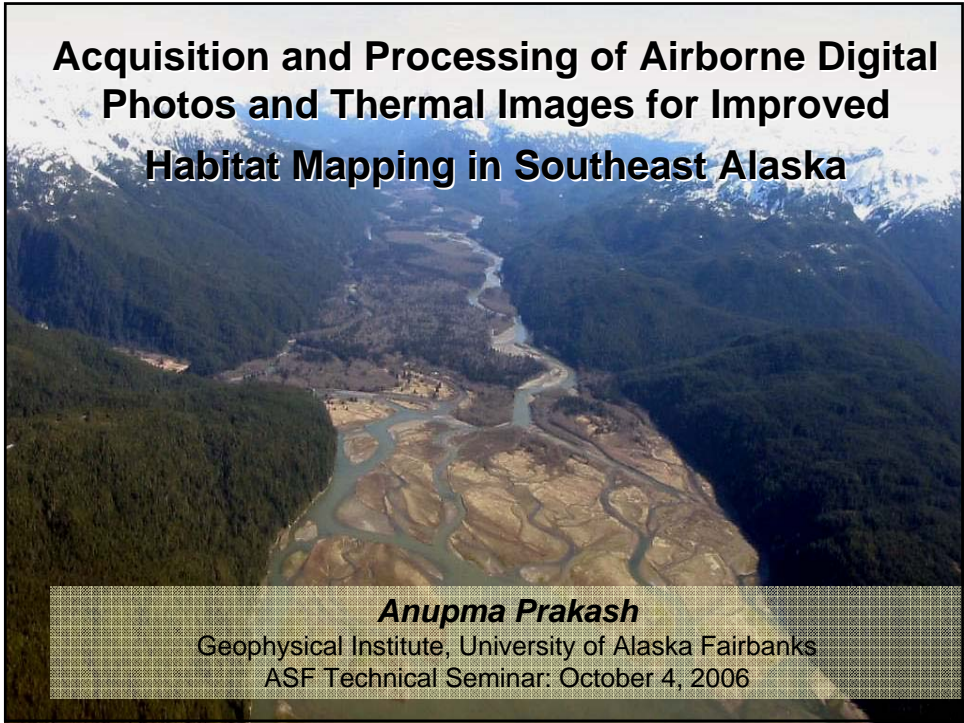


Acquisition and Processing of Airborne Digital Photos and Thermal Images for Improved Habitat Mapping in Southeast Alaska



Anupma Prakash

Geophysical Institute, University of Alaska Fairbanks
ASF Technical Seminar: October 4, 2006

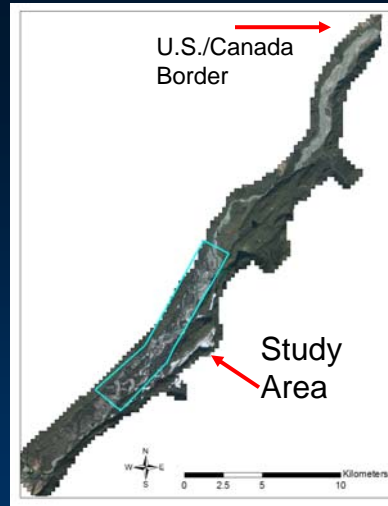
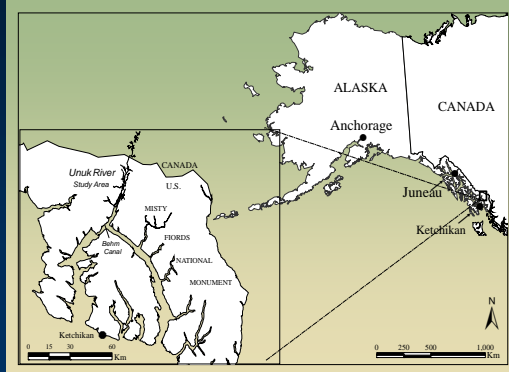
Acknowledgements



This presentation is based on the research work carried out by Kathy Smikrud, graduate student at SFOS, UAF

- ❖ Joseph Margraf: Professor SFOS, UAF (primary advisor)
- ❖ Brian Frenette: AK Dept. of Fish and Game, Juneau, AK
- ❖ Jeff Nichols for help with data acquisition
- ❖ Thanks to Jon Dehn, for providing the FLIR camera

Study Area Unuk River



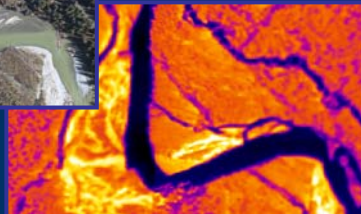
Study Area = 12 River Km

- ❖ Alaska portion of Unuk River characterized as large floodplain with braided, glacial-outwash channels
- ❖ Unuk River is the 4th largest Chinook salmon producer in SE Alaska

Components of the study



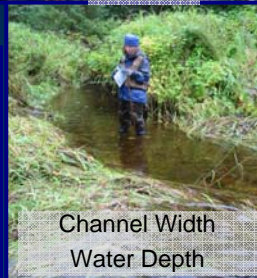
- ❖ Mapping and Monitoring Large Wood
- ❖ Land Cover Classification
- ❖ GIS Salmon Habitat Indicator Mapping (*In Progress*)



Traditional Stream Habitat Surveys



- ❖ Foot Based
- ❖ Time Intensive
- ❖ Very Costly
- ❖ Not Practical for Large Areas



Large Rivers – Alternative Methods

- ❖ Remote Sensing offers an Alternative Method to Monitor Habitat within these Large River Systems



Lower part of study area

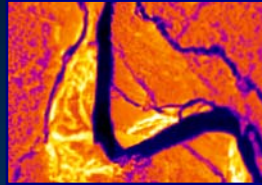


Upper part of study area

Input Data

- Digital Aerial Photos

 - Kodak DCS760



Pixel size = 1.88 m

- Thermal Imagery

 - ThermaCamS40



Pixel size = 0.45 m

- Sat Imagery

 - IKONOS

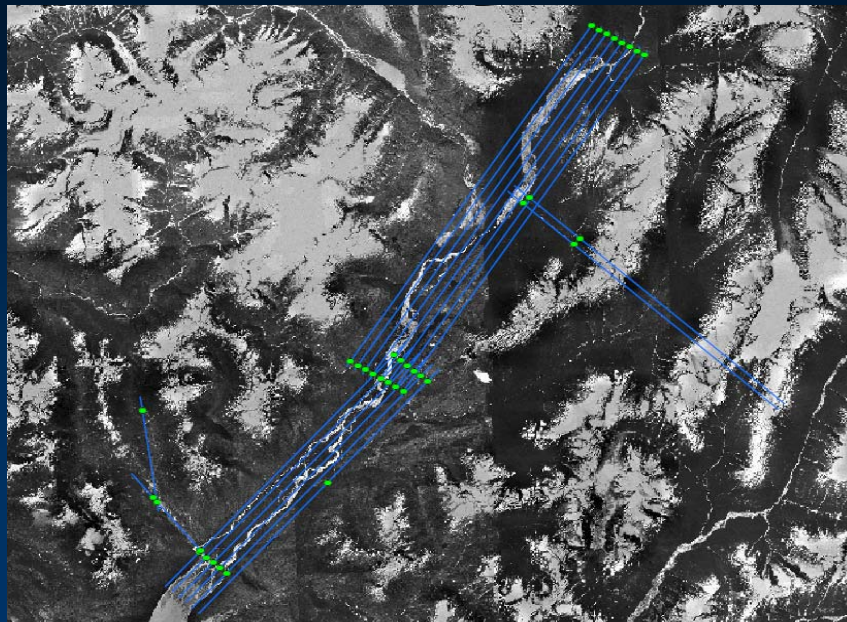


IKONOS pan sharpened
Pixel size = 1 m

- Field Observations



Measuring Field Temps.



Aerial Image Acquisition

Ever spend 6 hours a day in a floatplane?

- ❖ Spring flights in 2003, 2004, & 2005
- ❖ Images acquired by ADF&G



Platform: Beaver aircraft

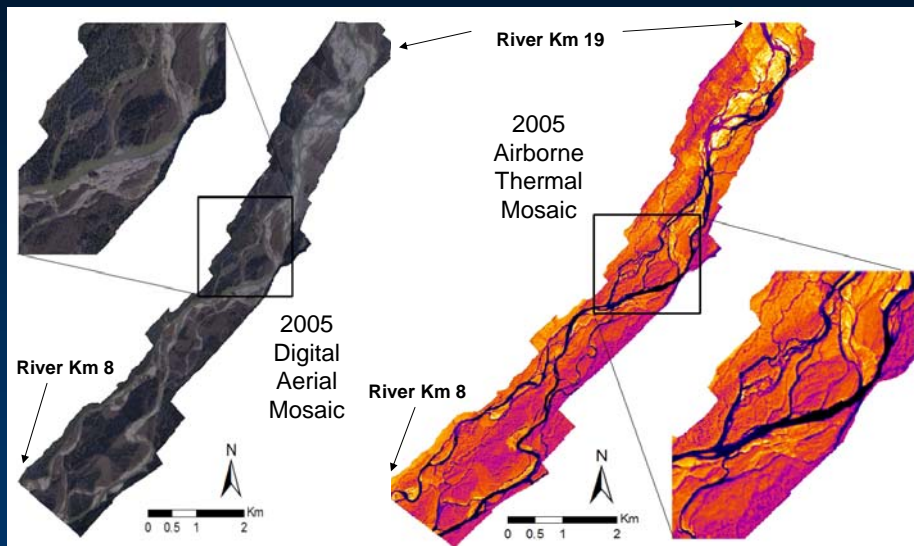


Camera Mount in Aircraft Belly

Sensors Used:

- ❖ Digital Camera: Kodak DCS760
- ❖ Thermal Sensor: ThermaCamS40 (2005 only)

Study Area Mosaics

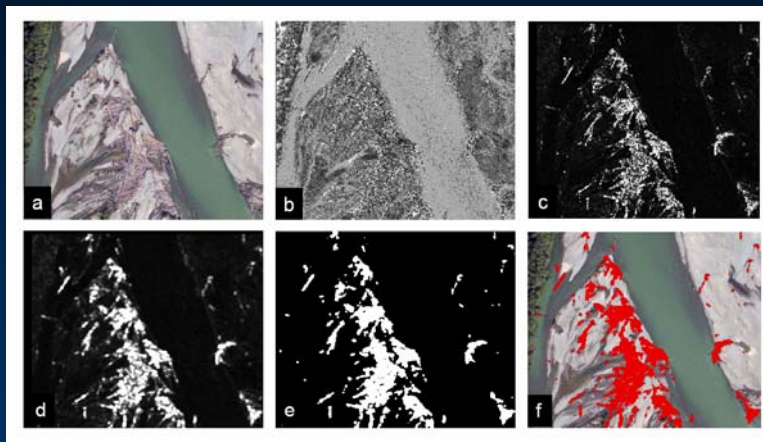


Large Wood Dynamics

- ❖ Fish Habitat Indicator
- ❖ Large Rivers (Data Gap)
Quantity
Spatial and temporal variability



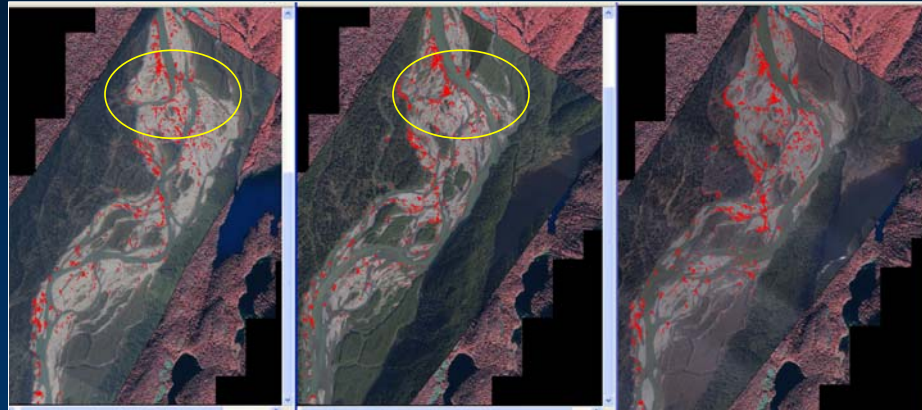
Large Wood Detection



Smikrud, K.M. and A. Prakash, 2006. Monitoring large woody debris dynamics in the Unuk River, Alaska using digital aerial photography, *GIScience & Remote Sensing*, 43(2):142-154.

Results-Large Wood Dynamics

Monitoring Large Wood-Change over Time

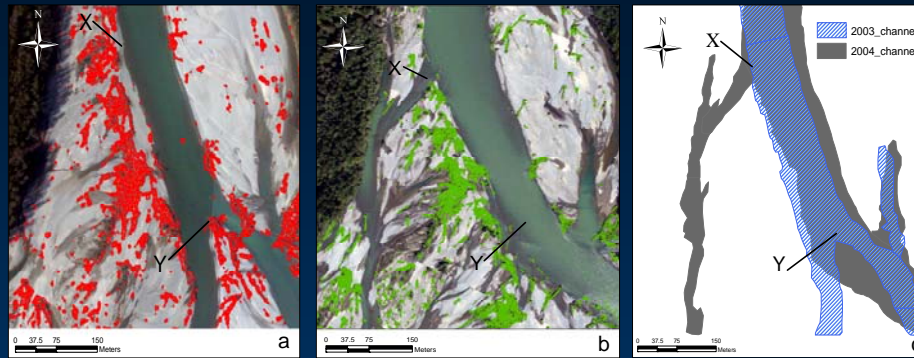


2003

2004

2005

Upper Study Area



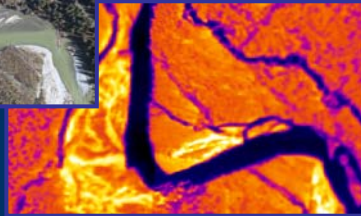
Components of the study



- ❖ Mapping and Monitoring Large Wood

- ❖ Land Cover Classification

- ❖ GIS Salmon Habitat Indicator Mapping (*In Progress*)



Landcover Classification / Habitat Mapping

- ❖ Remote Sensing can be used to Estimate the Type, Variety, and Extent of Land Cover throughout a Study Area
- ❖ Land Cover Classifications are being used to model Wildlife habitat and in Predicting Species Distributions

Land Cover Classes



Deciduous
Alder /Cotton Wood



Sand / Gravel



Water



Coniferous:
S. Spruce/
W. Hemlock



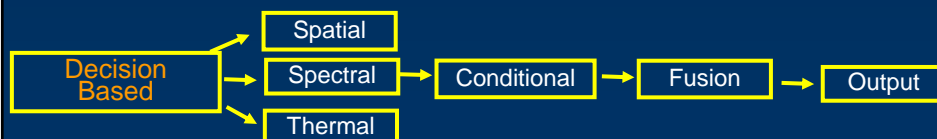
Wet Sand/Gravel



Large Woody Debris

Strategy

- Examine land-cover classification results using spectral information on the digital photos
 - Examine land-cover classification results using spatial information on the digital photos
 - Examine a land-cover classification using the thermal imagery
- ❖ **Determine which data combination produces the best classification result for the study area**



Digital Aerial Image - Visible Bands



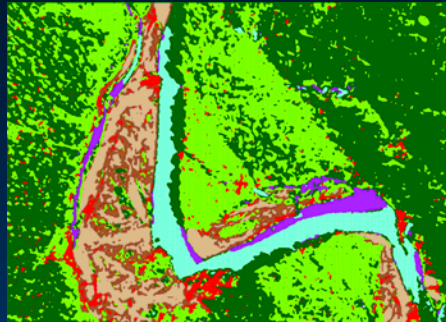
Ground Pixel Size: 45 cm
Only 3 Spectral Bands Acquired (Visible)

Supervised Classification –Optical Image



- ❖ Spectral Only: Maximum Likelihood Classifier
- ❖ Good for Deciduous (83.81 - 96.7%)
- ❖ Good for Coniferous (86.09 - 89.66 %)
- ❖ Good for dry sand/gravel (96.61 – 98.28 %)
- ❖ Fairly good for wet sand/gravel (72.73 -74.36 %)
- ❖ Not good for water (~ 72 %) and Not good for LWD

LWD added as a separate class (Optical Spatial Classification)

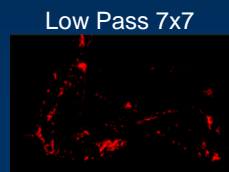
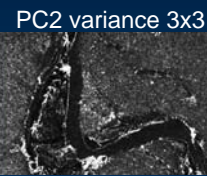
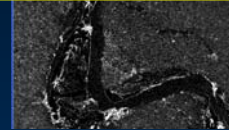


- Large Woody Debris
- Coniferous
- Deciduous
- Shallow Water
- Water
- Gravel- Sand
- Wet Sand/Gravel

Added as a new class-w/ spatial component

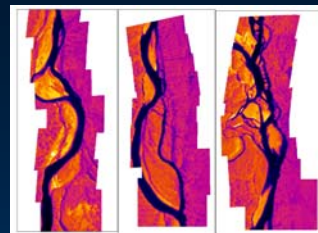
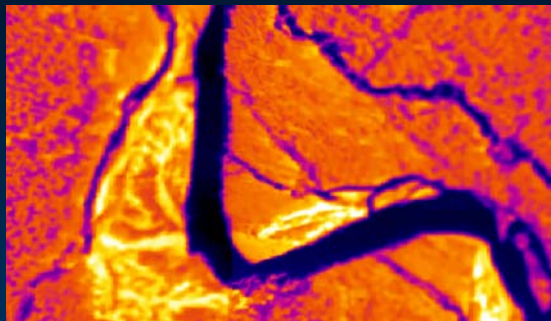
~ 96 %

Spatial-Large Wood



Threshold Wood Image

Thermal Infrared Imagery



Unuk River-Uncontrolled mosaicks
Temp. Range 4-36° C

- ❖ Acquired simultaneously with aerial photos
- ❖ Sensor: ThermaCamS40 (forward looking infrared)
- ❖ Spatial Resolution: 1.88 pixel sizes
- ❖ Spectral Resolution: 7.5 to 13 μm
- ❖ Detects Temp. Differences of 0.8 ° C



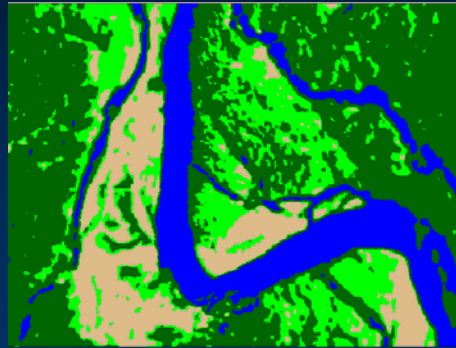
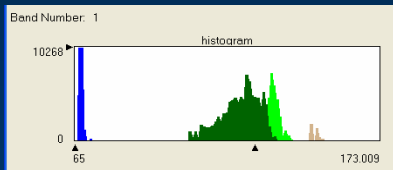
Temp 4.6-12° C

Supervised Classification- 4 Classes

Thermal Infrared-1 band

Classes:	Training Signature Statistics	
	Mean	Std. Dev.
Water	69.36	5.65
Gravel/Sand	155.95	7.14
Coniferous	123.27	6.63
Deciduous	138.21	2.90

Histogram of Training Signatures



Spectral Signature Overlap Greatly Reduced in Comparison to Visible Bands.

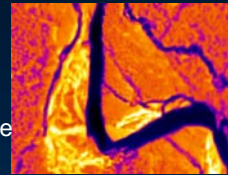
Thermal Imagery less influenced by Shadows than Optical Bands!

Accuracy Assessment

Thermal Infrared Only-1 Band Only

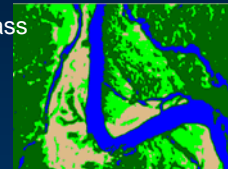
Qualitative Assessment:

- ❖ The ability to classify water is increased in comparison to optical
- ❖ Vegetation on the gravel bars emits very similar thermal signature as forest land-cover-creating misclassified surfaces
- ❖ Gravel bars in lower right corner misclassified with coniferous class

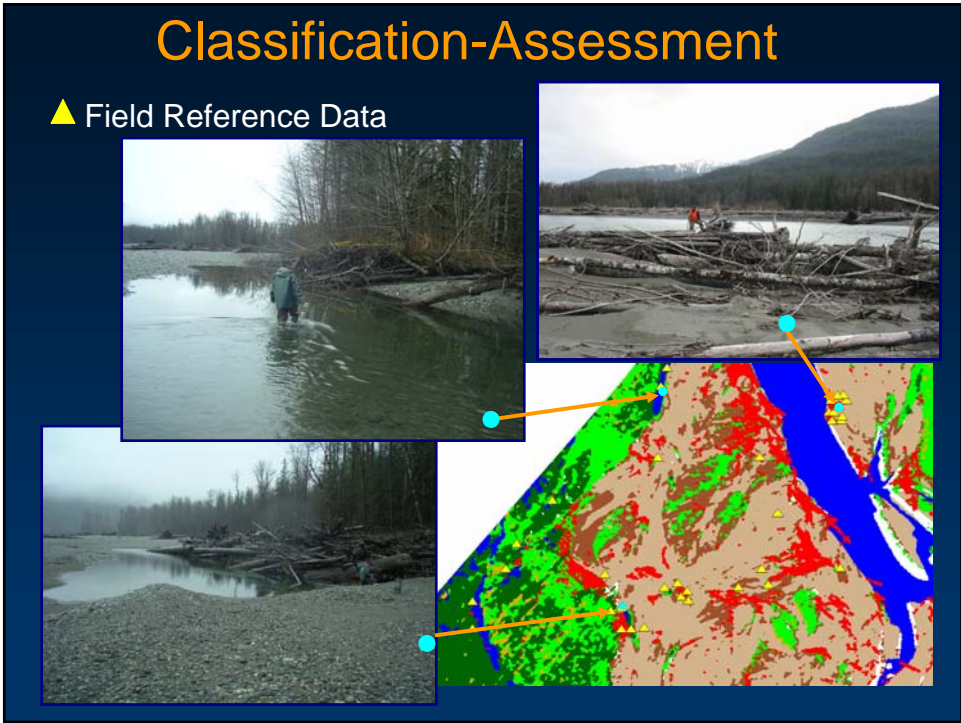
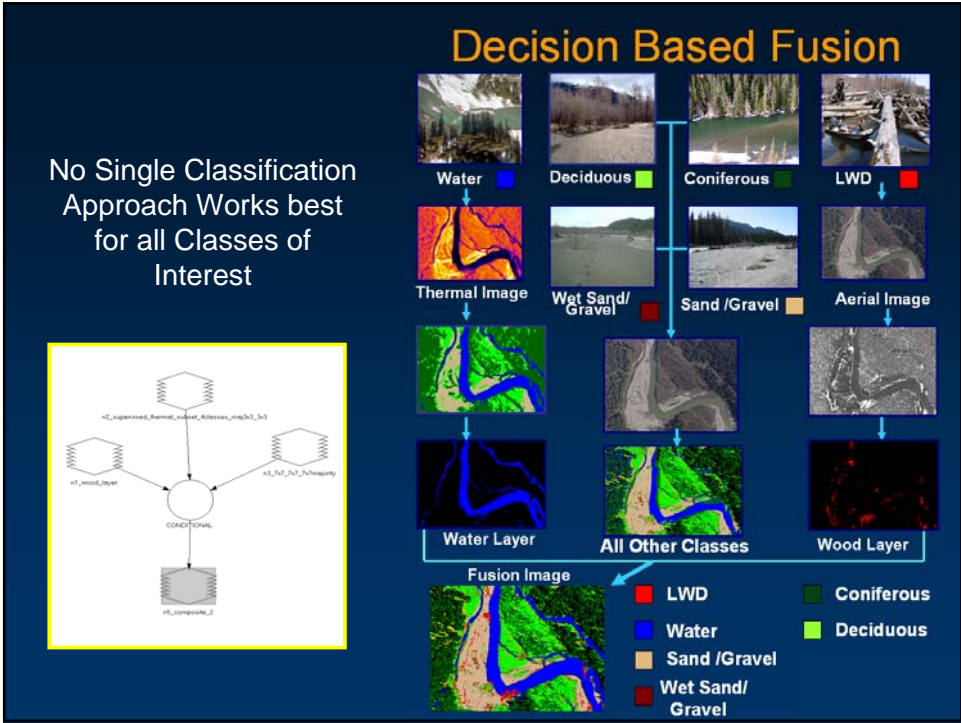


Quantitative Assessment:

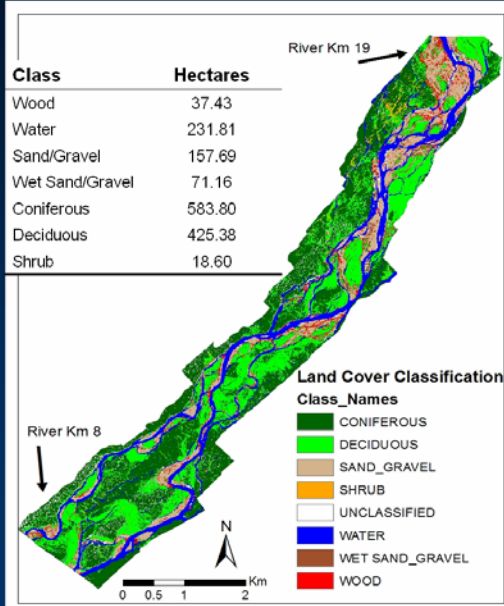
Overall Accuracy Assessment = 78.50%
Overall Kappa Statistics = 0.6897



Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Class-Leafy Vegetation	40	40	21	52.50%	52.50%
Class-Water	34	33	32	94.12%	96.97%
Class-Gravel-Sand	39	29	27	69.23%	93.10%
Class-Coniferous	86	98	77	89.53%	78.57%



2005 Study Area Classification



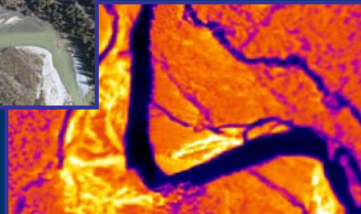
Components of the study



❖ Mapping and Monitoring Large Wood

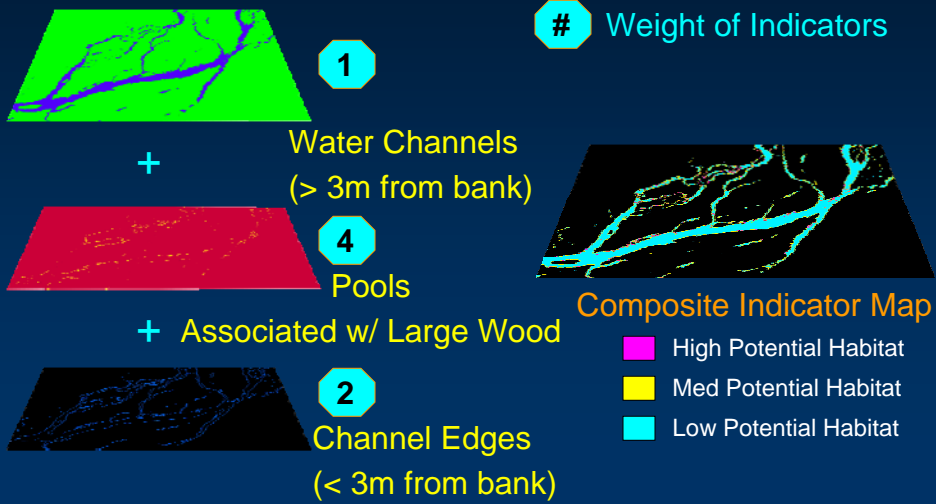
❖ Land Cover Classification

❖ GIS Salmon Habitat Indicator Mapping (*In Progress*)

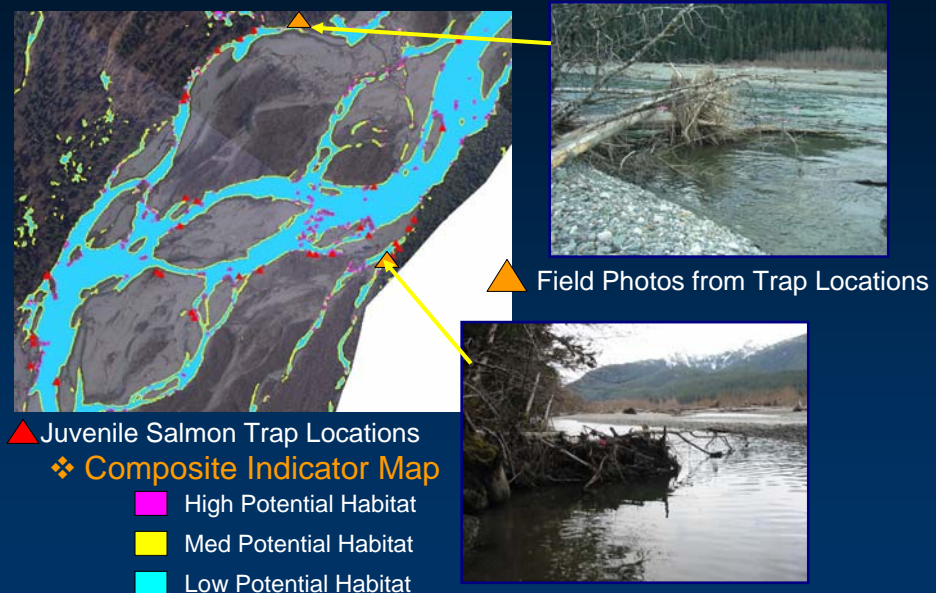


GIS Indicator Mapping-Example

❖ Mapping Salmon Habitat Indicators



Salmon Habitat Indicator Mapping



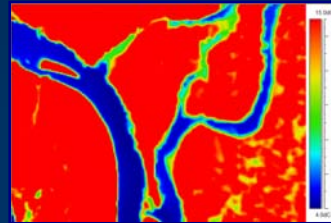
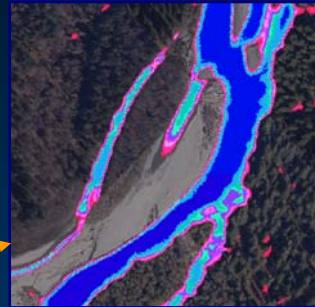
Conclusions-Future Work

❖ Conclusions

- ❖ LWD detection
- ❖ Decision Based Classification
- ❖ Indicator mapping

❖ Future Work

- ❖ Continue salmon habitat indicator mapping
- ❖ Examine temperature patterns in the thermal imagery as an additional habitat indicator



Acknowledgements



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- ❖ Brian Frenette: AK Dept. of Fish and Game, Juneau, AK
- ❖ Jeff Nichols for help with data acquisition
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Thanks For Your Attention

