

## **NMFS Auke Bay Laboratory Marine Ecology and Stock Assessment (MESA) Program Activities and Accomplishments, April 1, 2008 – April 1 2009**

**April 2009**

### **Overview**

The Auke Bay Laboratories (ABL), located in Juneau, Alaska, are a division of the NMFS Alaska Fisheries Science Center (AFSC). In 2006, what was formerly called ABL's "Groundfish Assessment Program" changed its name to the "Marine Ecology and Stock Assessment Program" (MESA), a name which more accurately reflects the varied tasks and research of this group. The MESA Program is primarily involved with research and assessment of sablefish and rockfish in Alaska and with the study of fishing effects on the benthic habitat. Presently, the program is staffed by 17 scientists, including 16 permanent employees and 1 term employee. One personnel change in 2008 was that a former MESA staff member, Pat Malecha, transferred back to the MESA Program from ABL's Marine Salmon Program. Four employees in other ABL programs have also been involved with groundfish-related research in the past year.

In 2008 field and laboratory research, ABL's MESA Program, in cooperation with the AFSC's RACE Division, conducted the annual NMFS sablefish longline survey in Alaska. Other field and laboratory work by ABL included: 1) continued juvenile sablefish studies, including routine tagging of juveniles and electronic archival tagging of a subset of these fish; 2) a laboratory study of habitat preferences for young-of-the-year slope rockfish; 3) an investigation of the effect of maternal age on viability of quillback rockfish larvae; 4) a deep-water (> 1,000 m depth) longline study of giant grenadier and sablefish abundance in the western Gulf of Alaska; and 5) a forage fish study of Pacific herring/humpback whale interactions.

Ongoing analytic activities in 2008 involved management of ABL's sablefish tag database, analysis of sablefish logbook and observer data to determine fishery catch rates, and preparation of four detailed status of stocks documents for Alaska groundfish: sablefish; Gulf of Alaska sharks; Bering Sea/Aleutian Islands sharks; and grenadiers. Another important analytic activity in 2008 was completion of an analysis of competition for hooks in the longline survey between sablefish and other species.

For more information on overall activities of the Auke Bay Laboratory MESA Program, contact MESA Program Manager Phil Rigby at (907) 789-6653.

### **Groundfish Studies**

#### Groundfish Stock Assessments

The ABL MESA Program prepares stock assessments for sablefish, sharks, and grenadiers in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, and for rockfish in the Gulf of Alaska. These assessments are presented to the North Pacific Fishery Management Council in the form of

Stock Assessment and Fishery Evaluation (SAFE) reports. These reports consist of full assessments either annually or biennially, depending on the species or management group; for those species on a biennial assessment cycle, short “executive summary” assessments are prepared for the off-years. In 2008, the ABL MESA program produced full assessments for sablefish, Gulf of Alaska sharks, Bering Sea/Aleutian Islands sharks, and grenadiers. For rockfish in the Gulf of Alaska, 2008 was an off-year in the assessment cycle, and only executive summary assessments were produced.

### *Stock Assessment for Sablefish in the Gulf of Alaska, Eastern Bering Sea, and Aleutian Islands*

Relative to the 2007 assessment, we made some substantive changes to the 2008 assessment. When moving to a sex-specific model in 2007, the number of selectivity parameters was greatly increased. These parameters were estimated with high correlation and low precision. For this year we used simpler selectivity functions and linked some selectivity curves to improve parameter estimation without greatly affecting model fit or trends. We showed two steps to a recommended model that reduced the total parameters by thirteen with minimal effects on the overall model fit. New input data included relative abundance and length data from the 2008 longline survey, relative abundance and length data from the 2007 longline and trawl fisheries, and age data from the 2007 longline survey and longline fishery.

The fishery abundance index was up 5% from 2006 to 2007 (the 2008 data are not available yet). The survey abundance index decreased 2% from 2007 to 2008 and follows a 14% decrease from 2006 to 2007. Relative abundance in 2008 is 3% lower than 2000, and is at an all-time low for the domestic longline survey. Spawning biomass is projected to be similar from 2008 to 2009, and begin declining through 2012. We also include results from a study to test for sablefish cannibalism in pots, which showed no evidence of cannibalism, and the results of a gear experiment comparing hand-baited versus machine-baited longline sets. Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points are calculated using recruitments from 1977-2003. The updated point estimates of B40%, F40%, and F35% from this assessment are 115,120 t (combined across the EBS, AI, and GOA), 0.095, and 0.113, respectively. Projected spawning biomass (combined areas) for 2009 is 103,127 t (90% of B40%), placing sablefish in sub-tier “b” of Tier 3. The maximum permissible value of  $F_{ABC}$  under Tier 3b is 0.085 which translates into a 2009 ABC (combined areas) of 16,080 t. The maximum permissible yield for 2009 is an 11% decrease from the 2008 ABC of 18,030 t. The OFL fishing mortality rate is 0.101 which translates into a 2009 OFL (combined areas) of 19,000 t. This decrease is supported by an all-time low in the domestic longline survey abundance estimate and no evidence of any large incoming recruitment classes.

Spawning biomass is projected to decline through 2012, and then is expected to increase assuming average recruitment is achieved. Because of the lack of recent strong year classes, the maximum permissible ABC is projected to be 14,895 t in 2010 and 14,086 in 2011. Projected 2009 spawning biomass is 36% of unfished spawning biomass. Spawning biomass has increased from a low of 30% of unfished biomass in 2001 to a projected 36% in 2009. The 1997 year class has been an important contributor to the population but has been reduced and comprises only 13%

of 2008 spawning biomass. The 2000 year class appears to be larger than the 1997 year class, but is only 85% mature and should also comprise 23% of spawning biomass in 2009. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

For more information, contact Dana Hanselman at (907) 789-6626.

#### *Center for Independent Experts (CIE) Review of Alaska Sablefish Assessment*

A review of the Alaska sablefish stock assessment was held at NMFS Auke Bay Laboratories in Juneau, Alaska from March 17-19, 2009. NMFS requested the Center for Independent Experts (CIE) to conduct this technical peer review. The CIE is a group affiliated with the University of Miami that provides independent peer reviews of NMFS science nationwide, including reviews of stock assessments for fish and marine mammals. This CIE review panel was comprised of three international experts and an AFSC assessment scientist who chaired the meeting. The panel evaluated whether the assessment incorporates the best available scientific information and provides a reasonable approach to understanding the population dynamics and stock status of sablefish in Alaska. Members of the public observed the presentations and participated in the discussions between the CIE panel and the NMFS scientists responsible for data collection and analysis. The final report is due on April 23, 2009, and will consist of individual reports from each panelist and a summary report. The meeting chair will present the results of the review during the September 2009 NPFMC Groundfish Plan Team meeting.

For more information, contact Dana Hanselman at (907) 789-6626.

#### *Shark Bycatch Assessment in Alaskan Waters*

The shark bycatch assessment chapters from 2008 for the Bering Sea/Aleutian Islands (BSAI) and for Gulf of Alaska (GOA) were updated for 2009 and presented to the North Pacific Fishery Management Council's Groundfish Plan Teams in November 2008.

Incidental catch estimates for sharks are now available from the NMFS Alaska Regional Office (AKRO). Incidental catch for sharks was updated with the most recent AKRO estimates, and incidental catch from the years 1997–2007 was established as a baseline for identifying options for setting future sustainable incidental catch limits for sharks in the BSAI and GOA. Bottom trawl survey biomass data were updated for the 2008 Eastern Bering Sea (EBS) slope and shelf. Previous survey data were available from NMFS AFSC bottom trawl surveys in the EBS shelf (1979–2008), EBS slope (historical 1979-1991, and new time series 2002, 2004, 2008), and Aleutian Islands (1980–2006). Previous trawl survey data were available from NMFS AFSC bottom trawl surveys conducted triennially and biennially in the GOA (1984–2007).

There are currently no directed commercial fisheries for shark species in federally or state managed waters of the BSAI or GOA, and most incidentally captured sharks are not retained. In the BSAI, average incidental catch of Pacific sleeper sharks from 1997–2007 (414 mt)

represented 8.6% of the available Pacific sleeper shark biomass from BSAI bottom trawl surveys in 1996–2007 (total of the average biomass from three surveys was 5,168 mt). Historically, BSAI survey catches of Pacific sleeper sharks were rare, and abundance trends from the surveys were unreliable as evidenced by the high uncertainty in the biomass estimates. However, the new EBS slope bottom trawl survey (2002 and 2004) showed a substantial biomass of Pacific sleeper sharks on the EBS slope in 2002 (25,445 mt) but not in 2004 (2,260 mt). The EBS slope survey was conducted again in 2008. The EBS shelf survey did not encounter sharks in 2007 or 2008 and the biomass estimates were zero, but the EBS slope survey did encounter sharks in 2008 (2,051 mt). Spiny dogfish and salmon sharks were rarely encountered in commercial fisheries or bottom trawl surveys in the BSAI. Therefore, spiny dogfish and salmon sharks were not assessed separately in the BSAI.

In the GOA, average bycatch of spiny dogfish from 1997–2007 (482 mt) represented less than 1% of the available spiny dogfish biomass from GOA bottom trawl surveys in 1996–2007 (average biomass of spiny dogfish in the surveys was 66,771 mt). The 2001 survey did not include all areas of the Eastern GOA; hence, it may not be comparable with the other surveys for species such as spiny dogfish which appear to be relatively abundant in the Eastern GOA. Average bycatch of Pacific sleeper sharks from 1997–2007 (304 mt) represented less than 1% of the available Pacific sleeper shark biomass from GOA bottom trawl surveys 1996–2005 (average biomass of Pacific sleeper sharks was 37,821 mt). Average bycatch of salmon sharks from 1997–2007 (63 mt) was relatively small, and GOA bottom trawl survey biomass estimates for salmon sharks were unreliable because salmon sharks were only caught in four hauls from 1996–2007.

For more information, contact Cindy Tribuzio at (907) 789-6007

### *Assessment of Grenadiers in Alaska*

In 2008, an updated complete assessment was done for grenadiers in Alaska and incorporated as an appendix into the North Pacific Fishery Management Council's (NPFMC) annual Stock Assessment and Fishery Evaluation Report. The first-ever assessment of grenadiers was done in 2006. Assessment of grenadiers is needed because of the possible inclusion of grenadiers in the NPFMC's Groundfish Management Plans and also because of the relatively large numbers of these fish that are taken as bycatch in other directed fisheries. Presently, grenadiers are not "specified" (i.e., included) in these management plans. As a result, fishermen are free to catch as many grenadiers as they want, and there is no official tracking of catch by management.

Giant grenadier (*Albatrossia pectoralis*) appears to be the only grenadier species to warrant management concern in Alaska at present. Survey information indicates that giant grenadier is the most abundant fish on the continental slope at depths 400-1,000 m in all surveyed areas of Alaska except the eastern Gulf of Alaska. As such, it has a significant role in the slope ecosystem and is an important predator in this habitat. Although there has been little or no directed fishing for giant grenadier in Alaska, substantial numbers are taken as bycatch and discarded in the sablefish and Greenland turbot longline and pot fisheries. Discard mortality is 100%. Estimated annual catches of giant grenadier in Alaska based on observer data have ranged between 11,000

mt and 21,000 mt in the years 1997-2008. By geographic region, these catches averaged 2,901 mt in the eastern Bering Sea (EBS), 2,244 mt in the Aleutian Islands (AI), and 10,789 mt in the Gulf of Alaska (GOA).

In the assessment, data from AFSC bottom trawl and longline surveys were used to compute corresponding biomass estimates of giant grenadier as follows: EBS, 518,778 mt; AI, 979,256 mt; and GOA, 488,414 mt. The assessment applied an  $F=M=0.078$  approach to these biomass estimates to compute overfishing levels (OFLs) for giant grenadier in each region, and then multiplied the OFLs by 0.75 to compute the following ABCs: EBS, 30,349 mt; AI, 57,286 mt, and GOA, 28,572 mt. When these values are compared with the estimated catches of giant grenadiers, it appears that giant grenadiers are not being overfished at this time. However, the reported longevity, slow growth, and deep-sea habitat of this species makes it susceptible to overfishing. Furthermore, a high proportion of the catch is likely female because mostly female giant grenadier live at the depths where the commercial fishery operates. Disproportionate removal of females by the fishery could put stocks of giant grenadier at greater risk. Because of these special concerns for susceptibility of giant grenadier to overharvest, fishery managers should closely monitor future catches to ensure that overfishing does not occur.

The AFSC REFM Division Age and Growth Program aged giant grenadier for first time in 2006-2007 based on otoliths collected during the 2004 and 2006 NMFS longline surveys in the GOA for an age of maturity study. These ages were used in 2008 as the basis for determining the new mortality estimate of 0.078 that was used in the OFL and ABC computations. The aging procedure developed by the Age and Growth Program is considered experimental, and a small study was conducted in 2008 based on carbon 14 analysis of the otoliths in an attempt to confirm some of the ages. This study proved unsuccessful because carbon 14 could not be found in sufficient concentration in the otoliths, and other means of validation will be necessary.

For more information, contact Dave Clausen at (907) 789-6049.

### *Stock Assessment for Pacific Ocean Perch in the Gulf of Alaska*

Pacific ocean perch (POP), *Sebastes alutus*, is the dominant fish in the slope rockfish assemblage and has been extensively fished along its North American range since 1940. Since 2005, Gulf of Alaska rockfish have been moved to a biennial stock assessment schedule to coincide with the biennial AFSC trawl survey that occurs in this region. In even years (such as 2008's assessment for the 2009 fishery) when there is only new catch information, we run only the projection model with updated catch data for single-species, age-structured assessments. In odd years (like 2007), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. New information for this year's projection is updated 2007 catch at 12,954 t and the best estimate of the 2008 catch at 12,258 t. Catch estimates used in last year's model were 12,410 t and 13,500 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 15,111 t from the updated projection. This ABC is very similar to last year's ABC of 14,999 t. Female spawning biomass remains above  $B_{40\%}$ , with projected biomass stable.

For more information contact Dana Hanselman at (907) 789-6626.

#### *Stock Assessment for Northern Rockfish in the Gulf of Alaska*

Northern rockfish are the second most abundant slope rockfish in the Gulf of Alaska. Since 2005, Gulf of Alaska rockfish have been moved to a biennial stock assessment schedule to coincide with the biennial AFSC trawl survey that occurs in this region. In even years (such as 2008's assessment for the 2009 fishery) when there is only new catch information, we run only the projection model with updated catch data for single-species, age-structured assessments. In odd years (like 2007), we run a full assessment with all new survey and fishery data accumulated since the last full assessment. New information for this year's projection is updated 2007 catch at 4,187 t and the best estimate of the 2008 catch at 3,904 t. Catch estimates used in last year's model were 3,866 t and 4,550 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 4,363 t from the updated projection. This ABC is similar to that projected in last year's SAFE for 2009 (4,350 t). The stock is not overfished, nor is it approaching overfishing status.

For more information, contact Jon Heifetz at (907) 789-6054.

#### *Stock Assessment for Rougheye and Blackspotted Rockfish in the Gulf of Alaska*

A separable age-structured model is the primary assessment tool for Gulf of Alaska rougheye and blackspotted rockfish. This consists of an assessment model, which uses survey and fishery data to generate a historical time series of population estimates, and a projection model which uses results from the assessment model to predict future population estimates and recommended harvest levels. For Gulf of Alaska rockfish in alternate (even) years we present an executive summary to recommend harvest levels for the next (odd) year. For this off-cycle year, we only updated the 2007 projection model estimates with revised catch data for 2007 and a new catch estimate for 2008.

Orr and Hawkins (2008) formally verified the presence of two species, rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*S. melanostictus*), in what was once considered a single variable species with light and dark color morphs. Hereafter we refer to these two species together as the rougheye rockfish complex. Preliminary analysis of results from a 2005 and 2006 two-day experiment on the sablefish longline survey near Yakutat suggests a high proportion of misidentification for blackspotted rockfish. When compared to positively-identified genetic samples, at-sea scientists in the experiment only correctly identified blackspotted rockfish 47% of the time. Results from the expert scientist identification on photos of the same samples were improved but only to 63% accuracy. However, identification of rougheye rockfish was nearly 100% accurate in both cases. Upon reevaluation of photos, there were several other features that are important for correctly identifying blackspotted rockfish (J. Orr, personal communication). A new at-sea field identification pamphlet will be prepared and tested with genetic samples in the

2009 NMFS groundfish trawl survey to determine whether rapid and accurate identification of the two species can occur.

When observers and survey biologists can reliably identify both species, we can begin to develop a rationale for mixed species assessments and the potential implications for overfishing a weaker stock. We are also beginning to examine whether differences in life history characteristics (e.g., age and growth) exist for the two species. When combined with accurate species-specific catch and survey data, such information will help determine whether one species is a weaker stock and has a potential for overfishing.

New information for this year's projection is updated 2007 catch at 425 t and the best estimate of the 2008 catch at 370 t. Catch estimates used in last year's model were 397 t and 517 t for 2007 and 2008, respectively. For the 2009 fishery, we recommend the maximum allowable ABC of 1,284 t from the updated projection. This ABC is very similar to last year's ABC of 1,286 t. The stock is not overfished, nor is it approaching overfishing status. Female spawning biomass is well above  $B_{40\%}$ , with projected biomass stable.

For more information, contact Kalei Shotwell at (907) 789-6056.

#### *Stock Assessment for Shortaker Rockfish and "Other Slope Rockfish" in the Gulf of Alaska*

Shortaker rockfish and "other slope rockfish" are distinct management categories in the Gulf of Alaska (GOA), but their assessments are presented in a combined report because both assessments are based on biomass estimates from trawl surveys, instead of modeling. "Other slope rockfish" are comprised primarily of sharpchin, harlequin, silvergray, and redstripe rockfish, plus a number of minor species. Rockfish in the GOA have been moved to a biennial stock assessment schedule to coincide with data from the AFSC biennial trawl surveys in the GOA. In 2008, no trawl survey was conducted in the GOA, and for this off-cycle year there is no new survey information for shortaker and other slope rockfish; therefore, the 2008 ABC values were rolled over and remain unchanged for 2009. As in previous assessments since 1994, an average of the Gulf-wide biomass from the three most recent trawl surveys (presently the 2003, 2005, and 2007 surveys) was used to determine current exploitable biomass. This results in an exploitable biomass of 39,905 mt for shortaker rockfish and 90,283 mt for "other slope rockfish". Applying either an  $F=0.75M$  or an  $F=F_{40\%}$  rate (depending on the species) to these values of exploitable biomass results in recommended ABCs for the Gulf of Alaska in 2008 and 2009 of 898 mt for shortaker rockfish and 4,297 mt for "other slope rockfish". Compared with ABCs in 2006 and 2007, these are both slight increases. Gulfwide catch of shortaker rockfish was 650 mt in 2007, and estimated catch in 2008 was 562 mt. Gulfwide catch of "other slope rockfish" in 2007 was 690 mt, and estimated catch in 2008 was 793 mt.

Shortaker rockfish have long been considered one of the most difficult rockfish species to age. In 2005, the AFSC REFM Division's Age and Growth Task developed a new, experimental technique for ageing otoliths of this species. In early 2007, this technique was used for the first time for "production ageing" of a sample of shortaker rockfish from the 2005 GOA trawl survey.

The maximum age was 116 years, and the estimated mean population age in the GOA was quite old, 44 years. In 2008, a validation study of the shortraker ageing method was conducted based on carbon 14 levels in the otoliths from nuclear bomb testing in the 1960s. Results were unsuccessful, however, because carbon 14 could not be found in sufficient quantity in the otoliths. Thus, alternative validation techniques will be necessary to verify the ageing methodology.

For more information contact Dave Clausen at (907) 789-6049

### *Stock Assessment for Pelagic Shelf Rockfish in the Gulf of Alaska*

The pelagic shelf rockfish assemblage consists of four species (dusky, dark, yellowtail, and widow rockfish) that inhabit waters on the continental shelf in the Gulf of Alaska (GOA). Dusky rockfish (*Sebastes variabilis*) is by far the most abundant species in the group, and has been the target of an offshore bottom trawl fishery since the late 1980's. Dark rockfish (*S. ciliatus*) share an inshore reef or kelp environment with black rockfish (*S. melanops*), and the two species are often caught together. In 1998, black rockfish in Alaska were placed under state jurisdiction.

In March 2007, the North Pacific Fishery Management Council took final action to remove dark rockfish from both the GOA FMP (PSR Complex) and BSAI FMP (other rockfish complex). Removing the species from the Federal FMP serves to turn full management authority of the stock over to the State of Alaska in both regions. At this time, the rules to implement these FMP amendments have not yet been finalized. Therefore, it would not be until at least the 2010 fishing season that dark rockfish would be removed from Federal management (including the associated contribution to OFLs and ABCs under the respective complexes in both regions) and full management authority would be turned over to the State.

Rockfish in the GOA have been moved to a biennial stock assessment schedule to coincide with data from the AFSC biennial trawl surveys in this region. In 2008, there was no new trawl survey so an updated projection is all that is required. For dark, widow, and yellowtail rockfish, the 2007 stock assessment estimates are rolled over for the 2009 fishery, resulting in a recommended ABC of 508 t. For dusky rockfish, new information for this year's projection model was updated 2007 catch at 3,318 t and the best estimate of the 2008 catch at 3,527 t. Catch estimates used in the 2007 model were 3,245 t for 2007 and 4,719 t for 2008. This year's projection model for dusky rockfish results in a recommended ABC of 4,723 t which is similar to last year's dusky ABC of 4,719 t.

For the pelagic shelf rockfish complex, ABC and OFL for dark, widow, and yellowtail rockfish are combined with the ABC and OFL for dusky rockfish. For the 2009 fishery, we recommend the maximum allowable ABC for the pelagic shelf rockfish complex of 5,231 t. This ABC is similar to last year's ABC of 5,227 t. The stock is not overfished, and dusky rockfish is not approaching overfishing status.



For more information, contact Chris Lunsford at (907) 789-6008 or Kalei Shotwell at (907) 789-6056.

## Groundfish Research

### *2008 Sablefish Longline Survey*

The AFSC has conducted an annual longline survey of sablefish and other groundfish in Alaska from 1987 to 2008. The survey is a joint effort involving the AFSC's Auke Bay Laboratories and Resource Assessment and Conservation Engineering (RACE) Division. It replicates as closely as practical the Japan-U.S. cooperative longline survey conducted from 1978 to 1994 and also samples gullies not sampled during the cooperative longline survey. In 2008, the thirtieth annual longline survey of the upper continental slope of the Gulf of Alaska and eastern Aleutian Islands was conducted. One hundred-forty-eight longline hauls (sets) were completed during 4 June–1 September 2008 by the chartered fishing vessel *Alaskan Leader*. Sixteen kilometers of groundline were set each day, containing 7,200 hooks baited with squid.

Sablefish (*Anoplopoma fimbria*) was the most frequently caught species, followed by giant grenadier (*Albatrossia pectoralis*), shortspine thornyhead (*Sebastolobus alascanus*), arrowtooth flounder (*Atheresthes stomias*), and Pacific cod (*Gadus macrocephalus*). A total of 74,257 sablefish were caught during the survey. Sablefish, shortspine thornyhead, Greenland turbot (*Reinhardtius hippoglossoides*), spiny dogfish shark (*Squalus acanthias*), and lingcod (*Ophiodon elongates*) were tagged and released during the survey. To date, 221,167 sablefish have been tagged during the survey time series with 17,261 recoveries. Length-weight data and otoliths were collected from 2,003 sablefish. Killer whales (*Orcinus orca*) took fish from the longline at three stations in the Aleutian Islands region and two stations in the western Gulf of Alaska. Sperm whales (*Physeter macrocephalus*) were often present during haul back and were observed depredating on the longline at 18 stations in the eastern Gulf and 3 stations in the central Gulf of Alaska. This is the highest incidence of sperm whale interactions ever encountered during the survey. Occurrence of depredation in the eastern Gulf has ranged from 10% of sampling days that sperm whales were present in 2001 to 90% in 2008.

Several special projects were conducted during the 2008 longline survey. Spiny dogfish and lingcod were tagged with archival temperature/depth tags in the West Yakutat and central Gulf of Alaska regions. Photographs of sperm whales observed during the survey were taken for contribution to the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) sperm whale catalog. Yellow Irish lords were sampled for maturity information in the Aleutian Islands to help support sculpin life history studies. Finally, a 2-day gear experiment was conducted near Yakutat to compare the catching efficiency of standard, hand-baited survey gear to auto-baited gear.

For more information, contact Chris Lunsford at (907) 789-6008.

### *Competition for Hooks on the Sablefish Longline Survey*

Catch rates from longline surveys are used as indices of abundance for many fish species. Relative abundance estimates from longline surveys do not usually account for possible effects of gear saturation, which potentially creates competition among fish for baited hooks and misrepresentations of abundance trends. Scientists at ABL examined correlations between catch rates of sablefish (*Anoplopoma fimbria*) and giant grenadier (*Albatrossia pectoralis*) and between sablefish and shortraker (*Sebastes borealis*) and rougheye rockfish (*Sebastes aleutianus*) from 25 years of AFSC longline surveys in Alaska waters for evidence of competition for hooks. Sablefish and giant grenadier catch rates were negatively correlated in all six sablefish management areas (Bering Sea, Aleutian Islands, Western Gulf Of Alaska, Central Gulf of Alaska, West Yakutat, and East Yakutat/Southeast Outside), and sablefish and rockfish were negatively correlated in five of the six areas (all areas except Aleutian Islands). This indicates that there is likely competition for hooks on the AFSC longline surveys. Comparative analyses were done for AFSC trawl survey catch rates and no negative correlations were observed, indicating that the negative correlations on AFSC longline surveys are not due to differing habitat preferences or direct competition, but more likely can be attributed to competition for hooks. Available adjustments for hook competition may be biased if the probability of capture does not decrease linearly with baited hooks. A better understanding of each fish species' catch probabilities on longline gear is needed before adjustments for hook competition can be made. A journal article was recently published on this study.

For more information, contact Cara Rodgveller at (907) 789-6052.

### *Sablefish Tag Program*

The ABL MESA Program continued the processing of tag recoveries and administration of the reward program during 2008. Total sablefish tag recoveries for the year should exceed 600 when all are received. One fish at liberty for 35.4 years was recovered in 2008; it was released in Chatham Strait and recovered off Whale Bay on Baranof Island. Two other fish were out just under 30 years: one was released and recovered off Kodiak and the second was released off Salisbury Sound in southeast Alaska and recovered off Prince William Sound. Twenty-two sablefish tagged as juveniles were recovered in 2008. Three of these were the first recoveries of archival-tagged juveniles; data from these archival tags, which will provide information on the depth and temperature experienced by the fish, are still being analyzed.

Tags from shortspine thornyheads, Greenland turbot, Pacific sleeper sharks, lingcod, and spiny dogfish are also maintained in the Sablefish Tag Database. Nine thornyheads, two turbot, and one archival-tagged spiny dogfish were recovered in 2008. The dogfish, a female, was released off Yakutat and recovered off northern Washington 205 days later.

Releases in 2008 included 3,295 adult sablefish, 607 shortspine thornyheads, 39 turbot (including 31 with archival tags), 49 lingcod (all archival), and 459 juvenile sablefish (121 archival).

For more information, contact Nancy Maloney at (907) 789-6060.

### *Juvenile Sablefish Studies*

Juvenile sablefish studies have been conducted by the Auke Bay Laboratories in Alaska since 1984 and were continued in 2008. A total of 337 juvenile sablefish (age 1+) were tagged with spaghetti tags and released during two cruises to St. John Baptist Bay near Sitka between May 15-19 and July 18-20. During the 2nd cruise, an additional 121 juvenile sablefish were implanted with electronic archival tags. Approximately 435 rod hours were recorded to catch the fish that were tagged in the two cruises. This relatively small bay is the only known location in Alaska where juvenile sablefish have been consistently found on an annual basis.

The electronic archival tags will provide information on juvenile sablefish behavior and habitat during their transition from nearshore rearing areas to the age at which they are intercepted by the fishery. Since 2003, a total of 526 electronic archival tags have been released on juvenile sablefish in St. John Baptist Bay. These tags record the temperature and depth experienced by the fish and are designed for recovery in the commercial fishery when the fish are age 2+ or greater. We had expected to recover some archival tags in the 2008 fishery, and indeed we received three returns from the 2008 fishery. The juvenile sablefish tagging cruise will be conducted again this year from July 14-20.

For more information, contact Dana Hanselman at (907) 789-6626.

### *Live Capture of Young-of-the-Year Slope Rockfish*

As young-of-the-year, slope rockfish can be found in the upper water column over abyssal depths. Eventually, they adapt to a demersal life and are associated with the benthos. The relationship between juvenile slope rockfish and benthic habitat is poorly understood due to the depths at which the fish reside, which is usually greater than 150-200 m. In 2008, scientists from Auke Bay Laboratories Marine Ecology and Stock Assessment (MESA) Program took part in research activities aimed at capturing live young-of-the-year slope rockfish. The ultimate objective of the project is to identify habitat utilization of juvenile slope rockfish amongst various benthic habitat types such as sponge and coral.

In August, 27 surface trawls were performed onboard the Alaska Department of Fish and Game's (ADF&G) vessel *Medeia*. Trawling took place up to 60 nautical miles offshore of Southeast Alaska between Icy Point and Cape Ommaney. The trawl was equipped with an aluminum aquarium codend (livebox) that directed fish and invertebrates into a calm water-filled holding chamber. Once on deck, live specimens were transferred from the aquarium codend to holding tanks with running seawater. At the conclusion of the cruise, live rockfish were transferred to the Auke Bay Laboratories' Ted Stevens Marine Research Institute and placed in laboratory aquariums. Of the 1,478 rockfish captured, about 90% survived the trawling process including fish as small as 14 mm.

An estimated five or six different species of rockfish were captured in 2008, although genetic analyses will confirm species identifications. In a similar cruise in 2007, several species of rockfish were collected including Pacific ocean perch (*Sebastes alutus*), redstripe rockfish (*S. proriger*), rougheye rockfish (*S. aleutianus*), redbanded rockfish (*S. babcocki*), and rosethorn rockfish (*S. helvomaculatus*). The aquarium codend caught other live species as well, including juvenile and adult salmon (*Oncorhynchus* spp.), Pacific saury (*Cololabis saira*), larval rex sole (*Glyptocephalus zachirus*) and Dover sole (*Microstomus pacificus*), and Pacific herring (*Clupea pallasii*). Many unidentified small squid were also captured live. The greatest biomass in the catch was attributed to jellyfish, primarily *Aequorea* sp.

Once acclimated to conditions in the behavior lab, the rockfish were observed in four distinct habitat types (coral, sponge, cobble, and gravel) under both daytime and nighttime conditions. Habitat-mediated predation rates were also determined within the four habitats using great sculpin (*Myoxocephalus polyacanthocephalus*) as predators. This study builds on previous work that focused on quillback rockfish (*S. maliger*), a demersal shelf rockfish. These assessments will be helpful in determining the relative productivity of various habitats and will aid in establishing priorities for their protection.

For more information, contact Pat Malecha at (907) 789-6415.

#### *Catch Efficiency of Longlines for Shortraker and Rougheye Rockfish in Alaska*

Demersal rockfish of the family *Sebastes* can be difficult to assess with bottom trawl gear because they may inhabit untrawlable rocky habitats. In contrast, longline gear can often be successfully fished in these areas; however, many factors can affect longline catch rates besides fish density. In field studies conducted in 1994 and 1997 at 19 sites off Southeast Alaska, comparative data were collected on longline catch rates of shortraker (*Sebastes borealis*) and rougheye rockfish (*Sebastes aleutianus*) and on fish densities calculated from observations from a manned submersible. The purpose of these studies was to estimate the catchability coefficient of these two species on longline gear. On separate occasions, rockfish behavior in the presence of longline gear was observed from the submersible. Understanding the behavior of these rockfish in the presence of longline gear will guide the application of their catch rates in stock assessments. Although the data were collected more than 10 years ago, analysis of these data was just initiated this year, and a manuscript is being prepared.

Densities of shortraker rockfish based on observations from the submersible varied from 0 to 6,813 fish per square kilometer (mean of all sites = 2,709, S.D. = 3,095, n = 19). Densities of rougheye rockfish varied from 0 to 11,102 fish per square km (mean of all sites = 5,170, S.D. among sites = 5,416, n = 19). For shortraker rockfish, the linear regression of density and catch rate was not significant ( $F$ -ratio = 0.562,  $r = 0.423$ ,  $p$ -value = 0.464). Rougheye rockfish catch rate was also not related to density at an  $\alpha$  of 0.05, but was at an  $\alpha$  of 0.1 ( $F$ -ratio = 3.085,  $r = 0.626$ ,  $p$ -value = 0.097). The non-significance could be due to sample sizes, clumped distributions, or rockfish behavior on longline gear.

On dives where rockfish were observed during a longline set, the number of free-swimming fish increased throughout a set at a quicker rate than fish were caught. Shortraker and rougheye rockfish were attracted to the longline but many were not being caught even when baited hooks were available. We may have detected this trend because we did not observe the longline for a long enough period, or because rockfish are out-competed by other bait predators. Despite not knowing the cause of the reluctance of shortraker and rougheye rockfish to bite a baited hook, this behavior may affect the relationship between longline CPUE and density. We continue to analyze these data and interpret the appropriateness of longline gear as an index of abundance for shortraker and rougheye rockfish.

For more information, contact Cara Rodgveller at (907) 789-6052.

*NMFS Auke Bay Laboratories and University of Alaska Fairbanks Joint Research on Spiny Dogfish in the Gulf of Alaska*

Scientists from the NMFS Auke Bay Laboratories, the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, and the University of Washington School of Aquatic and Fishery Sciences continued a joint study on spiny dogfish (*Squalus acanthias*) in the Gulf of Alaska. Little is known about the life history or ecological role of spiny dogfish in the North Pacific despite the fact that they comprise a relatively large biomass in coastal northeast Pacific waters.

Spiny dogfish are a long-lived, slow-growing species. Length at age data collected from 2004-2007 in cooperation with the Sablefish Longline Survey, the Alaska Observer Program, and ADF&G and University of Alaska Fairbanks surveys were examined to determine the growth and age structure of the species in the Gulf of Alaska. Results suggest that spiny dogfish are among the slowest growing species of shark and grow to a larger size, older age, and mature later in the Gulf of Alaska than other regions in which they occur. Demographic analyses also suggest that the species has a low rate of natural mortality and fecundity, which combined with the age assessment suggest that the species can only tolerate a low level of fishing mortality. Recent work has been completed on an analysis of the diet of spiny dogfish, ontogenetic shifts in diet, and the potential ecological impacts on a seasonal and regional scale. The age, growth, demographic, and diet analyses are now included in the annual Stock Assessment and Fishery Evaluation (SAFE) report for sharks in the Gulf of Alaska.

For more information, contact Cindy Tribuzio at (907) 789-6415.

*Deep-water Longline Study for Giant Grenadier and Sablefish*

In August 2008, ABL used the chartered commercial longline vessel *Beauty Bay* to conduct a deep-water longline survey feasibility study in the western Gulf of Alaska. The objective was to investigate the abundance and biological characteristics of giant grenadier and sablefish in deep waters of the Gulf of Alaska that have not been previously sampled in fishery surveys. Longline

and trawl surveys in Alaska both indicate that these two species are by far the most abundant fish at depths 400-1,000 m on the continental slope, but their abundance in deeper water is unknown. The study consisted of fishing five longline stations on August 6-10 east of Dutch Harbor at depths up to 1,620 m. However, due to vessel mechanical problems and the difficult fishing conditions encountered at the deep-water stations, total fishing effort in the study was ~40% less than had been planned, and depth coverage was also less than ideal.

The study demonstrated that fishing longlines in deep water can present special problems, and that extra fishing effort may be needed to compensate for these problems. Because of the limited fishing effort and incomplete depth coverage, results of the study were not conclusive. However, catch rates of sablefish were extremely low, and those of giant grenadier were relatively high. This suggests that biomass of sablefish at depths >1,000 m in the western Gulf of Alaska is probably inconsequential, whereas considerable biomass of giant grenadier may exist at these depths. An unexpected finding of the study was the large abundance of another grenadier species, Pacific grenadier, at some of the deep-water stations. At one station, Pacific grenadier were caught on 56% of the hooks that were set.

For more information, contact Dave Clausen at (907) 789-6049.

#### Other Research by the ABL MESA Program – Forage Fish

##### *Humpback Whale/Pacific Herring Interactions in Southeastern Alaska*

Humpback whales in southeastern Alaska are known to feed on a variety of prey ranging from plankton to small fish, with the two main food sources being Pacific herring and euphausiids (krill). Pacific herring are commercially and culturally important and an important food source for marine predators throughout Alaska. During the winters of 2006-2009, ABL's MESA and Habitat Programs, the Marrowstone field station, WA, and University of Alaska Southeast teamed up to study the interactions of herring and humpback whale populations in waters around Prince William Sound, Sitka, and Juneau. We identified, counted, and tracked whales and conducted herring surveys using echo-integrated trawl surveys for relative biomass, prey availability, and predator-prey interactions. We used pelagic trawls to collect specimens for species identification, species composition, length-weight relationships, and length frequencies for fecundity, maturity, echo-integration, biological impedance, disease, and energy content analysis. The main objective of this study is to quantify how whales affect herring biomass.

Field work has been conducted over the last several winters to service two projects funded by the Exxon Valdez Oil Spill Trustee Council: a whale study and a herring energetics study. The objectives of the whale study include: 1) estimate the abundance of herring in two depressed populations, Lynn Canal (LC) and Prince William Sound (PWS) and in a robust population in Sitka Sound (SS) by conducting echo-integration trawl surveys (EITS); 2) estimate the number of individual humpback whales based on photo identifications from these three regions (LC, PWS, SS); 3) identify the seasonal prey species of humpback whales using EITS; 4) model the impact

of whale predation on herring populations in the three regions; and 5) estimate the caloric content of humpback whale diets throughout the winter.

The objectives for the herring study have three components. The first is to examine two mechanisms of potential energetic bottlenecks in depressed herring populations by comparing potential for overwinter mortality of juvenile herring in three herring populations (LC, SS, PWS), by measuring pre-winter condition and overwinter energy use, and to quantify the potential for reduced reproduction of adults investment in these three populations by measuring pre-winter condition, overwinter energy use, and gonad quality (gonad weight, gonad lipid, protein, calories, fecundity, etc.). The second component is based on controlled lab experiments in which we measured the metabolic rate and energy utilization rate of herring at six temperatures for comparison to field observations. The last component is to examine the effect of disease (*Ichthyophonus*) on energy use in herring. The purpose of this latter component is to determine if infected herring use energy more rapidly than non-infected herring, making them more susceptible to overwinter mortality, and to investigate whether fasting herring (i.e., herring in the winter) are more susceptible to infection.

For more information contact David Csepp at (907) 789-6075.

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## Other ABL Staff Working on Groundfish

Scott Johnson	Essential Fish Habitat, Forage Fish
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Christine Kondzela	Rockfish Genetics
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Auke Bay Laboratory Marine Ecology and Stock Assessment (MESA) Program  
Publications and Papers, Jan 1, 2008 - Mar 31, 2009  
(MESA and other ABL authors in bold)

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