Nate Bickford

Project #060782

Annual Progress Reports

2. Project Title

Using otolith chemical analysis to determine larval drift of Prince William Sound Pacific herring (*Clupea pallasii).*

3. Principal Investigator's Name(s)

Nate Bickford

4. Time Period Covered by the Report

01 October 2005 – 01 September 2006

5. Date of Report

15 September 2006

6. **Summary of Work Performed –** This section shall include a brief summary of work performed during the reporting period, including any results available to date and their relationship to the original project objectives. Any deviation from the original project objectives, procedures or statistical methods, study area, or schedule shall be included. Any known problems or unusual developments, and any other significant information pertinent to the project, shall also be described.

During the first eleven months of this project we have made progress towards achieving all project objectives.

1) Use trace element signatures of edge portions of juvenile Pacific herring (*Clupea pallasii)* otoliths to identify the otolith chemical signature of individual rearing bays within Prince William Sound (PWS).

2) Use trace element signatures of core portions of herring otoliths to identify individual spawning regions with in PWS.

3) To compare otolith data with the 3D-PWS model for larval drift.

We extracted the sagittal otoliths from intact frozen juvenile herring collected during the Sound Ecosystem Assessment (SEA) project (n=638). Thin sections were then cut laterally across the otolith to expose the core and edge portions of the otolith. The otoliths were then mounted onto slides with crystal-bond thermal glue and polished. Juvenile otoliths were then aged prior to trace element analysis on the Laser Ablation Inductively Coupled Mass Spectrometer (LA-ICP-MS). Quality control of age estimates was completed as estimates were compared between 3 professional investigators.

LA-ICP-MS analysis consisted of analysis of the core material, accreted at the natal location, and edge material, accreted at the capture location. These raw elemental counts were processed using GEO Pro v1.00. These calibrated and calculated counts for the isotopes Sr^{88}, Mg^{24}, and Ba^{138} were all normalized to Ca^{48} as a ratio. The isotopes Sr^{87} and Sr^{86} were compared to each other as a ratio (Barnett-Johnson et al. 2005). Diagnostic test were done on the data including, Brown and Forsythe test for constant variance and the Kolmogorov-Smirnov Lilliefors test for normality (Brown & Forsythe 1974; Lilliefors, 1967). These data were then transformed were needed to best meet the assumptions of ANOVA by limiting the adverse effects of non-normality on my inferences. These explanatory variables were then compared using One-way ANOVA (α=0.05) to identify the possible sources of variance amongst the independent variables: capture bay, management area, capture year, capture season, capture month, and year-class. Tukey-Kramer honestly significant differences (HSD) Post Hoc test was used for multiple comparisons between the dependent variable.

7. **Summary of Future Work to be Performed –** This brief summary shall describe work to be performed during the upcoming year, if changed from the original

proposal. A description of any proposed changes in objectives, procedural or statistical methods, study area, or schedule shall be included.

Principal component analysis (PCA) will be used to aggregate the data and reduce dimensionality of our samples from each habitat. The PCA results will distinguish geographically distinct groups of herring. Geographical distinct regions identified from edge data will enable us to create a discriminate function that will be used to assign class membership to the core signatures. Identification of natal areas from the juvenile otoliths will be compared with the capture locations. This will enable us to assess the accuracy of the 3D-PWS model for larval drift in PWS (Norcross et al. 2001).

8. **Coordination/Collaboration –** This section shall describe efforts undertaken during the reporting period to achieve the coordination and collaboration provisions of the proposal, if applicable.

NA

9. **Community Involvement/TEK and Resource Management Applications –** This section shall describe efforts undertaken during the reporting period to achieve the community involvement/TEK and resource management application provisions of the proposal, if applicable.

NA

10. **Information Transfer –** This section shall list (1) publications produced during the reporting period, (2) conference and workshop presentations and attendance during the reporting period, and (3) data and/or information products developed during the reporting period.

Preliminary data was presented as a poster in January 2006 during the Alaska Marine Science Symposium in Anchorage, AK. In June 2006, Juvenile herring data was also orally presented during the North American Benthological Society (NABS) in Anchorage, AK, by Seanbob Kelly.

Our preliminary data consists of bivariate identification of regional elemental signatures. Using the edge data we have assessed the elemental signatures of several bays for the years 1995-1997 (Fig. 1). We have used a similar analysis to identify natal origins of herring through the core elemental signatures (Fig. 2).

These preliminary data show us that regional elemental signatures can be identified within the bays of PWS in P. herring. Presentation of this initial data was intended to illustrate the promise of our project. Final inferences and conclusions pertaining to our project are forthcoming.

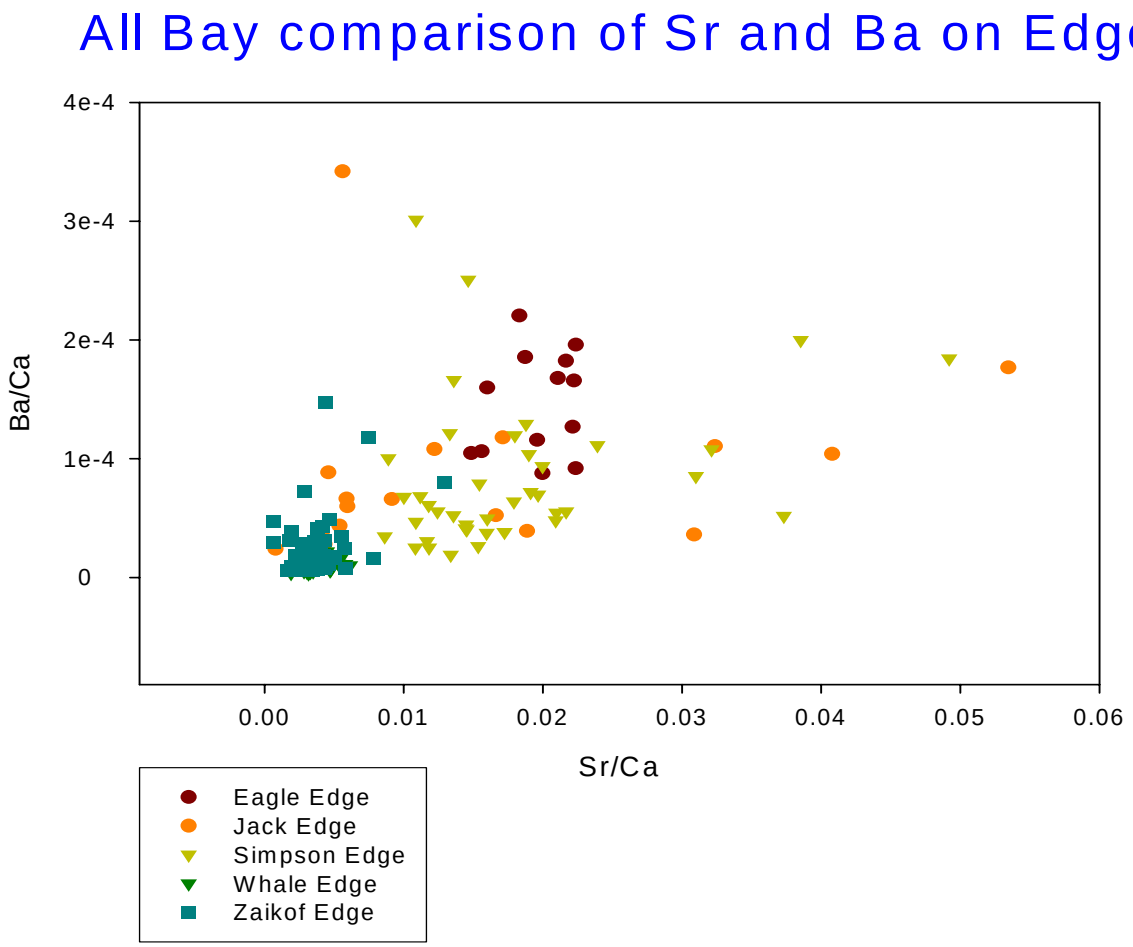

Fig. 1

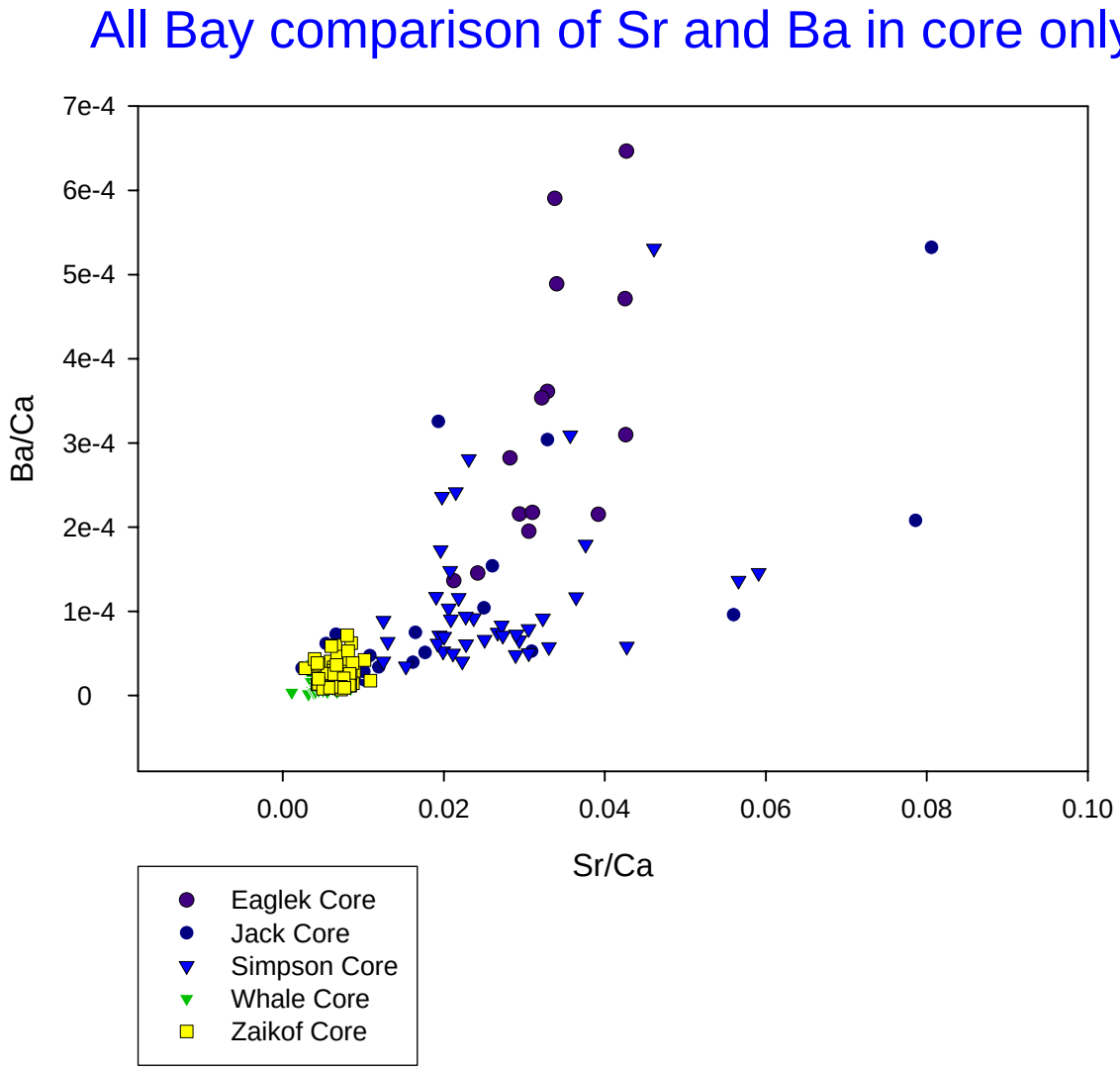

Fig. 2

11. **Budget –** This section shall explain any differences and/or problems between actual and budgeted expenditures, including any substantial changes in the allocation of funds among line items on the budget form. Any new information regarding matching funds or funds from non-Trustee Council sources for the project shall be included.

There have been no problems to date

Works Cited

Barnett-Johnson, R.; Ramos, F; Grimes, C.; MacFarlane, R. (2005). Validation of Sr isotopes in otoliths by laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICPMS): opening avenues in fisheries science applications. *Can. J. Fish. Aquat. Sci.,* 62, 2425-2430.

Brown, M. B. and Forsythe, A. B. (1974). Robust tests for the equality of variances. *Journal of the American Statistical Association*, 69, 364-367.

Lilliefors, H. (1967). On the Kolmogorov-Smirnov test for normality with mean and variance unknown. *Journal of the American Statistical Association*, 62, 1-24.

Norcross, B. L.; Brown, E.; Foy, R.; Gay, S.; Kline, T.; Mason, D.; Patrick, E.; Paul, A.J.; Stokesbury, K. (2001). A synthesis of the life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska. *Fisheries Oceanography*, 10 suppl. 1, 42-57.