Protocol: Fish Assemblages

Parks Where Protocol will be Implemented: BELA, CAKR, GAAR, KOVA, NOAT

Justification/Issues being addressed:
The diversity of streams, lakes, large rivers and lagoons in the ARCN provide critical habitat and food sources for fish. According to the Alaska Natural Heritage Association, 27 freshwater and anadromous fish species have been documented in ARCN; however, on average only 65% of the species expected to occur in each of the units have been documented. Thus, more extensive inventories of fish are needed. Fish assemblages in ARCN include species at a variety of trophic levels with different life history characteristics, including rare and unique species such as the sheefish (*Stendous leucichthys nelma (Pallas*)).

The Kobuk and Koyukuk rivers are major chum salmon spawning streams. Sheefish also spawn in the Kobuk. Sheefish and whitefish are the most important subsistence fishes in ARCN, whereas arctic grayling, arctic char/Dolly Varden, sheefish, and lake trout represent the major sport fishes. Approximately 22 species of fish are found in the Noatak drainage, including arctic grayling (*Thymallus arcticus*) and arctic char (*Salvelinus alpinus*), which are the most common sport fish in ARCN.

Many fish populations and their associated habitats are particularly important to residents who rely on subsistence resources within and near park units. Coastal lagoons in ARCN have been the primary fishing grounds for local indigenous populations for the past 9,000 years. Because subsistence fish species and their associated habitats are important to local communities they must be managed, protected and preserved under ANILCA (Alaska National Interest Lands Conservation Act). Fish are also important to visitors who may be attracted to some parks because of the quality of sport fishing and/or unique species available. Many of the large deep lakes in ARCN (e.g. Chandler, Selby, Feniak, Matcharak and Walker Lakes) are renowned for their fisheries resources. If access to the parks increases in the future, exploitation of fish resources may increase and potentially impact local fish populations; therefore, monitoring of those populations should be a priority. Despite their remoteness, the arctic park units receive disproportionately high levels of deposition of semi-volatile organic compounds, such as mercury and persistent organic pollutants from global industries. Long-lived fish species occupying higher trophic levels, such as northern pike, burbot and sheefish, provide a useful means of assessing bioaccumulation of contaminants (Jewett and Duffy 2007) across landscapes, which may vary in their ability to process and, in some cases, biomagnify contaminants. A 2006 survey that included two lakes in ARCN found that concentrations of methylated mercury in lake trout in these lakes were higher than recommended for consumption: however, fish from the rest of ARCN have not been sampled. Thus, there is a strong need to conduct contaminant sampling in high subsistence areas.

Monitoring Questions:
Some of the specific monitoring questions that will be addressed with this protocol include:

1. What are the trends in fish species distribution and habitat associations in ARCN streams, lakes, rivers and coastal lagoons and how do these trends relate to presence of exotic species/diseases and trends in water quality, hydrologic and habitat alterations in these ecosystems?
2. How are consumptive use and/or intense human use of habitat impacting fish assemblages and size distributions in lagoons and large deep lakes?
3. What are the status and trends of contaminant concentrations in piscivorous and benthivorous fish and can these trends be predicted using information about lake food webs, hydrology and/or patterns of vegetation, disturbance and deposition on the landscape?
4. Is the diversity and abundance of anadromous species increasing over time?
5. Are trends in salmon diversity and abundance contributing to production in freshwater spawning areas and surrounding vegetation?

Objectives are as follows:

1. Estimate fish community composition and condition (length-weight relationship) during monitoring of stream, lake and lagoon ecosystems in ARCN every 2 to 5 years at Tier 1 (high priority sites) and every 10 to 15 years at other sites. Relate trends in fish distribution and condition to the presence of exotic species/diseases and trends in water quality, hydrologic and habitat alterations in these ecosystems. ***Justification.*** *Freshwater and anadromous fish are good integrators of long-term landscape-scale change because they are long-lived and relatively mobile. Furthermore, the health of freshwater fish populations in ARCN is an important park management issue and may serve as a measure of freshwater ecosystem condition.*
2. Compare status and trends of fish species composition, growth rates, and size distribution of fish in highly accessible large, deep lakes and lagoons to those parameters in more remote lakes and lagoons to where ecosystem monitoring is already occurring. Estimates of consumptive use will be determined as part of the Subsistence Harvest and Visitor Use monitoring plans. ***Justification.*** *Many fish populations and their associated habitats are particularly important to subsistence users. Because habitat quality and fish are important to local communities they must be managed, protected and preserved under ANILCA. Fish are also important to visitors who may be attracted to some parks because of the quality of sport fishing and/or unique species available. If access to the parks increases in the future, increased exploitation of fish resources and damage of critical habitat may occur and therefore should be monitored.*
3. Determine select contaminant concentrations in piscivorous and benthivorous fish captured while monitoring stream, lake and lagoon ecosystems in ARCN every 2 to 5 years in high priority lakes and every 10 to 15 years in other lakes. Relate trends in fish contaminant concentrations to trends in habitat quality and water quality and quantity in these ecosystems. ***Justification.*** *Fish populations are an important resource for subsistence users who fish within the park units. Despite their remoteness, the arctic park units receive disproportionately high levels of long-range deposition of semi-volatile organic compounds, such as mercury and persistent organic pollutants from global industries. Water quality, structure of*

lake food webs, hydrology and/or patterns of vegetation, and deposition on the landscape can influence availability, transport and biomagnifications of some contaminants considered harmful to fish and human consumers.

4. Collect traditional ecological knowledge regarding the composition and abundance of anadromous species returning to spawn near local villages along the Noatak and Kobuk Rivers every 2 to 10 years. Obtain harvest rates for anadromous species in ARCN from ADF&G every 2 to 5 years. ***Justification.*** *Model projections and recent documentation suggest that the range of anadromous fish species may be moving northward.*
5. Determine trends in isotopic signatures of riparian vegetation and a ubiquitous primary consumer in salmon spawning areas every 5-10 years. When feasible, $\delta^{15}N$ signatures from sediment cores may provide a past record of historic salmon abundance, and give us an indication past and current salmon population status and trends. ***Justification.*** *The return of anadromous salmon to fresh water brings marine-derived nutrients and may contribute to increases in productivity of aquatic ecosystems, riparian vegetation and terrestrial mammals. Changes in isotopic signatures of riparian vegetation and primary consumers will indicate increased abundance of anadromous salmon are subsidizing aquatic and terrestrial systems in spawning habitats.*

Basic Approach:

Because freshwater and anadromous fish are good integrators of long-term landscape-scale change, trends in fish distributions, contaminant concentrations, harvest and habitat quality will be linked to several other vital signs being monitored by ARCN. These vital signs include, Lake Communities and Ecosystems, Stream Communities and Ecosystems, Lagoon Communities and Ecosystems, Surface Water Dynamics and Distribution, Subsistence Harvest/Use, Invasive/Exotic Species, Invasive/Exotic Diseases, Fire extent and Severity, Terrestrial Vegetation and Landscape Dynamics, Snow and Ice, Climate and Weather, Wet and Dry Deposition, Point Source Human Effects, Visitor Use and Rare and Unique Vital Signs.

We plan to share data and collaborate with ADF&G, employing their methods when feasible. Since the early 1980's, ADF&G has conducted periodic surveys of anadromous fish in and around the ARCN parks units. We will use ADF&G harvest reports to assess trends in fish harvest. In 2008, ADF&G will conduct sampling of sheefish movement and distributions in reaches of the Kobuk River near GAAR and KOVA. This study will provide valuable information informing development of a fish monitoring program in the ARCN.

We will work with Central Alaska Network Aquatic Ecologist, and University of Alaska-Fairbanks fish biologists to further develop protocols for assessing fish assemblages, diet, habitat associations and marine-freshwater-terrestrial linkages. We will also solicit advice and assistance from fisheries experts at US Fish and Wildlife Service, local consulting agencies, and Utah State University. We will pursue development of protocols and processing of samples for biocontaminants in fish. Future collaborations will likely include Alaska Division of Environmental Conservation; environmental toxicologists and

fish biologists. Field work involving collection of freshwater and anadromous fishes will be conducted in conjunction with sampling efforts for aquatic vital signs when possible. High priority lakes, streams, rivers and lagoons will be sampled every 2 to 5 years; whereas, low priority systems will be sampled every 5 to 15 years or on a one-time only basis.

Principal Investigators and NPS Lead:
We will collaboratively develop protocols with Amanda Rosenberger (University of Alaska). NPS Leads will be Greta Burkart (907-455-0669), Trey Simmons and Amy Larsen.

Development Schedule, Budget, and Expected Interim Products:
In cooperation with the University of Alaska, the NPS leads will begin development of a protocol for monitoring population parameters in the Spring of 2008. Protocol development for measuring environmental pollutants in fish will also begin in Spring 2008. Reviews of fish assemblage protocols will be completed in FY 2011 and full implementation will occur in the summer of 2011.