WASHINGTON SEA GRANT
PROJECT COMPLETION SUMMARY REPORT

INSTRUCTIONS: Please provide a lay summary for your completed project that includes the following project elements:

- objectives
- methodology
- rationale
- major findings
- significance of results

If relevant, also include:

- students supported (number and degree level)
- partnerships
- outreach activities

Please note that this summary will be submitted in the Washington Sea Grant annual report to the National Sea Grant Office and will be available to the public via the NIMS database and the Washington Sea Grant website.

WSG Project Number:	**R/F-149**
Project Title:	Long-term Changes in Genetic Diversity and Population Structure of Pacific Herring (*Clupea pallasi*) in Puget Sound
Project period:	2/1/2004 – 1/31/2008

Principal Investigator(s) and Affiliation:

Lorenz Hauser	School of Aquatic and Fishery Science, University of Washington
Pat McAllister	Washington Department of Fish and Wildlife (retired, replaced by **Kurt Stick**)
Greg Bargman	Washington Department of Fish and Wildlife

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*(Please provide your summary here. Character limit: **5,000 characters**, including spaces):*

Despite their economic importance, relatively little is known about long-term changes in population structure of exploited marine species. Recent reductions in abundance of herring stocks in the Pacific Northwest have renewed the attention of management agencies, scientists and the public on human effects on marine fish biodiversity. The issue is of particular relevance in Puget Sound herring where some known spawning

aggregations have severely declined in abundance. Local depletion may lead to the extinction of locally adapted populations, resulting in a loss of biodiversity and a reduction in the productivity and adaptability of the species as a whole. The investigation of the population dynamics of exploited fish is therefore of crucial importance in achieving sustainable fisheries while conserving existing biodiversity. Here, we assessed the long term stability of genetic population structure in Pacific herring in Puget Sound, using scale samples collected since the 1970s for ageing, and extant sample collected 1999-2007.

Samples of herring were collected from pre-spawning holding aggregation near their presumed spawning beaches. Genetic variability was screened at 12 microsatellite loci, regions of the genome that are tandemly repeated and exhibit variation in the number of repeats. Unfortunately, scale samples could not be used because of extensive contamination on the scales caused by sperm spilled by males. The same problem was encountered in extant samples (fin clippings), but here contamination could be removed by treatment in bleach. In order to test for small scale genetic differentiation on the beaches, herring eggs were collected from one of the sites and also analyzed using the 12 microsatellites.

Genetic data allowed two primary conclusions: (i) Cherry Point herring, a population distinguished by late spawn timing, exposed spawning site and recent population decline, was genetically differentiated from all other herring populations in all years, demonstrating long-term genetic and demographic isolation of that population; (ii) Case Inlet (Squaxin Pass) herring in the south of Puget Sound, were genetically differentiated from other populations in 1999 and 2002, but not in 2005, suggesting that this population was isolated until 2005, but subsequently replaced by herring from further north in Puget Sound. Potentially, this replacement represents a loss of genetic diversity in Puget Sound herring, though these results need to be confirmed with further samples collected in 2007. Analyses of egg samples are still ongoing, but suggest extensive relatedness of eggs at small spatial scales.

Our results have significant impacts on the management of Puget Sound herring: (i) Cherry Point is indeed an isolated population, and recent declines in abundance are unlikely to be compensated by immigration from other populations. Management should consider this population as an independent unit, and protect spawning grounds as well as manage catches of adult fish independently for that population. Such a strategy is already in place at the Washington Department of Fish and Wildlife, and our results support this approach. (ii) Although herring numbers in Case Inlet appear to be stable, our results suggest that a local population has disappeared and has been replaced by other stocks. If verified, our results suggest the need for continued monitoring of genetic diversity of herring and the use of metapopulation theory incorporating local extinctions and recolonization in marine fisheries management. Current WDFW management goals of protecting individual spawning grounds are supported by these data, as presently underutilized spawning grounds may become important in the future.

The project supported one graduate Masters student, Danielle Mitchell, who has since moved on the a research scientist position at the University of Washington and who is now working as a Research Associate for Alder Biopharmaceuticals, Inc. The project was a collaboration with the Washington Department of Fish and Wildlife, providing opportunity to place research within a management context.