wahoo) and some potential gains (larger bigeye and yellowfin). Overall, any potential impact on the fishery was found to be negligible.

Assessing the State of Japanese Coastal Fisheries and Sea Turtle Bycatch (2009–2013)

Locally managed small-scale coastal fisheries operate across the country in Japan. However, the wide variety of gear types and operating seasons were not well-documented. Certain coastal pound net fisheries were known to cause sea turtle mortality. However, bycatch and mortality rates vary by location, and threats from other types of coastal fishing gear were relatively unknown. The Council supported the STAJ from 2009 to 2013 to conduct an assessment of coastal fisheries across

Japan to determine the types of coastal fisheries that pose the greatest threat to sea turtle populations. Results showed that large pound nets had the highest bycatch of sea turtles, followed by small pound nets. Other gears with sea turtle interactions included gill net, bottom trawl and surround nets. However, frequency of sea turtle interactions and mortality rates varied within each gear type as well as by location, highlighting the need for mitigation measures that can be adopted to each operation. The project also contributed to an increased understanding of sea turtle distribution in coastal waters.

Databases and Assessments

Turtle Research and Monitoring Database System (2003–2014)

The Turtle Research and Monitoring Database System (TREDs) was developed specifically for sea turtle researchers to collate and standardize data on tagging, nesting, stranding and other biological information. Data compiled in this database can be used for stock assessments of sea turtles, particularly for green and hawksbill turtles in the Pacific Islands. TREDs was developed as a joint initiative between the Council, Secretariat of the Regional Pacific Environment Programme (SPREP), South-East Asia Fisheries Development Centre, the Secretariat of the Pacific Community, the Queensland Environmental Protection Agency, NMFS Pacific Islands Regional Office and the Marine Research Foundation-Malaysia. The Council supported this project since 2003 through SPREP, which houses and manages the database for their member countries and territories in the Pacific Islands.

After many years of development, TREDs was successfully launched at the 29th Symposium on Sea Turtle Biology and Conservation in Brisbane,

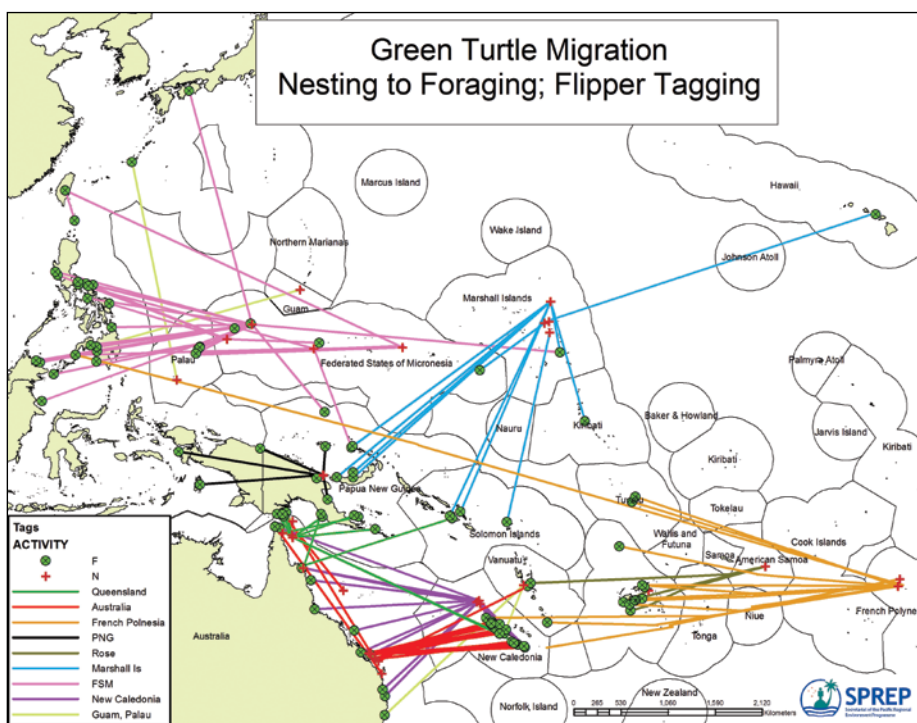


Figure 4. TREDs facilitate the collation of sea turtle data collected across the Pacific Islands, including tagging data. This map was produced by SPREP using TREDs data showing flipper tag recoveries between nesting and foraging sites. (Map Source: SPREP)

Australia in February 2009, and is now being used by a number of the SPREP member countries. To ensure that TREDs is fully implemented in SPREP member countries and that capacity needs and database exchange

are effectively facilitated in the Pacific Islands area, the Council continued the support for the SPREP database program and TREDs maintenance until 2014.

Population Assessment and Modeling (2003, 2004, 2006)

The Council worked with Milani Chaloupka of Ecological Modelling Services to conduct population assessments and modeling of sea turtles to inform the ESA Section 7 consultation process. Assessments conducted by Chaloupka included a green turtle stochastic simulation model, a hawksbill simulation model and a loggerhead global population assessment. Results of these assessments were published in several peer-reviewed scientific journals, including the following:

- (1) Chaloupka M, Balazs G. 2007. Using Bayesian state-space modeling to assess the recovery and harvest potential of the Hawaiian green sea turtle stock. *Ecological Modelling* 205:93-109.
- (2) Marcovaldi M, Chaloupka M. 2007. Conservation status of the loggerhead sea turtle in Brazil: An encour-

aging outlook. *Endangered Species Research* 3:133-143.

Genetic Analysis of Japanese Loggerhead Turtle Population (2009–2011, 2014–2015)

The Council supported the STAJ from 2009 to 2010 and 2014 to 2015 to conduct a genetic analysis of loggerhead samples to characterize rookery stock structure and composition of pound net fishery bycatch in Japan. This project was conducted in collaboration with Peter Dutton of the NMFS Southwest Fisheries Science Center.

More than 500 samples collected from all major nesting regions were analyzed in 2009. The analysis showed significant differences in haplotype frequencies among regional rookeries, suggesting that northern (Eastern Kyusyu to Bousou) and southern (Yakushima and Nansei Islands) rookeries are demographically distinct. A significant finding was the strong differentiation of

the Nansei Islands population, which is characterized by a haplotype common to southern hemisphere (Australian and New Caledonian) loggerhead stock that had not been seen in the North Pacific before this study. Yakushima Island, which represents more than 40 percent of loggerhead nesting in Japan, was found to be genetically distinct from the other rookeries. However, the absence of strong differentiation among the other rookeries north of Yakushima suggested some level of connectivity that warrants further investigation.

Additional samples were analyzed in 2010 and 2014 to characterize the genetic stock composition of loggerhead bycatch by coastal pound nets and to further examine the genetic structure among Japanese rookeries. Results of these analyses are in preparation for publication in peer-reviewed scientific journals.

Meetings and Workshops

Western Pacific Sea Turtle Cooperative Research and Management Workshop

The Council has hosted a series of sea turtle workshops to exchange scientific information, gather an update on the status of population trends and help build consensus for a regional approach towards research and conservation. The first meeting of the series was held in 2002, prior to the formal establishment of the Council's Sea Turtle Conservation Program, and as a result played an integral role in determining the direction of the Council's program. The second workshop was convened as a series of three workshops focused on specific species in 2004 and 2005. An additional loggerhead expert workshop was held in December 2007. These workshops provided a platform in which sea turtle researchers were able to compile the most recent information on research and conservation activities, and to develop cooperative working relationships. The number of participants and publications resulting from each workshop are as follows:

First Western Pacific Sea Turtle Cooperative Research and Management Workshop —February 2002 (Honolulu, Hawai'i)

Participants: 60 scientist, managers and educators from more than 20 countries

Publication: Kinan I, editor. 2002. *Proceedings of the Western Pacific Sea Turtle Cooperative Research and Management Workshop*; 2002 Feb 5–8; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.



Participants of the Second Western Pacific Sea Turtle Cooperative Research and Management Workshop discuss leatherback conservation issues in a working group.

Second Western Pacific Sea Turtle Cooperative Research and Management Workshop

Part 1: *Hawksbill & Leatherback Workshop*

May 2004 (Honolulu, Hawai'i)

Participants: Approximately 40 scientist, managers, and educators actively engaged in hawksbill and leatherback research and conservation in the Western Pacific.

Publication: Kinan I, editor. 2005. Proceedings of the Second Western Pacific Sea Turtle Cooperative Research and Management Workshop, Volume I: West Pacific Leatherback and Southwest Pacific Hawksbill Sea Turtles; 2004 May 17-21; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.

Part 2: *Loggerhead Workshop*

March 2005 (Honolulu, Hawai'i)

Participants: Approximately 25 scientist and managers actively engaged in loggerhead research and conservation in the Pacific.

Publication: Kinan I, editor. 2006. Proceedings of the Second Western Pacific Sea Turtle Cooperative Research and Management Workshop, Volume II: North Pacific Loggerhead Sea Turtles; 2005 March 2-3; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.

North Pacific Loggerhead Sea Turtle Expert Workshop—

December, 2007 (Honolulu, Hawai'i) (convened jointly with NOAA Fisheries)

Participants: Approximately 20 experts on loggerhead research and conservation in the North Pacific.

Publication: WPRFMC and NMFS. 2008. Report of the North Pacific Loggerhead Sea Turtle Expert Workshop; 2007 Dec 19-20; Honolulu, HI. Honolulu (HI): Western Pacific Regional Fishery Management Council.

Bellagio Sea Turtle Meeting Series

The WorldFish Center and NMFS jointly convened a meeting in Bellagio, Italy, in November 2003 to draft an Action Plan on Pacific Sea Turtles (Bellagio meeting). The Council was a co-sponsor and Council participated in the meeting. A subsequent meeting to develop a strategic plan to guide the prioritization and long-term financing of Pacific leatherback turtle conservation and recovery objectives was convened in July 2007 in Terengganu, Malaysia (Terengganu workshop). The Council played an instrumental role in the Terengganu workshop as a co-organizer and major sponsor. The number of participants and publications resulting from the Bellagio meeting series are as follows:

Pacific leatherback sea turtle (Illustration: NOAA Fisheries)



Bellagio Meeting—November 2003 (Bellagio, Italy)

Participants: Multi-disciplinary group of 25 economists, marine life policy experts, fishing industry and fisheries professionals, conservation, sea turtle and natural resource management specialists and development assistance researchers.

Publications: Steering Committee, Bellagio Conference on Sea Turtles. 2004. What can be done to restore Pacific turtle populations? The Bellagio Blueprint for Action on Pacific Sea Turtles. Penang, Malaysia: The WorldFish Center.

Dutton PH, Squires D, Ahmed M (eds). 2012. Conservation of Pacific Sea Turtles. UH Press.

Terengganu Workshop—July 2007 (Terengganu, Malaysia)

Participants: 45 experts on sea turtles, fisheries, conservation and finance from 10 countries.

Publication: Steering Committee, Bellagio Sea Turtle Conservation Initiative. 2008. Strategic planning for long-term financing of Pacific leatherback conservation and recovery: Proceedings of the Bellagio Sea Turtle Conservation Initiative, Terengganu, Malaysia; 2007 July 17–20; Terengganu, Malaysia. Penang, Malaysia: The WorldFish Center.



Participants of the Terengganu Workshop of the Bellagio Sea Turtle Meeting Series to develop a strategic plan to guide the Pacific leatherback turtle conservation and recovery

Other Meetings Convened or Sponsored by the Council

The Council has convened or sponsored a number of other meetings, workshops and symposia, including the following:

- Mariana Archipelago Green Turtle Workshop
- Annual Symposium on Sea Turtle Biology and Conservation (Hosted by the International Sea Turtle Society)
- Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding (IOSEA-MoU) Meeting of the Signatory States
- Annual Japanese Sea Turtle Symposium (Hosted by the Sea Turtle Association of Japan)
- SPREP Regional Sea Turtle Meeting

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(*Dermochelys coriacea*). Photo by Nicolas Pilcher,
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