California Genetic Stock Identification Pilot Project-2007
Preliminary Report
August 2007

Project Overview

In 2007, the NMFS Southwest Fisheries Science Center, California Department of Fish and Game, University of California Santa Cruz and the commercial salmon fishing fleet, with the California Salmon Council acting as liaison, commenced a collaborative pilot research project to evaluate the use of genetic stock identification (GSI) technology to estimate stock composition and provide preliminary information about the spatial and temporal distribution of stock composition in the landed catch. Using the template developed in the multilateral meeting held in September 2006 at the Pacific Fishery Management Council office in Portland, OR, and given the limited available funds, we chose a limited question for evaluation, the north/south distribution of stock composition in the San Francisco management area (Point Arena to Pigeon Point), primarily through comparison of stock composition north and south of the Point Reyes line. The project involved the collection at sea of fin clips for genetic analysis, scales for aging analysis and catch location GPS coordinates for each individual fish sampled. Heads were also collected from sampled fish with adipose fin clips for subsequent coded wire tag extraction. The genetic analysis was then performed by NMFS and UC Santa Cruz staff at the Science Center lab in Santa Cruz, and the scale-age analysis will be performed by the CDFG Ocean Salmon Project in Santa Rosa. The California Salmon Council recruited 16 boats from the commercial fleet out of Bodega Bay, San Francisco and Half Moon Bay to participate in sample collection and selected a port liaison at each location to coordinate the collection of samples and associated data, and transmit them to the collaborators. May and July were chosen as the months for investigation, since these two months have historically had the largest landings of any months open to fishing in 2007. The study design for the project was to sample 1600 fish in May, 800 fish from north of Point Reyes and 800 to the south, then repeat this in July for a total of 3200 fish sampled and analyzed. Sample sizes were based upon considerations of statistical precision criteria and all sampling was during the course of normal, in-season fishing activity, with participating vessels not restricted as to where or when they fished.

Results

The project participants collected and submitted a total of 1075 tissue samples in May and 1651 samples in July. The May project effort resulted in a broad north/south distribution of sample collection, including the submission of 186 samples from between Pigeon Point and Monterey Bay, south of the project focus area. Samples were collected May 16-30. After removing samples that did not yield usable data, there were a total of 422 fish sampled from Point Arena to Point Reyes, and 460 fish from Point Reyes to Pigeon Point. The geographic distribution of the May samples is found in Figure 1.

The July project effort resulted in the collection of 1493 samples that yielded both sufficient genetic data and GPS coordinates for analysis, and 1016 of these samples were from Point Arena to Point Reyes and 477 fish from south of Point Reyes. These samples were collected July 1-22. The geographic distribution of the sampled catch was substantially different in May and July. In May, nearly all of the samples collected from the southern portion of the study area (south of Point Reyes) came from south of the Farallon Islands, whereas nearly all of the July samples were from north of the Farallon Islands. The geographic distribution of the July samples is found in Figure 2.

The stock composition estimates for the sampled catch in May and July are found in Figure 3. The stock composition estimates in both months were strikingly similar, with the catch dominated by four main stocks - Central Valley fall Chinook, Klamath River Chinook, California Coastal Chinook, and Rogue River Chinook - which comprised approximately 93% of the catch in both time periods. The estimates of catch proportions for three of these four stocks did not differ by more than 1% in the two periods, and the fourth, Klamath River Chinook, differed by only 4%. The two other California ESA-listed stocks, Central Valley winter Chinook and Central Valley spring Chinook, were nearly absent from the sampled catch in both periods.

Better information about the distribution of protected stocks and those that have not met conservation objectives in the recent past is an important possible outcome of such a GSI project and may allow the redirection of fishing effort to provider greater access to abundant stocks while limiting impacts on stocks of conservation concern. As such, we examined the north-south distribution of Klamath River Chinook and California Coastal Chinook within the study area. The May project sampled fish in largely discrete sub-areas within the study area including the unintentional, yet ultimately insightful, collection of samples from the Monterey management

area. In contrast, the July project sampled fish in a continuous geographic distribution, nearly all of which was north of the Golden Gate.

We classified the Klamath River and California Coastal Chinook-identified fish from the May sample by geographic sub-area: Point Arena to Point Reyes, Point Reyes to Pigeon Point, and south of Pigeon Point, and compared the stock proportion estimates in the three sub-areas (Table 1). North-south trends were apparent for both stocks, with the proportion of California Coastal Chinook 3 times greater in the northern sub-area than in the central sub-area and 4 times greater than in the southern sub-area. The pattern for Klamath River Chinook was similar, with the proportion in the northern sub-area about 1.5 times greater than in the central sub-area, and about 3 times greater than in the southern sub-area. In contrast, the north/south distribution of the July sampled catch had minimal differences for both Klamath River and California Coastal Chinook (Table 1).

The scale-age analysis and coded wire tag portions of the project are not yet complete and will be presented in the final project report.

Discussion

The 2007 pilot project was largely successful at demonstrating the utility of GSI to provide high resolution data on catch stock composition for a given time and area, and of the ability of the commercial fishing fleet and agency/university scientists to undertake collaborative research. The genetic data demonstrated that the catch is dominated by four stocks, Central Valley fall (~60%), Klamath River (~12%), California Coastal (~12%) and Rogue River Chinook (~9%), with small numbers of fish from a variety of other stocks present. Few Central Valley winter or spring Chinook were sampled in the project (~1%). A decrease in the stock composition estimates from north to south was found for both Klamath River and California Coastal Chinook in the May sample, but no such trends were found in the July data. The major difference in the north-south distribution of the sampled catch in the two time periods is likely at least a partial explanation for this contrast. However, it is interesting to note that the overall stock composition for most stocks remained very similar in spite of the different sampling distributions. Preliminary analysis of the May data on a fine geographic scale found that sampling of both stocks was concentrated in relatively small areas. Such stock-specific concentrations, should they be confirmed with larger samples, may have great potential for future management applications.

The data from this pilot project point towards great promise for the use of genetic methodology to better understand the stock composition of California's Chinook salmon fisheries and the ocean distribution of the species. However, more information is needed before such data can be used in management and assessment. For example, current assessment methodology is age-specific and GSI does not provide age information. Any future use of GSI-based information for management using the current assessment framework will require the successful derivation of age from scale pattern analysis or use of parentage-based individual tagging, an emerging genetic technology currently under development by project participants with funding from the CalFed/Sea Grant Science Fellows program. In addition, the interpretation of stock contribution estimates for currently unassessed stocks (e.g. California Coastal, Central Valley spring Chinook) will require additional information on stock abundance/escapement, since such proportions must be considered within the context of the total abundance of the specific stock. Consensus is also building that the evaluation of spatial and temporal distribution of Chinook salmon must assess interannual variability for any future application of GSI data, and not rely on only one or two years of data.

The collaborating groups came to agreement on the study plan May 1, and sampling began May 16. Such a short lead time meant that many things had to come together very quickly, including recruiting fleet participants, assembling and distributing sampling gear, preparing laboratory systems, and training participants. That the project came close to its objectives under such circumstances is encouraging for the future of collaborative research on California's Chinook salmon. Nonetheless, several minor problems arose, including the degradation of some genetic tissue samples due to storage and handling conditions and the loss of some location data for individual fish. In addition, a substantial logistical problem was the lack of timely availability of funds for project participants. Perhaps the most important issue that arose is that the limited scope of the project, particularly the necessity for in-season sampling, did not allow for stratified sample collection across the study area and time periods. Directing fishing effort and sampling to specific areas and times, which would require much greater compensation for vessel owners, will be necessary to overcome this constraint.

Project Future

The project advisory committee is developing a proposal for a larger collaborative project in coordination with Oregon that would last 3-5 years and evaluate the ocean distribution of

Chinook salmon stocks through a combination of in-season sample collection, test fishing in closed times and areas, and test fishing in areas not normally fished. As such, the project may require an exempted fishing permit. Following the outline developed at the aforementioned 2006 meeting in Portland, the project will thoroughly evaluate the north/south distribution of stocks in the San Francisco management area, the inshore/offshore distribution of fishery impacts on Klamath River and other Chinook stocks, and the potential for rapid-turnaround, weak-stock, quota management. The ultimate goal of such a project will be a replicated assessment of stock composition for all times and areas, so as to provide fine-scale information about the ocean distribution of Chinook salmon in the waters off of California. A detailed proposal will be provided to the Council in the near future and in preparation for a coordinated California/Oregon submission to the S-K grant program. Such a project will require significant future funding, and no funding has been secured to continue this project at any level.

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FV Blind Faith
FV Bridgett B
FV Dos Peros
FV Flora M
FV Fortuna
FV Happy Trails
FV Juliet
FV Mara
FV Moriah Lee
FV Reelization
FV Sea Star
FV Seaward
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Figure 1

May fishery samples

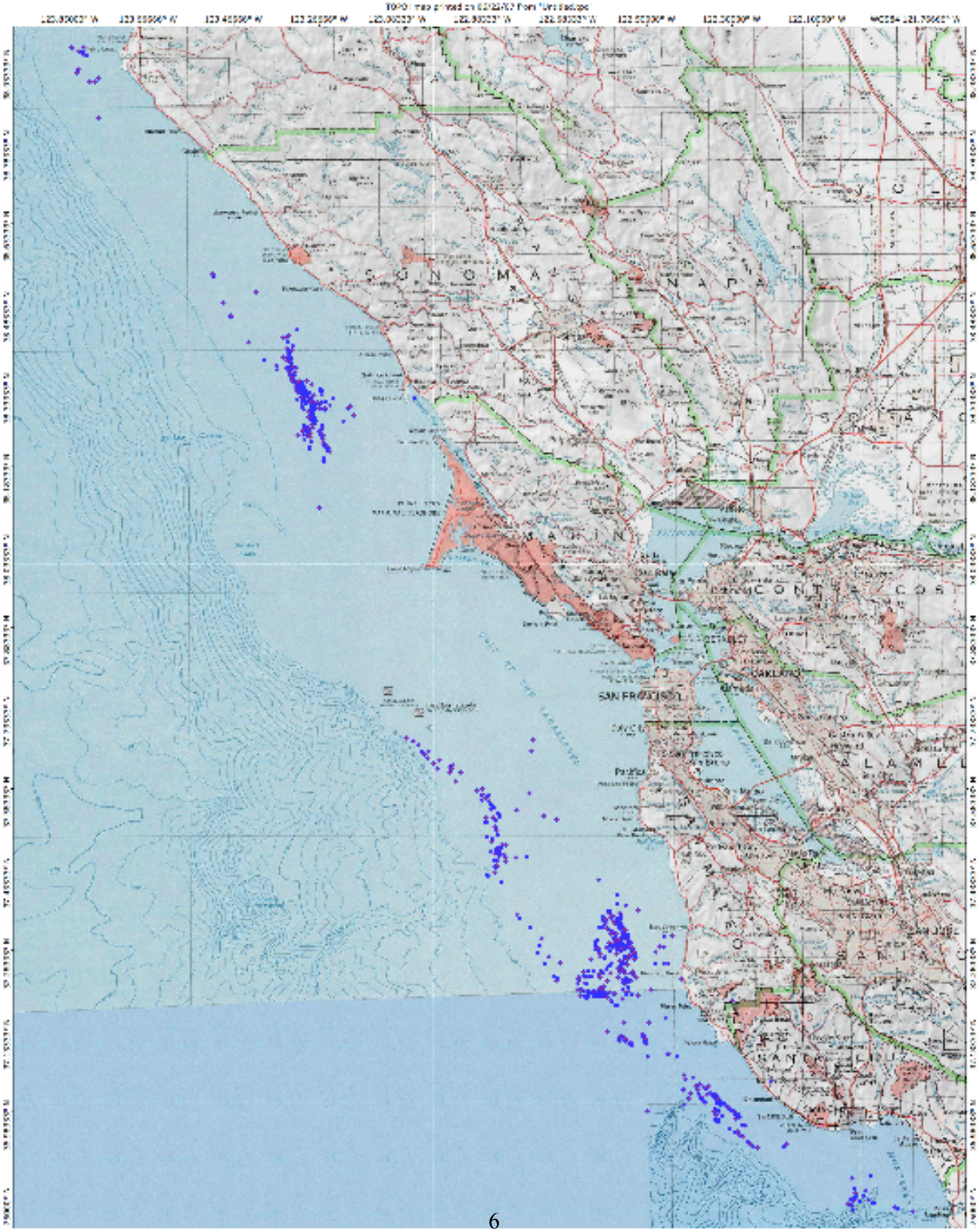


Figure 2

July fishery samples

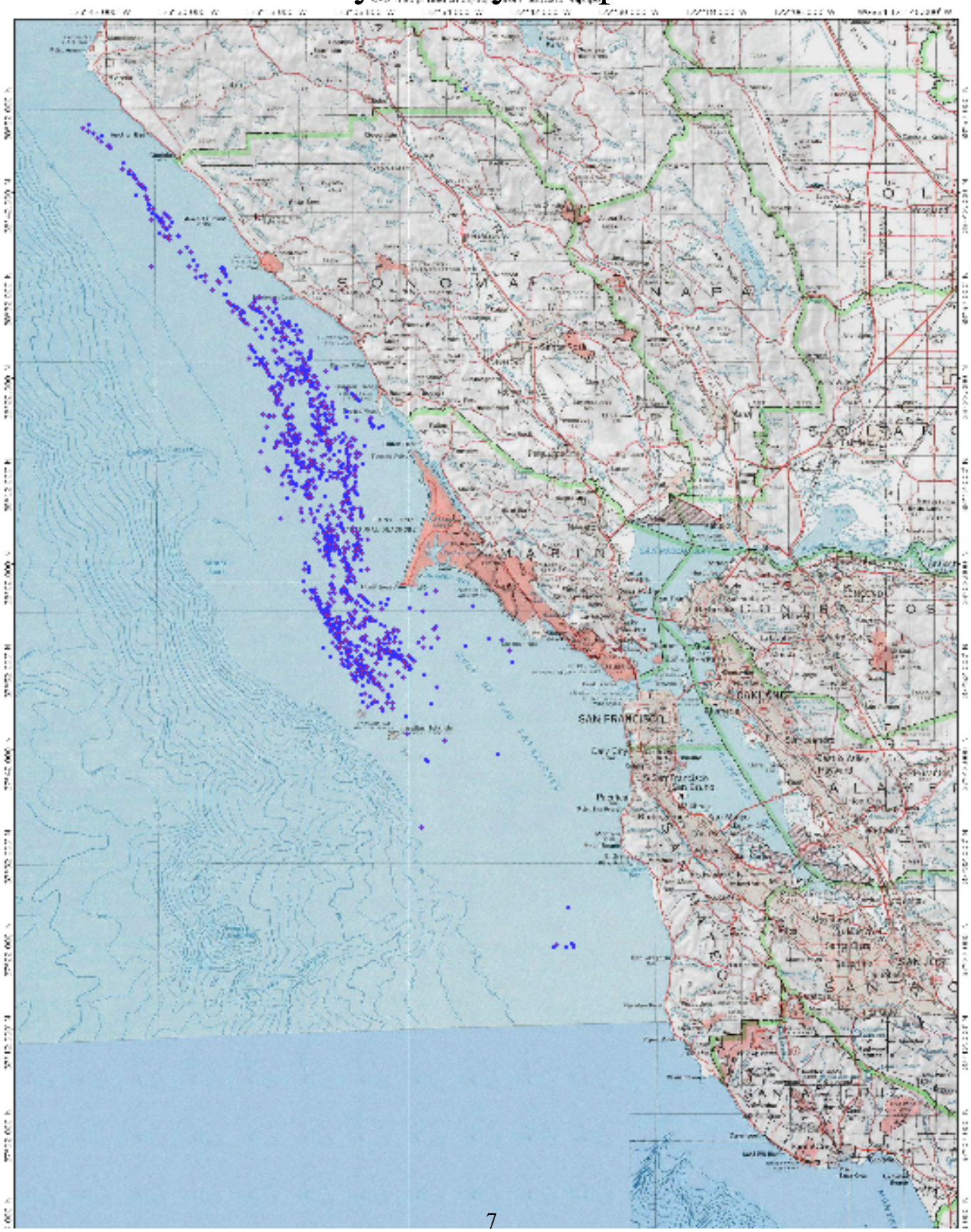
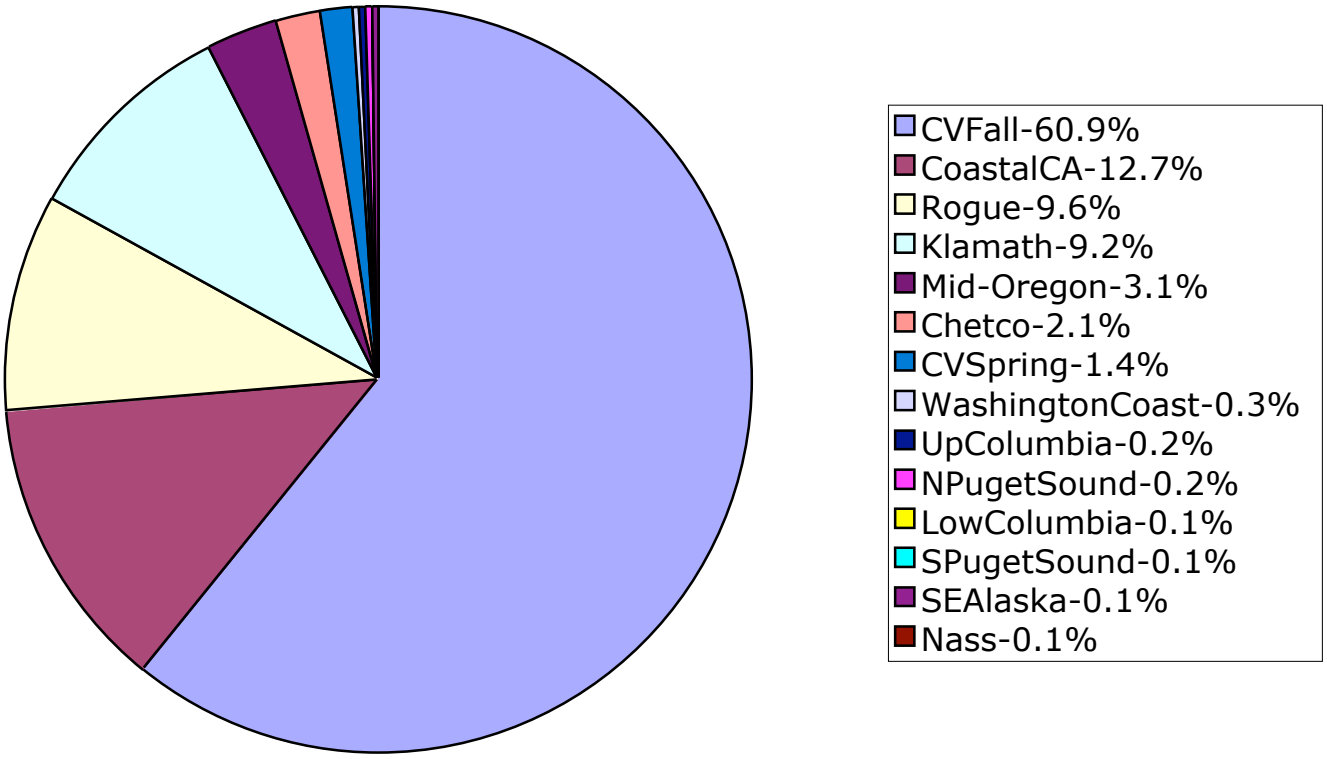


Figure 3

GSI Results for May 2007-
Stock proportion estimates from 1075 fish



GSI Results for July 2007-
Stock proportion estimates from 1539 fish

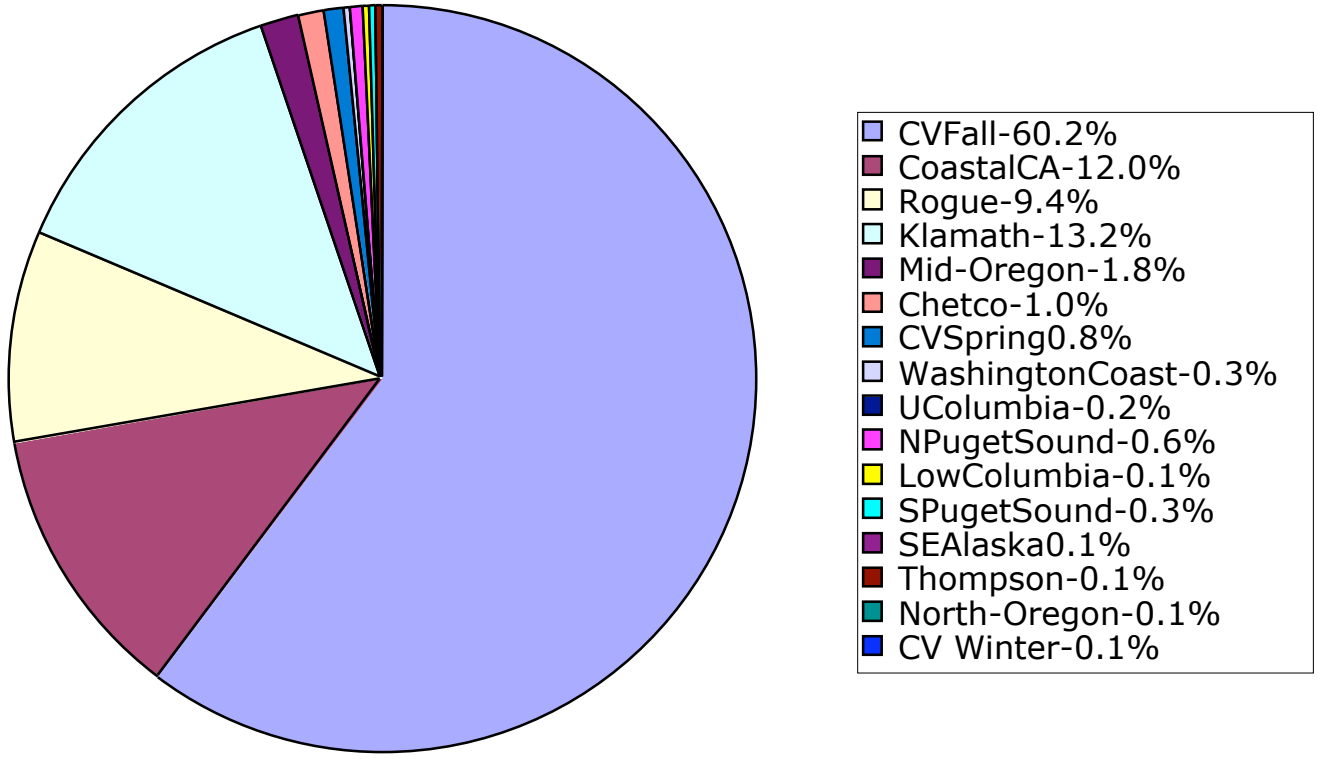


Table 1

Analysis of estimated stock composition by area and month

Estimated Stock proportions by latitudinal region-May

	Overall (N=1068)	Pt Arena-Pt Reyes (N=422)	Pt Reyes-Pigeon Pt (N=460)	South of Pigeon Pt (N=186)
Coastal CA	12.65	22.27	6.96	5.38
Klamath	9.21	12.80	7.83	4.30

Estimated Stock proportions by latitudinal region-July

	Overall (N=1493)	Pt Arena-Pt Reyes (N=1016)	Pt Reyes-Pigeon Pt (N=477)
Coastal CA	11.96	12.40	11.32
Klamath	13.19	13.98	11.53