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NOAA FISHERIES

PACIFIC ISLANDS FISHERIES SCIENCE CENTER

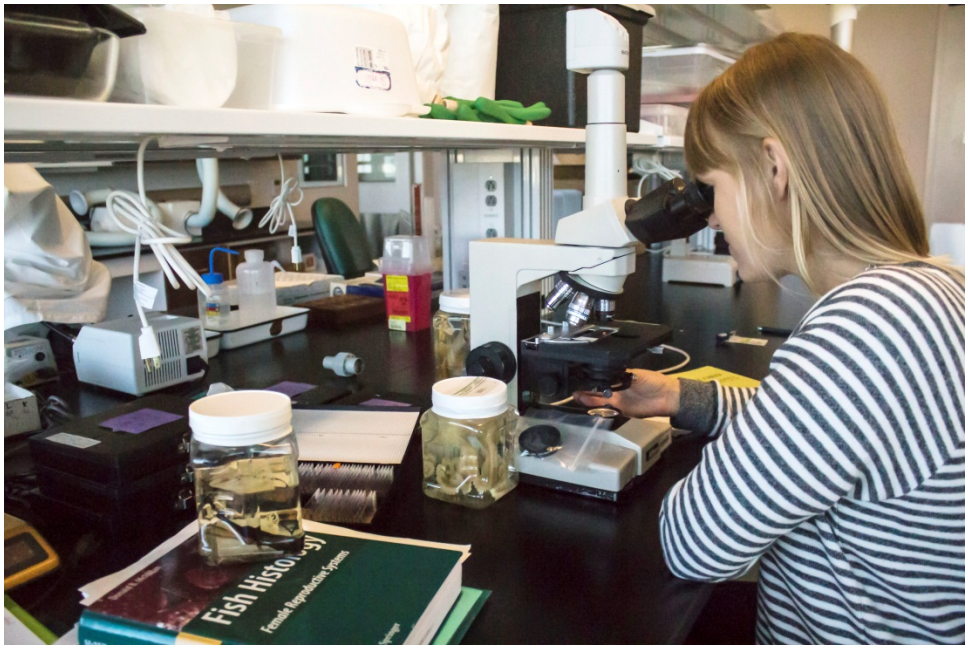
The Pacific Islands Fisheries Science Center (PIFSC) conducts research in a wide variety of programs that may be of interest to the Western Pacific Fishery Management Council (Council). This report is organized around the research divisions of the PIFSC as a series of highlights.

Report to the Western Pacific Fishery Management Council

June 2014

OUTREACH AND EDUCATION ACTIVITY

Science Camp coming in June



JIMAR scientist Aimee Hoover at the microscope. At the June Science Camp, NOAA Fisheries and JIMAR staff will provide 60 8th-graders with hands-on learning about marine science and research.

NOAA Fisheries Pacific Islands Region, in partnership with the Joint Institute for Marine and Atmospheric Research, will be hosting its first Science Camp during the week of June 23-27, 2014. The camp targets students from underserved communities entering into 8th grade next school year. Sixty students have been invited to the NOAA Inouye Regional Center on Ford Island to learn about the important work of NOAA Fisheries' scientists through engaging hands-on activities. The objectives are for the students to:

- Understand how different technologies are used for scientific research from fish stock assessment, studies of fish life history and plankton, and investigation of protected species' foraging.
- Realize their own role in causing environmental problems such as marine debris and what they can do to help solve the problems.
- Understand basic ideas of modeling by studying the transfer of energy between marine organisms, and each species' place in the marine food web.
- Be exposed to real life experiences with scientific equipment in hands-on situations in order to stimulate student interest in pursuing marine science careers.

PROTECTED SPECIES DIVISION (PSD)

Researchers Intervene to Assist Injured Monk Seals

Staff of the Hawaiian Monk Seal Research Program (HMSRP) Health and Disease group had an eventful start to 2014. On New Year's Day, a frequently-seen juvenile female seal (RK96) was reported off Oahu with an ulua hook at the corner of her mouth and several feet of trailing line, an entanglement hazard. HMSRP staff used an inflatable boat to reach the seal on an offshore islet, then removed the hook and line and successfully released the seal.

Juvenile female monk seal "R1KU" was successfully treated for a traumatic injury and infection of the right eye and then released to the wild.

Later in January, an injured monk seal on Niihau in the main Hawaiian Islands was brought to the attention of the HMSRP by the Robinson family, owners of the island. The seal known as "R1KU" was found with a traumatic injury to its right eye. Seals can often cope with such injuries in the wild, and because this seal appeared otherwise healthy, it was treated in the wild with an injection of long-acting antibiotics. However, when the seal was resighted a month later, there were indications it had lost weight and sustained an infection. Accordingly, HMSRP staff intervened and with the help of the U.S. Coast Guard, R1KU was transported to rehabilitation facilities at the new NOAA Inouye Research Center (IRC) on Oahu. There, surgery was performed to remove the damaged, nonvisual eye. R1KU made a full recovery over a period of three weeks and resumed appropriate behavior after being returned to the wild. The seal's release on Niihau was made possible through the support of the Coast Guard and the Robinson family. This was the first seal housed and rehabilitated at the NOAA IRC.

In addition to new facilities, rehabilitation staff how have new tools at their disposal. In March, HMRSP staff and colleagues from The Marine Mammal Center (TMMC) received two days of customized training in the use of a new, state-of-the-art, portable, battery-powered digital radiography system. The unit was donated to TMMC specifically for use on monk seals and will allow first responders to screen seals for ingested foreign bodies (*i.e*., hooks) before resources are expended in transport or rehabilitation of injured seals. The training helped prepare HMRSP and TMMC staff acting as first responders and/or rehabilitators to use this equipment in both field and hospital settings. The hospital settings will soon include the TMMC's new Hawaiian monk seal hospital ("Ke Kai Ola") in Kailua-Kona on the island of Hawaii. The hospital is expected to be ready to receive seals in the summer of 2014, as the pools, life support and water filtration systems, and interim food preparation facilities are already in and functioning. Construction of ancillary buildings and other elements of the hospital will be complete later this year. When not needed at the hospital, the digital radiography unit will be housed at the NOAA IRC so that it is ready for immediate emergency deployment.

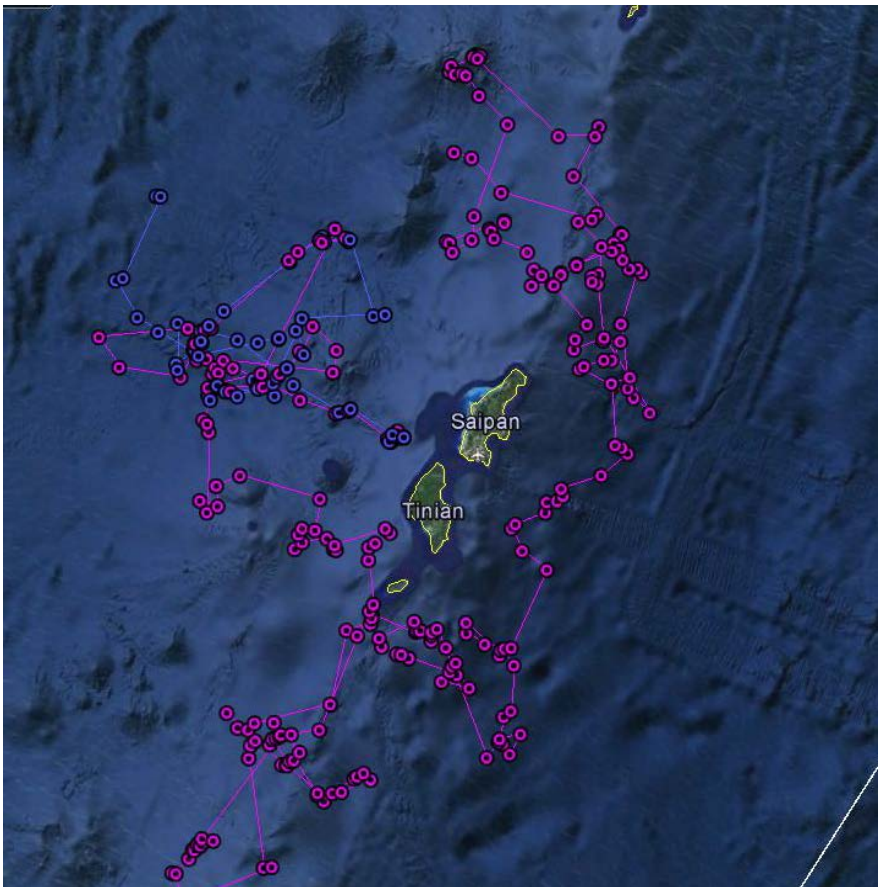
Pacific Scientific Review Group Meets in Honolulu to Review Marine Mammal Stock Status

During April 1-4, PIFSC co-hosted the 2014 meeting of the Pacific Scientific Review Group (Pacific SRG) along with the NOAA Fisheries Pacific Island Regional Office (PIRO) and the Southwest Fisheries Science Center (SWFSC). The meeting was held in the NOAA Fisheries facilities at Pier 38 in Honolulu. The Pacific SRG is an independent expert panel responsible for annual peer reviews of NMFS stock assessment science for marine mammals in the Pacific. The agenda for the meeting included presentation of Stock Assessment Reports (SARs) prepared by PIFSC and SWFSC staff. The assessments are conducted in accordance with requirements of the Marine Mammal Protection Act. New analyses and updated SARs were presented for a variety of species, but topics of particular interest within the Pacific Islands Region included analyses of false killer whale injuries sustained through interactions with hook and line fishing gear; the proration of estimated Hawaii longline fisheries bycatch among Hawaii's false killer whale stocks; evaluation of potential impacts of Hawaii's state-managed nearshore fisheries on cetaceans; serious injury determination for stranded and ship-struck cetaceans; Bayesian analyses of cetacean growth rates to inform new estimates of the maximum net productivity rate (Rmax), a critical parameter for determining allowable limits of human-caused mortality; updates on monk seal recovery actions and assessments; and discussion of stock delineation guidelines.

Cetacean Surveys Continue in Waters of the Mariana Islands

In April, the PIFSC's Cetacean Research Program conducted surveys for cetaceans in the waters surrounding Guam and the Commonwealth of the Northern Mariana Islands (CNMI) in an effort to further develop a record of cetacean occurrence in the region and to gather photos and biopsy samples for population studies. PIFSC has been conducting similar surveys in the region since 2010, but this was the first springtime expedition. The project was carried out in partnership with the U.S. Navy. Over 15 days of survey effort, 15 groups of cetaceans of various species were sighted, including spinner dolphins, spotted dolphins, bottlenose dolphins, rough-toothed dolphins, melon-headed whales and pygmy killer whales. Thousands of photographs of the mammals were taken and will be used to assess their movements, abundance and population connectivity. Biopsy samples from melon-headed whales and bottlenose dolphins will contribute toward ongoing studies of genetic population structure in the Marianas region as well as a Pacific-wide evaluation of population connectivity for these species. Two satellite tags were deployed on melon-headed whales off Tinian, providing five and 17 days of movement data. Tag tracks suggested broad movement south to Rota, offshore to reefs west of Saipan and north to nearly Farallon de Medinilla. The research team returned to the Marianas in May, conducting additional small boat-based surveys in Guam, Rota, and Saipan. A survey of cetaceans in waters of the CNMI, including the Islands Unit of the Marianas Trench Marine National Monument, from the NOAA Ship *Oscar Elton Sette* has been delayed due to maintenance issues with the ship.

Rough-toothed (front) and bottlenose dolphin off Aguijan in the Northern Mariana Islands (NOAA photo by Daniel Webster).



Satellite-determined tracks of 2 melon-headed whales tagged near Tinian and monitored from April 18 to May 4 2014 during PIFSC cetacean surveys in the Northern Mariana Islands.

FISHERIES RESEARCH AND MONITORING DIVISION (FRMD)

First Satellite Tracks of Neonate Sea Turtles in the South Atlantic Ocean

The International Fisheries Program is working to understand the migratory behavior and dispersal patterns of oceanic stage loggerhead sea turtles (*Caretta caretta*) in the South Atlantic Ocean. This study complements our ongoing research to identify means of reducing incidental capture of sea turtles in pelagic longline fisheries. Working with collaborators from the University of Central Florida (UCF) and Projecto Tamar in Bahia, Brazil, PIFSC scientist Yonat Swimmer tagged and released nineteen neonate loggerhead

turtles using modified small-scale solar-powered satellite tags (Fig. 1) developed by Dr. Kate Mansfield of UCF.

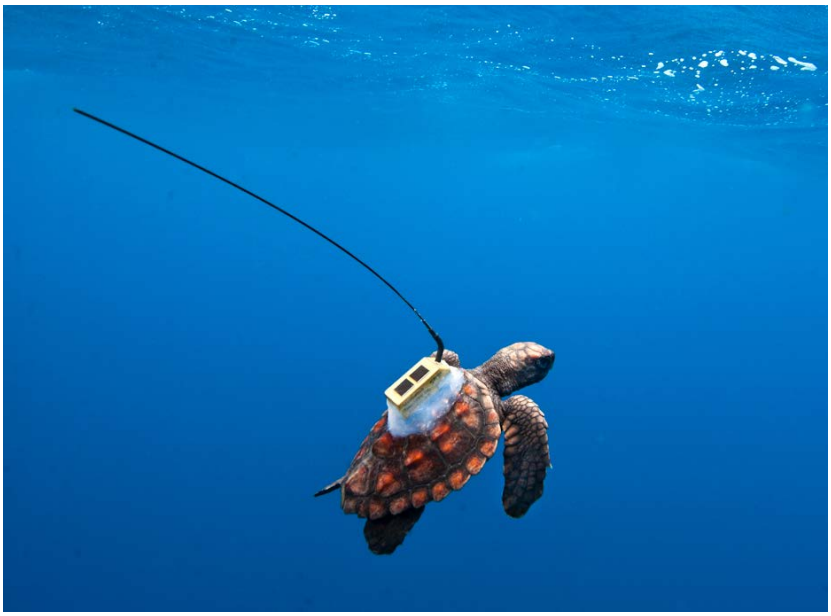


Figure 1. A solar-powered satellite transmitter enables tracking of neonate loggerhead turtles. (photo credit: TAMAR)

The turtles had been reared in a laboratory to an age of 4-13 months, growing to a straight carapace length (SCL) of 10.8-26.8 cm and a weight of 235-2800 grams. They were released at 4 times spanning the loggerhead nesting season (November and December 2012, and March and May 2013) to coincide with changes in the ocean current pattern along the coast of Bahia, Brazil where the turtles were born. Current direction is southerly during early/mid season, and northerly later in the nesting season (Fig. 2). Oceanographic drifters were released along with the turtles to collect concurrent information on current patterns, and to examine the probability that turtles were passively drifting with the prevailing ocean currents.

Except for two turtles whose tags transmitted for less than 5 days, the transmission duration of the tags varied from 26 and 120 days (mean =65 days, SD=24 days, n=17). Over the tracking period the turtles traveled between 575 and 4758 km (Fig 3). While some of the turtles traveled along the continental slope (north or south depending on the prevailing current pattern), others also moved to oceanic waters. Initially, all turtles followed a general circulation pattern observed with initial drifter trajectories. Unlike loggerhead turtles in the North Atlantic, they drifted off the continental shelf with trajectories parallel to the coast. The preliminary tracking data suggest that the distribution and movement of young loggerhead turtles in the South Atlantic are influenced by seasonal changes in current regimes. This information is helpful for identifying loggerhead turtles' vulnerability to fishing activity in the region in relation to season and changes in current regimes.

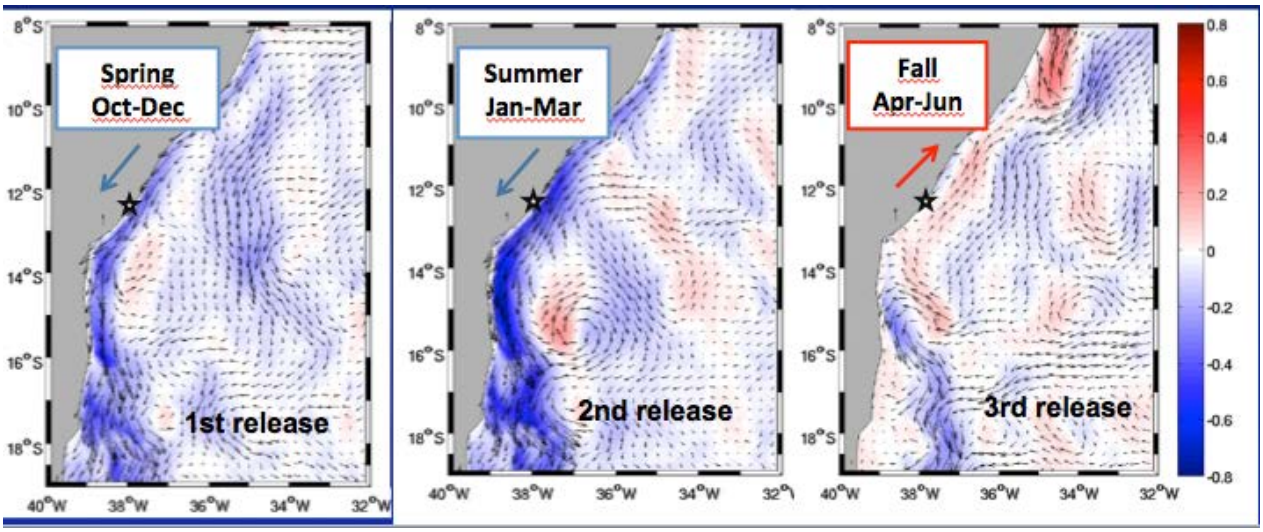


Figure 2. Sea surface currents in the South Atlantic Ocean, where tagged neonate loggerhead turtles were released, vary by season.

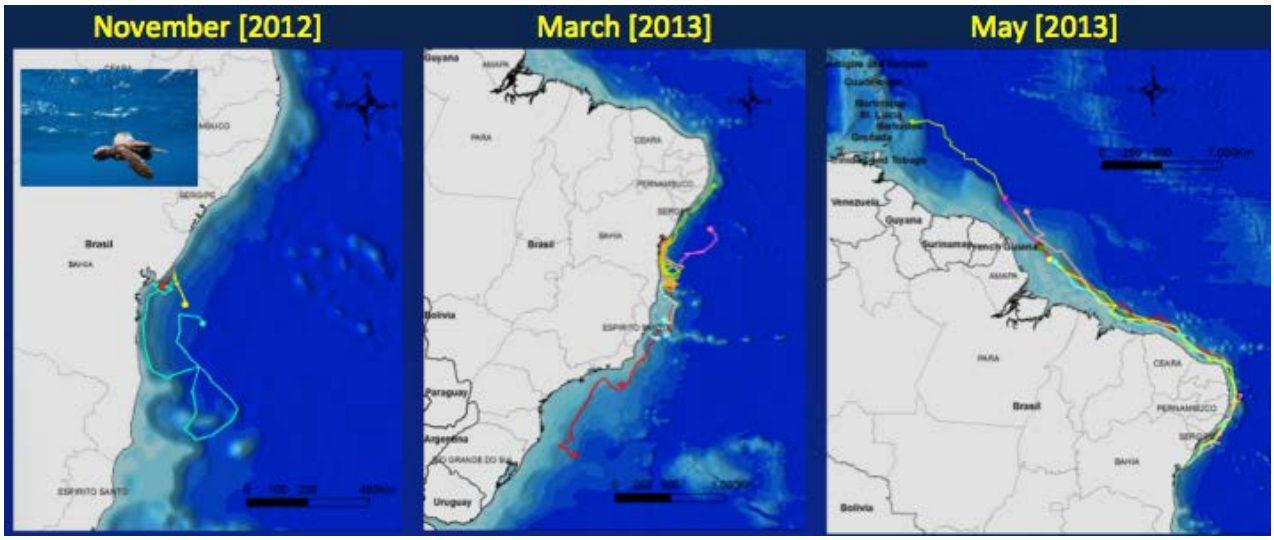


Figure 3. Tracks of 17 satellite-tagged neonate loggerhead turtles after their release (in 4 batches) from Bahia, Brazil during in 2012-2013.

Synopsis of North Pacific Swordfish Stock Assessments in 2014

In February 2014, PIFSC Stock Assessment Program scientists completed stock assessments for the Western and Central North Pacific Ocean (WCNPO) and Eastern Pacific Ocean (EPO) swordfish stocks (Fig. 1A). Both stock assessments were conducted through the international collaborative efforts of the Billfish Working Group of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC). For both stocks, total catch and standardized CPUE were applied in a state-space Bayesian surplus production model based on data from 1951 to 2012 and included stock projections for 2013-2017. Annual swordfish catches from both stocks have fluctuated around 10,000 metric tons in recent years for a combined yield of approximately 20,000 metric tons (Fig. 1B). Stock status was assessed relative to maximum sustained yield (*MSY*) reference points with an overfished definition of $B<½B_{MSY}$ and an overfishing definition of $H>H_{MSY}$. [B is stock biomass and B_{MSY} is the stock biomass supporting maximum sustainable yield; H and H_{MSY} are equivalent harvest rates].

Swordfish stock status in the Western and Central North Pacific: Overall the WCNPO swordfish stock is not overfished or experiencing overfishing (Fig. 2A). The WCNPO estimated biomass in 2012 was 72,500 metric tons, or 19% above the estimated B_{MSY} of 60,720 metric tons. The WCNPO estimated harvest rate in 2012 of 0.14 was 44% below the estimated H_{MSY} of 0.25 (Fig. 3A). Future annual WCNPO catches could increase to 16,000 metric tons (50% above the recent average yield) before reaching either a 50% probability of overfishing or becoming overfished by 2017.

Swordfish stock status in the Eastern Pacific: In contrast, the EPO swordfish stock was experiencing overfishing from 2010-2012 with a 57 out of 100 chance that overfishing was occurring in 2012 (Fig. 2B). The EPO assessment model exhibits a retrospective pattern that causes the model to overestimate biomass and underestimate harvest rate, and any management decisions should consider this fact. The EPO estimated biomass in 2012 was 59,300 metric tons, or roughly 90% above the estimated B_{MSY} of 31,300 metric tons. The EPO estimated harvest rate in 2012 was 0.19, or about 5% higher than the estimated H_{MSY} of 0.18 (Fig. 3B). Recent annual yields of 10,000 metric tons are roughly twice the MSY level and if these high catches continue, the probability of overfishing will increase in the future. If future annual EPO yields were reduced to 7,800 metric tons (80% of recent catch), there would still be a 50% probability of overfishing by 2017.

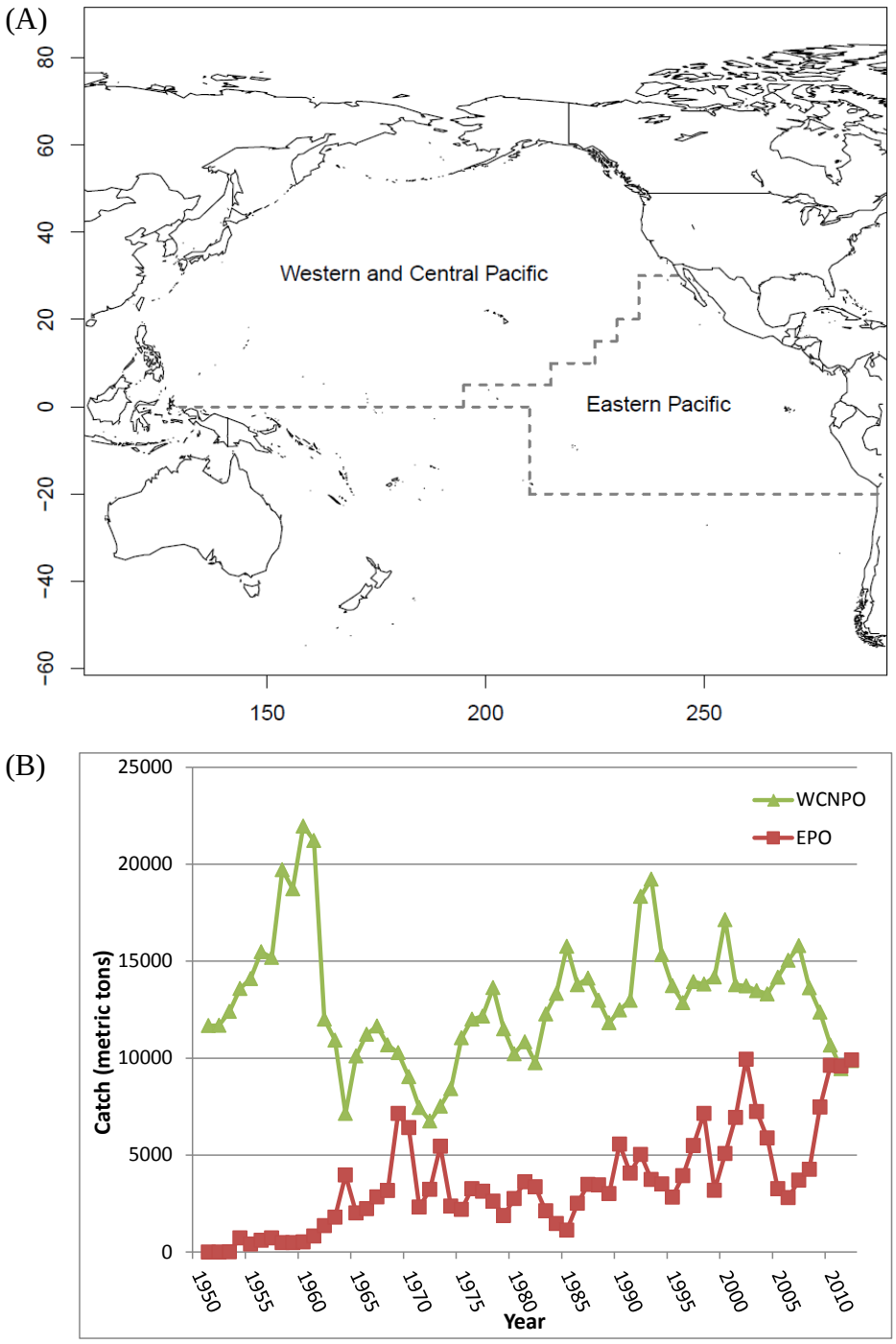


Figure 1. (A) Two-stock structure for swordfish (*Xiphias gladius*) in the North Pacific Ocean, indicating separate stocks in the Western and Central North Pacific Ocean (WCNPO) and in the Eastern Pacific Ocean (EPO). (B) Total catch (metric tons) from 1951 to 2012 for each of the two swordfish stocks in the North Pacific Ocean.

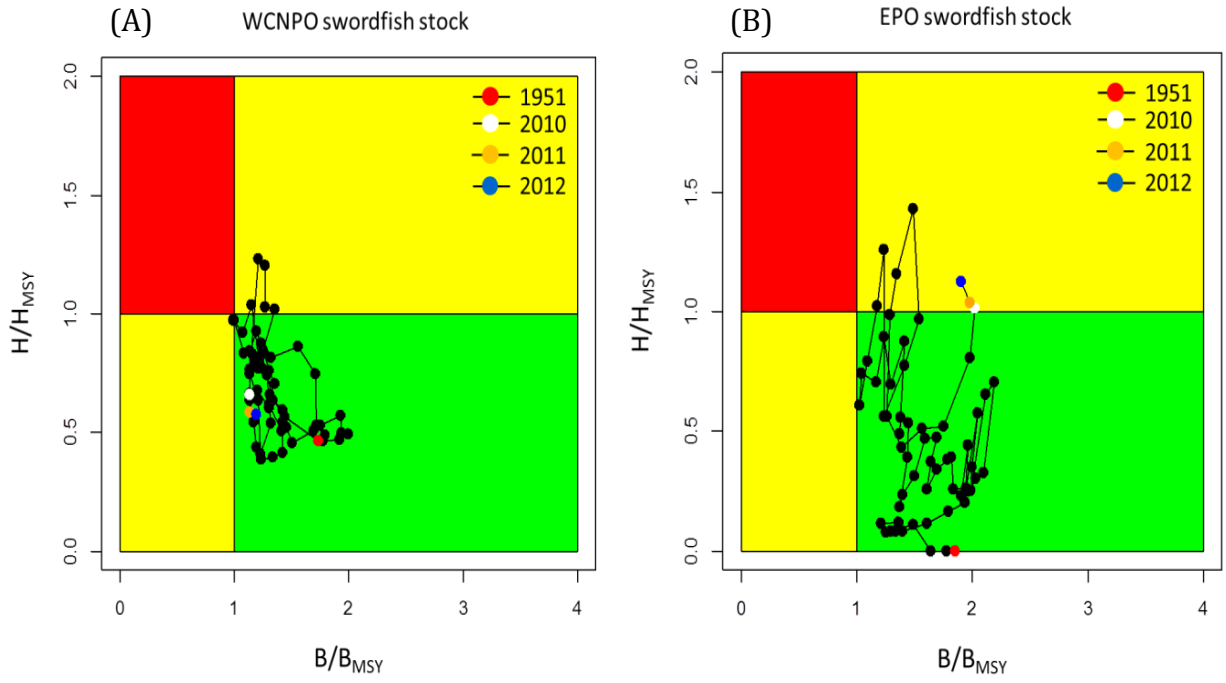


Figure 2. Kobe plots indicating the status of two swordfish (*Xiphias gladius*) stocks in the North Pacific Ocean. (A) Kobe plot for the Western and Central North Pacific Ocean stock of swordfish. (B) Kobe plot for the Eastern Pacific Ocean swordfish stock. Green quadrant indicates biomass is above B_{MSY} (stock is not overfished) and harvest rate is below H_{MSY} (overfishing is not occurring). Red quadrant indicates stock is overfished and overfishing is occurring.

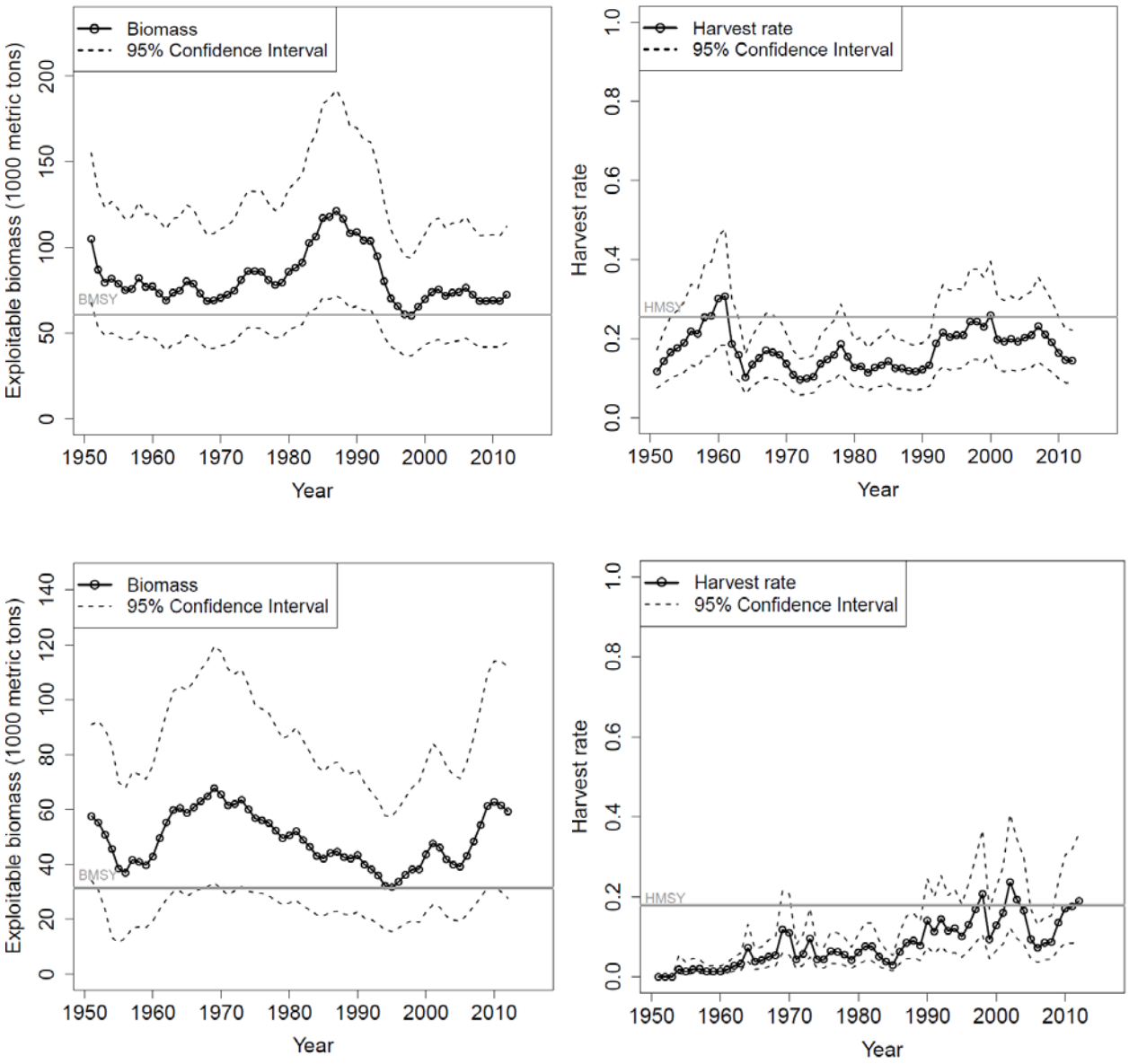


Figure 3. Trends in exploitable biomass (left, units of 1000 metric tons) and harvest rate (right) of swordfish (*Xiphias gladius*) for (A) the Western and Central Pacific Ocean stock and for (B) the Eastern Pacific Ocean stock. Estimated mean values (black dots and solid line), 95% confidence intervals (black dotted line), and estimated biological reference points (B_{MSY} and H_{MSY}, gray solid line) are presented.

Data Summaries Highlight Progress in Bio-Sampling Program

Summaries of the Commercial Fisheries Bio-Sampling (CFBS) data for each island territorial jurisdiction in the Pacific Islands Region have been prepared for inclusion in Archipelagic Plan Team Reports for the Western Pacific Regional Fishery Management Council, for use in developing improved Annual Catch Limits (ACLs), and to meet other reporting requirements. The CFBS Program, begun in 2010, was a NMFS innovation to enhance data collection, primarily on insular fisheries. The Program adds scope to other territorial catch monitoring data collections like the creel survey time series, all coordinated by the Western Pacific Fisheries Information Network (WPacFIN). The CFBS staff, supported by the PIFSC Insular Fisheries Monitoring Program (IFMP), collected measurements of fish length and weight, along with biological samples, from fishermen and vendors in Guam, the Commonwealth of the Northern Mariana Islands (based on Saipan), and American Samoa (based on Tutuila).

The methods used to gather CFBS data are generally the same in all three locales. However, variations in successes and challenges exist. On some islands, the program has been more successful reaching vendors and on others it has worked directly with some fishermen. Nevertheless, whether at sales locations or landing areas, all fish sampled by the CBFS are keyed to the species level and length and weight measurements taken. In addition, the CFBS provides comprehensive sampling of fish otoliths and gonads to support in-depth life history studies. This summary does not describe the laboratory portion of the work in which the biological samples are processed; that work is undertaken by the PIFSC Life History Program.

The catch, effort and length-frequency data collected by the CFBS can be used in stock assessment. Once a large sample of weight-length data is available for a given species, the program uses length-weight relationships to estimate the weight for subsequent samples of fish that are only measured, so that samplers are able to speed up the sampling process. The goal is to get the most complete sample of length-frequency, catch, and effort data by trip, while minimizing processing time, thus reducing the inconvenience to the fishermen and the markets while providing them with valuable data, and encouraging their continued participation in the program.

A summary of the CFBS data for each of the island jurisdictions (2010-2013) is provided in Tables 1-3. The sampling program provides a detailed estimate of catch by species, for trips sampled. Vendor selection preferences can affect which species are brought to a given market. Individual fishermen's catch may reflect unique traits based on individual fishing habits (areas fished, etc.). Not every fishery is sampled and the areas fished on a given sampling day affect the variety of species found. These sources of variation create familiar issues with respect to the use of sampled data to represent the larger fishery, as is also the case with the creel surveys. The CFBS has an advantage in sampling some fishery sectors such as spear fishing that are poorly covered by the more structured creel surveys, in spite of the

creel surveys more structured attempt to provide representative sampling for purposes of expansion. One concern is to ensure that the catch estimated from CFBS data collected at the vendor and fishermen level does not overlap with (and thus double count) catch estimated from creel survey and vendor reporting programs undertaken by WPacFIN. The IFMP is working on determining the extent of overlap in order to improve total catch estimates. It will be challenging to incorporate subsectors of commercial fisheries that are better reached by this relatively new monitoring program into expanded estimates from the creel surveys to produce more comprehensive estimates of overall catch. Approaches for integrating the two data sources are being explored. However, compared to the creel surveys the CFBS data is a short time series that cannot supplant the longer (i.e. creel survey) time series for some important applications.

In summary, for selected fisheries in each area where it is being conducted the CFBS is providing length, weight, and life history samples for accurately identified fish.

Table 1. Summary of bio-sampling data for Tutuila, American Samoa.

Summary of Regional Commercial Fisheries Biosampling Data: 2010-2013				
	Island Area = Tutuila, American Samoa			
Parameters	2010	2011	2012	2013
Fishermen-Trips	14	205	667	619
Gears/Methods	1	3	4	3
Method(s)	Spearing (Snorkle)	Spearing, Atule-Mixed, Bottomfishing	Spearing, Bottomfishing, Trolling, Atule Mix	Spearing, Bottomfishing, Trolling
Number of Species Sampled	53	185	243	212
% Sample/Weighed Individually (% number fish)	88%	56%	44%	37%
Weight Sampled (Lbs)	620	11,350	32,665	29,763
Total Weight Estimated (Lbs)	700	15,304	47,953	48,092
% Sampled/Estimated by Weight	88%	74%	68%	62%
Estimated Lbs. Top 10 Species Sampled *(list includes any species that made it into the top 10 during any of the 4 years)*				
Acanthurus lineatus	274	3,944	12,382	13,662
Naso lituratus	35	372	1,238	1,547
Sargocentron tiere	18	286	766	541
Scarus oviceps	36	495	704	494
Lutjanus kasmira	0	288	666	1,270
Lethrinus rubrioperculatus	0	508	1,384	1,479
Myripristis berndti	16	160	350	261
Chlorurus japanensis	32	573	2,096	1,457
Ctenochaetus striatus	11	266	1,038	1,027
Scarus rubroviolaceus	64	1,417	3,076	2,648
Acanthurus nigricans	9	139	271	369
Naso unicornis	49	982	2,912	2,424
Panulirus sp.	0	389	1,653	93
Panulirus penicillatus	0	580	1,107	1,996

Table 2. Summary of bio-sampling data for Guam.

Summary of Regional Commercial Fisheries Biosampling Data: 2010-2013				
	Island Area = Guam			
Parameters	**2010**	**2011**	**2012**	**2013**
Fishermen-Trips	139	242	298	270
Gears/Methods	4	8	10	7
Method(s)	Spearing (w/wo SCUBA), Bottomfishing, Trolling, Gillnet	Spearing (w/wo SCUBA), Bottomfishing, Trolling, Talaya, Gillnet, Spin casting, Hook/Line	Spearing (w/wo SCUBA), Bottomfishing, Trolling, Talaya, Gillnet, Spin casting, Jigging, Surround, Hook/Line	Spearing (w/wo SCUBA), Bottomfishing, Trolling, Talaya, Gillnet, Hook/Line
Number of Species Sampled	145	182	178	169
% Sample/Weighed Individually (% number fish)	100%	100%	68%	60%
Weight Sampled (Lbs)	4,790	26,507	17,475	9,602
Total Weight Estimated (Lbs)	4,790	26,507	25,638	17,230
% Sampled/Estimated by Weight	100%	100%	68%	56%
Estimated Lbs. Top 10 Species Sampled *(list includes any species that made it into the top 10 during any of the 4 years)*				
Naso unicornis	1,158	6,682	9,121	5,901
Naso lituratus	355	1,107	1,761	1,075
Hipposcarus longiceps	308	1,286	1,030	731
Scarus rubroviolaceus	229	942	339	252
Scarus altipinnis	193	1,066	999	444
Acanthurus lineatus	139	297	334	200
Lethrinus rubrioperculatus	109	560	394	327
Monotaxis grandoculis	99	643	659	381
Scarus schlegeli	87	335	252	267
Acanthurus nigricauda	70	549	274	157
Siganus argenteus	59	242	283	209
Epinephelus fasciatus	42	167	188	268
Lethrinus obsoletus	20	99	110	157
Myripristis berndti	17	171	275	184
Siganus spinus	0.3	3	22	89

Table 3. Summary of bio-sampling data for Saipan and other CNMI locales.

Summary of Regional Commercial Fisheries Biosampling Data: 2011-2013 *(only 2 samples during 2010)*			
	Island Area = Saipan (some landings from Rota & other banks)		
Parameters	**2011**	**2012**	**2013**
Fishermen-Trips	528	524	699
Gears/Methods	3	4	5
Method(s)	Spearing (Snorkle), Hook/Line, Bottomfishing (small amount)	Spearing (Snorkle), Hook/Line, Bottomfishing, Atulai	Spearing (Snorkle), Hook/Line, Bottomfishing, Atulai (increasing amount from 2012), Talaya
Number of Species Sampled	135	161	177
% Sample/Weighed Individually (% number fish)	92%	38%	33%
Weight Sampled (Lbs)	20,798	14,356	20,297
Total Weight Estimated (Lbs)	22,052	22,488	36,388
% Sampled/Estimated by Weight	94%	64%	56%
Estimated Lbs. Top 10 Species Sampled *(list includes any species that made it into the top 10 during any of the 4 years)*			
Acanthurus lineatus	1,839	1,487	1,956
Naso lituratus	1,908	1,789	2,060
Siganus argenteus	1,069	592	1,395
Naso unicornis	2,550	1,448	2,877
Mulloidichthys flavolineatus	364	525	516
Parupeneus barberinus	601	547	838
Lethrinus atkinsoni	622	316	501
Scarus rubroviolaceus	1,905	1,192	2,760
Scarus ghobban	570	448	823
Chlorurus sordidus	445	97	492
Siganus spinus	113	342	397
Lethrinus obsoletus	307	273	435
Selar crumenophthalmus	0	88	1,498
Panulirus penicillatus	157	0	1,452

Expedition in Maui Triangle Evaluates Methods for Next-Generation Assessment of Hawaii Bottomfish Stock

In April of 2014, researchers from the NOAA Pacific Islands Fisheries Science Center (PIFSC) carried out a multi-faceted scientific expedition in waters in the main Hawaiian Islands as part of the Center's mission to develop an advanced, fishery-independent survey for Hawai'i Deep 7 bottomfish. The study area was the "Maui Triangle", the waters between Maui, Molokai, Lanai and Kaho'olawe (Maui Nui). A research team of PIFSC scientists on the NOAA Ship *Oscar Elton Sette* was joined in the study by colleagues from the NOAA Northwest Fisheries Science Center, University of Hawaii at Manoa (UHM), Joint Institute for Marine and Atmospheric Research at the University of Hawaii at Manoa (JIMAR), and the Pacific Islands Fisheries Group (PIFG). NOAA Corps LT Faith Knighton served as Chief Scientist for the 15-day expedition (designated as SE1402), with PIFSC scientist Dr. Benjamin Richards serving as Science Advisor.

The expedition's objective was to accomplish a near-simultaneous survey of deepwater bottomfish using 3 fishery-independent methods, or gears: an autonomous underwater vehicle (AUV) stereo-video camera system, deployed from the *Sette*; baited underwater stereo-video camera systems (or BotCam), deployed by a UHM team aboard the collaborating research vessel *Huki Pono*; and research hook-and-line fishing from several cooperating PIFG bottomfish fishing vessels.

During past expeditions, sampling areas for the survey were selected to maximize bottomfish encounter rates and to build a comprehensive dataset for method-to-method comparison and gear calibration. The April 2014 research effort departed from that experimental design, and instead adopted a stratified-random sampling approach to best characterize bottomfish abundance across the survey domain. Each gear was allocated to selected 500 m x 500 m survey grids within designated habitat strata, with the grids chosen at random in proportion the prevalence of each habitat type in the overall survey domain and taking into account the variation in the data from each habitat stratum as sampled during prior research missions. Survey grids were selected shortly before project mobilization to best allow for prevailing weather conditions, proximity to ports, and patterns of fish abundance, and to mitigate impacts of the fishing operations on activities of local fishermen and management regions.

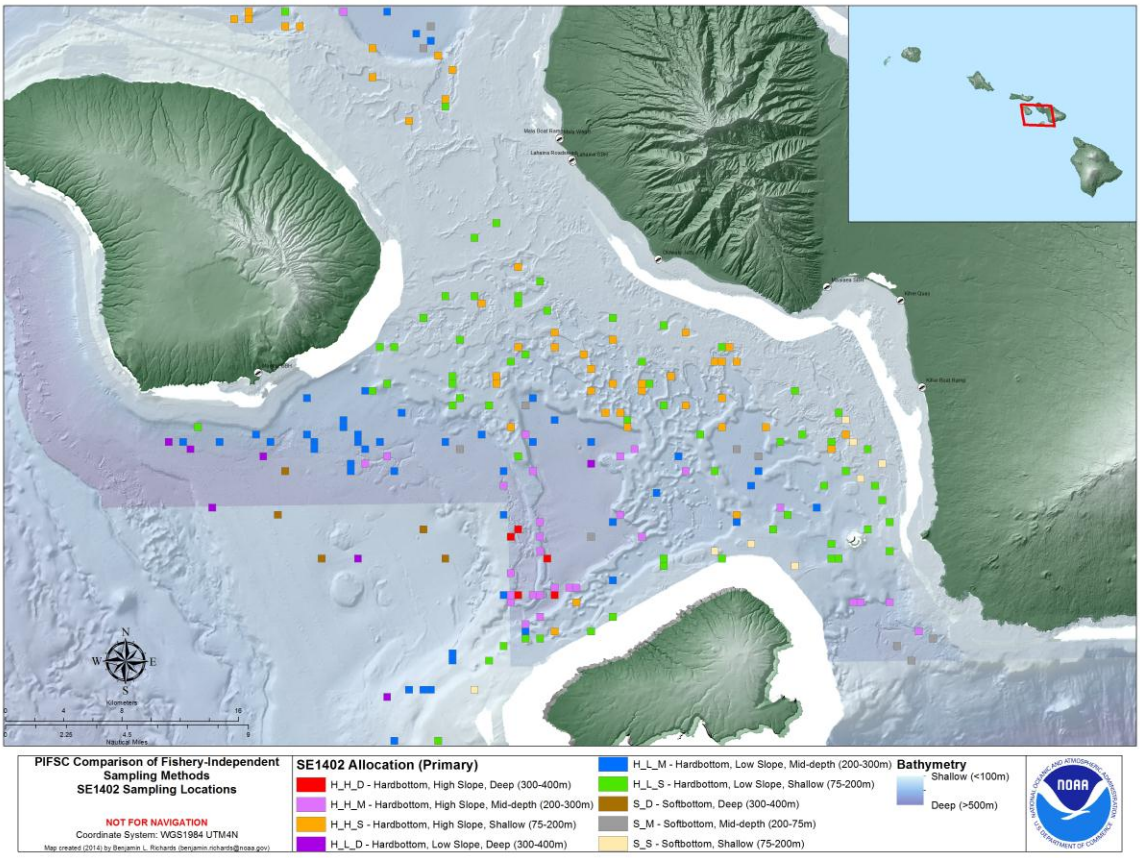
For the research fishing, a standard sampling unit was defined as 30 minutes of active fishing effort within a grid cell by one bottomfish vessel using each of two bait types on separate lines each containing four #22 hooks.

For the BotCam, a standard survey was defined as three BotCam deployments of 15-minute duration. Prior BotCam surveys have varied from 15 minutes to 45 minutes duration. For 75-85% of samples in which a bottomfish was observed, the time to first arrival of a bottomfish at the BotCam station occurred within 15 minutes. Habitat-specific abundance patterns did not differ between 15 and 45-minute deployments. Reducing the deployment time for BotCam increases sampling effort and reduces the

likelihood that fish observed by the BotCam are attracted from outside the defined sample area.

For the AUV, two 2-hour surveys provided an efficient ratio of sample number, survey time and refitting time. Within each grid cell, the AUV conducts three parallel 200 meter transects separated by 25 meters.

The results of the surveys are being used by the PIFSC Stock Assessment Program to evaluate the potential for development of an operational, fishery-independent, non-extractive, non-lethal survey methodology to estimate size-structured abundance of the Hawaii Deep 7 Bottomfish assemblage. The data collected during SE1402 will enable PIFSC to determine gear-specific optimum sampling rates and the sample size necessary to adequately quantify the Deep-7 bottomfish stock across its range. If the research is successful, the fishery-independent methodology can supplement the fishery-dependent methods presently used for stock assessment.



A map of the SE1402 survey area showing the primary sampling units (500-m x 500-m grid cells) within waters of the Maui-Nui region. Each of the candidate fishery-independent gears (BotCam, AUV, Research Fishing) was randomly allocated to each sampling unit.

ECOSYSTEMS AND OCEANOGRAPHY DIVISION (EOD)

Acoustic Survey Investigates Cetacean Foraging "Hotspot" on the Kona Coast of Hawaii

In March 2014, the NOAA Ship *Oscar Elton Sette* served as a research base for a team of PIFSC scientists exploring the habitat of cetaceans in coastal waters of the island of Hawaii along the Kona Coast region. The research was carried out in partnership with scientists from the Joint Institute for Marine and Atmospheric Research at the University of Hawaii at Manoa (JIMAR), Hawaii Institute of Marine Biology at the University of Hawaii (HIMB), University of Hawaii at Manoa, Department of Oceanography (UHM-OCEAN), University of Hawaii at Manoa, Marine Biology Program (UHM-MB), Monterey Bay Aquarium (MBA), and the NOAA Teacher at Sea (TAS) program.

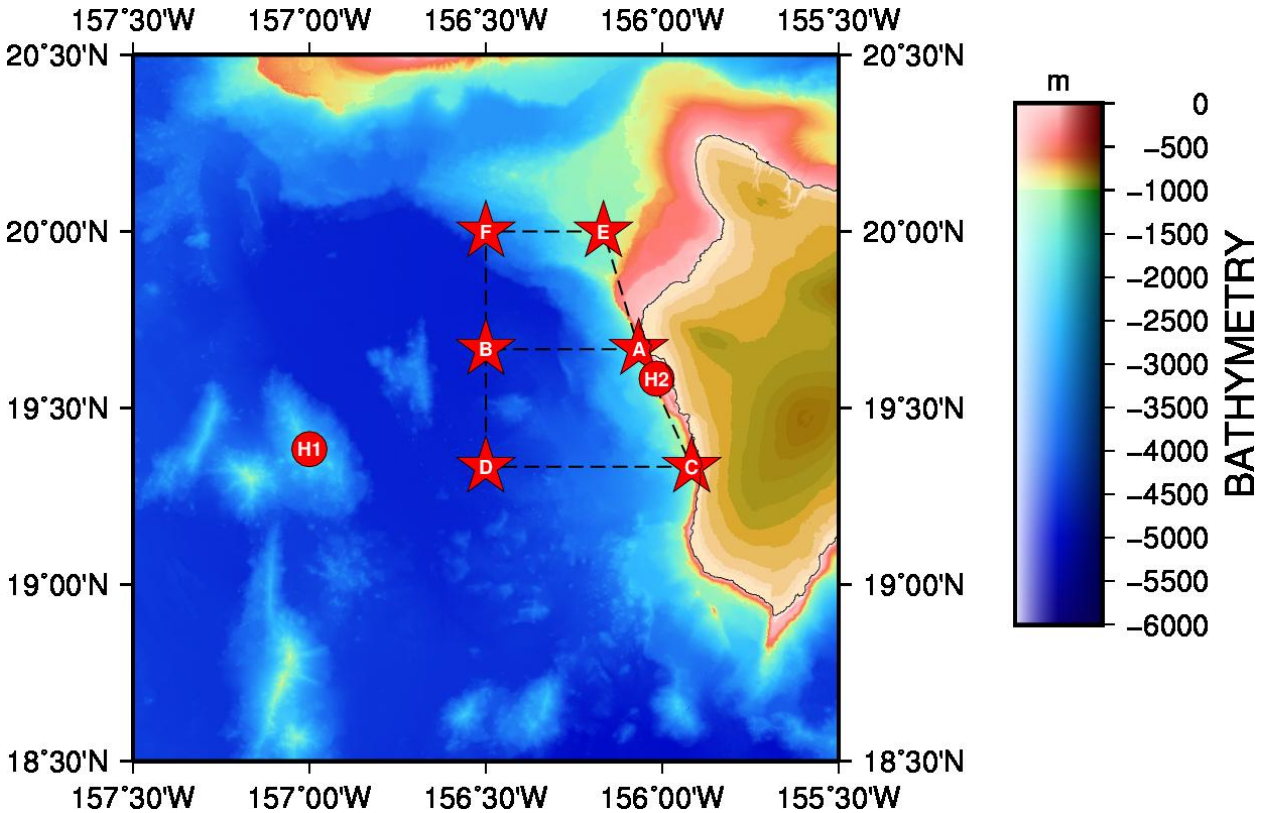


Figure 1. Operational area of research project SE1401 conducting cetacean forage research in the Kona IEA region. Symbols A-F mark locations the standard Kona IEA grid stations, and symbols H1 and H2 indicate location of HARP deployments and/or recoveries. Targeted research operations were focused around the nearshore stations (A & C) where deep cetacean foraging "hot spots" have been identified and characterized on previous missions.

The project designated SE1401 conducted operations in the waters around the NOAA Kona Integrated Ecosystem Assessment (IEA) region (Fig. 1) during 17-28 March. During the 12-day mission, the research team, led by Chief Scientist Dr. Donald R. Kobayashi from the PIFSC Ecosystems and Oceanography Division, worked on two objectives. First, the standard Kona IEA oceanographic and active acoustics survey was conducted to add another year's data to this valuable time series of observations (started in 2011 and continued in 2013) and provide new seasonal coverage for winter months. Second, a deep nearshore "hotspot" for cetacean foraging was investigated using a variety of methodologies. Previous surveys using a Simrad EK60 acoustic sounder at a frequency of 70 kHz have delineated a large daytime and nighttime signal of biological activity (presence of organisms) at 400-600m depth nearshore. Tagged cetaceans have been recorded feeding within this layer and the water mass slightly above and below the layer. Physical and biological characteristics of the layer were studied using a variety of tools: a CTD unit and rosette of water sampling bottles; active acoustic surveys; a remotely operated vehicle (ROV) deployed from the *Sette;* a BlueView sonar imaging unit attached to the ROV; a Didson sonar imaging unit lowered on the CTD rosette; a GoPro camera on the CTD rosette; baited deep handline gear and squid-jigging gear; and a Cobb midwater trawl.

This report presents some of the acoustics data collected around the foraging hotspot along multiple transects using the Simrad EK60 acoustic sounder at 38 kHz and 70 kHz. Acoustics Team leader Adrienne Copeland from HIMB collected, processed, and summarized the data to construct both daytime and nighttime vertical profiles of reflective biomass from 0-700m depth (Fig. 2). The results showed that the strong scattering density observed in the 2011 and 2013 summer cruises, primarily at the 70 kHz frequency, also was present in March 2014 with very comparable densities. These results provide continued support for the hypothesis that a relatively abundant island-associated mesopelagic boundary layer is the basis for a food web that supports insular cetacean stocks in the region. These acoustic data are used in our cetacean habitat modeling project in collaboration with Erin Oleson (PSD) and Robin Baird (Cascadia Research Collective) under the Kona IEA research initiative.

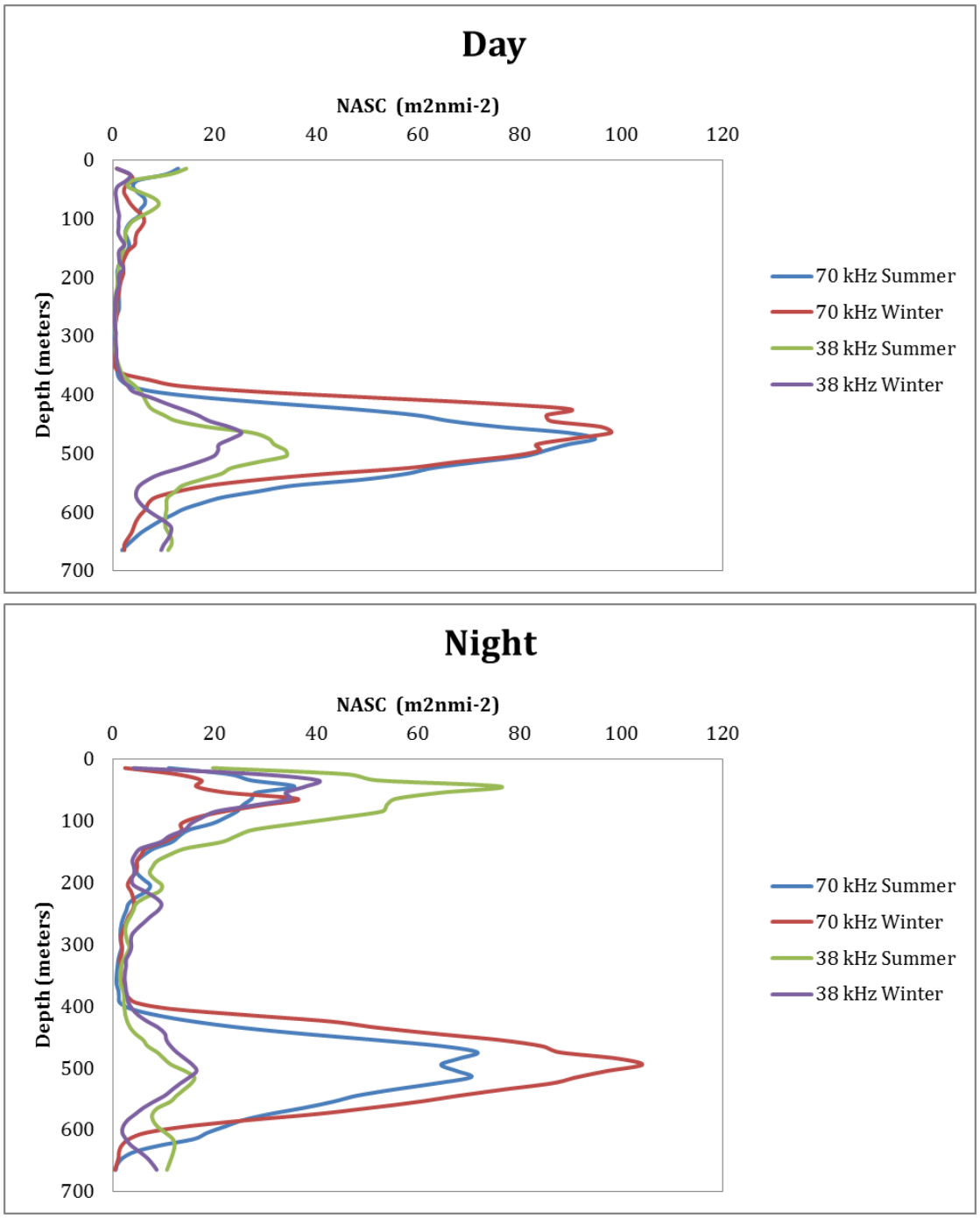


Figure 2. Daytime (upper panel) and nighttime (lower panel) vertical profiles of reflective biomass from 0-700m depth over the cetacean foraging "hot spots" from deployment of the Simrad EK60 acoustic sounder at 38 kHz and 70 kHz during winter and summer surveys. Data are aggregated from transects between stations A and C for each season.

CORAL REEF ECOSYSTEM DIVISION (CRED)

Coral Reef Ecosystems of Wake Atoll and the Mariana Archipelago Monitored

In late May CRED scientists completed a research mission of nearly 3 months aboard the NOAA Ship *Hi`ialakai* In waters of Wake Atoll and the Mariana Archipelago. From March 5 to May 20, scientists on PIFSC cruise HA-14-01 studied coral reef ecosystems around Wake Atoll, Guam, and the Commonwealth of the Northern Marianas (CNMI) and examined the ocean environment around the hydrothermal vent system at Maug in the CNMI. This expedition was the 6th mission for the CRED-led Pacific Reef Assessment and Monitoring Program (Pacific RAMP) to Wake Atoll and islands in the Mariana Archipelago since 2003.

On a reef off Rota Island in the CNMI, divers conduct a belt-transect survey of the benthos during the PIFSC mission HA-14-01, the 6th expedition in the Marina Archipelago since 2003 for the Pacific Reef Assessment and Monitoring Program, led by the PIFSC Coral Reef Ecosystem Division. *NOAA photo by Bernardo Vargas-Ángel.*

The survey methods used during Pacific RAMP missions for environmental and ecological monitoring are interdisciplinary and varied. At Rapid Ecological Assessment (REA) sites, surveys for reef fishes are conducted to document species richness, abundance, and size composition. At the same locations, surveys of benthic and coral communities describe the percent composition of bottom-dwelling organisms in addition to the densities, sizes, and health conditions of coral colonies. During broad-scale towed-diver surveys along designated transects, divers record observational data

on large-bodied fishes (>50 cm total length), percent composition of the seafloor and its biota, coral stress, and conspicuous invertebrates. Studies of microbial communities involve water sampling and document the diversity and abundance of bacteria and viruses and their interactions with coral reefs. Pacific RAMP cruises also include studies of the diversity of cryptic invertebrates and deploy various oceanographic instruments and other platforms to collect data on water temperature, salinity, carbonate chemistry, and other physical characteristics of coral reef environments.

Pacific RAMP, part of the National Coral Reef Monitoring Plan of NOAA's Coral Reef Conservation Program, is a long-term monitoring effort designed to collect information on the status coral reef ecosystems in the U.S. Pacific and to detect trends in coral reef ecosystem health and properties. During this latest expedition, scientists established climate monitoring stations at Guam, Saipan, Pagan, Maug, and Wake Atoll for assessment of the potential early effects of ocean acidification on cryptobiota (e.g., small, hidden organisms) and the rates of reef carbonate deposition and coral calcification.

The volcano on Pagan Island in the CNMI emits plumes of gas and steam on the evening of April 20, 2014 as seen in this photo taken during the PIFSC mission HA-14-01. *NOAA photo.*

On Leg IV of the expedition, May 13–18, the research focus was on ocean and climate change including ocean acidification. CRED researchers and several partners collected data at Maug, the site of an active hydrothermal vent system, and evaluated the setting as a potential site for more detailed and long-term studies of the effects of ocean

acidification on coral reef environments. During the transits between Maug and Saipan, the *Hi`ialakai*'s multibeam sonar was used to fill in gaps in existing coverage of bathymetry data in the region. Research partners participating on Leg IV included NOAA colleagues from the Pacific Marine Environmental Laboratory, Atlantic Oceanographic and Meteorological Laboratory, Office of Ocean and Atmospheric Research, and NOAA Diving Program as well as scientists from the National Institute of Standards and Technology, Scripps Institution of Oceanography of the University of California San Diego, University of Guam, CNMI Bureau of Environmental and Coastal Quality, and Moss Landing Marine Laboratories.

Annual Report of Coral Reef Fish Monitoring is Part of New Multi-level Communication Strategy

On April 1, PIFSC published the first report in a new annual series that summarizes data recently collected on reef fishes by the Coral Reef Ecosystem Division. PIFSC Data Report DR-14-003 is the last piece in a new multi-tier communications strategy launched by scientists from CRED's Fish Ecology Team. The 112-page document completes a new standardized communication framework centered on transparent, reproducible reporting to increase the efficiency and reliability with which monitoring data collected on coral reef fishes are disseminated.

The communication strategy has four levels, each of increasing complexity and detail. At the first level, immediately following each segment or leg of a research expedition, which typically covers a region or archipelago, the team produces a monitoring brief that outlines the sampling effort and an overview summary of the new data. For example, the 2-page fish monitoring brief for surveys at Wake Atoll during PIFSC mission HA-14-01 was published on March 25, 2014 just days after those surveys were completed. The brief was issued as PIFSC Data Report DR-14-007, entitled "Pacific Reef Assessment and Monitoring Program fish monitoring brief: Pacific Remote Island Areas 2014," and can be accessed at http://www.pifsc.noaa.gov/library/pubs/DR-14-007.pdf.

At the second level of the new communication strategy, an annual status report will be produced within the first three months of each calendar year. This status report presents the new site-level data collected at Rapid Ecological Assessment (REA) sites, sets the region and islands surveyed in the context of the wider Pacific area that CRED surveys, and reports on diver performance. The third and fourth tiers of the strategy provide more in-depth analyses for specific projects.

PIFSC Data Report DR-14-003, entitled "Pacific Reef Assessment and Monitoring Program data report: ecological monitoring 2012–2013—reef fishes and benthic habitats of the main Hawaiian Islands, American Samoa, and Pacific Remote Island Areas," can be accessed at http://www.pifsc.noaa.gov/library/pubs/DR-14-003.pdf.

SOCIOECONOMICS AND PLANNING GROUP (SPG)

PIFSC Economists Assess Downward Trend in American Samoa Longline Fishery

Participants in the American Samoa longline fishery have reported extensive operational challenges in recent years, and the PIFSC Socioeconomics and Planning Group (SPG) has responded to Council requests to examine the problems. SPG economist Minling Pan recently completed an assessment of trends in fleet-wide net revenue for the period 2006 to 2013 and used a comparison of cost-earnings data for 2001 and 2009 to provide context for understanding the downturn in the fishery in 2013.

Last year, Pan and University of Hawaii colleague Shawn Arita calculated that American Samoa-based longline operators generated an average revenue of $448,817 per vessel during 2009. The average profit margin was a mere $6,379 — a 96 percent decrease from the early 2000s when PIFSC researchers Joe O'Malley and Samuel Pooley calculated average net returns of over $177,000 per vessel. Among the 23 active owner-operators surveyed in 2009, 48 percent reported net losses. When vessel depreciation is considered, the vast majority of participants were operating in the red that year. Rising fuel costs and relatively low catch rates (CPUE) for albacore – the principal target species – are thought to be closely associated with poor fleet-wide economic performance.

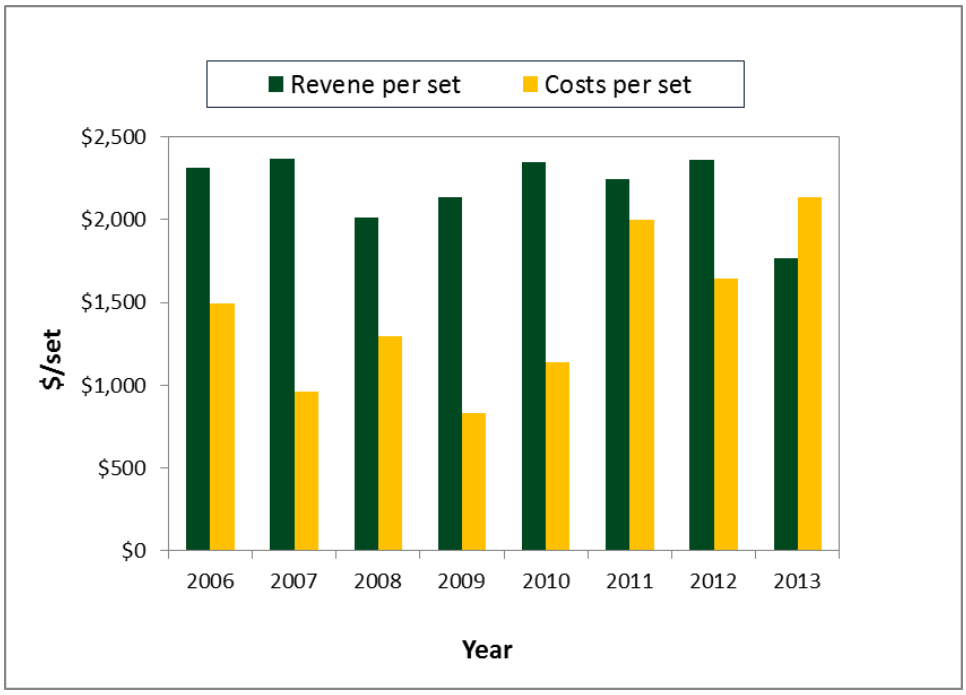


Figure 1. Revenue and cost per set in the American Samoa longline fishery, 2006-2013.

Low CPUE and rising trip costs continued to challenge the American Samoa longline fleet through 2013. Pan's analysis indicates that if CPUE for albacore is lower than 14.3 fish

per 1000 hooks, and if the market price for albacore is held at $1.00 per pound (as it was during much of the 2000s), the profit margin for the average vessel will be negative — as was the case for certain owner-operators in 2009. During 2013, albacore CPUE declined to 11.9 fish per 1000 hooks, resulting in even greater fleet-wide losses than were noted five years earlier.

The continuous data collection program used to monitor fleet-wide economic performance since 2006 also indicates persistent economic challenges for the American Samoa fishery. As shown in Fig. 1, operating costs have increased substantially since the mid-2000s, reaching their peak in 2013. Although a number of owner-operators generated net gains during 2012, the costs of fishing exceeded landings-generated revenue by a significant margin in 2013, and by the end of that year much of the fleet was inactive and 18 owners had posted "For Sale" signs on their vessels.

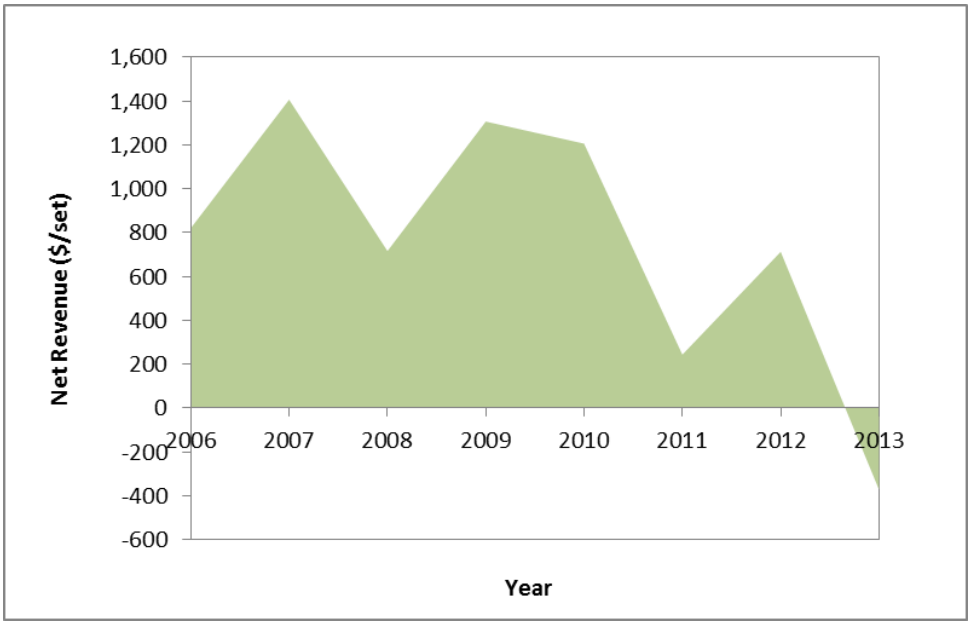


Figure 2. Net revenue per set in the American Samoa longline fishery, 2006-2013.

Fig. 2 further illustrates the poor economic performance of the fleet in recent years. During the period 2006 to 2013, net revenue per set fluctuated year to year but trended downward, becoming negative in 2013. Net revenues during 2011 and 2012 were $244 and $713 per set, respectively — much lower than in 2009 when the figure was $1,307 per set. Net revenues bottomed out at -$372 per set in 2013.

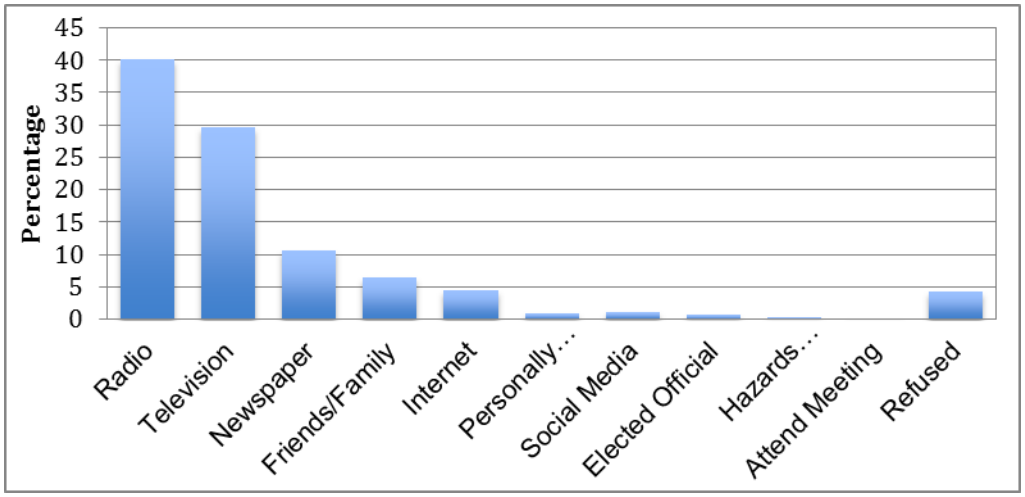
In conclusion, SPG's analysis indicates that participants in the American Samoa longline fishery earned scant profits during 2009 and that the situation had worsened considerably by 2013, with widespread negative returns on fishing effort. The analysis reveals that lack of profitability is linked in large part to diminishing CPUE and low market prices for albacore. Near-term recovery of the fishery will necessitate increases

in catch and prices paid for albacore, and an easing of costs associated with commercial fishing.

Guam Survey Investigates Local Perceptions of Vulnerability to Storms and Climate Change

PIFSC social scientist Dawn Kotowicz recently presented initial results from a survey designed to assess local perceptions of vulnerability to storms and climate change on Guam. The presentation was made in Guam at the Coastal Vulnerability Assessment Workshop, attended by elected officials, disaster planners, natural resource managers, fishermen, and members of the general public from across the island. The workshop was held in conjunction with the Regional Island Sustainability Conference, convened 15–16 April 2014.

Funded by the NOAA Coastal Storms Program (CSP), the survey research undertaken by Kotowicz and collaborating partner Laura Biggs of the University of Guam Sea Grant College aimed to: (1) aid in assessing local vulnerability to coastal storms and hazards; (2) identify potential gaps in an all-hazards approach to disaster resilience, and (3) facilitate development of plans for village-based participation in the regional disaster planning process. The overall intent of the CSP is to improve the quality of life in coastal regions by minimizing threats posed by storms and storm-related hazards.



Frequency of use of disaster-related information sources on Guam.

Kotowicz and Biggs developed their survey in response to concerns expressed by regional disaster planners that Guam residents are not sufficiently aware of the risks associated with storms and other climate-related threats common to the region. Part of this concern stems from the fact that Guam has not been significantly impacted by a climatic event since Super Typhoon Pongsona struck the island in 2002, and because the many persons who have recently moved to the island have not experienced storms of

such magnitude in their lifetimes. Notably, Super Typhoon Pongsona generated sustained winds of 144 mph on Guam, with gusts to 173 mph. The storm caused the sinking or grounding of a number of vessels and total damages are thought to have exceeded $700 million.

Four hundred face-to-face surveys were undertaken with Guam residents between January and April 2014 concerning coastal hazards. The sampling approach was designed to account for geographic and demographic variability around the island, including that associated with extensive military holdings and personnel in the northern region, the mixed urban-rural nature of the central region, and the largely rural and heavily marine resource-dependent communities of the southern region.

Data on local perceptions of vulnerability to storms and climate change were collected in 400 face-to-face surveys in Guam.

Of the 400 persons who responded to the survey, only five percent reported that their households had *not* been affected by a natural hazard in the past. The vast majority of respondents had indeed been impacted, with ocean storms the most commonly reported problem. Most reported receiving news of impending weather threats via radio and television.

With regard to hazard disaster relief, 33 percent of survey respondents stated that they had received assistance from governmental and non-governmental disaster aid

programs, with assistance typically received from remote sources such as FEMA and local sources such as the village mayor's office.

The survey also assessed resident's perceptions about climate change and its potential impacts on their home island. Roughly 75 percent of persons responding to the survey reported their belief that Guam's climate had changed over the past ten years, with most respondents asserting that the local climate had warmed and that fewer typhoons than normal had occurred during the period.

Participants in the 2014 Coastal Vulnerability Assessment Workshop included residents from Guam and the Commonwealth of the Northern Mariana Islands. There was great interest in preliminary results of the survey, and initial findings were used as a means for eliciting additional information about climate-induced threats to life and property in the region, along with experience-based options for mitigating the various problems. Direct experience and long-term environmental knowledge were used to help define priorities for a nascent strategic plan that will be used to prepare Guam for future weather-related problems, including those that threaten use of the ocean and its resources for purposes of commerce, food, and recreation.

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