AGE, LENGTH, AND STOCK COMPOSITION OF COLUMBIA BASIN CHINOOK, SOCKEYE, AND STEELHEAD SALMON AT BONNEVILLE DAM

Project Goals:

1. Estimate weekly and annual age and length-at-age composition of spring, summer, and fall chinook, steelhead, and sockeye stocks at Bonneville Dam. This data is used in run forecasts by the U.S. v. Oregon Technical Advisory Committee and the U.S. Chinook Technical Committee for the Pacific Salmon Commission.

2. Estimate the proportion of fish with pinniped-caused wounds, headburn, gas bubble trauma, descaled, or suffering from other wounds or diseases.

3. Estimate stock composition and migration timing using genetic stock identification and PIT tags.

Project Background:

In 1985, the US-Canada Pacific Salmon Treaty was signed to manage research and enhance Pacific salmon. The treaty established the Spawning Escapement-Monitoring program to assess indicator stocks within the Columbia River Basin and improve methods for providing population estimates, escapement monitoring, establishing spawner-recruit relationships and developing harvest management approaches (PST 1985). As part of this program, the Columbia River Inter-Tribal Fish Commission (CRITFC) has developed a comprehensive research strategy to monitor the age and stock composition of adult Pacific salmon returning to the Columbia River. This project has monitored the above Bonneville Dam adult migration of sockeye salmon (Oncorhynchus nerka) since 1985, spring Chinook salmon (O. tshawytscha) since 1987, summer Chinook salmon since 1990, up-river bright fall Chinook salmon since 1998 and summer steelhead (O. mykiss) since 2004. Monitoring the age structure, hatchery fraction and stock composition of the adult Columbia River salmonids provides valuable information used by the Pacific Salmon

Commission's (PSC) United States Chinook Technical Committee (USCTC) and the U.S. v. Oregon's Technical Advisory Committee (TAC) for the region's salmon management.

Accurate determination of stock composition and run timing is extremely important to fisheries managers which promted the inclusion of Genetic Stock Identification (GSI) studies and mark recapture studies to our normal sampling regime at the AFF. GSI studies have been conducted since 2004 and Passive Integrated Trasponder (PIT) tag studies since 2006. Since both projects relate to RPA's in the Hydro Biop, both projects were included in the Columbia River Accords. Starting in 2009 all fish are sampled for GSI and receive a PIT tag.

Sampling Methods:

Fish Collection

Fish of each species will be trapped at the AFF and anesthetized. Chinook salmon under 35 cm in length were not sampled to exclude precocious juveniles (known as minijacks). All sizes of sockeye and steelhead will be sampled. Each fish will be measured for fork length to the nearest 0.5 cm, checked for identifying fin marks, tags, coloration and condition. Scale samples will be collected from all fish for aging and caudal fin tissue was collected from all fish for genetic stock composition analysis. All fish sampled will be scanned for PIT tags and if one is not present then a tag will be incerted in the abdomen near the pelvic girdle. All fish will be revived in a freshwater tank or pool and returned to a fishway leading to the Washington shore fish ladder.

Fish Coloration and Condition

Fish coloration and condition will be recorded for all species at the time of sampling. Coloration will be based on qualitative observations with the categories of Bright, Intermediate and Dark. Overall fish condition will also qualitatively assessed and classified on a scale of 1 to 5. Fish classified as a 5 has no major injuries that break the skin, 4 has injuries that broke the skin, 3 has injuries that penetrate the muscle tissue, 2 has injuries that penetrate a body cavity and 1 are fish missing large sections of the body. In addition to the fish condition

classification, specific recognizable injuries or afflictions were recorded. These included percentage of descaling, marine mammal injuries, net damage, parasites, fungus, headburn, gas bubble trauma, deformities, and various other injuries.

Age Determination

To minimize the scale sample rejection rate, six scales (three per side) will be collected for each Chinook and steelhead sampled (Knudsen 1990) and four scales (two per side) will be collected from each sockeye salmon sampled. Scales will be mounted and pressed according to methods described by Clutter and Whitesel (1956) and the International North Pacific Fisheries Commission (1963). Individual samples will be visually examined and categorized using well-established scale age-estimation methods (Gilbert 1913, Rich and Holmes 1929). A sub-sample of scales will be independently reviewed by Washington Department of Fish and Wildlife for corroboration of age estimates. Direct age validation (Beamish and McFarlane 1983) is now possible because of the availabitliy of known origin PIT tagged fish and will be part of our regular aging protocols.

Age and Length-at-Age Composition

Age composition will be determined by weighing the proportion of each age class sampled by the total counts of each species passing Bonneville dam during each Statistical Week. The length-at-age composition for each species sampled will be determined by calculating the mean length for each age class present during each Statistical Week.

Steelhead Hatchery/Wild Determination

Most hatchery reared steelhead in the Columbia River Basin are marked by removing a fin, typically the adipose fin. Some hatchery-origin steelhead are released unmarked and to identify these individuals scale pattern analysis methods were developed by Oregon Department of Fish and Wildlife (ODFW) to determine hatchery versus wild origin. Hatchery steelhead typically experience faster freshwater growth which results in relatively wide spaces between circuli,

whereas natural origin fish typically show much slower fresh water growth narrowing the distance between circuli. In addition, hatchery origin fish are reared to smolt in a single year whereas the natural origin fish tend to remain in fresh water for two to three years.

Due to the wide variety of requests for hatchery and wild determinations by various agencies using different methods, we decided in 2006 to allow the managing agencies to make their own determinations based on the raw age, scale pattern, and fin mark data.

Steelhead A/B Run Determination

A-run steelhead occur throughout the Columbia and Snake river basins and rarely exceed the length of 78 cm, whereas B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon rivers and typically exceed 78cm (Busby et al. 1996). Determination of A-run or B-run will be based on length measurement.

Steelhead Gender Determination

Methods developed by ODFW were used in gender determination. Gender was determined by snout and/or body shape. Male steelhead tend to have a more protruding snout and may have beak development. Female steelhead tend to have a more rounded, short snout and a wider body near the anus indicating they contain roe.

Project Deliverable

Annual reports, titled "Age and length composition of Columbia Basin chinook, sockeye, and steelhead salmon at Bonneville Dam" can be found on our website at www.critfc.org. Future BPA annual reports will be found on the BPA or CRITFC websites.

References:

Beamish, R.J., and G.A. McFarlane. 1983. The forgotten requirement for age validation in fisheries biology. Transactions of the American Fisheries Society 112:735-743.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS- NWFSC-27, 261 p. Online at: http://www.nwfsc.noaa.gov/publications/techmemos/tm27/tm27.htm. Last accessed on 15 March 2004.

Clutter, R.I., and L.E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. International Pacific Salmon Fisheries Commission Bulletin 9.

Gilbert, C.H. 1913. Age at maturity of the Pacific coast salmon of the genus *Oncorhynchus.* United States Bureau of Fisheries Bulletin 32:1-22.

International North Pacific Fisheries Commission. 1963. Annual report – 1961. Vancouver, Canada.

Knudsen, C.M. 1990. Bias and variation in stock composition estimates due to scale regeneration. Pages 63-70 *in* N.C. Parker, A.E. Giorgi, R.C. Heidinger, D.B. Jester, Jr., E.D. Prince, and G.A. Winans (editors). Fish-Marking Techniques. American Fisheries Society Symposium 7. Bethesda, Maryland.

PST (Pacific Salmon Treaty). 1985. Treaty between the United States of America and the government of Canada concerning Pacific salmon. Treaty Document Number 99-2.

Rich, W.H., and H.B. Holmes. 1929. Experiments in marking young chinook salmon on the Columbia River, 1916 to 1927. United States Bureau of Fisheries Bulletin 44:215-64.