Auke Bay Laboratories (ABL)

FISHERY ECOLOGY, DIET, & ZOOPLANKTON PROGRAM

Development of the Sidewinder Winch for Deploying Instruments at Sea

Scientific research on shallow marine nearshore processes in recent decades has spawned many new developments in mechanical and electronic equipment used on small vessels. However, typical winches available for deploying oceanographic instruments and nets do not allow flexibility of use among vessels. The Southeast Coastal Monitoring project (SECM) is one research project that formerly used NOAA vessels exclusively and now conducts annual surveys using a variety of charter vessels of different sizes. The SECM project recently collaborated with Markey Machinery (Seattle) to develop the "Sidewinder," a new block winch that can be used on vessels as small as 24 ft and that eliminates the need for semi-permanently mounted hydraulic winches used with small gear.

SECM researchers conduct annual surveys to sample juvenile salmon, their predators, and associated zooplankton and oceanographic features from May through August in northern Southeast Alaska. Sampling stations are within a few km of shore and bottom depths are typically 50-300 m. During this work, a variety of small oceanographic instruments and nets are deployed from both NOAA and chartered vessels ranging in size from 24 to 165 ft. Vessel configuration varies widely, and sampling operations must be adapted to vessel layout, space limitations, and permanent machinery. Fish trawling requires large winches and reels typically located midship, while oceanographic sampling requires small winches that are typically mounted on one side on an upper deck. Some vessels do not have a winch of the appropriate size or location to conveniently deploy small instruments according to standard specifications. While the SECM project has a small hydraulic winch with a separate electronic display showing meters of line out, the equipment is nonetheless relatively heavy and non-portable and requires a semi-permanent mounting location near hydraulic lines. In addition, this winch is inconvenient because several staff are needed to monitor its operation and coordinate with vessel power to meet specific sampling gear requirements such as deployment and retrieval at defined speeds and line angles.

Figure 1. The Sidewinder block winch, showing aluminum housing of the drum below the (left to right) planetary reducer, brake, line guide, motor, and lifting handles above.

The Sidewinder was designed to address the limitations of these hydraulic deck-mounted winches. Its block design is relatively lightweight and portable, with overall size of approximately 34 × 37 in and a weight of 150 lb. The drum and internal level-wind are protected by an aluminum frame below the enclosed electric drive 3-HP motor, reduction gear box, and brake (Fig. 1). The entire water resistant unit can be suspended over the side of the vessel from a sturdy davit or J-frame on a small vessel (Fig. 2) or from a boom on a larger vessel (Fig. 3). The drum has 400 m capacity for lightweight "Spectra" soft-line. Gear mechanics are chain-driven and allow the terminal end of the line with instruments attached to be at 90° angle to the turning drum (Fig. 3). The Sidewinder is 24-V battery operated, connected by cable to two 12-V deep-cycle marine batteries monitored by a programmable battery gauge. Another cable connects to the remote control box, which features a joystick, emergency stop, and displays for speed (0-2.0 m/sec), line scope, and line angle. The winch is capable of 200 lbs continuous pull at full drum. An optional manual override with ratcheting pawl allows line retrieval using a standard socket wrench in case of drive or battery failure. Operational safety is ensured by the completely contained mechanics, having the working line and load out-board, the built-in overload slip clutch, and by using the remote control box. The Sidewinder has been especially useful in extending SECM capability to deploy Bongo plankton nets (~100 lbs) in double oblique trajectory to 200-m depths from small vessels.

By Molly Sturdevant, Gary Nishimura, and Joe Orsi

Figure 2. The Sidewinder block winch suspended from a davit on a 24' research vessel.

Figure 3. A Bongo net being retrieved by the Sidewinder block winch suspended from a midship boom on a 165' vessel. The remote control operator is partially visible at right, and the net is retrieved through a "barn door" by the scientist below in the hardhat.

Gadid Growth Studies at Little Port Walter Marine Station

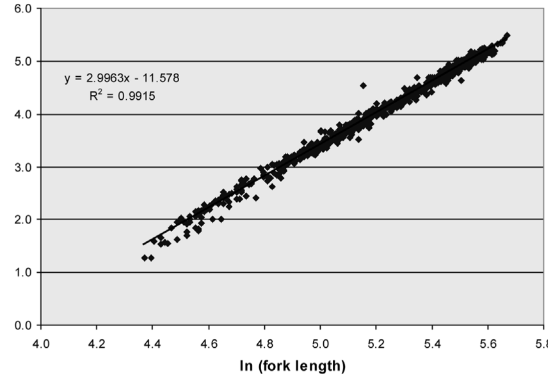
Pacific cod (*Gadus macrocephalus*) and walleye pollock (*Theragra chalcogramma*) are two of the most important commercial species in Alaskan fisheries and ecologically important as prey to marine mammals, seabirds, and fish. Yet little is known about the growth of young-of-the-year Pacific cod and walleye pollock over time. Survey data provides information on a fish's size at a distinct time period, but very little research has been done concerning the growth of individual fish over an extended period of time under controlled conditions.

In August 2009, researchers at Auke Bay Laboratories' Little Port Walter Marine Station collected young-of-the-year Pacific cod and walleye pollock that had congregated in a marine fish trap used to capture returning adult Chinook salmon. A total of 446 Pacific cod and 24 walleye pollock were collected and subsequently divided into two saltwater net pens (2.1 × 2.1 × 2.4 m) The fish adjusted easily to pelletized fish food composed of 52% protein, 22% fat, 12% ash, 10% moisture, 1% fiber, and 1.7% phosphorous. Length and weight data were taken bimonthly on a subset of the populations. Length frequency data were taken on both populations in November 2009, June 2010, and August 2010. Otoliths were collected from mortalities and will be analyzed for age validation.

In June 2010, 50 Pacific cod and 8 walleye pollock were tagged with passive integrated transponder (PIT) tags to begin tracking growth rates of individuals. At this time the walleye pollock were moved into a single net pen and the Pacific cod were split into three 2.1 × 2.1 × 2.4 m net-pens of varying fish density: 197, 143, and 50 individuals in each net. The different densities were designed to see if growth would be affected by crowding. Unfortunately, there was a high rate of mortality after the June data point, possibly the result of handling stress and warmer than normal saltwater temperatures. Because of the increased mortality, all Pacific cod were moved into a single 3.7 m^3 net-pen positioned farther from shore in August 2010. All remaining fish in both populations were PIT-tagged in August when the two groups consisted of 216 Pacific cod and 17 walleye pollock.

Specific growth rates between June and August 2010 of PIT-tagged Pacific cod ranged from 0.31% body wt/d to 1.15% body wt/d. Average specific growth of tagged Pacific cod was 0.74, ± 0.17 % body wt/d. Pacific cod grew rapidly in the fall of 2009, and then growth decreased through the winter months and began to increase in early spring through summer (Table 1a). No data were collected in fall 2009 for walleye pollock; however, their growth virtually ceased in winter and then increased rapidly in early spring, more so than their feed rate (Table 1b). Log transformed length to weight

a



b

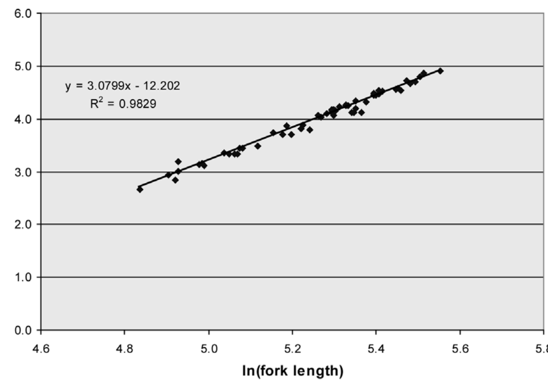


Figure 4. Log transformed length-weight data for Pacific cod (a) and walleye pollock (b) from September 2009 to August 2010.

Table 1. Average fork length, average wet weight, specific growth rates (% $G=(\ln(Wt_2)-\ln(Wt_1)/dt)*100$), and feed rate for Pacific cod (a) and walleye pollock (b) from the first year of captivity.

a)

Sample date	Number	Average length (mm)	Average weight (g)	% Body wt/d	Feed Rate (%)
9/4/2009	100	106.13	11.95		2.00
11/4/2009	95	147.61	31.78	1.58	1.40
1/8/2010	101	163.65	42.08	0.43	0.60
3/20/2010	110	176.65	52.25	0.30	0.50
6/4/2010	80	214.54	90.41	0.71	1.00
8/12/2010	216	247.17	141.60	0.64	2.00

b)

Sample date	Number	Average length (mm)	Average weight (g)	%Body wt/d	Feed Rate (%)
9/4/2009					2.00
11/4/2009	5	141.80	22.08		1.40
1/8/2010	6	145.33	23.22	0.08	0.60
3/20/2010	9	169.78	36.44	0.63	0.50
6/4/2010	23	203.76	66.46	0.78	1.00
8/12/2010	17	228.82	93.95	0.49	2.00

data show a strong linear relationship for Pacific cod and walleye pollock in the first year of captivity (Figure 4a and 4b).

Young-of-the-year Pacific cod and walleye pollock exhibit different annual growth patterns. Although both species were fed identical rations, growth of walleye pollock virtually ceased during winter and increased rapidly in the spring; growth of Pacific cod slowed only slightly through the winter and increased gradually throughout the spring and summer. The growth rate of walleye pollock exceeded the feeding rate in the early spring months, indicating that walleye pollock can use energy stored from the previous summer and fall as a hedge for the following year's growth. This may prove to be an important survival strategy in years when prey is limited.

By Angela Feldmann

Jeffrey Fujioka Retires After 35 Years

Noted for his ability to cut to the chase on complex issues, derive mathematical solutions and develop new approaches, mentor numerous students and ABL employees, and convey meaningful responses with few words, Dr. Jeffrey Tad Fujioka retired from federal service on 1 October 2010.

Jeff's talents as a forthright counselor, statistician, and assessment scientist will be sincerely missed by those who worked with him. He leaves behind a legacy of innovative solutions that include a million dollar longline survey that pays for itself, a wide range of mathematical solutions, numerous stock assessments and papers, and a habitat model that can quantify fishing impacts. Especially important were his long-term efforts on management and research of sablefish, one of Alaska's most valuable fisheries.

Those of us left behind will be wishing Jeff an enjoyable, fishy, and productive retirement.

By Phil Rigby

Fisheries Monitoring & Analysis (FMA) Division

FMA Staff Participate in Fisheries Conference in Galway Ireland

Over 200 fishers and fisheries scientists from all over the world gathered in Galway, Ireland, in late August 2010 for a 4-day conference to consider the collection and interpretation of fishery-dependent data. Participants of the conference "Making the Most of Fisheries Information, Galway 2010" explored how fishery-dependent information and data can better contribute to fisheries resource assessments, management and policy-making, and how fishers themselves can add their vast experience and traditional knowledge into the processes.

Conveners of the conference included AFSC Deputy Director Bill Karp, NOAA Fisheries, Seattle, U..S.A; Norman Graham, Fisheries Science Services, Marine Institute, Galway, Ireland; Kjell Nedreaas, Institute of Marine Research, Bergen, Norway; and Richard Grainger, Food and Agriculture Organization, Rome, Italy. NOAA Fisheries Chief Science Advisor Steven Murawski served as one of four keynote speakers.

Staff attending the conference from the FMA Division were Martin Loefflad, Patti Nelson, Craig Faunce, and Jennifer Cahalan. Loefflad and Nelson contributed a poster illustrating the scope of the North Pacific Groundfish Observer Program (NPGOP) highlighting the history, current operations, client needs, technological advances, and future issues.

Craig Faunce presented two posters and a talk. In the first poster, he and AFSC scientist Steven Barbeaux (Resource Ecology and Fisheries Management (REFM) Division) summarized two potential sources of bias present in observer data: the deployment effect and the observer effect. A deployment effect was evidenced by differences in the ratio of observed to unobserved trips within fisheries, and the observer effect was evidenced by differences in the total landed pounds of retained fish during trips conducted by vessels when observed compared to when they were not. The second poster, co-authored with AFSC scientists Sarah Gaichas (REFM), used the NPGOP as a case-study example of how fishery-dependent data can support ecosystem-based fishery management, in this case the food-web models of the REFM Division's Resource Ecology and Ecosystems Modeling program. Faunce also presented a talk summarizing work done by FMA in the Gulf of Alaska rockfish fishery. Much of the data used in the catch accounting system for the proper debiting of quotas relies on landings reports from such facilities. The project demonstrated the feasibility and utility of observer samples as an audit tool to verify species' identifications in industry reports. These works support ongoing efforts by the FMA Division to design and implement the newly restructured fee-based observer program.

Jennifer Cahalan collaborated with Jennifer Mondragon and Jason Gasper (NMFS Alaska Region Sustainable Fisheries Division) on two studies, both contributing to ongoing efforts to improve catch and bycatch estimation methods used in fisheries quota management in Alaska. The first investigated the role of the "nearest-neighbor" imputation method currently used to predict the species composition of the unsampled hauls. This imputation method was compared with a simple mean estimator and a ratio estimator in a simulation study using 2009 observer data and preliminary analysis showed it to perform relatively well. The second study provided case examples from the Alaska groundfish fisheries of competing the management needs and the practical constraints associated with calculating catch and bycatch estimates.

Cahalan also gave a poster presentation of a summary of sampling results from the 2009 North Pacific Groundfish Observer Program. An analysis of annual sampling efforts was provided for each of the major gear and vessel types highlighting the varied and difficult sampling situations faced by observers (see feature article in this issue).

The final book of abstracts and conference program can be found on the Web at: http://www.marine.ie/fisherydependentdata/Documents/Book%20of%20abstracts/Book%20of%20Abstracts%20master.pdf Full conference proceedings will be available soon.

By Patti Nelson

Habitat & Ecological Processses Research (HEPR)

Bering Sea Project (BEST/BSIERP) Fieldwork Complete

The fourth and final field year of the Bering Sea Project (BEST/BSIERP) finished in early October when first the chartered fishing vessel *Epic Explorer* on 6 October and then the NOAA ship *Miller Freeman* on 7 October came into port. Scientists and crew aboard the *Epic Explorer* completed a surface trawl/acoustics survey. Scientists and crew aboard the *Miller Freeman* completed a moorings and hydrographic cruise. In 2010, cruises supporting the Bering Sea Project have been underway since February and have followed the same intensive schedule (February to October, http://bsierp.nprb.org/meetings/calendar.html) since 2008 (the cruise schedule was less intense in 2007). Altogether, ships were at sea for about 420 days in 2010 in support of the Bering Sea Project.

The Bering Sea Project is a comprehensive $52 million investigation of the eastern Bering Sea supported by the North Pacific Research Board and the National Science Foundation with in-kind support from NOAA and the U.S. Fish and Wildlife Service. The program goal is to understand how climate change is affecting the Bering Sea ecosystem and the consequences of these changes on lower trophic levels for fish, seabirds, marine mammals, and ultimately people. Nearly a hundred principal scientists are linked through a vertically integrated process and modeling program. The fieldwork will be followed by synthesis and reporting during 2011 and 2012.

By Mike Sigler

National Marine Mammal Laboratory (NMML)

ALASKA ECOSYSTEMS PROGRAM

Northern Fur Seal Research in 2010

The National Marine Mammal Laboratory's (NMML) Alaska Ecosystems Program (AEP) conducted a number of studies on northern fur seals (*Callorhinus ursinus*) during 2010 with field components that began in July and continued through October. The primary research objectives of monitoring population trends and investigating the ecology and health of the fur seal population on the Pribilof Islands (St. Paul and St. George) were accomplished through a variety of projects, including studies of pup condition, causes of mortality, and testing of telemetry devices. However, the majority of the AEP's research efforts involved three projects that collected data on fur seal abundance, fine-scale foraging behavior of adult females in the Bering Sea, and age-specific vital rates of females on St. Paul Island.

Northern fur seal abundance and population trends were assessed on the Pribilof Islands during 2010 by obtaining counts of adult males and estimates of the numbers of pups born. Adult males were counted in July, and pups were sheared (Fig. 1) in August 2010. Analyses of the summer's population assessment data will occur at the conclusion of this year's field seasons.

Figure 1. Sheared and unsheared pups on East Reef rookery, St. George Island, Alaska, 2010. Photo by Jamie King.

Fine-scale foraging behavior studies of northern fur seals were conducted during August–October 2010 at St. Paul and St. George Islands. Specific objectives of the project were to obtain higher-resolution location and diving data during adult female foraging trips in the Bering Sea. Twenty-two instruments were deployed on St. Paul Island on females at four different rookeries, and 10 were deployed on St. George Island on females at two different rookeries. Known-age females were targeted at Polovina Cliffs rookery on St. Paul Island and on South Rookery on St. George Island.

Research efforts by the AEP on age-specific vital rates of northern fur seals continued on St. Paul and St. George Islands in 2010. Fieldwork on St. George Island focused on demographic objectives: tagging females for mark-recapture studies, extracting teeth for age estimation, large-scale pup tagging, and initiation of tag sighting and behavioral observations. Fieldwork on St. Paul Island focused on tag-sighting efforts throughout the summer and large-scale pup tagging in the fall.

By Rod Towell

CETACEAN ASSESSMENT & ECOLOGY PROGRAM

Mary Ann Sherman: The Life and Death of a Whaling Wife

The bulk of scientific research at NMML concerns marine mammals in the present; but occasionally our investigations find us delving into the past. Logbooks of 19th-century American whaling ships can tell us a great deal about the historical distribution of whales in many parts of the world, and this information can be used to assess how abundant whales once were and the habitats that were important to them in past centuries. Logbooks can also serve to guide us in planning current surveys of regions of which we know little. However, in the course of reading these fascinating historical accounts for science, we often discover equally compelling stories about the individuals who sailed aboard these ships. One such tale is told briefly below.

Logbooks and journals from old whaling days are available in various places, but nowhere is there a collection that rivals that found in New Bedford, Massachusetts. The New Bedford Whaling Museum curates a huge collection of such documents, an archive that was greatly supplemented some years ago by the closure of the Kendall Whaling Museum, which transferred all of its logbooks to New Bedford to form an unparalleled joint resource.

The logs make fascinating reading. Daily entries vary from brief and barely legible to extensive and beautifully illustrated. Some reflect the unsung artistic talents of long-dead captains or mates, who set down on now-yellowing pages in ink or watercolor their visions of lush tropical islands, harsh Arctic seas, ships met with along the way, and of course whales. Voyages were often long: 4 or 5 years away from a New England port (most commonly New Bedford or Nantucket) was not an unusual duration for a whaling expedition, with ships cruising far from home into the Pacific or Indian Ocean in their relentless pursuit of valuable whale oil and whalebone (baleen).

Some logs present rather dry, mundane records of no more than vessel positions and whales caught. Others, however, exhibit a more human element—although not always a positive one. Whaling ships were usually not pleasant abodes: men were crowded into small spaces, fed with frequently poor food, and forced to work in conditions that were often rough, cold, or filthy. Mutinies were not uncommon, and poorly paid, disgruntled seamen would sometimes attempt to jump ship in port. Long stretches of boredom were interrupted by bouts of frenetic and often dangerous activity when the crews found and chased whales.

Needless to say, the great majority of ships were crewed by men alone. But, very occasionally, a captain would bring his wife along for the voyage. Such was the case with Captain Abner Sherman, who commanded the whaler *Harrison*. A full-rigged ship of 371 tons, the *Harrison* sailed from New Bedford on 21 May 1845 on a voyage that would last more than 5 years. Aboard her were 31 men—the youngest 19 years old, the oldest 32—and one woman. This was Mary Ann Sherman, aged 19, the illegitimate daughter of a New Bedford preacher named Zoeth and, allegedly, an Irish maid. Abner, 32 years old, was Mary Ann's first cousin; they had married in January of the same year.

We can only imagine what it was like for a young girl to live within the confined space and distinctly ungenteel atmosphere of a whaler. Furthermore, the *Harrison* was not a happy ship, as is attested by the log (KWM log # 964, which my wife and I recently read in New Bedford). Whether because Sherman was poor at picking crew, or a bad captain generally, the logbook records many instances of discontent and fomenting mutiny: we read of crew being whipped or put in irons or running away in port. In March of 1846, the *Harrison* was in Tahiti, and the entry for March 7 reads, in part, "Put the steward in the rigging and flog him, gave him a dozen lashes for being sassy."

Twelve days later, three men refused to go to their duty stations when leaving Tahiti; Sherman responded by giving them 12 lashes each and putting them in irons. Later, we read of more floggings and even the threat of shooting; and when the ship landed in Sydney in January the following year, 10 men ran away and the captain is recorded as "chasing them on shore."

It cannot have been pleasant for Mary Ann to have been a part of this querulous masculine society, but she certainly saw a lot of the world. The *Harrison* went from New Bedford to the Azores (known then as the "Western Isles," where they captured their first sperm whale), thence to the Cape Verdes, Tristan da Cunha, the Chatham Islands, Tahiti, Maui, the Gulf of Alaska (where they made a number of catches, probably of right whales), Sydney, and New Zealand. From Sydney, they traveled north to Kamchatka and the foggy, cold waters of the Okhotsk Sea; this was in August 1847 and, sadly, that is where the logbook ends.

The log for the second half of the voyage has never been found. This is regrettable, because we know from other sources that the vessel returned to Sydney for repairs after running aground and sustaining damage on a reef in Samoa. In 1849, returning to Sydney after largely unsuccessful whaling off New Zealand, Sherman decided to refit the *Harrison* to carry paying passengers to California for the Gold Rush.

On 5 January 1850, on the ensuing voyage to San Francisco, Mary Ann died—of what illness we do not know. She was just 24 years old. The vessel put into Rarotonga in the Cook Islands, and Sherman buried his wife there in a grave that remains to this day. My collaborator and close friend Nan Hauser has lived on Rarotonga for 15 years and directs Cook Islands Whale Research, with whom NMML has conducted satellite tagging of humpback whales. Nan searched for Mary Ann's grave for a year and finally found it in a patch of wildly overgrown and uncleared land. On a recent visit to the island, Nan and I went to the grave and, with the help of a couple of friends, a chainsaw, and a machete, cleared the vegetation and let sunlight stream onto Mary Ann's headstone for the first time in what was likely more than a century (Fig. 2). Next to her grave is that of a 16-year-old boy named William Dunnett, whose headstone records the bare fact that he died on a British schooner in the 1840s; unlike Mary Ann's, his story is entirely unknown.

Unusual for a whaling captain, Sherman left the *Harrison* in San Francisco, eventually making his way back to New Bedford. He died there in 1893 at the age of 79 after being thrown from a horse-drawn carriage (in an accident caused, according to the local newspaper, by "excessive speed"). A man named Savage (who was not part of the original crew) brought the *Harrison* home, and she finally docked at a New Bedford wharf on 13 October 1850. The voyage had not been very successful and was cursed by ill fortune. Among other incidents, a vessel which Sherman met en route and paid to ship home his accumulated store of oil and whalebone sank shortly afterwards, with the loss of all cargo (and, therefore, profit).

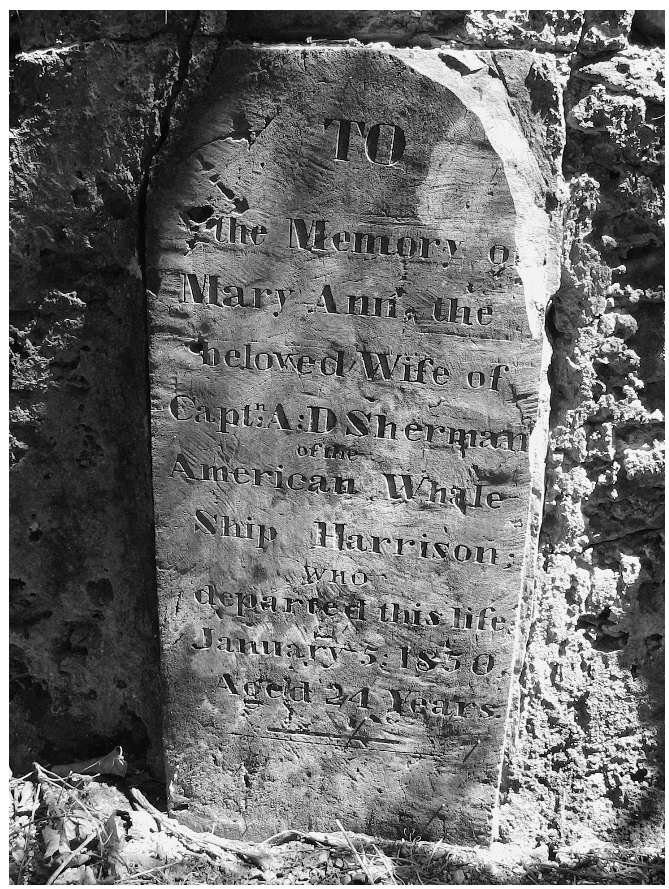


Figure 2. The grave of Mary Ann Sherman on Rarotonga, September 2010. Photo by Phil Clapham.

Mary Ann Sherman's was not the only death aboard the *Harrison*. The incomplete log in the New Bedford Whaling Museum records three other deaths, all in 1847, and all with no hint as to cause. Given the life of a whaler, it could have been anything from disease to an accident aboard or mortal injury resulting from a clash with an angry harpooned whale. As for Mary Ann, she herself took ship, presumably, for love of her husband. In so doing, she abandoned forever the home life she knew well, saw a good portion of the world, and—directly or indirectly—became a victim of the vast ocean on which she spent her last years. Standing by her lonely grave in Rarotonga, I recalled a quotation from the Spanish writer Madariaga: "Beware of love, for it is a wide, wide sea. Beware of the sea, for it is a wide, wide love."

By Phil Clapham

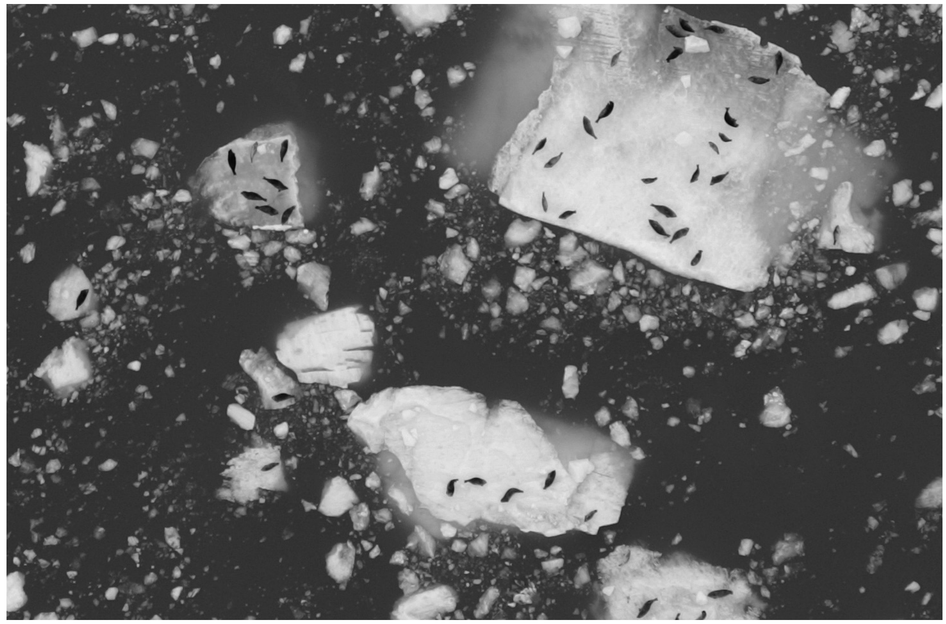


Figure 3. Image of harbor seals hauled out on tidewater glacial ice in LeConte Bay taken with the forward-motion-compensating (FMC) camera array.

POLAR ECOSYSTEMS PROGRAM

NMML Researchers Census Harbor Seals Along Coastal Alaska

NMML's Polar Ecosystems Program (PEP) is responsible for monitoring and estimating the abundance of harbor seals in Alaska. The PEP conducts aerial surveys of harbor seals every July/August during the seals' annual molt, when they haul out of the water while shedding and growing new hair. The 2010 surveys were conducted from the last week in July through the end of August. We utilized six aircraft, including three NOAA twin-engine planes (one AC-Shrike and two DHC-Twin Otters) and three chartered single-engine floatplanes. The scientific crew was made up entirely of NMML employees and contractors with a significant amount of aviation safety and survival training.

Harbor seals range from Southeast Alaska through the extent of the Aleutian Islands and north into Bristol Bay. Prior to 2008, for logistical purposes, Alaska was divided into five regions—Gulf of Alaska, northern Southeast Alaska, southern Southeast Alaska, Aleutian Islands, and the north side of the Alaska Peninsula and Bristol Bay—and one region was surveyed each year. Beginning in 2008, the PEP developed and implemented a new system that allows annual surveys across the entire range of harbor seals in Alaska. In 2010, the survey sites were prioritized by incorporating harbor seal stock divisions. We focus on surveying sites that make up a significant portion of each stock's population every year. Those sites with fewer seals are flown every 3 to 5 years. This should provide us with the data necessary to estimate harbor seal population and trends on an annual basis.

The 2010 surveys also included our continued effort to monitor the population and trends of harbor seals that rely on tidewater glacier habitats for pupping and molting. During the month of August, biologists photo-sampled ice-hauling seals in tidewater glacial fjords: Icy and Disenchantment Bays in the Gulf of Alaska; Tracy Arm, Endicott Arm, and LeConte Bay in Southeast Alaska; and College Fjord and Colombia Glacier in Prince William Sound. Seals in these fjords are scattered across enormous fields of floating ice that shift with ocean and wind currents, making them difficult to count.

Due to a need for improved image quality and enhanced coverage for glacial surveys, the PEP implemented a new aerial sampling method for ice-hauling seals in tidewater glacial fjords. A three-camera, forward-motion-compensating (FMC) camera array, consisting of three Nikon D2X cameras, was mounted in the belly port of a NOAA Twin Otter. Line transects were flown by NOAA Corps pilots, and flights were timed daily to overlap with the peak abundance of seals, which occurs between 1300 and 1600 hours. This new method allowed scientists to capture higher quality imagery of seals (Fig. 3) at multiple altitudes (1,000-2,500 ft). Flight times were reduced and image quality was significantly enhanced, improving our ability to estimate population abundance and trends. The images were georeferenced and analyzed using conventional GIS software to map seal locations. The estimated total abundance is calculated using spatial statistical models. Besides abundance estimation, the high-quality imagery also allows for detailed analyses of individual seals (e.g., discriminating mother-pup pairs and population structure) and ice characteristics.

The PEP also integrated thermal image tests (alongside standard tidewater glacial surveys) for harbor seal detection using a forward-looking infrared (FLIR) camera. Additional passes were flown at 200-ft altitude increments (600-1,900 ft) over areas with high seal densities. The goals of the thermal image testing were to determine a thermal resolution threshold for harbor seals on glacial ice in order to calculate effective thermal survey altitudes and to determine thermal boundaries and sources of thermal interference for automated image collection.

By Josh London and Erin Richmond

Resource Assessment & Conservation Engineering (RACE) Division

GROUNDFISH & SHELLFISH ASSESSMENT PROGRAMS

2010 Eastern Bering Sea Continental Shelf Bottom Trawl Survey

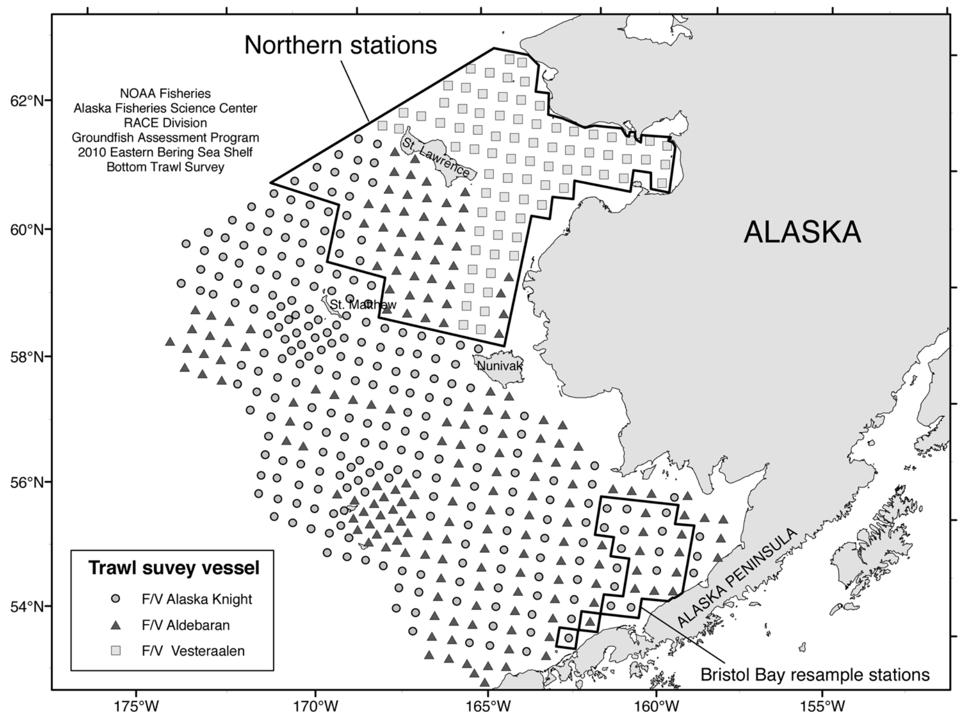


Figure 1. Sampled survey stations by vessel for the 2010 eastern Bering Sea shelf bottom trawl survey.

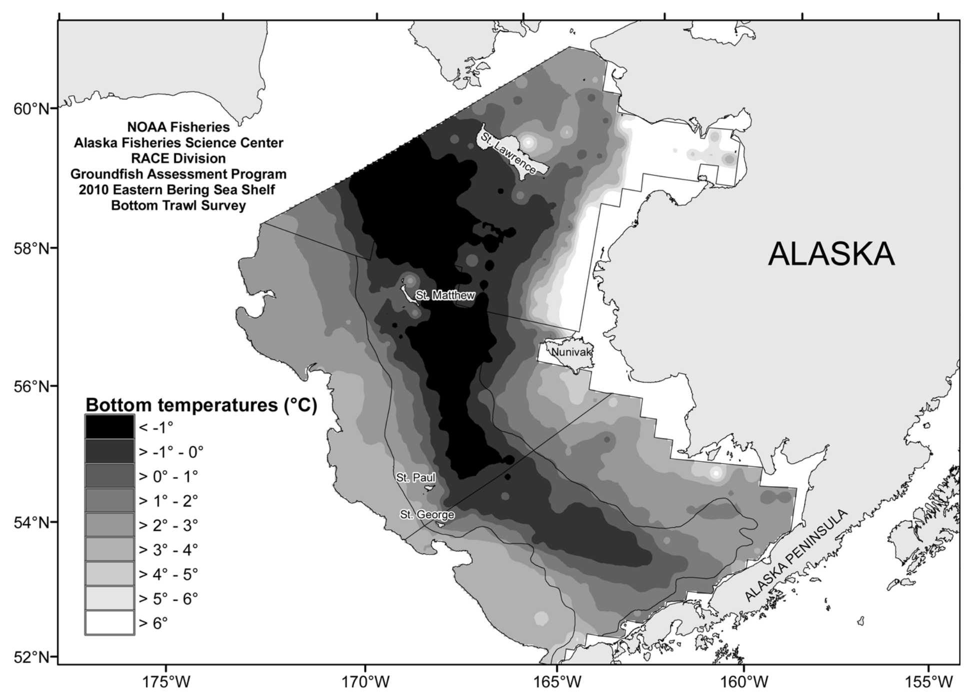


Figure 2. Distribution of bottom water temperatures (°C) observed during the 2010 eastern Bering Sea shelf bottom trawl survey.

The 29th annual bottom trawl survey of the eastern Bering Sea (EBS) continental shelf was conducted between 2 June and 15 August 2010 aboard the chartered fishing vessels *Alaska Knight*, *Aldebaran*, and the *Vesteraalen*. This year's survey expanded northward to include Norton Sound and areas above St. Mathew Island and St. Lawrence Island (Fig. 1) extending west to the U.S.-Russia Convention Line. The purpose of sampling these additional northern stations was to establish baseline information of crab and groundfish species within the northern Bering Sea as a part of a study examining the loss of seasonal sea ice due to climate change. This survey represents the greatest annual coverage of the eastern Bering Sea shelf dating back to the start of the survey time series in the early 1970s.

Scientists from the AFSC, as well as the Alaska Department of Fish and Game, the International Pacific Halibut Commission, and Kawerak Inc. participated in the survey and completed standardized biological sampling of crab and groundfish resources at 142 northern extension stations in addition to the 376 standard annual stations. The northern extension expanded area coverage from the standard 144,493 square nautical miles (nmi^2) to 200,088 nmi^2, with depths ranging from 11 to 200 m. In addition, the *Aldebaran* returned to Bristol Bay to resample 23 stations between 24 and 29 July due to the delaying effects of colder than average water temperatures on the red king crab reproductive cycle.

Bottom temperatures measured during the survey ranged from -1.6° to 12.3°C (Fig. 2). Mean bottom temperatures of the standard shelf area in 2010 were slightly warmer (1.33°C) than in 2009 (1.21°C) but continued a cold trend that began in 2006 where the cold pool (<2°C) has extended southward into the middle shelf and into Bristol Bay. In the northern shelf area, the cold pool was expansive, covering most of the area between St. Matthew Island and St. Lawrence Island. Nearshore waters above Nunivak Island and all of Norton Sound, however, were relatively warm with bottom temperatures exceeding 6°C (Fig. 2).

Data collections from the EBS shelf trawl survey included 192,000 individual length measurements representing 49 fish taxa; 9,991 age structures representing 17 fish taxa; 7,342 stomach samples representing 56 fish taxa; and 2,230 pathobiology samples from 42 different fish and invertebrate taxa.

Groundfish – In the standard area, a majority of trawl catches contained walleye pollock (*Theragra chalcogramma*), where biomass estimates increased from 2.28 million metric tons (t) in 2009 to 3.75 million t in 2010. The largest catches of walleye pollock were concentrated along the northwest outer shelf and near the Pribilof Islands where bottom temperatures were above 0°C. Pacific cod abundance also increased, from an estimated 0.43 million t in 2009 to 0.87 million t in 2010, likely due the individual growth of many smaller sized cod observed in 2009. Pacific cod were more broadly distributed across the shelf, however, like pollock, they were less abundant where bottom temperatures were < 0°C (e.g., cold pool). Estimates of 2010 biomass for most of the major flatfish species, including yellowfin sole (*Limanda aspera*), northern rock sole (*Lepidopsetta polyxystra*), flathead sole (*Hippoglossoides elassodon*), arrowtooth flounder (*Atheresthes stomias*), and Greenland turbot (*Reinhardtius hippoglossoides*), increased by 18% to 115% compared to 2009 estimates. The most abundant of the flatfishes were yellowfin sole (2.37 million t) and northern rock sole (2.06 million t).

Northern area catches were smaller compared to the standard area, but distributions of some the major species including Alaska plaice (*Pleuronectes quadrituberculatus*) (Fig. 3), yellowfin sole (Fig. 4), and snow crab (*Chionoecetes opilio*) extended significantly into the northern shelf. The four most abundant species in terms of estimated biomass in the northern area were yellowfin sole (0.42 million t), snow crab (0.32 million t), purple-orange seastar (*Asterias amurensis*; 0.28 million t), and Alaska plaice (0.30 million t). Bering flounder (*Hippoglossoides robustus*), overall a less abundant species, was found to have just over 50% of its estimated biomass in the northern area (Fig. 5).

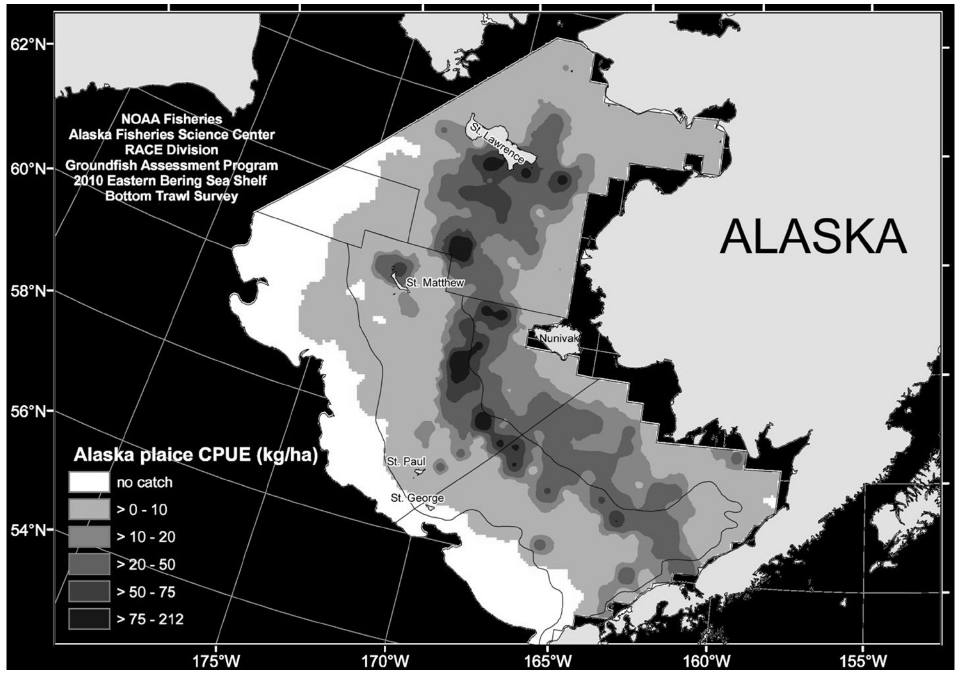


Figure 3. Distribution and relative abundance of Alaska plaice (*Pleuronectes quadrituberculatus*) for the 2010 eastern Bering Sea shelf bottom trawl survey.

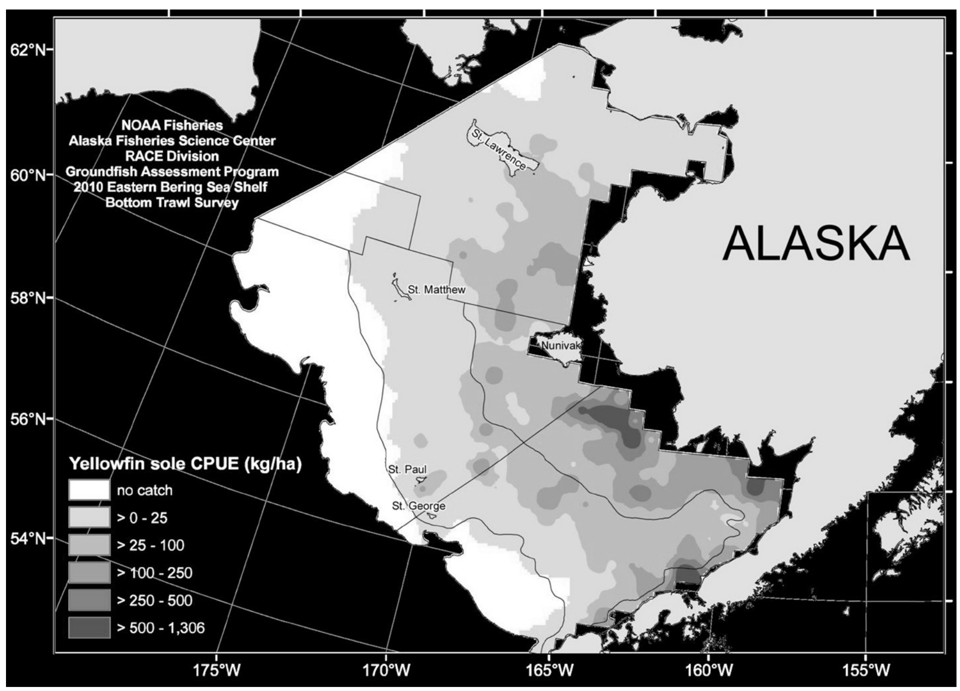


Figure 4. Distribution and relative abundance of yellowfin sole (*Limanda aspera*) for the 2010 eastern Bering Sea shelf bottom trawl survey.

Commercial Crab – In 2010, commercially important crab were caught at all but 21 of the standard stations (Fig. 6). Biomass estimates in metric tons of Bristol Bay legal male red king crab (*Paralithodes camtschaticus)* have decreased over the last 3 years from 33,541 t in 2007 to 21,347 t in 2010; mature males decreased from 34,262 t in 2009 to 30,248 t in 2010. Mature females in Bristol Bay increased between 2009 and 2010 from 28,758 to 40,797 t. Estimates for legal males in the Pribilof District show little change between 2009 (2,088 t) and 2010 (2,881 t); mature males increased from 2,454 to 3,107 t and mature female estimates have decreased from 590 t in 2009 to 379 t in 2010. The 2010 coefficients of variance (CV) of Bristol Bay mature male and female red king crab biomass estimates ranged from 16% to 27%; the Pribilof District mature male and female red king crab CVs ranged from 36% to 41%.

From 2009 to 2010, the estimated biomass of legal male blue king crab *(P. platypus)* in the Pribilof District increased from 170 to 202 t, while mature males decreased from 452 to 322 t, with a CV for legal and mature males of 46%–48%. In the St. Matthew Island Section of the Northern District, both mature and legal-sized males

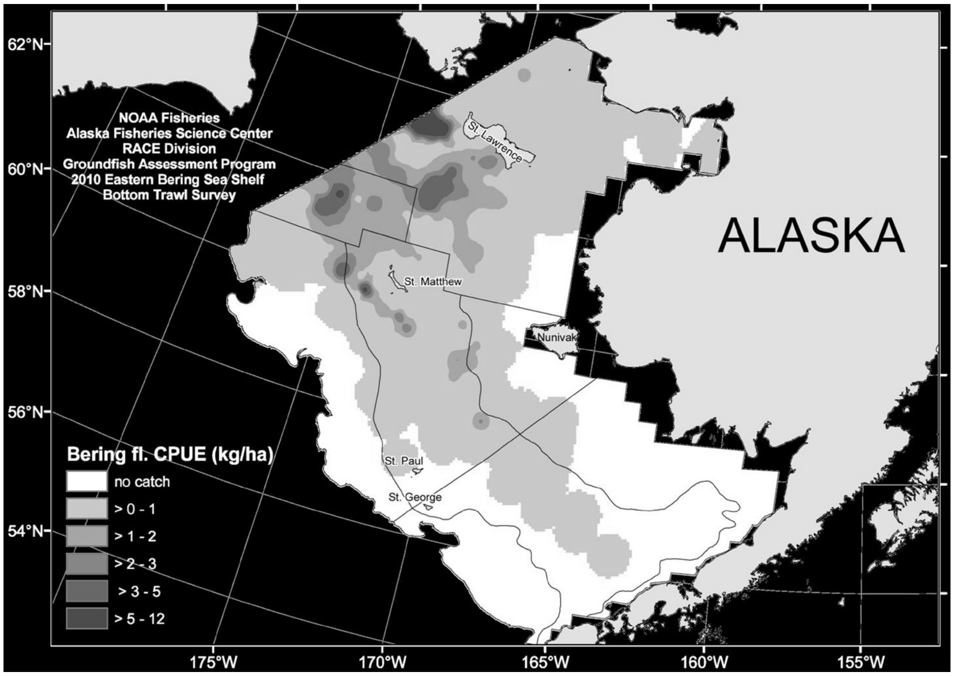


Figure 5. Distribution and relative abundance of Bering flounder (*Hippoglossoides robustus*) for the 2010 eastern Bering Sea shelf bottom trawl survey.

increased from 2009 estimates of 4,622 and 2,390 t to 8,141 and 4,317 t, respectively, above the average estimates from the previous 20 years. The CV for the St. Matthew Island Section mature male biomass was 26%.

Mature male Tanner crab *(Chionoecetes bairdi)* abundance decreased between 2009 and 2010 from 30,281 to 27,949 t; mature females also decreased from 14,832 to 5,922 t. Legal males showed an increase from 7,027 to 7,955 t. The CVs for mature male and female biomass ranged from 16% to 20%. Based on the mature male biomass, the Tanner crab stock was declared overfished in September 2010, and based on the female biomass the fishery was closed for the 2010-11 fishing season.

Estimated biomass of legal male snow crab *(C. opilio)* decreased from 149,714 to 136,140 t between 2009 and 2010, while mature male biomass increased from 103,550 to 107,131 t. Mature female biomass also increased from 68,026 t in 2009 to 132,166 t in 2010, with CVs for mature males and mature female snow crab ranging from12% to 18%.

The 2010 biomass estimates for legal-sized males of commercial crab stocks in the standard survey area of the eastern Bering Sea are shown in Table 1.

Because stock assessment models rely on growth increments and mating success, the delayed molt and mating cycle of female red king crab due to cold bottom water temperatures necessitated a return to Bristol Bay. By the time the resample was completed on 29 July, 96% of mature females had completed the molt and extruded new clutches.

Complete crab survey results from the EBS bottom trawl survey can be found on the AFSC website at http://www.afsc.noaa.gov/Kodiak/default.htm.

Northern Bering Sea crab catch distribution crab caught at each station by species is shown in Figure 7. Red king crab were caught at 22 of the 44 total stations within the Norton Sound Section of the Northern District. The 2010 biomass estimate of legal-sized males was 1,030 t, and was 1,656 and 263 t for mature and immature males, respectively. The biomass estimate of mature female red king crab was 347 t. The CV for all males and mature female biomass ranged from 31% to 49%.

The 2010 biomass estimate of legal-sized blue king crab males was 45 t, the estimate of mature and immature males was 566 and 590 t, respectively. The biomass estimate of mature female red king crab was 730 t. The CV range for blue king crab males and mature female biomass was 21%-100%. The majority of both mature and immature males and females were distributed off the northwest coast of St. Lawrence Island, while a smaller abundance of mature male and female blue king crab were distributed in shallow water south of Bering Strait.

Two immature Tanner crab, one male and one female, were caught during the survey at one station (AA-23; Fig. 7).

Table 1. The 2010 biomass estimates in metric tons (t) and pounds (lb) with 95% confidence intervals (± 1.96*SE) for legal-sized males of commercial crab stocks in the eastern Bering Sea.

	2010 Legal-sized male biomass	
Bristol Bay District red king crab (*Paralithodes camtschaticus*)	21,347 (7,504) (t)	47,062 (16,544) (lb)
Pribilof District red king crab (*P. camtschaticus*)	2,881 (2,049) (t)	6,351 (4,517) (lb)
Pribilof District blue king crab (*P. platypus*)	202 (191) (t)	445(421) (lb)
St. Matthew Island Section blue king crab (*P. platypus*)	4,317 (2,165) (t)	9,517 (4,773) (lb)
Southern Tanner crab, all Districts (*Chionoecetes bairdi*)	7,955 (3,172) (t)	17,536 (6,993) (lb)
Snow crab, all Districts (*C. opilio*)	136,140 (31,567) (t)	300,134 (69,593) (lb)
Snow crab, all Districts ≥ 4.0 inches	88,788 (24,996) (t)	195,472 (55,106) (lb)

Snow crab were caught at 118 of the 145 total northern extension stations, although legal-sized males were only caught at one station (BB-07). The 2010 biomass estimates of legal-sized males was 8 t, of mature and immature males was 8 and 182,348 t, respectively; the biomass estimate of mature female snow crab was 30,277 t. The CVs for snow crab males and mature female biomass ranged from 13% to 100%. Both immature male and female snow crab were widely distributed, while the majority of mature females were caught in the southwestern portion of the NBS.

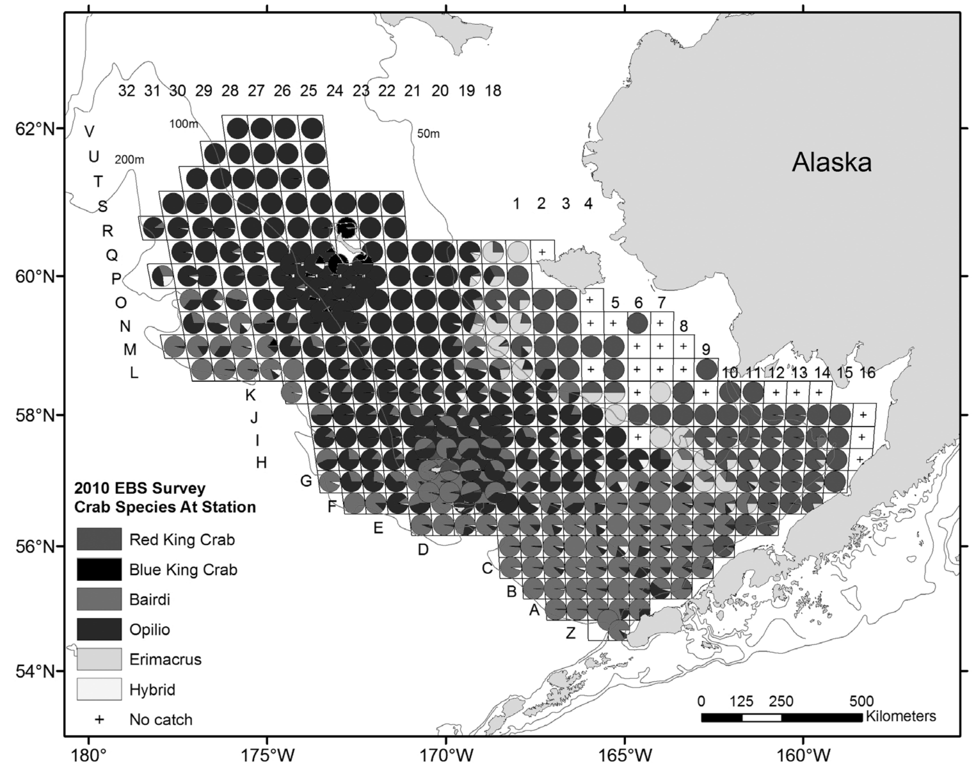


Figure 6. The 2010 eastern Bering Sea bottom trawl survey commercial crab species at station.

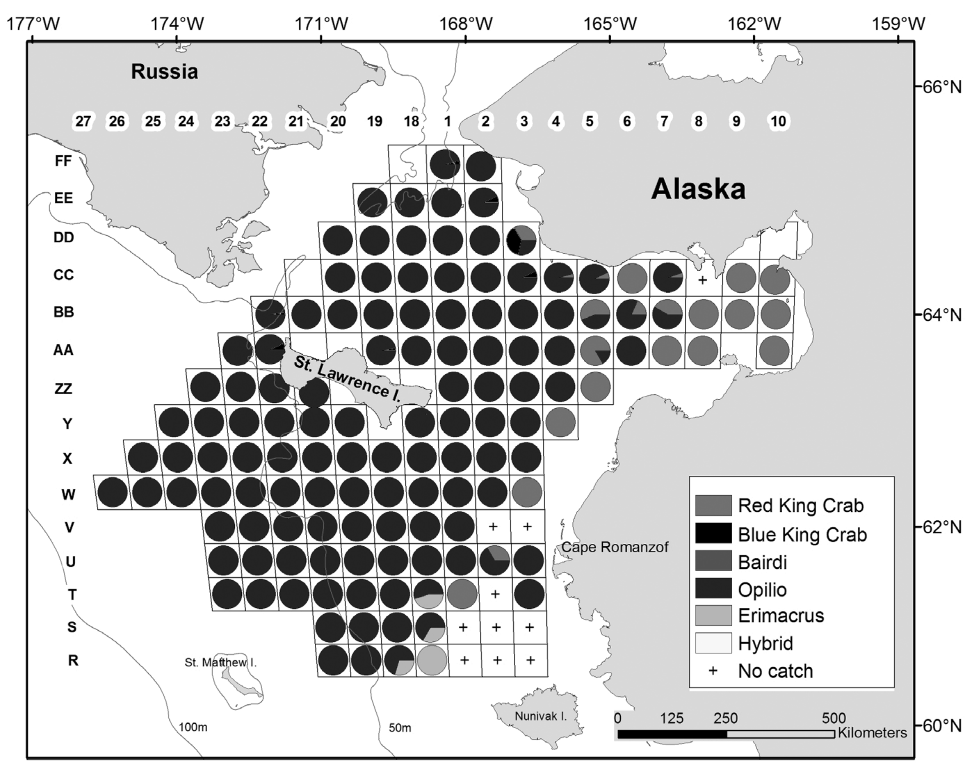


Figure 7. Distribution of commercial crab species caught at each station during the 2010 northern Bering Sea bottom trawl survey

Crab Special Projects – In addition to the assessment survey, a number of special projects were carried out to collect biological data on several crab species. Stomach samples from male and female Tanner crab as well as possible prey items were collected for diet studies. Hemolymph samples from red and blue king crab were taken for population genetics; samples were also collected from snow and Tanner crab to monitor bitter crab syndrome. Egg clutches from red king crabs were collected to investigate reproductive potential including egg quality and fecundity variability.

By Dan Nichol, Robert Foy, and Robert Lauth.

2010 Eastern Bering Sea Upper Continental Slope Groundfish Survey

During June and July 2010, the RACE Division conducted the biennial eastern Bering Sea upper continental slope groundfish survey. This effort was the fourth of a new series that includes previous surveys in 2002, 2004, and 2008. We conducted 200 successful tows between 200- 1,200 m along the continental slope of the eastern Bering Sea from Akutan Island toward the northwest to the international boundary using a stratified random design (Fig. 8) that distributes sampling effort in proportion to the area by depth and geographic subarea. The objectives of the survey are to describe the current composition, spatial and depth distributions, and relative abundance of groundfish and invertebrate resources, and to collect biological data from a variety of commercially and ecologically important species (Fig. 9). At each trawl station we collected environmental parameters including bottom depth, surface and bottom water temperatures, light levels, and sea states to relate long-term changes in fish and invertebrate distribution with changes in oceanographic conditions. In addition we completed more than 20 research projects requested from investigators.

By Gerald Hoff

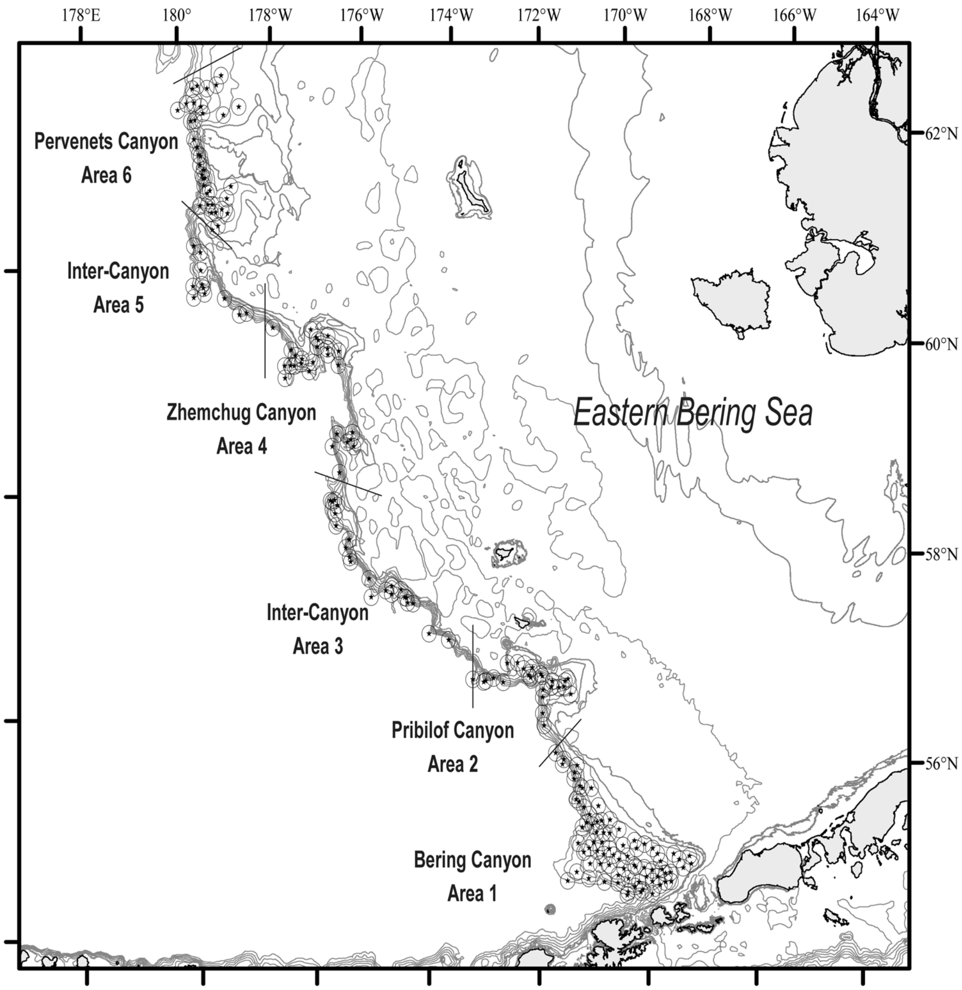


Figure 8. Stations (surveyed in the eastern Bering Sea upper continental slope groundfish survey in 2010. Isobath lines show 25-m depth contours.

Figure 9. Trawl catches aboard the chartered fishing vessel *Vesteraalen* are sorted during the 2010 eastern Bering Sea upper continental slope groundfish survey.

Habitat Researchers Test Subsea-positioning Technology

The Magnuson-Stevens Fishery Conservation and Management Act requires the National Marine Fisheries Service (NMFS) to characterize and map essential fish habitat and to protect these areas from adverse impacts due to fishing and other activities. Since 2006, scientists with the RACE Habitat Research Group (HRG) have been working collaboratively with NOAA's Office of Coast Survey (OCS), Office of Marine and Aviation Operations (OMAO), and the NOAA ship *Fairweather* to integrate the nautical-charting and habitat-mapping activities of these organizations in the eastern Bering Sea (EBS). This work involves a variety of towed instruments, including two different side scan sonar systems (Klein 5410, Klein 7180 LRSSS), a towed camera system (TACOS), and an over-the-side grab sampler (SEABOSS). In all cases, a subsurface tracking system is required to provide accurate positioning of the overboard system and the resulting data. To this end, an ultra-short baseline (USBL) system calculates the subsurface position of an object by combining acoustic range and bearing data from a vessel-mounted transceiver with attitude, heading and location information from the vessel's own navigation system. The object to be tracked needs to be equipped with an acoustic transponder or responder that communicates with the transceiver attached to the vessel. This technology does not require a transponder array to be deployed on the seabed before positioning can commence and is thus ideal for trackline work.

The AFSC purchased a wideband-enabled Sonardyne Fusion USBL system for the *Fairweather* in 2004 in order to provide capability for subsurface positioning of scientific and hydrographic instruments. In 2006, an over-the-side pole was fabricated for the transceiver using a proven AFSC design and was successfully used during extended at-sea operations in the EBS. This same pole catastrophically failed shortly after deployment in 2008. The USBL transceiver was subsequently installed in a vacant area of the ship's skeg during the *Fairweather*'s 2008-09 winter-repair period. However, performance problems associated with acoustic interference and multipath conditions were identified during sea trials in Puget Sound on 23 April 2009. The transceiver's proximity to the ship's hull and

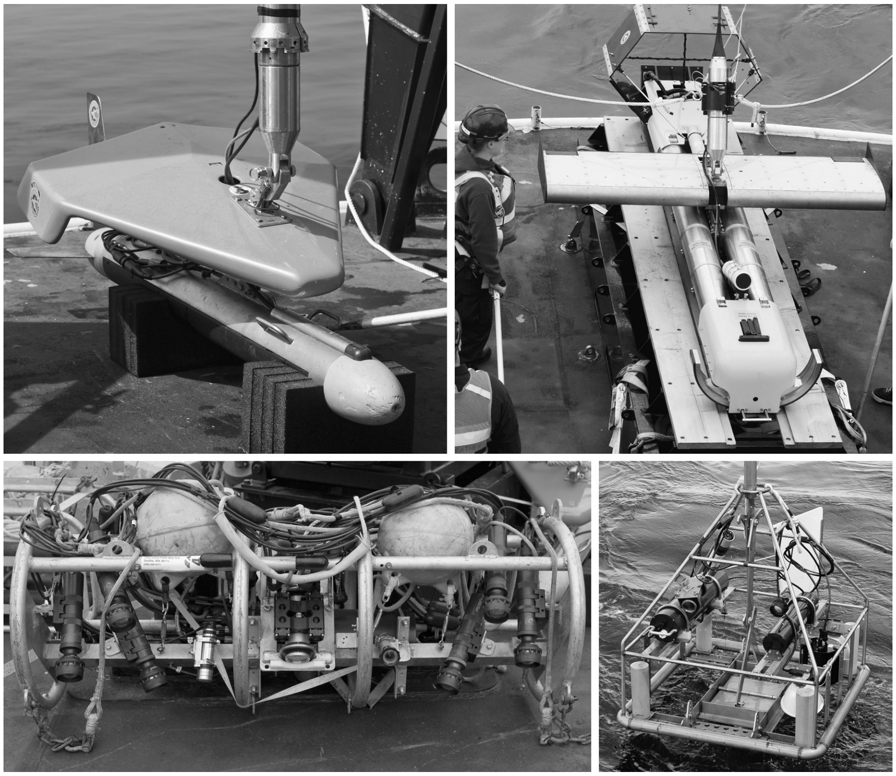


Figure 10. Towed scientific and hydrographic instruments that require subsea positioning capability (clockwise from upper left): Klein 5410 side scan sonar, Klein 7180 long-range side scan sonar, SEABOSS sediment grab/camera system, and the two-part TACOS video sled. SEABOSS was not included in this exercise because of acceptable performance during the 2009 FISHPAC-project cruise in the EBS.

propellers was identified as the most likely cause for these problems.

In order to better define the performance characteristics of this installation, systematic tests were undertaken during 29-30 June 2010 in the Freshwater Bay region of the Strait of Juan de Fuca, Washington (depths 120-150 m). In particular, various subsea-positioning scenarios were investigated using two different side scan sonar systems and a towed video system (Fig. 10). For each of the three towed instruments, specific combinations of speed over ground and bearing from the vessel trackline were tested. Prior to testing, a reconnaissance survey was conducted with the ship's Reson 7111 multibeam echosounder to identify potential hazards in the study area. A dynamic calibration of the USBL system was subsequently completed to determine system offsets and provide accurate positioning capability. The USBL performance while towing the side scan sonar systems was measured on a fixed X-shaped maneuvering pattern where the test conditions for each pass varied according to the predetermined plan for each instrument. A complete circuit of the "X" and the two accompanying turns was completed at each test speed. The maneuvering pattern was continuously navigated with a particular towfish until testing with that system was completed. The USBL performance while towing TACOS was measured in the same maneuvering area but did not include turns because of reduced steerage at the minimal headway required for this system.

Three methods were used to evaluate USBL signal quality and overall system performance using the data collected. This involved quality flags stored in the USBL-system software and analysis of post-processed positions of the towed instruments. In general, our results demonstrated inconsistent and, therefore, unreliable performance from a system that did not calibrate according to manufacturer's standards. Instrument-specific effects on positioning that are related to tow speed and layback angle were observed and represent deficiencies that limit certain multi-mission research and hydrographic surveying operations from the platform. Our HRG scientists will work closely with OMAO engineers during the *Fairweather*'s 2010-11 winter in-port to resolve the performance problems as part of preparation for the multi-mission FISHPAC-project cruise in the eastern Bering Sea scheduled for summer 2011. Although primarily a scientific study concerned with EFH characterization, the FISHPAC project will also provide hydrographic-quality bathymetric data to the NOAA Pacific Hydrographic Branch for updating nautical charts in areas with outdated or nonexistent information.

By Bob McConnaughey

NEWPORT LABORATORY: FISHERIES BEHAVIORAL ECOLOGY PROGRAM

Laboratory and Field Experiments to Support the Culture and Release of Hatchery-Reared Juvenile Red King Crab

The Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB) Program is a coalition of partners from the Alaska Fisheries Science Center, Alaska Sea Grant, the University of Alaska Fairbanks (UAF), the Alutiiq Pride Shellfish Hatchery in Seward, and fishermen's groups and coastal communities in the Gulf of Alaska and Bering Sea. The program was initiated in 2006 with the goal of investigating the feasibility of stock enhancement of Alaskan king crab species for the purpose of stock rehabilitation. While larval culture in Alaska began at the Kodiak Laboratory after the collapse of red king crab (RKC) in the mid-1980s, large-scale culture at the Alutiiq Pride Shellfish Hatchery has produced over 100,000 first-stage juvenile during the last 2 years. The program now faces the challenging tasks of determining the best practices for culture of juveniles to a stage appropriate for release, evaluating the best possible habitats for releases of juveniles, and understanding recruitment processes such as growth and mortality.

Laboratory studies conducted at the AFSC's Newport Laboratory and by the UAF in Juneau have shown that early-stage juvenile RKC prefer complex biogenic habitats formed by sessile invertebrates and macroalgae (Fig. 11) that provide both food and shelter. The strengths of the associations increase in the presence of both fish predators and larger cannibalistic RKC. The behavioral adaptation gives young crabs a significant survival advantage, particularly in the presence of a visual predator such as

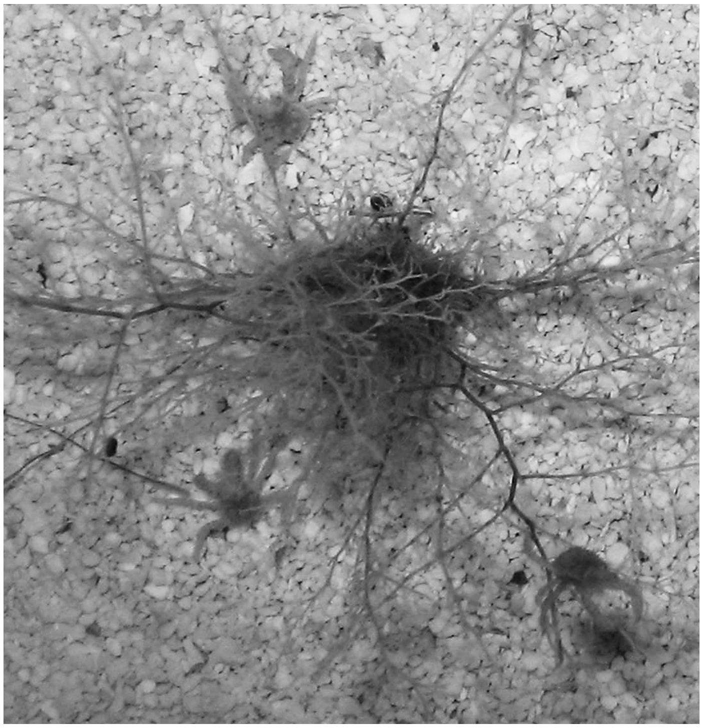


Figure 11. A hatchery-reared red king crab, approximately 5 mm in carapace length, approaching the highly preferred hydroid habitat in a laboratory trial.

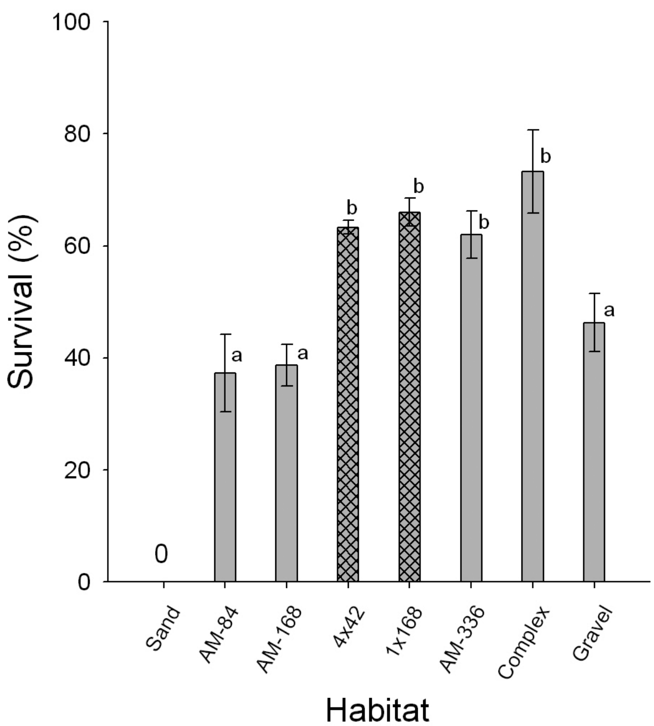


Figure 12. Survival of juvenile red king crab in nine different experimental substrata with age-1 Pacific halibut as predators. The treatments range in complexity from bare sand habitat, to several forms of algae (AM) and algal islands (4 x 42 and 1 x 168), to a complex habitat of algae, shells, and stones, plus a homogeneous gravel bottom. Values represent the mean percent survival of crab (±SE) for six replicate runs.

Pacific halibut (Fig. 12). Pacific cod were less effective predators than halibut, but the presence of structurally complex habitat increases the survival of RKC juveniles in both laboratory and field experiments, regardless of the predator type. Remote field video with tethered crabs (Fig. 13) has been critical in identifying the host of fishes and invertebrates that may be important predators on young king crabs and will be a useful tool in exploring release strategies for hatchery-reared juveniles. The results of these studies are guiding choices of release sites for hatchery-reared juveniles, but many questions are yet to be answered. For example, it will be important to determine the optimal size for release, and whether season or time of day might affect the subsequent survival of crabs in the field.

Other experiments recently completed in Newport include analyses of the effects of seawater temperature on growth rate and lipid storage and the effects of temperature on rates of cannibalism by age-1 RKC on age-0 crabs. These studies are useful in two ways – for maximizing hatchery production of juvenile crabs intended for release and for evaluating the likely impacts of warming climate on crab recruitment to the fishery.

By Allan Stoner

MIDWATER ASSESSMENT & CONSERVATION ENGINEERING PROGRAM

Acoustic-Trawl Survey of Walleye Pollock in the Eastern Bering Sea

Scientists with the Midwater Assessment & Conservation Engineering (MACE) program completed an acoustic-trawl (AT) survey of walleye pollock on the eastern Bering Sea shelf between

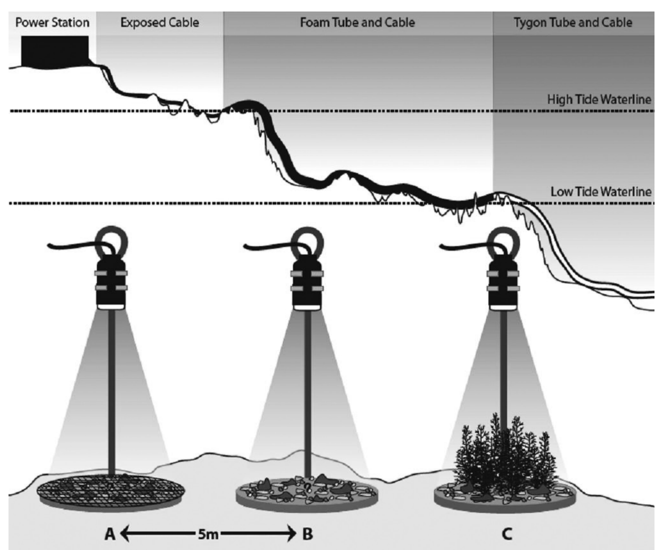


Figure 13. Diagram showing the apparatus used to observe predation events on tethered red king crab in the field. Underwater cameras with infra-red lighting are mounted above crabs positioned in different substratum types. A cable carries the live video image from each camera to a digital recorder on the adjacent shore. To date, tethered crabs and cameras have been placed in subtidal and intertidal locations with three different types of substratum, and more than 30 animal species have been observed in the video records. Several fishes and invertebrates have been identified as likely predators on red king crab juveniles in nearshore Juneau.

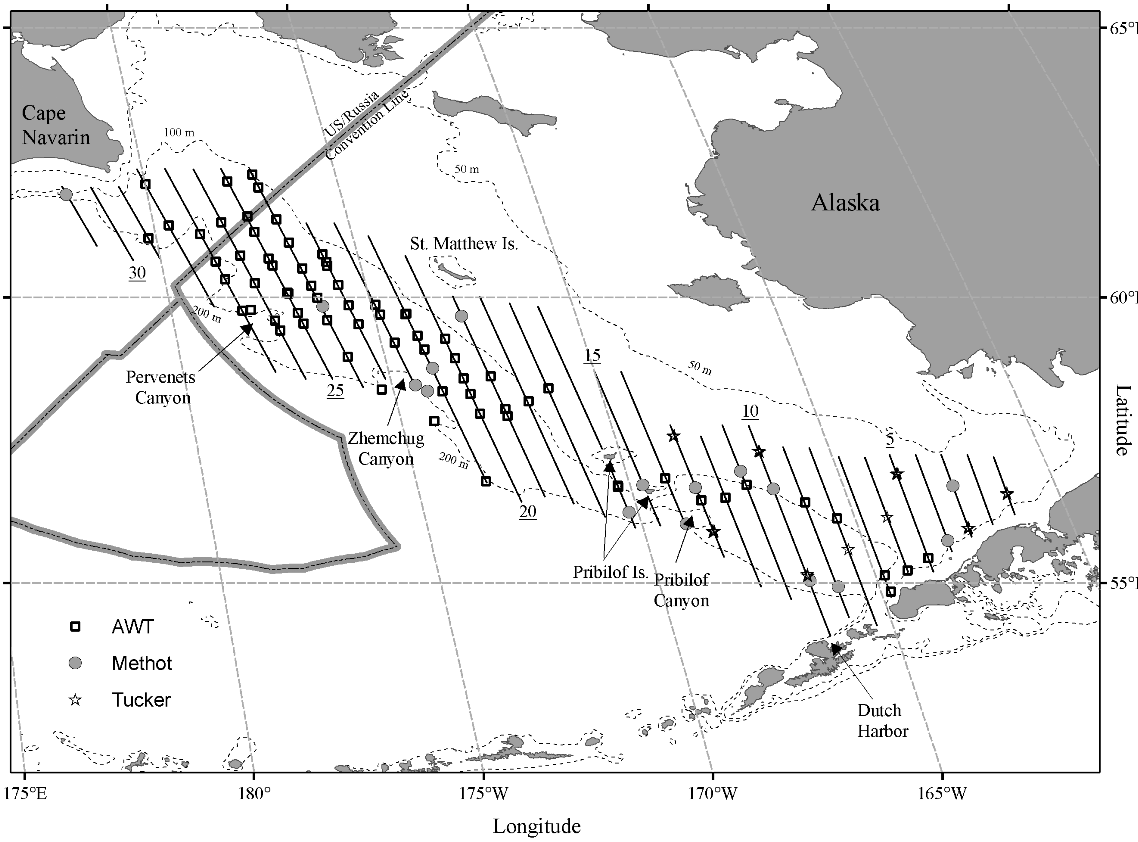


Figure 14. Transect lines with haul locations for Aleutian wing trawl, Methot trawl, and Tucker trawl during the summer 2010 acoustic-trawl survey of walleye pollock on the Bering Sea shelf. Transect numbers are underlined.

5 June and 7 August aboard the NOAA ship *Oscar Dyson*. The main purpose of the survey, conducted since 1979, was to estimate the midwater abundance of walleye pollock.

The 2010 survey was conducted westward from Bristol Bay, Alaska, to the Cape Navarin region of Russia along north-south transects spaced at 20 nmi apart (Fig. 14). Acoustic backscatter data were collected along transects at five individual echosounder frequencies (18, 38, 70, 120, and 200 kHz) during daylight hours. Opportunistic midwater trawls were conducted to classify the backscatter attributed to walleye pollock and other organisms. Physical oceanographic data were also collected. Walleye pollock abundance estimates were based on the backscatter detected at 38 kHz. Nighttime activities included collection of additional physical oceanographic data and trawl hauls, and work with other specialized sampling devices. Additional sampling in support of the Bering Sea Integrated Ecosystem Research Program (BSIERP) included conductivity-temperature-depth (CTD) casts with fluorometer and oxygen samples, expendable bathythermograph (XBT) casts, and underway water sample collections (salinity, chlorophyll fluorescence, oxygen, nutrients) to calibrate the shipboard seawater monitoring system. Daytime Methot and Tucker trawls were also conducted in support of an acoustics-based abundance estimate for euphausiids in midwater and where acoustic estimates were not possible near the seafloor and sea surface.

Temperature profile measurements indicated that summer 2010 was a warmer summer than 2008-09. Ocean surface temperatures observed in 2010 (1.8° – 12.3°C) were higher than those in 2009 (0.9° – 8.9°C) and 2008 (0.7° – 8.3°C), and the values ranged more widely as well. Bottom temperatures were coldest near St. Matthew Island (-1.6°C), cool along the shelf as far east as False Pass, and warmest late in the survey off Cape Navarin.

Catch composition for midwater hauls indicated that walleye pollock was the most abundant species captured by weight (89%). The next most abundant species was jellyfish (*Chrysaora melanaster*) at 10%. Jellyfish catch increased compared to 2009, when they comprised only 3% of the total catch by weight.

Pollock were found throughout the surveyed area, but most were found to the south and west of St. Matthew Island (Fig. 14). Estimated walleye pollock abundance (to within 3 m of bottom) was relatively high compared to recent surveys (2007-09). The 2010 preliminary pollock biomass estimate in the U.S. Exclusive Economic Zone was 2.323 million t. The 2009 biomass was 0.924 million t, and the estimated 2008 biomass was 0.997 million t. The estimated pollock biomass in Russia was 0.131 million t and represented 5.3% of the total midwater biomass; the 2009 estimate for Russia (0.005 million t) represented only 0.6% of the total surveyed biomass in that year.

Walleye pollock fork length (FL) composition differed by geographic area (Fig. 15). Fish between 35 and 70 cm with very few smaller juveniles made up the biomass east of 170°W (7.3% of total biomass). Length distributions were very similar for all fish west of 170°W (87.4% of total biomass) and those in Russia. The highest number of fish were in the 20-30 cm FL range (likely the 2008 year class), followed by the 2009 year class (<20 cm FL) and then by fish between 31 and 50 cm.

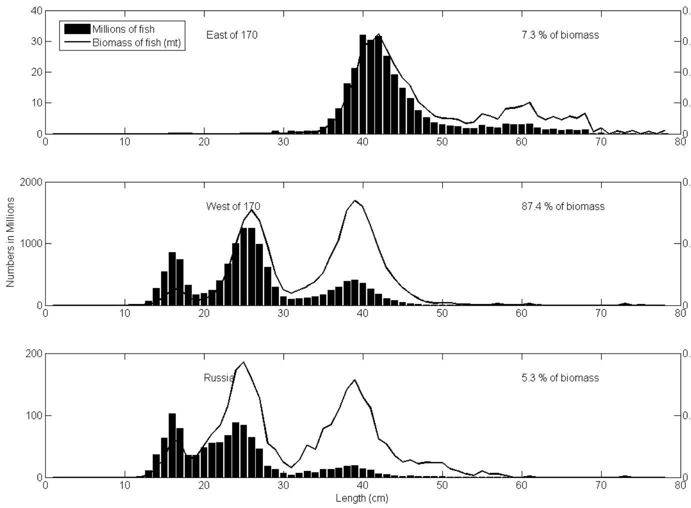


Figure 15. Population numbers and biomass at length estimated for walleye pollock between 16 m from the surface and 3 m off the bottom from the summer Bering Sea shelf acoustic-trawl survey in three geographic regions.

An experimental sideways-looking 70 kHz transducer was installed on the *Oscar Dyson* centerboard to investigate vessel-avoidance behavior by pollock during the survey. The degree to which pollock react to the vessel will be assessed by comparing pollock estimates of abundance and depth distribution to the side of the vessel with those observed directly below the vessel with a traditional downward-looking transducer. This method will enable pollock vessel-avoidance to be monitored continuously during a survey. First field tests of a non-extractive stereo camera-trawl system (Cam-Trawl) were also successfully completed during the survey. The Cam-Trawl consists of a stereo camera system attached to the back of a large trawl with no codend. The device is designed to determine the species identification, density, and size of animals as they pass by the camera and out through the rear of the open trawl.

By Taina Honkalehto and Abigail McCarthy

Resource Ecology & Fisheries Management (REFM) Division

RESOURCE ECOLOGY & ECOSYSTEM MODELING PROGRAM

Fish Stomach Collection and Lab Analysis

During summer 2010, Resource Ecology and Ecosystem Modeling (REEM) Program staff participated in the collection and preservation of stomach samples from AFSC groundfish surveys of the Aleutian Islands, eastern Bering Sea (EBS) continental shelf and slope, and northern Bering Sea (including Norton Sound). In the Aleutian Islands, 3,176 stomach samples were collected from 33 species, and the contents of 1,231 fish stomachs were analyzed at sea from 25 species. Sampling from the EBS continental slope resulted in the collection of 1,095 stomach samples from 11 species. Stomach sampling during the EBS continental shelf bottom trawl survey targeted pairing of zooplanktivores with bongo tows, resampling of predator species during repeated stations, and standard shelf-wide coverage of major predators of commercial species. In all, 4,898 stomach samples were collected from 15 species during this survey. During the northern Bering Sea survey, 2,028 stomach samples were collected from 36 species. In addition, 1,284 stomach samples were collected from four species during the EBS hydroacoustic survey.

Detailed analysis of these samples, particularly on the macrozooplankton, will be conducted for comparisons to data describing the macrozooplankton community from Methot trawls and multifrequency differencing. Laboratory personnel also dried 805 tissue samples in preparation for stable isotope analysis. Observers returned stomach samples from 21 Pacific cod in the Aleutian Islands and 177 Pacific cod and 272 walleye pollock in the eastern Bering Sea. In total, 2,865 records were added to the REEM food habits database.

By Troy Buckley, Geoff Lang, Mei-Sun Yang, and Richard Hibpshman

Comparing Euphausiid Size-Selectivity by Pollock and Nets

During an AFSC summer internship project conducted by Kelsey Kappler, euphausiids from the stomachs of walleye pollock were measured for comparison to the euphausiids caught in Methot plankton nets. The walleye pollock stomach samples and Methot euphausiid samples were collected during the 2009 EBS hydroacoustic survey. In general, Kelsey found the length distribution of euphausiids in the diet of walleye pollock was similar to that caught in the nets, with possibly a slight shift to the smaller side of the distribution for euphausiids consumed (Fig. 1). We believe this was not caused by physical or chemical effects of being consumed, nor by differences in measurement methods between the samples, because only intact euphausiids were measured and because the opposite shift in length distribution appears to occur for two of the less abundant species, *Thysanoessa longipes* and *T. spinifera*. Kelsey also found that the body length of consumed euphausiids was found to be similar for all sizes of walleye pollock examined (Fig. 2).

By Troy Buckley, Kelsey Kappler, Patrick Ressler, and Kerim Aydin

Ecosystem Modeling and Assessment

Drs. Sarah Gaichas and Kerim Aydin were invited to participate in the symposium “Ecosystem Approaches to Marine Fisheries Science and Management” at the American Fisheries Society (AFS) annual meeting in Pittsburgh, Pennsylvania, 12-16 September 2010. The symposium with poster session was organized by Michael Fogarty, Jason Link, William Overholtz, and Paul Perra (NEFSC). The symposium was intended to be a progress report on implementing an ecosystem approach to marine fisheries management, with examples of scientific analyses and management applications. A full symposium description, speaker list, and links to abstracts are available on the Web at http://afs.confex.com/afs/2010/webprogram/Session1124.html.

Dr. Gaichas presented “From the Aleutians to the Arctic: integrating ecosystem approaches within the Alaska fishery management process,” which reviewed the North Pacific Fishery Management Council’s (NPFMC) Aleutians Fishery Ecosystem Plan, the Arctic Fishery Management Plan, and the annual Ecosystem Considerations

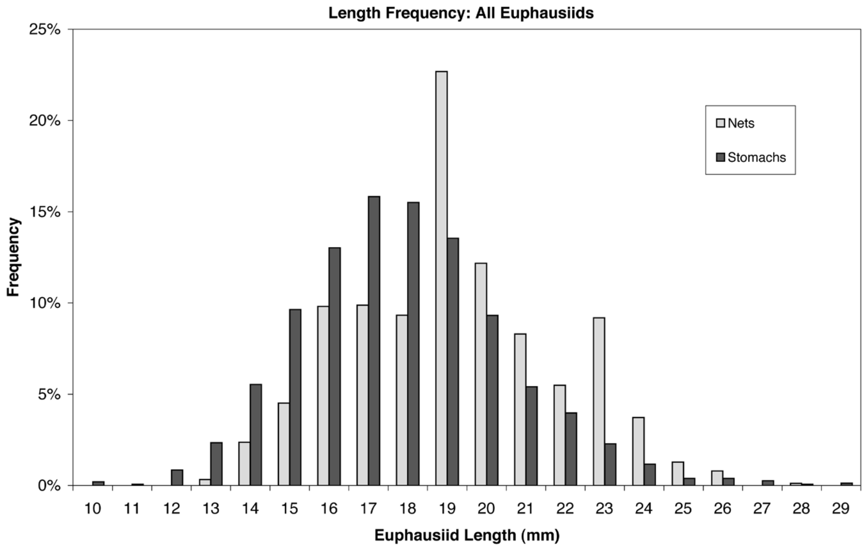


Figure 1. Length frequency of euphausiids caught by nets (light gray) and consumed by walleye pollock (dark gray) from the 2009 EBS hydroacoustic survey.

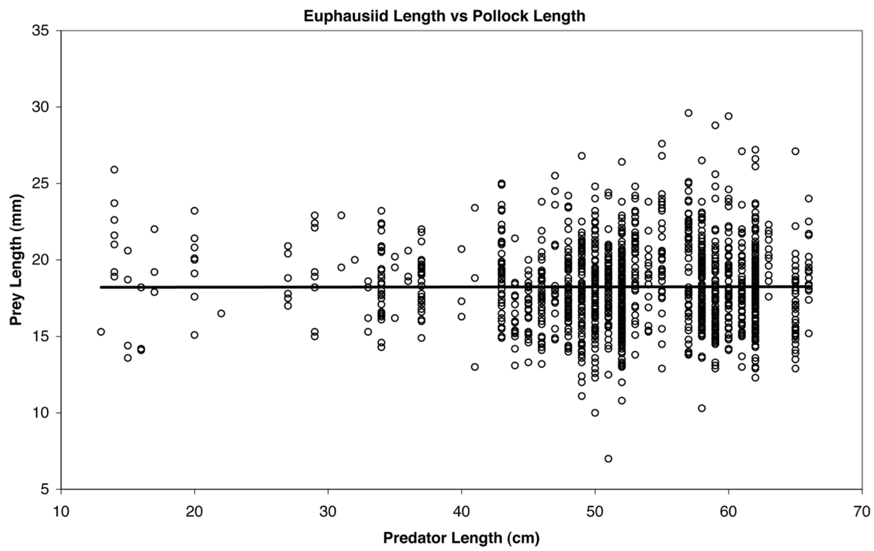


Figure 2. Consumed euphausiid lengths (mm) plotted against walleye pollock lengths (cm).

appendix to the stock assessment and fisheries evaluation (SAFE) report. Dr. Aydin presented "The use of models in ecosystem assessment processes in Alaska (experiences from the Alaskan Fisheries Council Process)," which emphasized the suite of ecosystem models in use and development at the AFSC, as well as current groundfish diet analyses relevant to the NPFMC's review of the August 2010 Steller sea lion Biological Opinion. The symposium was well attended and featured a closing discussion panel with fishery management council members and NMFS Regional Office staff from throughout the United States.

By Sarah Gaichas and Kerim Aydin

Ecosystem Indicators

The Ecosystem Considerations appendix section of the SAFE report is updated annually by REEM staff to provide information on relevant ecosystem components to the North Pacific Fishery Management Council (NPFMC) for consideration in management decisions. This appendix is composed of three parts: 1) an integrated ecosystem assessment, 2) a time series of ecosystem indicators that measure components of the ecosystem, and 3) management indices that reflect the impact of humans on the marine ecosystem. The last two parts are composed of individual contributions from a broad range of scientists. A draft has been completed for inclusion in the 2011 SAFE report. As of September, 15 contributions have been updated, and 3 new contributions have been added. One presents zooplankton data for the eastern Bering Sea, contrasting the community composition in warm and cold years and between northern and southern portions of the shelf (Fig. 3). The second presents an index of young-of-the-year Bering Sea pollock energy density as a predictor of winter survival and subsequent recruitment to 1-year-olds. The third uses both a juvenile salmon survival and a temperature index to predict recruitment of several groundfish species in the Bering Sea and Gulf of Alaska. Highlights from the draft were presented to the joint NPFMC plan teams in mid-September. Four additional contributions have been updated since the September draft was distributed.

By Sarah Gaichas and Stephani Zador

Food Web Model Results to Inform Stock Assessment Estimates of Mortality

In a recently accepted publication in the *Canadian Journal of Aquatic and Fisheries Sciences*, Drs. Sarah Gaichas and Kerim Aydin (REEM), and Robert Francis (University of Washington) examined food web relationships for commercially important species to identify sources of variability in mortality and production which are not included in standard single-species stock assessments. They used a static mass balance model to evaluate relationships between species in a large marine ecosystem, the coastal Gulf of Alaska (GOA). Four case study species groups were included to represent broader food web relationships: Pacific halibut, longnose skate, walleye pollock, and squids. For each, they presented the species' position within the food web, evaluated fishing mortality relative to predation mortality, and evaluated diet compositions. High trophic level species, whether commercially valuable (Pacific halibut) or incidentally caught (skates), were found to have mortality patterns consistent with single-species assessment assumptions, where fishing mortality dominates natural mortality. However, assessments for commercially valuable (pollock) or incidentally caught (squids) mid-trophic level species could be enhanced by including food web-derived predation information, because fishing mortality is small compared with high and variable predation mortality (Fig. 4). Finally, food web relationships were out-

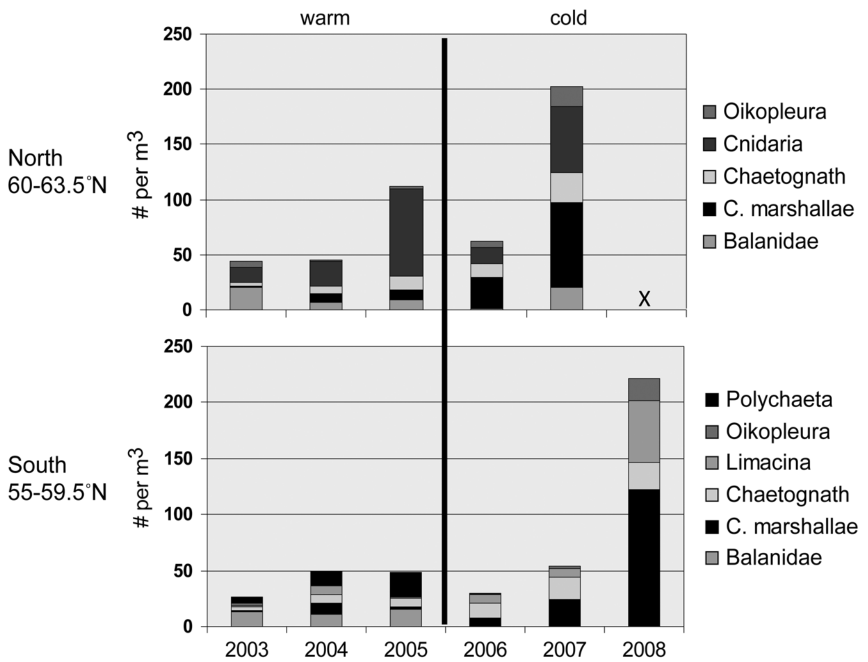


Figure 3. Mean abundance of large zooplankton (excluding euphausiids) collected with oblique bongo tows (505 µm mesh) on the Bering Sea shelf (< 100 m) during BASIS surveys in the northern (top panel) and southern (bottom panel) Bering Sea.

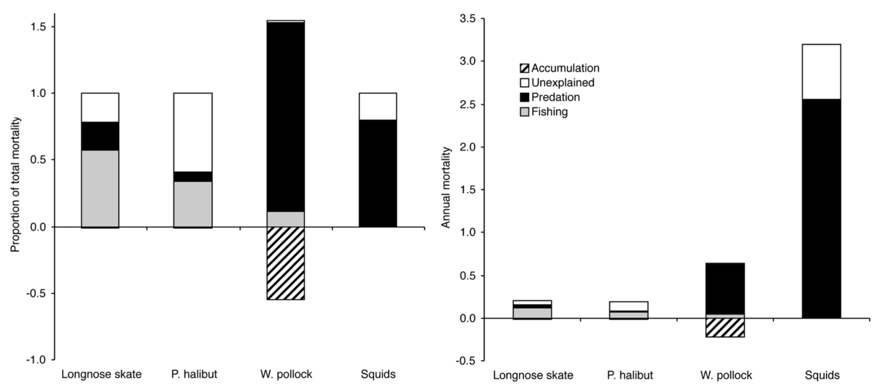


Figure 4. Mortality of species groups as partitioned by the GOA food web model, with case study groups arranged from highest (left) to lowest (right) trophic level. Left**:** fishing, predation, and unexplained mortality as a proportion of total mortality for each species (mortality sums to 1). Right: fishing, predation, and unexplained mortality relative to the total annual production rate of each case study species group (mortality sums to annual P/B ratio; P/B = Accumulation + Unexplained mortality + Predation mortality + Fishing mortality). Note that for pollock, the Accumulation (BA) term is negative in this sum.

lined that suggest how production of species may change with diet composition or prey availability.

By Sarah Gaichas

World Seabird Conference

Alaska Fisheries Science Center staff and contractors recently attended the First World Seabird Conference in Victoria, British Columbia, 7-11 September 2011. Oral and poster presentations were made on work being done at the AFSC on seabird bycatch, biology, and management. NOAA's National Seabird Program was a major sponsor of the conference, and nine of the NMFS regional offices and science centers were represented. Participants also staffed a NMFS booth in the conference exhibit hall.

This conference was the most coordinated, cross-agency representation of the National Seabird Program at an international meeting since the program's inception in 2001. More information about the World Seabird Conference is available on the Web at http://www.worldseabirdconference.com Abstracts of the presentations and posters by NOAA are available at http://alaskafisheries.noaa.gov/protectedresources/seabirds/national.htm#presentations, and AFSC poster presentations on seabird mortality on trawl vessels and fulmar food habits are available at http://www.afsc.noaa.gov/REFM/REEM/REEMPosters.php.

By Shannon Fitzgerald

Short-Tailed Albatross Bycatch

Two observed incidental takes of short-tailed albatross (Fig. 5) in the cod freezer longline fishery were reported in late August and mid-September, the first incidental takes of short-tailed albatross reported since 1998. The short-tailed albatross is an endangered seabird, and the groundfish demersal longline fishery operates under a Biological Opinion that provides an incidental take of four birds in a 2-year period. The year 2010 is the first year in the current 2-year period. Exceeding the allowable incidental take initiates an Endangered Species Act (ESA) Section 7 Consultation between NOAA and the U.S. Fish and Wildlife Service. According to the information bulletin released by NMFS "The first bird was taken on August 27, 2010, at 56°37' N and 172°57' W in NMFS reporting area 523. The bird had an identifying leg band from its natal breeding colony in Japan. It was a subadult at 7 years and 10 months old. The second bird was also taken in the Bering Sea/Aleutian Islands (BSAI) region on September 14, 2010, at 59°20' N and 176°33' W in NMFS reporting area 521. This bird also had an identifying legband and was 3 years and 10 months."

The Alaskan cod freezer longliner fleet has been one of the most proactive fleets anywhere in the world in trying to reduce their bycatch of seabirds. The fleet has been especially concerned with trying to eliminate the bycatch of short-tailed albatross. Given the high levels of observer coverage on these vessels, the fleet can be commended for going 12 years without an observed take and for the nearly 80% reduction overall in seabird bycatch. Its history of collaboration and taking the lead in seabird bycatch reduction is a model for other fisheries. The fleet was an integral component of research led by Washington Sea Grant on streamer lines, voluntarily started using streamer lines 2 years before regulations required their use, and has worked throughout it all

Figure 5. A short-tailed albatross in Alaska. Photo by fisheries observer Jose Vasquez.

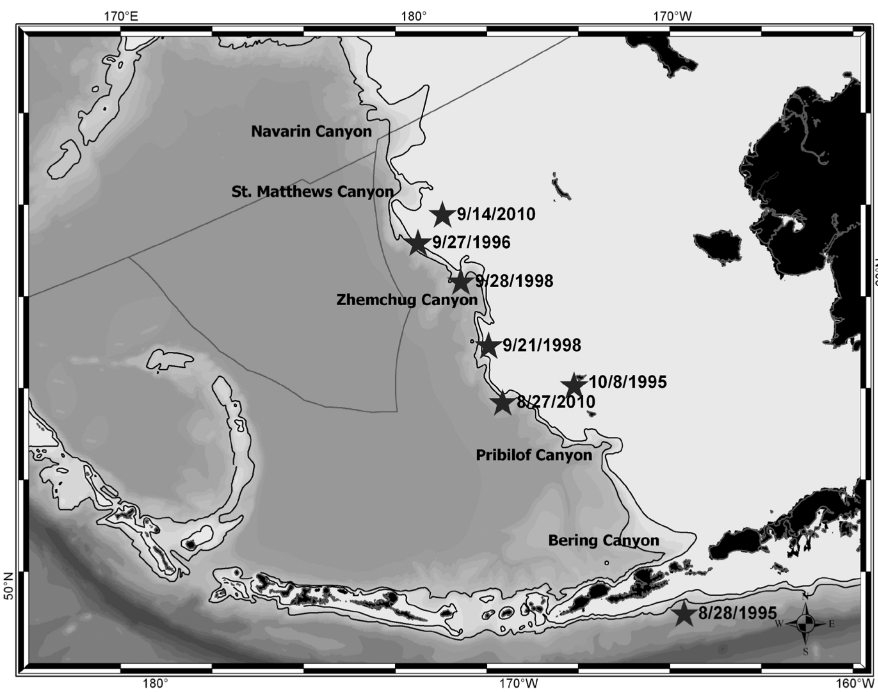


Figure 6. Locations and dates of short-tailed albatross takes in the Alaskan demersal groundfish fishery. Map courtesy of Rob Suryan, Oregon State University, using data on reported takes from the AFSC).

to take advantage of inseason data produced by the North Pacific Fisheries Observer Program (AFSC Fisheries Monitoring and Analysis Division), to monitor individual vessel performance. Their efforts continue as AFSC staff work with the Freezer Longline Coalition to develop programs to further reduce seabird bycatch by its vessels. To date, a total of seven short-tailed albatross have been taken in the Alaskan demersal groundfish fishery (blackcod and cod) since 1993. More information is available on the Web at http://alaskafisheries.noaa.gov/index/infobulletins/bulletin.asp?BulletinID=7271

By Shannon Fitzgerald

ECONOMICS & SOCIAL SCIENCES RESEARCH PROGRAM

Public Preferences for Additional Protection for Cook Inlet Beluga Whales

The population of Cook Inlet beluga whales (*Delphinapterus leucas*) is one of five distinct population segments (DPS) in U.S. waters. This DSP was listed as endangered under the Endangered Species Act in 2008. A survey project is being undertaken that will collect the information necessary to improve our understanding of the public benefits associated with the results of implementing additional protection actions for the Cook Inlet beluga whale, such as population increases or decreases in the risks of extinction. Information on these benefits are useful for decision makers to more fully understand the trade-offs involved in choosing among potential protection alternatives and to complement other information available about the costs, benefits, and impacts of protection alternatives.

The development stage of this project is complete. The survey materials were developed with feedback from scientists and analysts who study the species, and have been tested in focus groups and interviews. The materials are currently being reviewed by the U.S. Office of Management and Budget for use in a small pilot survey, which is expected to be implemented in early 2011.

By Dan Lew and Brian Garber-Yonts

Issues in Measuring the Value of Saltwater Recreational Fishing Trips

In the recreation demand literature, few issues are more important to modeling recreation behavior and determining the economic values of the recreation trips than the specification of the opportunity cost of time. The opportunity cost of time relates to how much a person's time is worth, and the past literature has shown that economic value estimates (e.g., the value of a fishing trip) are very sensitive to assumptions about its value. Still, researchers commonly assume the opportunity cost of time is a fixed fraction of a person's wage rate, which is problematic in part because it assumes people who are not currently employed outside the home have an opportunity cost of their time equal to $0. In this work, we test several assumptions about the opportunity cost of time and propose a specification for the opportunity cost of time that allows for non-wage factors to influence the estimated value of time instead of relying solely on an individual's wage to fully explain the individual's opportunity cost of time. This specification is used in a relatively sophisticated model of recreation demand of site choices and participation that is estimated with data on saltwater salmon fishing in Southeast Alaska. The results suggest there are two payoffs to this approach: 1) much better fits in statistical models and 2) new insights about the relationship between the magnitude of economic values (fishing trip values) and assumptions about the opportunity cost of time.

By Dan Lew and Doug Larson

Alaska Recreational Charter Boat Operator Research Development

On 5 January 2010, NMFS issued a final rule establishing a limited entry permit system for charter vessels in the guided halibut sport fishery in International Pacific Halibut Commission Areas 2C (Southeast Alaska) and 3A (Central Gulf of Alaska) (75FR554). This permit system is intended to address concerns about the growth of fishing capacity in this fishery sector, which accounts for a substantial portion of the overall recreational halibut catch in Alaska. The limited entry program is separate from other policies intended to regulate harvest of halibut by the guided fishing sector, such as the guideline harvest limit (GHL) policy established in 2003, which sets an acceptable limit on the amount of halibut that can be harvested by the recreational charter fishery during a year and establishes a process for the NPFMC to initiate harvest restrictions in the event that the limit is met or exceeded. At present, numerous harvest restrictions may be adopted by the Council in the event the GHL is surpassed, including several that would affect the charter boat industry, such as restrictions on client or crew fishing behavior (e.g., bag and size limits).

To assess the effect of regulatory restrictions (current or potential) on charter operator behavior and welfare, it is necessary to first obtain a better general understanding of the charter industry. Some information useful for this purpose is already collected from existing sources, such as logbook data. However, information on vessel and crew characteristics, services offered to clients, spatial and temporal aspects of their operations and fishing behavior, and costs and earnings information are generally not available from these existing data sources and, thus, must be collected directly from the industry through voluntary interviews or a survey. However, past debates over management of the halibut charter fishery were very divisive and created a political climate that was not conducive for a study like this one that depends upon voluntary responses.

Meetings with representatives of the charter boat industry were held in September 2008 in Homer and Sitka. Attendees expressed concern about the amount of information they might be asked to provide and their time costs associated with possible data collections but also were supportive of the idea of collecting information necessary for NMFS to better understand the charter boat harvest sector. During 2010, AFSC researchers began evaluating existing data sources, developing potential survey materials, and evaluating data collection methods that would minimize the burden on survey respondents and maximize response rates. In addition, AFSC researchers commissioned the development of a customized Web-based mapping application to collect and manage charter fishing trip information. The application will allow the capture of spatial information about charter trips, either by survey researchers or by charter vessel operators themselves, via password-protected entry to a secure website where they can input confidential data. AFSC researchers plan to use the information collected and stored with this software, in conjunction with the data collection survey results, to evaluate the spatial and temporal behavioral patterns of Alaskan charter fishing vessel owners to provide further insights on the effects of fisheries regulations on the charter fishing industry. The software is adaptable to the collection of spatial information in trip-based surveys in other recreational, charter, and commercial fishery research applications.

By Brian Garber-Yonts, Dan Lew, and Amber Himes

Improving Community Profiles for the North Pacific Fisheries: Hosting Conversations with Alaskan Fishing Communities

Incorporating community voices into the decision-making processes for fisheries is difficult. This is especially true in Alaska, which contains difficult terrain that makes travel around the state difficult and expensive. Subsistence fishing and hunting are common place, as is involvement in commercial fishing, and these activities often take precedence over attending fisheries management meetings. Although state and federal fisheries managers are required to obtain public input on fishing regulations, difficulties in participation may lead Alaskan communities to feel disenfranchised and removed from the decision-making process that ultimately affects their participation in commercial, sport, or subsistence fishing. In order to provide baseline information about a large number of Alaskan fishing communities to fisheries managers, the Economics and Social Science Research (ESSR) Program compiled existing information about and published community profiles for 136 Alaskan fishing communities in 2005. These community profiles have been widely used as the basis for fisheries management plans, social and economic impact assessments of proposed fishing regulations, and numerous discussions by natural resource agencies. However, it has become clear that the community profiles are lacking adequate information about those communities' dependence on fishing that would be integral in determining the social and economic impacts of fishing regulations on local communities.

In order to rectify this information gap, ESSR Program staff began the process of revising the community profiles by hosting conversations with community leaders and representatives around the state to engage them in how to revise the community profiles so that they better represent their involvement in fishing. This effort represents a paradigm shift in how communities are engaged in fisheries management in Alaska by bringing them into the information gathering process that indirectly informs policymakers. The basic assumption of this approach is that communities are best equipped to describe their relationship to fisheries; so to ensure that the new profiles reflect this knowledge, AFSC must be engaged with community representatives to ensure that local knowledge about the communities is incorporated.

Meetings were hosted during August and September 2010 in six Alaskan regional hubs with more than 100 community representatives ranging from tribal elders to community mayors to regional tribal consortiums. The meetings involved a group dialogue that provided an opportunity for ESSR social scientists and Alaska community representatives to come together and discuss how to make these community profiles more informative and representative of Alaska communities. The discussion focused on an exchange of local stories and knowledge that best illustrate the way in which fishing shapes the fabric of Alaskan communities; information that fishery managers need to know about Alaska communities that is not currently represented in the community profiles; and discovering how to work with communities to best gather this new information for each community. Throughout the meeting process, relationships and ties were built with community members, and it became evident that community input into this source of baseline information about Alaskan fishing communities is a crucial step forward in improving the involvement of communities in the fishery management process and getting their voices heard.

By Amber Himes-Cornell, Christina Package, Jennifer Sepez, and Allison Durland

Improving the Usefulness of Logbook Data in the North Pacific Groundfish Fisheries

ESSR Program researchers Drs. Stephen Kasperski and Alan Haynie are conducting research relating to the use of logbook data to improve knowledge for fisheries management in Alaska. Logbook reporting is a major data reporting requirement for fishers in the North Pacific groundfish fisheries. However, at present, the logbooks are not verified for accuracy nor digitized to make them available to fishery analysts. While NMFS has implemented a substantial observer program in the North Pacific to monitor the activities of large groundfish vessels and crab vessels, the majority of catcher vessels lack adequate observer coverage. For example, of the 603 catcher vessels that landed walleye pollock or Pacific cod in 2007, only 38 had full observer coverage, while 202 were between 60 and 125 ft and thus had only 30% observer coverage. Therefore, we lack information on the spatial distribution of catch and effort levels for 60% of these groundfish vessels.

Logbook data has the potential to provide a significant amount of information on vessel catch and effort. However, rather than expending large amounts of money to digitize logbooks whose accuracy and potential utility have not been ascertained, we are conducting a structured cost/benefit analysis to evaluate the current status of the North Pacific logbook data to determine how this information can be used to better inform fisheries management and reduce the reporting of redundant information.

By Stephen Kasperski and Alan Haynie

Spatial Economic Toolbox for Fisheries (FishSET)

The ESSR Program, working with the Pacific States Marine Fisheries Commission, is developing a set of data management and modeling tools to better incorporate fisheries data and predictive models in the fisheries management process. Since the 1980s, fisheries economists have employed spatial economic models in a variety of fisheries to better understand and statistically explain what factors influence the spatial and participation choices that fishermen make on the fishing grounds. The Spatial Economic Toolbox for Fisheries (FishSET) will provide tools for analysts to better predict how fisheries will spatially respond to different hypothetical or actual management actions. In addition to developing a software package that brings together the principle existing spatial economic models, FishSET will provide a collection of tools that will allow for the maintenance, integration, and data quality verification of different data sets in all of the NMFS Regions. FishSET will also allow easy comparison between models developed in the future and the suite of existing fisher location choice models. This will provide analysts with a clearer understanding of the strengths of different modeling methods and will facilitate development of better models. Data and models for many spatial management problems will be developed before policy questions arise so that they can be better utilized in decision making. The FishSET toolbox will be developed and refined through 2011-12.

By Alan Haynie

Oral History of Oregon Residents in Alaska's Historical Commercial Fishing Boom Times

National Standard Eight of the Magnuson Stevens Fishery Conservation and Management Act states that "conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities." In order to meet the requirements of National Standard Eight, it is important that we understand the past participation of communities to "provide for the sustained participation" of these communities. Our study focused on those in the harvest sector including boat owners, captains, and crew members.

In 2010, the ESSR Program began a study to gather the oral history of Oregon fishermen who fished in Alaska during the 1960s-80s. (Recent field work by Oregon State University in Oregon fishing communities revealed that many current Oregon commercial fishermen got their start fishing in Alaska during the boom days of fishing. (See AFSC Quarterly Report, January-February-March 2010 issue.)) Thus far, a total of 21 unstructured interviews have been conducted in Newport, Oregon, and surrounding Oregon Coast communities and in Kodiak, Alaska. Interviews were conducted from July through the end of September. The historical narratives produced by the interviews will be compiled and submitted for publication. An analysis of the social implications will also be completed. With the permission of participants, the interview transcripts will be archived in the Voices from the Fisheries Oral History Database (http://voices.nmfs.noaa.gov/), available for use by researchers and the public.

This project is supported by the NOAA Preserve America Initiative, part of Preserve America, a federal initiative aimed at preserving, protecting, and promoting our nation's rich heritage. This project is also supported by NMFS.

By Christina Package

Estimating Regional Impacts of Alaska Saltwater Sportfishing

Saltwater sportfishing is an important economic activity in Alaska, generating jobs and sales within related industries throughout coastal regions and the state generally. Two recent NMFS surveys have collected data that can be used to understand to what extent saltwater sportfishing in Alaska contributes to the state's economy. In the first survey, data on saltwater fishing-related expenditures was collected by NMFS' Office of Science and Technology. The second survey procured trip-level expenditure data from Alaska resident anglers and non-resident anglers who saltwater fished in Southeast Alaska (SE) and/or Southcentral (SC) Alaska. In addition to trip expenditure information, the survey collected detailed information on fishing behavior that will be used to estimate the baseline demand for saltwater fishing trips in Alaska.

Based on data from these surveys, the economic impact of saltwater fishing by non-residents on the Alaska economy was estimated using a state preference model and a state-level computable general equilibrium (CGE) model. The estimated economic impacts are modest relative to the overall size of the Alaska state economy but may understate the impact on coastal regions, as the impacts are likely to be geographically concentrated on the coastal communities which are most directly involved with these economic activities. Therefore, as a next step, we began developing a "regional" level CGE model to calculate the "regional" level impacts of the saltwater angling-related expenditures. Recently, using 2006 IMPLAN data, we aggregated the coastal boroughs and census areas in the SC and SE regions into a single region; aggregated the 509 industries into 16 industries; and developed a social accounting matrix (SAM) for the study region. A CGE model for this combined region is being developed. The resulting model will enable analysts to investigate the localized effects on coastal areas.

By Chang Seung and Dan Lew

STATUS OF STOCKS & MULTISPECIES ASSESSMENT PROGRAM

DisMELS Workshop at NFRDI

In September 2010, Dr. William Stockhausen traveled to South Korea's National Fisheries Research and Development Institute (NFRDI) in Busan to hold a workshop for Korean fishery scientists on the use of the coupled biophysical, individual-based model DisMELS (the Dispersal Model for Early Life Stages) to predict recruitment for marine species with planktonic egg and larval early life stages. Travel for the workshop was provided by a project funded under the NOAA-R.O.K. Joint Project Agreement.

While at NFRDI, Dr. Stockhausen also gave a seminar in which he discussed using DisMELS to assess patterns of connectivity between spawning sites and nursery areas for marine species. He presented connectivity analyses for northern rock sole in the eastern Bering Sea based on a DisMELS model for that species developed in conjunction with AFSC scientist Dr. Janet Duffy-Anderson. Jung-Jin Kim, a Ph.D. student at Pukyong National University in Busan, also presented results from a DisMELS model for Korean market squid (*Todarodes pacificus*) that he has developed in collaboration with Dr. Stockhausen. His presentation included results from running the model backwards to identify potential spawning locations based on field sampling of older squid paralarvae in the Tsushima Strait and East China Sea.

DisMELS models have previously been developed for Alaska plaice and northern rock sole in the eastern Bering Sea as part of a study funded by NMFS' Fisheries and the Environment (FATE) Program. Other models are currently being developed for Greenland turbot (*Reinhardtius hippoglossoides*) and Pacific halibut (*Hippoglossus stenolepis*) in the eastern Bering Sea as part of a study funded by the North Pacific Research Board.

By William Stockhausen

Development of a Productivity-Susceptibility Analysis and its Application to Alaska Groundfish Stocks

Productivity-susceptibility analysis (PSA), which evaluates vulnerability to overfishing based upon a stock's biological productivity and susceptibility to the fishery, can be used to classify stocks within a fishery management plan (FMP), assist in the creation of stock complexes, and inform precautionary control rules. In the United States, NMFS has developed a PSA to evaluate the vulnerability of data-poor stocks. Evaluation criteria of productivity attributes were developed to be consistent with published relationships between quantities such as maximum size and age, growth rate, and natural mortality. Additionally, the NMFS approach includes a data quality score that describes the strength of information used to determine vulnerability. Productivity scores for stocks in Alaska FMPs varied widely, whereas susceptibility scores were less variable possibly because inclusion in an FMP in itself implies a conservation concern. No clear demarcation was observed between high and low vulnerability stocks. Several non-target stocks had vulnerability scores equal to or greater than those of target stocks, and determining vulnerability of data-rich target stocks provided a useful means for evaluating the relative vulnerability of data-poor stocks. The vulnerability and data quality scores have provided valuable information regarding the management of Alaska groundfish.

By Paul Spencer

AGE & GROWTH PROGRAM

Production Numbers

Estimated production figures for 1 January–30 September 2010 are presented below. Total production figures were 30,496 with 6,768 test ages and 259 examined and determined to be unageable.

Species	Specimens Aged
Alaska plaice	608
Arrowtooth flounder	1,615
Atka mackerel	1,742
Blackspotted rockfish	209
Dover sole	468
Dusky rockfish	606
Flathead sole	1,371
Giant grenadier	784
Greenland turbot	711
Northern rock sole	2,279
Northern rockfish	745
Pacific cod	1,961
Pacific ocean perch	1,714
Rex sole	875
Rougheye rockfish	415
Sablefish	2,357
Southern rock sole	958
Walleye pollock	9,802
Yellowfin sole	1,276

By Jon Short