Molecular Genetic Technology in Chinook Salmon Fishery Management

Molecular Ecology and Genetic Analysis Team
SWFSC Fisheries Ecology Division, Santa Cruz

Mission Statement

Provide biological inference, through collection of statistically robust molecular genetic datasets and development of rigorous analytical methods, to support NOAA protected resource and sustainable fishery mandates.

Molecular Population Genetics in Fishery Biology

- Variation in specific sections of the hereditary material, DNA, or its products, proteins, used for biological inference including:
  - Population structure and size
  - Population History
  - Behavior
  - Kin relationships
  - Natural Selection
  - Individual discrimination
  - Gender determination
  - Fishery stock proportions

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REPORT OF THE EXPERT PANEL ON THE FUTURE OF THE CODED WIRE TAG RECOVERY PROGRAM FOR PACIFIC SALMON

Panel Members

- John Clark, ADFG
- Rick Deriso, IATTC
- Carlos Garza, NMFS, CA
- David Hankin, HSU, CA (chair)
- Gary Morishima, MORI-ko, WA
- Brian Riddell, DFO, BC
- Carl Schwarz, SFU, BC
- Jim Scott, WDFW

  w/technical support from

  Marianna Alexandersdottir, NWIFC

MAJOR FINDINGS: Existing & Future Technologies

- 11-12. Existing technologies (otolith thermal marking & genetic stock identification (GSI) methods) can complement the CWT system, but cannot replace it.

- 14. “Typical” GSI methods can provide estimates of stock composition, but not of age or brood year. Scale ages are not judged reliable enough to adjust GSI data.

MAJOR FINDINGS: Existing & Future Technologies

- 16. GSI methods might be used to reduce fishery mortalities of natural stocks of concern….

- 17. Over the next several years, we believe that SNPs (single nucleotide polymorphisms) will replace microsatellite markers as the genetic tool of choice. Reasons include ease of standardization and greatly reduced costs.

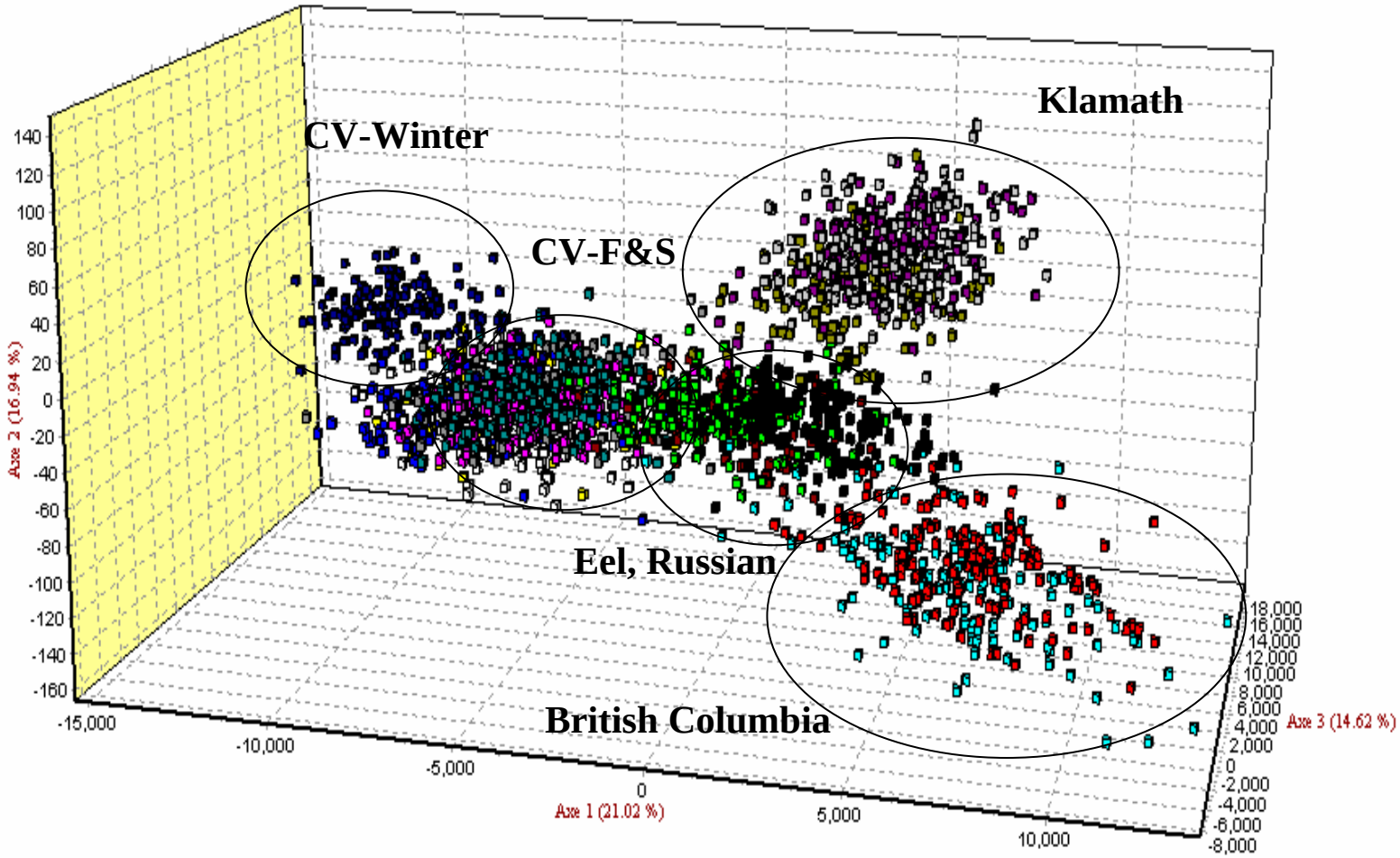
MAJOR FINDINGS: Existing & Future Technologies

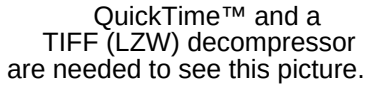
- 18. A novel genetic method, termed full parental genotyping (FPG), has been presented as an alternative to coded wire tagging. An empirical demonstration is needed to validate promising theoretical results.

Coastwide Chinook Salmon Genetic Stock ID

- GAPS (Genetic Analysis of Pacific Salmonids) Consortium
  - Eight lab collaboration to standardize microsatellite data for use in management of chinook salmon fisheries
  - Funding: Pacific Salmon Commission-Chinook Technical Committee
  - Participating labs: ADFG; CDFO-Nanaimo; CRITFC; NWFSC-Seattle; OSU; WDFW; SWFSC-Santa Cruz
  - Products: 1). Standard set of 13 microsatellites which can be used in all labs for mixed fishery analysis; 2). Genetic baseline dataset of ~120 fish from 105 populations that can identify all major stocks from Alaska to California

Factorial Correspondence Analysis of CA Chinook Salmon Individual Genotypes

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TIFF (LZW) decompressor
are needed to see this picture.

Molecular Genetic Technology in California Chinook Salmon Fishery Management- Proposal

Evaluation of catch stock composition on a fine temporal and spatial scale using genetic stock identification.

-Divide the coast south of Cape Falcon into 5 sectors

-Port sampling of recreational and commercial fisheries in each sector every 3-7 days

-200 samples per sector per sampling period

-Genetic stock identification techniques applied with 2-4 day turnaround time for catch stock composition estimates.

-Accurate and precise estimates of fishery mortality on a sector by sector basis for very fine time strata.

Genetic Stock Identification - An Example in Monterey Bay

-Recreational fishery: April, 2006

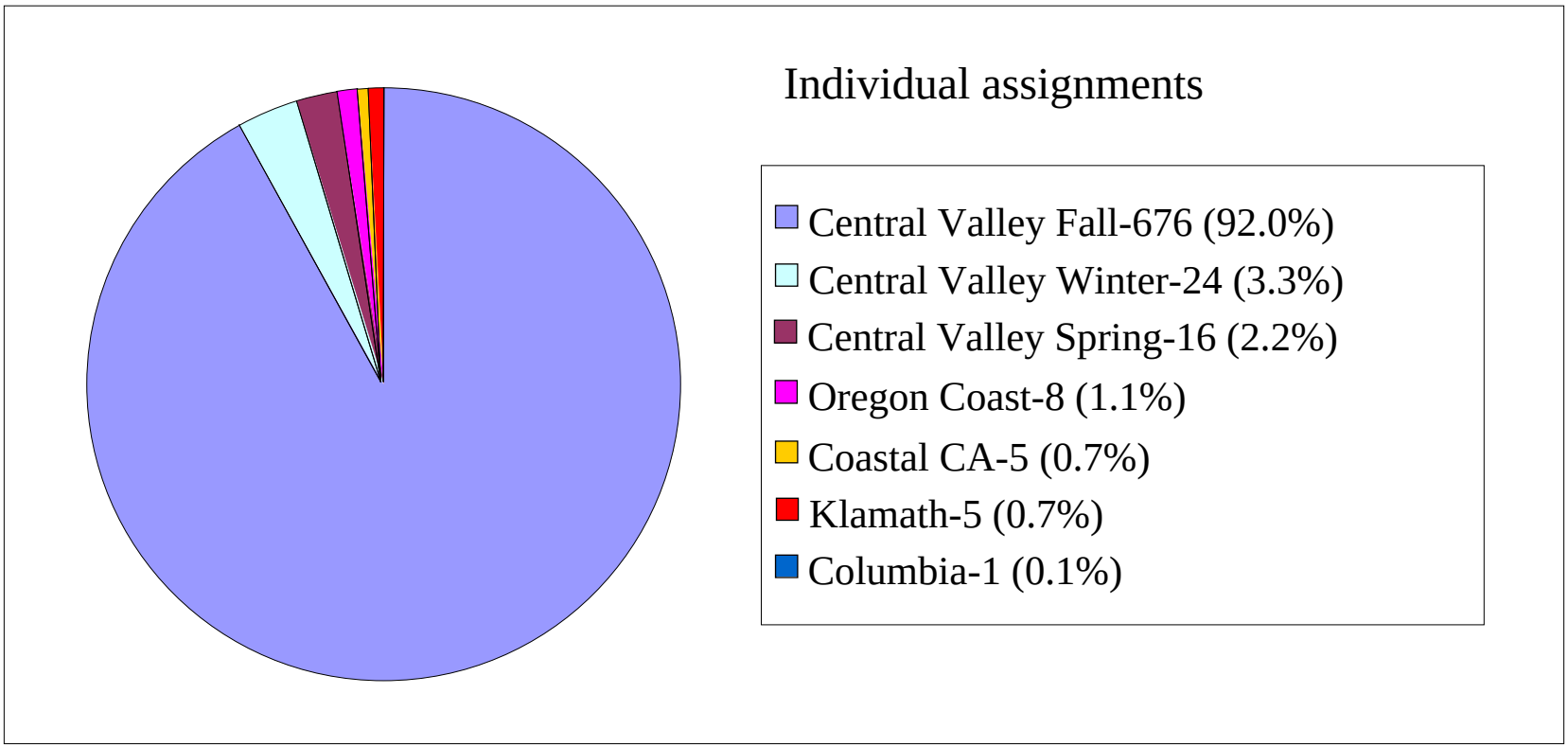
-Sampling from Monterey Bay ports: Santa Cruz, Moss Landing, Monterey - charter and private boats:

-735 fish sampled, small clips ($1cm^2$) from caudal fin, and genotyped at 13 GAPS microsatellite genes and compared to coastwide baseline database for stock assignment.

-Stock composition estimates available in 4-7 days from receipt of samples.

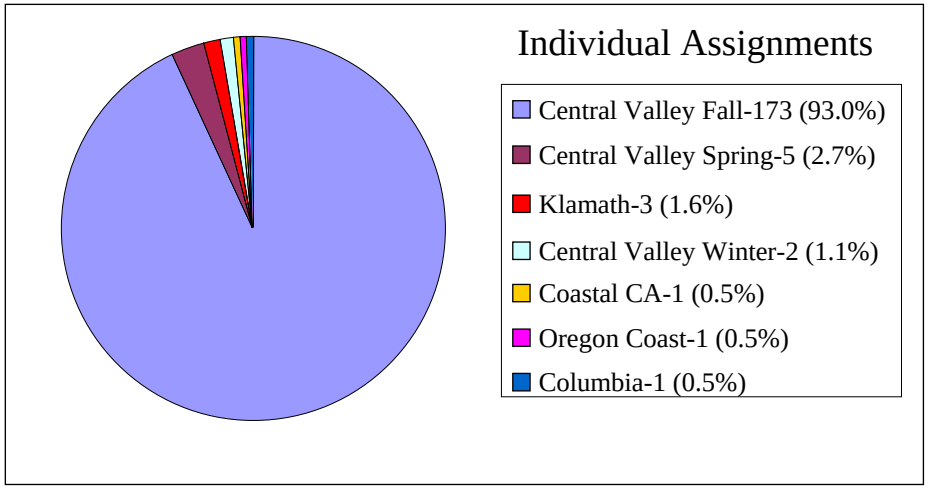
Genetic Stock Identification - An Example in Monterey Bay

Stock composition estimate-735 fish sport-caught: April, 2006

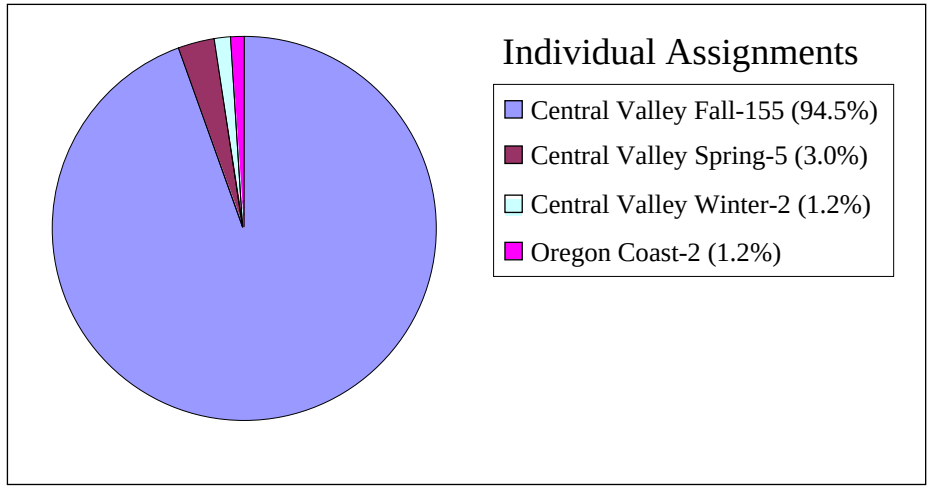


Chinook Salmon Genetic Stock ID-Monterey Bay Sport Fishery 2006

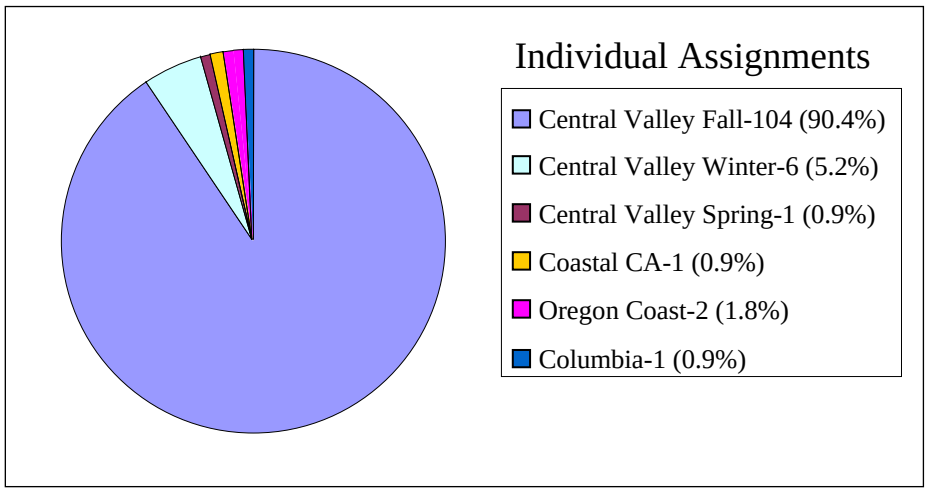
April 1: N=186



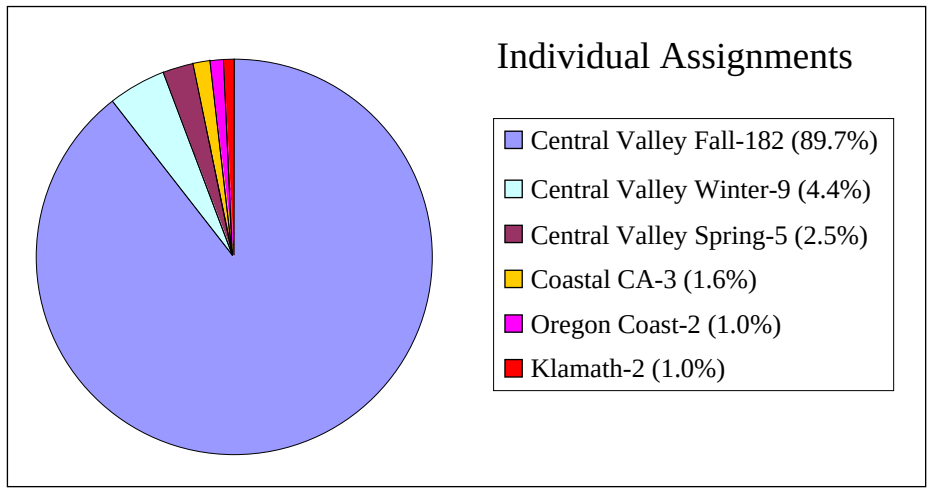
April 8: N=164



April 15: N=115

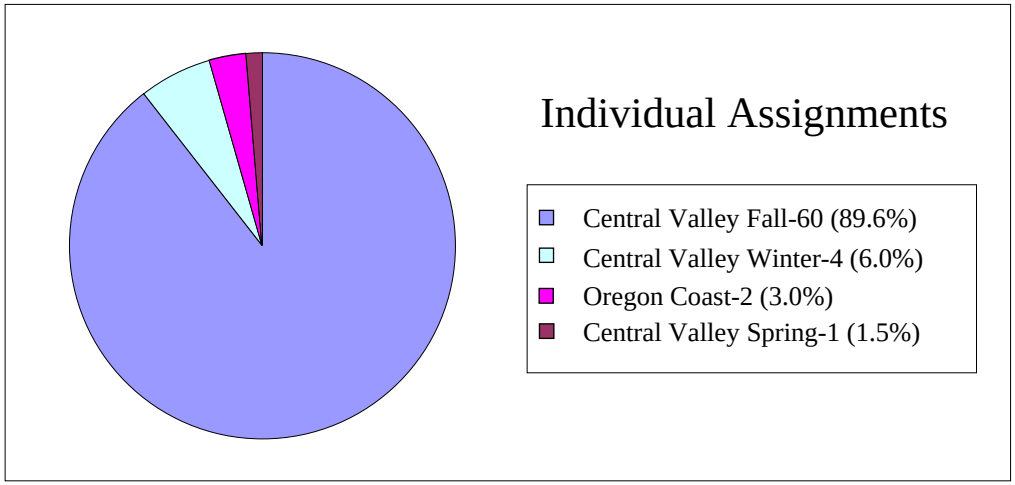


April 22: N=203



Chinook Salmon Genetic Stock ID-Monterey Bay Sport Fishery 2006

April 29: N=67



Difference in estimated catch proportion of Central Valley Winter fish before (1.1%) and after (4.9%) April 14 is suggestive, but not statistical significant after adjustment for multiple tests.

Current operational plan-SWFSC Chinook GSI project

-Integration of SWFSC sampling with existing California Recreational Fishery Survey sampling for continued collection of genetic samples from Monterey Bay ports.

-Collaboration with CDFG Ocean Salmon Project to analyze tissue samples collected from commerical fisheries this year and archived in past years

-Genetic analysis of ~200 samples/week for remainder of season.

-Workshops to discuss technical, logistical and policy aspects of genetic stock ID in Chinook salmon fishery management.

Uses of Genetic Stock Composition Information

-Stock-specific ocean distribution/migration patterns on fine spatial and temporal scales: prediction of contact rates

-Determination of cumulative fishery mortality for stocks of conservation concern in a quota fishery-possible this year

-Real-time (in-season) adaptive management of fisheries on fine spatial and temporal scales-possible next year.

Genetic Stock Composition in Fishery Management
Future prospects

-Validation of full parental genotyping (FPG) in Central Valley and Klamath Chinook hatcheries

-Implementation of integrated FPG and GSI sampling program for simultaneous collection of cohort/stock of origin for fish from FPG hatcheries and stock of origin for ALL sampled fish

-Evaluation of correlations between ocean conditions and ocean distribution/migration patterns of Chinook stocks?

Genetic Stock Identification for Coho Salmon

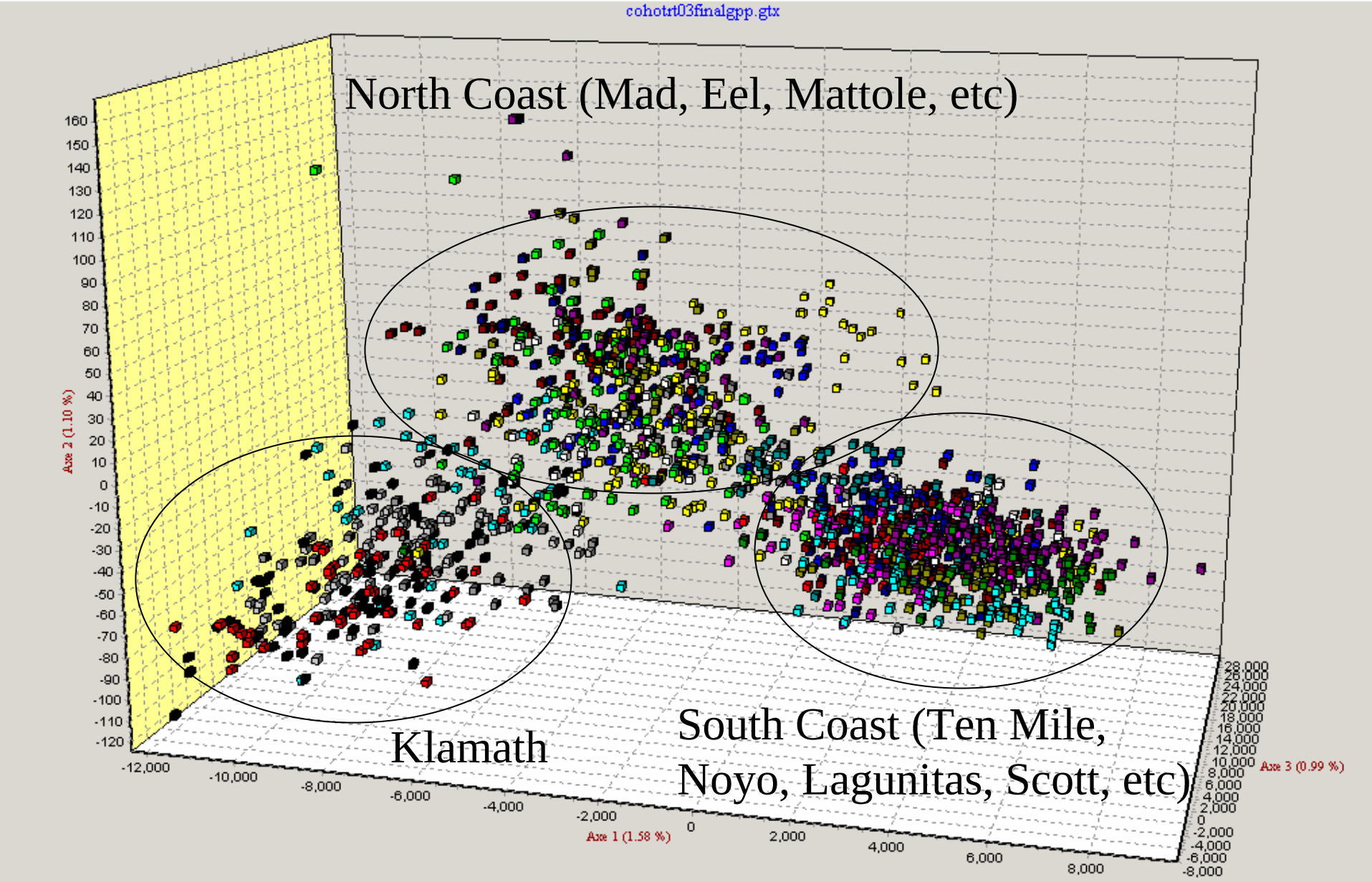
-Tissue from coho and Chinook salmon easily distinguished with genetic methods.

-Of ~750 fish sampled in April pilot project, 1 fish identified as coho salmon

-Southwest Fisheries Science Center has NON-standardized baseline that includes >6000 fish and representing all major coho salmon populations in California. High ID accuracy

-Southwest and Northwest Centers in process of integrating CA and OR baseline datasets for more widespread GSI.

California Coho Salmon-Factorial Correspondence Analysis



Acknowledgements

- Eric Anderson
- Scott Blankenship
- Gregory Charrier
- Anthony Clemento
- Celeste Gallardo
- Libby Gilbert-Horvath
- Allen Grover
- Heidi Fish
- Bill Fox
- Edith Martinez
- Paul Moran
- Devon Pearse