Taku River Satellite Imagery Final Report
DRAFT

Summary
The Taku River Satellite Imagery Project was a bilateral initiative involving the Taku River Tlingit First Nation (TRTFN) and the Alaska Department of Fish and Game (ADF&G). The project, funded under the Pacific Salmon Commission 2006 Northern Fund, successfully met all stated objectives through the acquisition of high resolution (QuickBird) satellite imagery for the Taku River floodplain The original intent was to collect all imagery during low water periods during 2006; however due to poor weather during this period, some imagery was acquired in the spring of 2007 and some from archival data (2003). The deliverables from this project (multi-spectral satellite imagery) are already showing tangible benefits by providing a basis for a salmonid habitat utilization model.

Introduction and project rational
Although some base map information existed for the Taku River drainage, nothing was seamless, resolution was low and information was outdated, thus lacking recent baseline imagery of the area. This made it difficult to compile maps for a particular purpose, due to the lack of information across borders or watersheds and individual sub-basins, and also because existing base maps were often not at a resolution that suited specific needs. The recent advances in high-resolution, remotely sensed digital products offered by QuickBird satellite imagery resolve these issues and provide the advantage of immediate integration with Geographic Information Systems (GIS) for map making and spatial assessments/analyses. The utility of such high resolution imagery for the Taku River was recognized by both the Alaska Department of Fish and Game and the Taku River Tlingit First Nation Fisheries Department. Consequently a joint proposal to acquire such imagery was submitted under the Northern Fund of the Pacific Salmon Commission in 2006.

Study Area
The Taku River provides one of the most productive wild salmon return rates and sustainable fisheries in the Pacific drainage. This diverse 16,900 km^2 region located in north-western British Columbia is the historical homeland of the Taku River Tlingit First Nation (TRTFN). The Taku River is the fifth largest river, in both area and discharge, to empty into the Pacific Ocean, and which originates from British Columbia .The Taku is a trans-boundary river, with a mouth at the head of Taku Inlet about 30 km southeast of Juneau, in the Alaska Panhandle. The Taku River itself is only 75 km long, being so named only below the junction of the Nakina and Inklin Rivers.

The Taku River drainage contains significant populations of spawning and rearing Chinook, sockeye, coho, chum and pink salmon. Run sizes of sockeye have averaged about 227,000 since 1984, ranging from 146,000 (1998) to about 405,000 (2001). In 2000 and 2001, the average run size was approximately 349,000 fish (DFO - IFMP). The

Taku River produces the most Chinook salmon of the Canadian transboundary and U.S. river systems that drain into Southeast Alaska. Run sizes of large Chinook have averaged about 49,000 since 1979, ranging from 12,000 (1983) to about 126,000 (1996). From 1979 to 1989, run sizes averaged 37,000 fish; from 1990 to 2001, they averaged about 60,000 fish.

Methods

The QuickBird satellite operated by DigitalGlobe, Inc. collected imagery (both panchromatic and multispectral bands at corresponding 0.60 m^2 and 2.44 m^2 resolution) across the area defined by the "area of interest" GIS polygon provided to them by ADF&G-Sport Fish and reviewed by the Taku River Tlingit First Nation Fisheries Department. Following acquisition, standard post-processing procedures were completed by DigitalGlobe (i.e. radiometric/sensor/geometric correction, and output to the desired cartographic projection). Radiometric corrections applied to this product by the vendor included: relative radiometric response between detectors, non-responsive detector fill, and a conversion for absolute radiometry. Sensor corrections account for: internal detector geometry; optical distortion; scan distortion; any line-rate variations; and mis-registration of the multi-spectral bands. Geometric corrections remove spacecraft orbit position and attitude uncertainty, earth rotation and curvature, and panoramic distortion. Individual images were organized, converted to ERDAS Imagine (*.img) format and mosaiced together by ADF&G-Sport Fish. The TRTFN Fisheries Department collected additional ground-control points to geo-reference these images, if in the future these are deemed necessary to improve the accuracy within the acquisition area of the Taku River.

Results

This project successfully acquired high-resolution imagery of the Lower Taku River floodplain that is now shared by government agencies and tribal entities in Alaska and Canada. This new Taku River imagery provides important baseline information for the area and will help to improve the understanding of important freshwater spawning and rearing areas augmenting management scenarios for these important salmon habitats.

The acquired satellite imagery includes the geographic extent from the Taku River's saltwater confluence in Taku Inlet upriver to the junction with the Inklin and Nakina Rivers. This geographic extent covers the Taku and Tulsequah Rivers, as well as portions of the main tributaries to these rivers and equates to approximately 1,435 km^2 encompassing approximately 70 river km northeast into BC. The original intent was to collect all imagery during low water of 2006; however poor weather during this period resulted in cloud cover densities that exceeded optimum levels for image capture. As a result, the project completion date was extended to allow some imagery to be acquired in the spring of 2007. One image was obtained from 2003 archival data.

Following acquisition, the imagery became immediately available for integration with existing spatial data sets in GIS, for map preparation and various reporting and investigation needs. The imagery is fully geo-referenced, allowing for accurate and current representation of this trans-boundary river system at a large scale. A total of 5 Quickbird scenes tiled into 256 individual images were obtained from DigitalGlobe, Inc..

Temporally, imagery was collected from 4 periods in time: May 15 2006, June 10 2006, July 03 2006, and May 18 2007. Some imagery was obtained from archival data collected on August 26, 2003. These data were delivered to TRTFN in a series of data directories that organize the images in terms of the acquisition dates, mode (multispectral vs. panchromatic), file format (Erdas .img, or .tiff), and level of processing (individual scenes or mosaics). In addition, ESRI shapefiles describing the spatial organization of the image "footprints" were included in the data set. A GIS technician was contracted by the TRT to organize these images into an ArcView project that would be easily referenced and accessed through the existing TRTFN GIS system.

Discussion

This project address the need for high-resolution base-line imagery that can be utilized to create maps for the purposes of planning/reporting, conduct watershed or sub-basin analyses and display habitat patterns or fish utilization. It documents existing watershed and habitat conditions, such as off-channel rearing and migration corridors for both adults and juveniles and will allow resource managers to share information on habitats on respective sides of the border using the same imagery. It will facilitate evaluation of the Taku River drainage on a watershed scale by creating highly accurate seamless baseline data.

In addition, historical data from 'on the ground' field activities (e.g., stock assessment, radio telemetry or habitat surveys) can be integrated through the GIS environment, allowing for more meaningful landscape assessments and map production, cumulatively presented in the context of current conditions, as captured by the imagery. In addition, the imagery will enhance the ability to conduct analysis of associations and relationships between habitat types and fish species utilization and distribution across an area of interest in relation to larger landscape features (e.g. spawning areas in relation to locations of alluvial fans)

The deliverables from the Taku Satellite project are already showing tangible benefits. For example, imagery collected during this project is currently being utilized in a joint project undertaken by the Salmonid Rivers Observatory Network (SaRON) and the TRTFN Fisheries Department. The SaRON is headed by the Flathead Lake Biological Station of The University of Montana in conjunction with the Wild Salmon Center and a number of other cooperators including the Taku River Tlingit First Nation. They have assembled a multi-disciplinary team of scientists to document salmonid biodiversity and productivity, as controlled by natural and human processes, in a suite of pristine Pacific salmon river ecosystems (observatories). This research focuses on salmonid habitat requirements. As part of work undertaken on this project in the fall of 2007, acoustic Doppler profile equipment was used to measure water velocity and depth. This information will be correlated with the satellite imagery to produce an image layer depicting flow and depth characteristics of the Taku River main stem. Work to date has been used by the TRT to help evaluate potential fisheries impacts along a proposed barge route. An example of this work is presented in Figure 1.

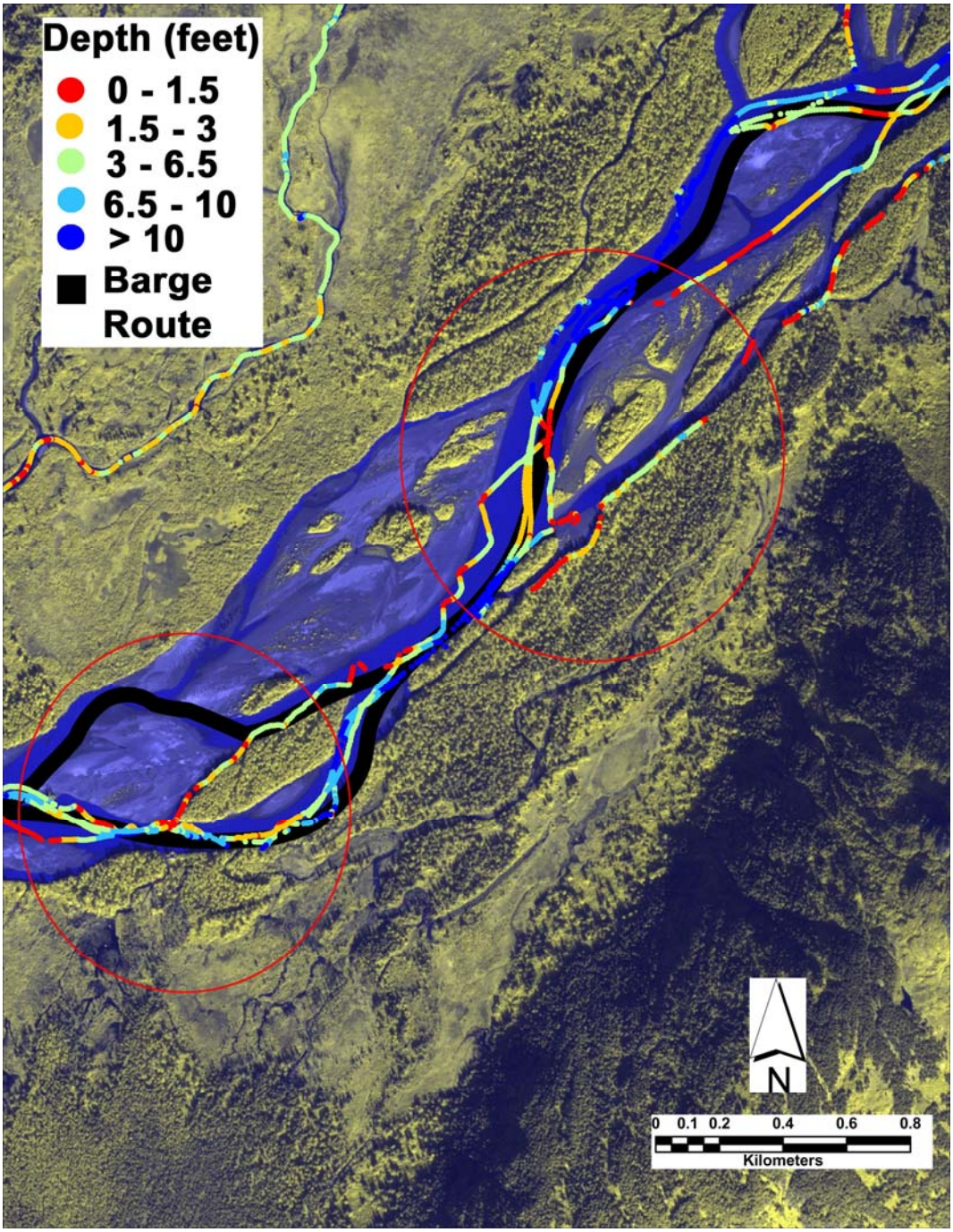

Figure 1. This image shows the Taku River near Cranberry Island; black line indicates proposed barge route, while the color gradients indicate water depth along survey routes with yellow to red gradients indicating water depths less than 3 feet.