Title: Combining bottom-trawl and midwater-acoustic surveys to assess semi-demersal fishes: Year 1 – mid-water fish sampling using a stereo camera system in a bottom trawl

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Project duration: 2 years

Funds requested: Year 1: $68,000; Year 2: $TBD

ASTWG Objective: (4) Transition AST to Operations

APPROVED BY AFSC

William Karp

11/3/11

Summary: Walleye pollock in the eastern Bering Sea (EBS) are assessed by conducting an acoustic-trawl (AT) survey on a NOAA vessel for the midwater or semi-pelagic component of the stock, and a bottom trawl (BT) survey on chartered fishing vessels for the demersal component. We propose development and demonstration of a method combining these surveys into a hybrid survey that can be conducted using only the chartered fishing vessels as an efficient option to assess semi-pelagic fish stocks when a dedicated NOAA Fisheries Survey Vessel (FSV) with acoustics capability is unavailable. Four years of acoustic data collected aboard the chartered vessels during the BT survey closely tracked the midwater pollock biomass obtained during the traditional AT survey (Honkalehto et al. 2011). An additional two years of these opportunistically collected data continue to be consistent with population trends. However, as no ancillary observational data are associated with the acoustic data comprising the index, an assumption about the size composition is required. To be more useful for fisheries management (and to remove the assumption about the size composition), direct observations are needed to more fully interpret the BT survey acoustic data. As time and money constrain the ability of the BT survey to obtain these observational data, we propose new tools and methods to obtain this information by developing a ruggedized stereo camera system, which is attached to the standard BT survey trawl (i.e., ruggedized CamTrawl). The system will be deployed in midwater to obtain size compositions of pollock and other pelagic fishes during standard BT survey operations. The ruggedized CamTrawl camera-frame component will be smaller than the original ASTWG-funded CamTrawl and will be designed to withstand the harsh conditions of standard daily deployments (including the ability to be easily attached and removed) on a bottom trawl. The use of the bottom trawl as a midwater pollock sampler will also be evaluated during the study. Thus, paired comparisons will be made between the bottom trawl (fished in mid-water) and the AT survey mid-water trawl to evaluate pollock size selectivity. Additionally, software will be developed which will evaluate accumulated backscatter during the BT survey to help determine when to conduct mid-water hauls. Because the costs to conduct the EBS BT survey (ca. $1.7 million) and AT survey (ca. $0.95 million) are substantial, these new proposed tools and methods to develop a combined AT and BT survey will result in dramatic savings and more efficient use of sampling platforms for NOAA.

Statement of Work:

Introduction. Traditionally, fisheries survey programs that sample demersal species have evolved relatively independently of those that sample pelagic species. This is the case, for example, at the Alaska, NW, and NE Fisheries Science Centers, which have well-developed bottom trawl (BT) survey and acoustic-trawl (AT) survey programs. In these situations, the focus has been to optimize sampling methods and hardware for the target habitat (midwater or sea floor) and species of interest. In some regions, species such as walleye pollock (AFSC), Pacific hake (NWFSC), and New England herring (NEFSC) may occur both in midwater and on the seafloor. Although large-scale surveys have been designed to target one or the other habitat, none have been designed to combine the methods and tools to effectively sample both of these habitats during the same survey – that is, a joint acoustic-trawl and bottom trawl (JABt) survey. There are situations, when combining these two survey efforts into a single multi-faceted survey (i.e., JABt survey)

may be highly efficient and could provide substantial savings in the assessment process of semi-demersal species, or in multi-species assessments where different pelagic and demersal species co-occur and their respective assessment surveys occur independently of one another. This type of combined survey approach has been conducted since the early 1980s by the Norwegians in the Barents Sea and Svalbard region (Hjellvik et al. 2003) and may be an appropriate survey strategy for assessing pollock and other species in US waters.

Walleye pollock, *Theragra chalcogramma*, is a semi-demersal fish, broadly distributed throughout the north Pacific with the largest concentrations found in the eastern Bering Sea (EBS). It forms one of the largest single species fisheries in the world (FAO 2010). We propose to develop a hybrid acoustic-trawl and bottom-trawl (JABt) survey to assess this species in the EBS using a combination of traditional and advanced sampling technologies to provide an alternative way to provide assessment information on this species over its entire vertical habitat. The successful demonstration of a JABt pollock survey will provide clear evidence that this combined survey approach could be used in other areas to provide an optimized survey strategy for improved multi-species assessments and improved semi-demersal species (e.g., pollock) assessments.

Rationale for EBS JABt survey. Researchers at the AFSC have been conducting two separate large-scale stock assessment surveys to estimate the distribution and abundance of walleye pollock in the eastern Bering Sea (EBS) for about three decades. The BT survey targets the demersal component of the stock (as well as other fishes and invertebrates) and the AT survey targets the semi-pelagic component. The effort and associated costs for conducting each of these two surveys is substantial. Both surveys are conducted over a 2-2.5 month period during the summer over a large area (Fig. 1). The BT survey has been conducted annually since 1982, covers an area of about 500 km^2 over bottom depths of 20-200 m, and requires approximately 375 bottom trawl hauls each survey. Two chartered commercial trawlers (~125 ft) with a scientific party of 6 persons each are required for the survey. The cost to conduct the survey, which includes costs for charters, fuel, shipping, overtime, and travel is about $1.7 million dollars. The EBS AT survey began as a triennial effort in 1979 but evolved into a mostly biennial schedule in recent years (i.e., occasionally conducted annually). It covers an area of 330 km^2 over 50-1500 m bottom depths. Acoustic data are currently collected along nearly 5500 nmi of transects and about 75-100 confirmation tows are made with large trawls. The NOAA

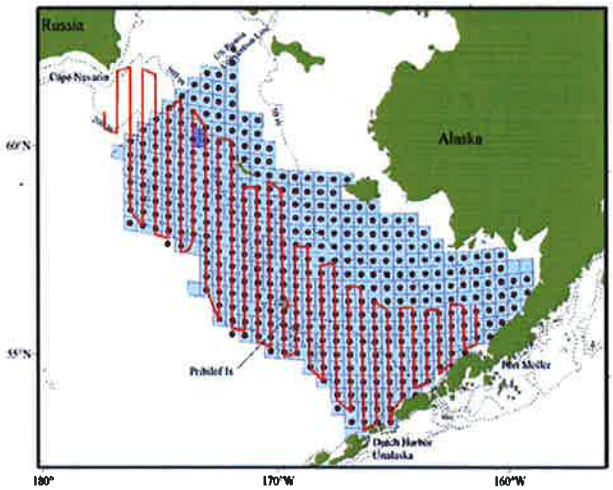

Figure 1. Typical AFSC acoustic-trawl trackline (red) of 20 nmi spaced north-south transects overlaid on AFSC bottom trawl survey grid where each point represents a trawl station.

ship *Oscar Dyson*, and a scientific party of 7 persons are used for this survey. The cost to conduct the survey, which includes costs for the ship (direct costs only), overtime, and travel is about $0.95 million. Substantial savings in survey costs for EBS pollock could be realized if the information required to provide pollock abundance estimates for both the semi-pelagic and demersal component of the EBS pollock stock could be collected using only one of these survey resources. The proposed study and resulting methods described below will ultimately enable EBS pollock or other similar semi-pelagic species abundance estimates by length to be made for both the midwater and demersal components, largely during the course of the standard BT survey. This will provide a means to conduct pollock (or similar semi-pelagic assessments) assessments when an FSV is unavailable to conduct a dedicated AT survey.

Current progress toward EBS JABt survey. A statistical age-structured assessment model is used for the assessment of pollock in the EBS (Ianelli et al. 2011, Fournier and Archibald 1982). Thus, survey estimates of total pollock abundance as well as abundance-at-length (age) are required as model inputs. Since summer 2006, quantitative *acoustic* data have been collected from the chartered commercial vessels during the annual BT survey in an effort to provide an index which serves as a proxy for total abundance of the semi-pelagic pollock component during alternate years when there is no AT survey (Honkalehto et al. 2011). Fortuitously, and for reasons unrelated to the Honkalehto study, the formal AT survey has occurred annually during summers 2006-2010 and has allowed 5 opportunities (consecutive years) to determine that the BT survey acoustic index tracks the AT survey abundance remarkably well (Fig. 2, Honkalehto et al. 2011). The BT survey index is based on pollock backscatter only; no size composition data are currently available to derive abundance-at-length estimates from these acoustics index data. Thus, we propose new methods and advanced sampling tools below to collect this size composition information in midwater to estimate the semi-pelagic pollock abundance-at-length (and total abundance) by further combining the BT and AT survey efforts into a JABt survey.

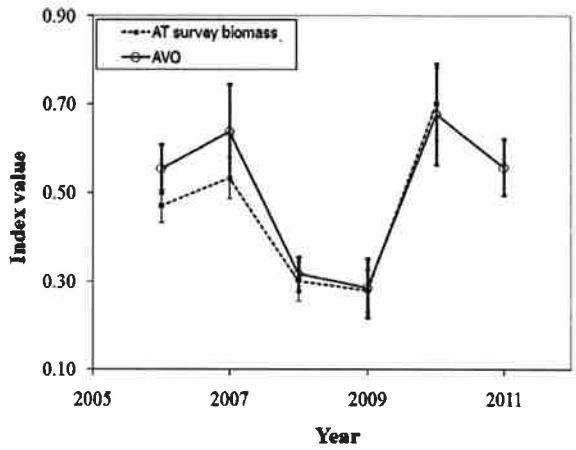

Figure 2. Eastern Bering Sea AT survey pollock biomass and BT survey acoustic pollock abundance index (AVO) for 2006-2011 with 95% confidence intervals based on 1-D geostatistical relative estimation error estimates. Each time series has been scaled to its mean value for the period 1999-2004 (not shown). No AT survey was conducted in 2011.

Detailed approach/tasks (Year 1):

Overview of tasks. Pollock size composition data from midwater are needed to derive semi-pelagic pollock abundance-at-length estimates using the BT survey acoustic data (Simmonds and MacClennan 2005; Honkalehto et al. 2007). Unfortunately, size composition data from on-bottom trawl catches (i.e., traditional BT survey tows) are not

appropriate to scale the midwater acoustic data as smaller, younger pollock are generally found in midwater whereas larger, older fish dominate on-bottom (Ianelli et al. 2010). Thus, to obtain midwater size composition estimates, year-1 tasks will focus on ruggedizing the ASTWG-funded CamTrawl (Fig. 3, Kresimir et al. 2010) for use in the traditional BT survey trawl (83-112 trawl), which will be deployed in midwater to provide size (and species) composition information. Other year-1 tasks include: determining the size selectivity of the bottom trawl to pollock when it is fished in midwater, and beginning development of customized software to accumulate backscatter collected aboard the BT survey vessels in near real time to assist in deciding when to conduct a trawl haul on pollock backscatter. At-sea tests of the ruggedized CamTrawl installed in the bottom trawl, trawl size selectivity, and preliminary evaluation of the accumulator software will be done aboard the *Oscar Dyson* during the summer 2011 EBS AT-survey. Specific tasks are detailed below.

Figure 3. The AFSC Camera-trawl (CamTrawl) system. View of the camera and frame assembly in the position it is in when actually attached to the deployed trawl (upper left). CamTrawl camera-frame assembly is attached to trawl with quick-release links at each corner of the frame base (upper right). CamTrawl being deployed aboard the *Oscar Dyson* (lower left). Typical images of walleye pollock taken during a midwater trawl haul (lower right).

Why CamTrawl? The BT survey is designed to cover a broad range of activities and focuses on a number of species. Furthermore, the most time-intensive activity during the BT-survey is catch processing to obtain basic information for numerous species and in fulfilling many special study requests. Additional time to process catches from midwater hauls is unavailable. However, the CamTrawl fished in midwater with an open codend provides a means to collect information without having to slow operations for catch processing. That is, the CamTrawl system will collect and store the needed size- and species-composition information with relatively little effort compared to that required for traditional catch processing. There are several reasons for this. First, CamTrawl can provide image data throughout an entire haul to dramatically improve the spatial sampling resolution compared to traditional midwater tows. This means that size- and species- information from multiple depth-discrete scattering layers can be sampled during a single haul. This eliminates the traditional strategy of conducting multiple tows (i.e., one tow per depth-discrete scattering layer) and the concomitant increase in catch processing effort. Second, CamTrawl is designed to be quickly deployed, recovered, and readied for redeployment (data download, replace battery). This was clearly demonstrated during the summer 2011 Gulf of Alaska AT-survey when use of CamTrawl on the midwater trawl added only about 20 minutes to each trawling event. We expect less time will be required for use on a chartered commercial trawler. Third, no time will be required at-sea for deriving size compositions from CamTrawl data as this can be done

after the cruise. This is obviously not the case if traditional catch processing of the midwater catches were to occur. For CamTrawl, automated sizing software will be used to derive length frequencies from images. Preliminary results from automated fish length

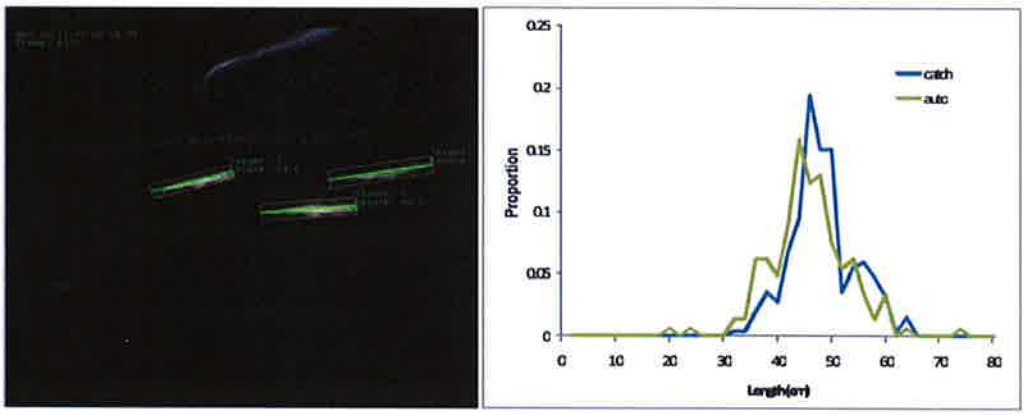

Figure 4. Comparison demonstrating no difference between estimated pollock size distributions derived from CamTrawl data using customized automated sizing software and that derived from manually measured lengths of captured fish. Panel on left illustrates sizing software length measurements from representative CamTrawl image.

analysis show good agreement between automated image-based length frequency and corresponding physical length measurements from the catch (Fig. 4). Due to the high proportion of pollock in midwater catches in the EBS (e.g., 98% of total catch weight for 2010 AT survey), less effort will be needed to ensure that identified fish targets are pollock.

Task 1: Ruggedized CamTrawl Design and Construction. Several modifications to the original CamTrawl design are needed to make it appropriate for the BT survey. The components will need to be attached to a housing chassis using shock resistant mounts (Fig. 5). Mounting the stereo-camera pair and acquisition hardware (miniaturized pc, power supplies, and triggering circuit) into a single housing will remove the need for specialized underwater cabling connections between these components, which lowers costs and removes possible points of failure from external connectors and cables. A custom housing with two parallel camera viewports will support a camera baseline separation of 25 cm, which is sufficient for accurate stereo-image based length measurements at ranges up to 5 m. Solid state hard drives will be used for data storage, and data downloading will be accomplished using a wireless connection. The cameras and other components incorporated into the design will be rated for industrial use, capable of operating at low temperatures encountered in the EBS and withstanding physical shocks of

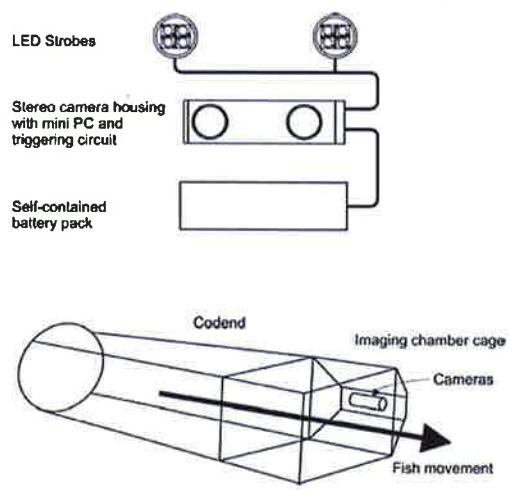

Figure 5. Proposed ruggedized Cam-Trawl camera and frame component. This ruggedized version will be attached to the back of trawl codend where it can be rapidly attached and removed.

back deck use. Power will be supplied using a dedicated battery pack such that replacement and charging of the batteries can be accomplished using a wet pluggable connector to remove the need for opening watertight connections. Lighting will be provided by LED strobes, which are power efficient and more robust than xenon flashtubes. A pressure switch will be used to start acquisition when the unit is deployed, while a deck cable for power will be used to access the data on retrieval. Incorporating all of these innovations into the instrument platform will provide a robust unit that is simple to operate, leveraging the experiences gained in the development of the original CamTrawl system.

The BT survey 2-seam bottom trawl will be modified so that the ruggedized CamTrawl camera-frame assembly can be quickly and securely installed and removed from the trawl. This will require building a dedicated and robust instrument cage which is attached to the end of the codend forcing fishes to pass by the cameras as they transit through the trawl and are ultimately released unharmed (Fig 5). The cameras and strobes will be mounted on one side of the cage, with the opposite side containing a dark canvas cover, to optimize image usability by taking lateral images of fish and to enable effective automated target detection. The cage will be appropriately sized for effective deployment from vessels historically chartered for the EBS bottom trawl survey. It will be neutrally buoyant by addition of flotation and constructed to withstand the rigors of operation in moderate to heavy seas. The design of the cage and the attachment methods will be guided in part by the trawl gear experts at AFSC and commercial fishers to ensure the final camera system is durable and can be safely deployed.

Task 2: Bottom trawl selectivity experiment. Unfortunately, BT-survey back-deck catch processing logistics make addition of a midwater trawl to the commercial BT survey trawler extremely difficult. However, it is common practice during standard pollock AT-surveys in the GOA to capture pollock when fishing a 4-seam bottom trawl (Poly North Eastern) in midwater under certain conditions (e.g., dense fish aggregations, close proximity to rough sea floor, bad weather; Guttormsen 2007). Additionally, the 2-seam EBS survey bottom trawl (83-112) has successfully captured pollock when this trawl has been occasionally fished relatively close to the sea floor (i.e., footrope 5-7 m off-bottom; Honkalehto et al. 2007, 2010). Based on this experience, we tentatively assume that the 2-seam bottom trawl (83-112) used during the standard BT survey may adequately sample pollock in midwater. We propose to conduct a paired trawl comparison experiment to test this assumption. The experiment will be conducted in the EBS during summer 2012 to evaluate whether there are detectable differences in size selectivity between the AT survey standard midwater trawl (Honkalehto et al. 2007) and the BT survey bottom trawl (83-112 trawl) when targeting pollock in midwater. This work will be conducted during the EBS AT survey aboard the *Oscar Dyson*. When substantial backscatter is observed during normal survey operations, one of the trawls will be selected at random to target the backscatter, and then a second haul will be conducted on the same backscatter with the other trawl. Paired trawling will be conducted throughout the surveyed area so that a wide range of fish sizes are available to the nets. A total of about 10-20 trawl pairs are planned for the work. This will require 3 additional days of NOAA ship time.

Task 3: Backscatter Accumulator software development. During a pollock AT survey, most midwater trawl hauls should ideally be conducted in areas where most of the backscatter is detected. During a typical BT survey, scientists are busy with catch processing and typically unavailable to monitor the echosounder to determine the need for a midwater tow. Conducting midwater hauls at random locations, or at the pre-assigned bottom trawl stations during the BT survey would be an unacceptable strategy for midwater sampling to interpret the acoustic data. We propose to develop software, which will accumulate unclassified backscatter within several depth strata. At a specified threshold, an audio/visual alarm will alert the chief scientist. Because most of the backscatter in many areas of the EBS represents pollock (Honkaleto et al. 2011), this alarm can provide guidance for when one should review the recent echosounder data. During the review, one could assess whether the substantial backscatter was likely pollock echosign (conduct midwater haul) or likely non-pollock backscatter (continue BT activities). In either case, the observer could reset the accumulator value to zero, provide instructions to the bridge regarding intent to fish, and then resume BT survey catch processing. A preliminary version of this software will be developed to run in parallel during the summer 2012 EBS AT survey to: 1) begin optimizing the software configuration (e.g., backscatter threshold levels for sounding notification alarm), and 2) determine the level of agreement between the software alarm notifications and actual decisions to haul, which are made by the scientific party. Funds to purchase a PC and hardware to implement an alarm are requested. The software will be developed at no cost to ASTWG. A production version of the software will be completed during a proposed year 2 of this study.

JABt uncertainty, Year-2 Tasks. There are several sources of uncertainty in the proposed effort to combine AT and BT surveys. Those based on Year-1 efforts will include durability of the ruggedized CamTrawl, bottom trawl selectivity to midwater pollock, and ability to conduct suitably directed midwater trawl hauls during a BT survey. During a proposed Year-2 of the study, operational efficiency of AT survey tasks will be evaluated aboard the BT survey vessels. This will include integration of the ruggedized CamTrawl operations during traditional BT survey operations, as well as installation and implementation of the backscatter accumulator software for assistance in optimizing placement of the midwater trawl hauls. Presuming year-2 results are encouraging, assessment of the JABt survey uncertainty will be comprehensively evaluated in summer 2014 when a comparison of resulting pollock abundance and biomass estimtates (by length) based on acoustic and midwater trawl data will be available from both the biennial AT survey and annual BT survey (i.e., JABt survey). Subsequent comparisons will continue to be made during alternate years (when AT surveys occur) to evaluate whether the JABt survey approach is appropriate for EBS pollock assessment needs.

Expected results

We expect to successfully complete the design and construction of the ruggedized CamTrawl system in time for testing and evaluation during the summer 2012 EBS AT survey. Based on our earlier work fishing a 4-panel bottom trawl in midwater, we are optimistic that the results of the paired trawl selectivity experiment during the summer 2012 survey will demonstrate similar pollock size selectivity compared to the standard midwater trawl.

Project Milestones/Schedule

Task	Jan-May	Jun-Aug
Ruggedized CamTrawl Construction	xx	
Ruggedized CamTrawl At-Sea Tests		xx
Trawl Selectivity Experiment		xx
Backscatter Accumulator Software Development	xx	
Backscatter Accumulator Software At-Sea Tests		xx

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Budget (Year 1)

Ruggedized CamTrawl	
Instrument cage	3,000
Main Housing (camera & computer)	2,500
LED Strobes (housings and components)	2,500
Domes (2, for cameras)	1,000
Cameras (2)	3,000
Cables	1,500
Batteries (2 sets + charger)	1,500
Total CamTrawl	15,000
Trawl Modifications	4,500
Shipping	2,500
Backscatter Cummulator PC, assoc. hardware	1,000
Vessel Time (*Oscar Dyson*) 3 days @ $15,000/day	45,000
YEAR 1 TOTAL	**$ 68,000**

Budget Justification

To conduct the trawl selectivity experiment during the summer 2011 EBS acoustic-trawl survey will require 3 ship days over the course of the two month survey. The RACE Division Director (Russ Nelson) has indicated the additional NOAA ship time is not available in the current FY 2012 ship schedule for survey-related research so ASTWG funds are requested for this ship time. Ruggedized CamTrawl hardware funds are requested but actual construction of the device will be by AFSC staff at no cost to ASTWG. The Backscatter Accumulator software development will be done at no cost to ASTWG although funds are required to obtain hardware for implementation of the system at-sea.

Justification for $5k increase in Budget cost (63k to 68k). Initially, an estimate of $13k was used for the daily cost of *Dyson* time. This initial estimate was revised to $15k based on information from the AFSC vessel coordinator (John Clary).

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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. *accepted.* Short-term effects of commercial fising on the distribution and abundance of walleye pollock. Canadian J. Fish Aquatic Sci.

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Recent Collaborators

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Curriculum Vitae

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Education:

B.S. Oceanography - Humboldt State University, Arcata, California, 1969

M.S. Oceanography - University of Washington, Seattle, Washington, 1972

Ph.D. Fisheries - University of Washington, Seattle, Washington, 1981

Experience:

1991-Present Supervisory Research Fishery Biologist
Alaska Fisheries Science Center
National Marine Fisheries Service
Seattle, WA

1985 - 1991 Research Fishery Biologist
Southwest Fisheries Science Center
Honolulu, Hawaii, USA

1983 - 1985 Research Associate
University of Washington
School of Fisheries
Seattle, Washington

1983 Assistant Professor, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

Recent Publications:

Somerton, DA, Williams, K, von Szalay, PG and Rose, CS.
2011. Using acoustics to estimate the fish-length selectivity of trawl mesh. ICES J Mar. Sci. 68:1558-1565.

Nichol, DG; Somerton, DA
2009. Evidence of the selection of tidal streams by northern rock sole (Lepidopsetta

polyxystra) for transport in the eastern Bering Sea.Fishery Bulletin Vol. 107: 221-234.
von Szalay, PG; Somerton, DA.
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von Szalay, PG; Somerton, DA; Kotwicki, S.
2007 Correlating trawl and acoustic data in the eastern Bering Sea: A firststep toward improving biomass estimates of walleye pollock (Theragra chalcogramma) and Pacific cod (Gadus macrocephalus)? Fisheries Research 867:71-83 .
von Szalay, PG; Somerton, DA; Kotwicki, S
2007.Correlating trawl and acoustic data in the eastern Bering Sea: A first step toward improving biomass estimates of walleye pollock (Theragra chalcogramma) and Pacific cod (Gadus macrocephalus)? Fish. Res. 86:77-83.
Somerton, DA, Munro, P, Weinberg, KL.
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Kimura, DK., DA Somerton.
2006. Review of statistical aspects of survey sampling for marine fisheries. Reviews in Fishery Science 14: 245-283.
Kotwicki, S, Weinberg, KL, Somerton, DA.
2006. The effect of autotrawl systems on the performance of a survey trawl. Fishery Bull.104: 35-45.
Weinberg, KL , Somerton, DA.
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Weinberg, KL, Otto, RS, Somerton, DA.
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Somerton, DA.
2004. Do Pacific cod (*Gadus macrocephalus*) and walleye pollock (*Theregra chalcogramma*) lack a herding response to the doors, bridles and mudclouds of survey trawls? ICES Journal of Marine Science 61:1186-1189.
Smith, KR, Somerton, DA, Yang, MS, Nichol, DG
2004. Distribution and biology of prowfish (*Zaprora silenus*) in the northeast Pacific. Fisheries Bulletin 102:168-178.
Somerton, DA.
2003. Bridle efficiency of a survey trawl for flatfish: measuring the length of the bridles in contact with the bottom. Fisheries Research. 60:273-279
Weinberg, KL, Somerton, DA, Munro, PT.
2002. The effect of trawl speed on the footrope capture efficiency of a survey trawl. Fisheries Research 58: 303-313

Kresimir Williams

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Education:

M.S. Auburn University, 2002, Fisheries And Aquaculture
B.S. Samford University, 1995, Biology

Positions:

Fishery Biologist, NMFS, NOAA, AFSC, Midwater Assessment and Conservation Engineering, 2003-present
Fisheries Observer, Alaskan Observes, Inc. 1997-2000

Research Interests:

Influence of fish behavior on survey design and uncertainty, advanced sampling technology and underwater instruments fish observation and enumeration, fisheries management, population modeling

Computer Skills:

Proficient programming skills in Matlab, Python, VB. Database design, image processing, 3-D visualization

Awards:

Bronze medal, NOAA, 2007 – for development of open design high precision fish measurement device
H.S. Swingle Award for Outstanding Master's Student, Auburn University, 4/02
Presidential Fellowship, Auburn University, 9/00 – 5/02
Russel – Barber Award for Excellence in Marine Studies, Samford University, 6/93

Publications:

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. 68:119-129.

Williams, K., Rooper, C. N., Towler, R. 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(3): 352-362.

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Williams, K; Papanikos, N; Phelps, RP; Shardo, JD. 2004. Development, growth, and yolk utilization of hatchery-reared red snapper *Lutjanus campechanus* larvae. *MARINE ECOLOGY-PROGRESS SERIES* 275: 231-239.

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PROFESSIONAL PROFILE

Experienced in all stages of instrument design from concept to production including circuit design and layout, sensor integration, and embedded and host software development with extensive background in software development using languages common to the scientific community.

EXPERIENCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ALASKA FISHERIES SCIENCE CENTER, SEATTLE, WA
MIDWATER ASSESSMENT AND CONSERVATION ENGINEERING — 2004 TO PRESENT
IT Specialist

UNIVERSITY OF WASHINGTON, SEATTLE, WA
SCHOOL OF AQUATIC AND FISHERY SCIENCES
FISHERIES ACOUSTICS RESEARCH LAB — 2000 TO 2004
Research Consultant

UNIVERSITY OF MICHIGAN, ANN ARBOR, MI
COOPERATIVE INSTITUTE FOR LIMNOLOGICAL AND ECOLOGICAL RESEARCH
GREAT LAKES ENVIRONMENTAL RESEARCH LAB — 1997 TO 2000
Programmer/Analyst

SHIELD INSURANCE SERVICES, GRAND RAPIDS, MI — 1996 TO 1997
Applications Developer

EDUCATION

B.S., Fisheries and Wildlife, Michigan State University, East Lansing, MI — 1995

AWARDS

NOAA Bronze Medal — 2007
For inventing and refining an inexpensive electronic measuring device to provide quick and accurate measurements of fish lengths.

PUBLICATIONS

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. Can J. Fish. Aquat. Sci.68:1231-1242.

Williams, K., Towler, R., Wilson, C. D. 2010. Cam-Trawl: A Combination Trawl and Stereo Camera System. Sea Technology 51(12): 45-50.

Williams, K., Rooper, C. N., Towler, R. 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(3): 352-362.

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Kotwicki, S., De Robertis, A., von Szalay, P., Towler, R. 2009. The effect of light intensity on the availability of walleye pollock (*Theragra chalcogramma*) to bottom trawl and echo-integration trawl surveys in the Eastern Bering Sea. Can J. Fish. Aquat. Sci., 6:983-994

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Towler, R H, Jech, J M, Horne, J K 2003. Visualizing fish movement, behavior, and acoustic backscatter. Aquat. Living Resour., 16: 277-282.

CURRICULUM VITAE

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Education:

1993 Ph.D. (Fisheries), University of Washington, Dissertation: "Studies on the Population structure of Skipjack tuna in the Central and Eastern Pacific Ocean"

1984 B.S. (Fisheries, Cum Laude) Humboldt State University

Professional Experience:

1991-pres. *Fisheries Scientist, Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center, NMFS, Seattle*: Primary responsibilities are to conduct fishery stock assessments on groundfish species in the Northeast Pacific Ocean and Bering Sea. Serves as principal investigator in assessments on a number of different fish stocks or species complexes in these regions. Conducts research on processes underlying production of marine fish stocks and provides advice regularly to the North Pacific Fisheries Management Council. Since 2002 has served as Chair of the groundfish Plan Team for the North Pacific Fishery Management Council (has served as a member since 1994). Science advisor to the Commission for the Conservation of Southern Bluefin Tuna since 2000 and to the South Pacific Regional Fisheries Management Organization.

2001-pres. *Affiliate Faculty, University of Washington.* Serves on a number of graduate student committees and makes regular presentations at seminars and classes. Promoted to Affiliate Professor in 2009.

1988-1991 *Research Assistant, Fisheries Research Institute, University of Washington.* Conducted investigations into the population structure of tropical tunas, including the development of alternative stock identification techniques. Examined the methods and feasibility of using hard-part chemistry as natural tags in tunas for stock identification purposes.

1991 *Fisheries Consultant, FAO, Rome - South Pacific Regional Fisheries Support Programme.* Compiled a report on the biology and fisheries of flyingfish in the Pacific Islands. The report detailed recommendations for research and fisheries development of flyingfish resources

1986-1988 *Fisheries Research Scientist, Tuna and Billfish Assessment Program, South Pacific Commission.* Worked with an international research team on the assessment of tuna stocks in the western and central tropical Pacific Ocean. Responsibilities included developing in-country fishery data collection systems, analyzing and reporting on the status of tuna stocks in the region, maintaining fisheries statistics on foreign and domestic fishing activities, and training local fisheries officers.

1984-1986 *Lab Director, Achotines Marine Laboratory, Inter-American Tropical Tuna Commission.* Supervised and administered the development and construction of the Inter-American Tropical Tuna Commission's (IATTC) fisheries research lab based in Panama.

1980-1982 *Associate Scientist, Inter-American Tropical Tuna Commission.* Directed two bluefin tagging experiments in coastal fishing villages in different parts of Japan.

1978-1980 *Experimental Officer, South Pacific Commission, New Caledonia.* Served as a technical expert in tagging tunas and conducting surveys for baitfish.

Recognition

Bronze medal	February 2010 awarded a bronze medal for contribution to EIS on Chinook salmon bycatch analysis.
Employee of the year	NOAA Fisheries Service, 2009
Service	NEPA Excellence, The Steller sea lion protection measures EIS, 2003

Publications

Hollowed, A.B., K.Y. Aydin, T.E. Essington, J.N. Ianelli, B.A. Megrey, A.E. Punt, and A.D.M. Smith. 2011 Experience with quantitative ecosystem assessment tools in the northeast Pacific. Fish and Fisheries. 00-00.

Ianelli, J.N., A.B. Hollowed, A.C. Haynie, F.J. Mueter, and N.A. Bond. 2011. Evaluating management strategies for eastern Bering Sea walleye pollock (*Theragra chalcogramma*) in a changing environment. ICES Journal of Marine Science, doi:10.1093/icesjms/fsr010.

Mueter, F. J., N.A. Bond, J.N. Ianelli, and A.B. Hollowed. 2011. Expected declines in recruitment of walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea under future climate change. ICES Journal of Marine Science.

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Dorn, M., J. Boldt, N. Bond, A. Hollowed, J. Ianelli, J. Overland, S. Rodionov, and T. Wilderbuer. 2004. Management implications of low-frequency variability in marine fish survival patterns in the North Pacific. ICES Journ. of Marine Science, CM 2004/M:10.

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Ianelli, J.N. 2002. Simulation analyses testing the robustness of productivity determinations from west coast Pacific ocean perch stock assessment data. North American Journal of Fisheries Management 22:301–310.

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Gaichas, S. and J.N. Ianelli. 1999. An alternative approach to analyses of other species in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, 2000. North Pacific Fishery Management Council, PO Box 103136, Anchorage, AK 99510. 98p.

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Thresher, J. and J.N. Ianelli. [eds] 1997. Proceedings of the international workshop on the skeletal microanalysis of marine fish. CSIRO Tech. Memo. [In prep.].

Gillett, R.D. and J.N. Ianelli. 1993. Flyingfish. *In* Wright, A. and L. Hill [eds.] Nearshore Marine Resources of the South Pacific. Inst. of Pacific Studies, Suva, Fiji. 710 p.

Ianelli, J. and J. Heifetz. 1995. Decision analysis of alternative harvest policies for the Gulf of Alaska Pacific ocean perch fishery. Fisheries Research 24:35-63.

Gillett, R.D. and J. Ianelli. 1991. Aspects on the biology and fisheries of flyingfish in the Pacific islands. FAO Field Document. RFSP, November, 1991. 49p.

Hankin, D.G., N. Diamond, M.S. Mohr, and J. Ianelli. 1989. Growth and reproductive dynamics of adult female dungeoness crabs, *Cancer magister,* in northern California. ICES Journ. du Conseil Expl. de Mer. 46: 94-108.