Protocol: Salmon

Parks Where Protocol Will Be Implemented: ALAG, ANIA, KATM, KEFJ, LACL

Justification/Issues Being Addressed: Pacific salmon (*Oncorhynchus spp.*) play a critical role in maintaining productivity of many freshwater and adjacent terrestrial systems in SWAN parks by transporting marine-derived energy and nutrients upstream, by consumption of returning spawners by terrestrial predators, and by processes related to the decomposition and redistribution of post-spawning carcasses and their nutrients (Naiman et al. 2002, Schindler et al. 2003). Adult spawners provide a crucial food resource to brown bears (*Ursus arctos*), an excellent recreational opportunity to anglers, and an important subsistence and cultural resource to Native Alaskans. Sockeye (*Oncorhynchus nerka*) is an especially important species in this regard within SWAN parks and is specifically named in the enabling legislation of LACL. Therefore, monitoring abundance and condition of sockeye salmon returning to spawn (escapement) is of paramount importance to sustain this critical species. In addition, tracking spawner distribution and number of recruits per spawner within streams and lakes across time provides a measure of habitat quality and change (Hilborn et al. 2003). Changes in timing of spawning runs may indicate climatic shifts. Freshwater residence time and condition of out-migrating juvenile salmon are used to indirectly measure productivity of natal habitats.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:

Questions:

- Are sockeye salmon abundance and productivity changing in SWAN parks?
- Is the timing of upstream sockeye salmon migration and spawning changing in SWAN parks?
- Are the number of recruits per spawner, freshwater residence time, or body condition of sockeye salmon changing in SWAN parks?

Objectives:

- Devise and implement a protocol for obtaining past, present, and future data from ADF&G on spawner abundance and distribution, timing of spawning runs, and freshwater residence time of sockeye salmon from sampled systems in SWAN parks.
- Estimate long-term trends in spawner abundance, growth rates and distribution, timing of spawning runs, and freshwater residence time and body condition of sockeye salmon in SWAN parks.

Basic Approach: *Spawner Abundance, Distribution, and Run Timing*. ADF&G currently uses a combination of counting towers, a sonar station, a weir, and aerial surveys to monitor abundance and/or distribution of spawning sockeye salmon in selected streams and lakes within SWAN parks. Returning sockeye are counted from towers from both sides of a stream for 10 min each hour during the spawning runs; estimates are multiplied by 6 to generate an estimate of total daily and seasonal escapement (Fair 2003). ADF&G operates counting towers adjacent to KATM on the Naknek River and on the Alagnak River. In addition, USGS-BRD Alaska Science Center operates a counting tower for spawning sockeye salmon on the Newhalen River, which drains Lake Clark (Woody 2004), although funding for this operation is secured only through 2007. ADF&G uses a weir to monitor sockeye salmon returning to spawn in Delight Lake in KEFJ (Edmundson et al. 2001), operates a sonar station on Crescent River in LACL to record spawning sockeye salmon passing through its sensors (King et al. 1993), and conducts aerial surveys for spawner abundance and distribution of all five Pacific salmon in selected streams and lakes in ANIA, ALAG, KATM, and LACL.

Spawner Productivity and Body Condition. We will calculate number of recruits per spawner (Hilborn et al. 2003). Scales taken from returning spawners and from archived samples can be used to measure

growth rates in freshwater and in the ocean. Additionally, body condition (e.g., weight/length^3) of juvenile and adults fish measured in the field provides an index of vitality.

Freshwater Residence Time. ADF&G collects scales from a subsample of sockeye salmon captured by beach seine as they pass counting towers in the Naknek and Alagnak Rivers and from a subsample of fish passing through the weir at Delight Lake. USGS-BRD also collects scales from fish passing its counting tower on the Newhalen River. In addition to the measurements for growth and condition, these scales are analyzed to estimate length of freshwater residence for each annual run of sockeye salmon.

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- Laurel Bennett, NPS-SWAN (NPS Lead)

Development Schedule, Budget, and Expected Interim Products: Because this is an existing monitoring program, costs to SWAN will be limited to those incurred for analyzing body condition and growth data from scales.

2006 Draft SOPs ($ to be determined).

2007 Implement and test data acquisition protocol ($ to be determined).

2008 Peer review and finalize ($ to be determined).

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