Washington Contribution to the 2010 Meeting of the Technical Sub-Committee (TSC) of the Canada-US Groundfish Committee

May 5th – 6th, 2010

Edited by

Theresa Tsou

Contributions by

Henry Cheng
Corey Niles
Wayne Palsson
Kurt Stick
Farron Wallace

Washington Department of Fish and Wildlife

May 2009

Review of WDFW Groundfish Research, Assessment, and Management Activities in 2009

A. Puget Sound Area Activities

1. Puget Sound Groundfish Monitoring, Research, and Assessment *(Contact: Theresa Tsou 360-902-2855, tien-shui.tsou@dfw.wa.gov; Wayne Palsson 425-379-2313, Wayne.Palsson@dfw.wa.gov) Marine Fish Science Unit*

Staff of the Puget Sound Marine Fish Science (MFS) Unit includes Wayne Palsson, Robert Pacunski, Tony Parra, and Jim Beam. In addition, Courtney Adkins and Pete Sergeef work as MFS employees during the spring 2009 bottom trawl survey. Unit tasks are primarily supported by supplemental funds from the Washington State Legislature for the recovery of Puget Sound bottomfish populations. The main activities of the unit include the assessment of bottomfish populations in Puget Sound, the evaluation of bottomfish in marine reserves, and the development of conservation plans for species of interest. Groundfish in Puget Sound are managed under the auspices of the Puget Sound groundfish Management Plan (Palsson, et al. 1998).

a. Rockfish Conservation Plan

Twenty-eight species of rockfishes occur in the inland marine waters of Washington, here defined as Puget Sound. The Washington Department of Fish and Wildlife manages these species and the various commercial and recreational non-tribal fisheries that have either targeted rockfishes or have caught them incidentally to other targeted species. Rockfishes and other groundfish are managed for non-tribal users under the auspices of the Puget Sound Groundfish Management Plan and are co-managed with the Treaty Tribes of Washington. We completed a technical review on the Biology and Assessment of Rockfishes in Puget Sound (Palsson et al. 2009) that serves as a source document for the development of a Puget Sound Rockfish Conservation Plan.

In the technical report, we summarized current knowledge of Puget Sound rockfish biology (life history, habitat usage, and ecosystem linkage) and provide an overview of their exploitation history and population status through 2007 (Palsson et al. 2009). Because the data sources are poor, we used an adaptation of the American Fisheries Society's Criteria for Marine Fish Stocks at Risk (Musick 1999, Musick et al. 2000) and available indices from fisheries dependent and independent surveys. Because of a lack of complete catch and demographic information, formal stock assessments with retrospective and predictive models could not be conducted. The status of rockfish populations in Puget Sound were evaluated in terms of their vulnerability to extinction and, and where appropriate, populations will be evaluated for their fishery potential and biological reference points. To achieve this, information on fishery landings trends, species composition trends, and yield per recruit for nine rockfish species from Puget Sound were evaluated for long-term trends. The majority of rockfish stocks or populations in Puget Sound were in the Precautionary condition, but several species once important to recreational fisheries in Vulnerable or Depleted status. The patterns of stocks status were generally similar between

the two regions for the 17 species of rockfish examined. Seven (19%) of the 32 populations present in either North or South Sound were in Healthy status. Eighteen populations (56%) were in Precautionary status, while two populations (6%) were in Vulnerable status, and five populations (16%) were in Depleted status. Many of the Precautionary ratings reflected a lack of information regarding the population.

A draft of the Puget Sound Rockfish Conservation Plan (PSRCP) was prepared by a team of managers and scientists during 2008. In October 2009, WDFW released the draft in a draft Environmental Impact Statement under the auspices of the Washington State Environmental Protection Act. The plan identified four alternative actions under eight management policy areas including Natural Production, Habitat, Fishery Management, Ecosystem, Monitoring, Research, Outreach and Education, and Enhancement including artificial propagation and artificial reefs. The alternatives considered for each policy area ranged from status quo to options that were less or more conservative that the management actions being currently taken. The objectives for the PSRCP are as follows:

1. Provide a framework of policies, strategies and actions for preserving healthy stocks of rockfish in Puget Sound by restoring and maintaining their abundance, distribution, diversity, and long-term productivity in their natural habitats;

2. Seek to maintain rockfish populations throughout Puget Sound to achieve cultural, economic, and ecosystem benefits for current and future residents of Washington State in a manner consistent with the primary conservation goal;

3. Meet all federal and state laws, including treaty obligations;

4. Ensure policies are succinct, relevant, and easily understood by the public and Department employees;

5. Seek productive partnerships that help the WDFW achieve policy objectives;

6. Use the best available science, sound fisheries management, and professional judgment to achieve excellence in stewardship of public resources; and

7. Monitor and periodically report to the Washington Fish and Wildlife Commission and the public on the implementation and outcomes of Commission-approved policies.

WDFW identified initial, preferred alternatives that afforded greater conservation benefits to rockfish. The overarching approach is to manage naturally produced rockfish in intact habitats maintained by WDFW's habitat conservation approach of no net loss of habitat. All WDFW fisheries will be managed to maintain healthy stocks of indicator species of rockfish. Artificial, hatchery propagation will only be considered to bring depleted rockfish stocks to healthier levels, and artificial habitats will only be considered to restore or mitigate for degraded rockfish habitats. Rockfishes will be managed in an ecosystem context with greater efforts to understand food-web dynamics and the interactive effects of stressors. More comprehensive monitoring and research programs will be implement to inform managers and citizens that will lead to better

evaluations of management actions and provide the basis for adaptive management. More extensive public outreach and education efforts will lead to rockfish being recognized for their important roles in the ecosystem throughout Washington.

During the initial 30 day comment period, a strong public opinion was voiced to provide more time for comment and to revise the plan with more citizen input. WDFW extended the comment period into 2010 and established a 13 member Rockfish Advisory Group comprised by recreational fishers, scuba divers, non-governmental organization representatives, and an academic. Their first meeting was held in late December. The group began to advise managers on several recreational regulation proposals aimed at reducing the harvest of rockfish. A revised PSRCP will be released in 2010 for comment and subsequent adoption by WDFW.

b. ESA Petition for Five Deep-water Rockfishes

In 2007, NOAA Fisheries received a petition to list yelloweye, canary, bocaccio, redstripe, and greenstriped rockfishes under the Endangered Species Act. NOAA accepted this petition and formed a Biological Review Team to evaluate distinct population segments and the risks of extinction. In April 2009, NOAA recommended that all five species constituted a distinct population segment within some portions of Puget Sound (Federal Register, April 23, 2009; vol. 74, No. 77, Pages 18516-18542). They did not recommend listing of greenstriped or redstripe rockfish but did recommend bocaccio be listed as endangered and yelloweye and canary rockfishes be listed as threatened under the terms of the federal Endangered Species Act. These three species have never been dominant in the groundfish harvest of Puget Sound, but have severely declined in frequency over the past thirty years. MFS staff continues to provide technical consultations and data to NOAA scientists and managers under provisions of the ESA.

c. 2008 San Juan Archipelago ROV survey

From 29 September to 26 November 2008, the MFS staff conducted an ROV survey of the rocky habitats within the San Juan Archipelago (SJA). The survey was designed using available high-resolution (1-5 m^2) geomorphic habitat maps developed by Dr. Gary Greene and his graduate students at the UCSB Moss Landing Marine Laboratories. These maps and some previous survey results provided a sampling frame of rocky habitats in the San Juan Islands. The survey area was stratified by depth along the 20-fathom contour to allow for comparisons to earlier drop-camera surveys of the region. A total of 207 transects were completed, ranging in depth from the surface to 250 m (820 ft), with an average length of 320 m. The most common species observed were kelp greenling, copper rockfish, quillback rockfish, Puget Sound rockfish, lingcod, and juvenile gadids. Other species observed with the ROV were yelloweye rockfish, bocaccio, widow rockfish, greenstriped rockfish, tiger rockfish, black rockfish, yellowtail rockfish, and brown rockfish. Approximately 50 hours of videotape were collected during the survey. Review and analysis of the videotapes was completed at the end of the 2009. Initial results found 420,000 quillback rockfishes and 535,000 copper rockfishes occur in the SJA. Standard errors for these common species were less than 14%. A manuscript is being prepared describing the methods and population survey results.

d. Continued investigation of the 2006 Recruitment Event of Young-of-the-Year Rockfishes in Puget Sound

During 2009, MFS staff reoccupied dive sites surveyed in 2006 that documented a remarkable settlement of post-larval, young-of-the-year (YOY) rockfishes in the inland waters of Washington. As in 2007-2008, divers observed very few YOY rockfish at the eighteen index sites in Central and Southern Puget Sound in 2008. Large numbers of now 2+ year-old copper and quillback rockfish were observed on adult habitats adjacent to several of the nearshore YOY sites. Also in 2009, MFS staff observed what appears to be an immigration of 2+ year- old black rockfish to Puget Sound and the San Juan Islands. MFS staff hypothesize that these fish are emigrating from waters along the Washington coast and western Strait of Juan de Fuca where large numbers of juvenile pelagic rockfishes were observed during the 2006 recruitment event. Divers are also following the recruitment of copper and quillback rockfishes that occurred in 2008 in Hood Canal.

e. Low Dissolved Oxygen Conditions at Sund Rocks Marine Reserve

Hood Canal is a fjord connected to Puget Sound in the north and extending 100 km to the south. The steep sides of the canal extend to depths of 180 m in the north and range to depths of over 125 m for most of the water body. Hood Canal is one of the water bodies identified in the Pew Ocean Commission report as a hypoxic dead zone. Dissolved oxygen (DO) concentrations of less than 2 mg/l have been observed for decades in deep and shallow waters in the southern portion of the canal, and these low concentrations have been attributed to naturally poor circulation resulting from low estuarine flow and bottom water replacement. Between 2002 and 2006, low DO concentrations have become chronic, extending into nearshore waters and possibly becoming worse due to eutrophication. Mass mortality events of fishes and invertebrates (Fish Kills) in 1926 and 1963 likely have resulted from poor water quality in this fjord naturally prone to hypoxia. Marine Fish Science staff has been conducting regular surveys at the Sund Rock Marine Reserve Site since 2001, with additional surveys conducted when extreme hypoxic conditions arise. Monitoring at this site by MFS staff continued in 2009 to detect potential impacts to fish populations inhabiting the local area. Similar to 2007 and 2008, no extreme hypoxic events or fish kills were reported, thus 2009 can be classified as a low-impact year. MFS staff continued their participation in the Hood Canal Dissolved Oxygen Program as partners and scientists.

f. Bottom Trawl Surveys of Puget Sound

Since 1987, WDFW has conducted bottom trawl surveys in Puget Sound that have proven invaluable as a fisheries-independent indicator of population abundance for fishes living on unconsolidated habitats. These surveys have been conducted at irregular intervals and at different scales since 1987. Early surveys between 1987 and 1991 were synoptic surveys of the entire Puget Sound, later were stratified, random surveys focusing on individual sub-basins, and beginning in 2008 became synoptic again with stations at fixed sites.

From May 11th through June 11th, 2009, WDFW conducted a bottom trawl survey to assess the abundance of groundfishes in the inland marine waters of Washington (Puget Sound). The

survey area was divided into Puget Sound's oceanographic basins including the Eastern and Western Strait of Juan de Fuca, San Juan Archipelago, Strait of Georgia, Whidbey Basin, Central Puget Sound, Southern Puget Sound, and Hood Canal. The goal of the survey was to detect long-term changes in abundance of fishes living on or near the bottom and to characterize the structure of the fish communities. The specific objectives of this survey were to estimate the relative abundance, species composition, and biological characteristics of groundfish species at pre-selected, permanent index stations. Key species of interest include Pacific cod, walleye pollock, Pacific whiting, English sole, spiny dogfish, and skates, but all species of fishes and invertebrates will be identified and recorded.

This survey was the second "Index" survey of Puget Sound, a departure fromt the stratified – random designs use prior to 2008. This new design is used to assess changes in the relative abundance of key groundfish species because reoccupying fixed stations will minimize the variation in sea floor and habitat and provide more powerful inter-annual comparisons. For the new survey design, we divided each oceanographic basin into two geographic components (north and south or east and west) for representative coverage. We selected previously trawled stations within each component area from pre-existing depth zones such that one station would be occupied between depths of 30 to 240 feet, from 240 to 360 feet, and greater than 360 feet. Two replicate trawl samples were collected at each stations and were spaced several hundred meters apart to be close to each other but not directly over the first trawl location. We occupied 51 index stations during 2009 among eight oceanographic basins, two geographic component areas, and three depth zones (8 x 2 x 3). An additional set of three stations was planned for the central portion of Central Puget Sound to better represent this elongate basin.

While WDWF adopted a new survey design, the trawling procedure of the survey was similar to previous WDFW trawl surveys (Palsson et al. 2002, 2003). The 58-foot *F.V. Chasina* was the chartered sampling vessel, and it was equipped with an agency-owned 400-mesh Eastern bottom trawl fitted with a 1.25 inch codend liner. The net was towed at each station for a distance of 0.40 nautical miles at a speed of 1-3 knots, and the tows lasted approximately 12 minutes. Net openings ranged from 8 to 14 m depending upon depth and the amount of cable towing the net. The resulting catch was identified to species, weighed and enumerated, and most of the catch was returned to the sea. The density of fish at each station was determined by dividing the catch numbers or weight by the area sampled by the net. Some of the catch was taken for biological samples that were sampled on deck or preserved laboratory analysis.

During the 22 survey days, we occupied 51 stations and conducted 102 bottom trawls (Figure 1). Some 100,000 individual fish among 89 species weighing 14 mt were collected. Spotted ratfish, English sole, and walleye pollock were the most common species in the samples in terms of weight, but this year, Pacific cod were the eighth-most abundant species. The cod measured between 18 to 64 cm and averaged 28 cm in total length, corresponding to a fish beginning its second year of life. The cod were present in all basins and the pattern suggests a strong 2008 year class. The climate of 2008 was one of the coldest since the mid-1970s supporting the idea that for two decades, cod have been limited in abundance by a warm climate.

g. Marine Reserve Monitoring: Evaluation of No-Take Refuges for Rocky Habitat Fishes

WDFW has developed a system of 24 fully and partially protected marine reserves in Puget Sound, fourteen of which are significant for groundfish resources. As the system has expanded, MFS staff regularly monitors a core of the marine reserve sites on a frequent basis and visit other subtidal reserves on a periodic basis. This monitoring effort builds upon field research at many of these sites that was begun as early as 1986. The fieldwork consists primarily of scuba divers using standardized techniques to conduct visual censuses along a fixed strip transect at central Puget Sound sites or of the site "footprint" at south Puget Sound sites. Along with estimating fish density, divers measure individual fish, and in the case of lingcod, quantify nesting activity. Specific monitoring activities in 2009 included surveying a number of the Puget Sound reserves and comparable fished sites. Several reserves in central Puget Sound were visited six times during 2009 as an extension of a study initiated in 1995 that takes advantage of previous information collected at Orchard Rocks. Prior to 1998 when Orchard Rocks was declared a fully protected reserve, MFS staff conducted monitoring in 1986, 1987, and from 1995-1997. With the addition of a new fished-site treatment located 1 nm across the channel at Point Glover, the newly created Orchard Rocks refuge in a formerly monitored fished area provided MFS staff with an excellent opportunity to evaluate the before and after impacts of refuge creation with a comparable fished-site treatment. Monitoring at Zee's Reef and Colvos Passage that began in 2002 continued with six surveys conducted in 2009. Several of the sites showed a marked increase in the number of 2+ year-old copper and quillback rockfish at most sites, although brown rockfish continue to be the dominant species at most of the central Puget Sound sites, whereas a more even distribution of the three species was seen at the southern sites.

MFS staff also conducted scuba surveys at established sites in San Juan channel to examine the nesting success of lingcod in marine reserve and fished areas. An analysis of the data collected in 2009 and in the past several years shows that lingcod at the marine reserve sites continue to be larger, more abundant, and have higher nest densities than fish at non-reserve (i.e., fished) sites.

h. Acoustic-Trawl Surveys of Pacific Hake in Puget Sound

Puget Sound once supported thriving commercial fisheries of Pacific hake (*Merluccius productus)* where a thriving population occurred among the waters of Possession Sound, Saratoga Passage, Port Gardner, and Port Susan. The fisheries once harvested between 1,000 and 6,800 mt of hake per year between 1970 and 1986 but harvests declined to less than 300 mt in the late 1980s. The fishery was closed after 1991. Corresponding to the fishery declines, the population abundance assessed by acoustic-midwater trawl surveys declined from 28,000 mt in 1978 to 5,200 mt in 1991, the last year of a fishery. The Port Susan component of the population declined to only 1,300 mt in 2000, the same year that this species was being considered for protection under the Endangered Species Act. Although, hake in central Puget Sound were not listed, they remain an ESA candidate species and a Species of Concern under a NOAA Fisheries program. The commercial fishery and scientific activity historically focused on Port Susan and adjacent waters, but hake have also occurred regularly in Hood Canal but the nature of the population has not been specifically addressed. WDFW suspended its acoustic-trawls surveys in 2002 due to declining funds but partnered with NOAA Fisheries to conduct several surveys in Puget Sound in the winter of 2009. Three surveys bracketed the expected March time of peak spawning, and the surveys were expanded to not only include Port Susan and Possession Sound

but Saratoga Passage as well as explore whether Pacific hake also spawned in northern Hood Canal. This project specifically sought to: 1) Assess the present abundance of hake in Port Susan and adjacent waters using acoustic-trawl technology and 2) collect age, maturity, and other biological information from Puget Sound and Hood Canal hake.

Surveys were conducted on the evening to morning periods of February, March, and April. An additional survey of northern Hood Canal was conducted in March 2009. All surveys were conducted between sunset and sunrise. Two vessels participated in the nigh-time surveys. A small research vessel conducted the acoustic survey, and a chartered commercial fishing vessel conducted the mid-water trawl survey. Mechanical problems delayed the acoustic survey of the Whidbey Basin in March until two days after the midwater trawl survey.

Of the three acoustic-midwater trawl surveys of the Whidbey Basin, the February survey resulted in the greatest estimated biomass of 2,700 mt (Figure 4). This biomass was 50% to 75% greater that the survey estimates March and April. The 2009 abundance of Pacific hake of in Port Susan, Possession Sound, and Port Gardner averaged 1,700 mt and was the second lowest abundance on record. Hake abundance once was over 15,000 mt in 1982, declined to between 2,800 and 8,100 mt in the 1990s, and decreased to only 1,300 mt in 2002, the lowest abundance ever.

Our survey in Hood Canal confirmed that spawning hake are present at the same time spawning hake are aggregated in Port Susan. The small specimens, likely corresponding to recruitment from the previous year indicates that a self-perpetuating stock may be present in Hood Canal. Genetic analysis of tissues taken during the surveys will test this hypothesis. Despite the prohibition of the hake fishery in Port Susan after 1991, the hake population in the Whidbey Basin has not recovered.

i. Other Activities

Tony Parra initiated a collaborative effort to describe a newly observed ecological phenomenon of small sculpins cleaning inside the mouths of lingcod. During surveys of marine reserves where larger lingcod are more common, WDWF divers have observed lingcod with their mouths agape. Further observations and photography found several species of sculpins inside the mouths or on the heads of the lingcod. While cleaner fish ecology has been described in several coral reef communities, the possible occurrence of these relationships in cold temperate communities underscores the subtle ecosystem relationships that need to be understood for ecosystem management.

2. Herring Stock Assessment (*Contact: Kurt Stick (360) 466-4345 ext. 243)*

Annual herring spawning biomass was estimated in Washington in 2009 using spawn deposition and acoustic-trawl surveys. WDFW Region 4 staff based in the Mill Creek and La Conner offices currently conduct these assessment surveys of all adult herring stocks in Washington's

inside waters annually. Stock assessment activities for the 2010 spawning season are in progress.

The herring spawning biomass estimate for all Puget Sound stocks combined in 2009 is 13,298 tons (see table below). The cumulative total is an increase from the 2008 total of 11,038 tons, which is lower than the recent peak of 17,765 tons in 2006, and less than the mean cumulative total for the previous ten year (1999-2008) period of 14,256 tons.

The combined biomass of south/central Puget Sound (including Hood Canal) stocks in 2009 of 10,381 tons is relatively high, and is an increase from the 2008 total of 8,082 tons. Cumulative biomass of north Puget Sound stocks is currently at a low level of abundance. The spawning biomass of this region's largest, the Cherry Point stock, remained at a critically low level in 2009 at 1,341 tons; compared to a range of 3,100 to almost 15,000 tons between 1973 and 1995. Herring spawning activity for the Strait of Juan de Fuca region remained relatively low in 2009, with an estimated spawning biomass of only 251 tons.

PUGET SOUND HERRING SPAWNING BIOMASS ESTIMATES (SHORT TONS) BY STOCK AND REGION, 2000-2009.

	YEAR									
	2009	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Squaxin Pass	817	1025	557	755	436	828	2201	3150	1597	371
Wollochet Bay	359	45	35	27	67	52	152	106	133	142
Quartermaster Harbor	843	491	441	987	756	727	930	416	1320	743
Port Orchard-Port Madison	1755	1186	1589	2112	1958	700	1085	878	2007	1756
South Hood Canal	156	223	70	244	210	176	207	166	187	140
Quilcene Bay	3064	2531	2372	2530	1125	2342	916	2585	2091	2426
Port Gamble	1064	208	826	774	1372	1257	1064	1812	1779	2459
Kilisut Harbor	0	0	24	54	170	184	448	774	612	107
Port Susan	251	345	643	321	157	429	450	775	587	785
Holmes Harbor	1045	686	572	1297	498	673	678	573	275	281
Skagit Bay	1027	1342	1236	2826	1169	1245	2983	2215	2170	646
South-Central Puget Sound Total	10381	8082	8365	11927	7918	8613	11114	13450	12758	9856
Fidalgo Bay	15	156	159	323	231	339	569	865	944	737
Samish/Portage Bay	320	409	348	412	218	351	299	496	470	196
Int. San Juan Is.	0	60	33	285	41	67	72	158	219	128
N.W. San Juan Is.	0	0	0	0	0	0	13	131	62	90
Semiahmoo Bay	990	662	1124	1277	870	629	1087	1012	1098	926
Cherry Point	1341	1352	2169	2216	2010	1734	1611	1330	1241	808
North Puget Sound Total	2666	2639	3833	4513	3370	3120	3651	3992	4034	2885
Discovery Bay	205	248	42	1325	33	252	207	148	137	159
Dungeness/Sequim Bay	46	69	34	0	0	22	44	131	93	138
Strait of Juan de Fuca Total	251	317	76	1325	33	274	251	279	230	297
Puget Sound Total	13298	11038	12274	17765	11321	12007	15016	17721	17022	13038

3. Puget Sound Ambient Monitoring Program (PSAMP) *(Contact: Jim West 360- 902-2842, James.West@dfw.wa.gov)*

The Washington Department of Fish and Wildlife continues to be a key component of the Puget Sound Ambient Monitoring Program Project (PSAMP), a multi-agency effort to assess the health of Puget Sound. To assess how the health of the Sound is affected by chemical contamination of it's fish, the PSAMP Fish Component monitors "legacy" pollutants like PCBs and DDTs that

persist in the ecosystem despite restrictions in their use, PAHs, which are compounds associated with petroleum and with combustion, heavy metals, and emerging toxics like PBDEs that are used as flame retardants.

B. Coastal Area Activities

I. Coastal Groundfish Management *(Contact: Corey Niles, 360-249-1223, Corey.Niles@dfw.wa.gov), Intergovernmental Resource Management*

Activities Related to Pacific Fishery Management Council

The Department contributes technical support for coastal groundfish management issues via participation on the Groundfish Management Team (GMT), the Scientific and Statistical Committee (SSC), and the Habitat Steering Group (HSG) of the Pacific Fishery Management Council (PFMC). The Department is also represented on the Scientific and Statistical Committee and Groundfish Plan Teams of the North Pacific Fishery Management Council. Landings and fishery management descriptions for PFMC-managed groundfish are summarized annually by the GMT in the Stock Assessment and Fishery Evaluation (SAFE) document.

II. Coastal Groundfish Monitoring, Research, and Assessment (*Theresa Tsou 360-920-2855, tien-shui.tsout@dfw.wa.gov; Farron Wallace 360-902-2712, Farron.Wallace@dfw.wa.gov) Marine Fish Science Unit*

Staff of the coastal Marine Fish Science (MFS) Unit includes Farron Wallace, Henry Cheng, Lorna Wargo, John Pahutski, Bob Le Goff, Donna Downs, Victoria Okimura, and Brian Walker. Unit tasks are primarily supported by the combination of state general and federal funds. The main activities of the unit include the assessment of groundfish populations off Washington coast, the monitoring of groundfish commercial landings, and the tagging project.

a. **Black Rockfish Tagging Study**

In 1998, WDFW began a multi-year mark-recapture survey near Westport Washington, the principal location of recreational landings of black rockfish along the Washington coast. The survey design involves annual releases of coded wire tagged (CWT) fish and recovery of tagged carcasses from the recreational fishery, both of which are currently on going. From 1998 to 2001, WDFW's R/V Corliss was used to capture, tag and release about 3,000 black rockfish annually. Fish are released on pinnacles distributed throughout the area fished by the Westport charter fishing fleet. Each CWT tagged fish had two tags placed in the opercular musculature; one on each side of each fish's head. The tags were marked to allow for identification of specific individuals upon subsequent recapture. No tag immediate shedding or tag related mortality was observed during holding experiments during 1998, 1999 and 2003. Since 2002, commercial charter vessels have been used, including F/V Hula Girl, F/V Slammer and F/V Tequila Too. Since 2004, tagged and released fish increased to 4,000-7,000 annually. In 2004, passive integrated transponder (PIT) tags were used to reduce the labor needed to read and match recovered tags. In 2005, all tagged fish released were tagged with both CWTs and PIT tags, which will allow estimation of PIT tag loss rates (since CWT loss rates are already known). Tag

detection experiments in 2006 indicated that detection of PIT tags during high volume recovery where fish are in the detectors range for less than a second was less than 60%. CWT tag detection was over 95%. Due to this, PIT tags were excluded from tag releases in 2007.

In 2009, all groundfish species caught during a tagging trip were double tagged with a single CWT and a single PIT tags. The CWT allows for significantly improved tag detection rates and the PIT tag allows for greater efficiency in identifying the individual fish since CWT do not have to be removed and read. Further, PIT tag loss rate is less than 1% as from our study and as described in other salmon tagging studies and other historical fisheries tagging studies. In 2009 we also included 5 index sites off central Washington coast to allow for longitudinal study in the near future that may reduce uncertainty of random sampling and other factors affecting the tagging experiment. In addition, we do not need to kill the fish to recover the CWT in at-sea experiments. Further, since we release any recaptured fish this permits us to evaluate longitudinal growth and individual variation of each fish. This experiment information is expected to provide unbiased information on bycatch CPUE and biomass trend of recreational black rockfish fishery.

On an annual basis, roughly 40% of the total Westport recreational black rockfish catch is sampled for CWT tags by passing fish carcasses through a metal detector tube (Northwest Marine Technologies R8000). If CWT's are detected the fish are then evaluated for PIT tags and all information is tracked on a daily basis.

b. Skate morphological study

In the past, management of skates (*Rajidae*) was considered a low priority mainly due to their low economic value. As a result, limited fishery data exist for skates and very little is known about skate's life characteristic traits. The paucity of data has prompted Washington Department of Fish and Wildlife (WDFW) to increase data collection for skate species in order to provide better science to support management decisions and stock assessments. Longnose and big skates are the most abundant skate species encountered off the Washington Coast, and are caught mainly as by-catch from commercial fisheries targeting other groundfish. However, more stringent regulations on many groundfish species have resulted in added fishing pressure on skates. Biological data collections for skates are difficult; the current method of obtaining total length (TL) measurement for skates is problematic due to their size, dorso-ventrally compressed shape and large pectoral fins. The maximum confirmed length is 203.9 cm TL and individual fish have been known to weigh up to 91 kilograms. Too often these biological sampling efforts have been thwarted because the skates were simply too large and heavy for technicians (who typically work alone), to move a skate into a position that would allow accurate length measurements to be collected.

In 2008, Donna Downs conducted a research project to determine if another scientifically and ergonomically sound measurement method for skates could be facilitated. Three alternative length measurements were investigated and regression analysis confirmed a tight correlation between total length (TL) and each alternative measurement. The coefficient of determination values were significant for longnose and big skate ($R^2 = 0.96981$, P value <0.05 and $R^2 = 0.969112$, P value < 0.05) respectively. All three alternative measurements depict a credible method for acquiring length-sex frequency data. Analysis did not reveal a significant difference between males and females with regards to size, resulting in these data being pooled. During the

2010 Annual Port Sampling meeting, Donna presented the research results and established the "*distance between spiracles length*" as the measurement method of choice. Efforts are now underway to implement this ergonomically-friendly measurement technique into the commercial groundfish sampling program. Donna has initiated the training of staff at Bellingham and Neah Bay Washington ports as well as working collaboratively with Yuk Cheng in writing a paper for peer-review publication.

c. **Cooperative Rockfish Sampling Survey Update**

A join rockfish longline survey with the International Halibut Commission (IPHC) was conducted annually since 2006. In 2006, there were 25 rockfish added to the existing 27 IPHC survey stations off Washington coast, whereas 18 rockfish stations were kept during 2007-2009. The locations of rockfish survey stations were selected based on an advanced systematic adaptive sampling framework that utilized historical rockfish catch from the IPHC survey stations, the Pacific Coast Groundfish EFH Mapper program, spot prawn logbook trawling data. The goals are to reduce the uncertainty of the estimation of catch per unit effort and to resolve the spatial confounding factors affecting the distribution of rockfish species.

d. **Underwater Remotely Operated Vehicle Survey**

Yelloweye information from the annual Washington IPHC survey has been incorporated into the Pacific Fishery Management Council's yelloweye rockfish stock assessment since the first assessment in 2001. However, abundance varies widely between years and this information has not been informative to the assessment model. In an effort to better understand IPHC survey covariates, WDFW conducted a ROV survey in collaboration with SRI International and the University of Washington during September 2008. The objectives of the survey were to gather data to establish habitat associations and explore catch rates of yelloweye rockfish across time and area. Area swept estimates were derived from precise navigation data collected from a Ring Laser Gyro and Doppler Velocity Log in conjunction with a three-beam video menstruation system.

Survey stations were selected based on information previously collected from a collaborative longline rockfish survey with the International Halibut Commission (IPHC). Stations are located in areas of known high abundance of yelloweye rockfish and one of the stations has historically produced more than 90 percent of the total yelloweye rockfish caught in the IPHC annual longline survey off Washington. Due to bad weather at the start of the survey, the first several days and six transects were completed in Puget Sound near San Juan Islands. The remaining twelve transects were conducted at the IPHC "rockfish stations" off Cape Flattery Washington. Transects were conducted between IPHC start and end points for skates set during the 2007 survey.

Review, data acquisition from digital video files and summarization of initial results has been completed. We had over 2,300 fish observations of at least 36 separate species, fifteen of which were rockfish. An interesting observation that was noteworthy is our observation of adult yelloweye social defense behavior when an individual was attacked by a large lingcod. A manuscript is being prepared describing the methods and survey results that will be completed by December, 2010.