Project Title: Improving biomass estimates through habitat based surveys in the Gulf of Alaska

Principal Investigators: Chris Wilson[1], Chris Rooper[1], Tom Weber[2], Paul Spencer[1], Dana Hanselman[1], Jon Heifetz[1]

[1]Alaska Fisheries Science Center
Seattle WA 98115 *and*
Juneau AK 99801

[2]Center for Coastal and Ocean Mapping
University of New Hampshire
Durham NH 03824

Project Duration: 2 years (2012, 2013)

Total Funding Requested: $160,959
Year 1: 70,959
Year 2: 90,000

Project Title: Improving biomass estimates through habitat based surveys in the Gulf of Alaska

Background: Groundfish stock assessments in the Gulf of Alaska (GOA) depend heavily on time series of estimated biomass from bottom trawl (BT) surveys conducted on a biennial basis. These BT surveys use stratified random designs where densities of fish from survey tows are expanded across stratum areas to compute biomasses (and variances). All locations within a stratum are assumed, in theory to have equal probability of being sampled. However, this is often not true in practice as survey strata in Alaska and throughout U.S. waters often contain substantial areas of untrawlable ground that cannot be sampled using research survey nets (Zimmermann 2003, Cordue 2007). The expansion of fish densities estimated from trawlable areas to untrawlable areas potentially results in both bias and imprecision in survey abundance estimates, depending upon the relative amounts of untrawlable versus trawlable habitat as well as the relative fish density differences in these two habitat types (c.f., Jones et al. *in press*). Thus, to accurately assess groundfish populations, reliable estimates are needed of both the areal extent of untrawlable substrate within survey strata as well as the fish densities in both habitat types.

Approach: We propose to generate rockfish (*Sebastes spp.*) density estimates in untrawlable (and trawlable) areas in the GOA to assess the potential impact that these estimates can have on stock assessment efforts. We chose rockfishes as our focal species group because survey indices of abundance for rockfishes typically have high variance and their distribution typically encompasses untrawlable habitat. An acoustic-camera (AC) survey method, developed in 2009 as part of a North Pacific Research Board funded project, will be used to provide abundance estimates for the dominant rockfish species (Rooper et al. *in press*, Jones et al. *in press*) in untrawlable and trawlable habitats. The survey data will be collected in both habitats throughout much of the central and western GOA during fieldwork conducted in FY13 (see below). The results will provide a basis for empirical estimation of the proportion of the population available to the RACE bottom trawl survey, which can help in estimating catchability in the stock assessment.

The AC survey will be done in conjunction with the planned summer 2013 GOA biennial AFSC acoustic-trawl (AT) pollock survey to be conducted from the NOAA Ship *Oscar Dyson*. The AT survey covers the entire continental shelf from about 170°W (Island of Four Mountains) to 140°W (Yakutat Bay). The AT survey is designed to collect acoustic and trawl data along parallel transects spaced 20 nmi apart and running between the inner and outer shelf. Unfortunately, there is insufficient vessel time during the AT survey to conduct a comprehensive AC rockfish survey over the entire AT survey area. Thus, a stratified-random AC survey design is proposed as an initial, cost-effective approach to characterize the difference in rockfish densities between untrawlable and trawlable areas. The survey area west of Kodiak Island between bottom depths of 50 to 200 m will be divided into two strata (untrawlable, trawlable) based on information from the RACE bottom trawl survey, which has been used to delineate untrawlable areas in GOA. Sites in each stratum will be randomly selected to survey using AC methods to estimate rockfish abundances with as little disruption to the AT pollock survey as possible.

Details of the proposed sampling approach are as follows. The BT survey is conducted at stations on a grid of 5 km square grid-cells in the GOA. Historically, each assigned grid-cell has been designated as

either trawlable or untrawlable based on qualitative interpretation of echosounder data observed aboard the chartered commercial fishing vessels during BT surveys or bottom trawl performance (von Szalay et al. 2010). Our two strata (trawlable, untrawlable) will be formed from these classified grid-cells, and AC survey sampling will target up to 50 randomly selected cells in each strata. The selection of the grid-cells will be constrained to cells that are located along the 20 nmi AT survey transects so that acoustic data collected during normal AT survey operations can be leveraged for the proposed work. Thus, acoustic and camera data located along AT survey transects within these grid-cells will be used to estimate rockfish densities (Jones et al., *in press*, Rooper et al., *in press*). One to two stereo drop camera tows will be conducted in each grid-cell, and will target the observed fish acoustic backscatter. The proposed experimental design is flexible enough that the work could easily be expanded to additional sites that could be sampled using AC survey methods during subsequent AT surveys (e.g., summer 2015) and to additional areas (i.e., eastern GOA) to refine our proposed summer 2013 estimates. Multibeam (Simrad ME70) data will also be collected along the AT survey trackline as methods are currently being developed with these data to quantitatively assess trawlability using seafloor backscatter metrics (Weber et al., *in review*). Analysis of the multibeam data will serve to more precisely characterize the trawlability of the seafloor where rockfish densities will be estimated during 2013. For example, some portion of an "untrawlable" cell (based on BT survey classification methods described above) may, in fact, be reclassified as trawlable based on the more fine-scale multibeam results, and this new information may help to explain unexpected fish density levels encountered within a given cell.

As there is no additional vessel time to conduct the AC survey during AT survey operations and insufficient staff resources and expertise to successfully complete the proposed study, we are requesting FY12 funds to support 50% of the cost (matching funds from UNH) of a fulltime post-doctoral position for 1 year beginning in spring 2013. We also plan to request FY13 funds to purchase 6 additional days of *Oscar Dyson* ship time during the summer 2013 RACE AT survey to complete the proposed study (see Budget Justification below).

Benefits: This project builds on our earlier work to assess rockfishes in untrawlable habitat, and will benefit stock assessments in several ways. Biomass estimates can be refined by accounting for untrawlable regions in the survey area to better estimate the survey catchability coefficient (*q)*, which largely reflects the availability of the population to the survey gear. Estimates of *q* for Alaska rockfishes are currently hypothesized to reflect the differential densities between trawlable and untrawlable habitats, and empirical data would improve specification of Bayesian priors on *q*. Finally, methods developed here and knowledge gained through this and related studies can ultimately be used to begin time series of rockfish abundance estimates in untrawlable areas to complement traditional BT survey data.

Deliverables: The deliverables at the conclusion of this two year project will be:

- Density estimates of shelf rockfishes from trawlable and untrawlable areas based on 2013 acoustic-camera survey results in conjunction with refined estimates of seafloor trawlability from multibeam (Simrad ME70) data.
- Field based estimates of catchability (q) for shelf rockfish species.

Budget:

FY2012 Funds:	
50% cost of University New Hampshire Post-doc (1 yr)	58,710
Travel (UNH-AK) 2 ea for 2013 survey participation	5,000
XBT probes for summer 2013 survey – (15 cases)	7,249
Total FY 2012 Funding Requested:	**$70,959**
FY2013 Funds:	
Ship time (6 Program Funded Dyson days @ $15k/day)	90,000
Total FY 2013 Funding Requested:	**$90,000**

Budget Justification: This will be a two year study. Funds are requested in FY12 to provide 50% support for a one year post-doctoral position to begin in spring 2013 to prepare for the summer 2013 GOA survey. These post-doc funds will be transferred to University of New Hampshire via a grant in FY12 to have those funds in place to support the post-doctoral position when needed in 2013. The proposed acoustic-camera survey work will be conducted during the regularly scheduled summer 2013 acoustic-trawl survey. The project is heavily leveraged with matching funds, as the UNH, Center for Coastal and Ocean Mapping will support 50% of the post-doctoral position, and RACE funds will support mobilization, travel, and salary (e.g., survey overtime costs) for NOAA scientists to conduct the acoustic-camera survey work along with the regularly scheduled RACE summer 2013 acoustic-trawl pollock survey. Travel funds are requested for two UNH researchers to participate on the 2013 survey (one on first and one on last cruise leg) to oversee collection of the multibeam data and contribute to other proposed survey activities. These travel funds will be included in the FY12 grant to UNH. Funds are also requested for XBT probes to collect vertical temperature profile data, which are needed in the analysis of the multibeam data for seafloor mapping. These will be purchased in FY12. The need for FY13 funds for 6 additional DAS is based on the number of available ship days expected on the *Dyson* in 2013

Literature Cited:

Cordue, P. 2006. A note on non-random error structure in trawl survey abundance indices. ICES J. Mar. Sci. 64:1333–1337.

Jones, D.T., C.D. Wilson, A. De Robertis and C.N. Rooper. *In press*. Evaluation of Rockfish Abundance in Untrawlable Habitat: A Comparison of Remote Sampling Tools. Fishery Bulletin.

Rooper, C.N., M.H. Martin, J.L. Butler, D.T. Jones, and M. Zimmermann. *In press*. Estimating species and size composition of rockfish in acoustic surveys of untrawlable areas using a remote operated vehicle, bottom trawl, and stereo video camera. Fishery Bulletin.

von Szalay, P. G., N. W. Raring, F. R. Shaw, M. E. Wilkins, and M. H. Martin. 2010. Data report: 2009 Gulf of Alaska bottom trawl survey. NOAA Tech. Memo. NMFS-AFSC-208, 245 p.

Weber, T., C. N. Rooper, J. L. Butler, D. T. Jones, and C. D. Wilson. *In review*. Seabed classification for trawlability using the Simrad ME70 multibeam echosounder on Snakehead Bank in the Gulf of Alaska. Fish. Bull.

Zimmermann, M. 2003. Calculation of untrawlable areas within the boundaries of a bottom trawl survey. Can. J. Fish. Aquat. Sci. 60:657–669.

Christopher D. Wilson

Address
NOAA Fisheries, Alaska Fisheries Science Center
7600 Sand Point Way NE, Bldg 4, Seattle, WA 98115 USA
phone**:** 206-526-6435, Fax: 206-526-6723
email: chris.wilson@noaa.gov

Education
Ph.D. (Oceanography) 1992, University of Hawaii, Honolulu
M.S. (Fisheries) 1985 Oregon State University, Corvallis
B.S. (Fisheries) 1978 University of Washington, Seattle

Professional Experience

2004-present	Program Manager, Midwater Assessment and Conservation Engineering (MACE) Program (Fisheries Acoustics), NOAA, Alaska Fisheries Science Center, Seattle.
1992-2004	Fishery Biologist, Midwater Assessment and Conservation Engineering, NOAA, Alaska Fisheries Science Center, Seattle.
1986-1992	Oceanographer & Graduate Research Assistant, NOAA, Pacific Islands Fisheries Science Center, Honolulu Laboratory, Honolulu (Ph.D. and other work).
1981-1985	Research & Teaching Assistants, Department of Fisheries and Wildlife, Oregon State University (M.S. and other work).
1980-1981	Research Assistant; National Institute of Water and Atmospheric Research - Fisheries, Wellington, New Zealand.
1977-1979	Fisheries Biologist/Research Assistant; Fisheries Research Institute, University of Washington, Seattle.

Scientific Committee Memberships
NOAA Advanced Sampling Technology Working Group
ICES Fisheries Acoustics Science and Technology Working Group
Dissertation committees of two students (Univ. Washington)

Recent Publications

Walline, P.D., **Wilson, C.D**., Hollowed, A.B., Stienessen, S.C. 2012. Short-term effects of commercial fising on the distribution and abundance of walleye pollock. Canadian J. Fish Aquatic Sci 69: 354-368.

Honkalehto, T.H., Ressler, P.H., Towler, R.H., and **Wilson, C.D.** 2011. Using acoustic data from fishing vessels to estimate walleye pollock abundance in the eastern Bering Sea. Canadian Journal of Fisheries and Aquatic Sciences 68:1231-1242.

Williams, K., Punt, A.E., **Wilson, C.D.**, Horne, J.K. 2011. Length-selective retention of walleye pollock, Theragra chalcogramma, by midwater trawls. ICES J Mar. Sci.

De Robertis, A. and **Wilson, C.D**. 2011. Silent ships do not always encounter more fish (revisited): comparison of acoustic backscatter from walleye pollock recorded by a noise-reduced and a conventional research vessel in the eastern Bering Sea ICES J. Mar Sci.

De Robertis A, **Wilson C. D.**, Williamson N. J., Guttormsen M. A., Stienessen S. (2010) Silent ships sometimes do encounter more fish. Part I: Vessel comparisons during winter pollock surveys. ICES J Mar Sci. 67: 985-995.

De Robertis A., **Wilson C. D.**, (2010) Silent ships sometimes do encounter more fish. Part II: Concurrent echosounder observations from a free-drifting buoy and vessels. ICES J of Mar Sci. 67:996-1003.

Mann, D.A., **Wilson, C.D**., Song, J. and Popper, A.N. 2009. Hearing sensitivity in the walleye pollock, *Theragra chalcogramma.* Trans. Am. Fish. Soc. 138:1000-1008.

Guttormsen, M. A. and **Wilson, C. D**. 2009. *In situ* target-strength measurements of capelin (Mallotus villosus) in the North Pacific Ocean. ICES J. Mar. Sci. 66: 258-263.

Agostini, V.N., Hendrix, A.N., Hollowed, A.B., **Wilson, C.D**., Pierce, S.D., and Francis, R.C. 2008. Climate-ocean variability and Pacific hake: a geostatistical modeling approach. J. Mar. Systems 71: 237-248.

De Robertis A, Hjellvik V, Williamson NJ, **Wilson CD** (2008) Intervessel comparison of walleye pollock acoustic backscatter recorded by a noise-reduced and a conventional research vessel. Bioacoustics 17: 228-230.

De Robertis A, Hjellvik V, Williamson NJ, **Wilson CD** (2008) Silent ships do not always encounter more fish: comparison of acoustic backscatter recorded by a noise-reduced and a conventional research vessel. ICES Journal of Marine Science 65: 623-625.

Stienessen, S. C., and **C. D. Wilson**. 2008. Juvenile walleye pollock aggregation structure in the Gulf of Alaska. *In*: G. H. Kruse, K. Drinkwater, J. N. Ianelli, J. S. Link, D. L. Stram, V. Wespestad, and D. Woodby (eds.), Resiliency of Gadid Stocks to Fishing and Climate Change. Alaska Sea Grant Program, Alaska, USA, pp. 271-287.

Hollowed, A.B., **C.D. Wilson**, P. Stabeno, and S. Salo. 2007. Effect of ocean conditions on the cross-shelf distribution of walleye pollock (*Theragra chalcogramma/*) and capelin (*Mallotus villosus*). Fish. Oceanogr. 16:142-154.

Agostini, V.N., R.C. Francis, A.B. Hollowed, S.D. Pierce, **C.D. Wilson**, A.N. Hendrix. 2006. The relationship between hake (*Merluccius productus*) distribution and poleward sub-surface flow in the California Current System. Can. J. Fish. Aquatic Sci. 63: 2648-2659.

De Robertis, A. and **C.D. Wilson**. 2006. Walleye pollock respond to trawling vessels. ICES J. Mar. Sci. 63: 514-522.

Mckelvey, D. and **C.D. Wilso**n. 2006. Discriminate classification of fish and zooplankton backscattering at 38- and 120-kHz. Trans. Am. Fish. Soc. 135: 488-499.

Recent Collaborators

Demer, D.A., NOAA Fisheries, SW Fisheries Science Ctr, San Diego, CA
Godo, O.R., Institute of Marine Research, Bergen, Norway
Hollowed, A.B., NOAA Fisheries, Alaska Fisheries Science Ctr, REFM Div., Seattle WA
Jech, J.M., NOAA Fisheries, NW Fisheries Science Ctr, Woods Hole, MA
Rooper, C.N., NOAA Fisheries, Alaska Fisheries Science Ctr, Seattle WA
Somerton, D.A., NOAA Fisheries, Alaska Fisheries Science Ctr, RACE Division, Seattle WA
Stabeno, P.J., OAR, Pacific Marine Environmental Lab., Seattle, WA
Wade, P., NOAA Fisheries, National Marine Mammal Lab. Seattle, WA
Weber, T.C. Center for Coastal & Ocean Mapping, Durham NY

Christopher N. Rooper
Work: NMFS, Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle WA 98115
(206) 526-4689
Chris.Rooper@noaa.gov

Education

Ph.D. University of Washington, Aquatic and Fishery Sciences, 2002
M.S. University of Alaska, Fairbanks, Fisheries and Aquatic Sciences, 1996
B.S. Oregon State University, Biology, 1991

Employment

2002-present Research Fishery Biologist- Alaska Fisheries Science Center, RACE Division, Seattle Washington, USA.

Currently I am employed as a research fishery biologist with the RACE Division of the Alaska Fisheries Science Center. My duties are divided into two areas. First I serve as a member of the RACE Division groundfish survey program providing support for stock assessments of Alaska fish species. This entails participating in planning and carrying out trawl surveys of the Gulf of Alaska and Aleutian Islands regions and providing analyses and support for RACE Division research needs in Alaska. Most recently, I am the AFSC team leader for a three year deep-sea coral and sponge research program to be carried out in the Gulf of Alaska and Aleutian Islands. Prior to this, I was the survey coordinator for the Aleutian Islands bottom trawl survey which entails planning, managing, and leading a large scale survey of groundfish resources in the Aleutian Islands, Alaska. My second duty is to conduct independent research on fish habitat supporting Habitat and Ecosystem Process Research in Alaska. I am also currently leading two independent research projects; one studying juvenile Pacific ocean perch at sites in the Aleutian Islands, and a multidisciplinary study to determine the best methodologies for assessing rockfish biomass in untrawlable areas of the Gulf of Alaska. This research has focused on studying rockfish using a combination of underwater video and trawls.

Five most relevant publications

Rooper, C.N., G. R. Hoff & A. De Robertis. 2010. Assessing habitat utilization and rockfish (Sebastes sp.) biomass in an isolated rocky ridge using acoustics and stereo image analysis. Can. J. Fish. Aquat. Sci. 67:1658-1670.

Rooper, C.N. & M.H. Martin, 2009. Predicting presence and abundance of demersal fish: a model application to shortspine thornyhead (Sebastolobus alascanus). Mar Ecol Prog Ser 379:253-266

Rooper, C.N. 2008. An ecological analysis of rockfish (Sebastes spp.) assemblages in the north Pacific along broad-scale environmental gradients. Fishery Bulletin 181:1-11.

Boldt, J. L. & C. N. Rooper. 2009. An examination of links between feeding conditions and energetic content of juvenile Pacific ocean perch in the Aleutian Islands. Fishery Bulletin 107:278-285.

Rooper, C.N., J.L. Boldt & M. Zimmermann. 2007. An assessment of juvenile Pacific Ocean perch (*Sebastes alutus*) habitat use in a deepwater nursery. Estuarine, Coastal, and Shelf Sciences 75:371-380.

Five other publications

Rooper, C.N., M.E. Wilkins, C. Rose & C. Coon. 2011. Modeling the impacts of bottom trawling and the subsequent recovery rates of sponges and corals in the Aleutian Islands, Alaska. Cont. Shelf Res. 31:1827-1834

Williams, K., C.N. Rooper, & R. Towler. 2010. Use of stereo camera systems for assessment of rockfish abundance in untrawlable areas and for recording pollock behavior during midwater trawls. Fish Bull 108:352-362

Rooper, C. N. 2008. Underwater video sleds: Versatile and cost effective tools for habitat mapping, p. 99-107. In J. R. Reynolds and H. G. Greene (editors), Marine Habitat Mapping Technology for Alaska. Alaska Sea Grant College Program Report No. AK-SG-08-03, University of Alaska, Fairbanks.

*Rooper, C.N. & M. Zimmermann. 2007. A bottom-up methodology for integrating underwater video and acoustic mapping for seafloor substrate classification. Continental Shelf Research 27:947-957.

Rooper, C. N., D. R. Gunderson, & D. A. Armstrong. 2006. Evidence for resource partitioning and competition in nursery estuaries by juvenile flatfish in Oregon and Washington. Fish Bull 104:616-622

Collaborators in the past 4 yeears

David Armstrong (UW-SAFS), Kerim Aydin (AFSC), Jennifer Boldt (DFO-Canada), John Butler (SWFSC), Catherine Coon (BOEMR), Dave Demer (SWFSC), Alex De Robertis (AFSC), Peter Etnoyer (NOAA-OAR), Joe Godlewski (NEFSC), Don Gunderson (UW-SAFS), John Harms (NWFSC), Ron Heintz (AFSC), Gerald Hoff (AFSC), Darin Jones (AFSC), Kathy Kulitz (USFWS), Franz Meuter (SFAS-UAF), Michael Martin (AFSC), John Olson (AKR), Jodi Pirtle (UNH-CCOM), Jennifer Reynolds (NURP-UAF), Paul Spencer (AFSC), Robert Stone (ABL), Charles Thompson (SEFSC), Rick Towler (AFSC), Tom Weber (UNH-CC0M), Mark Wilkins (AFSC), Kresimer Williams (AFSC), Chris Wilson (AFSC), Mark Zimmermann (AFSC)

Thomas C. Weber
Center for Coastal and Ocean Mapping
Chase Ocean Engineering Lab
University of New Hampshire
24 Colovos Road
Durham, New Hampshire 03824
Tel: 603-862-1659 Fax: 603-862-0839
e-mail: weber@ccom.unh.edu

Professional Preparation

2006	Pennsylvania State University, State College, PA PhD in Acoustics
2000	University of Rhode Island, Kingston, RI M.S. in Ocean Engineering
1997	University of Rhode Island, Kingston, RI B.S. in Ocean Engineering

Appointments

1/2006-Present	**Research Assistant Professor** in Ocean Engineering at University of New Hampshire, Center for Coastal and Ocean Mapping
8/2001 – 12/2005	**Research Assistant** at Pennsylvania State University
6/2000 – 7/2001	**Member of Technical Staff (systems engineer)** at Raytheon Company, Sensor Systems Engineer Department.
1/1998 – 6/2000	**Partner** at Pyrcon, LLC (sonar R&D).

Journal Articles

Weber, T., C. N. Rooper, J. L. Butler, D. T. Jones, and C. D. Wilson. *In review*. Seabed classification for trawlability using the Simrad ME70 multibeam echosounder on Snakehead Bank in the Gulf of Alaska. Fish. Bull.

Weber, T., A. De Robertis, S. Greenaway, S. Smith, L. Mayer, and G. Rice, "Estimating oil concentration and flow rate with calibrated vessel-mounted acoustic echo sounders," *Proc. Nat. Acad. Sci.*, December 2011. doi:10.1073/pnas.1108771108

Weber, T., A. Lyons, and D. Bradley, "Consistency in statistical moments as a test for bubble cloud clustering," *J. Acoust. Soc. Am.*, 130(5), pp. 3396-3405. November 2011.

Kessler, J., D. Valentine, M. Redmond, M. Du, E. Chan, S. Mendes, E. Quiroz, C. Villanueva, S. Shusta, L. Werra, S. Yvon-Lewis, and T. Weber, "A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico," *Science* 331 (6015) pp. 312-315, January 2011.

McGonigle, C., J. Grabowski, C. Brown, T. Weber, and R. Quin, "Detection of deep water benthic macroalgae using image-based classification techniques on multibeam backscatter at Cashes Ledge, Gulf of Maine, USA," *Estuarine, Coastal and Shelf Science*, 91 (1), 87-101, January 2011.

Schmidt, V., T. Weber, D. Wiley, and M. Johnson, "Underwater tracking of humpback whales (megaptera novaeangliae) with HF pingers and acoustic recording tags," *J. Oce. Eng.*, 35(4), 821-836. *October 2010.* (student paper)

Weber, T., H. Pena, and J. M. Jech, "Consecutive acoustic observations of an Atlantic herring school in the Northwest Atlantic," *ICES J. Marine Sci.* 66: 1270-1277. April 2009.

Gurshin, C.W., J. M. Jech, W. H. Howell, T.C. Weber, and L. A. Mayer, "Measurements of acoustic backscatter and density of captive Atlantic cod with synchronized 300-kHz multibeam and 120-kHz split-beam echosounders," *ICES J. Marine Sci.*, 66: April 2009.

Weber, T., "Observations of clustering inside oceanic bubble clouds and the effect on short-range acoustic propagation," *J. Acoust. Soc. America*, 124(5), pp. 2783-2792, November 2008.

Weber, T.C., A.P. Lyons, and D.L. Bradley, "Acoustic propagation through bubble clouds exhibiting spatial structure in the fluctuating number density," *IEEE J. of Oceanic Eng.* 32 (2), pp. 513-523, April 2007.

Holland, C.W., T.C. Weber, and G. Etiope, "Acoustic Scattering from Mud Volcanoes and Carbonate Mounds," *J. Acoust. Soc. Am.* 120(6), pp. 3553-3565, December 2006.

Weber, T.C., A.P. Lyons, and D.L. Bradley, "An estimate of the gas transfer rate from oceanic bubbles derived from multibeam sonar observations of a ship wake," *J. Geophys. Res.*, Vol 110, C04005, April, 2005.

Synergistic Activities

- Invited workshop participant for "An Ocean Infrastructure Strategy for U.S. Ocean Research in 2030" held by the National Research Council (2010).
- Member of organizing panel, and breakout panel, at a spring 2009 habitat mapping workshop sponsored by the Gulf of Maine Mapping Initiative (GOMMI).
- Acoustical Oceanography Technical Committee member, Acoustical Society of America
- Paper reviewer for Journal of Acoustical Society of America, IEEE Journal of Oceanic Engineering, ICES Journal of Marine Science, Aquatic Living Resources, Marine Technology Society, and Physics Today.
- Lecturer in underwater acoustics (undergraduate/graduate) at the University of New Hampshire.

Collaborators (past 5 years)

Dr. David L. Bradley, Penn State Applied Research Laboratory; Dr. Alex De Robertis, NOAA Alaska Fisheries Science Center; Dr. Jon Grabowski, Gulf of Maine Research Institute; Sam Greenaway, NOAA Office of Coast Survey; Dr. Danny Grunbaum, University of Washington; Dr. Michael Jech, NOAA Northeast Fisheries Science Center; Dr. Molly Lutcavage, University of New Hampshire; Dr. Anthony P. Lyons, Penn State Applied Research Laboratory; Dr. Larry Mayer, University of New Hampshire; Dr. Gary Melvin, Department of Fisheries and Oceans Canada; Dr. Hector Pena, Institute of Marine Research, Norway; Glen Rice, NOAA Office of Coast Survey; Dr. Chris Rooper, NOAA Alaska Fisheries Science Center; Val Schmidt, University of New Hampshire; Sarah Stiennesen, Alaska Fisheries Science Center; Dr. Tim Stanton, Woods Hole Oceanographic Institute; Dr. Jason Stockwell, University of Vermont; Dr. Dave Wiley, Stellwagen Bank National Marine Sanctuary; Dr. Chris Wilson, NOAA Alaska Fisheries Science Center

CURRICULUM VITAE

PAUL D. SPENCER
NMFS, Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle, WA 98115

Telephone: 206-526-4248
Fax: 206-526-6723
email: Paul.Spencer@noaa.gov

PROFESSIONAL PREPARATION:

St. Could State University, St. Cloud, MN	Biology	B.S., 1986
University of Minnesota, St. Paul, MN	Fisheries	M.S., 1989
University of Rhode Island, Narragansett, RI	Oceanography	Ph.D., 1997

APPOINTMENTS:

1998-present Research Fisheries Biologist, Alaska Fisheries Science Center
1997-1998 Research Fisheries Biologist, Southwest Fisheries Science Center, Tiburon, CA.

SCIENTIFIC INTERESTS: Modeling of fisheries population dynamics and management, fisheries oceanography, survey design, rockfish reproductive biology.

SELECTED PUBLICATIONS

Hanselman, D.H., P.D. Spencer, and D.R. McKelvey. In review. Application of an adaptive acoustic/trawl survey to reduce uncertainty in rockfish biomass estimates. Fishery Bulletin.

Spencer, P.D., D.H. Hanselman, and D.R. McKelvey. In review. Simulation modeling of a trawl-acoustic survey design for patchily-distributed species. Fisheries Research.

Gharrett, A.J., R.J. Riley, and P.D. Spencer. In press. Genetic analysis reveals restricted dispersal of northern rockfish along the continental margin of the Bering Sea and Aleutian Islands. Trans. Am. Fish. Soc.

Ormseth, O.A. and P.D. Spencer. 2011. Analyzing the vulnerability of Alaska groundfish to overfishing. Fisheries Research 112:127-133.

Spencer, P.D., and J.N. Ianelli. 2010. Assessment of the Pacific ocean perch stock in the eastern Bering Sea and Aleutian Islands. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region as projected for 2011, pp. 1033-1084. North Pacific Fishery Management Council, 605 W. 4th Ave, suite 306. Anchorage, AK 99501.

Patrick, W.S., P. Spencer, J. Link, J. Cope, J. Field, D. Kobayashi , P. Lawson, T. Gedamke, E. Cortés, O. Ormseth, K. Bigelow, and W. Overholtz. 2010. Using productivity and susceptibility indices to assess the vulnerability of U.S. fisheries to overfishing. Fishery Bulletin 108:305-322.

Spencer, P.D. 2008. Density-independent and density-dependent factors affecting temporal changes in spatial distributions of eastern Bering Sea flatfish. Fish. Oceanogr. 17:396-410.

Spencer, P.D., D. Hanselman, and M. Dorn. 2007. The effect of maternal age of spawning on estimation of F_{msy} for Alaskan Pacific ocean perch. In J. Heifetz, J. DiCosimo, A.J. Gharrett, M.S. Love, V.M. O'Connell, and R.D. Stanley (eds.). Biology, assessment, and management of north Pacific rockfishes, pp 513-533. Alaska Sea Grant, University of Alaska Fairbanks.

Hanselman, D., P. Spencer, K. Shotwell and R. Reuter. 2007. Localized depletion of three Alaska rockfish species. pp. 493-511 In J. Heifetz, J. DiCosimo, A.J. Gharrett, M.S. Love, V.M. O'Connell, and R.D. Stanley [eds.]. Biology, assessment, and management of north Pacific rockfishes. Alaska Sea Grant College Program, University of Alaska Fairbanks.

Spencer, P.D. and J.N. Ianelli. 2005. Application of a Kalman filter to a multispecies stock complex. pp. 613-634 In G. Kruse, V. Galluci, I. Perry, T. Shirley, P. Spencer, B. Wilson, and D. Woodby. [eds.]. Fisheries assessment and management of new and developed fisheries in data-poor situations. University of Alaska Sea Grant College Program, University of Alaska Fairbanks.

Spencer, P.D. and J.S. Collie. 1997. Patterns of population variability in marine fish stocks. Fisheries Oceanography 6:188-204.

SELECTED SERVICE ON SCIENTIFIC COMMITTEES:

1. Member, North Pacific Fisheries Management Council Gulf of Alaska Fishery Management Plan Team, 2008 - present.
2. Member, NMFS Climate Change Vulnerability Working Group, 2011-present.
3. Member, National Marine Protected Area Science Center Institute working group on maternal age effects and marine reserves, 2007-2008.
4. Member, European Union COST Workgroup on Fish Reproduction and Fisheries (FRESH), 2008-2011.
5. Co-chair, Magnuson-Stevens Reauthorization Act Technical Guidance Team for Vulnerability Evaluation, 2007-2009.

COLLABORATORS AND OTHER AFFILIATIONS:

Nick	Bond	JISAO, UW	Jim	Ianelli	NMFS-AFSC
Mike	Canino	NMFS-AFSC	Sarah	Kraak	U. College Cork, Ireland
Lorenzo	Cianelli	Oregon State U.	Tara	Marshall	U. of Aberdeen, Scotland
Jane	DiCosimo	NPFMC	Olav	Ormseth	NMFS-AFSC
Martin	Dorn	NMFS-AFSC	Chris	Rooper	NMFS-AFSC
Tim	Essington	U. of Washington	Fran	Saborido-Rey	CSIC, Vigo, Spain
Diana	Evans	NPFMC	Ingrid	Spies	NMFS-AFSC
Anthony	Gharrett	UAF-Fairbanks	Edward	Trippel	DFO- St Andrews, NB
Dana	Hanselman	NMFS-AFSC	Chang	Ik Zhang	Pkuyung University
			Mark	Zimmermann	NMFS-AFSC

DANA H. HANSELMAN
Auke Bay Laboratories/NMFS/NOAA
17109 Lena Loop Rd, Juneau, AK 99801
(907)789-6626, dana.hanselman@noaa.gov

PROFESSIONAL PREPARATION

University of Michigan, Ann Arbor	Ecology	BS	1997
University of Alaska, Fairbanks	Fisheries Biology	MS	2000
University of Alaska, Fairbanks	Fisheries Biology	PhD	2004

APPOINTMENTS

November 2010-present. Fellow
National Research Council

August 2008 – present. Affiliate Faculty
University of Alaska, Fairbanks--Fisheries Division, Juneau, AK.
Research activities: 2 Ph.D. committees, statistics, population genetics

June 2003-present. Research Fishery Biologist. Auke Bay Laboratories/NOAA. Juneau, AK
Supervisor: Phillip Rigby.
Research activities: Responsible for stock assessments of several rockfish species and Alaska sablefish. These assessments and supporting marine ecological research provide advice to the North Pacific Fishery Management Council. Participate in at-sea field research on rockfish and sablefish surveys. Other activities include research on rockfish biology and surveys, sablefish distributions, and population dynamics.

August 1998-May 2003. Graduate Research Assistant.
University of Alaska, Fairbanks--Fisheries Division, Juneau, AK.
Advisor: Dr. Terrance J. Quinn II.
Research activities: Rockfish survey sampling designs and stock assessment.

RECENT PUBLICATIONS

Courtney, D.L., J. N. Ianelli, D. Hanselman, and J. Heifetz. 2007. Extending statistical age-structured assessment approaches to Gulf of Alaska rockfish (Sebastes spp.). *In* Heifetz, J., DiCosimo J., Gharrett, A.J., Love, M.S, O'Connell, V.M, and Stanley, R.D. (eds.). Biology, Assessment, and Management of North Pacific Rockfishes. Alaska Sea Grant, University of Alaska Fairbanks. pp 429–449.

Hanselman, D.H. 2004. Gulf of Alaska Pacific ocean perch: stock assessment, survey design and sampling. Ph.D. Thesis. University of Alaska Fairbanks, School of Fisheries and Ocean Sciences. 172 pp.

Hanselman, D.H., and Quinn II, T.J. 2004: Sampling rockfish populations: adaptive sampling and hydroacoustics. *In* Sampling rare or elusive species. Edited by W. Thompson, Island Press, Washington. pp. 271-296.

Hanselman, D.H., T.J. Quinn II, C. Lunsford, J. Heifetz and D.M. Clausen. 2003. Applications in adaptive cluster sampling of Gulf of Alaska rockfish. Fish. Bull. 101(3): 501-512.

Hanselman, D. H., C. Lunsford, and C. Rodgveller. 2011. Assessment of the sablefish stock in Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501. pp. 307-412.

Hanselman, D. H., S. K. Shotwell, P.J.F. Hulson, J. Heifetz, and J. N. Ianelli. 2011. Assessment of the Pacific ocean perch stock in the Gulf of Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501. Pp. 821-892.

Hanselman, D. H., T. J. Quinn, C. Lunsford, J. Heifetz, and D. M. Clausen. 2001. Spatial inferences of adaptive cluster sampling on Gulf of Alaska rockfi sh. In Spatial processes and management of marine populations, p. 303−325. Univ. Alaska Sea Grant Program, Fairbanks, AK.

Hanselman, D., P.D. Spencer, S.K. Shotwell, and R.R. Reuter. 2007. Localized depletion of three Alaskan rockfish species. Proceedings of the 23rd Lowell Wakefield Fisheries Symposium: Biology, Assessment, and Management of North Pacific Rockfishes.

Hulson, P.J.F., D.H. Hanselman, and T.J. Quinn. 2011. Effects of process and observation errors on effective sample size of fishery and survey age and length composition using variance ratio and likelihood methods. ICES J. Mar. Sci. 68: 1548-1557.

Hulson, P.J.F., D.H. Hanselman, and T.J. Quinn. 2012. Determining effective sample size in integrated age-structured assessment models. ICES J. Mar. Sci. 69: 281–292.

Hulson, P.J.F., J. Heifetz, D.H. Hanselman, S. K. Shotwell, and J. N. Ianelli. 2011. Assessment of the northern rockfish stock in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501. Pp. 893-970.

Lunsford, C., S.K. Shotwell, P.J.F. Hulson, and D.H. Hanselman. Assessment of the dusky rockfish stock in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501. Pp. 1009-1104.

Malecha, P. W., D. H. Hanselman, and J. Heifetz. 2007. Growth and mortality of rockfish (Scorpaenidae) from Alaskan waters. NOAA Tech. Memo. NMFS-AFSC-172. 61 p.

Mundy, P.R., D.M. Allen, J.L. Boldt, N.A. Bond, S. Dressel, E.V. Farley Jr., D.H. Hanselman, J. Heifetz, R.R. Hopcroft, M.A. Janout, C. Ladd, R.C. Lam, P.A. Livingston, C.R. Lunsford, J.T. Mathis, F.J. Mueter, C.N. Rooper, N. Sarkar, S.A.K. Shotwell, M.V. Sturdevant, A.C. Thomas, T.J. Weingartner, and D. Woodby. 2010. Status and trends of the Alaska Current Region, 2003-2008, pp. 142-195 *In* S.M. McKinnell and M.J. Dagg [Eds.] Marine Ecosystems of the North Pacific Ocean, 2003-2008. PICES Special Publication 4, 393 p.

Rodgveller, C. J., M. F. Sigler, D. H. Hanselman, and D. H. Ito. 2011. Sampling efficiency of longlines for shortraker and rougheye rockfish using observations from a manned submersible. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 3:1-9.

Shotwell, S.K., M.D. Adkison, and D.H. Hanselman. 2005 . Accounting for climate variability in forecasting Alaskan chum salmon in data-limited situations. *In*: Kruse, G.H., V.F. Gallucci, D.E. Hay, R.I. Perry, R.M. Peterman, T.C. Shirley, P.D. Spencer, B. Wilson, and D. Woodby (eds.), Fisheries assessment and management in data-limited s ituations. Alaska Sea Grant College Program, University of Alaska Fairbanks.

Shotwell, S.K., D.H. Hanselman, and D. Clausen. 2011. Assessment of the rougheye and blackspotted rockfish stock complex in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501. pp. 1105-1192.

Spencer, P., D.H. Hanselman, and M. Dorn. 2007. The effect of maternal age of spawning on estimation of Fmsy for Alaska Pacific ocean perch. *In* Heifetz, J., DiCosimo J., Gharrett, A.J., Love, M.S, O'Connell, V.M, and Stanley, R.D. (eds.). Biology, Assessment, and Management of North Pacific Rockfishes. Alaska Sea Grant, University of Alaska Fairbanks. pp 513 – 533.

AWARDS

June 2000-June 2003. NMFS/Sea Grant National Population Dynamics Fellowship

July 2009. Presidential Early Career Award for Scientists and Engineers (PECASE)

MEMBERSHIPS

June 2003-present. North Pacific Fishery Management Council Rockfish Working Group

Februrary 2007-present. U.S./Norway Catch estimation working group. (NOAA/IMS)

August 2008-present. North Pacific Fishery Management Council Groundfish Plan Team.

February 2008-present. National working group on the implementation of National Standard Guideline 1 of the reauthorization of the Magnuson Act.

April 2009 – present. NOAA Strengthening of Science Working Group

COLLABORATORS AND CO-AUTHORS (LAST 48 MONTHS):

Milo	Adkison	UAF-Fairbanks	Alan	Kronlund	DFO-Nanaimo, BC
Anthony	Booth	Rhodes U., S. Africa	Franz	Mueter	UAF-Fairbanks
Anne	Beaudreau	UAF-Fairbanks	Brian	Pyper	FishSciences
William	Clark	IPHC-emeritus	Terry	Quinn	UAF--Fairbanks
Jane	DiCosimo	NPFMC	Chris	Rooper	NMFS-AFSC
Martin	Dorn	NMFS-AFSC	S. Kalei	Shotwell	NMFS-AFSC
Jeff	Fujioka	NMFS-AFSC	Mike	Sigler	NMFS-AFSC
A.J.	Gharrett	UAF-Fairbanks	Paul	Spencer	NMFS-AFSC
Jonathan	Heifetz	NMFS-AFSC	Diana	Stram	NPFMC
Jim	Ianelli	NMFS-AFSC	Katy	Echave	NMFS-AFSC
Pete	Hulson	NMFS-AFSC	Mark	Zimmermann	NMFS-AFSC

Jonathan Heifetz

U.S. Department of Commerce, NOAA,
National Marine Fisheries Service
Alaska Fisheries Science Center
Auke Bay Laboratories
17109 Pt. Lena Loop Rd
Juneau, AK 99801

Phone: (907) 789-6054
FAX: (907) 789-6094
E-mail: jon.heifetz@noaa.gov

EDUCATION
Ph.D., 1996. University of Alaska Fairbanks
M.S., 1982. Humboldt State University, Arcata, CA
B.S., 1978. Emory University, Atlanta, GA

PROFESSIONAL EXPERIENCE
1982 to present**.** Fishery Research Biologist (Supervisory since 2006), Marine Ecology and Stock Assessment Program, NMFS, Alaska Fisheries Science Center, Auke Bay Laboratories, Juneau, Alaska. Determine population dynamics of Gulf of Alaska groundfish, study effects of fishing gear on sea floor habitat, and investigate habitat requirements of groundfish. Coordinate research, advise, lead analyses and write reports for assessing stocks of sablefish and rockfish in Alaska. Conduct research on ecologically sensitive habitat types (e.g., coral and sponge habitat). Chief scientist and participant on numerous research cruises throughout Alaska.

1996 to present. Member of the North Pacific Fishery Management Councils, Gulf of Alaska Plan Team

1999 to present. Adjunct faculty, University of Alaska Fairbanks, Juneau Center Fisheries and Ocean Sciences. Presently serving on two graduate student committees.

RECENT COLLABORATORS
Dr. Anthony Gharrett, University of Alaska Fairbanks
Dr. Jamal Moss, AFSC, Auke Bay Laboratories

SELECTED PUBLICATIONS

Heifetz, J., R. P. Stone and S.K. Shotwell. 2009. Damage and disturbance to coral and sponge habitat of the Aleutian Archipelago. Mar. Ecol. Prog. Ser. 397:295-303.

Heifetz J, D. Woodby, J. Reynolds, and R.P. Stone. 2007. Deep sea coral distribution and habitat in the Aleutian Archipelago. North Pacific Research Board Final Report 304, 303p. Accessed 20 Feb 2009 http://doc.nprb.org/web/03_prjs/r0304_final.pdf

Heifetz, J., B.L. Wing, R.P. Stone, P.W. Malecha, and D.L. Courtney. 2005. Corals of the Aleutian Islands. Fish. Oceanogr.14 (suppl. 1):131-138.

Heifetz, J. 2002. Coral in Alaska: distribution, abundance and species associations. Hydrobiologia. 471: 19-28.

Heifetz J. and N. Maloney. 2001. Estimation of tag reporting rates for sablefish in the northeastern Pacific Ocean. Alaska Fish. Res. Bull. 8: 1-11.

Heifetz, J., D. A. Anderl, N. E. Maloney, and T. L. Rutecki. 1999. Age validation and analysis of ageing error from marked and recaptured sablefish, *Anoplopoma fimbria*. Fish. Bull 97:256-263.

Heifetz, J. and T. J. Quinn II. 1998. Dynamics of a migratory fish population with applications to the management of sablefish. In F. Funk, T. J. Quinn II, J. Heifetz, J. N. Ianelli, J. E. Powers, J. F. Schweigert, P. J. Sullivan, C.-I. Zhang (eds.), Fishery stock assessment models. Alaska Sea Grant College Program, University of Alaska Fairbanks, AK-SG-98-01. 219-244.

Heifetz, J., M. L. Murphy, and K V. Koski. 1986. Effects of logging on winter habitat of juvenile salmonids in Alaskan streams. N. Am. J. Fish. Manage. 5:302-308.

Heifetz, J., S. W. Johnson, K V. Koski, and M. L. Murphy. 1988. Migration timing, size, and salinity tolerance of sea-type sockeye salmon (*Oncorhynchus nerka*) in an Alaska estuary. Can. J. Fish. Aquat. Sci. 46:633-637.

Ackley D. R. and J. Heifetz. 2001. Fishing practices under maximum retainable bycatch rates in Alaska's groundfish fisheries. Alaska Fish. Res. Bull. 8: 22-44.

Freese, L., P.J. Auster, J. Heifetz, and B.L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrates in the Gulf of Alaska. Mar. Ecol. Prog. Ser. 182:119-126.

Fujioka, J. T., C. R. Lunsford, J. Heifetz, and D. M. Clausen. 2007. Stratification by echosounder signal to improve trawl survey precision for Pacific ocean perch, p. 473-492. In J. Heifetz, J. DiCosimo, A. J. Gharrett, M. S. Love, V. M. O'Connell, and R. D. Stanley (editors), Biology, Assessment, and Management of North Pacific Rockfishes. University of Alaska Sea Grant Program Report No. AK-SG-07-01, University of Alaska, Fairbanks.

Clausen, D. and J. Heifetz. 2002. The northern rockfish, *Sebastes polyspinis*, in Alaska: commercial fishery, distribution, and biology. Mar. Fish. Rev. 64(4): 1-28.

Palof, K. J., J. Heifetz, and A. J. Gharrett. 2011. Geographic structure in Alaskan Pacific ocean perch (*Sebastes alutus*) indicates limited lifetime dispersal. Mar. Biol. 158:779–792.
Date Entered: 2012-01-10

Reynolds, J. R., S. C. Rooney, J. Heifetz, H. G. Greene, B. L. Norcross, and S. K. Shotwell. 2012. Habitats and demersal fish communities in the vicinity of Albatross Bank, Gulf of Alaska, p. 539-553. In P. T. Harris and E. K. Baker (editors), Seafloor Geomorphology as Benthic Habitat. Elsevier.

Shotwell, S. K., J. Heifetz, D. L. Courtney, and H. G. Greene. 2008. Mapping marine benthic habitat in the Gulf of Alaska: Geological habitat, fish distributions, and fishing intensity, p. 349-368. In B. J. Todd and H. G. Greene (editors), Mapping the Seafloor for Habitat Characterization. Geol. Assoc. Canada. Spec. Paper 47