PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (Trustee Council Data Policy*, adopted March 17, 2008) and reporting requirements (Procedures for the Preparation and Distribution of Reports**, adopted June 27, 2007).

PROJECT TITLE:	**100806: Are herring energetics limiting. Part III. Disease challenges (Close-out)**
Printed Name of PI	**Johanna Vollenweider**
Email:	**Johanna.Vollenweider@noaa.gov**
Mailing Address	**Auke Bay Laboratories, NOAA Fisheries, 17109 Pt. Lena Loop Rd.**
City, State, Zip	**Juneau, AK 99801**
Phone:	**907-789-6612**
Signature of PI:	Date:
Printed Name of PI	**Ron Heintz**
Email:	**Ron.Heintz@noaa.gov**
Mailing Address	**Auke Bay Laboratories, NOAA Fisheries, 17109 Pt. Lena Loop Rd.**
City, State, Zip	**Juneau, AK 99801**
Phone:	**907-789-6058**
Signature of PI:	Date:
Printed Name of PI	**Paul Hershberger**
Email:	**phershberger@usgs.gov**
Mailing Address	**WFRC, Marrowstone Marine Field Station, 616 Marrowstone Pt Rd**
City, State, Zip	**Nordland, WA 98358**
Phone:	**360-385-1007 x 225**
Signature of PI:	Date:

* www.evostc.state.ak.us/Policies/data.cfm
** www.evostc.state.ak.us/Policies/reporting.cfm

FY10 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: 100806: Are herring (*Clupea pallasi*) energetics in PWS a limiting factor in successful recruitment of juveniles or reproductive investment of adults? Part III: Impacts of *Ichthyophonus* on metabolic rates of fasting herring. Close-Out

Project Period: FY10: October 1, 2009 – April 15, 2010

Primary Investigator(s): Johanna Vollenweider[1], Ron Heintz[1], Stan Rice[1], and Paul Hershberger[2]

[1]Auke Bay Laboratories, NOAA Fisheries
17109 Pt. Lena Loop Road
Juneau, AK 99801

[2]Marrowstone Marine Field Station, USGS
616 Marrowstone Point Road
Nordland, Washington 98358

Study Location: Herring samples from laboratory trials conducted at Marrowstone Marine Field Station (Nordland, WA) will be shipped to Auke Bay Labs for chemical analysis.

Abstract: Pacific herring (*Clupea pallasi*) in PWS have not rebounded following the population crash in 1993. We propose to determine if energy availability is limiting production of PWS herring. We made field collections of Pacific herring over the course of 3 winters to examine two energetic mechanisms that could potentially inhibit herring recruitment in PWS: 1) overwinter mortality of juveniles, and 2) low reproductive energy investments by adults. These processes were compared among thriving (Sitka Sound) and depressed (Lynn Canal) herring stocks to evaluate PWS collections. Field observations were supplemented with laboratory trials in year 2 to measure how metabolic rates and other bioenergetic parameters vary with temperature, thus calibrating the field observations from various habitats. Initial results indicate that PWS herring lose energy at a higher rate over winter than populations in southeast Alaska. High rates of energy utilization may be a factor of increasing predation rates (project 080804) or elevated prevalence of disease (project 080819). In year 3, laboratory trials with disease challenges are underway at Marrowstone Marine Field Station, which will determine if exposure to *Ichthyophonus* increases metabolic costs and if fish in poor nutritional condition are more susceptible to *Ichthyophonus*. Together, these data sets will illustrate how potential energetic bottlenecks may be limiting PWS herring and how disease impacts energy costs.

In this proposal, we request funding for a 4th year (FY10) to close-out the herring energetics project. With the exception of the laboratory component of the project, all other aspects of the project are on schedule. During the first lab trial, we encountered mortality rates higher than anticipated and subsequently reran the trial, setting us behind schedule by several months. We expect the laboratory trials to be complete by the end of September, in which case chemical analysis of the laboratory-collected samples will roll-over into FY10. The requested FY10 funding is to pay for the chemical analysis of those samples, for completion of analysis, writing reports and manuscripts, and for travel to present the integrated results of this 3-year study.

Estimated Budget:

EVOS Funding Requested *(must include 9% GA)*

FY10	FY11	FY12	FY13	Total
$60.7 K				$60.7 K

Non-EVOS Funds to be used:

FY10	FY11	FY12	FY13	Total
$57.4 K				$57.4 K

PROJECT PLAN

I. NEED FOR THE PROJECT

We request funding for a close-out year (FY10) for the herring energetics project. The majority of funds requested are for chemical analysis of laboratory-derived samples from disease challenge trials. Additional monies are requested for travel to present results integrating the three years of study. During this year, we will complete chemical analysis, data analysis, reports and manuscripts.

A. Statement of Problem

The reasons underlying recruitment failure among Prince William Sound (PWS) herring stocks are unknown. Historically, PWS herring stocks were sustained by the periodic recruitment of strong year classes. These year classes occurred approximately every four years and sustained an important economic base for people living in the region. Significant recruitment events have not happened in the last decade and the population size is severely constrained. The causes underlying these recruitment failures are currently unknown, but they may relate to disease, predation, or reduced forage quality. Surveys conducted in the late 1990's and early 2000's indicate that viral hemmorhagic septicemia (VHS) may be reducing recruitment of early age classes and ichthyophoniasis may be reducing the maximum age at maturity.

In addition to acute effects, disease could affect recruitment by increasing energetic demand. In earlier EVOS funded studies, the SEA project determined overwinter survival was a major limiting factor for young of the year (YOY) and probably age-1 herring (Norcross et al. 2001). Both year classes are highly vulnerable to predation, and must grow rapidly to minimize their exposure to some predators. However, allocation of ingested energy to growth obviates allocation to energy storage. In winter, food availability is severely limited and fish must rely heavily on energy reserves to meet metabolic demand. This means that juvenile herring must successfully negotiate the conflicting demands of growth and energy storage if they are to survive winter. In energetically demanding winters, relatively small herring have little energy reserves and high metabolic demand. Any additional drain on their energy reserves will likely make them vulnerable to mortality. Increased antibody titers resulting from low level infections may cause increases in energetic demand due to the relative high cost of protein synthesis. Increased disease prevalence and intensity therefore could increase vulnerability to mortality through natural causes during periods when exogenous energy supplies are diminished.

A second potential bottleneck to the recruitment process relates to the availability of high quality forage. Adult herring spawn in spring so that hatching coincides with the spring bloom. The paucity of prey available in the months prior to spawning means that adult herring must produce gametes under conditions of extremely limited exogenous energy sources. This accounts for the relative peaks in energy content of adult herring at the onset of winter (Vollenweider 2005). If forage quality in fall is poor, adults will enter winter with reduced nutritional condition and they will have reduced energy available for provisioning offspring.

Over the course of 3 winters, we have made energetic assessments of age 0, 1 and adult herring at the beginning and end of winter from three regional populations; PWS (depressed population, high disease prevalence), Lynn Canal (depressed population, low disease prevalence) and Sitka Sound (robust population, moderate disease prevalence). To aid in interpretation of the field data, physiological parameters of fasting herring were measured in the laboratory for different life

stages and temperatures to generate an energetic model. The energetic model will then be used to calibrate field observations across dissimilar habitats. In year 3 (currently underway), fasting trials were replicated with disease challenges to determine if exposure to *Ichthyophonus* increases metabolic costs and if fish in poor nutritional condition are more susceptible to *Ichthyophonus.* In year 4 (FY10), we will complete the chemical analysis of these laboratory-derived samples, analyze data and write reports/manuscripts integrating the field and lab components collected over the past 3 years.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

This project addresses "Injured Resources and Services: Evaluation and Restoration". In particular, we will examine Pacific herring, an injured resource which has been classified as "not recovered". One indication of recovery has been identified as highly successful recruitment of a year class. We will directly test hypotheses for recruitment failures. Identification of processes contributing to recruitment failures (or conversely, ruling out of these processes) will provide valuable information to managers for remediation.

II. PROJECT DESIGN

A. Objectives

We request funding for a close-out year (FY10) for the herring energetics project, during which time we will complete chemical analysis of samples, analyze results and write reports and manuscripts. No new work is proposed, and the over-arching objectives of the study remain the same as previously described in FY07, FY08 & FY09 proposals:

1) Compare the potential for overwinter mortality of juvenile herring from 3 populations, PWS and Lynn Canal (depressed populations), and Sitka Sound (robust population) by measuring their pre- and post-winter condition and rate of overwinter energy utilization.

2) Compare the potential for reduced reproductive potential of adult herring from 3 populations, PWS and Lynn Canal (depressed populations), and Sitka Sound (robust population) by measuring their pre- and post-winter condition, rate of overwinter energy utilization, and energetic cost of spawning.

3) Determine energy utilization rates of fasting herring at multiple temperatures under controlled laboratory conditions to compare to observations of overwinter energy utilization measured in the field.

4) Test the hypothesis that increased *Ichthyophonus* prevalence in PWS herring results in an increased metabolic cost relative to other locations in the state using lab trials to determine if exposure to *Ichthyophonus* increases metabolic costs and if fish in poor nutritional condition are more susceptible to *Ichthyophonus.*

B. Procedural and Scientific Methods

Procedural and scientific methods are the same as outlined previously in proposals for FY07, FY08 and FY09.

C. Data Analysis and Statistical Methods

Data analysis and statistical methods are the same as outlined previously in proposals for FY07, FY08 and FY09.

D. Description of Study Area

The study area is the same as previously described in proposals for FY07, FY08 and FY09. Field samples were collected in PWS, Sitka Sound, and Lynn Canal. Laboratory trial are conducted at Marrowstone Marine Field Station, WA.

E. Coordination and Collaboration with Other Efforts

Field collections: The field collection component of the project has relied heavily on collaboration with existing platforms in PWS operated by ADFG and PWSSC. In addition, data provided in this project will be of direct use to the EVOSTC funded project examining effects of whale predation. Furthermore, this project has supplied the disease study with samples at every possible collection period. Our collaborative efforts have led to opportunistic development of our hypotheses and formation of new ideas, one of which is to compare disease incidence and energy content in individual fish (which will be pursued).

Laboratory culturing and energetics measurements: The laboratory component of the project has relied heavily on collaboration with the expert personnel and facilities at the USGS Marrowstone Marine Field Station. Cost sharing with the EVOS TC-funded Herring Disease Program was utilized to minimize budgetary requirements. The Marrowstone facility and staff are unique in that they are amongst a handful of facilities in the world which are proficient at culturing Pacific herring. Some NOAA staff will make periodic trips to aid in specific measurements of the cultured fish.

Energetic assessments and chemical analyses: Proximate and lipid content of field collections and laboratory tests were conducted by TSMRI. The bioenergetic measurements such as assimilation efficiency, maximum consumption rate and routine metabolic rates will be of direct interest to bioenergetic modelers.

III. SCHEDULE

A. Project Milestones

November 2009: Complete chemical analysis of samples from disease challenge trials
September 2010: Submit final report

B. Measurable Project Tasks

FY 10, 1st quarter (October 1, 2009-December 31, 2009)

September	Receive and begin processing disease challenge samples in the chemistry lab
	Analyze data for field-caught samples
November	Complete chemical analysis of disease challenge samples
December	Analyze data, write report/manuscripts

FY 10, 2nd quarter (January 1, 2010-March 31, 2010)

January	Attend AK Marine Science Symposium

FY 10, 3rd quarter (April 1, 2010-June 30, 2010)
April Continue data analysis and write-up

FY 10, 4th quarter (July 1, 2010- September 30, 2010)
September Submit final report

IV. PUBLICATIONS AND REPORTS

Vollenweider JJ, Heintz RA (2010) Regional variation in energy consumption of juvenile Pacific herring (*Clupea pallasi*) overwintering in Alaska. Peer Reviewed Journal.

Vollenweider JJ, Heintz RA (2010) Regional variation in energy expenditure of spawning Pacific herring (*Clupea pallasi*) in Alaska. Peer Reviewed Journal.

Heintz RA, Vollenweider JJ, Hershberger P (2010) Parameterization of the Wisconsin model to determine metabolic costs of activity in Pacific herring (*Clupea pallasi*). Peer Reviewed Journal.

Hershberger P, Vollenweider JJ, Heintz RA (2010) Impacts of Icthyophonus infection on Pacific herring (*Clupea pallasi*) energetics. Peer Reviewed Journal.

Hershberger P (2010) Temperature effects on mortality kinetics of *Icthyophonus*-infected Pacific herring (*Clupea pallasi*). Peer reviewed journal.

Final Report

V. BUDGET JUSTIFICATION

We request a total of $60.7 K for the project close-out in FY10.

Personnel Services ($5.3 K requested): One month of salary for Vollenweider is requested for sample organization, data analysis and report/manuscript writing. Six months of Vollenweider's salary will be provided in-kind by NOAA to complete these tasks ($31.8 K). $25.6 K of additional in-kind salaries (NOAA funding) will be contributed in FY10 for work performed by Heintz (report and manuscript writing) and Bradshaw (protein analysis and bomb calorimetry). No overtime is requested as all the field and lab work will be completed by the end of FY09.

Travel: ($6.4 K requested): Travel funds are requested for 2 PIs to travel from Juneau to the AK Marine Science Symposium ($3.2 K). Additional funds ($3.2 K) are requested for Vollenweider's travel to the national American Fisheries Society meeting to present the integrated results of the 3-years of study.

Contractual: ($35.0 K requested). $35.0 K is requested for contracted laboratory technicians to perform the chemical analysis of the laboratory-derived samples. These analysis include sample preparation, lipid extraction, QA analysis of the data, and data archiving.

Commodities: ($9.0 K requested): Requested funds will be used to purchase consumable laboratory supplies (solvents, gases, glassware, etc) ($8.0 K) and to ship samples ($1.0 K) from the Marrowstone Marine Research Station (where the laboratory trials are being conducted) to Juneau where chemical analysis of the samples will be conducted.

Equipment: ($0 K requested). No equipment funding is requested.

General Admin ($5.0 K requested) Funds are calculated as 9% of the total direct cost.

****** No funding is requested for the USGS, Marrowstone Marine Research Station. Laboratory trials will be concluded in FY09 under current funding.

Literature Cited

Norcross BL, Brown ED, Foy RJ, Frandsen M, Gay SM, Kline TC, Mason DM, Patrick EV, Paul AJ, Stokesbury KD (2001) A synthesis of the life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska. Fish Oceanogr 10(1) 42-57.

Vollenweider JJ, Heintz RA (In Review) Seasonal variation in whole-body proximate composition and energy content of forage fish in southeastern Alaska. Mar Ecol Prog Ser.

VI. DATA MANAGEMENT AND QA/QC STATEMENT

1. **Study design.** The field component has a stratified study design. Samples were collected from each of the 3 study sites (PWS, Sitka Sound, Lynn Canal) pre-winter, post-winter, and post-spawning. Adults and juveniles were targeted during each sampling bout. Fish were collected from multiple herring schools and bays if possible to prevent school-specific biases. Samples collected from the laboratory component are taken at the onset, at prescribed intervals, and at the termination of the lab trials. Sample sizes (field and lab components) are based on previous studies by Auke Bay Laboratories which indicate optimal sample sizes for sampling power.

2. **Acceptable data.** Acceptable chemistry data will conform to standard QA criteria employed by our laboratory.

3. **Data characteristics.**
    a. Field collections of fish: data include lengths, weights, gender, Bio-electric Impedance measurements (proxy for condition), gonadosomatic index, age, stomach fullness, diet composition, whole body proximate composition (lipid, protein, caloric content) and gonad proximate composition (lipid, protein, caloric content).
    b. Other field measurements: water temperature (CTD casts)
    c. Lab collections of fish (fasting trials): data include lengths, weights, whole body proximate composition (lipid, protein, caloric content), growth rates, energy loss rates (i.e. metabolic rate), consumption, length-based compensatory growth rates, RNA/DNA ratios (growth index)
    d. Lab collections of fish (disease challenges): data include mortality rates, infection rates, whole body proximate composition (lipid, protein, calories)
    e. Other lab measurements (fasting trials & disease challenges): daily mean water temperature, temperature units

4. **Algorithms to convert signals from sensors to observations.** Lipid and water content will be determined gravimetrically. Protein is determined using proprietary software for our Leco Tru-spec CHN analyzer. Separate calibration curves will be developed for RNA and DNA for each batch of 15 samples. CTD data will be converted from .hex files (collection format) using proprietary software from SeaBird.

5. **Sample handling and custody.** Biological information for each sample will be entered onto a custody sheet. The custody sheet has columns for sample identification number (SIN), fish length, weight, age, sex, gonadosomatic index, stomach fullness, diet composition, collection date, collection location (general location and latitude/longitude), collection method, the collector's name, and a column for any comments that might be important in interpretation. Examples of commentary would be any noticeable evidence of disease or parasites. The sample numbers will be assigned in the field. Sample identification numbers on custody sheets will be used to track the progress of samples through the analytical process and to correlate those results with the initially collected biological information. All QA and analytical results will reside in our database and can be tracked by the sample number. Electronic and hard copies of custody sheets are maintained at ABL.

6. **Calibration and performance evaluation of analytical instrumentation.** For gravimetric determination of lipid content, a duplicate sample will be analyzed per group of 15-20 fish along with a standard reference sample (SRM) and blank. A second set of samples will be re-analyzed if the coefficient of variation for the duplicates was greater than 25% or if the reference sample value not within 15% of the established value or if detectable lipid is found in the blank A whole herring homogenate is used as the SRM. The lipid content of the herring homogenate was initially determined in a group of samples that included the National Institute of Standards and

Technology (NIST) SRM-1946, which has a certified value for lipid. The NIST SRM-1946 is processed monthly, along with the herring SRM to ensure consistency. We employ blanks (cane sugar) and reference materials (herring) to verify the protein results. Periodically a NIST standard is used to further test accuracy. RNA and DNA analyses include blanks and reference materials. There is no NIST standard for RNA and DNA so we use a pollock that has been repeatedly analyzed.

7. **Data reduction and reporting.** All field data will be tabulated by location, collection year, collection period (pre-winter, post-winter, pre-spawn). All lab data will be summarized by temperature and duration after fasting was initiated or disease was introduced. See the proposal for details.

Johanna J. Vollenweider
NOAA Fisheries, AFSC
Auke Bay Laboratories
17109 Pt Lena Loop Rd
Juneau, AK 99801 USA

Voice: (907) 789-6612
Fax : (907)789-6094
EMAIL: Johanna.Vollenweider@noaa.gov

EDUCATION:

B.S. Marine Biology, Chemistry Minor, December 1998, University of North Carolina, Wilmington

M.S. Fisheries Biology, May 2005, University of Alaska, Fairbanks Alaska
Advisor: Brendan P. Kelly, Ph.D.

SELECTED BIOENERGETIC/LIPID BIOCHEMISTRY PUBLICATIONS:

Vollenweider J, Heintz R, Kelly BP (*Submitted*) Seasonal variation in whole-body proximate composition and energy content of forage fish in southeastern Alaska. Marine Ecology Progress Series

Hudson J, Heintz R, **Vollenweider J** (*Submitted*) Overwinter changes in energy content and proximate composition of juvenile capelin and eulachon in southeastern Alaska. Fishery Bulletin

Heintz R, **Vollenweider J**, Sigler M (*Submitted*) Seasonal and ontogenetic changes in the energy allocation strategies of walleye pollock. Canadian Journal of Fisheries and Aquatic Science

Vollenweider J, Womble J, Heintz R (2006) Estimation of seasonal energy content of Steller sea lion (*Eumetopias jubatus*) diet. In: Sea Lions of the World. AW Trites, SK Atkinson, DP DeMaster, LW Fritz, TS Gelatt, LD Rea, and KM Wynne (Eds). Alaska Sea Grant College Program, University of Alaska Fairbanks. p 117-130.

Vollenweider JJ (2005) Variability in Steller sea lion (*Eumetopias jubatus*) prey quality in southeastern Alaska. Juneau Center, School of Fisheries and Ocean Sciences, Fairbanks

Vollenweider JJ, Heintz RA, Hudson J (*In prep*) Seasonal and annual energy phenology of Pacific herring (*Clupea pallasi*) in Lynn Canal, southeastern Alaska

Schaufler L, Logerwell E, **Vollenweider J** (2006) Geographical variation in Steller sea lion prey quality in Alaska. In: Sea Lions of the World. AW Trites, SK Atkinson, DP DeMaster, LW Fritz, TS Gelatt, LD Rea, and KM Wynne (Eds). Alaska Sea Grant College Program, University of Alaska Fairbanks. p 117-130.

Hillgruber N, **Vollenweider JJ** (*In prep*) Distribution, composition and energy density of zooplankton in the southeastern Bering Sea. For submission to Marine Biology or Fisheries Oceanography. Currently published as a final report to NPRB (2006)

Vollenweider JJ, Csepp D. Steller sea lion (*Eumetopias jubatus)* response to pre-spawning eulachon (*Thaleichthys pacificus)* in northern southeastern Alaska. ASFC Quarterly Research Report. July-Sept 2005.

Wildes S., **Vollenweider JJ,** Guyon, J. (Submitted) Genetic stock structure of Pacific herring in Lynn Canal, Southeast Alaska

Sigler MF, Tollit DJ, **Vollenweider JJ**, Thedinga JF, Csepp DJ, Womble JN, Wong MA, Rehberg MJ, Trites AW (In final review) Foraging response of a marine predator, the Steller sea lion, to seasonal changes in prey availability. Marine Ecology Progress Series.

Csepp D, **Vollenweider JJ**, Sigler MF (Internal Review) Seasonal abundance and energy availability of forage species to marine predators in southeastern Alaska

RECENT COLLABORATIONS INVOLVING BIOENERGETICS

Csepp, D. NOAA Fisheries, Auke Bay Lab, Groundfish Assessment Program, Juneau, AK
Heintz, R.A. NOAA Fisheries, Auke Bay Lab, Nutritional Ecology Lab, Juneau, AK
Hillgruber, N. University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Juneau, AK
Hudson, J. NOAA Fisheries, Auke Bay Lab, Nutritional Ecology Lab, Juneau, AK
Kelly, B.P. University of Alaska Southeast, Juneau, AK
Logerwell, E. NOAA Fisheries, AK Fishery Science Center, Seattle, WA
Mathews, E. University of Alaska Southeast, Juneau, AK
Schaufler, L. NOAA Fisheries, Auke Bay Lab, Nutritional Ecology Lab, Juneau, AK
Sigler, M. NOAA Fisheries, Auke Bay Lab, Groundfish Assessment Program, Juneau, AK
Tollit, D. N Pacific Universities Marine Mammal Research Consortium, B.C., Canada
Womble, J.N. NOAA Fisheries, Auke Bay Lab, Groundfish Assessment Program, Juneau, AK

Ron A. Heintz
Fishery Research Biologist
National Marine Fisheries Service
Auke Bay Laboratory
11305 Glacier Hwy.
Juneau, AK 99801 USA

Voice: (907) 789-6058
Fax : (907)789-6094
EMAIL: Ron.Heintz@NOAA.GOV

EDUCATION:

B.S. Ecology Ethology and Evolution, June 1979, University of Illinois, Urbana Illinois
M.S. Fisheries Biology, May 1987, University of Alaska, Juneau Alaska
PhD May 2009 University of Alaska, Fairbanks Alaska

PROFESSIONAL MEMBERSHIPS:

American Fisheries Society
American Institute of Biological Scientists
American Chemical Society

EMPLOYMENT AND STUDY FOCUS:

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Auke Bay Laboratory since 1985.

Prior to 2000

Examined the effects of crude oil exposure during embryogenesis on the life history of fish.

Since 2000

Leads AFSC Nutritional Ecology Laboratory program investigating the nutritional status and trophic relationships of marine forage species.

SELECTED BIOENERGETIC/LIPID BIOCHEMISTRY PUBLICATIONS:

Heintz, R, Wipfli, M. and J.P. Hudson. . Submitted. Identification of marine-derived lipids in juvenile coho salmon (*Oncorhynchus kistuch*) and aquatic insects using fatty acid analysis. Transactions of the American Fisheries Society.

Heintz, R. and J. P. Hudson. Submitted. Effects of Diet Quality on Energy Loss in Fasting Coho Salmon (*Oncorhynchus kisutch*). Transactions of the American Fisheries Society.

Heintz, R.. and L. Schaufler. Submitted. Energy allocation strategies of resident Dolly Varden (*Salvelinus malma*) in anadromous and non-anadromous streams. Transactions of the American Fisheries Society.

Vollenweider, Johanna J. **R. Heintz** and B. Kelly. In Review. Seasonal variation in the proximate composition and whole-body energy content of forage fish. Marine Ecology Progress Series.

Heintz R. and J Volllenweider. In Review. Seasonal and ontogenetic changes in the energy allocation strategies of walleye pollock. Can. J. Fish. Aquat. Sci.

Cox, M. K. and **R. Heintz** In press. Phase angle as a new method to measure fish condition. Fishery Bulletin. Accepted February 2009.

Otis, T., **R.A. Heintz** and K.P. Severin. 2008. Discriminating among Alaska's herring stocks using heart fatty acid profiles and otolith microchemistry. Oil Spill Restoration Project Final Report (Restoration Project 02538), Alaska Department of Fish and Game, Homer, Alaska.

Vollenweider, Johanna J., Jamie Womble, **Ron Heintz**. 2006. Forage fish species contribution to total energy content of Steller sea lion diet in southeastern Alaska. Proc. 22nd Wakefield Fisheries Symposium: Sea Lions of the World

Heintz, R.A., B.D. Nelson, J. Hudson, M. Larsen, and L. Holland. 2004. Marine subsidies in freshwater: Effects of salmon carcasses on lipid class and fatty acid composition of juvenile coho salmon. Trans. Am. Fish. Soc. 133:559-567.

Gende, S.M., T.P. Quinn, M.F. Willson, **R. Heintz**, T. M. Scott. 2004. Magnitude and fate of salmon-derived nutrients and energy in a coastal stream ecosystem. J. Fresh. Ecol. 19:149-160.

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Budget Category:	Proposed FY 10	Proposed FY 11	TOTAL PROPOSED
Personnel	$5.3	$0.0	$5.3
Travel	$6.4	$0.0	$6.4
Contractual	$35.0	$0.0	$35.0
Commodities	$9.0	$0.0	$9.0
Equipment	$0.0	$0.0	$0.0
SUBTOTAL	$55.7	$0.0	$55.7
General Administration (9% of subtotal)	$5.0	$0.0	$5.0
PROJECT TOTAL	$60.7	$0.0	$60.7
Other Resources (Cost Share Funds)	$0.0	$0.0	$0.0

COMMENTS: In-kind contributions used as cost-share for the work in theis proposal. All in-kind contributions are funded by NOAA base funds ($57.4 K).

Employee	Position Description	Contribution	Duration	Amount
Vollenweider, J.	Fisheries Research Biologist (ZPII-1)	Data analysis, report/manuscript writing	6 months	$31.8 K
Heintz, R.	Director, Nutritional Ecology Lab (ZPIII-3)	Report/manuscript writing	1 month	$9.6 K
Bradshaw, R.	Research Chemist (ZPIII-1)	Protein analysis and bomb calorimetry	2 months	$16.0 K

FY10 - 11

Project Title: Are Herring Energetics Limiting?
Lead PI: Vollenweider
Agency: NOAA

FORM 3A
TRUSTEE AGENCY SUMMARY

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Position Title	Step	Budgeted	Costs	Overtime	Sum
J. Vollenweider	Fisheries Research Biologist	ZPII-1	1.0	5.3		5.3
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		1.0	5.3	0.0	
					Personnel Total	$5.3

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Trips for 2 to attend the AK Marine Science Symposium	0.6	2	8	0.3	3.2
Trip for 1 to attend the national American Fisheries Society Mtg	0.8	1	6	0.4	3.2
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$6.4

FY10

Project Title: Are Herring Energetics Limiting?
Lead PI: Vollenweider
Agency: NOAA

FORM 3B
PERSONNEL &
TRAVEL DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Contractual Costs: Description	Contract Sum
Laboratory technician for chemical analysis of lab-collected specimens	35.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$35.0

Commodities Costs: Description	Commodities Sum
Supplies for chemical analysis of lab-collected specimens	8.0
Shipment of specimens and equipment from Marrowstone to Juneau	1.0
Commodities Total	$9.0

FY10

Project Title: Are Herring Energetics Limiting?
Lead PI: Vollenweider
Agency: NOAA

FORM 3B
CONTRACTUAL & COMMODITIES DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
None			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$0.0

Existing Equipment Usage: Description	Number of Units	Inventory Agency
Leco Protein Analyzer	1	NOAA
Accelerated Solvent Extractor (Lipid Content)	1	NOAA
Leco Thermogravimetric Analyzer (Moisture & Ash content)	1	NOAA
Parr Semi-Micro Bomb Calorimeter (Caloric content)	1	NOAA

FY10

Project Title: Are Herring Energetics Limiting?
Lead PI: Vollenweider
Agency: NOAA

FORM 3B
EQUIPMENT
DETAIL