

## 2019 GENETIC STOCK IDENTIFICATION STUDY PROPOSAL

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The Pacific Fishery Management Council's (PFMC) Scientific and Statistical Committee previously reviewed proposals for Genetic Stock Identification (GSI) and non-retention at-sea sampling in November 2007 (Agenda items F.2.a and F.2.b). Updates on this GSI project was provided to the Council in March 2012 (Agenda item G.1.c). The project proposal was discussed during the Methodology Review, November 2015. Most recently, the Council heard a proposal for this project in March 2016 ([Agenda Item E.4.b](#)). Available impacts in 2017 and 2018 limited the scope of the study to normal commercial fishing activity. Ideally the scope would also include non-retention sampling when the fishery is closed.

Here we propose examination of "Fine scale ocean distribution patterns of Klamath River Chinook salmon, in comparison to other stocks of interest, including the ESA-listed California Coastal Chinook." This work is funded by a 2015 Saltonstall-Kennedy (SK) grant to the California Salmon Council. The project summary from the proposal is attached. The goal of this project, which is part of the larger West Coast Salmon Genetic Stock Identification (WCS-GSI) Project, is to improve resolution of the ocean distributions of Klamath River Chinook (KRC) and California Coastal Chinook (CCC), with emphasis on geographic differences that may be useful for developing management regulations. This will be accomplished through at-sea sampling of Chinook salmon during both normal commercial fishing activity and non-retention sampling during times and areas closed to commercial fishing. Samples will be analyzed with genetic identification and scale analysis methods to assign a stock of origin and age to each fish. Laboratory results and at-sea data (location of capture, length, etc) will be combined to produce fine-scale stock-specific distribution information that is not obtainable with current dockside sampling methods. These data will be available to develop methodology to incorporate both genetic data and fine-scale harvest data in management decisions.

The original 2015 proposal for the SK grant (summary attached, with results from retention sampling in 2016) has been modified to increase the number of samples per area-week stratum in response to concerns that sample sizes would be insufficient to address statistical analysis requirements. The geographic and temporal focus has been narrowed to cover the time from mid-July through mid-September, as past data indicate that the largest difference between KRFC and CCC occurs later in the commercial season. Total sampling numbers over the season are

decreased; impacts to stocks of concern are therefore lower than with the previous sampling plan.

Specifically, we propose doubling the sampling targets per area-week stratum (from 100 to 200) while focusing on times and areas (from the OR-CA border to Point Reyes) that 1) are most likely to show a catch per unit effort difference in the stocks of interest, and 2) provide data with the most utility for management.

The proposed project continues work from previous years (2010-2018), where data suggest a late-season difference in stock distributions between the ESA-listed California Coastal stock and the Klamath River hatchery fish that are used as their management proxy. Depending on the final season structure adopted by the PFMC, the WCS-GSI Project proposes targeting collection of approximately 4800 samples, including 1200 non-retention samples in closed times and areas. The exact location of non-retention sampling will be determined by 2019 season structure, management and scientific priorities, and availability of sampling vessels. Table 1 describes the proposed sampling plan, formulated with the understanding that the final sampling plan may be altered to accommodate the final, approved PFMC commercial season.

The fraction of Central Valley fall Chinook encounters varies considerably by area-week and by year. We have observed stock fractions in the focal areas of between 43-73%, with an annual average of 54%. Fractions of CCC vary from 2-10%, with an annual average of 5%; fractions of KRC vary from 4-11%, with an annual average of 7%. At these rates we expect to observe at least a few individuals of each stock of interest in samples of 200 fish per area-week stratum.

Management zone	Port	1-15	16-31	1-15	16-29	1-8	9-27
		July		August		September	
OR-KMZ	Brookings						
KMZ	Crescent City						
	Eureka					200	
Fort Bragg	Fort Bragg					200	
San Francisco-N	Bodega Bay					400	
San Francisco-S	San Francisco						
	Half Moon Bay						

Table 1. Proposed sample targets, 2019. Previously observed stock concentrations indicate sample targets of 200 fish per area-week stratum. Red cells are times and areas anticipated to be closed to commercial fishing. Green cells are anticipated to be open.

*Estimated Impacts.* It is proposed to collect 1200 non-retention samples. Mortality during catch-and-release sampling is estimated at 31%, resulting in 372 mortalities. Actual mortality estimates for all stocks, including SRFC, will be provided by the STT during the PFMC 2019 salmon preseason management process.

**Project Summary** 2014/2015 Saltonstall Kennedy (2014/15 S-K)

**Application Organization:** California Salmon Council

**Title:** Fine scale ocean distribution patterns of Klamath River Chinook salmon, in comparison to other stocks of interest, including the ESA-listed California Coastal Chinook

**S-K Priorities:** Theme #2.A: improve the cost effectiveness, accuracy, timeliness, and methods for the collection, reporting, and dissemination of fishery-dependent data; provide advanced sampling techniques to improve data collection in otherwise inaccessible habitats, and improve current stock assessments by refining estimates of population dynamics; and improve current sampling methods for fisheries not included in existing surveys.

Theme #3.B: improve stock assessments, as high uncertainty in fisheries stock assessments leads to lower allowable catches; and improve stock definitions and understanding of stock boundaries.

**Award dates:** January 1, 2016 –April 30, 2020

**Principal investigator:** David J. Goldenberg, CEO, California Salmon Council

**Collaborating partners:**

Nancy Fitzpatrick, Executive Director, Oregon Salmon Commission

John Carlos Garza, Supervisory Research Geneticist, NMFS Southwest Fisheries Science Center, and Adjunct Professor of Ocean Sciences, UCSC

Michael O' Farrell, Research Fishery Biologist, NMFS Southwest Fisheries Science Center

Will Satterthwaite, Research Ecologist, NMFS Southwest Fisheries Science Center

Jeff Feldner, PFMC Board member

**Species addressed:** Chinook salmon (*Oncorhynchus tshawytscha*)

**Resources addressed:** California and Oregon ocean troll fisheries

### **Proposed activities:**

The west coast commercial Chinook salmon (*Oncorhynchus tshawytscha*) fishery is managed on a stock-specific basis. Access to the fishery has been severely constrained in the past decades due to concerns about harvest of fish from stocks considered weak or listed as Threatened under the U.S. Endangered Species Act (ESA). Even in years when other stocks are healthy and abundant, conservation objectives for a single stock may limit harvest in the mixed-stock ocean fishery. Since 2006, fisheries have been limited or closed entirely when conservation objectives were not met for Klamath River fall run Chinook (KRFC), California Coastal Chinook (CCC), or Sacramento River fall run Chinook (SRFC). The constraining stock changes from year to year, but the need to understand stock-specific ocean distribution patterns throughout the historical fishing season (May-September) remains. Current fishery management strategy responds to changes in population numbers on a stock-specific basis by limiting effort in certain times and areas; this strategy inherently requires a stock-specific temporal-spatial understanding of ocean distribution.

Data from previous years (2010-2014) suggest 1) a late-season difference in stock distributions between the ESA-listed California Coastal stocks and the Klamath River hatchery fish used as a management proxy; and 2) major differences in the relative catch rates of Klamath River fall run Chinook and Sacramento fall run Chinook north and south of Point Reyes, a potential new management boundary. The work proposed here will address geographic areas where more data are needed, refine sampling methods to obtain data that are more representative of the commercial fishery, and construct cohort-specific data for sampled fish. Through a targeted sampling effort to distinguish the distributions of KRFC, CCC, and SRFC stocks

between Humbug Mountain and Pigeon Point (Klamath Management Zone in Oregon and California, Fort Bragg Management Area, San Francisco Management Area), we will conduct a spatiotemporal analysis of stock distributions in the commercial ocean fishery.

Genetic methods assign stock of origin for all fish independently of coded wire tag (CWT) insertion, allowing naturally-spawning CCC stocks to be evaluated separately from the KRFC proxy stock. At-sea sampling methods produce fine-scale geographic and depth data which are not possible with current dockside sampling methods; combined with stock identity and age information derived from laboratory analyses, we can produce high-resolution, time-scaled maps of age-specific catch probabilities. These data and visualizations will be available to develop methodology to incorporate both genetic identification data and fine-scale harvest data in management decisions.

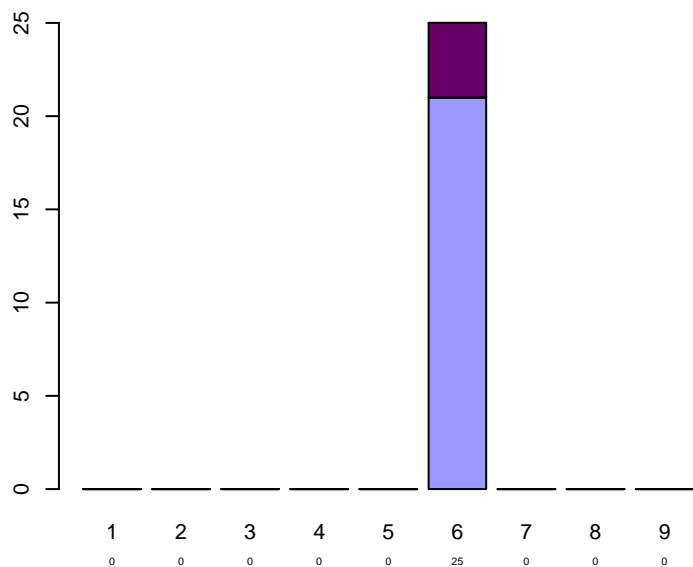
Since 2007, our collaboration of fishermen, scientists, and managers has been collecting samples and associated metadata during normal fishing operations. We will build upon past work and our collaborative network to continue at-sea sample and data collection. We will contract with commercial fishermen in California and Oregon to collect at-sea samples and associated metadata during normal fishing operations. Sample and data collection will be conducted during the commercial season in 2016; we have experience obtaining the necessary permits to conduct non-retention sampling as allowed by the Pacific Fishery Management Council. Tissue samples will be analyzed with genetic methods to assign the stock of origin of each fish; scale samples will be analyzed to determine age cohorts. Stock-specific catch per unit effort estimates will be generated for each management zone on a monthly basis. In the case of the San Francisco Management Zone, Point Reyes will be added as a theoretical management boundary, dividing the management zone into two areas for analysis.

We will work in partnership with Fish Trax Inc. to include all data in a comprehensive fishery informatics network. This system will allow for quick data upload to a secure online database; data sharing between fishermen, scientific partners, and managers; generation of weekly reports for distribution to the fleet; and analysis of fine-scale, stock-specific harvest models.

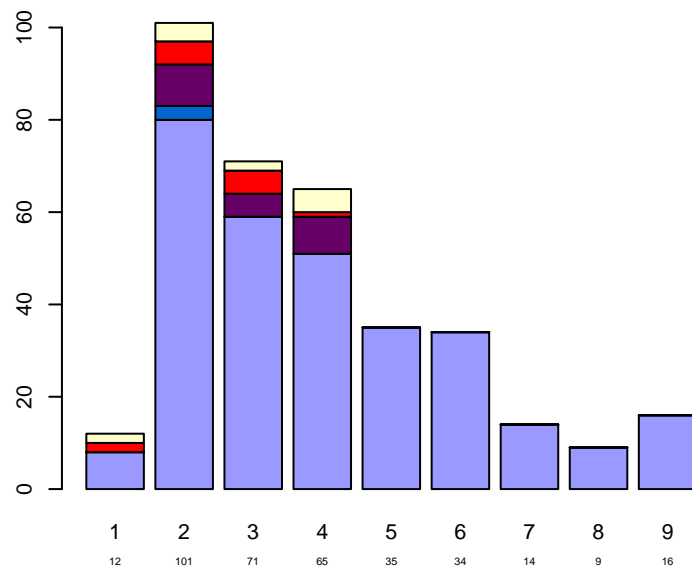
### **Anticipated benefits:**

This project directly engages fishermen in data collection activities and the management process. The fine-scale stock distribution models will reduce the geographic uncertainty surrounding commercial ocean harvest of Chinook salmon. Identifying catch probability patterns of ESA-listed stocks will reduce the bycatch of those stocks in the commercial fishery. Reduced uncertainty potentially can lead to reduced precautionary harvest restrictions and increased fishing opportunities. In contrast to CWT datasets, GSI has the promise of delivering catch composition estimates to fishermen and managers within a week of harvest.

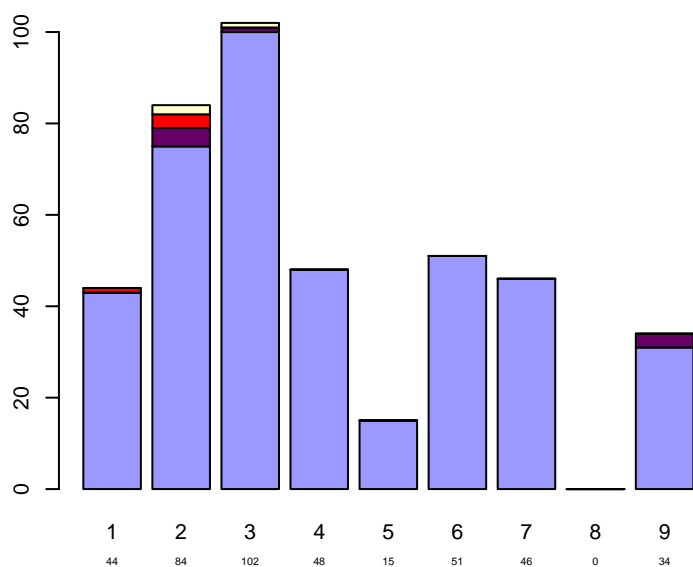
**KMZ\_CA**  
n = 25



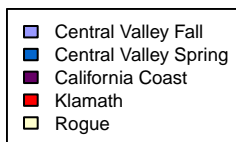
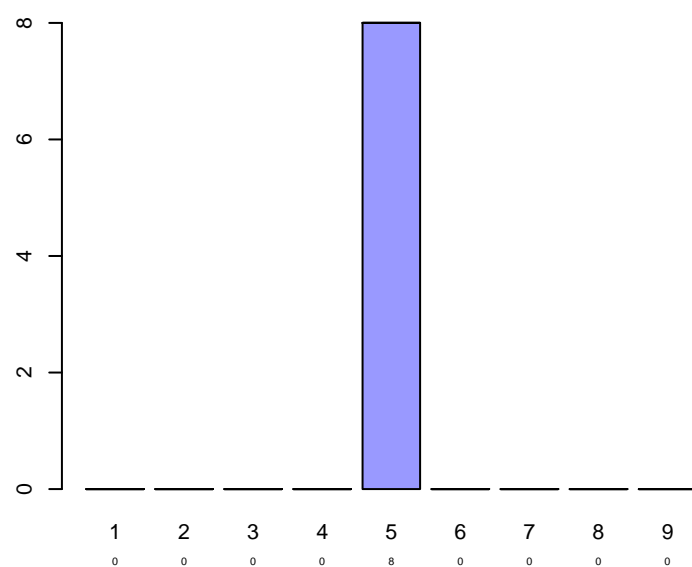
**FB**  
n = 357



**BB**  
n = 424



**SF**  
n = 8



Results from 2016 at-sea retention sampling  
806 Chinook salmon were sampled in 3 management zones from the first week of August through the last week of September, 2016. Stock compositions were more mixed in the first weeks of August compared to the later weeks of September.  
Note that the small sample size in San Francisco was a test sampling.

March 14, 2012

MEMORANDUM FOR: William W. Stelle, Jr., Regional Administrator

FROM: Dr. John Carlos Garza, Southwest Fisheries Science Center  
Dr. Pete Lawson, Northwest Fisheries Science Center

SUBJECT: 2012 Sampling Plan for West Coast Salmon Genetic Stock Identification Collaboration

This Memorandum provides our request for a Scientific Research Permit to conduct sampling of Chinook salmon in closed times and areas off the West Coast in 2012. The permit holders would be Dr. John Carlos Garza, SWFSC, and Dr. Peter Lawson, NWFSC, principal investigators for the project.

The West Coast Salmon Genetic Stock Identification (GSI) Collaboration (WCS-GSI) is a partnership of fishermen organizations, universities, states, tribes, and the National Marine Fisheries Service, formed in 2006 to explore potential uses of GSI for West Coast salmon fisheries management. It is built around sampling techniques developed by the Collaborative Research on Oregon Ocean Salmon project (Project CROOS) that enable fishermen to sample their catch at sea. The resulting data allow analysis of stock-specific spatial catch distributions at a scale that provides new opportunities to manage fisheries, in-season, to target strong stocks while limiting weak-stock impacts. To date, WCS-GSI has sampled over 25,000 Chinook salmon in California, Oregon, and Washington during normal troll operations, dockside, or with catch-and-release methods in closed times and areas. Sampling in closed times and areas provides valuable scientific information that is otherwise unobtainable. During catch and release sampling, no fish are retained. The exact nature of the permit will be determined by the seasons set and impacts allowed through the Pacific Fishery Management Council preseason planning process.

Objectives: Objectives of sampling vary depending on the configuration of open seasons. The most ambitious objective maps the distribution of Chinook salmon stocks caught in U.S. ocean fisheries weekly from May through October. This comprehensive sampling is only possible in years when there are substantial ocean fisheries and sufficient impacts available to allow limited sampling in closed times and areas. More limited objectives include concentrated sampling in areas of high economic or scientific interest, sampling to develop and test protocols and statistical designs, and non-catch sampling activities to gather oceanographic data and test new data collection hardware and software.

Sampling protocol: Sampling will be conducted by commercial salmon trollers under charter to sample specific areas or collect specific data. All sampling in closed times and areas will be catch and release. Boats will be directed by project staff to fish in accordance with the Scientific Research Plan. Boats are equipped with geographic information system (GIS) recorders to monitor the vessel track and to record the exact time and location of each fish caught. The fishermen collect tissue and scale samples for GSI and age analysis, and record fish length and depth of capture. Fish may be tagged for future identification. To reduce handling time and stress to the fish, each boat will have two fishermen (captain and crew) specially trained and equipped in catch and release sampling. Handling methods were developed by Dr. Peter Lawson and participating fishermen while conducting hooking mortality studies in 1992.

Research Vessels: Commercial fishing vessels will be chartered to participate in this study by the Oregon Salmon Commission (OSC) and the California Salmon Council (CSC). The OSC and CSC are both state agencies, eligible to charter Scientific Research Vessels as described below:

Scientific research vessel means a vessel owned or **chartered by, and controlled by**, a foreign government agency, U.S. government agency (including NOAA or institutions designated as federally funded research and development centers), **U.S. state** or territorial **agency**, university (or other educational institution accredited by a recognized national or international accreditation body), international treaty organization, or scientific institution.

The research vessels will be chosen from a pool of pre-registered applicants, based on suitability for specific sampling and availability at the time. Pre-registration will require applicant names to be submitted by the OSC and CSC to NMFS for approval. Vessels will be screened for proper licenses, certifications, inspections, insurance (if required), and other requirements as determined by NMFS and the permit holders (Drs. Lawson and Garza). Permit holders will issue letters for each boat to carry while engaged in research activities. Final boat selection and operation instructions will be the responsibility of the Permit holders. Enforcement entities will be informed of the identities and dates and areas of activity of research vessels.

Vessels will be operating under a Scientific Research Plan prepared by and directed by NMFS scientists in consultation with other members of the WCS-GSI collaboration. The exact Research Plan to be used depends on decisions made by the PFMC during the March and April meetings.

### **Scientific Research Plan**

The conceptual plan is presented here for consideration, but the final details will depend on seasons and allocations determined by the PFMC preseason planning process. Approximate impacts presented here are preliminary estimates. The PFMC Salmon Technical Team (STT) will prepare impact estimates for all stocks during the PFMC's season-setting process. Compliance of the proposed research activities with ESA and NEPA requirements will be assessed during the Council's annual planning process.

Synoptic sampling plan: The object of this sampling plan is to collect 200 samples from each fishery management areas (or subdivision) for each week that fish are available to be caught from May through September. The sample size of 200 per area-week derives from past years' experience with statistical uncertainties and GSI stock assignment uncertainties. This plan can be implemented when large areas of the coast are opened for commercial fishing and permit sampling in closed areas can be used to supplement the larger dataset.

Approximate impacts: There are eight primary management areas south of Cape Falcon, Oregon, and 26 weekly periods in May through September. Thus, there are a total of 208 area-week periods. The proposed season alternatives for the 2012 commercial season include significant open times and areas; there are between 36 and 42 closed area-weeks depending on the final season adopted by PFMC. Complete sampling in closed times and areas would result in a maximum of 42 area-weeks x 200 fish = 8400 fish sampled and released. The total mortality expected for this type of sampling would be 31% of



the encounters: 2604 mortalities. The fraction of encounters expected to be Sacramento River fall Chinook (SRFC) varies considerably by area-week and by year, but overall might be on the order of 50%: 1302 SRFC mortalities. Actual mortality estimates for all stocks, including SRFC, will be provided by the STT during the PFMC 2012 salmon preseason management process.

## **Reports**

A summary of the final Scientific Research Plan, based on the PFMC's decision, will be included in Preseason Report III. Data, as appropriate, will be made available in a timely manner at [www.pacificfishtrax.org/](http://www.pacificfishtrax.org/) and a written report submitted to PFMC for consideration at the November meeting. It is anticipated that results will be reviewed by the PFMC Scientific and Statistical Committee and STT as part of the salmon methodology review process. A summary of activities and results will also be included in the annual Review of Ocean Salmon Fisheries.

Address communication concerning this memorandum to Peter Lawson ([peter.w.lawson@noaa.gov](mailto:peter.w.lawson@noaa.gov)) or J. Carlos Garza ([carlos.garza@noaa.gov](mailto:carlos.garza@noaa.gov)).



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Southwest Fisheries Science Center  
Fisheries Ecology Division  
110 Shaffer Road  
Santa Cruz, California 95060

April 23, 2012

MEMORANDUM FOR: William W. Stelle, Jr., Northwest Regional Administrator

FROM: *for* Dr. Francisco Werner, Director  
Southwest Fisheries Science Center

Dr. John Stein, Director *John E. Stelle*  
Northwest Fisheries Science Center

SUBJECT: Request for Scientific Research Permit for 2012 Sampling Plan for  
West Coast Salmon Genetic Stock Identification Collaboration

This Memorandum provides our request for a Scientific Research Permit to conduct sampling of Chinook salmon in closed times and areas off the West Coast in 2012 for the purposes of collecting genetic stock identification (GSI) and associated data. The permit holders would be Dr. John Carlos Garza, SWFSC, and Dr. Peter Lawson, NWFSC, principal investigators for the project. A permit similar to the one requested here, SAL-2010-01, was issued to Dr. Churchill Grimes and Dr. Peter Lawson in 2010. Under that permit a total of 3687 Chinook salmon were sampled and released in California and Oregon.

The West Coast Salmon Genetic Stock Identification (WCS-GSI) Collaboration is a partnership of fishermen organizations, universities, states, tribes, and the National Marine Fisheries Service, formed in 2006 to provide better information about the ocean distribution and migration patterns of Pacific Salmon and to explore potential uses of GSI for West Coast salmon fisheries managed by the Pacific Fisheries Management Council (PFMC). It is built around sampling techniques that enable fishermen to sample fish at sea and collect exact catch location information for individual fish. The resulting data allow analysis of stock-specific spatial catch distributions at a scale that provides new opportunities to manage fisheries so as to target abundant stocks while limiting impacts on less productive stocks. To date, WCS-GSI has sampled over 25,000 Chinook salmon in California, Oregon, and Washington during normal troll operations, dockside, or with catch-and-release methods in closed times and areas. During catch and release sampling, no fish are retained. Such fishery-independent, non-retention sampling in closed times and areas provides valuable scientific information that is otherwise unobtainable. The permit request for such non-retention sampling in 2012 follows the seasons adopted by the PFMC in the preseason planning process and all requests herein have been approved by the PFMC as part of this process.

Objectives: Goals of non-retention sampling vary depending on the configuration of open commercial fishery seasons. The most ambitious objective samples Chinook salmon in all fishery management areas subject to PFMC-managed ocean fisheries on a weekly basis from May through September. This comprehensive sampling is accomplished through coordination of fishery-dependent sampling during open seasons and the fishery-independent, *non-retention* sampling in closed times and areas for which a permit is requested.





Other objectives of the research include an ongoing evaluation of boundaries in the San Francisco Management Area and the development and testing of new protocols and statistical designs, as well as non-catch related activities to test new data collection hardware and software.

**Sampling protocol:** Sampling will be conducted by commercial salmon trollers under charter to sample specific areas or collect specific data. All sampling in closed times and areas will be catch and release, with no fish retained. Boats will be directed by project staff to fish in accordance with the Scientific Research Plan (see below). Boats are equipped with geographic information system (GIS) recorders to monitor the vessel track and to record the exact time and location of each fish caught. Tissue and scale samples for GSI and age analysis are collected, and fish length and depth of capture are recorded. Fish may be tagged for future identification. To reduce handling time and stress to the fish, each boat will have two fishermen (captain and crew) specially trained and equipped in catch and release sampling. Handling methods were initially developed by Dr. Peter Lawson and participating fishermen in 1992. Methods were refined and a written protocol developed for sampling in 2010, which is attached.

**Research Vessels:** Commercial fishing vessels will be chartered to participate in this study through a collaboration with the California Salmon Council (CSC) and the Oregon Salmon Commission (OSC). The CSC and OSC are both state agencies, eligible to charter Scientific Research Vessels as described below:

Scientific research vessel means a vessel owned or **chartered by, and controlled by,** a foreign government agency, U.S. government agency (including NOAA or institutions designated as federally funded research and development centers), **U.S. state** or territorial **agency**, university (or other educational institution accredited by a recognized national or international accreditation body), international treaty organization, or scientific institution.

The research vessels will be chosen from a pool of pre-registered applicants, based on suitability for specific sampling and availability at the time. Pre-registration will require applicant names to be submitted by the CSC and OSC to NMFS for approval. Vessels will be screened for proper licenses, certifications, inspections, insurance (if required), and other requirements as determined by NMFS and the permit holders (Drs. Garza and Lawson). Permit holders will issue letters for each boat to carry while engaged in research activities. Final boat selection and operation instructions will be the responsibility of the Permit holders. Enforcement entities will be informed of the identities and dates and areas of activity of research vessels.

### **Scientific Research Plan**

Vessels will be operating under a Scientific Research Plan prepared by and directed by NMFS scientists in consultation with other members of the WCS-GSI collaboration. The exact Research *Plan to be used depends* on decisions made by the PFMC during the April meeting, but the conceptual plan for synoptic sampling through coordination of fishery-independent, non-retention sampling with fishery-dependent sampling is presented here for consideration.

Approximate impacts presented here are preliminary estimates. The PFMC Salmon Technical Team (STT) will prepare impact estimates for all stocks during the PFMC's season-setting process. Compliance of the proposed research activities with ESA and NEPA requirements will be assessed during the Council's annual planning process.

**Synoptic sampling plan:** The object of this sampling plan is to collect 200 samples from each fishery management area (or subdivision) north of Pigeon Point for each week that fish are available to be caught from May through September. The sample size of 200 per area-week derives from statistical considerations related to the ability to accurately estimate differences in proportions of ESA-listed stocks and GSI stock assignment uncertainties. This sampling rate can reasonably be achieved when catch rates are high during both commercial fishing and permitted fishery independent sampling in closed times and areas. The Monterey Fishery Management Area is not proposed for fishery-independent sampling, because past sampling has shown that this fishery is dominated by the Central Valley Fall Run stock and the amount of non-retention sampling necessary to reliably estimate proportions of the other, rare, stocks is prohibitively large.

The PFMC season structure includes 30 closed area-weeks during May-September in the San Francisco, Fort Bragg, and California Klamath Management Areas. Our permit request is therefore to sample all such closed area-weeks at a maximum rate of 200 fish per area-week.

### **Approximate impacts**

There are eight fishery management areas that are PFMC-managed and which are the focus of this study, and approximately 21 weekly periods in May through September. As an objective of the study is to evaluate a possible management area boundary at Point Reyes, the areas north and south of there are treated as separate for sampling purposes. The 2012 commercial season includes 33 closed area-weeks, with the areas north and south of Point Reyes considered separately. Complete sampling in closed times and areas with the maximum catch rate would result in 33 area-weeks x 200 fish = 6600 fish maximum sampled and released. The total mortality expected for this type of sampling would be 31% of encounters: a maximum of 2046 mortalities. A spreadsheet detailing the maximum expected impacts is attached. The fraction of encounters expected to be Sacramento River fall Chinook (SRFC) varies considerably by area-week and by year, but overall is likely to be on the order of 50% for a maximum of 1023 SRFC mortalities. Actual mortality estimates for all stocks, including SRFC, will be provided by the STT during the PFMC 2012 salmon postseason evaluation.

### **Reports**

A summary of the final Scientific Research Plan, based on the PFMC's decision, will be included in Preseason Report III. Data, as appropriate, will be made available in a timely manner at [www.pacificfishtrax.org/](http://www.pacificfishtrax.org/) and a written report submitted to PFMC for consideration at the November meeting. It is anticipated that results will be reviewed by the PFMC Scientific and Statistical Committee and STT as part of the salmon methodology review process. A summary of activities and results will also be included in the annual Review of Ocean Salmon Fisheries.

Please address communication concerning this memorandum to John Carlos Garza ([carlos.garza@noaa.gov](mailto:carlos.garza@noaa.gov)) or Peter Lawson ([peter.w.lawson@noaa.gov](mailto:peter.w.lawson@noaa.gov)).

Effort tables

WCS-GSI At Sea Sampling Plan-2012

	Weeks open for sampling					= non-retention (N-R)		Total weeks open		
	May	June	July	Aug	Sept			Open	N-R	All
<b>Final</b>										
KMZ-CA	5	4	4	4	2			2	17	19
Ft. Bragg	5	4	1	4	4			11	10	21
San Francisco-North	5	3	4	4	4			18	3	21
San Francisco-South	5	3	4	4	4			18	3	21
Monterey										
N.B. One week added to open sampling column for SF Managen Total										
								49	33	82
Areas in June and three weeks for Ft. Bragg in July										
<b>Final</b>										
KMZ-CA	1000	800	800	800	400			0	3400	3400
Ft. Bragg	1000	800	200	800	800			2200	2000	4200
San Francisco-North	1000	600	800	800	800			3600	600	4200
San Francisco-South	1000	600	800	800	800			3600	600	4200
Monterey										
N.B. 200 samples added to open sampling column for SF Manag Total										
								9400	6600	16000
N.B. 200 samples added to open sampling column for SF Manag Total										
										2046
ment Areas in June and 600 samples for Ft. Bragg in July										
Samples per time/are	800									Hooking mortality rate of 0.31 assumed