DRAFT

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center

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Appendix A

PIFSC Research Gear and Vessel Descriptions

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Table of Contents

List of Figures

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1. Trawl Nets

A trawl is a funnel-shaped net towed behind a boat to capture fish. The codend, or 'bag,' is the fine-meshed portion of the net most distant from the towing vessel where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so that they can be collected in the codend. The opening of the net, called the 'mouth', is extended horizontally by large panels of wide mesh called 'wings' (Figure A-1). The mouth of the net is held open by hydrodynamic force exerted on the trawl doors attached to the wings of the net. As the net is towed through the water, the force of the water spreads the trawl doors horizontally apart.

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or 'warps,' to winches on the deck of the vessel. The cables are played out until the net reaches the fishing depth. Commercial trawl vessels travel at speeds between two and five knots while towing the net for time periods up to several hours. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. At the end of the tow the net is retrieved and the contents of the codend are emptied onto the deck. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into the research vessel and the trawl gear monitor the position and status of the net, speed of the tow, and other variables important to the research design.

Most PIFSC research trawling activities utilize 'pelagic' trawls, which are designed to operate at various depths within the water column. Because pelagic trawl nets are not designed to contact the seafloor, they do not have bobbins or roller gear, which are often used to protect the foot rope of a 'bottom' trawl net as it is dragged along the bottom.

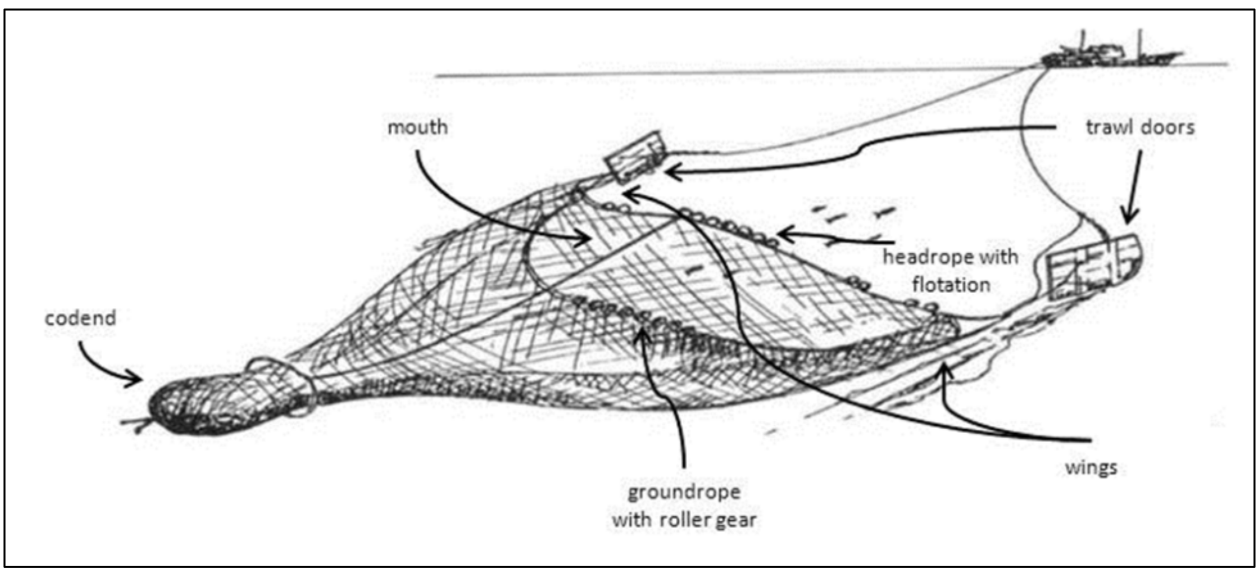


Figure A-1 General schematic of a trawl net

<u>Cobb Trawl</u>: The PIFSC uses a "Stauffer" modified Cobb midwater trawl (Cobb trawl) to sample pelagic species as well as pelagic stages of insular fish species in the Hawaiian Archipelago. Target species are snapper and, grouper species within the 0-175 m depth range. Sampling of pelagic species is conducted using a Cobb trawl with a mouth opening of about 686 m^2 (Figure A-2). For the codend, a 1 m diameter stainless steel ring and 1mm Nitex mesh plankton net is sewn to the rear-most portion of the outer net body near where the inner liner terminates. The plankton net terminates into a zipper-attached ~10 liter capacity canvas bag which serves as the codend and holds the catch contents of the trawl.

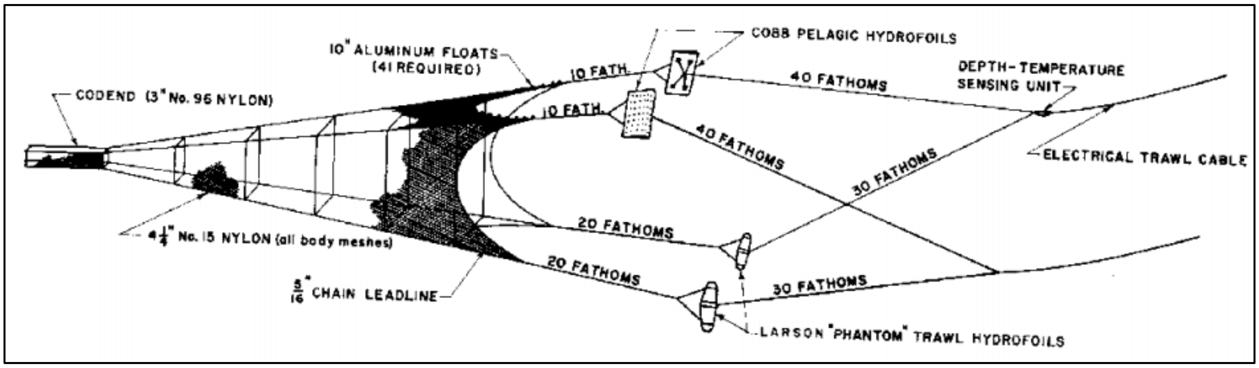


Figure A-2 Cobb trawl

2. Plankton Nets

PIFSC research activities include the use of plankton sampling nets that employ very fine mesh to sample plankton and fish eggs from various parts of the water column. Plankton net mesh sizes generally range from 20 to 500 micrometers. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently.

<u>Isaacs-Kidd Trawl</u>: The Isaacs-Kidd trawl is used to collect midwater or surface biological specimens larger than those taken by standard plankton nets. The net is attached to a wide, V-shaped, rigid diving vane that keeps the mouth of the net open and maintains the net at depth for extended periods (Yasook et al. 2007) (Figure A-3). The Isaacs-Kidd trawl is a long, round net approximately 6.5 m (21.3 ft) long, with a series of hoops decreasing in size from the mouth of the net to the codend, which maintain the shape of the net during towing (Yasook et al. 2007). The PIFSC uses two sizes of Isaacs-Kidd trawls for various research purposes, a 6-ft wide model and a 10-ft wide model. These nets may be towed either at the surface of the water or at various midwater depths depending on research protocols or where acoustic signals indicate the presence of study organisms.

Figure A-3 Isaacs-Kidd 6-ft trawl

<u>Neuston Net</u>: Neuston nets are used to collect zooplankton that live in the top few centimeters of the sea surface (the neuston layer). This specialized net has a rectangular mouth opening usually 2 or 3 times as wide as deep (e.g., 1 meter by 1/2 meter, or 60 cm by 20 cm) (Figure A-4). Neuston nets sometimes use hollow piping for construction of the net frame to aid in flotation. They are generally towed half submerged at 1-2 knots from the side of the vessel on a boom to avoid the ship's wake.

Figure A-4 Neuston net

<u>Bongo Net</u>: A bongo net looks like two ring nets whose frames are yoked together and allows replicate samples to be collected concurrently (Figure A-5). Bongo nets are towed through the water to sample plankton over a range of depths. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample. Some bongo nets can be opened and closed with remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site.

Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-5 Bongo net

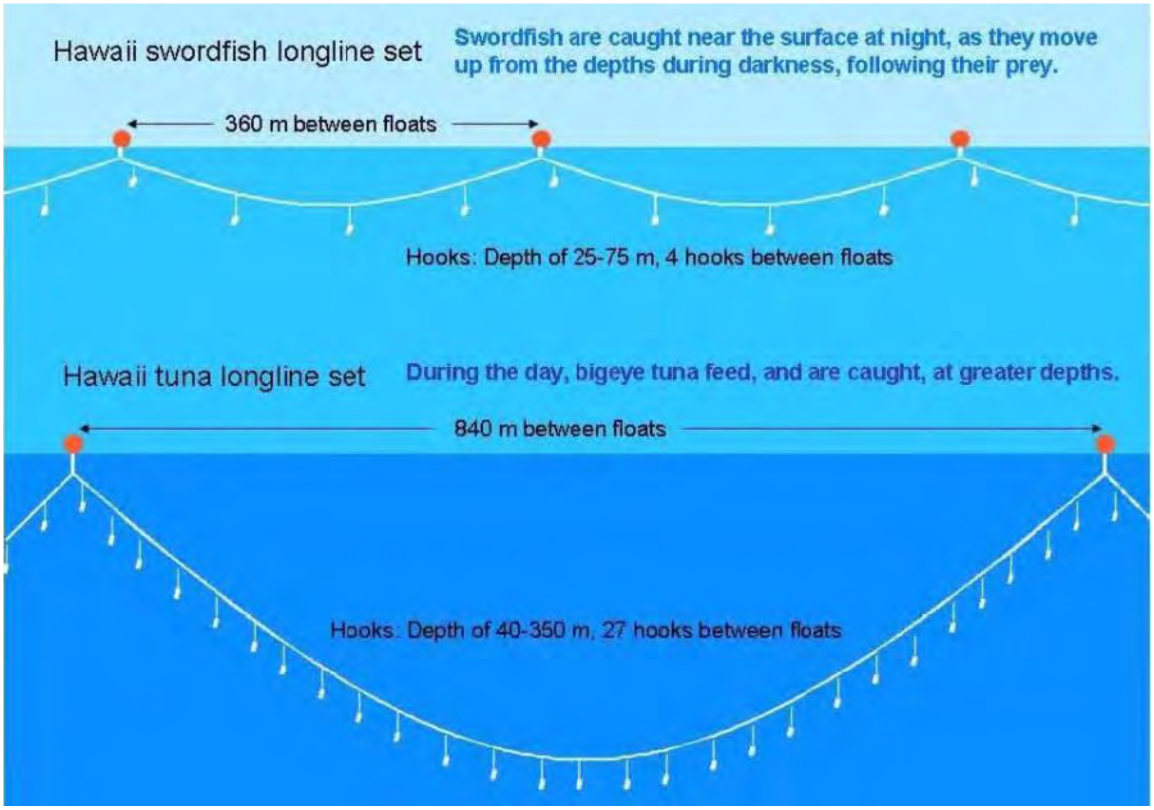
<u>Plankton Drop Net</u>: Plankton drop nets are small hand held nets made up of fine mesh attached to a metal hoop with a long rope attached for retrieval (Figure A-6). These nets are used for stationary surface sampling of the surrounding water.

Figure A-6 Plankton drop net

<u>One Meter Ring Net</u>: A ring net is generic plankton net, made by attaching a net of any mesh size to a metal ring of any diameter. There are 1 m, .75 meter, .25 meter and .5 meter nets that are used regularly. The most common zooplankton ring net is 1 meter in diameter and of mesh size .333mm, also known as a 'meter net'

3. Longline

Longline vessels fish with baited hooks attached to a mainline or ‘groundline’. The length of the longline and the number of hooks depend on the species targeted, the size of the vessel, and the purpose of the fishing activity. The PIFSC uses pelagic longline gear deployed at various depths to target different species and to avoid non-target species. Deep-set gear is deployed at depths greater than 100 m and is used to target tunas, e.g., bigeye tuna. Shallow-set gear is deployed at depths less than 100 m and is used to target swordfish. Both types of gear are used to test bycatch mitigation technology to reduce interaction and mortality of marine mammals, seabirds, and sea turtles in pelagic longline fisheries. The longline gear used by the PIFSC for research typically has 600 to 2000 hooks attached to a mainline of up to 60 miles in length. Hooks are attached to the mainline by another thinner line called a ‘branchline’. The length of the branchline and the distance between branchlines depends on the purpose of the fishing activity. Buoys are used to keep pelagic longline gear suspended near the surface of the water, and flag buoys (or ‘high flyers') equipped with radar reflectors, radio transmitters, and/or flashing lights are attached to each end of the mainline to enable the crew to find the line for retrieval (Figure A-7).



Credit: USFWS 2012

Figure A-7 Schematic example of shallow-set and deep-set pelagic longline gear

4. Trolling

Trolling is a type of hook-and-line fishing method where multiple lines are towed behind a boat to catch species such as salmon, mahi mahi and albacore tuna (Figure A-8). Gear used by the PIFSC have four troll lines each with 1-2 baited hooks towed at 4-6 knots.

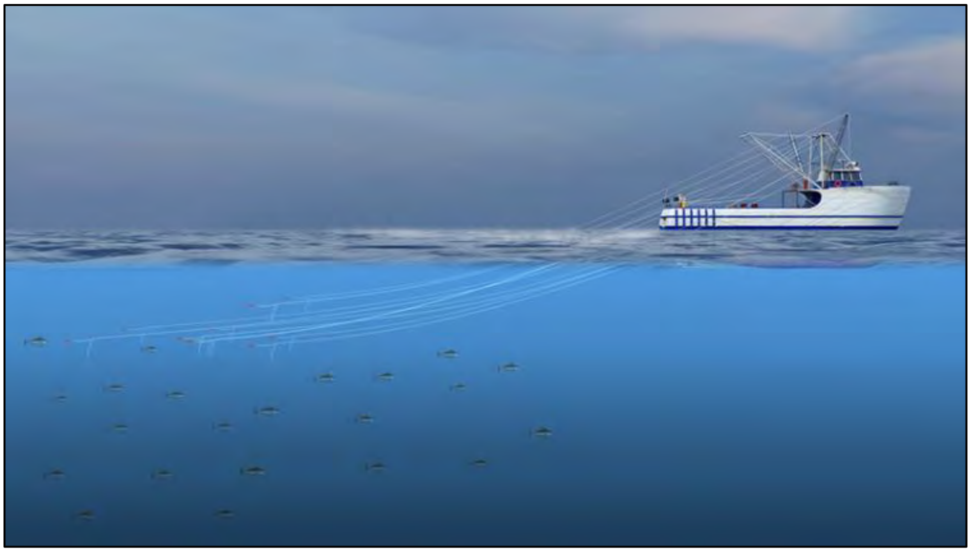


Figure A-8 Trolling

5. Hook-and-Line

The PIFSC uses various types of hook-and-line gear that include standard handlines, rods and reels with lures or bait, as well as electric or hydraulic reels (Figures A-9) with multiple lines and hooks. These set-ups may be used while stationary or mobile. The gear used in PIFSC bottomfish surveys consists of a main line constructed of dacron or monofilament with a 2–4 kg weight attached to the end (Figure A-10). Several 40–60 cm sidelines with circle hooks are attached above the weight at 0.5–1 m intervals. A chum bag containing chopped fish or squid may be suspended above the highest of these hooks. The gear is retrieved using hydraulic or electric reels after several fish are hooked.

Figure A-9 Example of an electric reel used for bottomfishing

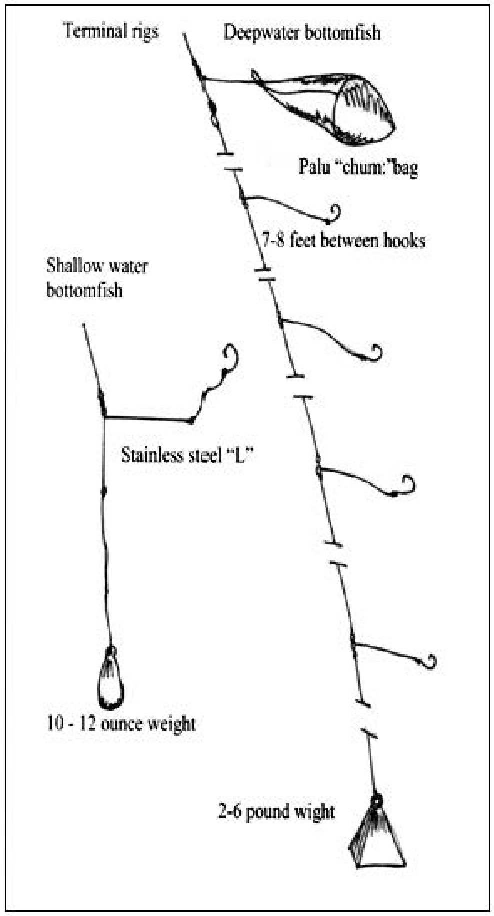


Figure A-10 Typical set-up for bottomfishing hook-and-line gear

6. Lobster Traps

Lobster traps are deployed in the Northwestern Hawaiian Islands to study the life history and population dynamics of lobster. The lobster traps consist of one string per site, with 8 or 20 traps per string, separated by 20 fathoms of ground line (Figure A-11). The traps are deployed within two separate depth regimes: 10-20 or 21-35 fathoms.

Figure A-11 Lobster traps being deployed

7. Miscellaneous Fishing Gear

<u>Spear Gun</u>: Spear guns are used by scuba divers to collect specimens for ecosystem surveys. There are two different types of spear guns, band powered and air powered. The band powered gun consists of a spear a stock and a handle with a trigger (Figure A-12). The air powered gun holds the spear inside of the barrel that contains air which is at ambient pressure until activated by a hand pump that increases the pressure.

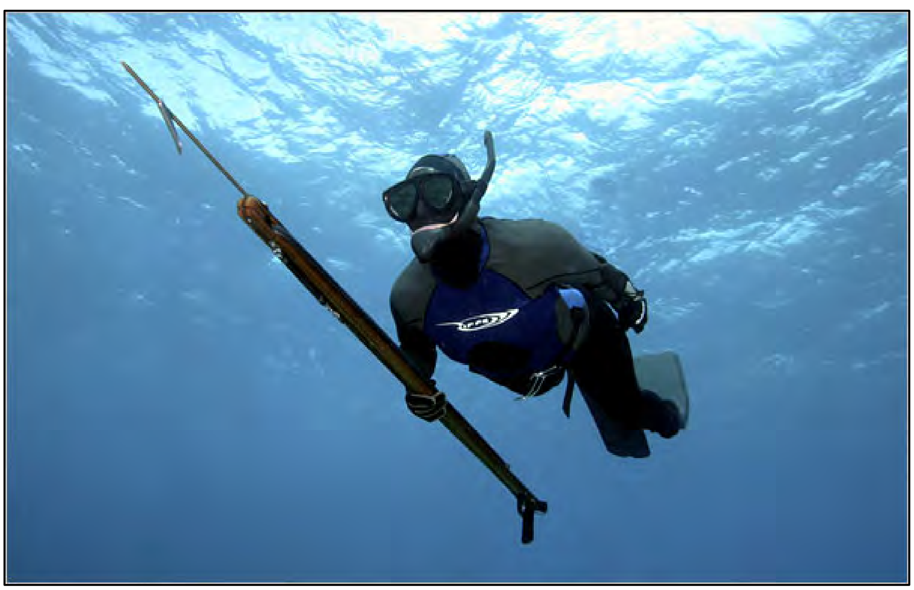


Figure A-12 SCUBA diver with band powered spear gun

<u>Slurp Gun</u>: Slurp guns are clear plastic tubes designed to catch small fish by sliding a plunger backwards out of the tube (Figure A-13). The plunging action causes seawater, and hopefully the fish you are trying to catch, to be sucked into the tube via displacement. The diver caps the tube or covers it with a dip net and places the fish into a containment device (net bag, plastic bucket with holes, etc.).

Figure A-13 Slurp gun

<u>Hand Net</u>: A mesh bag attached to a hoop that is constructed of wood or metal. A hand net is used during the Pacific Reef Assessment and Monitoring Program to collect samples of coral, algae, and sessile invertebrates. During the PIFSC Lagoon Ecosystem Characterization a 12-in diameter small mesh hand net is also used to sample fish species.

<u>Dip Net</u>: A dip net is a bag net attached to a long rod that is used by hand to scoop fish or other organisms of interest from the water (Figure A-14). Dip nets come in various sizes, including a commonly utilized dip net with a diameter of 19 in and ¼ in mesh size.

Figure A-14 Dip net

<u>Barbless Circle Hooks</u>: The PIFSC began a barbless hook awareness program in 2004 in order to increase awareness about the benefits of reducing injury and mortality of non-target species using barbless hooks over barbed hooks. Figure A-15 shows a series of different sized circle hooks that are used in different fisheries, all of which have depressed barbs (barbless) except the top middle hook. On the top row, left to right, are size Mustad 20, 18, and 16. The bottom row, left to right, has hooks size Mustad 12 and 11. The PIFSC donations of barbless circle hooks are made primarily at shore-based fishing tournaments or other outreach events. Under this program the PIFSC donates up to 35,000 barbless hooks per year.

Figure A-15 Circle hooks of various sizes: all but the top center hook have depressed barbs

8. Reef Monitoring Devices

<u>Pneumatic/Hydraulic drill for coral coring</u>: The PIFSC uses two different types of drills to obtain core samples: pneumatic and hydraulic drills. The pneumatic drill is powered by air and is smaller and hand held (Figure A-16). The hydraulic drill is considerably larger, requiring two people to operate. The core samples collected by the PIFSC are approximately 4 cm in diameter and no more than 100 cm long. The samples are processed in the lab to study structure and biological properties of the coral (Figure A-17).

Source: http://pipa.neaq.org/2012/06/studying-climate-change-with-coral.html

Figure A-16 A CRED diver collects a coral core during a Pacific Reef Assessment and Monitoring Program cruise

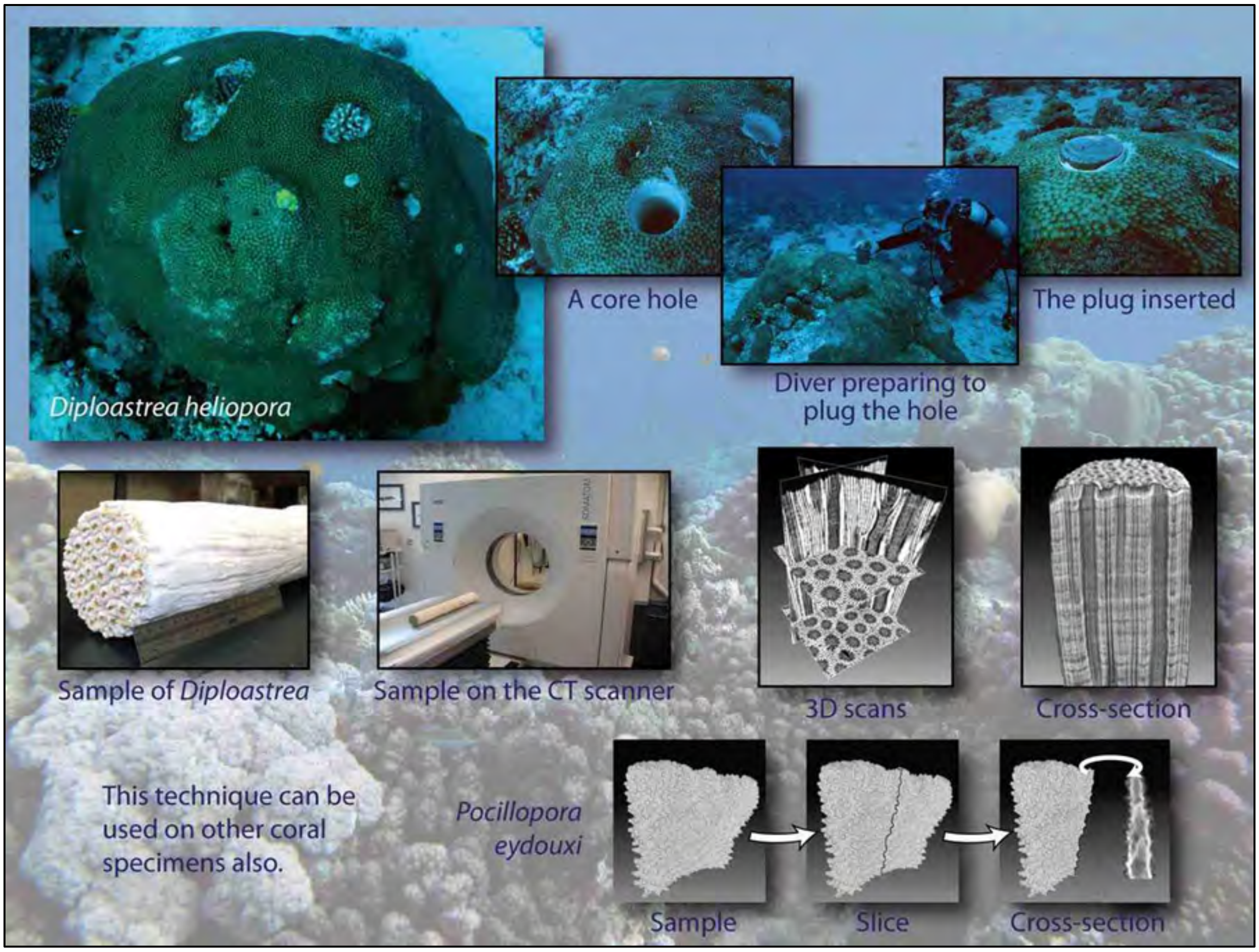


Photo courtesy of the Cohen Lab, Woods Hole Oceanographic Institution

Figure A-17 Diagram illustrating coral-coring process and core analysis

Calcification Acidification Units (CAU's): Rates of net calcium carbonate accretion are monitored with calcification accretion units (CAUs), which allow for recruitment and colonization of crustose coralline algae and hard corals. Each CAU consists of 2 gray PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod which is installed by divers into the bottom (avoiding corals) (Figure A-18).

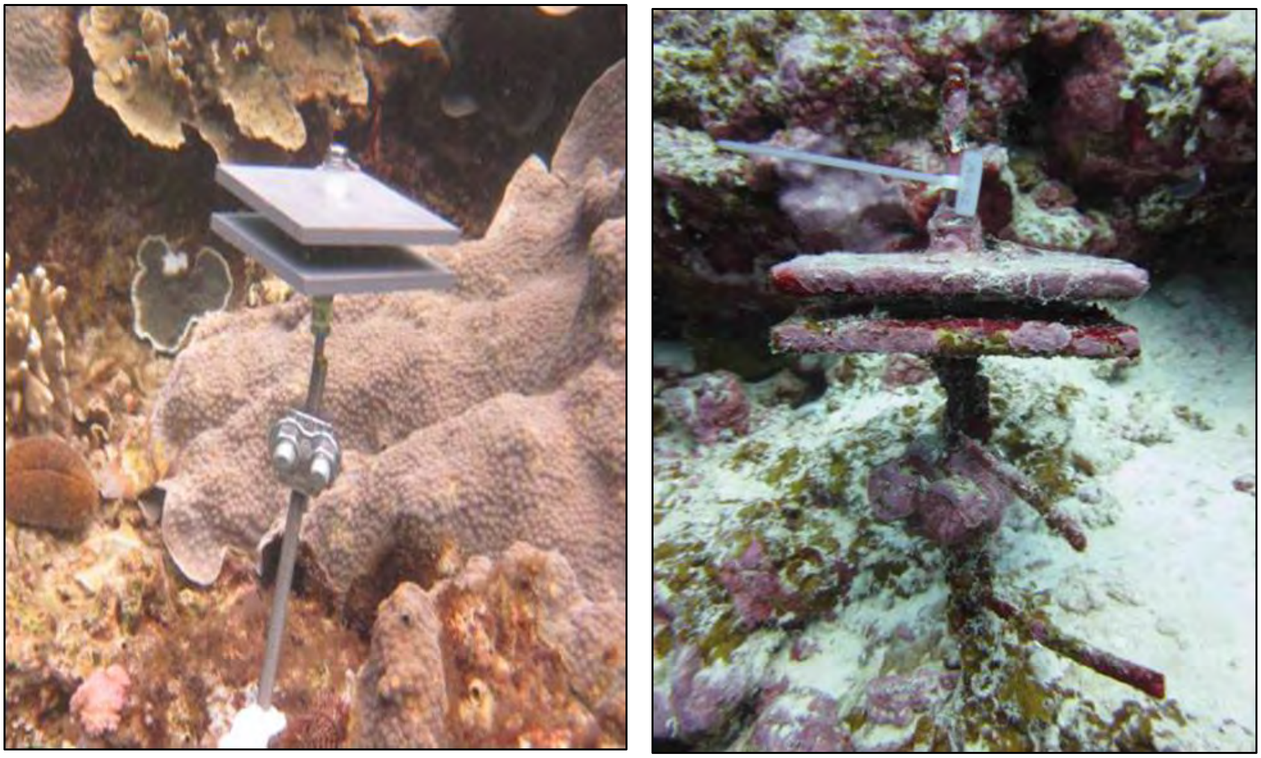


Figure A-18 Calcium acidification unit pre-deployment and two years after deployment

Autonomous Reef Monitoring Structures (ARMS): ARMS are used to examine the biodiversity and community structure of the cryptobiota community. The cryptobiota community is targeted for biodiversity and community composition measurements because it is the most numerically abundant and diverse community on a reef system (Ginsburg 1983). The ARMS used by the PIFSC for Pacific Reef Monitoring Assessments are 36 x 46 x 20 cm structures placed on pavement or rubble, secured to the bottom by stainless steel stakes and weights in proximity to coral reef structures (Figure A-19).

Figure A-19 ARMS structure three years after deployment

Bioerosion Monitoring Unit (BMU): Bioerosion monitoring units are small blocks made up of coral structures which are layers of calcium carbonate. These units are frequently attached to CAUs for the measurement of coral erosion due to ocean acidification. The PIFSC uses 1 x 2 x 5 cm pieces of relic calcium carbonate and deploys them near reef structures for a period of 1-3 years (Figure A-20).

Figure A-20 Bioerosion monitoring block with CAU unit

9. Submersibles Pisces IV and Pisces V

The Pi*s*ces IV and Pi*s*ces V are three-person, battery-powered, submersibles with a maximum operating depth of 2000m (6,500 ft) (Figure A-21). The submersibles are equipped with HD and SD video cameras on a pan and tilt that allow the science observer to record detailed images of bottom terrain, sea life and sample collecting. Each of the submersibles is equipped with two mechanical arms that give the submersibles the ability perform very fine sampling of fragile marine organisms or operating samplers or scientific instruments. The submersibles have a hydraulically operated "sample tray" that can be configured with a variety of sample collecting boxes or instruments. The submersibles are equipped with a pinger receiver system that enables them to track a signal from 8 to 80Khz. This allows the submersibles to track each other or to locate lost instruments or relocate bottom monitoring sites marked with a pinger or transponder. The submersibles are launched and recovered with a specialized A-frame on the aft deck of their support vessel, the *Ka'imikai-o-Kanaloa*.

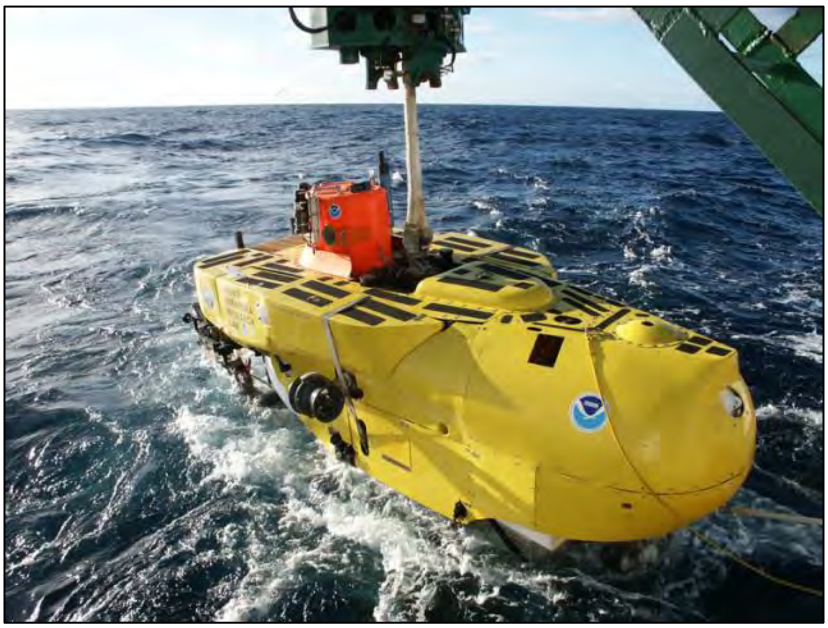


Figure A-21 Submersible

10. Remote Operated Vehicles (ROV), and Autonomous Underwater Vehicle (AUV)

Super Phantom S2 ROV: The Super Phantom S2 is a powerful, versatile, remotely operated vehicle (ROV) with high reliability and mobility (Figure A-22). This light weight system can be deployed by two operators and is designed as an underwater platform which provides support services including color video, digital still photography, navigation instruments, lights and a powered tilt platform. A wide array of specialty tools and sampling devices are available. The basic configuration of the ROV provides color video, digital still photos, laser scaling device, position information of the ROV and support ship, vehicle heading, and vehicle depth.

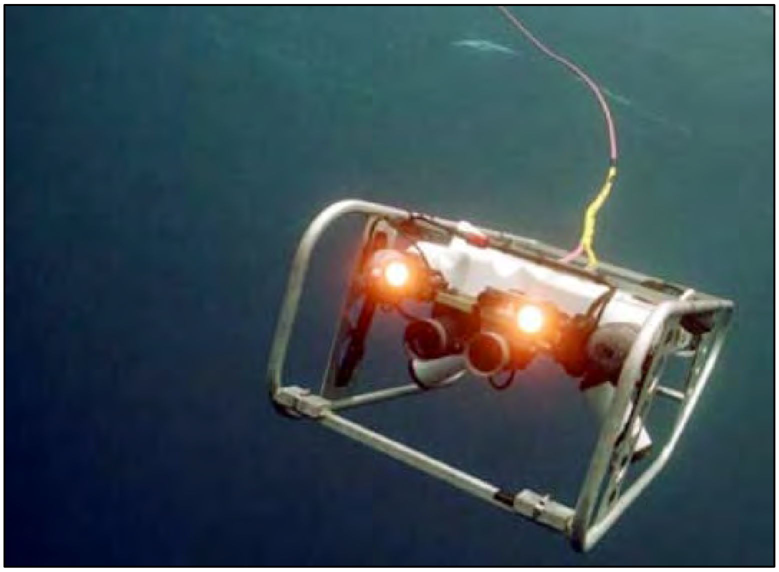
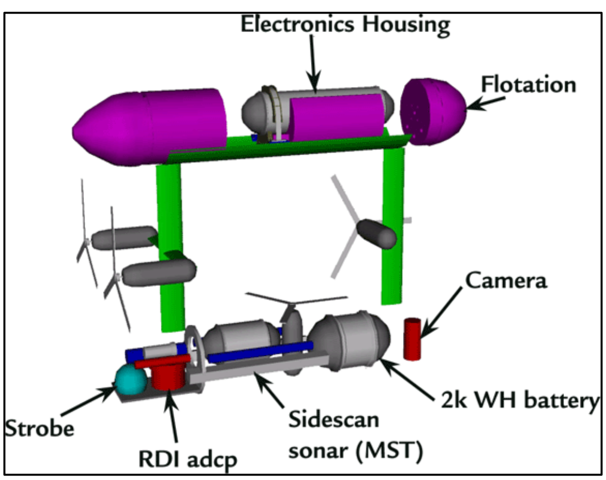


Figure A-22   ROV Super Phantom

<u>The SeaBED-class AUV</u>: Unlike other more traditional AUV's, the SeaBED employs a twin-hull design that provides enhanced stability for low-speed photographic surveys (Figure A-23). SeaBED is designed to autonomously follow the terrain approximately 3 to 4 m above the sea floor, collecting high resolution color and black-and-white imagery while maintaining a forward speed of .25 - .5 m/sec. For this mission, SeaBed is also outfitted with a forward-looking stereo video camera system as well as a forward-looking imaging SONAR unit. The stereo-video system is similar to that used on the BRUVS and allows for accurate measures of fish abundance and size structure. The imaging SONAR unit is being tested as a means to assess fish assemblage outside the visual range of the cameras and in zero light situations including nocturnal or operations in depths to which light does not reach.



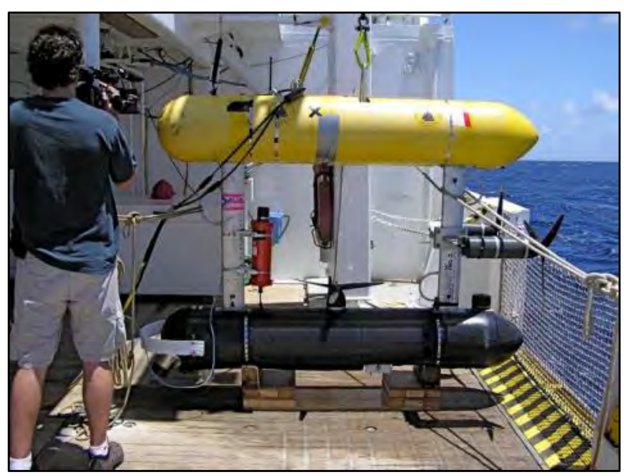


Figure A-23   The SeaBED-class AUV

SeaBED is approximately two meters long and weighs nearly 200 kg. It has two main pressure housings, a top hull and a bottom hull. The CPU electronics are located in the top hull, and the batteries, cameras, and sensors are located in the bottom hull, and all are connected by wet cabling that is routed through vertical struts. With a maximum depth range of 2,000 m, and maximum single-dive time of 6 - 8 hours, SeaBED can be used to survey habitats ranging from shallow coral reefs to deep groundfish environments.

The AUV is programmed while still aboard the ship. Programming parameters include navigational waypoints, speed, altitude to maintain above the seafloor, and frequency of photographs. Once submerged, the AUV does not resurface until the end of its mission. The AUV reports its position to the ship periodically in telemetry messages via acoustic MODEM. If any of these telemetry messages indicate an unexpected change in the AUV's planned mission, the mission can be aborted via acoustic MODEM message, resulting in the AUV returning to the surface for recovery.

The SeaBED AUV carries a forward-facing ROS Navigator black-and-white, low-light stereo-video camera system, two 5 megapixel, 12 bit dynamic range Prosilica GigE strobe-lighted cameras, one perpendicularly downward-looking and one forward looking (~35°). Imagery from the downward-looking camera can be analyzed to characterize the benthic communities while the forward-looking cameras are used to collect species-specific abundance and length information. Combined, these 2 imagery data sets can be used to create spatial species-specific abundance, biomass, and length-frequency distributions, along with the benthic communities around which they associate. An onboard Seabird model 49 FastCat CTD records temperature and salinity data along the AUV track, providing further environmental insight.

11. SeaGlider, or WaveGlider

Also known as Acoustic or Oceanographic Gliders (Figure A-24), these are autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide semi-continuous measurements for up to several months.

Photo credit: D’Spain, G.

Figure A-24 Oceanographic glider

12. Underwater Video Cameras

BotCam: The Bottom Camera or ("BotCam") system includes programmable control functions which allow for the activation of imaging systems, bait release mechanisms, image scaling indicators, and acoustic release to enable recovery of the camera (Figure A-25). The camera bait station can be deployed repetitively during a survey of a site or can sit dormant on the seafloor ready for activation at a preset time. Further, the stereo-video configuration of the camera system allows for the sizing and ranging of both fish and benthic features. Development of a field-tested deep-water camera bait station, coupled with a standard method to analyze the collected image data, will provide a cost-effective and non-extractive alternative method to assess the abundance and size composition of bottomfish populations in deepwater habitats.

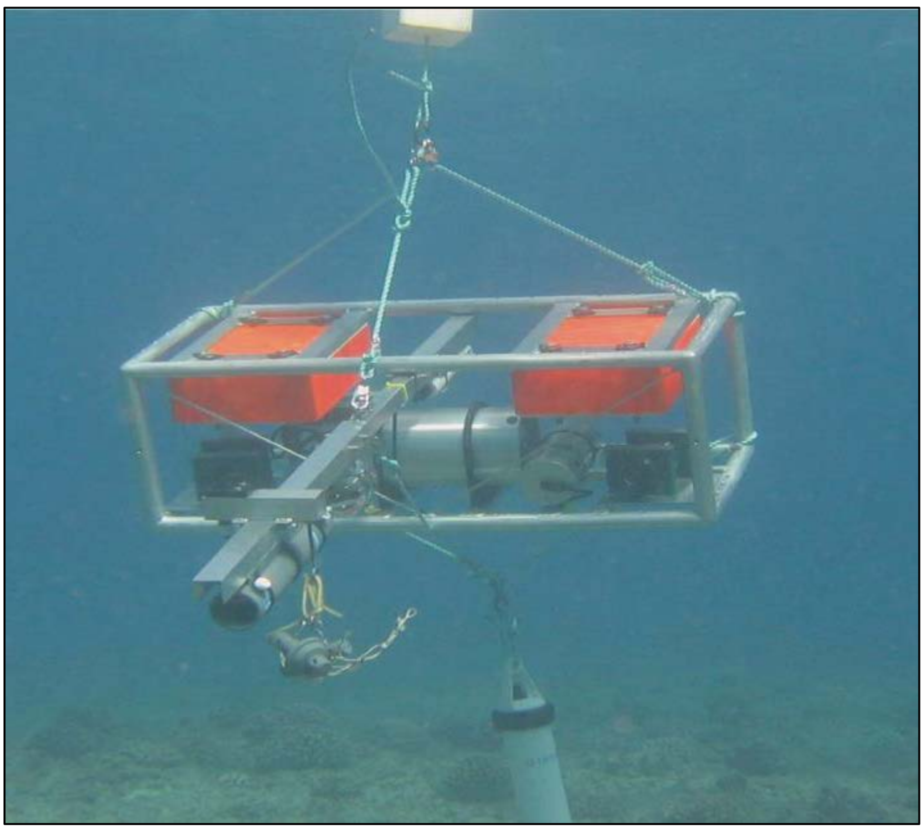


Figure A-25 BotCam

MOUSS: The MOUSS, or Modular Underwater Survey System, is a next generation BotCam that is currently under development (Figure A-26). MOUSS is rated to 500 m and uses highly light sensitive stereo-vision cameras that allow for the identification, enumeration, and sizing of individual fish at a range of 0-10 m from the system. In Hawaiian waters, the system can effectively identify individuals to a depth of 250 m using only ambient light. MOUSS is an evolution of the existing remote camera bait station (BotCam) developed in 2005 by PIFSC. MOUSS is an improvement over the older analogue because it is three times lighter (92 lbs versus 310 lbs), able to attach to different deployment platforms, and captures high-resolution digital footage. The size and weight reduction allows for hand deployment from cooperative research vessels and small boats while the use of high-resolution digital video allows for more accurate and precise fish identifications and measurements

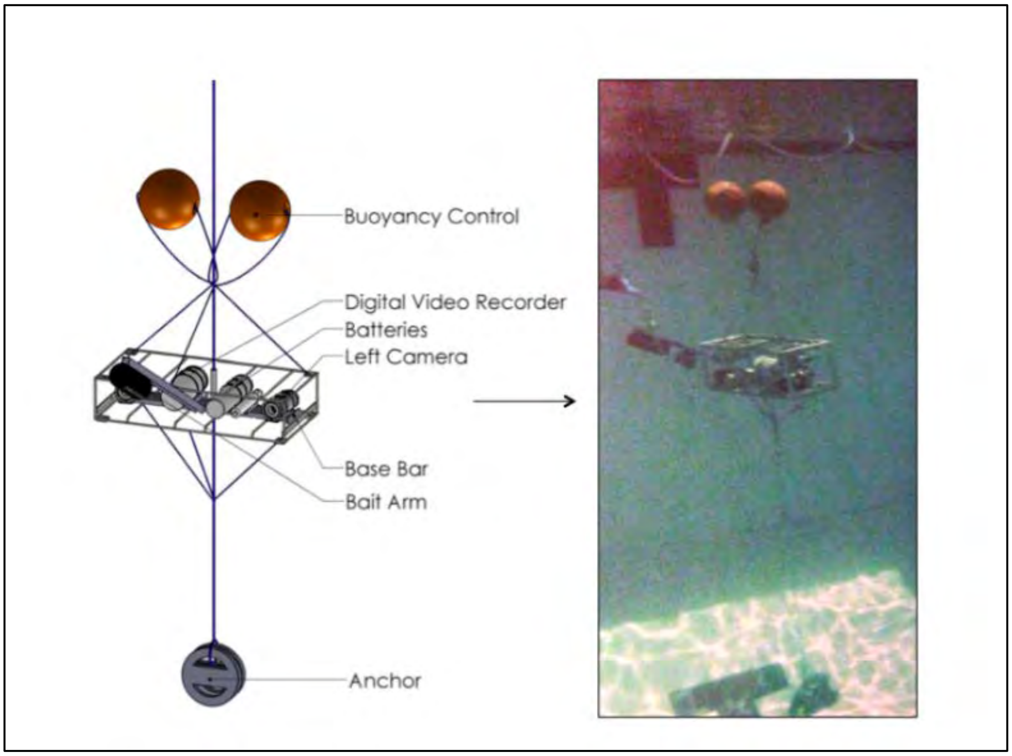


Figure A-26 MOUSS model (left) and prototype during pool test (right)

<u>Baited Remote Underwater Video System (BRUVS)</u>: BRUVS are similar to the existing BotCam technology but are more suitable for deployment on coral reef systems because they are smaller, lighter, and can be deployed closer to a substrate (Figure A-27). Coral Reef Ecosystem Division (CRED) uses BRUVS for reef surveys to depths of ~100 m. Each BRUVS uses high-definition video cameras mounted 0.7 m apart on a base bar that is inwardly converged at 8°. This stereo-video system allows us to identify fish species and to accurately and precisely determine fish sizes and their distances from the camera when the video images from these cameras are subsequently analyzed. The use of bait attracts a wide diversity of fish species into the field of view of the cameras, but CRED is also experimenting with unbaited deployments.

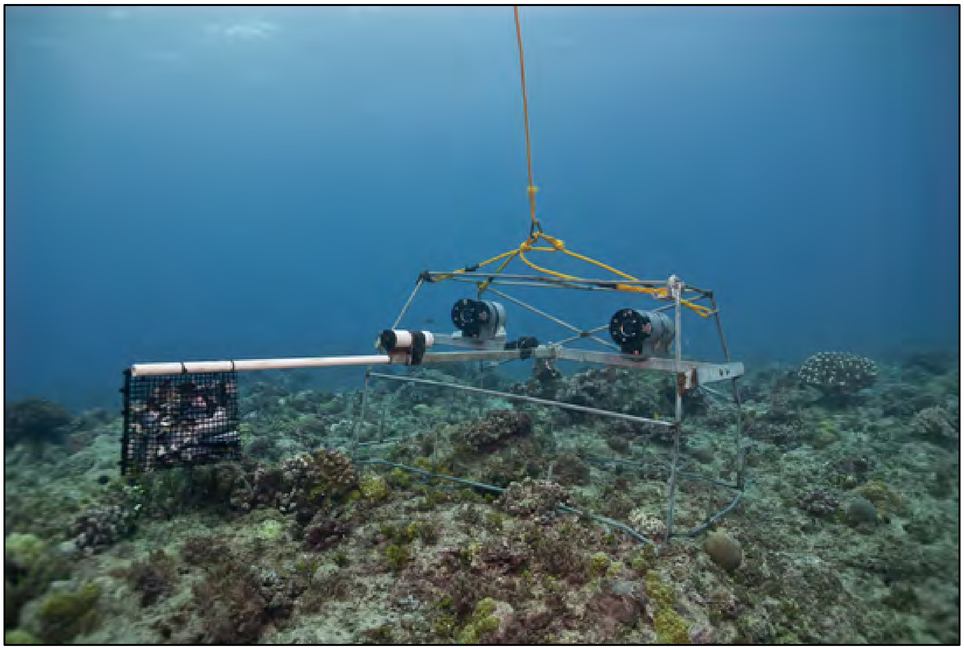
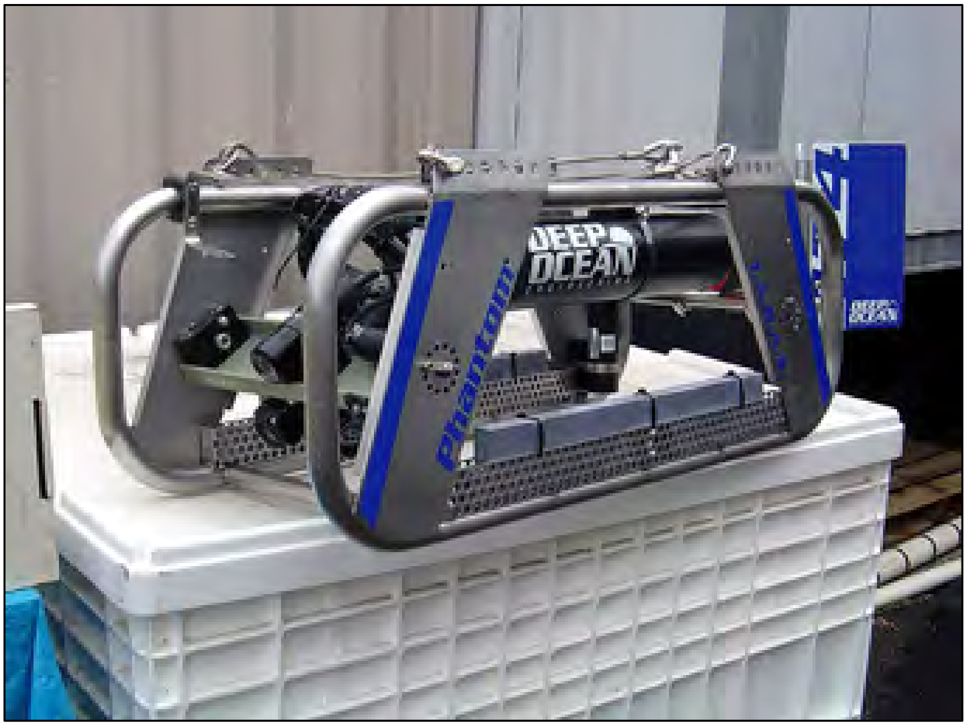


Figure A-27 BRUVS

Towed Optical Assessment Device (TOAD): The Towed Optical Assessment Device (TOAD) is a camera sled built around a stainless steel tubing frame (Figure A-28). It is equipped with a Deep Sea Power & Light (DSP&L) Multi SeaCam 2060 low-light color video camera angled downwards to provide imagery of the seabed while allowing some view of upcoming obstacles, and a downward-facing Ocean Imaging System 12000 digital still camera (consisting of a Nikon D90 digital SLR camera within an aluminum housing). Illumination is provided by two forward-facing 50 watt DSP&L LED Multi SeaLites for the video camera and a downward-facing strobe for the still camera. A pair of downward-facing DSP&L SeaLaser 100 parallel lasers provide scale for still imagery. The sled also has a Tritech PA200 altimeter to detect the height of the camera sled above the seafloor, and a pressure (depth) sensor and fluxgate compass, all installed inside an electronics bottle. The 75-lb camera sled is attached to a control console via umbilical cable that provides a real time feed from the video camera to an electronics console installed on the towing vessel. The TOAD is generally deployed from the vessel while it is drifting or slowly (≤ 1.5 knots) motoring above the seafloor. Operators manning the console adjust the length of cable out to keep the sled at an altitude of approximately 2 m above the seafloor to maximize imagery quality. Dives typically last from 5 to 20 minutes in duration but can run for several hours depending on the mission. Dive depths are most commonly between 20 – 100 m but have exceeded 200 m in depth in a few instances. Still imagery is the primary data recovered by the TOAD and enable PIFSC scientists to quantitatively characterize benthic communities and substrates. Images are typically taken at 15 second intervals and generally only every other photograph is classified.



Source: http://www.pifsc.noaa.gov/cred/survey_methods.php

Figure A-28 TOAD

13. Underwater Sound Playback System (Lubell LL916 piezoelectric)

The Lubell LL916 piezoelectric underwater sound playback system (Figure A-29) has a frequency response of 200Hz to 20kHz and comes with an underwater amplifier and projector. The PIFSC utilized the underwater speaker during their Cetacean Ecology studies to assist in calibration of the passive acoustic equipment. The speaker was suspended from a small boat or ship to a depth of about 100 meters and was set to transmit sound to passive acoustic recording devices in order to understand the detection distances and frequency–dependent variations in the device performances.

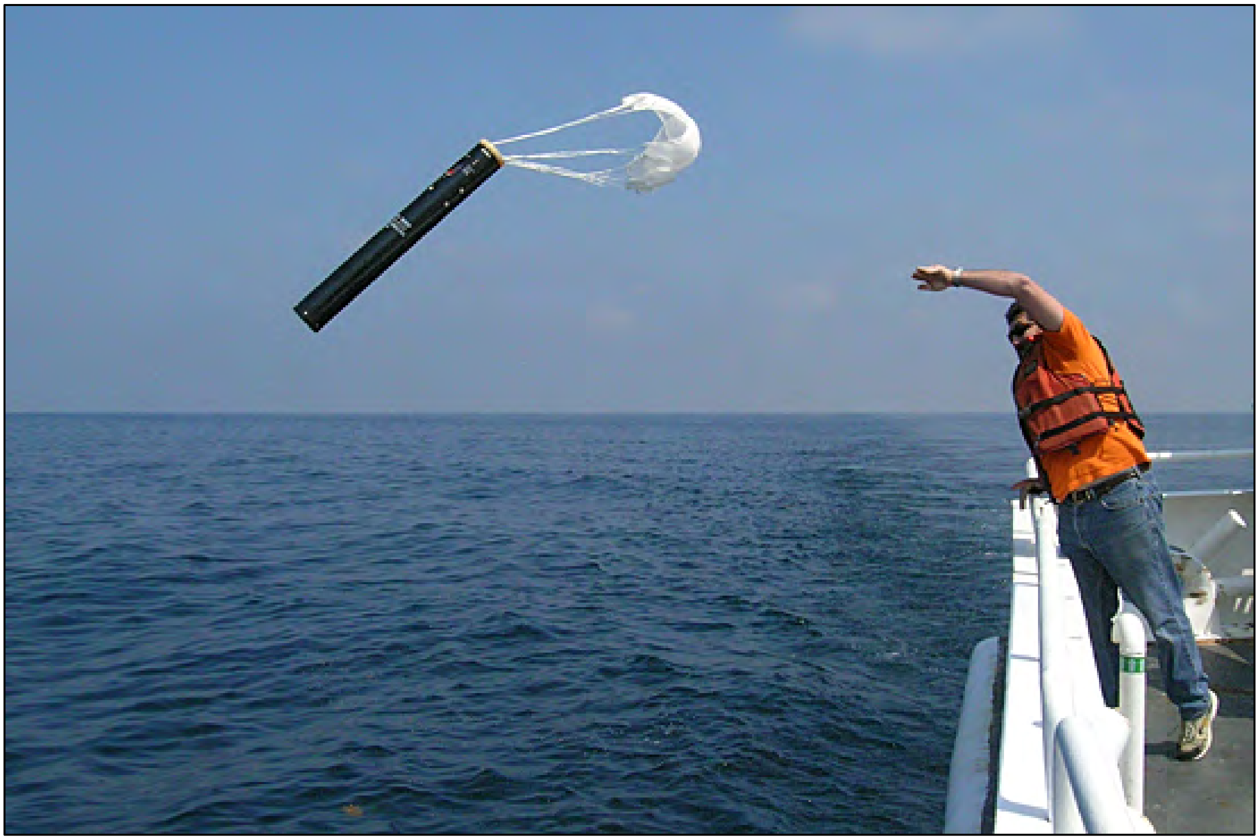
Figure A-29 Lubell LL916 piezoelectric underwater sound playback system

14. High-Frequency Acoustic Recording Package (HARP)

HARPs consist of three parts; hydrophones to convert sound pressure into a voltage signal that is amplified and filtered, a Data Acquisition System (DAS) that records and stores sound, and digital disk drives for recording onto disk (Figure A-30). The internal components of a HARP hydrophone include: two transducers, a signal conditioning electronics circuit board, and connector. These components are packaged in a thin-walled, pliable, polyurethane tube filled with oil to provide good acoustic coupling of the transducers with the seawater while protecting the circuit board from the environment. The seafloor instrument frames are compact arrangements of flotation, data recording electronics, batteries, ballast and release systems which free-fall to the seafloor, record sound for a specified period, and are recalled back to the sea surface for data retrieval and battery replenishment. Seafloor packages are easy to deploy and recover from typical oceanographic ships and mid-sized fishing vessels. In all configurations listed, the hydrophone sensor was designed to be tethered 10 m above the seafloor package which provides a quieter acoustic background for better sound recordings than near the sea surface.

Figure A-30 HARP

<u>Sonobuoy</u>: A sonobuoy is a relatively small expendable HARP system that can be dropped from a ship in order to study underwater acoustics (Figure A-31). Once the sonobuoy is deployed, a radio transmitter attached to a float remains on the surface for communication with the ship while one or more hydrophones below the surface record underwater acoutics.



Source: http://www.whoi.edu/page.do?pid=80696&i=2724

Figure A-31 Sonobuoy being deployed

15. Ecological Acoustic Reader (EAR)

Passive acoustic data is collected using an Ecological Acoustic Recorder (EAR). The EAR is a microprocessor-based autonomous recorder that samples the ambient sound field on a programmable duty cycle. EARs are generally programmed to record for periods of 30 seconds every 15 minutes at a sampling rate of 25-40 kHz, although these settings are at times different depending on the site and target sounds. An event detector allows for loud sounds that fall within certain parameters to turn on the recorder during duty periods to capture a 15-second recording. Data obtained from each EAR are aurally and visually analyzed.

16. Active Acoustic Sources Used in PIFSC Fisheries and Ecosystem Research

A wide range of active acoustic sources are used in PIFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Table A-1 shows important characteristics of these sources used on

NOAA research vessels conducting NWFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output characteristics for predominant PIFSC acoustic sources

Abbreviations: kHz = kilohertz; dB re 1 μPa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies (kHz)	Maximum source level (dB re 1 μPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	38, 70, 120, 200	224	1 ms @ 1 Hz	Downward looking	7°
Simrad EM300 multibeam echosounder	30	237	0.7 to 15 ms @ 5 Hz	Downward looking	1°
ADCP Ocean Surveyor	75	223.6	1 ms @ 4 Hz	Downward looking (30° tilt)	4°
Netmind	30, 200	190	up to 0.3 ms @ 7 to 9 Hz	Trawl-mounted	50°

Single Frequency Sonars

Didson: The Didson sonars operate on a low frequency of 12 MHz that allows for high resolution for up to 30 m even in dark turbid waters. This type of sonar is used for fish imaging and identification.

Multi-frequency Sonars

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The PIFSC makes use of several multi frequency Echo-Sounders such as the

Simrad EK60: The Simrad EK60 is a split-beam echo sounder with built-in calibration. It is specifically suited for permanent installation onboard a research vessel. The Simrad EK60 can operate seven echo sounder frequencies simultaneously ranging from 18 to 710 kHz. the Simrad EK60 is comprised of one color display, one processor Unit (personal computer), an Ethernet switch, one or more transceiver units, and one or more transducers.

Simrad ES60: The Simrad ES60 is a split-beam echo sounder comprised of a color display, a processor unit, one or more transceiver units, one or more single beam transducers. The transceiver unit is normally mounted close to the transducer. This prevents noise from being picked up by a long transducer cable. It is connected to the processor unit with a standard Ethernet cable. The Simrad ES60 can operate on several echo sounder frequencies simultaneously ranging from 18 to 200 kHz.

Multi-beam Echosounder and Sonar

Multibeam echosounders (Figure A-32) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path.

The use of multiple acoustic 'beams' allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The multibeam echosounders used by PIFSC are mounted to the hull of the research vessels and emit frequencies in the 3.5-260 kHz range.

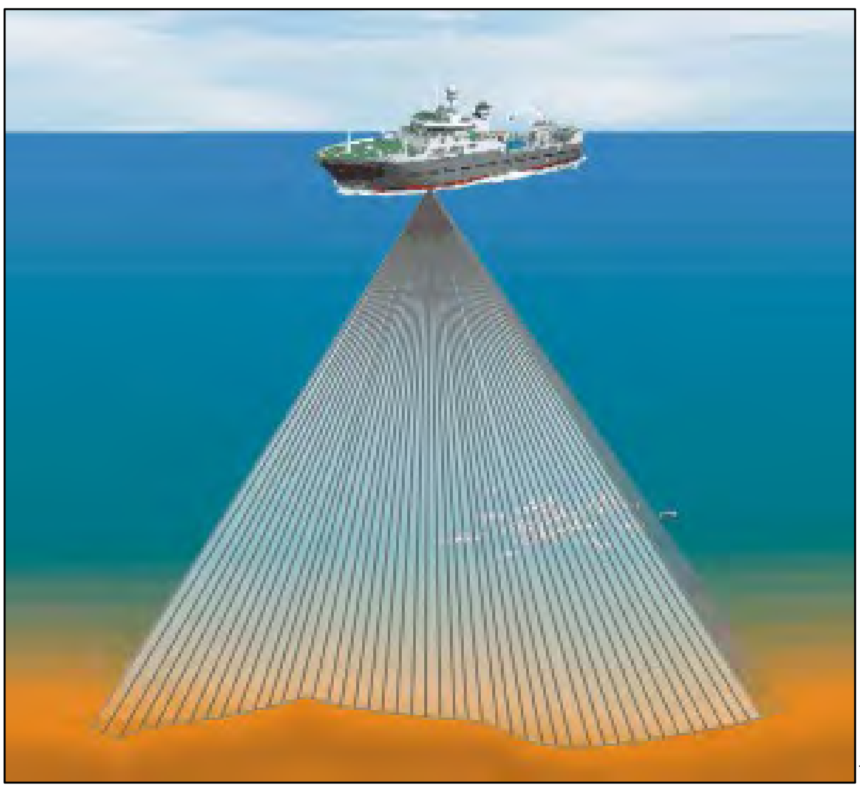


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Figure A-32 Multibeam sonar

Trawl Mounted OES Netmind

The NetMind™ Trawl Monitoring System allows continuous monitoring of net dimensions during towing to assess consistency, maintain quality control, and provide swept area for biomass calculations (Figure A-33). The NetMind system is utilized on every tow possible. Towing protocols are not altered based on the real time NetMind display.

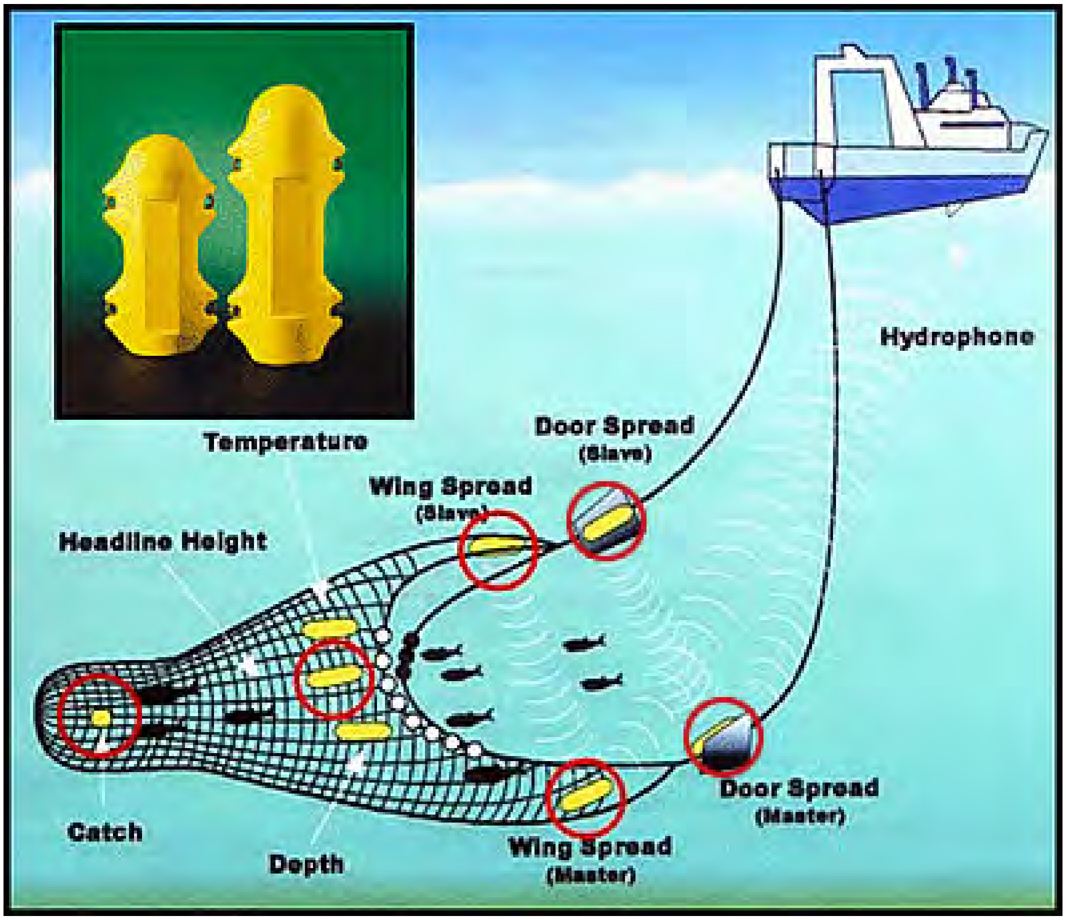


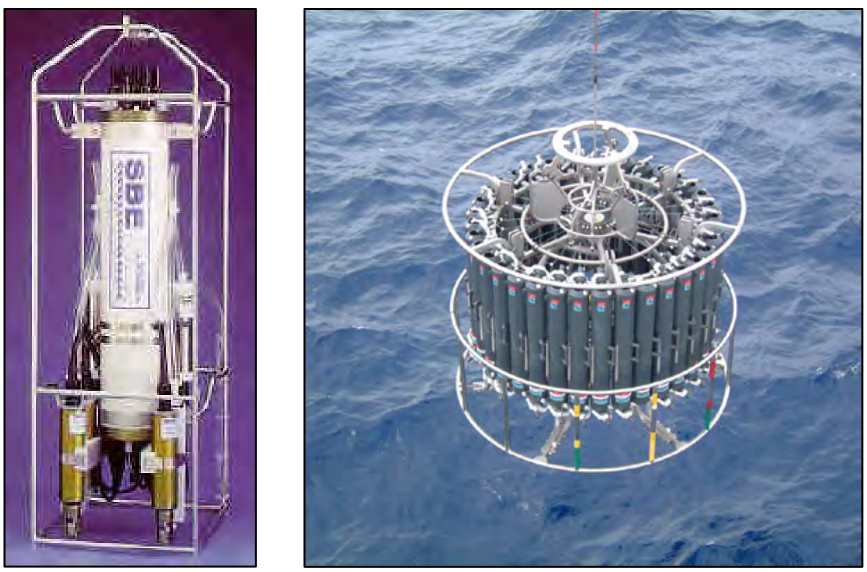
Figure A-33 NetMind

Acoustic Doppler Current Profiler (ADCP)

An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. An ADCP instrument can be mounted to a mooring or to the bottom of a boat. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings (WHOI 2011).

17. Conductivity, Temperature, and Depth (CTD)

A CTD profiler is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 m in diameter) metal rosette wheel (Figure A-34). The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the ship. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. A standard CTD cast, depending on water depth, requires two to five hours to complete (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.



Source: Sea-Bird Electronics, Bellevue WA

Figure A-34 Sea-Bird 911 plus CTD profiler and deployment on a sampling rosette.

Conductivity is measured as a proxy for salinity, or the concentration of salts dissolved in the seawater. Salinity is expressed in ‘practical salinity units’ (psu) which represent the sum of the concentrations of several different ions. Salinity is calculated from measurements of conductivity. Salinity influences the types of organisms that live in a body of water, as well as physical properties of the water. For instance, salinity influences the density and freezing point of seawater.

Temperature is generally measured using a high-sensitivity thermistor protected inside a thin walled stainless steel tube. The resistance across the thermistor is measured as the CTD profiler is lowered through the water column to give a continuous profile of the water temperature at all water depths.

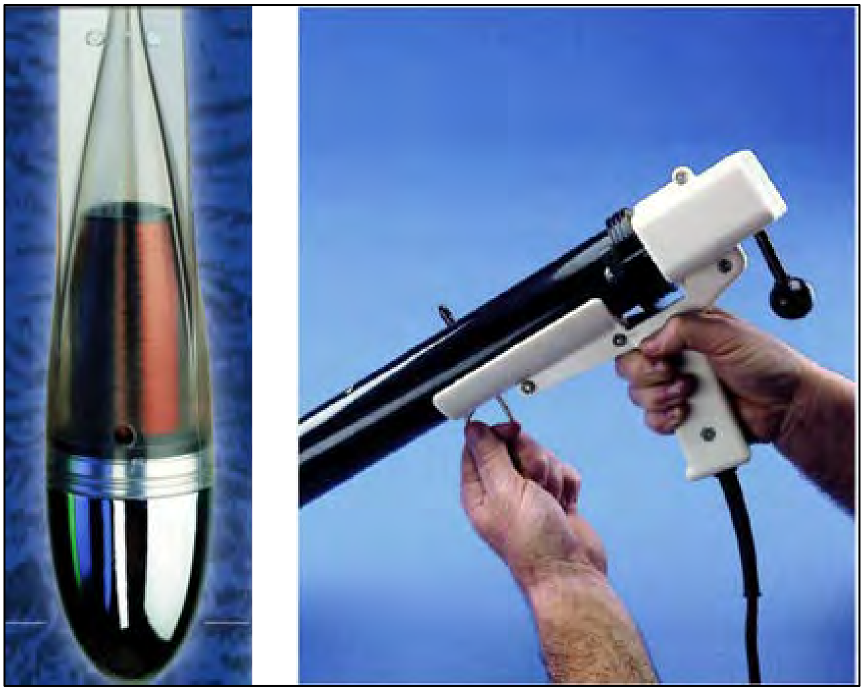
The depth of the CTD sensor array is continuously monitored using a very sensitive electronic pressure sensor. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties.

18. XBT (Expendable Bathythermograph)

A standard XBT/XSV system consists of an expendable probe, a data processing/recording system, and a launcher (Figure A-35). An electrical connection between the probe and the processor/recorder is made when the canister containing the probe is placed within the launcher and the launcher breech door is closed. Following launch, wire dereels from the probe as it descends vertically through the water. Simultaneously, wire dereels from a spool within the probe canister, compensating for any movement of the ship and allowing the probe to freefall from the sea surface unaffected by ship motion or sea state.

The XBT probes consist of a metal weight surrounding a temperature probe, attached to a copper wire that conducts the signal to the vessel. The copper wire is protected within a plastic housing. Probes are generally launched from the leeward side of the vessel and as far aft as possible. Launching from these locations helps obtain high reliability and minimizes the chances that the fine copper probe wire will come in contact with the ship's hull which may cause spikes in the data or a catastrophic wire break. A portable shipboard data acquisition system records, processes, and interprets the data the probes collect.

XBT drops occur at predetermined times along with surface chlorophyll sampling. Opportunistic drops may also occur. Typically, three XBT drops are made per survey day. XBT drops may be repeated if the displayed profile does not show a well-defined mixed layer and thermocline. Deep Blue probes are preferred, as they survey to a depth of 760 m and take approximately 2 minutes per drop. As the XBT probes are expendable, they are not retrieved and are left on the seafloor after data collection.



Source: Lockheed Martin Sippican Inc.

Figure A-35 Expendable XBT probe on the left; LM-3A hand-held launcher on the right

19. TDR (Time depth Recorders)

Memory based logging tools record their data against time. To provide a log in a standard format, it is necessary to also record the measured depth against time, then match and merge together the two time based data sets to produce a data record that includes the depth associated with each measured data point.

20. Vessels Used for PIFSC Survey Activities

NOAA Ship *Oscar Elton Sette*

Source: http://www.moc.noaa.gov/oes/

Figure A-36 ***Oscar Elton Sette***

The NOAA Ship *Oscar Elton Sette* (Figure A-36) operates throughout the central and western Pacific, and conducts fisheries assessment surveys, physical and chemical oceanography, marine mammal projects and coral reef research. It collects fish and crustacean specimens using midwater trawls, longlines, and fish traps. Plankton, fish larvae and eggs are also collected with plankton nets and surface and midwater larval nets. The ship routinely conducts scuba diving missions for PIFSC. Ample deck space enables *Oscar Elton Sette* to carry a recompression chamber as an added safety margin for dive-intensive missions in remote regions. The ship is also actively involved in NMFS PIFSC marine debris cruises, which concentrate scientific efforts on the removal, classification and density of derelict fishing gear across the Pacific Islands Region.

Ka'imikai-o-Kanaloa

Source: http://www.soest.hawaii.edu/UMC/cms/kaimikai-o-kanaloa/

Figure A-37 ***Ka'imikai-o-Kanaloa***

The University of Hawaiʿi research vessel *Ka'imikai-o-Kanoloa* or KoK (Figure A-37) is designed to operate in coastal blue and blue-water areas. Owned and operated by the University of Hawaii, at 223 feet, the KoK displaces 1,961 tons and can accommodate up to 13 crew and 19 scientists. The KoK can remain at sea for 50 days with a full crew and science party, cruising at a maximum speed of 11 knots. The KoK is well equipped for a range of general oceanographic research operations. A SeaBeam bathymetric mapping system is capable of charting the seafloor to depths of 11 kilometers. The vessel also has an Acoustic Doppler Current Profiler to measure profiles of water velocity relative to the ship, a Conductivity-Temperature-Depth system to measuring seawater parameters such as salinity and temperature, and an uncontaminated seawater system. Four laboratories are available for use on the ship: a rock lab for the storage and analysis of solid samples recovered from the ocean, a wet lab for chemical sample analyses, a clean lab, and a dry lab. The KoK's large, moveable A-Frame; trawl winch; and CTD winch allow for the launching of scientific equipment, such as the Pisces submersibles and other ROVs, permitting a variety of oceanographic operations to be conducted at sea. The KoK is equipped with a Trimble NAVTRAC in the bridge and Ashtech in the main lab. Both of these systems can receive Differential Global Positioning System (DGPS) signals. Vessel communications include HF (SSB) and VHF radios, INMARSAT-C satellite communications and Internet, and cellular phone.

NOAA Ship *Hi'ialakai*

Source: http://www.moc.noaa.gov/hi/

Figure A-38 *Hi'ialakai*

The NOAA Ship *Hi'ialakai* (Figure A-38) was acquired from the U.S. Coast Guard in October 2001, and was converted by NOAA from a T-AGOS surveillance vessel to a versatile platform that supports the research of NOAA's National Ocean Service (NOS), National Marine Sanctuaries (NMS), National Marine Fisheries Service (NMFS) and the Office of Oceanic and Atmospheric Research (OAR) as well as the U.S. Fish and Wildlife Service (USFWS) and the University of Hawaii. The ship operates across the PIR, including the Hawaiian Islands, American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam. *Hi'ialakai*, Hawaiian for "embracing pathways to the sea," is the primary platform for coral reef ecosystem mapping, bio-analysis assessments, coral reef health and fish stock studies. Scuba diving operations play a major role in scientific operations, and *Hi'ialakai* is well suited to support both shallow and deep-water dive projects. The ship is equipped to carry five small work boats for transporting divers to and from working areas, dive lockers to store scientific gear and equipment, and an air compressor to fill tanks. The ship also carries a three-person, double-lock recompression chamber; in the event of a diving accident, the diver can be treated on site. The *Hi'ialakai* carries out most of its dive intensive operations in the Northwest Hawaiian Islands.

NOAA Ship *Okeanos Explorer*

Source: http://www.moc.noaa.gov/oe/

Figure A-39 ***Okeanos Explorer***

The NOAA Ship *Okeanos Explorer* (Figure A-39) is the only federally funded U.S. ship assigned to systematically explore our largely unknown ocean for the purpose of discovery and the advancement of knowledge. Telepresence, using real-time broadband satellite communications, connects the ship and its discoveries live with audiences ashore. Since the ship was commissioned on August 13, 2008, the *Okeanos Explorer* has traveled the globe, exploring the Indonesian 'Coral Triangle Region;' benthic environments in the Galápagos; the geology, marine life, and hydrothermal systems of the Mid-Cayman Rise within the Caribbean Sea; and deep-sea habitats and marine life in the northern Gulf of Mexico. Mapping activities along the West and Mid-Atlantic Coasts have furthered our knowledge of these previously unexplored areas, setting the stage for future in-depth exploration activities. The *Okeanos Explorer* is 224 feet in length and displaces 2,298.3 metric tons. The equipment aboard the *Okeanos Explorer* includes remotely operated vehicles, multibeam sonar for as deep as 6,000 meters, and telepresence capabilities.

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Appendix B

Spatial Distribution of PIFSC Fisheries Research Effort by Gear Type

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Table of Contents

List of Figures

List of Figures

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Spatial Distribution of PIFSC Fisheries and Ecosystem Research Effort by Gear Type

This appendix provides a brief synopsis of PIFSC fisheries and ecosystem research effort by gear type and by research area for extractive or bottom-contact gear efforts (Remotely Operated Vehicles [ROVs], longline fishing, dipnet, trap gear, surface and midwater trawls, hook-and-line gear, camera drops, various coral monitoring units, and hand gear by divers). The level of effort at a particular research area can and often does vary from year to year. For example, many surveys only visit the MARA, ASARA, and WCPRA approximately once every three years, but the HARA can be surveyed every year. In addition, the seasonal timing of most research activities is variable from year to year depending on the availability of research vessels and other logistical considerations. The information in this appendix is therefore an approximation of a typical three-year survey cycle of PIFSC fisheries and ecosystem research based on the average level of gear deployment for all surveys and projects under the Status Quo Alternative. Tables B-1 through B-4 summarizes the research effort in each research area, with general descriptions of survey and gear types, along with effort levels. Figures B-1 through B-4 summarizes the general spatial effort in each research area for each major gear type. This allows the reader to judge the concentration of research by gear type in different PIFSC research areas. When combined with the tables referenced above, it provides a more complete understanding of the PIFSC research effort. See Table 2.2-1 and Appendix A for complete details on the gears used in PIFSC fisheries and ecosystem research.

Table B-1 PIFSC research effort by gear type in the HARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
HAWAI‘I ARCHIPELAGO RESEARCH AREA (HARA)				
Longline	Pelagic Longline Hook Trials	Pelagic longline and trolling; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Longline Gear Research	Pelagic longline; up to 60-mile mainline		10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 knots (kts) towed for 60-240 minutes (min) at depths down to 250 meters (m)
	Kona Integrated Ecosystem Assessment Cruise	Stauffer Modified Cobb Net	15-20 tows per year	3 kts towed for 60-240 min at depths down to 200 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Kona Integrated Ecosystem Assessment Cruise	Isaacs-Kidd trawl, Neuston nets, ring net, Bongo nets, plankton drop net	15-20 tows per year	3kts towed for up to 50 min at depths down to 200 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	350 operations per year	1-30 min soak time
	Northwestern Hawaiian Islands Bottomfish Surveys	Electric or hydraulic reel	256 operations per year	1-30 minute soak time
	Insular Fish Abundance Estimation Comparison Surveys	Hand, electric, and/or hydraulic reels	≤ 540 operations per year	≤ 30 min soak time

Gear type	Surveys	Gear Description	Sampling Events	Effort
Hand gear by divers	Pacific Reef Assessment and Monitoring Program (RAMP)	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	Bioerosion Monitoring Units (BMUs) Autonomous Reef Monitoring Structures (ARMS) Sea Bird Electronics Temperature Recorders (STRs) Calcification Acidification Units (CAUs) Water Samplers (PUCs, RAS) Carbonate Sensors (SEAFET, SAMI)	500 deployments per year	Deployed for 1-3 years
Camera drops	RAMP	Baited Remote Underwater Video Systems (BRUVS)	Up to 600 deployments per year	Deployed for approximately 1 hour (hr)
	Insular Fish Abundance Estimation Comparison Surveys	Underwater Video Camera (BotCam)	380 deployments per year	Deployed for 30-60 min at depths down to 350 m
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year
Trap gear	Northwestern Hawaiian Islands Lobster Surveys	Lobster traps	Up to 360 strings set per year	One string per site with 8 or 20 traps per string at depths of 10-20 or 20-35 fathoms

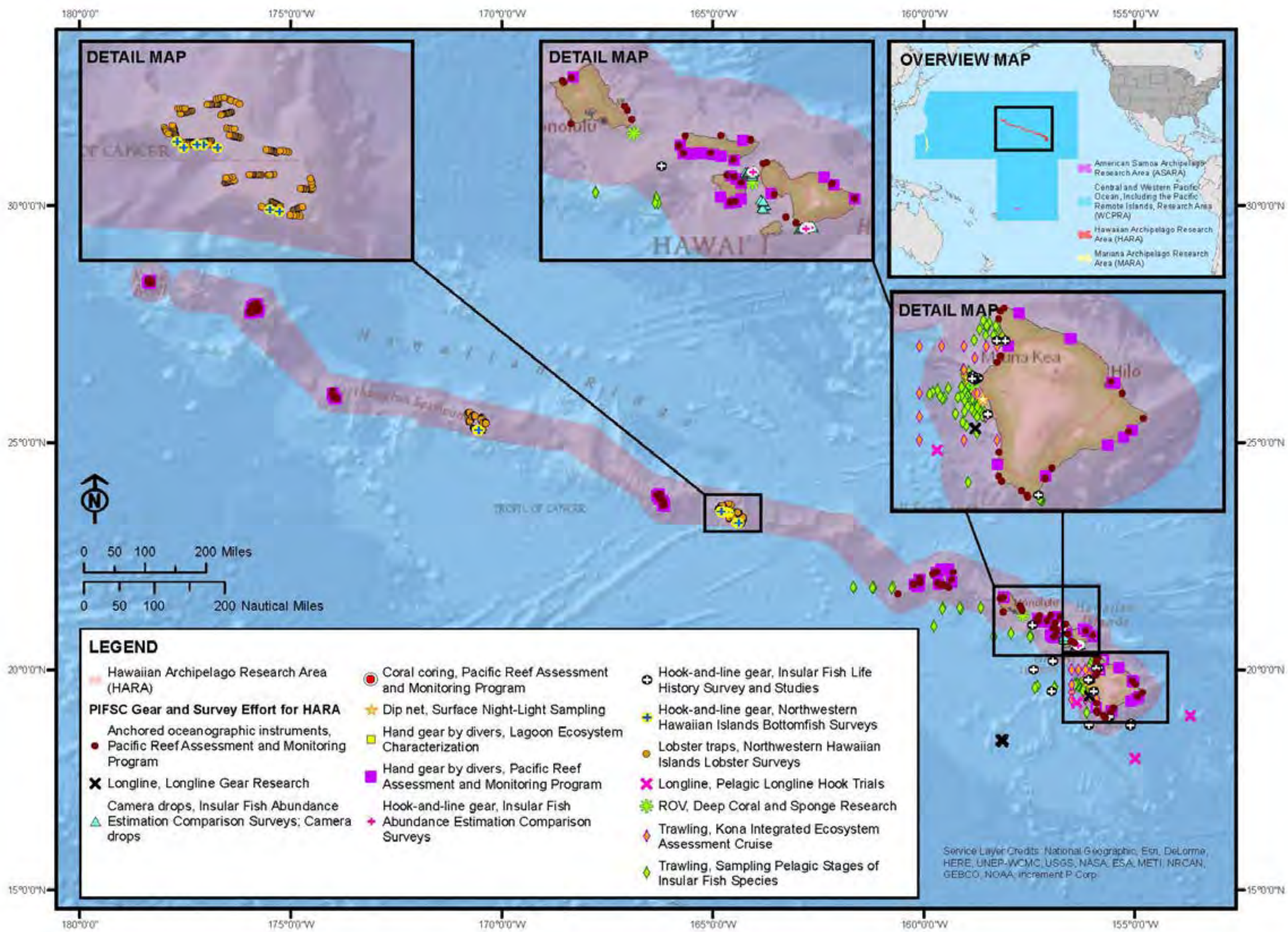

Figure B-1 **Distribution of PIFSC research effort in the HARA for an approximate three-year survey cycle under the Status Quo Alternative**

Table B-2 PIFSC research effort by gear type in the MARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
MARIANA ARCHIPELAGO RESEARCH AREA (MARA)				
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 meters m
	Mariana Resource Survey	Stauffer Modified Cobb Net	15-20 tows per year	3 kts
		Isaacs-Kidd midwater trawl	200 tows per year	
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Mariana Resource Survey	Isaacs-Kidd trawl, Neuston nets, ring net, and Bong nets	15-20 tows per year	3 kts towed for up to 60 min at depths down to 200 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
	Mariana Resource Survey	Electric or hydraulic reel	1000 sets per survey	Soaked for 10-60 min at depths of 200-600 m
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
	Mariana Resource Survey	Spear gun	Up to 1000 reef fish per year	Ad hoc fish collections
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year

Gear type	Surveys	Gear Description	Sampling Events	Effort
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year
Trap gear	Mariana Resource Survey	Kona crab traps and lobster traps	Up to 400 strings set per year and 25 gear sets per cruise	Up to 10 Kona crab nets per string and soaked for 20 min Up to 20 lobster traps per string and soaked overnight

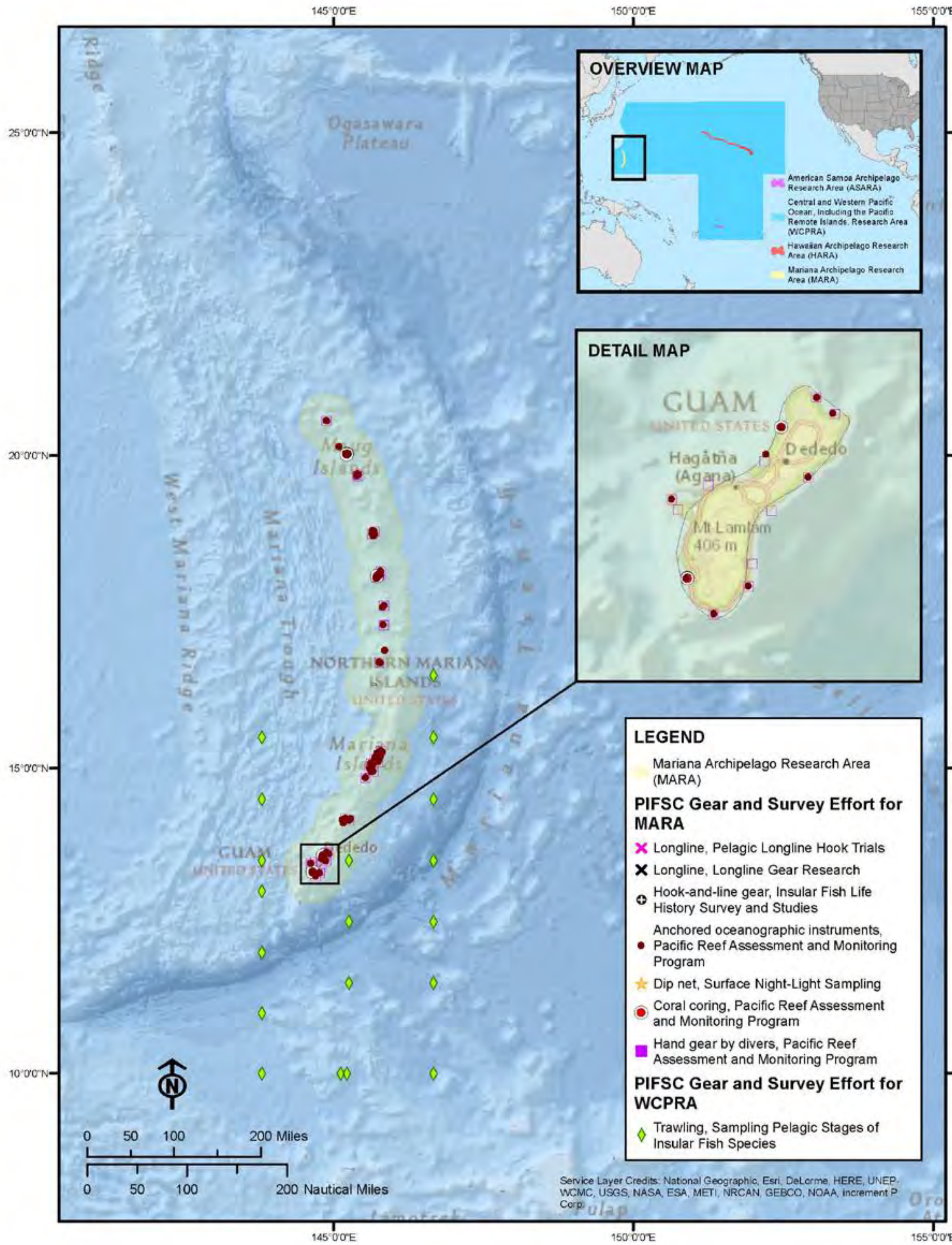

Figure B-2 Distribution of PIFSC research effort in the MARA for an approximate three-year survey cycle under the Status Quo Alternative

Table B-3 PIFSC research effort by gear type in the ASARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
AMERICAN SAMOA ARCHIPELAGO RESEARCH AREA (ASARA)				
Longline	Longline Gear Research	Pelagic longline; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year

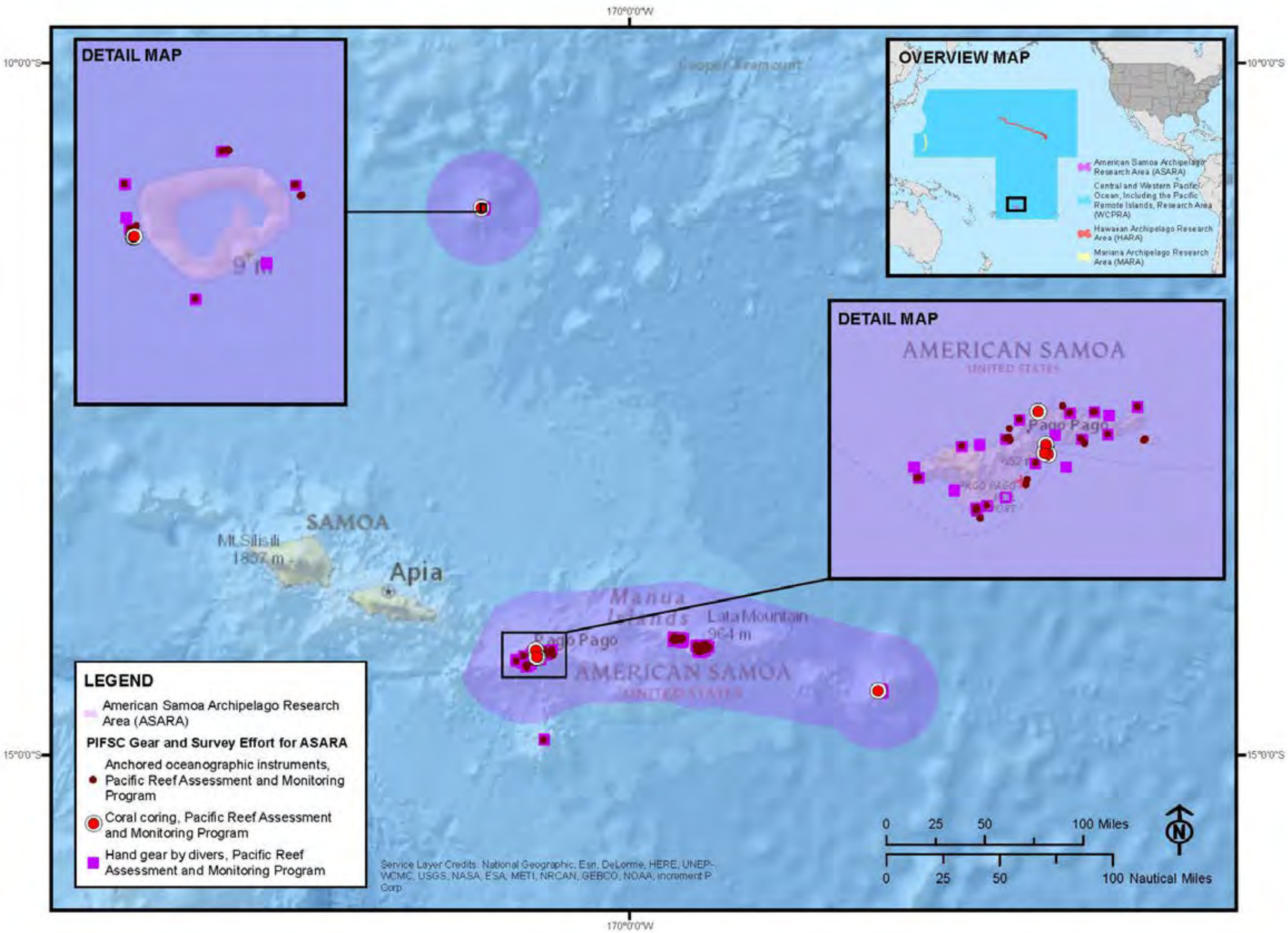

Figure B-3 **Distribution of PIFSC research effort in the ASARA for an approximate three-year survey cycle under the Status Quo Alternative**

Table B-4 PIFSC research effort by gear type in the WCPRA

Gear type	Surveys	Gear Description	Sampling Events	Effort
WESTERN AND CENTRAL PACIFIC RESEARCH AREA (WCPRA)				
Longline	Pelagic Longline Hook Trials	Pelagic longline and trolling; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Longline Gear Research	Pelagic longline; up to 60-mile mainline		10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 m
	Pelagic Oceanographic Cruise	Stauffer Modified Cobb Net	20 tows per year	3 kts towed for 60-240 min
		Plankton drop net	20 drops per year	Deployed down to 100 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Pelagic Oceanographic Cruise	Isaacs-Kidd trawl, Neuston nets, ring net, Bongo nets	20 tows per year	3 kts towed for 60-240 min at the surface
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook–and-line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
	Lagoon Ecosystem Characterization	Standard rod and reel	60 casts per survey	1-30 min casts

Gear type	Surveys	Gear Description	Sampling Events	Effort
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
	Lagoon Ecosystem Characterization	Hand nets	10 dives per survey	Approximately 10 fin clips per survey
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year

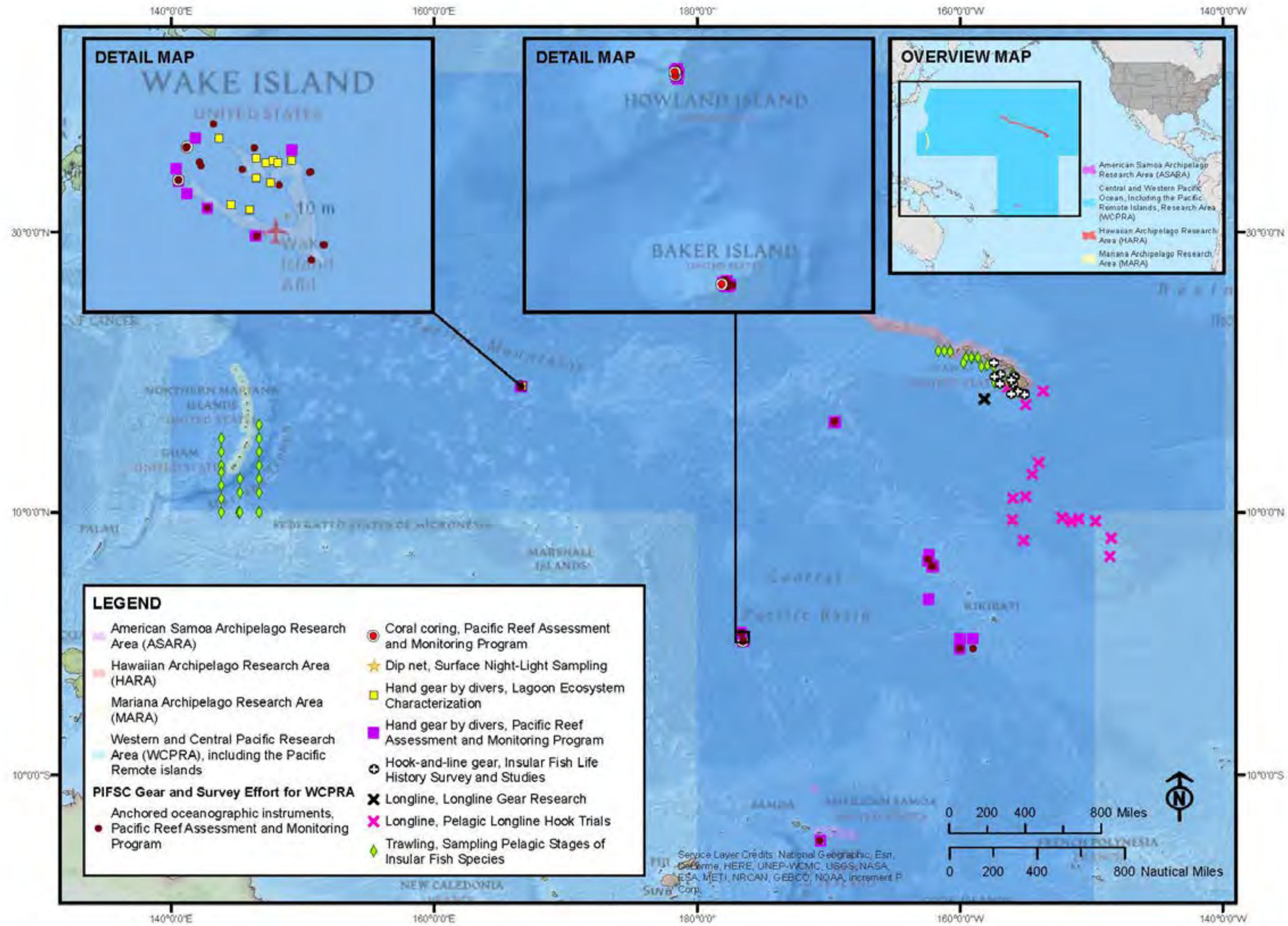

Figure B-4 Distribution of PIFSC research effort in the WCPRA for an approximate three-year survey cycle under the Status Quo Alternative

DRAFT

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded by the

Pacific Islands Fisheries Science Center

November 2015

Appendix D

Protected Species Handling Procedures

Prepared for the National Marine Fisheries Service by:

URS Group

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Anchorage, Alaska 99501

Science, Service, Stewardship

NOAA FISHERIES SERVICE

Pacific Islands Region

Identification, Handling, and Release of Protected Species

Sea Turtles

Marine Mammals

Seabirds

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

Sea Turtle Handling Guidelines

STEP 1:

Determine if the turtle is small enough to bring aboard.

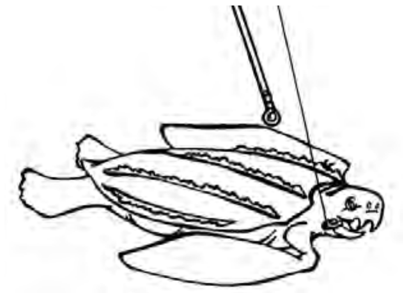
Remember to use gaffs only on fishing gear, not on turtles

IF TURTLE IS TOO BIG TO BRING ABOARD:

- Bring turtle close to boat by pulling gently on the line.
- Determine if turtle is hooked or entangled, and choose the proper tools to remove as much fishing gear as possible from the turtle – including the hook.
- If turtle is hooked and the hook is visible just inside the mouth or on the body, use long handled dehooker to remove hook. See **Step 3** for instructions.
- If turtle is entangled or the hook is deep inside mouth or throat and cannot be removed, use a long-handled line cutter to cut all lines.
- Skip to **Step 5**.

IF TURTLE IS SMALL ENOUGH TO BRING ABOARD:

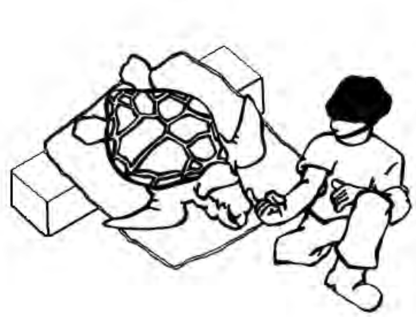
- Use dip net to bring turtle aboard.
- Do not bring turtle aboard by pulling on fishing line or by grabbing the eye sockets.
- It may be helpful to grab the front flippers close to the turtle's body when using the net to help bring it aboard.
- Go to **Step 2**.



STEP 2:

After the turtle has been brought aboard, determine if it is alive or appears dead.

A turtle that looks dead may just be very tired, and can regain strength with your help.



UNCONSCIOUS TURTLE - inactive and appears dead

- Keep the turtle on a tire in a secure, shaded place away from activity.
- Remove fishing gear using instructions in **Step 3**.
- Place turtle on its belly and elevate back flippers at least 6 inches for at least 4 hours to help remove water from its lungs while recovering.
- Place a wet towel on turtle. Do not cover nostrils. Occasionally wet turtle with a deck hose. Avoid spraying turtle's head.
- Perform a reflex test every 3 hours, by gently touching corner of eye and lightly pulling on tail. Movement may indicate the turtle is recovering.
- If there is no movement from reflex tests after at least 4 hours, but no more than 24 hours, release the turtle to the ocean using methods in **Step 4**.

CONSCIOUS TURTLE - active or awake

- Keep the turtle on a tire in a secure, shaded place away from activity.
- Remove fishing gear using instructions in **Step 3**.
- Release the turtle using methods in **Step 4**. You do not have to wait 4 or more hours before release.

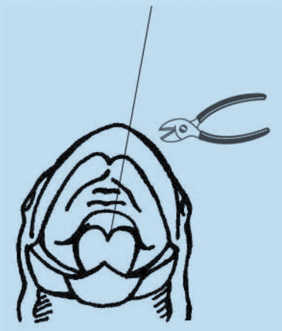
Questions? Call Pacific Islands Regional Office, Sustainable Fisheries Division at (808) 725-5000

When to Leave Hooks in Place.

It is normally best to remove all fishing gear from the turtle, but there are situations when the gear should not be removed. Leave hook in place and cut line as close as possible to hook if:

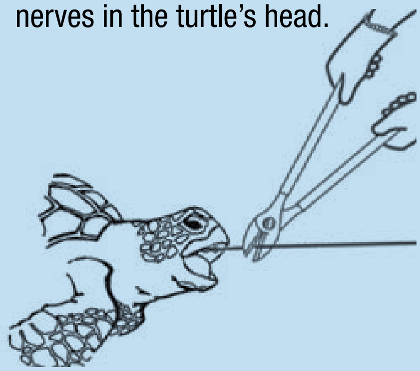
The hook has been swallowed.

Forcing a dehooking device down a turtle's throat may worsen its injuries or cause an infection.



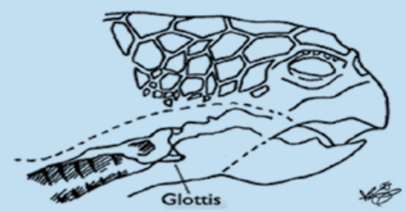
The hook has penetrated the roof of the mouth.

Trying to remove this hook may cause damage to the organs and nerves in the turtle's head.



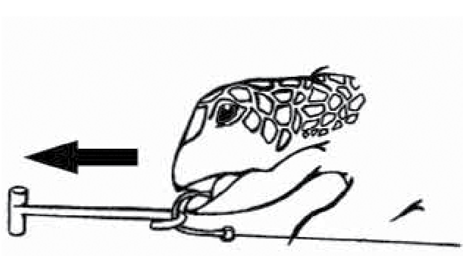
The hook is in the glottis.

The glottis is located at the back of the mouth and covers the airway. Attempting to remove hooks from the glottis may cause further damage and prevent the turtle from covering its airway during dives.



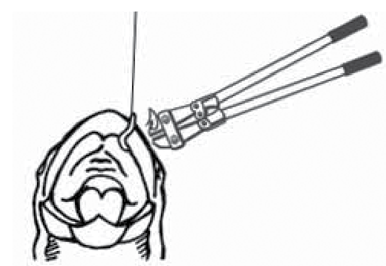
STEP 3:

Methods for removing fishing gear from a hooked turtle.



TURTLE HOOKED WITH BARB EXPOSED

1. Using bolt cutters, remove the barb of the hook.
2. Once barb has been clipped off, back the hook out to remove it.



TURTLE HOOKED WITH BARB EMBEDDED

1. Follow instructions on using a pig-tail dehooker.
2. If hook cannot be removed, cut line as close as possible to hook.

TURTLE IS HOOKED, BUT YOU CANNOT SEE HOOK

- Cut fishing line as close as possible to hook without pulling hard on line.

TURTLE ENTANGLED IN FISHING LINE

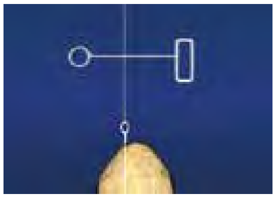
- Use monofilament or wire cutters to remove all fishing line from turtle.

IF BOLT CUTTERS ARE NOT AVAILABLE

1. Place a pig-tail dehooker or similar hand-held tool on the line above the hook. To get the dehooker on the line, refer to pig-tail dehooker instructions.
2. Slide device down the line to the bottom of the hook.
3. Pull the line so it is opposite from the handle of the dehooker.
4. Keep the line tight, then pull and twist the dehooker to remove the hook.

Sea Turtle Handling Guidelines

Dehooking J-hooks using a pig-tail dehooker with your right hand:

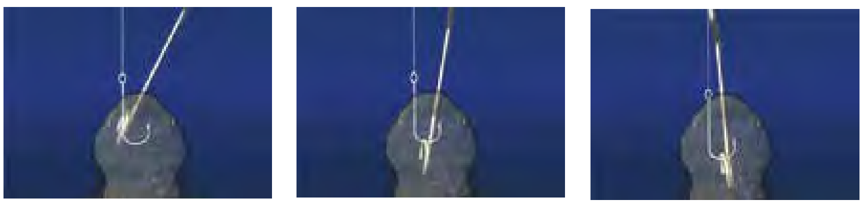


Place the dehooker at 90^0 to the line with the end of the pig-tail facing up.

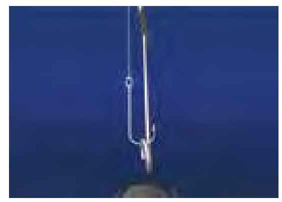
Draw the dehooker back towards you like a bow and arrow until loop pulls on line, maintaining contact between the dehooker and the line.

Rotate the dehooker 1/4 turn clockwise. (The line should be inside the curl of dehooker)

Run the dehooker down the line until it engages the bottom bend of the hook.

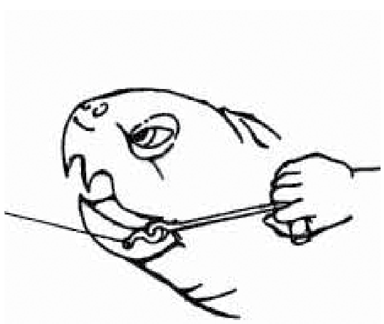


Pull the line tight and parallel to the dehooker. Give quick thrusts to remove the hook.



Keep line tight, so the hook remains inside the curl of dehooker, until hook is clear of the turtle.

Circle Hooks



When using the long-handled pig-tail dehooker on a turtle in the water, it may be easier to remove circle hooks if the line is not parallel to the dehooker's handle once the dehooker is on the line.

- While keeping the line tight, separate the line and dehooker, then try to push and twist the dehooker to dislodge the hook. This may work better than quick thrusts.
- If you cannot remove the hook, cut line as close as possible to the hook.
- If turtle is aboard, try to rotate the hook back out by using the line or pliers before using the dehooker. This may help remove the hook.

STEP 4:

Carefully return turtle to water.

1. Stop vessel, and take engine out of gear.
2. Release the turtle away from any fishing gear in the water.
3. Gently put turtle in the water, head-first.
4. Make sure turtle is clear of vessel before motoring away.

Photo courtesy of Steve Beverly

STEP 5:

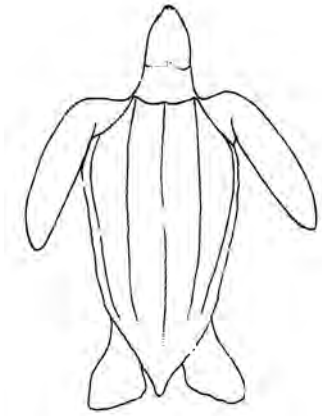
Record the interaction in your logbook.

1. Record the identified species.
2. Write down how much fishing gear remained on turtle after release.
3. Record any tag numbers observed on turtle.

Questions? Call Pacific Islands Regional Office, Sustainable Fisheries Division at (808) 725-5000

LEATHERBACK

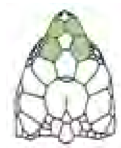
- Dark, leathery skin covers body and shell
- No scutes or scales like other turtles
- 5-7 head to tail ridges on back
- Adults are much larger than other turtles



Hard Shell Turtles

GREEN

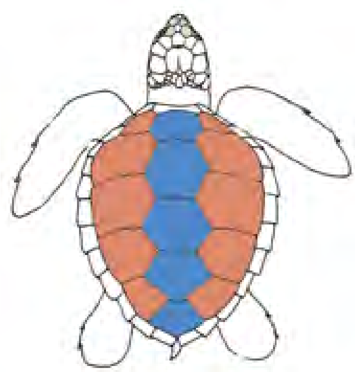
- 1 pair of prefrontal scales
- 5 central scutes
- 4 pairs of lateral scutes
- 4 inframarginal scutes on each side



TOP VIEW
OF HEAD

LOGGERHEAD

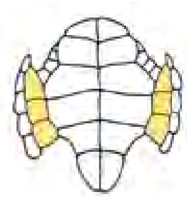
- 2 pairs of prefrontal scales
- 5 central scutes
- 5 pairs of lateral scutes
- 3 inframarginal scutes on each side



TOP VIEW

HAWKSBILL

- 2 pairs of prefrontal scales
- 5 central scutes
- 4 pairs of overlapping lateral scutes
- 4 inframarginal scutes on each side



BOTTOM VIEW
OF TURTLE

Prefrontal Scales
Central Scutes
Lateral Scutes
Inframarginal Scutes

OLIVE RIDLEY

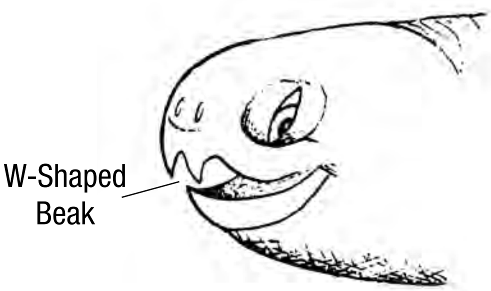
- 2 pairs of prefrontal scales
- 5 central scutes
- 5-9 pairs of lateral scutes
- 4 inframarginal scutes on each side with pores

Leatherback Sea Turtle

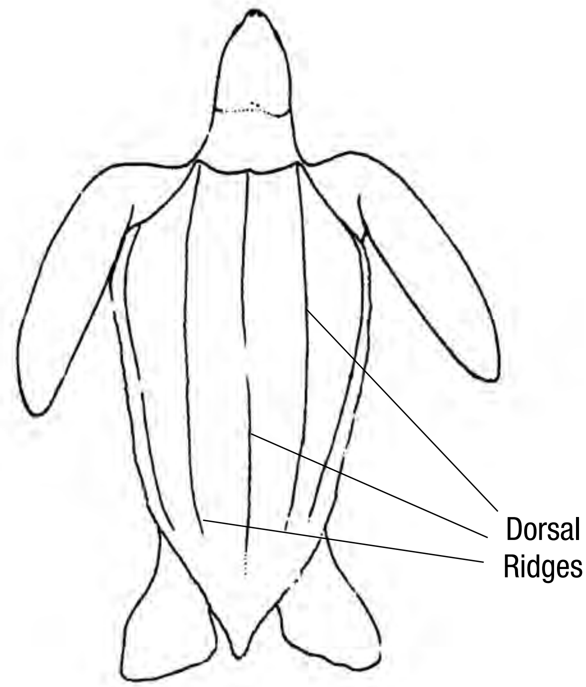
(Dermochelys coriacea)

- Only soft-shelled species
- Dark gray or black with variable white spotting
- 5-7 head-to-tail ridges on back
- Leathery shell
- No scales
- W-shaped upper jaw or beak
- May attain great size

Approximate range



SIDE VIEW
OF HEAD



TOP VIEW

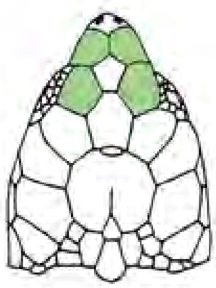
TURTLE FACTS:
Leatherback turtles interact with both the Hawaii swordfish (shallow-set) and tuna (deep-set) longline fisheries. They are usually hooked or entangled externally, rather than in the mouth. This turtle has a firm, leathery skin covering the shell and body, instead of a hard shell and scales like other turtles. They are highly migratory, swimming long distances across the Pacific from nesting to foraging areas. Leatherbacks are the largest of all sea turtles with adults reaching 6½ feet (2 meters) in length and over 1,500 pounds (681 kg).

Loggerhead Sea Turtle

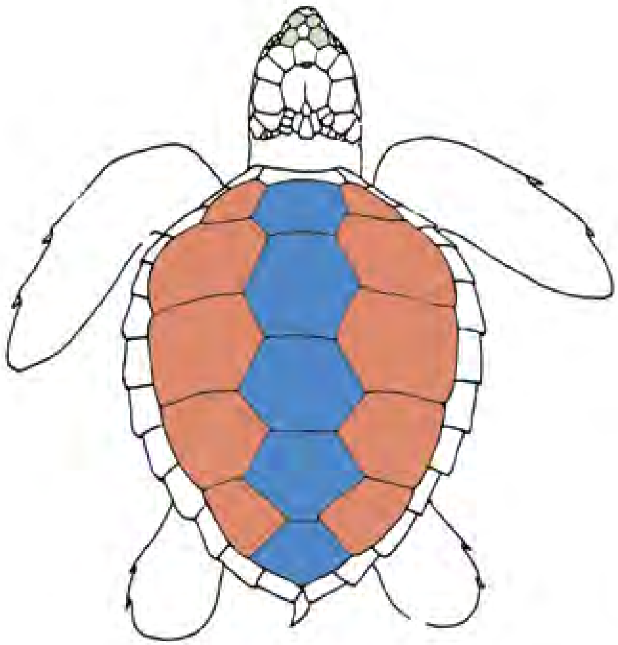
(Caretta caretta)

- 2 pairs of prefrontal scales
- 5 central scutes
- 5 pairs of lateral scutes
- 3 pairs of inframarginal scutes

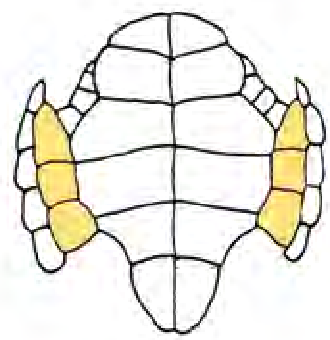
Approximate range



TOP VIEW OF HEAD



TOP VIEW



BOTTOM VIEW OF TURTLE

TURTLE FACTS:

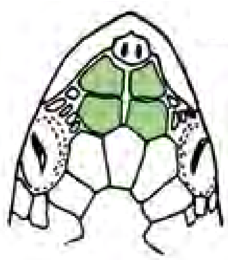
Loggerhead turtles interact with both the Hawaii swordfish (shallow-set) and tuna (deep-set) longline fisheries. In the North Pacific, juveniles hatched from nests in Japan swim across the ocean to feed and grow near the Mexican coast. They can spend decades in migratory and developmental habitats in Mexico and the central Pacific until maturity, when they return to Japan. Loggerheads can grow to over 36 inches (92 cm) in shell length and 250 pounds (113 kg). They have large heads, strong jaws, and typically have shells that are reddish-brown with a yellow underside.

Olive Ridley Sea Turtle

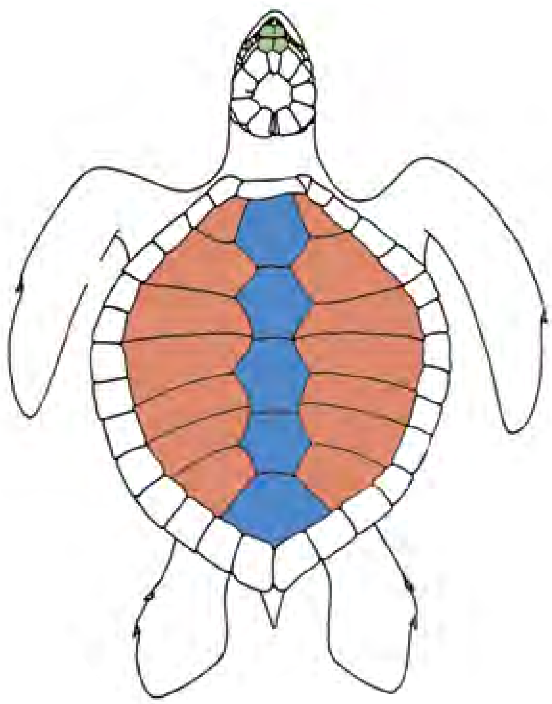
(Lepidochelys olivacea)

- 2 pairs of prefrontal scales
- 5 central scutes
- 5-9 pairs of lateral scutes
- 4 pairs of inframarginal scutes with one pore on each scute

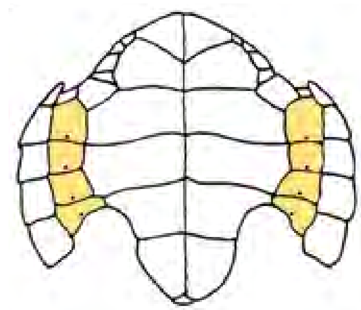
Approximate range



TOP VIEW OF HEAD



TOP VIEW



BOTTOM VIEW OF TURTLE

TURTLE FACTS:

Olive ridley turtles interact primarily with the Hawaii tuna (deep-set) longline fishery, and occasionally with the swordfish (shallow-set) fishery. These turtles are highly migratory and usually live in warm, tropical waters, but may also occur in cooler waters north of Hawaii. Olive ridley turtles are the smallest sea turtles, averaging 25 inches (61 cm) in shell length and 100 pounds (45 kg). Their shell is generally olive green with a light yellow underside. They sometimes have more lateral scutes on one side of their shell than the other. They are the only turtles in the Pacific with a pore on each inframarginal scute.

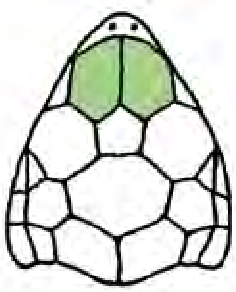
Questions? Call Pacific Islands Regional Office, Sustainable Fisheries Division at (808) 725-5000

Green Sea Turtle

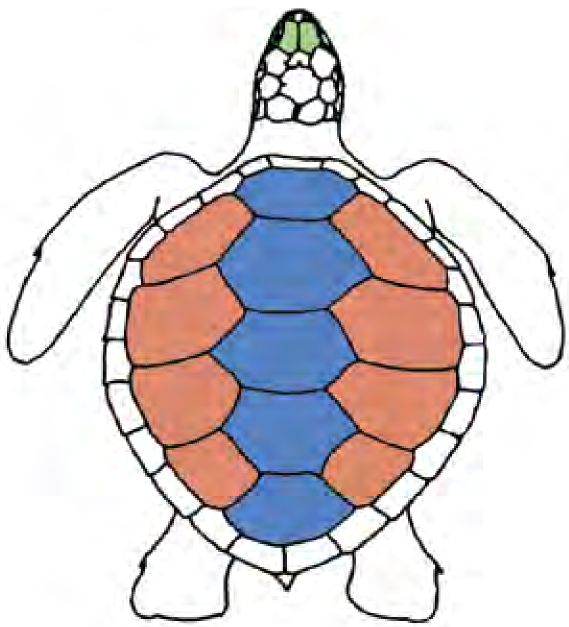
(Chelonia mydas)

- 1 pair of prefrontal scales
- 5 central scutes
- 4 pairs of lateral scutes
- 4 pairs of inframarginal scutes

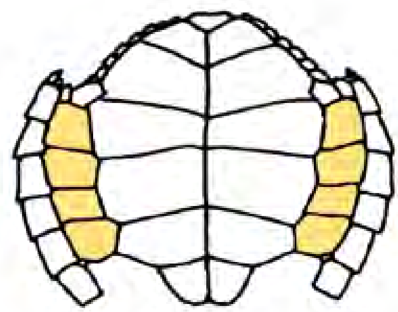
Approximate range



TOP VIEW
OF HEAD



TOP VIEW



BOTTOM VIEW
OF TURTLE

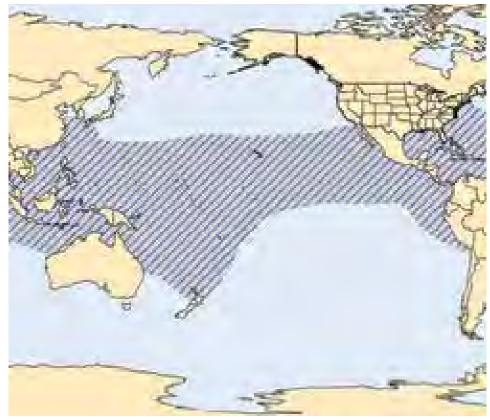
TURTLE FACTS:

The green turtle is the most widespread and commonly-known sea turtle in tropical and sub tropical waters. Green turtles are not usually caught in longline fisheries, but interactions can occur in the Hawaii and American Samoa fisheries. Green turtles are the largest of the hard-shell turtle species and can grow up to 47 inches (120 cm) in shell length and weigh over 300 pounds (136 kg). They get their name from the color of their fat. The shell color can range from yellow-green to reddish-brown to almost black. Loggerheads and olive ridley turtles can be easily mistaken for a green turtle. When in doubt, look at the head and check the number of prefrontal scales.

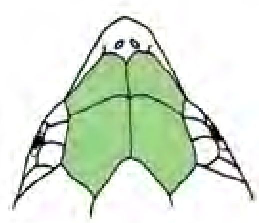
Hawksbill Sea Turtle

(Eretmochelys imbricata)

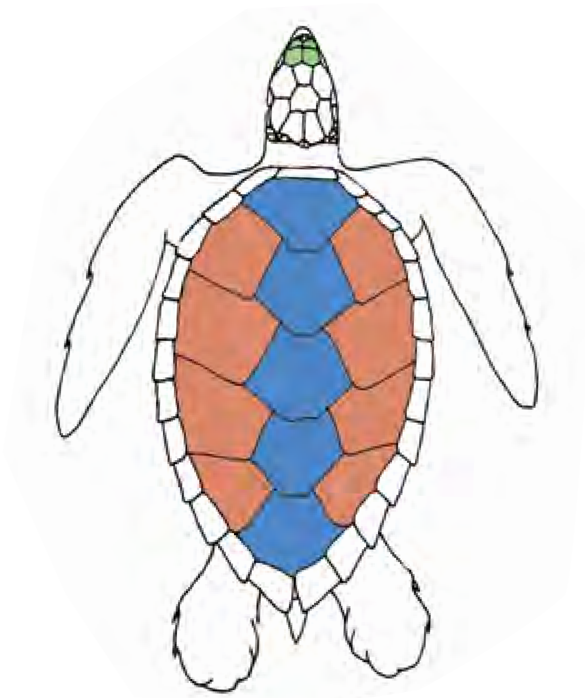
- 2 pairs of prefrontal scales
- 5 central overlapping scutes
- 4 pairs of overlapping lateral scutes
- 4 pairs of inframarginal scutes



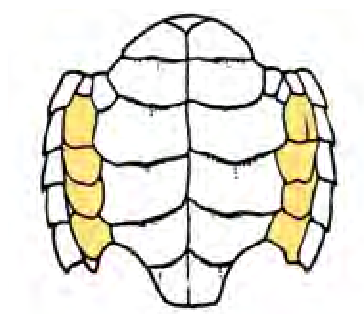
Approximate range



TOP VIEW
OF HEAD



TOP VIEW



BOTTOM VIEW
OF TURTLE

TURTLE FACTS:

There has been no reported interaction between a hawksbill turtle and the Hawaii longline fisheries. Hawksbills can be found in tropical and sub-tropical regions across the Pacific. They nest in low numbers throughout the Pacific, including Hawaii. Adult hawksbills can grow to almost 3 feet (90 cm) in shell length and weigh up to 200 pounds (91 kg). The hawksbill is named for its sharp, pointed, bird-like beak. The shell has "tortoise shell" coloring, ranging from dark to golden brown, with streaks of orange, yellow, brown and black. These are the only sea turtles that have overlapping scutes on the top shell, like roof shingles.

Questions? Call Pacific Islands Regional Office,
Sustainable Fisheries Division at (808) 725-5000

SAFETY FIRST! Hooked or entangled marine mammals can be very powerful and unpredictable.

NOTE: This page is not a substitute for the NOAA Fisheries Marine Mammal Handling and Release Guidelines placard that is required to be posted on Hawaii-based longline vessels.

Small Whales and Dolphins *(such as short-finned pilot whales, false killer whales, and Risso's dolphins)*

1. Make sure the crew is ready to help, and have dehooking and line-cutting equipment available.
2. Avoid sudden actions and movements that may scare the animal.
3. Do NOT use gaffs or sharp objects to grab or hold an animal.
4. **Determine if the animal is hooked or entangled.**

If the animal is hooked:
1. Maintain tension on the line, giving the hook a chance to straighten and release the animal without the hook or trailing line attached.
2. If the hook does not straighten, use a dehooker to remove the hook.
3. If the hook is not straightened or removed, use a long-handled line cutter to cut the line as close as you can to the hook.

If the animal is entangled:
1. If the mainline and branchline are tangled around the animal, secure the far side of the mainline to the boat. This will keep any remaining gear in the water from pulling on the line and the animal.
2. Use a long-handled line cutter to cut as much line off the animal as you can.

False Killer Whale

Risso's Dolphin

Large Whales *(such as fin whales, sperm whales, and humpback whales)*

- If a large whale is alive and hooked or entangled in fishing gear, immediately call the Disentanglement Hotline at 1-888-256-9840, or the U.S. Coast Guard on VHF Ch.16 for instructions.
- Move the vessel to minimize tension on the fishing gear.
- If a large whale is dead and hooked or entangled in fishing gear, immediately call the U.S. Coast Guard on VHF Ch.16 for instructions.

Humpback Whale

For All Interactions

- **The captain must be notified to supervise the handling and release of the animal**.
- Have an identification guide, pen and paper available.
- Write down a description of the animal and its injuries (take photos if possible):
  - How long was the animal?
  - What did the animal look like? Did it have stripes, spots, or different colors?
  - Was there fishing gear on the animal when it was released? If so, where, what kind, and how much?
  - Did you see any tags on the animal? If yes, did you see any letters or numbers on the tag?

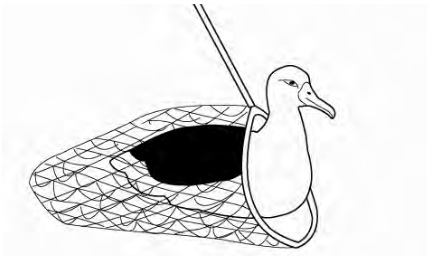
After an interaction with a marine mammal, get the rest of your fishing gear out of the water. Then record all the information about the interaction on your Marine Mammal Authorization Program Mortality / Injury Reporting Form, even if you had an observer aboard. Mail the form when you get to port.

CAUTION: Whales and dolphins may become hooked or entangled by longline gear, especially while eating bait or catch. If you suspect marine mammals are eating your bait or catch, consider moving 100 kilometers / 54 nautical miles or more to reduce the chance of marine mammal interactions.

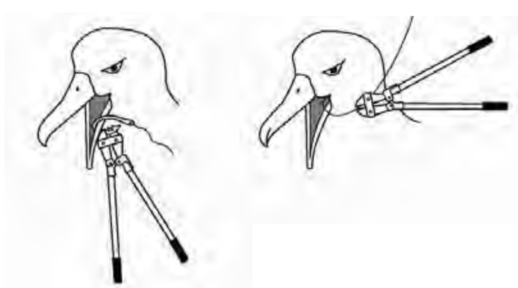
Seabird Handling Guidelines

PLEASE NOTE: If bird is a short-tailed albatross, follow special guidelines for handling short-tailed albatross. For all other seabirds, see below.

1. Stop vessel to reduce tension on the line and bring bird aboard using a dip net.



2. Working with another person, hold the back of the bird's head and isolate the hooked or entangled area while the other person takes the bird from the net. Fold the bird's wings to their natural resting position against the body.
3. Wrap the bird's wings and feet with a clean towel or blanket. Do not wrap the bird's body too tightly or block the nostrils, as these will prevent the bird from breathing.
4. Cut and remove all fishing line from bird. If bird is lightly hooked in the bill, leg, or wing, and the barbed end of the hook is visible, use bolt cutters to cut the barb and then back the hook out. If bird has been deeply hooked, cut the line as close as possible to hook and leave hook in place.



Never attempt to remove a hook from anywhere on a bird by pulling on line.

5. Allow bird to dry for 1/2 hour to 4 hours in a safe, enclosed place. Refer to **Release Guidelines.**
6. Record any leg band numbers observed on the bird in logbook.

Wear gloves, long sleeves and protective eyewear when handling seabirds. They have sharp beaks and give painful bites.

Release Guidelines

A bird is ready for release when its feathers are dry.

Albatross NOT ready to be released

Albatross ready to be released

If bird is ready for release:
Stop the vessel. Gently place bird onto the surface of the water. Do not throw bird in air or motor away if bird is not clear of vessel.

Questions? Call Pacific Islands Regional Office, Sustainable Fisheries Division at (808) 725-5000

Short-tailed albatross are an endangered species and have special handling requirements.

If you catch a short-tailed albatross:

Immediately try to contact National Marine Fisheries Service, U.S. Coast Guard, or U.S. Fish and Wildlife Service. They will contact an expert to give you advice in the handling and release of short-tailed albatross.

National Marine Fisheries Service (NMFS)
(808) 725-5000

U.S. Coast Guard (USCG)
08240.0 KHz (Daytime ITU Channel 816)
12242.0 KHz (Daytime ITU Channel 1205)
04134.0 KHz (Nightime ITU Channel 424)
06200.0 KHz (Nightime ITU Channel 601)

U.S. Fish and Wildlife Service at French Frigate Shoals (USFWS)
Contact frequency: 10.0054

If a short-tailed albatross is hooked or entangled:

1. Stop vessel to reduce tension on the line and bring bird aboard using a dip net.
2. Wrap the bird's wings and feet with a clean towel to protect its feathers from oils or damage.
3. Remove any entangled lines from the bird and determine if the bird is dead or alive.

   If dead, notifiy NMFS. Label the bird, put it in a plastic bag and store in freezer. Give bird to NMFS when you return to port.

   If alive, place bird in a safe, enclosed place and immediately contact NMFS, USCG and USFWS.

   If unable to make contact for 24-48 hours, determine if the bird is lightly, moderately, or deeply hooked. See description.
4. If bird is deeply hooked, keep bird in a safe, enclosed place until further instructed. Do NOT release the bird.
5. If bird is lightly or moderately hooked, remove hook by cutting the barb and backing hook out.
6. Allow bird to dry for 1/2 hour to 4 hours in a safe, enclosed place. Refer to **Release Guidelines.**
7. Record information in the short-tailed albatross recovery data form.

Short-tailed albatross fly across the entire North Pacific. Around Hawaii, only young short-tailed albatross (shown above) have been seen. The number of birds is increasing, but fewer than 4,000 birds remain in the wild.

Is the bird lightly, moderately, or deeply hooked?

Lightly Hooked: Hook is clearly visible on bill, leg or wing.

Moderately Hooked: Hooked in the mouth or throat with hook visible.

Deeply Hooked: Hook has been swallowed and is located inside the bird's body below the neck.

Release Guidelines

The bird is ready for release if it meets ALL of the following criteria:

- Stands on both feet with toes pointed forward
- Holds its head erect and responds to sound and motion
- Breathes without making noise
- Flaps and retracts wings to normal folding position
- Feathers are dry

If any of these conditions are not met, the bird cannot be released.

If bird is ready for release:
Stop the vessel. Gently place bird onto the surface of the water. Do not throw bird in air or motor away if bird is not clear of vessel.

Questions? Call Pacific Islands Regional Office, Sustainable Fisheries Division at (808) 725-5000

Laysan Albatross *(Phoebastria immutabilis)*

Feathers:
- White head, neck, and belly
- Dark brown upper wings and back
- Brown and white under wings
- Dark area around each eye

Legs/Feet Color: Pink to gray

Bill Color: Yellow-pink with gray tip

Black-footed Albatross *(Phoebastria nigripes)*

Feathers:
- Dark brown head, body, and wings
- Small white patch behind the eyes
- White ring around base of bill
- Adults - small white patch at base of tail

Legs/Feet Color: Black-brown

Bill Color: Black-brown

Short-tailed Albatross *(Phoebastria albatrus)*

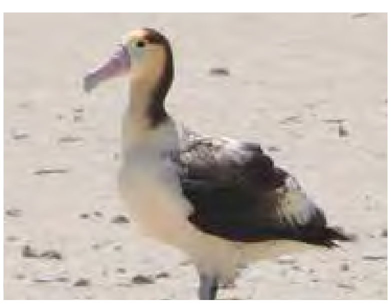
ENDANGERED SPECIES

JUVENILE

Feathers: Dark brown head, body, and wings

Legs/Feet Color: Brown-gray

Bill Color: Bright pink with a thin black line around base



SUB ADULT

Feathers:
- White neck, belly, and back
- Dark brown cap and back of neck
- Black and white wings

Legs/Feet Color: Pink to gray

Bill Color: Bright pink with a thin black line around base

ADULT

Feathers:
- Golden-yellow head and neck
- White back, base of tail, and belly
- Black and white wings

Legs/Feet Color: Pink to gray

Bill Color: Bright pink with a thin black line around base

Questions? Call Pacific Islands Regional Office,
Sustainable Fisheries Division at (808) 725-5000