Agenda Item I.1.b
Supplemental CROOS Report
September 2007

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Oregon Salmon Commission
P.O. Box 983
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5 September 2007

Dr. Don McIsaac
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
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Dear Dr. McIsaac:

This letter is to inform you and the Council of the current status of work being conducted by Project CROOS (Collaborative Research on Oregon Ocean Salmon) to implement genetic stock identification (GSI) in salmon fishery management. Project CROOS is a collaboration of industry, university, and agencies. In 2006 and 2007 Project CROOS has employed fishermen in the commercial troll Chinook fishery to collect fin clips for genetic stock identification (GSI) analysis from most of their catch. Along with fin clips, fishermen collect scale samples, record the location, length, and depth of capture, sea surface temperature, and occasionally collect stomach samples. Each fish receives a bar-code tag for tracking. This enables us to track the fish from the ocean through the processing plants to the market. The result is a data base of specific catch locations for each fish, along with ancillary data including age and stock of origin. In 2006 we conducted a pilot project in the Northern Oregon Coast fishery management area (the only area open for commercial Chinook fishing) in which we developed techniques and protocols for fishery sampling and analysis of stock distributions in space and time. The final report to the Oregon Watershed Enhancement Board of the Project CROOS 2006 season is available at http://www.projectcroos.com. The Executive Summary from the 2006 report is attached.

In 2007 commercial Chinook Salmon fishing was allowed for much of the period from May through October over the entire Oregon Coast. Our project for 2007 was designed to apply the techniques developed in the 2006 pilot project to characterize changing stock composition on the Oregon Coast over the course of the season. We planned to sample 200 fish from each management area in each week of open fishing from May through October. We also planned to conduct two experiments; a near-real-time management simulation in October and a marketing test in November. Sampling of ocean fisheries is on-going.

We have contracts with 141 fishermen from Brookings to Tillamook to collect at-sea samples and have employed 78 boats to date. Including voluntary efforts in May and the first two weeks of June we have completed 543 days of sampling. $122,335 has been distributed to the fishermen, with additional sampling anticipated in September and October. We have collected 3329 genetic samples from south of Cape Falcon to the Oregon-California border, along with scales, GPS track logs, and other data. Of those samples 801 have been analyzed and preliminary results are reported here. Scales have not yet been aged.

Table 1 shows the weekly distribution of effort (days fished), sampled catch, and catch per unit of effort from May through mid-August for three catch areas in Oregon. Chinook fishing on the Oregon Coast in 2007 has been extremely poor. Overall catch rate through mid-August was only 6.1 fish per boat day (this may be biased slightly low because we limited boats to 20 samples per day). Catch per day exceeded 10 fish in only 4 of the 36 time-area strata (week x area) in which fishing occurred. We met our sampling design of 200 fish per stratum in only 6 strata and came close (196 fish) in a seventh. Chinook were nearly absent from the Oregon Coast through most of May and June. In July and August catch rates increased, mostly on the South Coast, accompanied by a moderate increase in effort.

The distribution of sampling effort is much broader than it was in 2006, when the Southern Oregon Coast (SOC) and Klamath Management Zone (KMZ) were closed to fishing. Figure 1 illustrates the distribution of fishing effort and catch sampled in 2007 and shows extensive sampling south of Florence in addition to the Newport and Garibaldi areas that were the focus of 2006 sampling.

Table 2 reports a partial analysis of stock compositions by management area. Preliminary analysis of stock composition, aggregated over the season to date for each catch area, shows Central Valley stocks contributing 27.0%, 22.2%, and 15.9% in the NOC, SOC, and KMZ, respectively. Klamath contribution rates were 3.6%, 42.9%, and 44.6%. Rogue contribution rates were 7.2%, 8.6%, and 18.3%. Other important stocks in the NOC were Upper Columbia River summer/fall Chinook at 10.8%, 9.9% Mid Oregon Coast stock, and 7.7% Mid Columbia River tules.

Compared with 2006 in the NOC we saw lower contribution rates of Central Valley stocks (27.0% compared with 59.1% in 2006). Klamath proportions in NOC were under 3.6% in 2007 compared with 6.6% in 2006, although this difference may not be significant.

This has been a challenging season for Project CROOS. We mourn the passing of Scott Boley who was an ardent spokesman and source of new ideas for the Oregon commercial salmon fleet and regional fisheries management for the past 25 years or more. Project CROOS is, in large part, his legacy. Funding was late in coming and even now is not fully secured. Although the fishing season opened on April 10 we were not able to contract with fishermen until 17 June. Genetic lab technicians could not be hired until mid July. Finally, despite liberal seasons, the Chinook failed to show up and fishing has been the poorest in memory.

Despite these obstacles we have sampled, and continue to sample, fisheries from Cape Falcon to the Oregon-California Border and this is our first look at fisheries south of Florence. Central Valley Chinook are contributing to the fisheries at lower rates than last year. Several north-south gradients are evident in this year' s data. Klamath River contribution rates are higher in SOC and KMZ than in the NOC. Rogue River stocks contribute most heavily in the KMZ. Many northern stocks are found predominantly in the NOC and are practically absent from the KMZ. We anticipate exploring these distributional gradients in more detail this winter, once data collection and analysis is complete.

In addition to the stock distribution mapping, two experiments were planned for 2007. We had intended to conduct a near-real-time management simulation in August. We now hope to do this in October. A marketing test of the value of traceability to consumers is planned for November. Web-site development for fisheries management, science, fishermen, and marketing is under way, with focus group discussions being conducted in September.

In collaboration with the states of California and Washington we are developing a mechanism for

coordinating West Coast GSI management development and implementation, with initial meetings planned in September. We hope to develop a 3-5 year study plan that includes stock distribution mapping, development of a regional data base, and development of management applications. Other potential projects include scientific investigation into ocean environment effects on distribution and migration patterns, and development of web sites to aid mangers, fishermen, scientists, marketers, and the general public. Shorter term planning is focused on development of a proposal to use Saltonstall-Kennedy (SK) funds for sampling fisheries in 2008 and 2009. Details of this proposal will be available to the Council by 1 October and may include non-retention sampling in closed times and areas. Significant additional funds will be necessary if this project is to continue into 2008 and beyond.

Respectfully Yours,

Nancy Fitzpatrick
Administrator

Project CROOS collaborators:

- Oregon Salmon Commission
- Oregon State University
- Oregon Sea Grant
- Oregon Department of Fish and Wildlife
- Oregon Seafood Laboratory
- Oregon Watershed Enhancement Board
- Oregon Department of Agriculture
- Community Seafood Initiative
- NMFS, Northwest Region
- NMFS, Northwest Fisheries Science Center

Attachment

Table 1. Summary of weekly sampling for Project C ROOS on the Oregon Coast for 2007 through Mid-August. Weekly sampling goal was 200 fish per management area. Fishermen volunteered to collect samples before 17 June. NOC; Northern Oregon Coast, SOC; Southern Oregon Coast, KMZ; Klamath Management Zone in Oregon.

	Week starting:																	
	May					June				July					August			Season
	1	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	Total
Effort (days)																		
NOC				1				4	39		11	30	3	1	18	12	3	122
SOC	5	6	23	13	5		1	12	16		25	19	44	20	60	103	5	357
KMZ	2					3		3	5		10	17	2	1	15	6		64
Sampled catch																		
NOC								14	196		34	119	41	4	17	18	2	445
SOC	14	15	204	24	4	17	2	25	7		21	73	297	71	671	870	3	2381
KMZ						5		12	8		79	213	5		238	6		566
Catch per day																		
NOC				0.0				3.5	5.0		3.1	4.0	13.7	4.0	0.9	1.5	0.7	3.6
SOC	2.8	2.5	8.9	1.8	0.8		2.0	2.1	0.4		0.8	3.8	6.8	3.6	11.2	8.4	0.6	6.5
KMZ	0.0					1.7		4.0	1.6		7.9	12.5	2.5	0.0	15.9	1.0		8.8
Weekly Totals																		
Effort (days)	7	6	23	14	5	3	1	19	60	0	46	66	49	22	93	121	8	543
Sampled Catch	14	15	204	24	4	22	2	52	211	0	134	405	343	75	926	894	5	3329
Catch per Day	2.0	2.5	8.9	1.7	0.8	7.3	2.0	2.7	3.5	0.0	2.9	5.1	7.0	3.4	10.0	7.4	0.6	6.1

Table 2. Preliminary estimates of catch contributions (per cent), from genetic analysis, of Chinook in three management areas for Oregon commercial troll fishery through mid-August 2007 as sampled by Project CROOS. This analysis is based on a sub-sample of 801 fish from the 3329 genetic samples collected to date. NOC; Northern Oregon Coast; n = 222, SOC; Southern Oregon Coast; n = 324, KMZ; Klamath Management Zone in Oregon; n = 251.

Stock Group	Contribution Rate		
	NOC	SOC	KMZ
SSE Alaska Stikine R.	0.9	0.3	
Lower Skeena R.	0.9		
Nass R.	0.4		
Central BC Coast	1.8		
Upper Fraser R.		0.3	
Lower Fraser R.	1.4		
Mid Fraser R.	1.4		
Hood Canal	2.2	0.6	
N Puget Sound	0.4		
S Puget Sound	6.3	0.3	0.4
Washington Coast	0.4		
Lower Columbia R. fa	6.3	0.6	1.2
Lower Columbia R. sp	3.2		
Deschutes R. fa	3.2	0.9	0.4
Mid Columbia R. tule	7.7	0.9	
Upper Columbia R. su/fa	10.8	5.2	2.0
Snake R. fa	1.8	0.9	0.4
N Oregon Coast	1.4	0.9	
Mid Oregon Coast	9.9	6.5	5.6
Rogue R.	7.2	8.6	18.3
N Calif./S Oregon Coast	0.4	3.7	4.8
Klamath R.	3.6	42.9	44.6
California Coast	0.9	4.6	6.0
Central Valley fa/sp	27.0	22.2	15.9

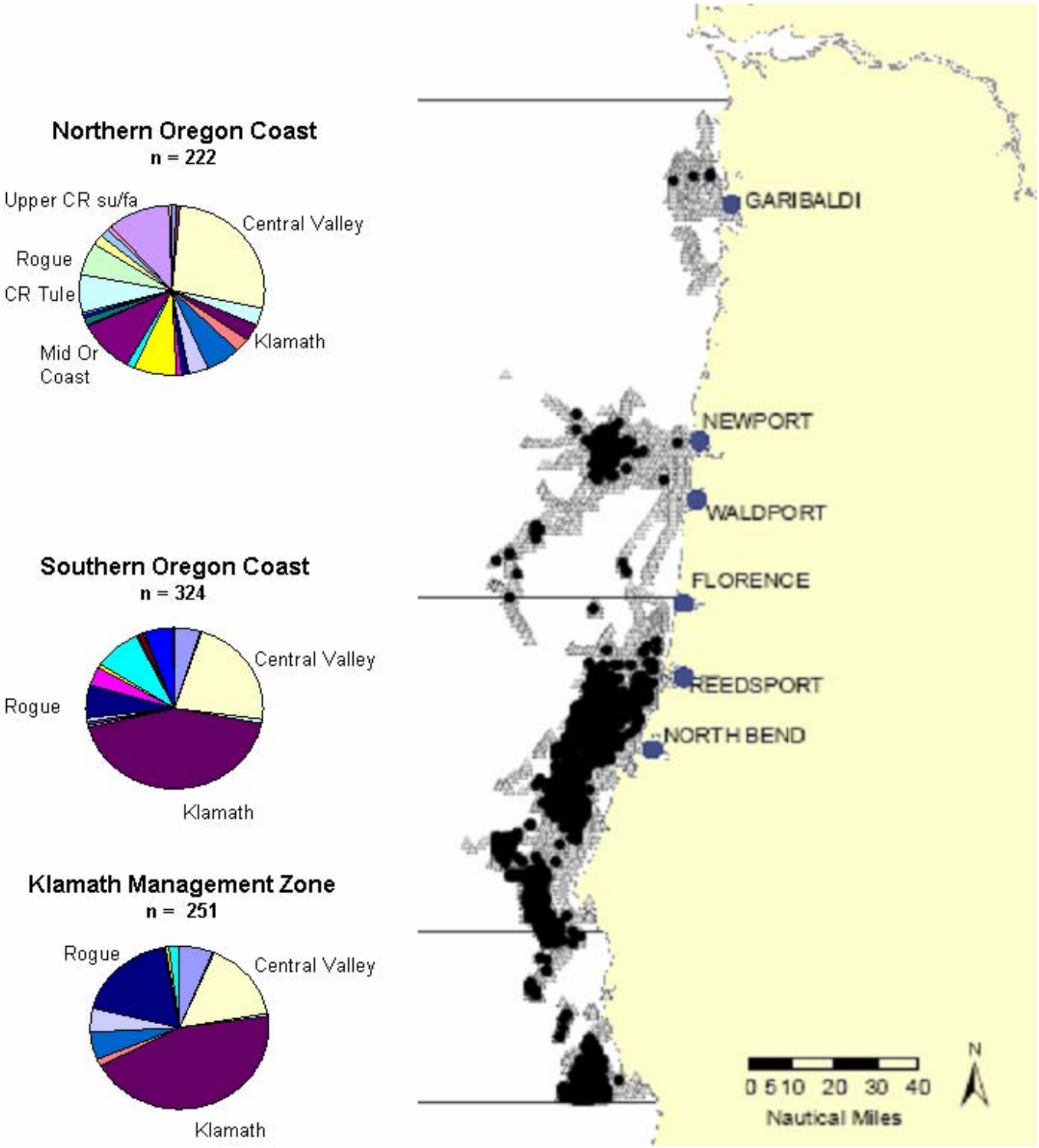


Figure 1. Spatial distribution of Project CROOS sampling through August 12 (gray triangles) and sampled catch (black circles). Pie charts illustrate preliminary catch compositions for three management areas.

PROJECT CROOS
Collaborative Research on Oregon Ocean Salmon

Using "Real Time" Genetic Information to Address the Klamath 'Weak' Stock Crisis for Oregon's Ocean Salmon Fishery

EXECUTIVE SUMMARY

Background

A major objective in salmon fishery management is ensuring access to healthy populations while also protecting weak stocks. Given limited understanding of the behavior and migration patterns of individual salmon stocks, it is difficult to manage stocks as distinct units. Ocean salmon managers are often compelled to institute large time/area closures to protect the weakest stocks. In 2006 this problem became acute when managers were forced to close most of Oregon and California's ocean troll salmon fishery to protect weak runs of Klamath River Chinook salmon. The result was the loss of 100's of jobs and millions of dollars in coastal income and a declaration of a "salmon disaster" by the Governors of California and Oregon.

To address the challenge of inadequate science supporting management of multi-stock ocean salmon fisheries, the Oregon Salmon Commission, together with scientists from Oregon State University and federal and state agencies co-located at the Hatfield Marine Science Center, formed the CROOS group (*Collaborative Research on Oregon Ocean Salmon*). CROOS proposed a comprehensive pilot project to test the potential of using *genetic stock composition* (GSI) and the GAPS database (Genetic Analysis of Pacific Salmonids) to identify in "real time" spatial and temporal characteristics of individual salmon stocks. It was proposed that the availability of "real time" data could potentially enable fisheries managers to 1) differentiate stocks in "real time" at refined spatial areas, 2) improve salmon conservation while allowing harvest of healthy stocks, and 3) integrate science and management of freshwater, estuarine, and marine salmon ecosystems. In June 2006, the Oregon Watershed Enhancement Board (OWEB), as part of a state-wide effort to provide salmon disaster assistance, agreed to fund a CROOS pilot project to test the potential application of GSI techniques.

Objectives

The goal of *Project CROOS* was to conduct collaborative and interdisciplinary research and develop protocols using GSI science in near "real time" that could 1) improve science, management, and marketing of West Coast salmon, 2) minimize harvest of "weak stocks," and 3) enhance economic value of the ocean salmon fishery. Specific objectives included 1) providing financial assistance to participating salmon fishermen, 2) developing sampling protocols for fishermen and fleet coordinators/managers, 3) conducting near "real time" GSI analysis, 4) developing digital technologies and "traceability" systems, 5) designing a comprehensive web site, 6) developing methods for collecting oceanographic information, and 7) considering potential of GSI technologies for improving salmon management.

Findings and Results

Financial Assistance The project provided financial assistance to 20% of the active Oregon fleet. More than 72 vessels participated in at least one opener (72 operators, 54 crew). Over 4,270 fish were sampled which represented 17% of the Oregon commercial salmon harvest in 2006. A total of $332,100 was distributed to operators and crew.

Protocols Project managers developed detailed protocols for biological sampling, data collection, fleet management, fishermen training, and project coordination.

Genetic Stock Identification (GSI) Over 4,200 tissue samples were delivered to the Coastal Oregon Marine Experiment Station (COMES) genetics laboratory along with associated digital or manual data. A total of 3,097 samples were processed and 2,567 fish were used to estimate stock mixture proportions. Probability values of stock assignment for these fish ranged from 28% - 100%. A total of 2,097 fish were assigned probabilities $\geq$ 90% to a specific hatchery or reporting region.

Stock Mixture Proportions The majority of sampled fish originated from California's Central Valley (59.08%). The Rogue River contributed the second greatest proportion (7.61%), followed by the Mid Oregon Coast (7.11%) and the Klamath basin (6.58%). The California Coast and Northern California/Southern Oregon Coast regions contributed 2.17% and 1.89% respectively. The Upper Columbia River summer/fall run was estimated to contribute 3.03% of the total. Twenty other stocks contributed less than 2% each.

100% Assignment of Coded Wire Tagged (CWT) Fish Thirty-one of the 2,097 fish that met the 90% probability criteria contained coded wire tags. All 31 CWT fish assigned to the correct hatchery of origin.

Near "Real Time" Analysis Near "real time" genetic analysis (within 24 - 48 hours after the fish were landed) was difficult to achieve during the initial few months of the project due to logistical issues and inadequate investment in laboratory resources. However, by September/October, fish were successfully assigned to individual genetic stock estimates in near "real time" and accompanying data entered into the database.

Geographic Information Systems (GIS) Maps GIS-based maps were developed that included troll tracks, precise time/location data on harvested fish, and menus for exploring relational data.

Dataloggers Digital datalogging devices for fishing vessels were successfully tested and proved to be easier to use than "manual" sampling protocols.

Website Development A working "prototype" website was developed capable of reporting information to multiple audiences using a variety of tools, maps and statistical analysis. The entire working website will be accessible by mid-late May 2007 at www.ProjectCROOS.com .

Oceanographic Data Collection by Autonomous Vessels A successful pilot test was conducted which showed that autonomous underwater gliders could be used in conjunction with commercial fishing vessels for collecting a wide range of oceanographic data.

Recommendations and Next Steps

Improving Project Protocols Many protocols will need adjustment in response to changing fishing and sampling conditions. CROOS project members can work with other West coast states, industries, and agencies to design, implement, and refine protocols.

Improving the GAPS Database The GAPS database requires continual improvement. Further characterization of stocks within and adjacent to the Klamath basin are recommended.

Expanding GSI Data Collection Coast Wide Implementing GSI for salmon management will require expanded data collection along the West Coast. Expanded data should be used to identify stock distribution patterns, test relevant hypotheses, and integrate oceanographic information.

Collecting and Integrating Oceanographic Information Oceanographic data will be critical for understanding salmon behavior and improving science and management. Future projects should combine vessel-based data collection with autonomous underwater gliders.

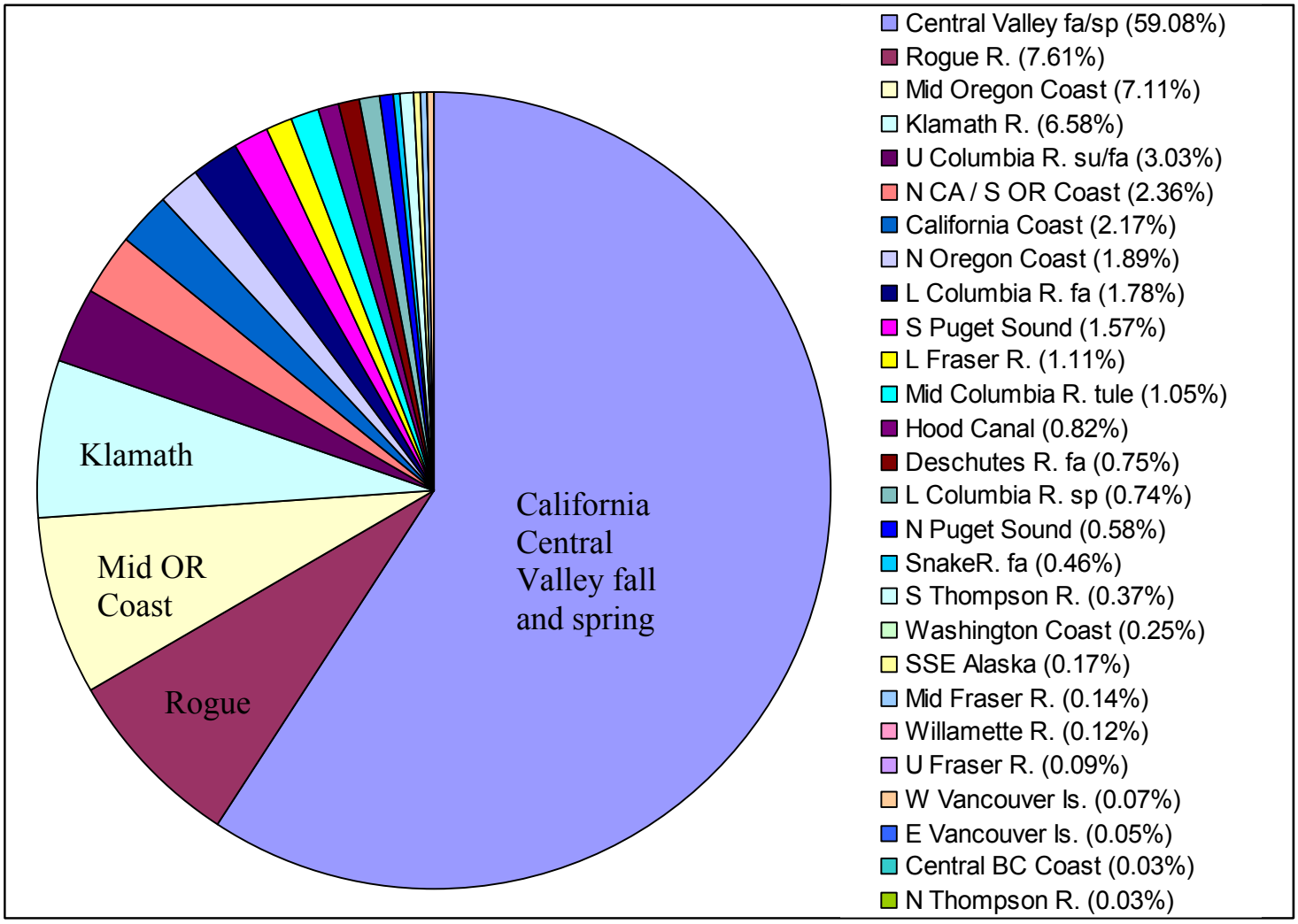
Improving the Design of Vessel Dataloggers Commercial digital dataloggers are inadequate given the needs for a tough, waterproof, relatively inexpensive, portable and reprogrammable logger. A national workshop should be conducted to examine digital-based data collection from commercial fishing vessels. Partnerships with private manufacturers should be evaluated.

Designing a Multiuse "Real Time" Website The prototype GIS-based website should be developed and tested to ensure security, privacy, reliability, and to accommodate multiple users.

Using Barcodes, Traceability, and the Website to Improve Salmon Marketing Test markets should be conducted that "link" individual harvest information from producers to consumers, enhance market development, and minimize fraud.

Developing and Testing GSI-based Salmon Management Models Management models should be developed that incorporate GSI information. Management simulations should be conducted with salmon managers in "real time" to evaluate in-season management approaches. Bioeconomic models should evaluate GSI information and industry incentives for improving management of the salmon fishery.

Genetic estimates of stock mixture proportions of Chinook salmon (n = 2567) harvested off the coast of Oregon during the 2006 Project CROOS pilot study. Mixture proportions were estimated using the GAPS (Genetic Analysis of Pacific Salmonids) standardized microsatellite baseline v2 with 166 populations combined into 44 reporting regions and program GMA (Kalinowski 2003).



Time series for fish harvested off the Coast of Oregon during two weeks in 2006. The week of September 17 - 23 (A) yielded 1173 fish sampled with 539 usable genotypes. The following week (B), September 24-30, provided 521 fish samples, of which 280 provided sufficient genotypic data. Fish that assigned to the Klamath basin are highlighted in red.