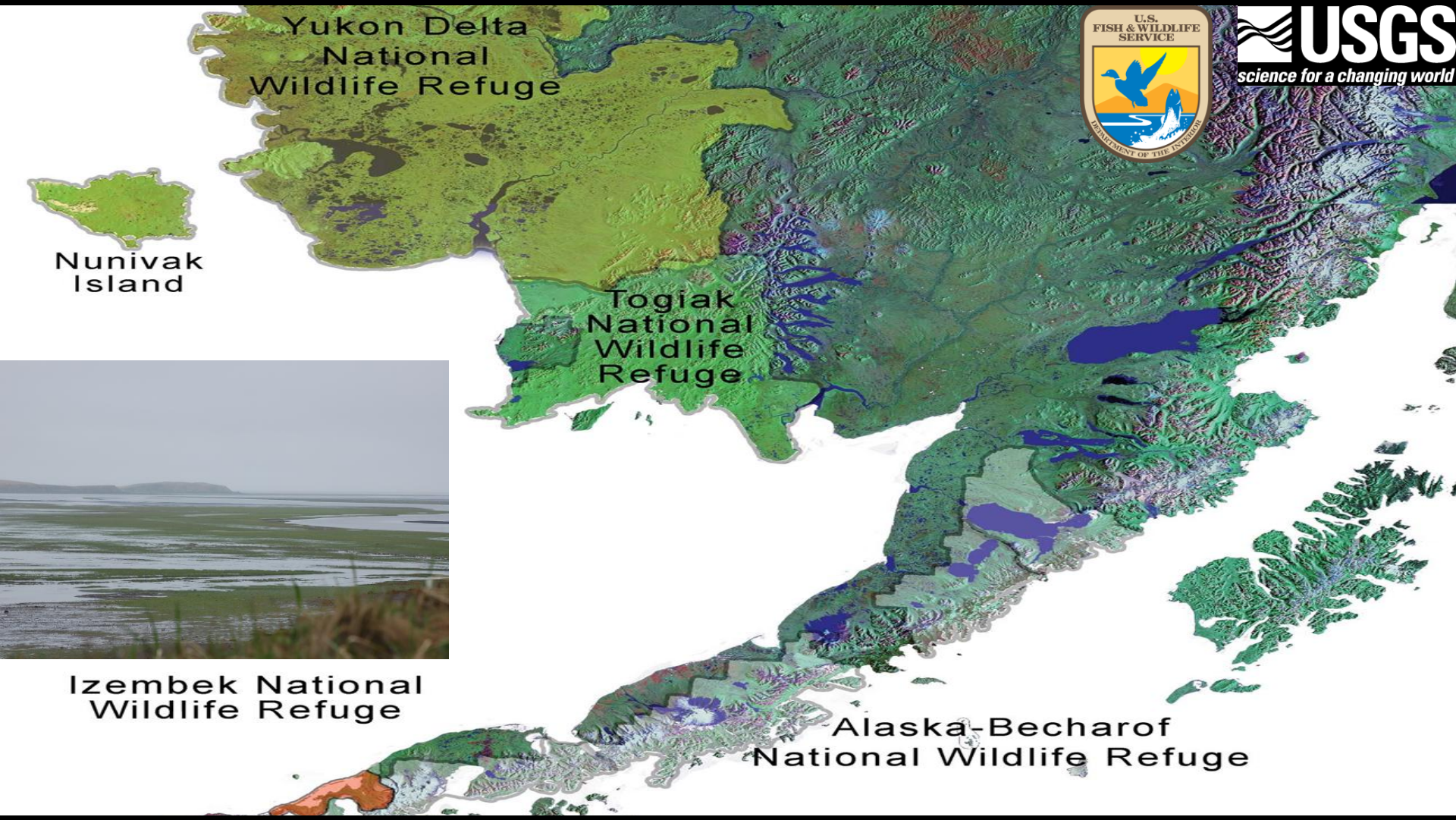
Eelgrass Ecosystem Assessments and Monitoring in Southwest Alaska



David Ward, Kyle Hogrefe, and Tyrone Donnelly, USGS-Alaska Science Center
Nancy Hoffman, Pat Walsh, Ron Britton and Tom Doolittle, USFWS-Refuges

Importance of Monitoring Eelgrass Ecosystems

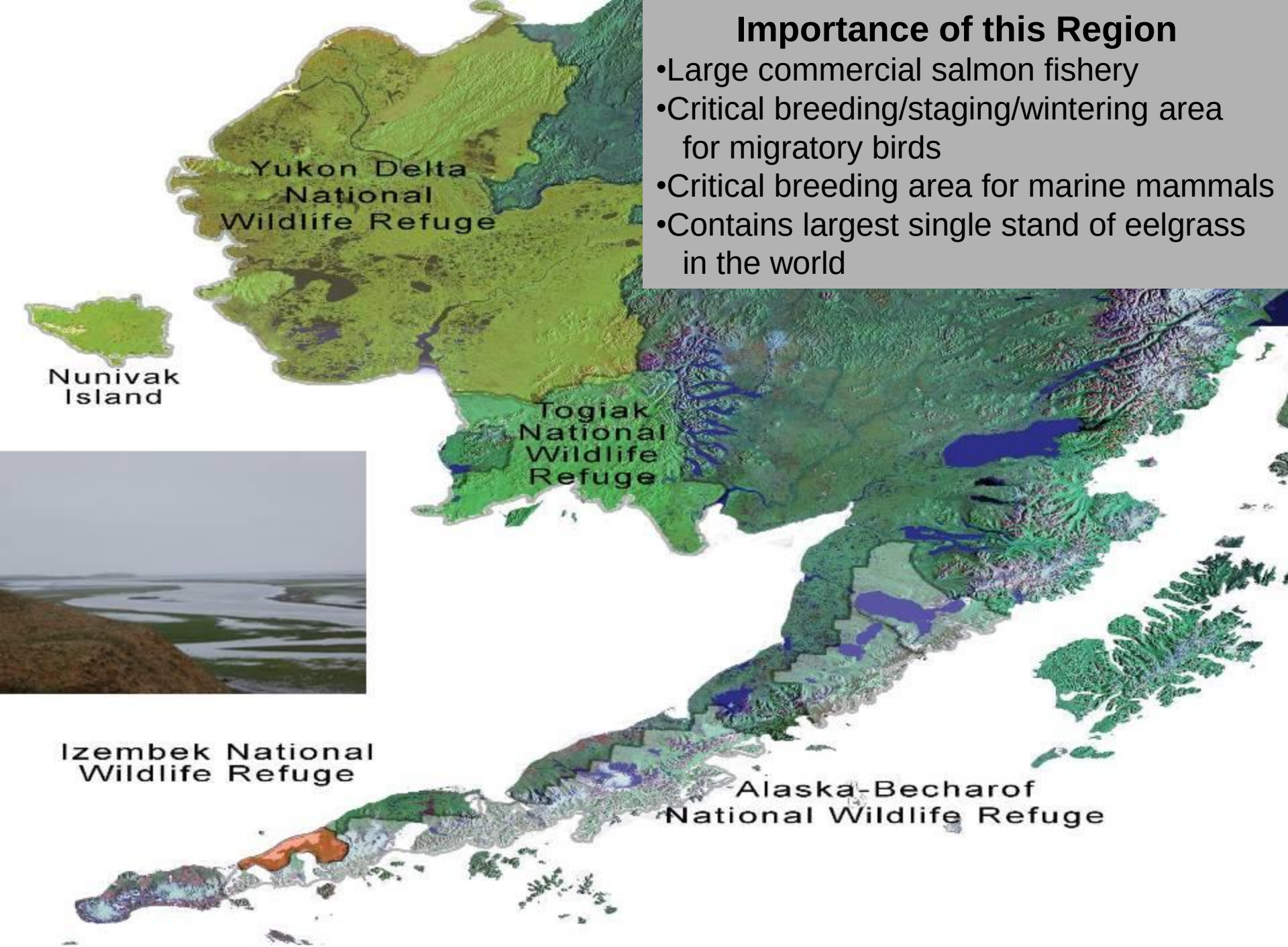
- Provides High-value Ecosystem Services- Seagrasses are highly productive, stabilize sediments, and support a complex trophic food web

- Critical Source of Food and Habitat- Support a rich assemblage of marine organisms. Essential fish habitat

- Sensitive Indicator of Environmental Change- Vulnerable to shifts in irradiance, water temperature, salinity and wave action

Importance of this Region

- Large commercial salmon fishery
- Critical breeding/staging/wintering area for migratory birds
- Critical breeding area for marine mammals
- Contains largest single stand of eelgrass in the world



Objectives

- Inventory

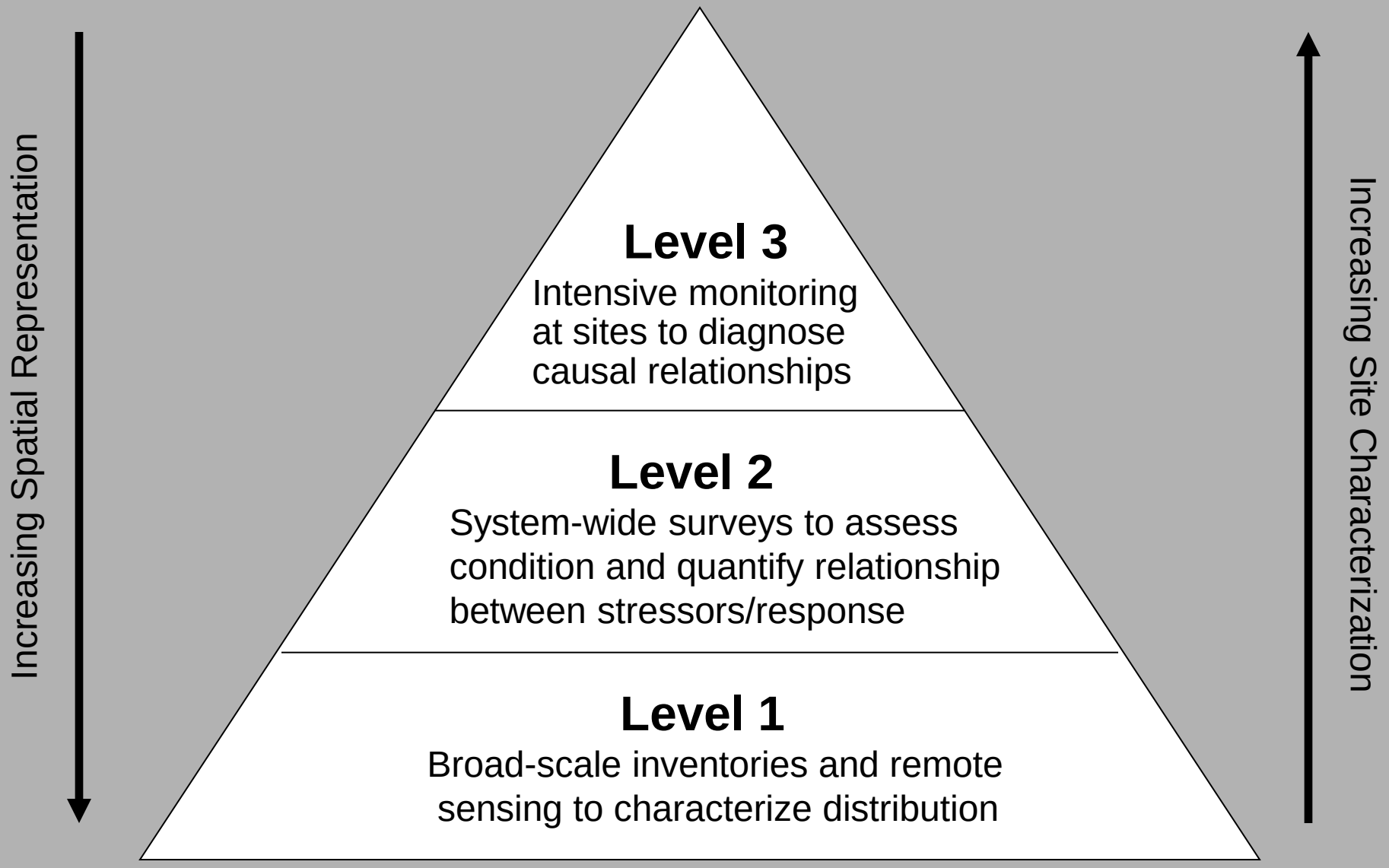
  - Develop baseline habitat maps of the areal extent and distribution of eelgrass using remote sensing techniques

- Monitoring

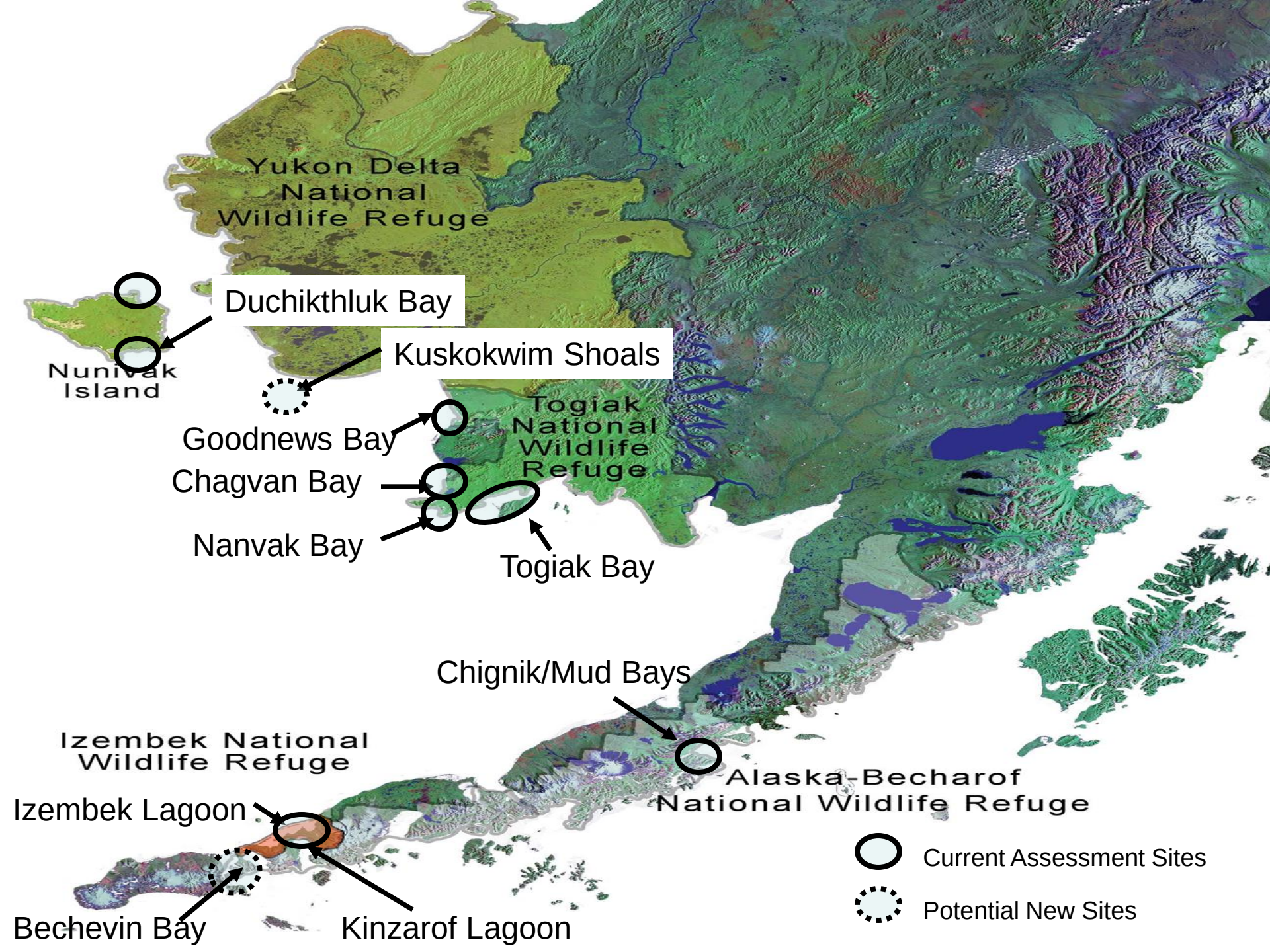
  - Gather synoptic eelgrass and environmental data at different scales (local and regional) to assess long-term change

  - Test methodology that can be used to establish a long-term monitoring network to assess changes in eelgrass ecosystems

Conceptual Monitoring Framework

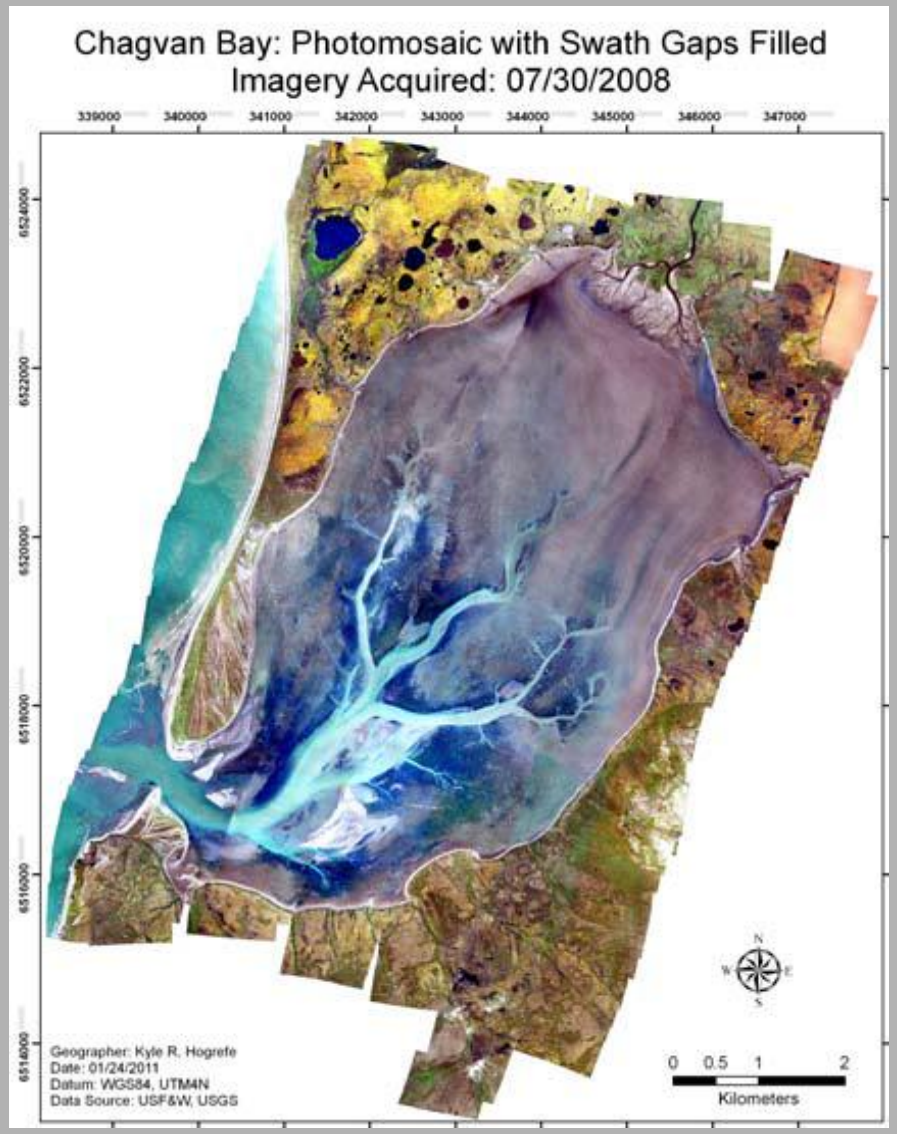


From Neckles and Kopp 2011

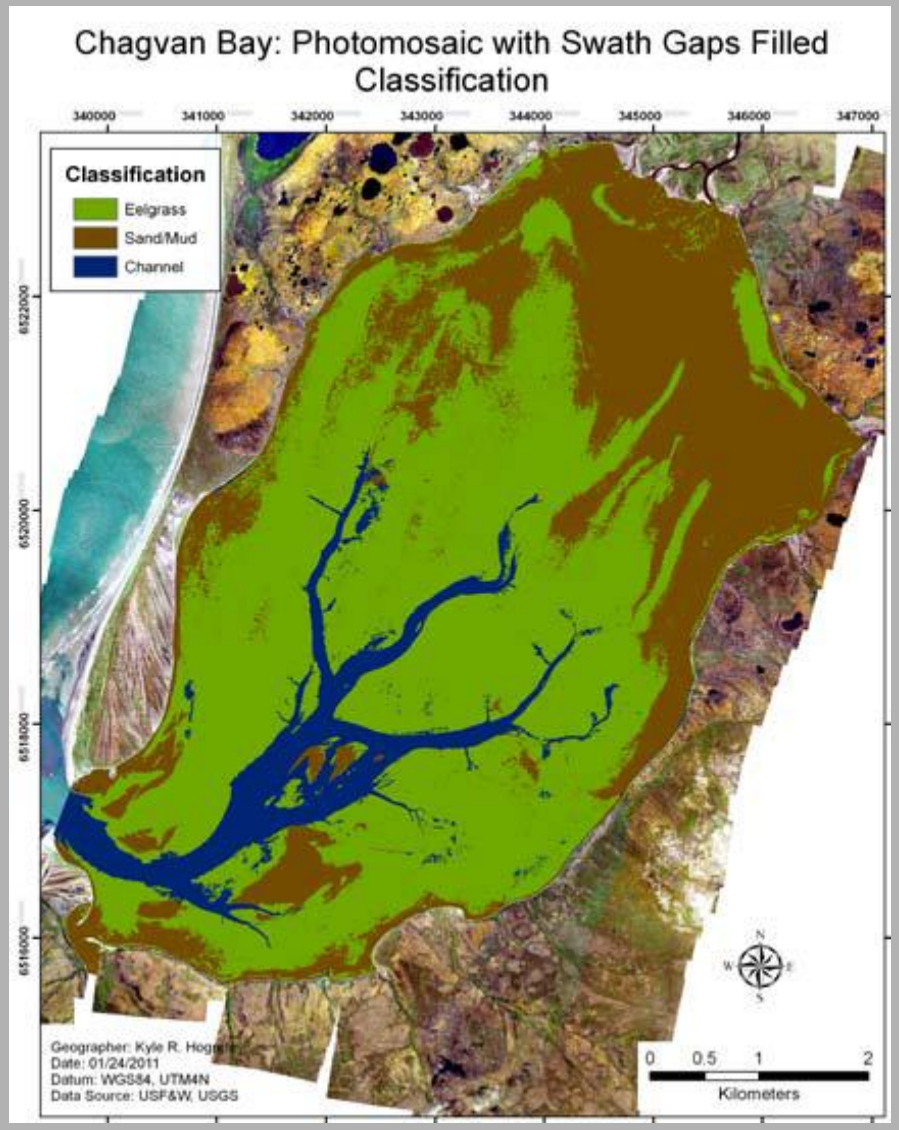

Yukon Delta National Wildlife Refuge
Duchikthluk Bay
Nunivak Island
Kuskokwim Shoals
Goodnews Bay
Togiak National Wildlife Refuge
Chagvan Bay
Nanvak Bay
Togiak Bay
Chignik/Mud Bays
Izembek National Wildlife Refuge
Alaska-Becharof National Wildlife Refuge
Izembek Lagoon
Bechevin Bay
Kinzarof Lagoon
Current Assessment Sites
Potential New Sites

Level 1- Inventory

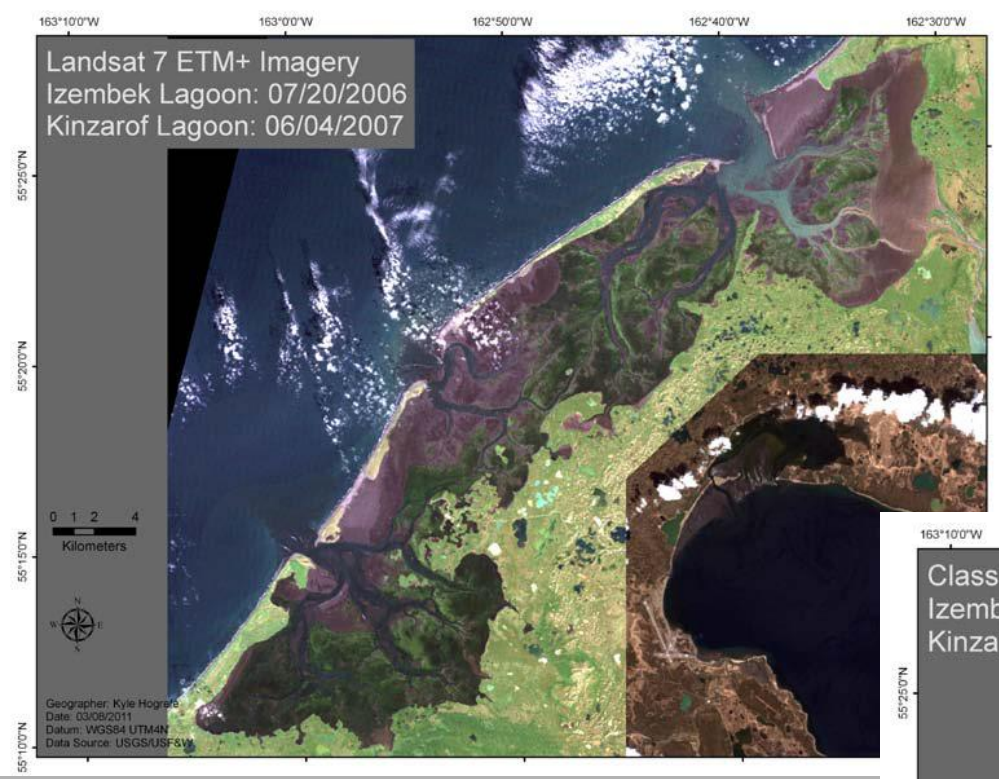
Mosaicked Photography



Classified Photography

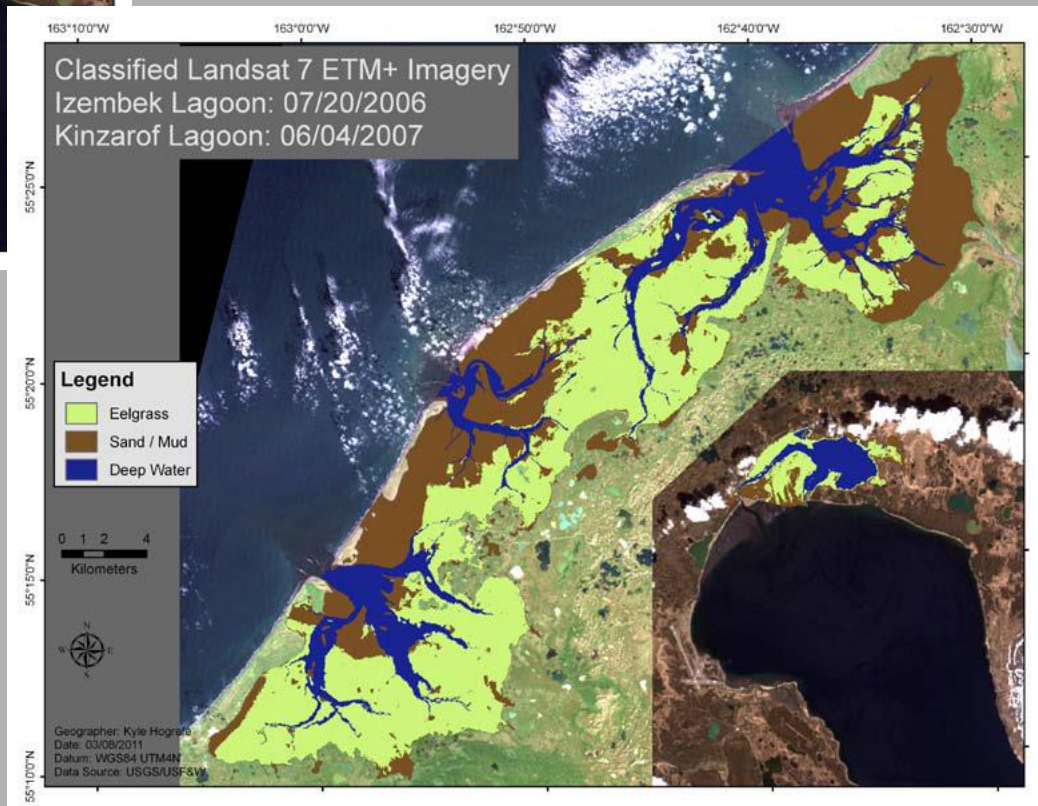


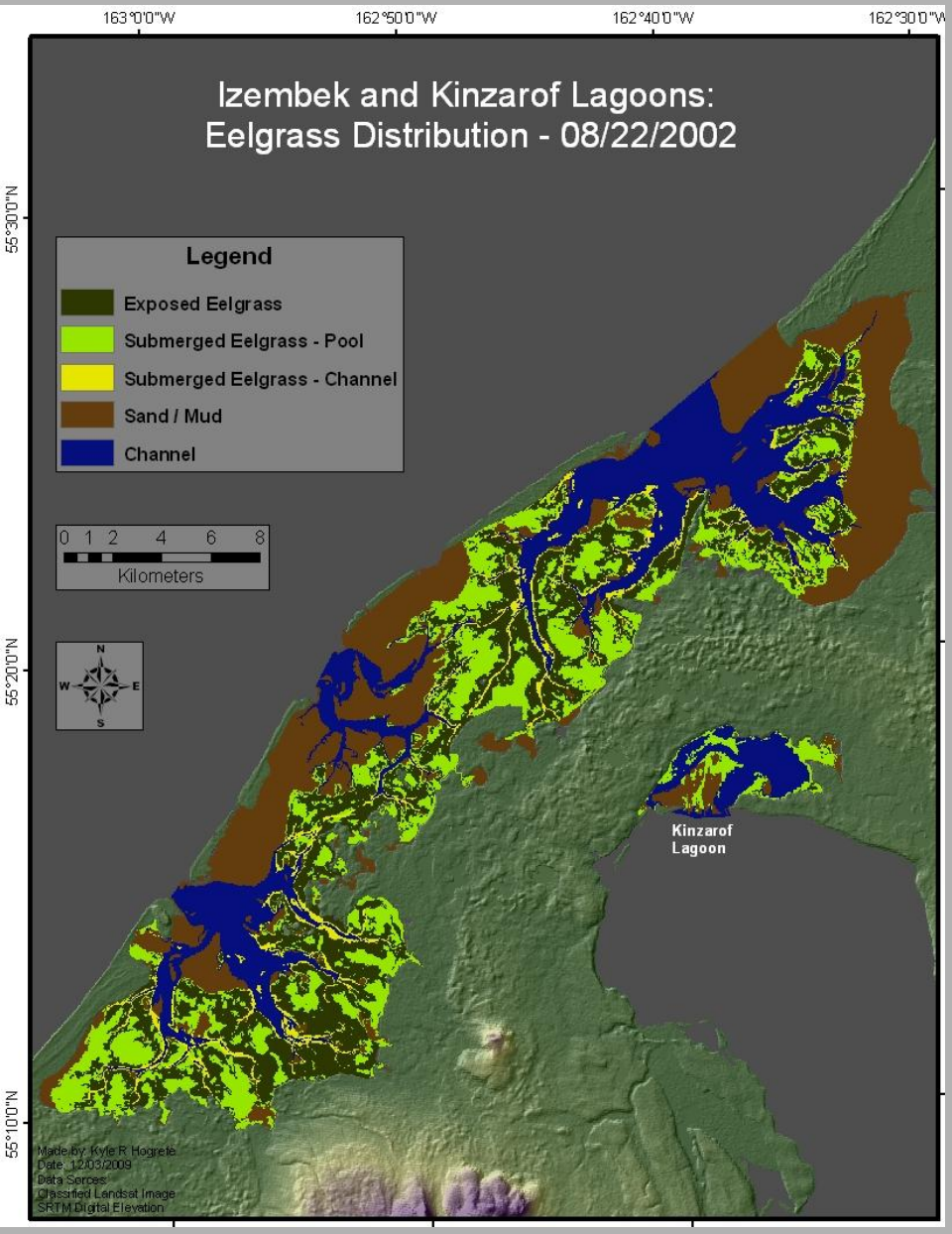
Level 1- Inventory

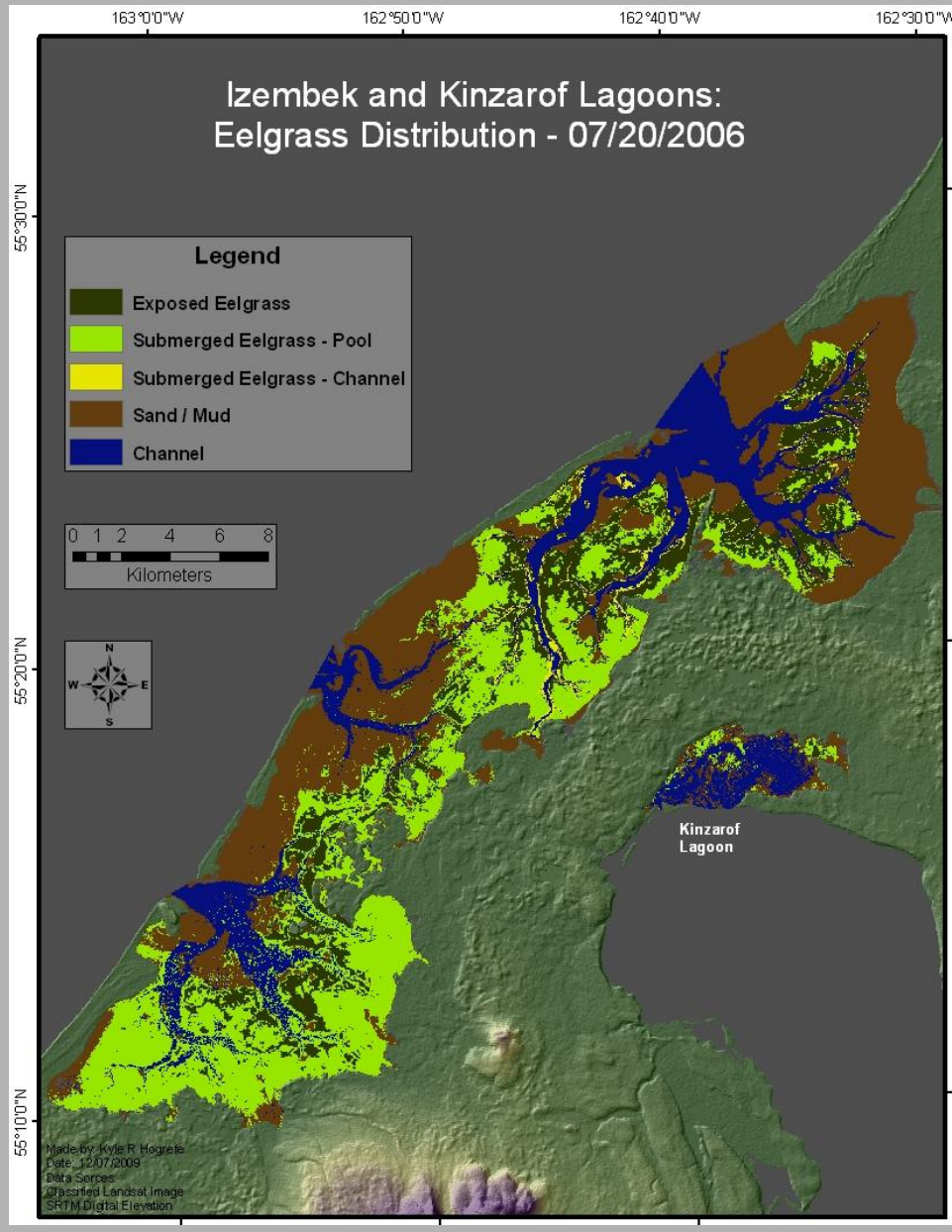


Raw Image

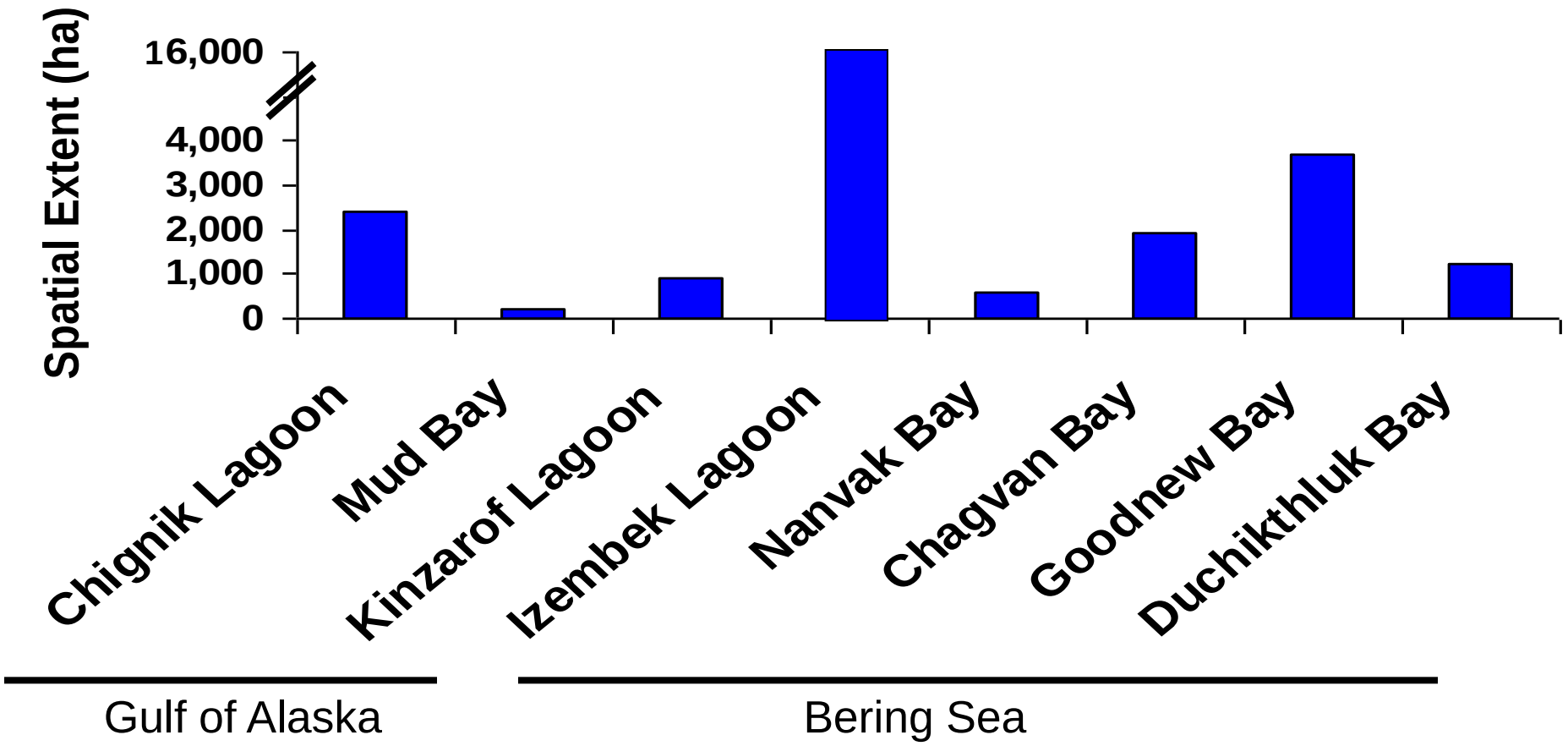
Classified Image



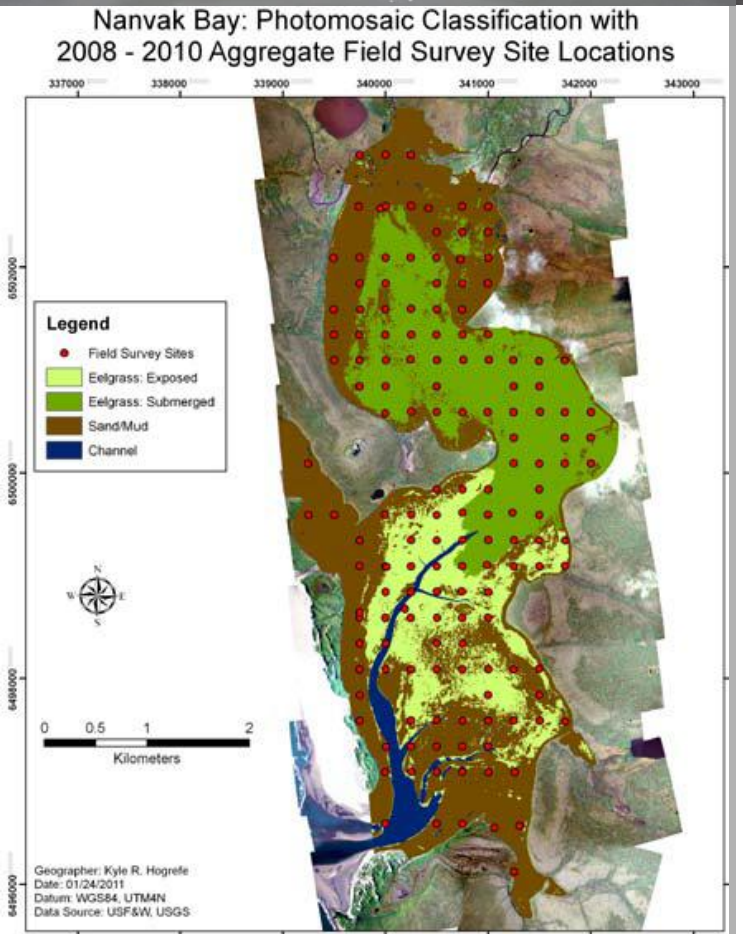

Izembek and Kinzarof Lagoons:
Eelgrass Distribution - 08/22/2002
163°0'0"W
162°50'0"W
162°40'0"W
162°30'0"W
55°30'0"N
55°20'0"N
55°10'0"N
Legend
Exposed Eelgrass
Submerged Eelgrass - Pool
Submerged Eelgrass - Channel
Sand / Mud
Channel
0 1 2 4 6 8
Kilometers
N
W
E
S
Kinzarof Lagoon
Made by: Kyle R Hogrefe
Date: 12/03/2009
Data Sources:
Classified Landsat Image
SRTM Digital Elevation

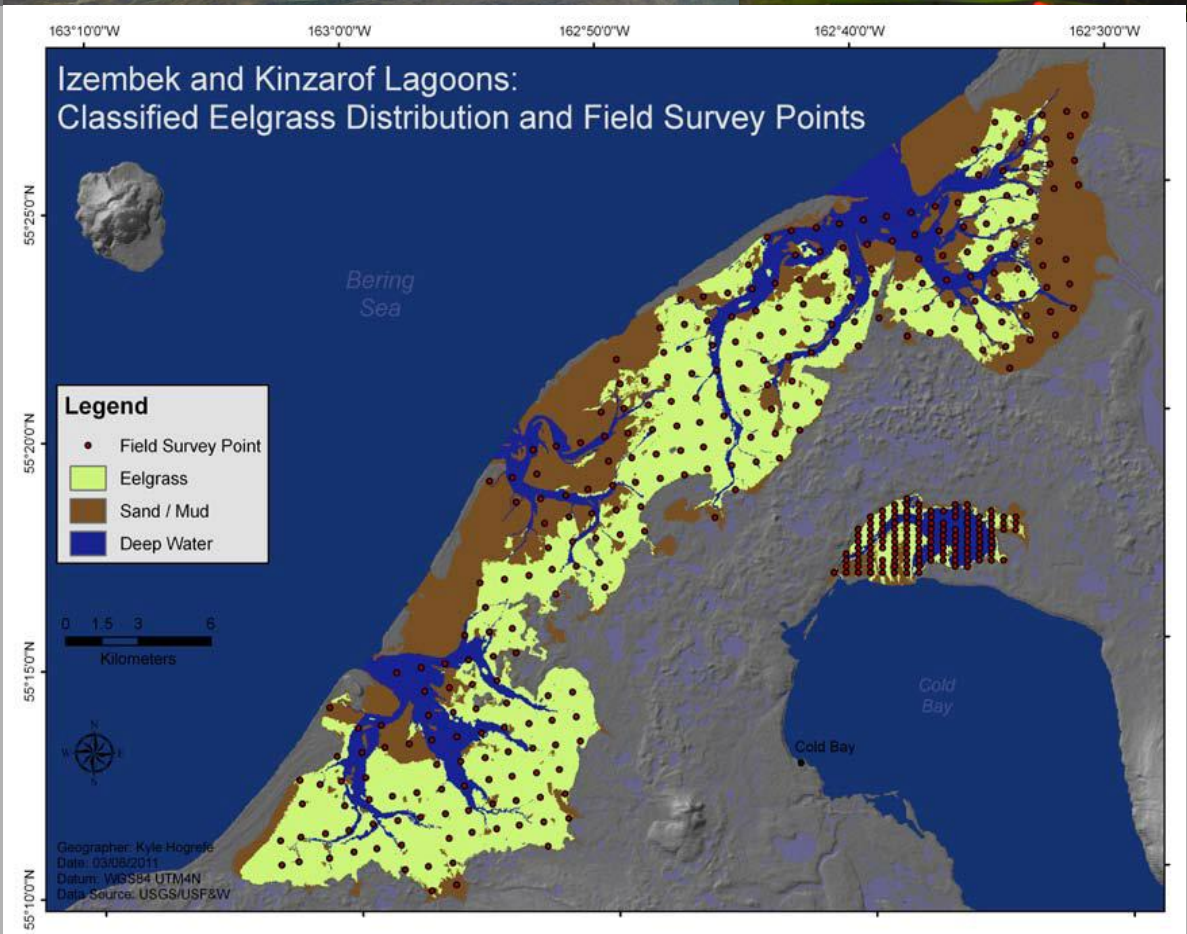

Izembek and Kinzarof Lagoons:
Eelgrass Distribution - 07/20/2006
163°0'0"W
162°50'0"W
162°40'0"W
162°30'0"W
55°30'0"N
55°20'0"N
55°10'0"N
Legend
Exposed Eelgrass
Submerged Eelgrass - Pool
Submerged Eelgrass - Channel
Sand / Mud
Channel
0 1 2 4 6 8
Kilometers
N
W
E
S
Kinzarof Lagoon
Made by: Kyle R Hogrefe
Date: 12/07/2009
Data Sources:
Classified Landsat Image
SRTM Digital Elevation

Eelgrass Spatial Extent



Level 2 – Broad-scale Surveys





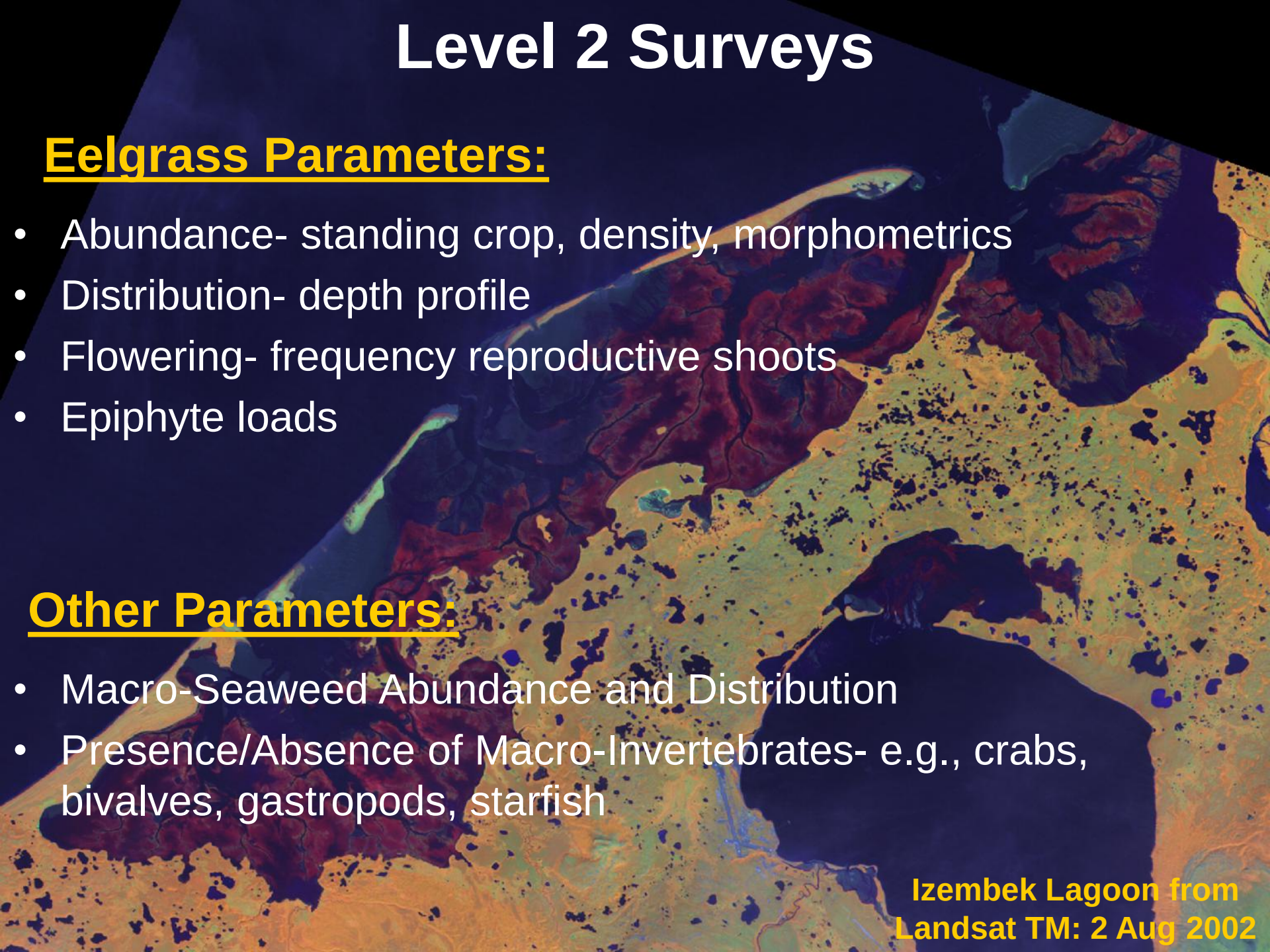
Level 2 Surveys

Eelgrass Parameters:

- Abundance- standing crop, density, morphometrics
- Distribution- depth profile
- Flowering- frequency reproductive shoots
- Epiphyte loads

Other Parameters:

- Macro-Seaweed Abundance and Distribution
- Presence/Absence of Macro-Invertebrates- e.g., crabs, bivalves, gastropods, starfish



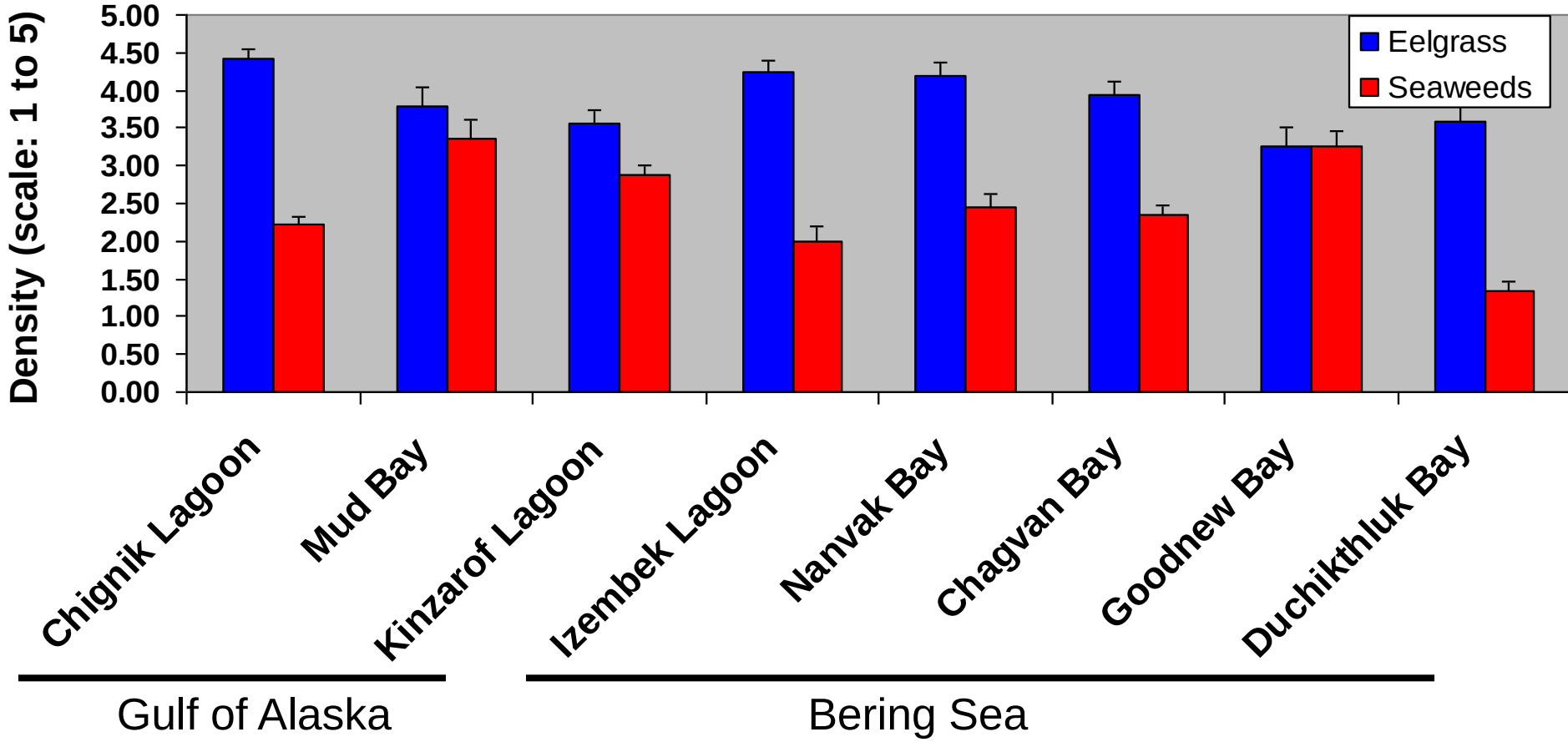
Izembek Lagoon from Landsat TM: 2 Aug 2002

Monitoring

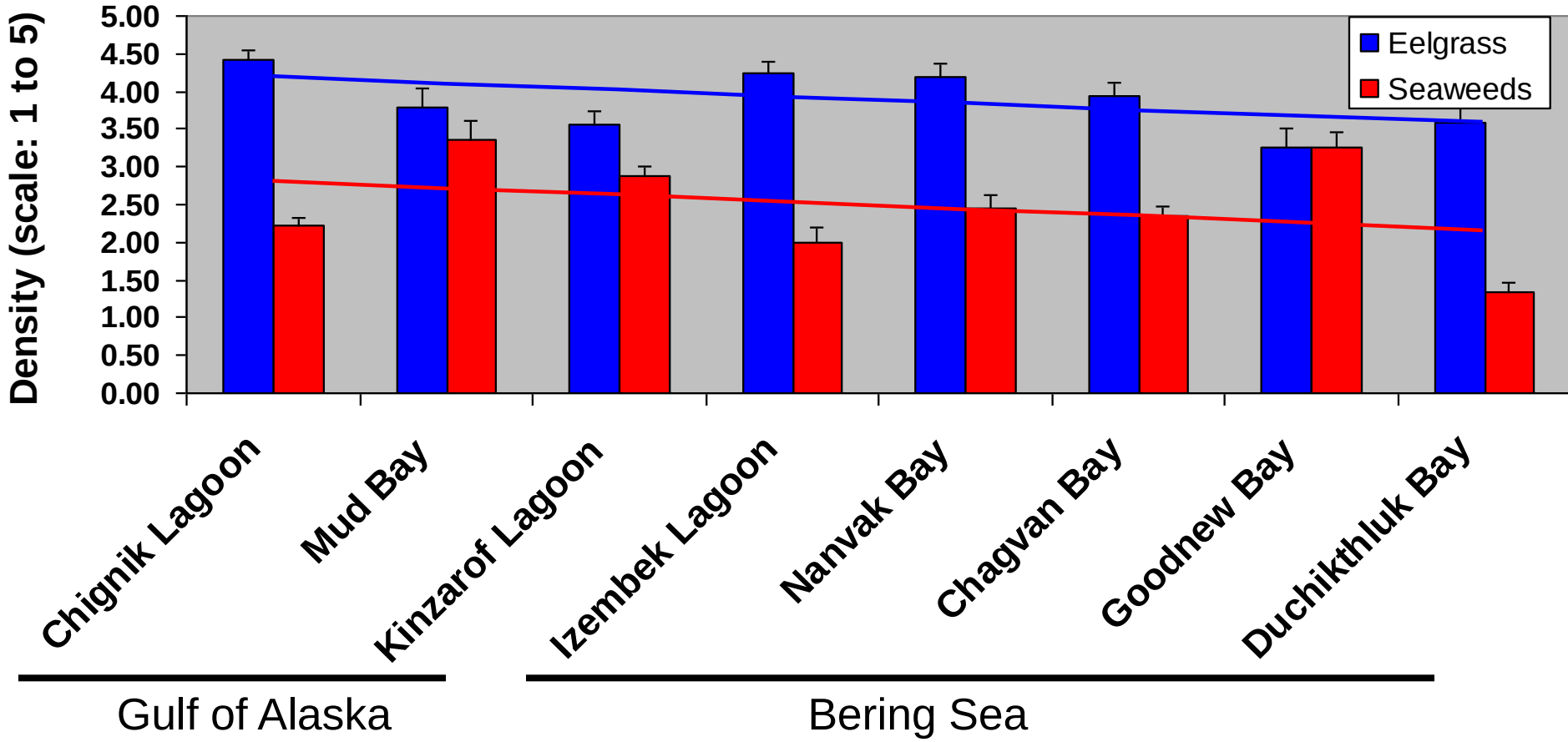
Environmental Parameters

- Water Temperature
- Salinity
- Turbidity
- Irradiance- light transmission- photosynthetically active radiation (PAR)

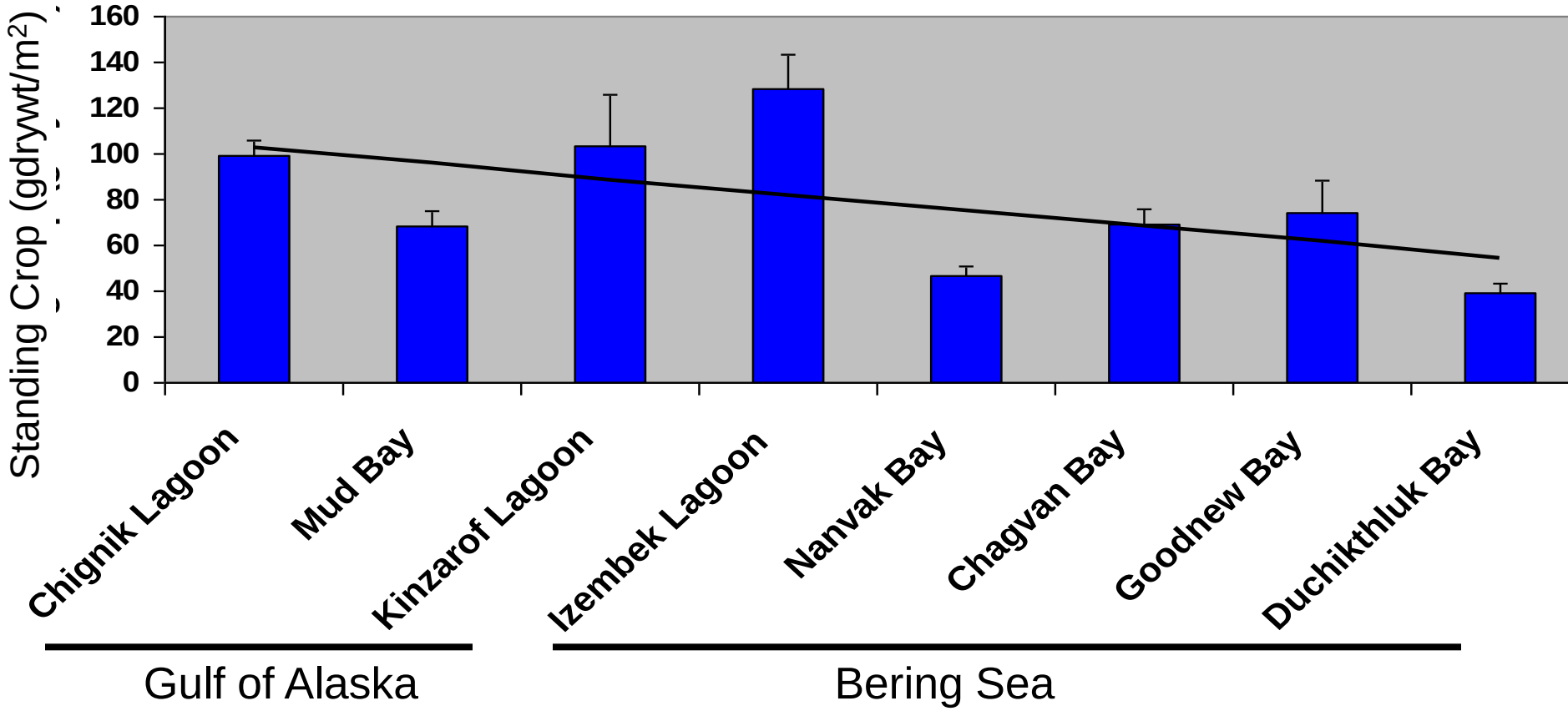
Eelgrass and Seaweed Density



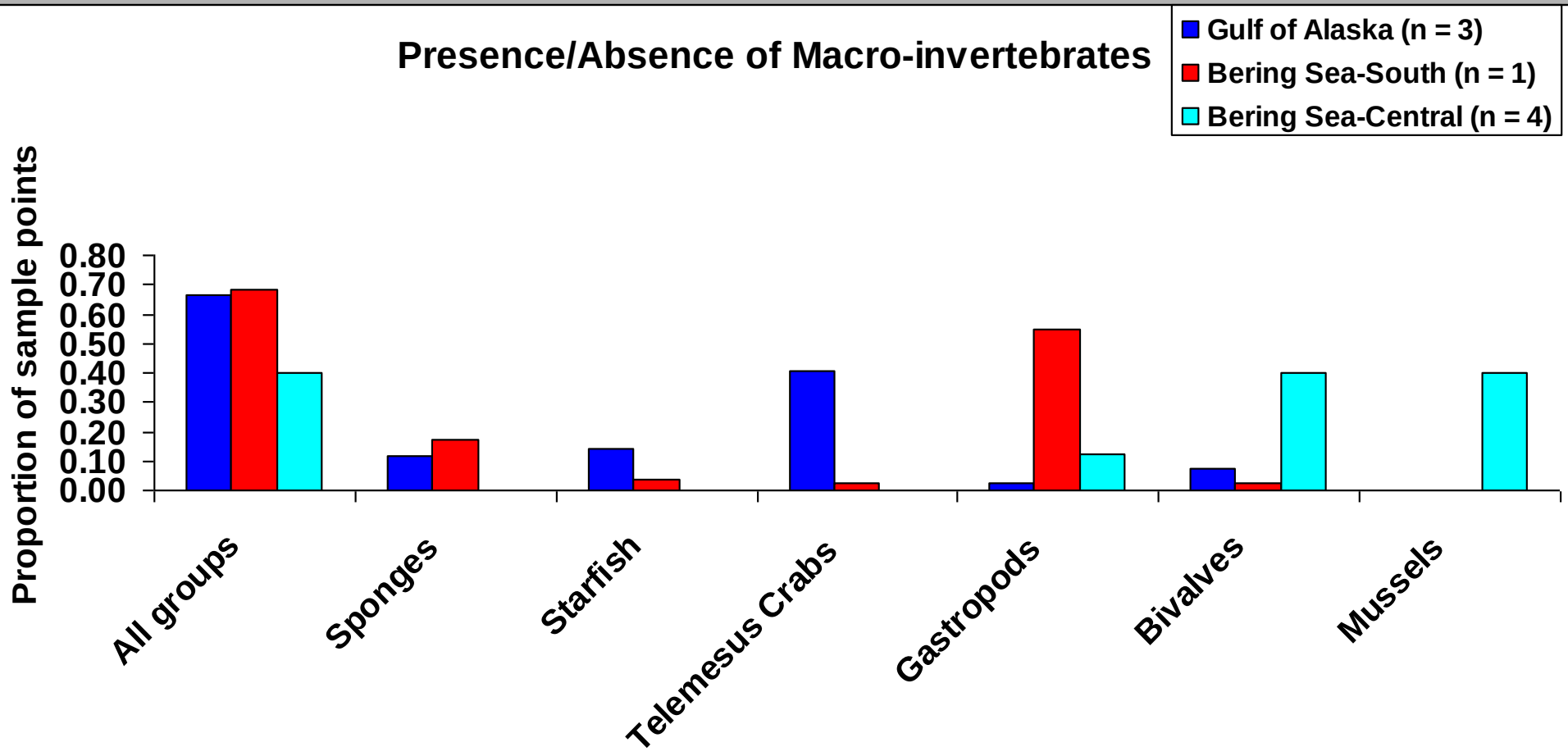
Eelgrass and Seaweed Density

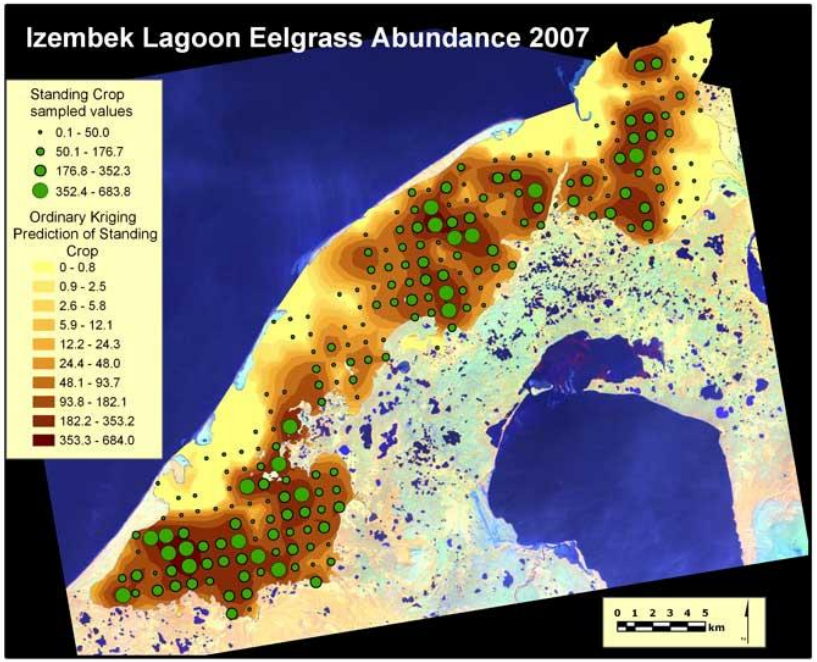


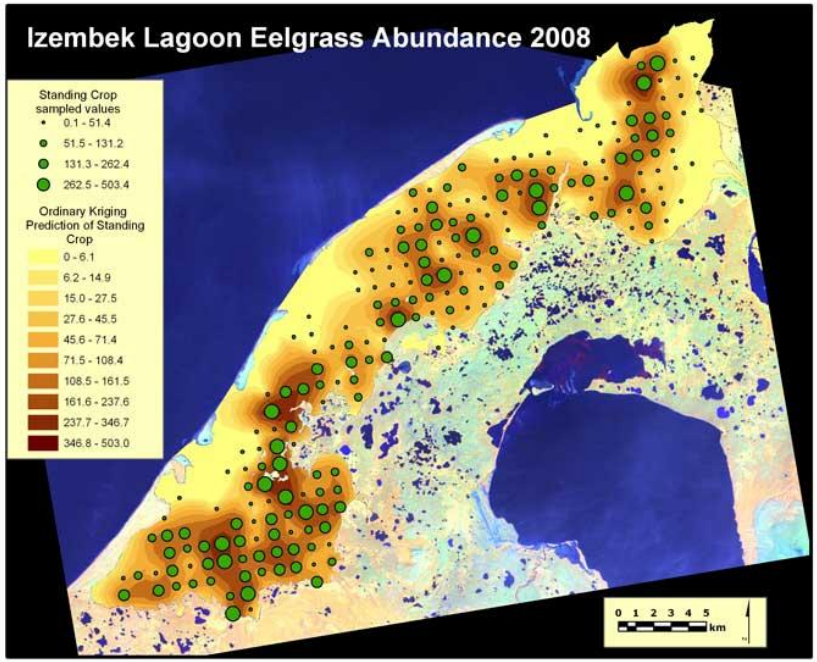
Eelgrass Abundance in 2010

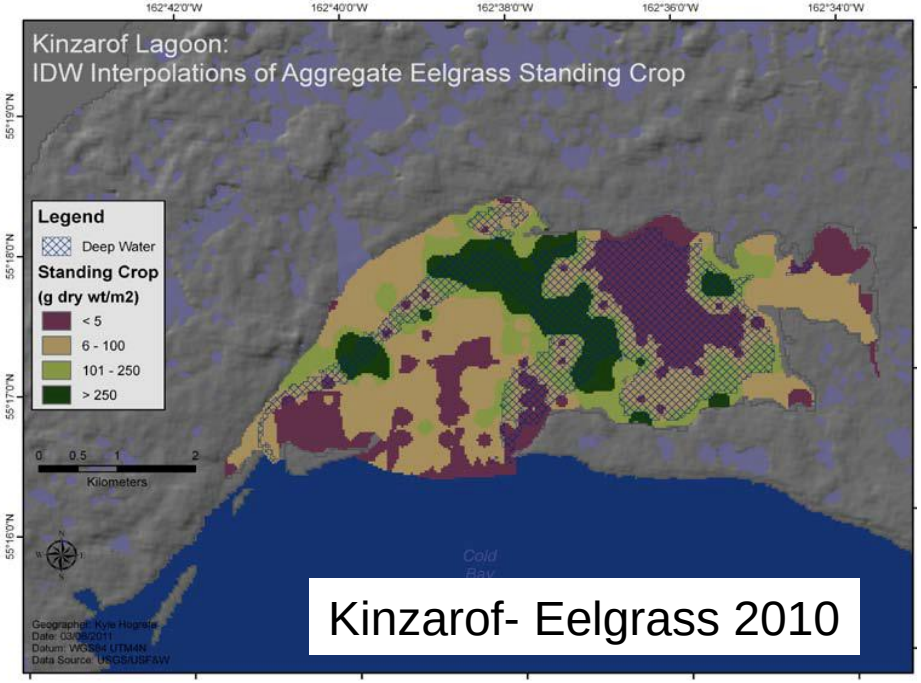


Presence/Absence of Macro-Invertebrates

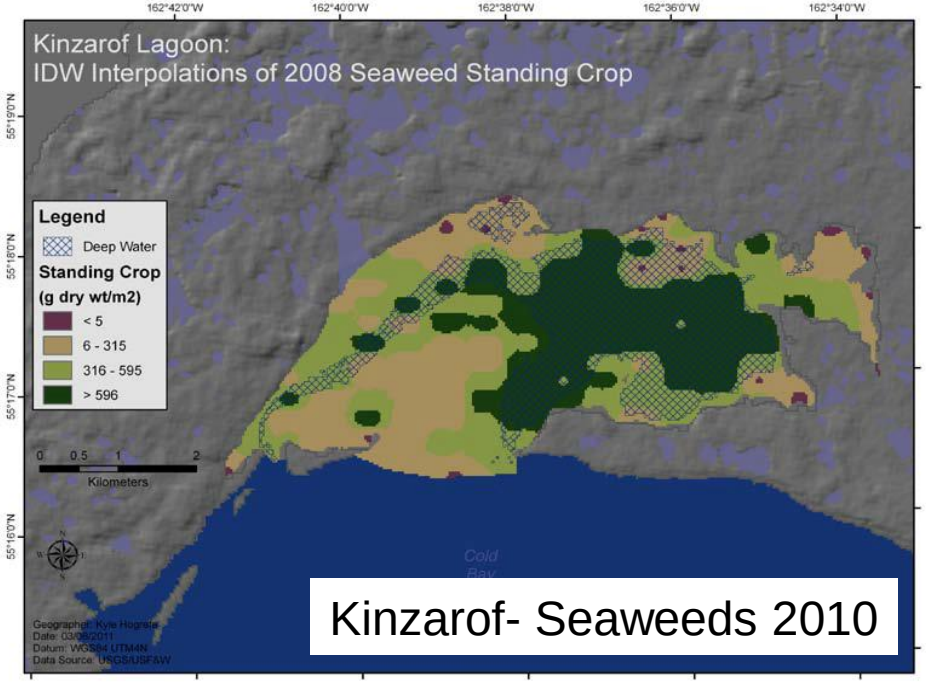




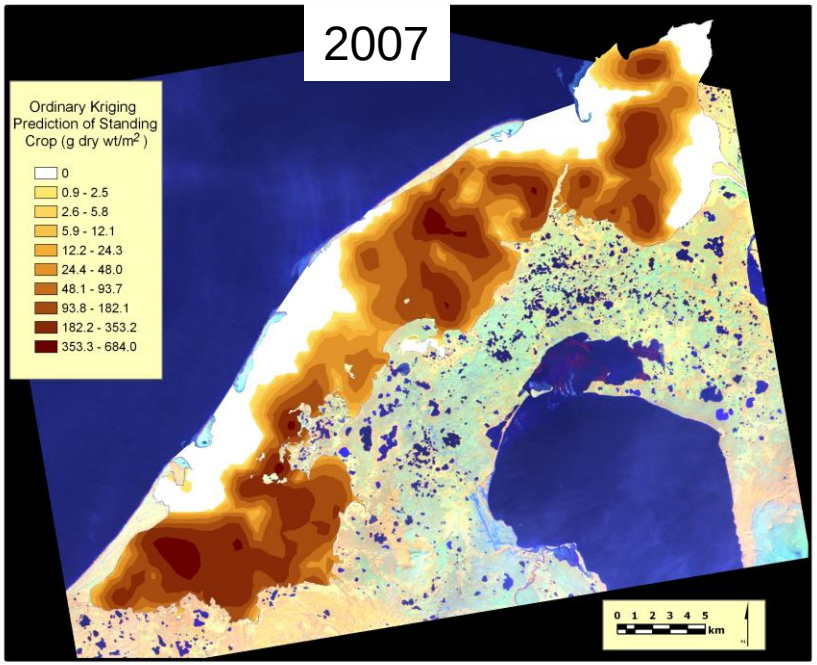


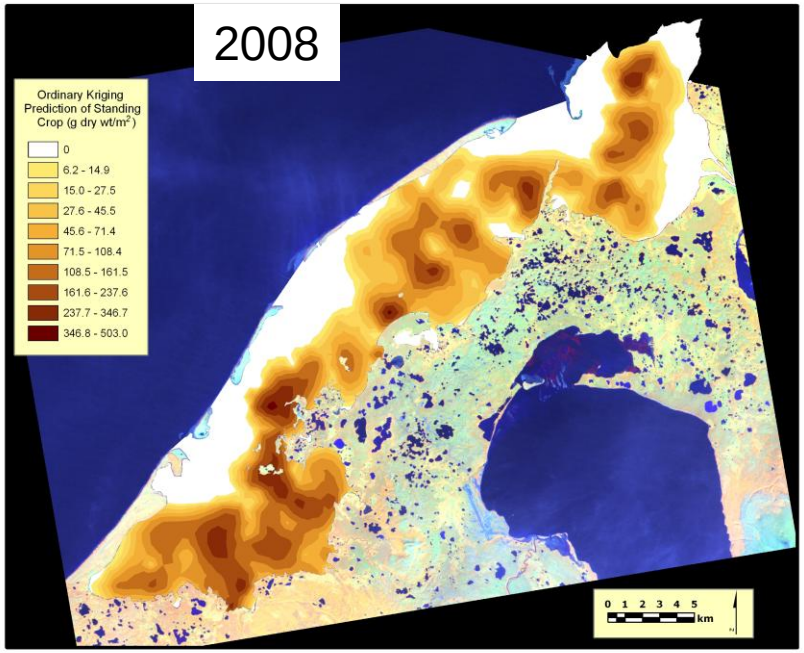


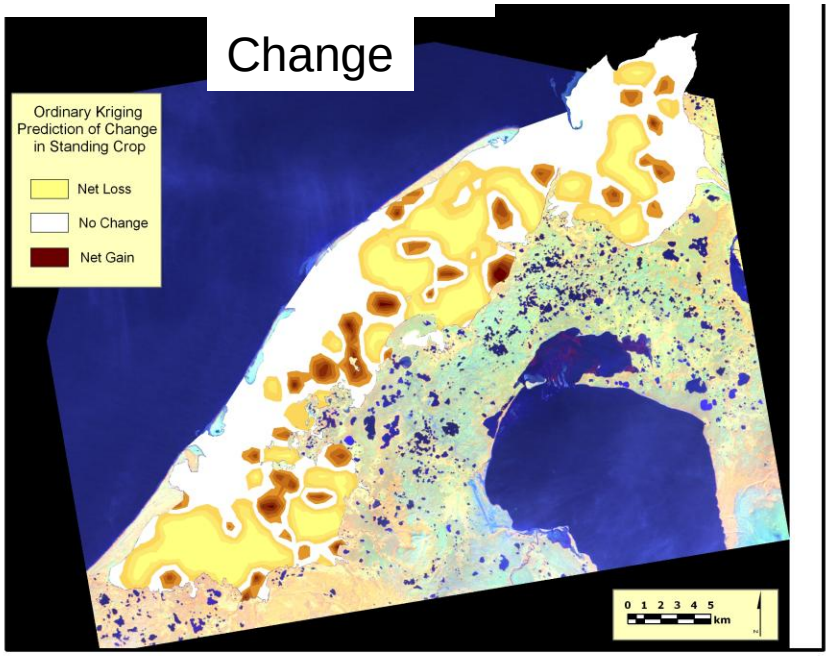
Kinzarof- Eelgrass 2010



Kinzarof- Seaweeds 2010


2007
Ordinary Kriging Prediction of Standing Crop (g dry wt/m2)
0
0.9 - 2.5
2.6 - 5.8
5.9 - 12.1
12.2 - 24.3
24.4 - 48.0
48.1 - 93.7
93.8 - 182.1
182.2 - 353.2
353.3 - 684.0
0 1 2 3 4 5
km


2008
Ordinary Kriging Prediction of Standing Crop (g dry wt/m2)
0
6.2 - 14.9
15.0 - 27.5
27.6 - 45.5
45.6 - 71.4
71.5 - 108.4
108.5 - 161.5
161.6 - 237.6
237.7 - 346.7
346.8 - 503.0
0 1 2 3 4 5
km


Change
Ordinary Kriging Prediction of Change in Standing Crop
Net Loss
No Change
Net Gain
0 1 2 3 4 5
km

Future Plans

- Finish Level 1 baseline inventories
- Finalize a monitoring plan for the 4 refuges

Acknowledgements

Special Thanks to:

- Bruce Casler
- Dominique Watts
- Abe David
- Pat Harris
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- Sandra Lindstrom
- Alvin Pederson
- Andy Ramey
- Kristine Sowl
- Michael Swaim