# System for Mapping and Predicting Species of Concern

NASA Biodiversity and Ecological Forecasting Team Meeting

5 May 2016

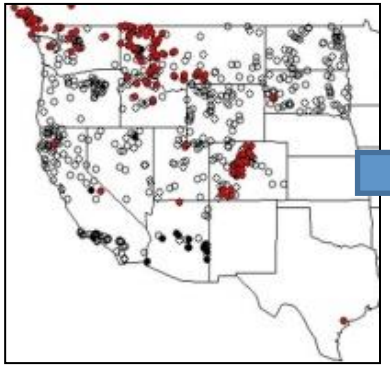
John Olson

# System for Mapping and Predicting Species of Concern

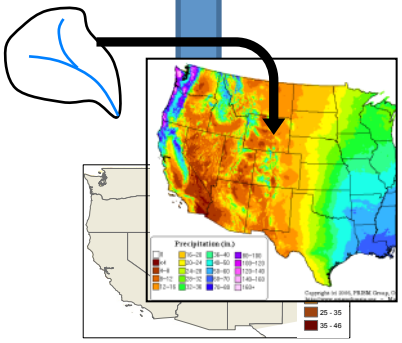
Application for natural resource managers to:

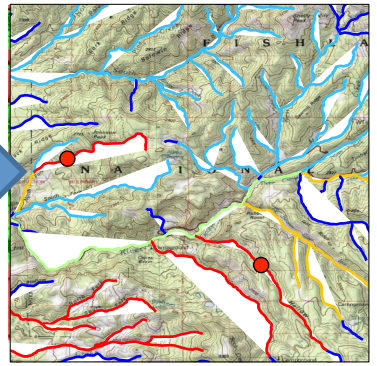
- Map current known and predicted occurrences
- Aquatic species of concern (T&E or invasives)
- Predict future changes in distributions

Existing Biological Data



Species Distribution Models





Predicted occurrences

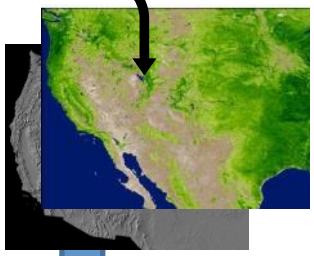
# System for Mapping and Predicting Species of Concern

Crowd Sourced Samples

eDNA

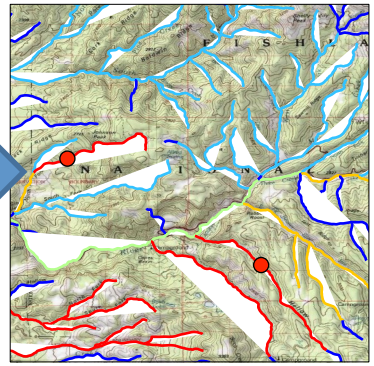
Genetic Identification

Satellite

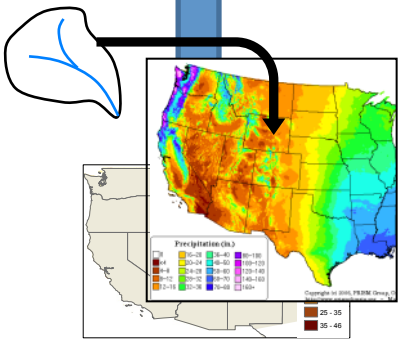


Existing Biological Data

Species Distribution Models



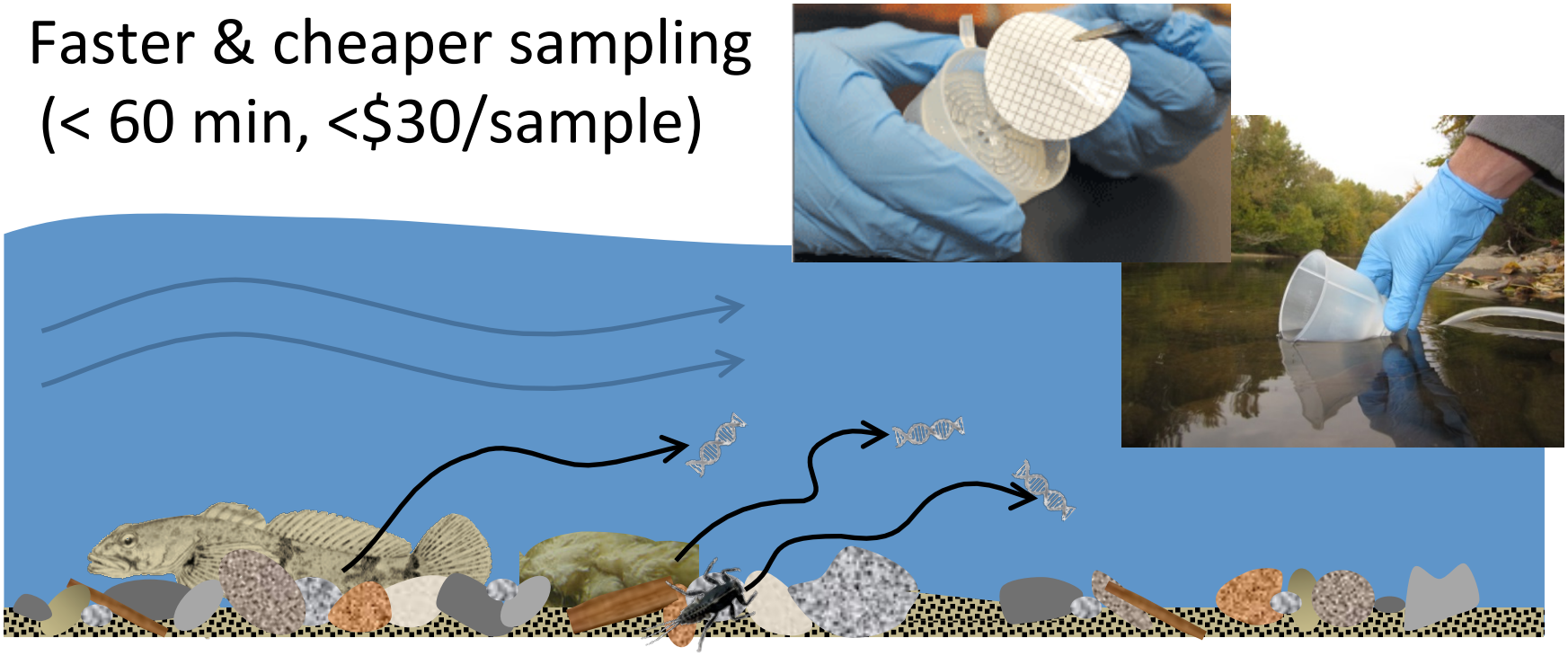
Predicted occurrences



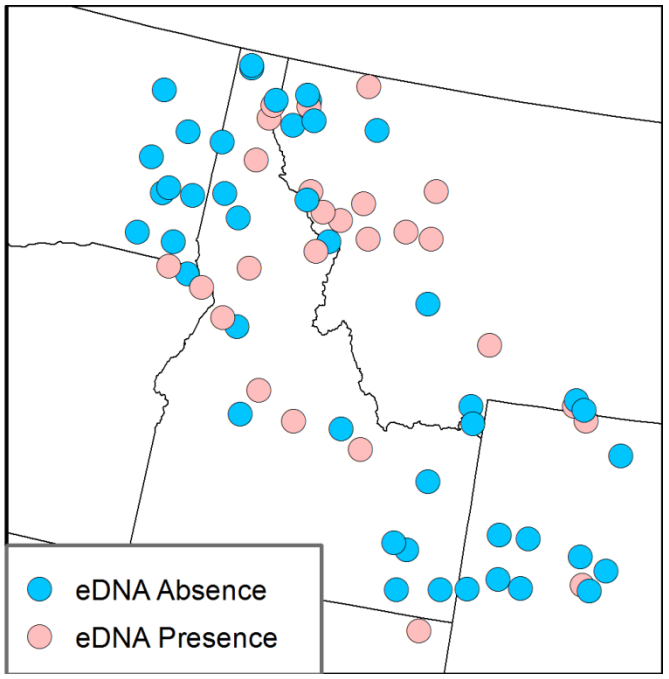
# System for Mapping and Predicting Species of Concern

Environmental DNA assessed using qPCR:

- Detection rates 80-96%
- Faster & cheaper sampling (< 60 min, <$30/sample)



# Demonstration Species: *Didymosphenia geminata*

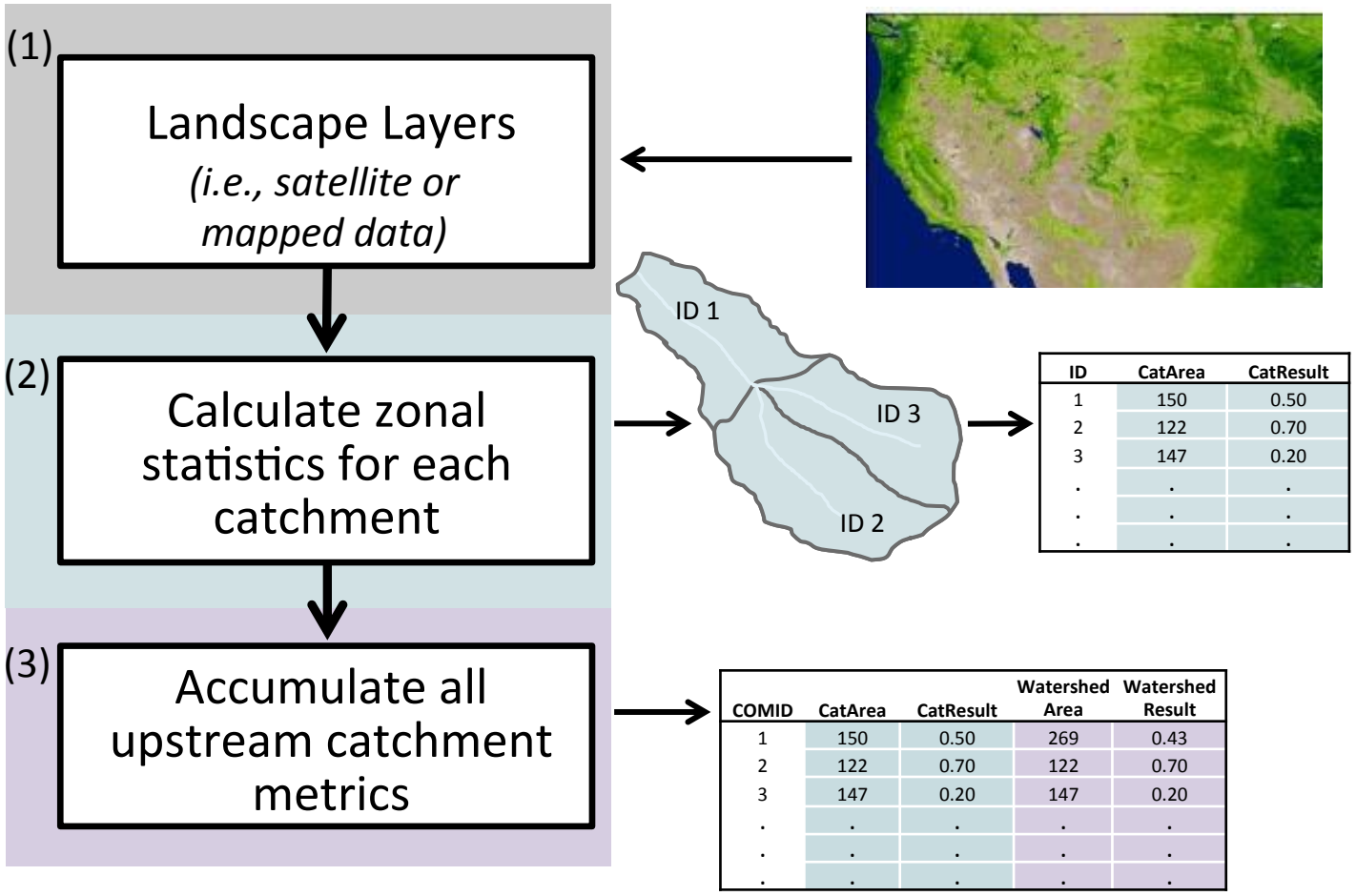



MaxEnt diatom model using both eDNA and traditional data 93-100% correct classification rates

| Response | AUC | CCR |
|---|---|---|
| Static | 0.94 | 0.93 |
| Temporal | 1.00 | 1.00 |
| eDNA | 0.77 | 0.70 |

More and better occurrence data
↳ Robust relationships to NASA data
↳ Results in more reliable predictions

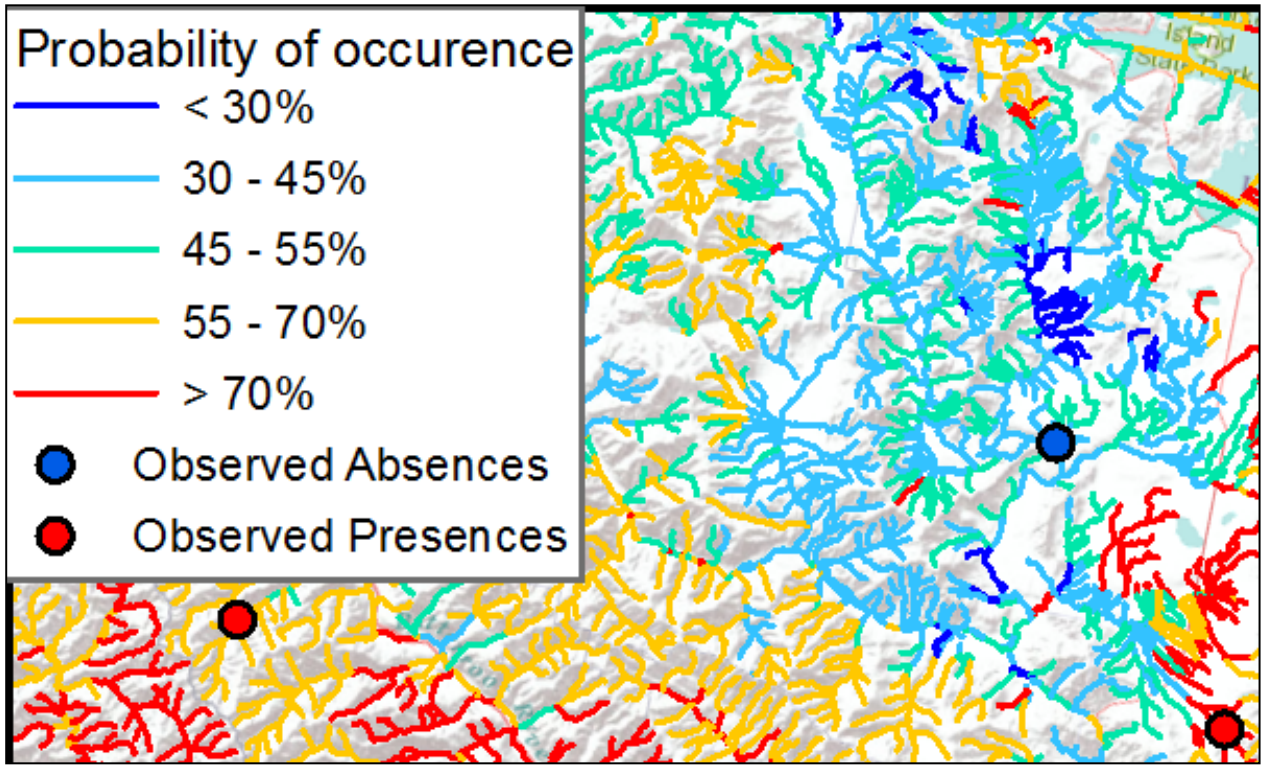
# Stream Characterizations at Landscape Scales - StreamCat




Hill et al., 2016, The Stream-Catchment (StreamCat) Dataset, JAWRA.
https://github.com/USEPA/StreamCat

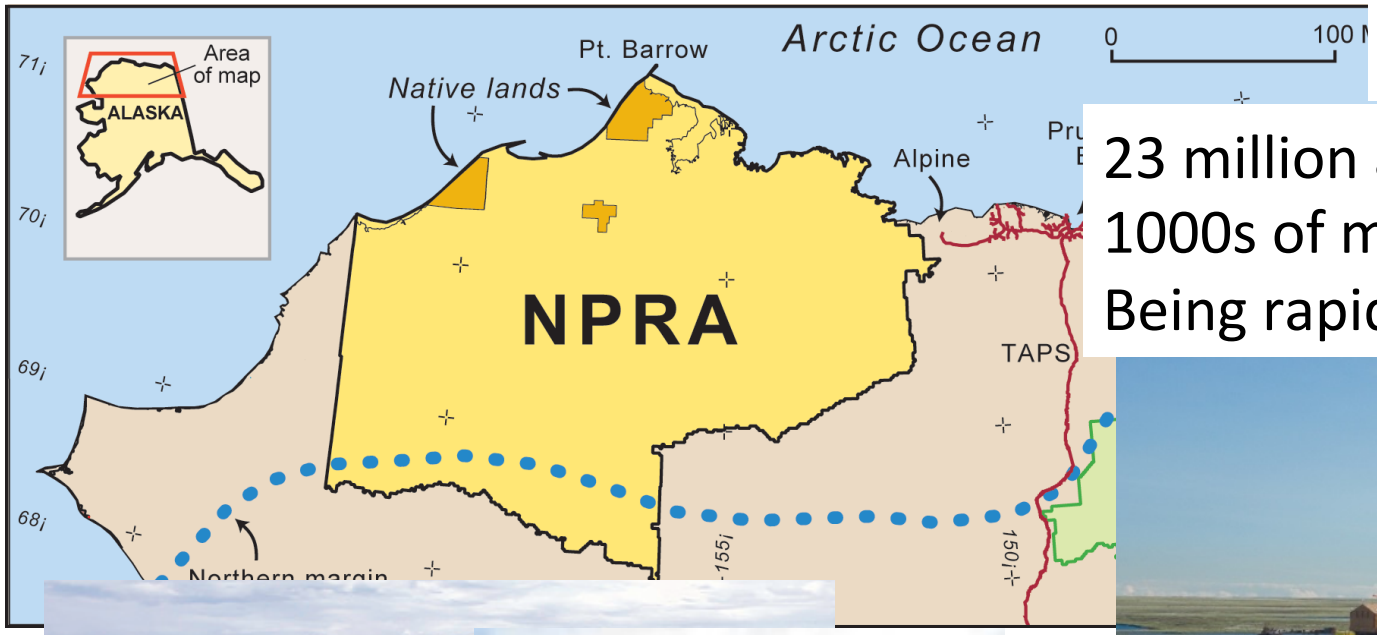
# Stream Characterizations at Landscape Scales - StreamCat

Using StreamCat, we can apply models to every stream segment in National Hydrologic Dataset




Applications to Maximum Entropy Models

# National Petroleum Reserve - Alaska




23 million acres

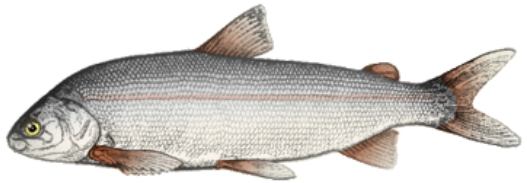
1000s of miles of streams

Being rapidly developed

# Task: Develop & apply eDNA probes & primers

Burbot
(*Lota lota*)

*Completed*



Broad Whitefish
(*Coregonus nasus*)

*Working*

N. Pike
(*Esox lucius*)

*Completed*

Least Cisco
(*Coregonus sardinella*)

*Working*

Arctic Grayling
(*Thymallus arcticus*)

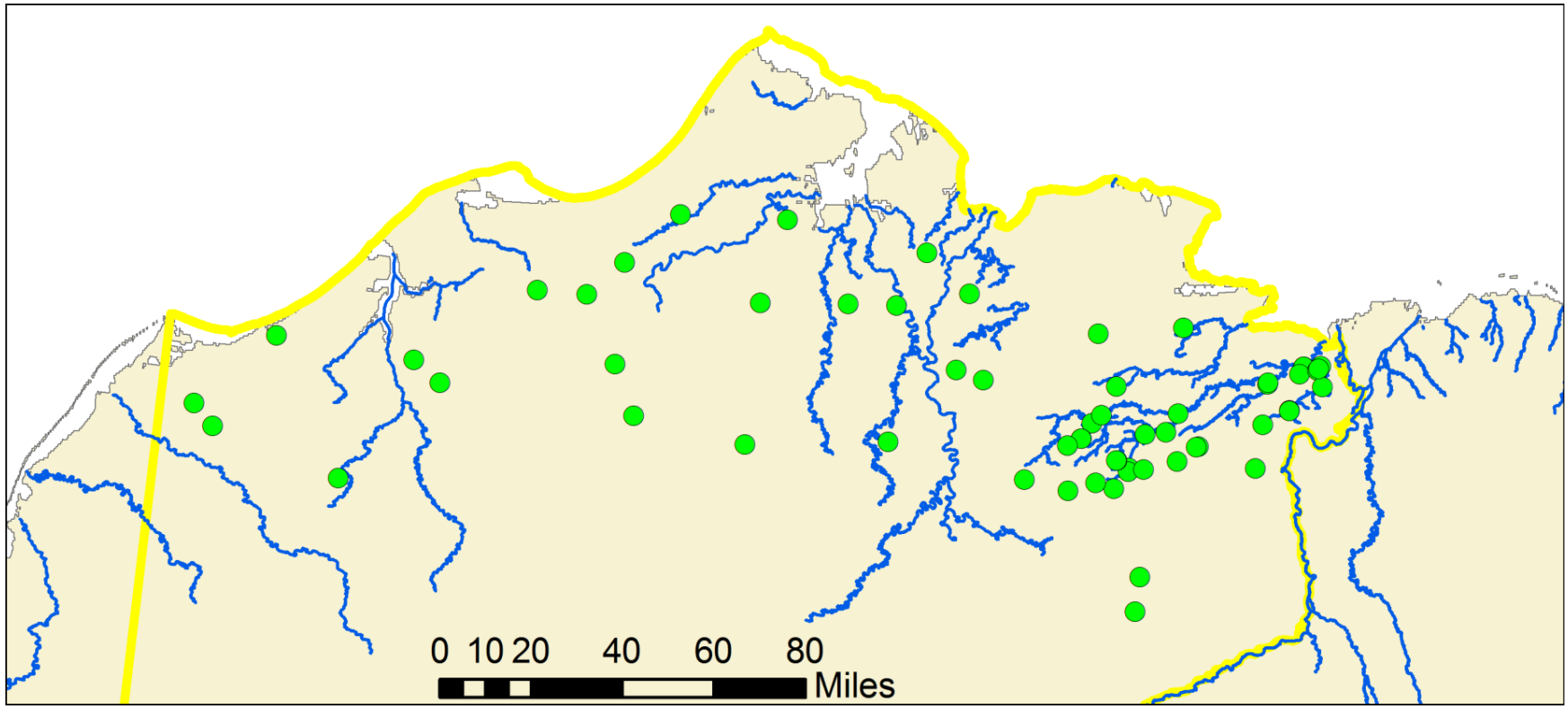
*Testing*

Humpback Whitefish
(*Coregonus pidschian*)

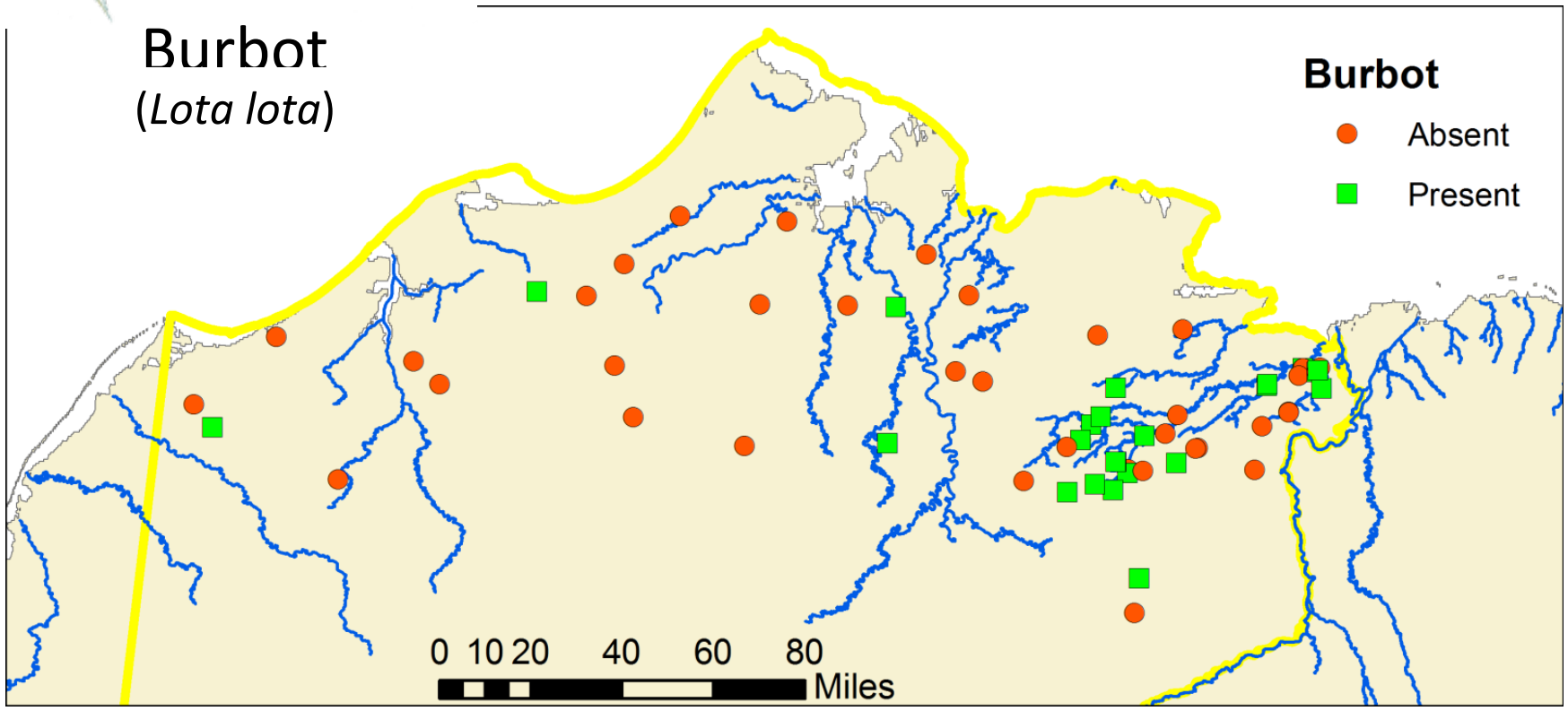
*Working*

# Task: Collect eDNA samples

64 Sites sampled by BLM & AK DEC crews in summer 2015

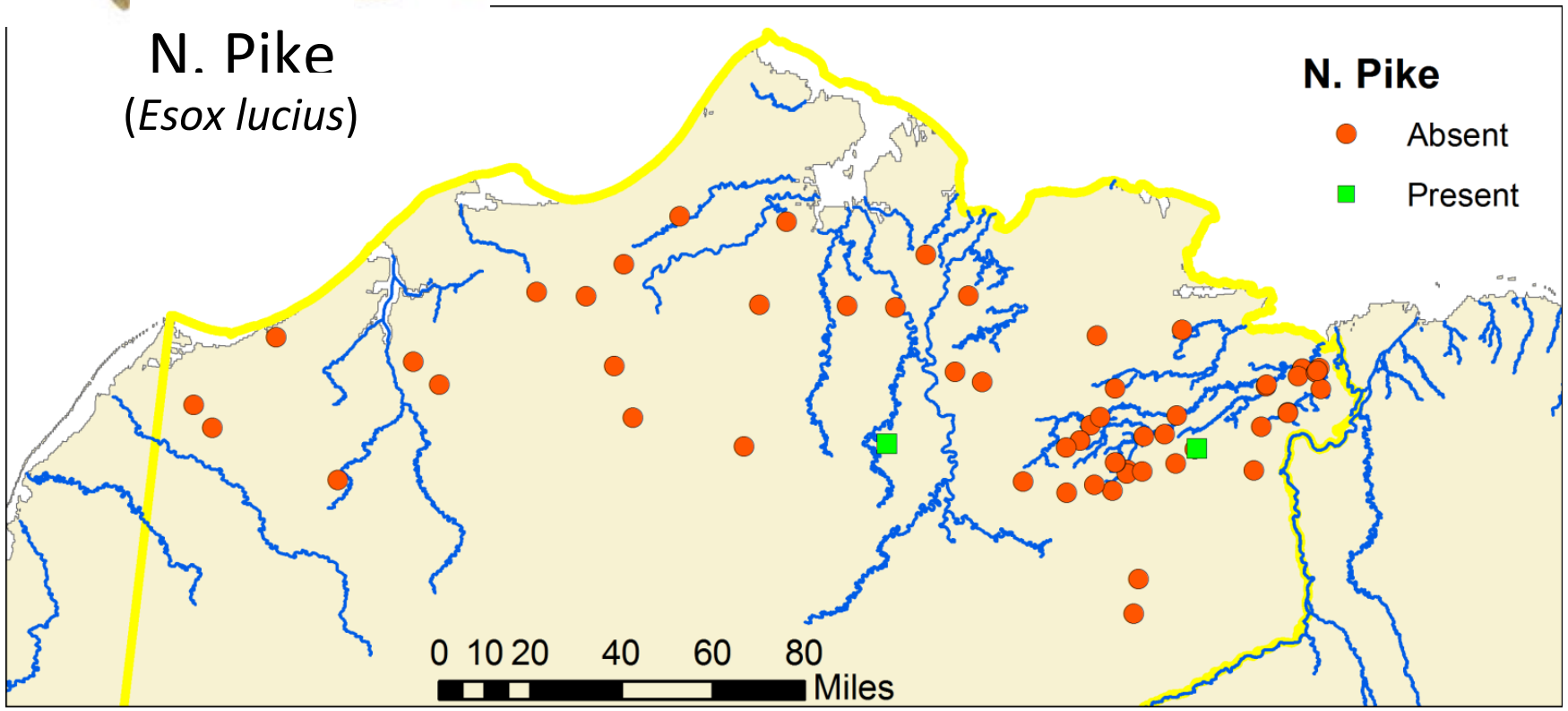


# Task: Develop & apply eDNA probes & primers



# Task: Develop & apply eDNA probes & primers

N. Pike
(*Esox lucius*)



# Task: Extract spatial/temporal predictor data

| Static Predictors |
| --- |
| Percent Lakes Unfrozen (SAR) |
| Drainage Area |
| Stream Slope |
| Soil Characteristics |
| Vegetation Type (Landsat) |
| Thermokarst Activity |

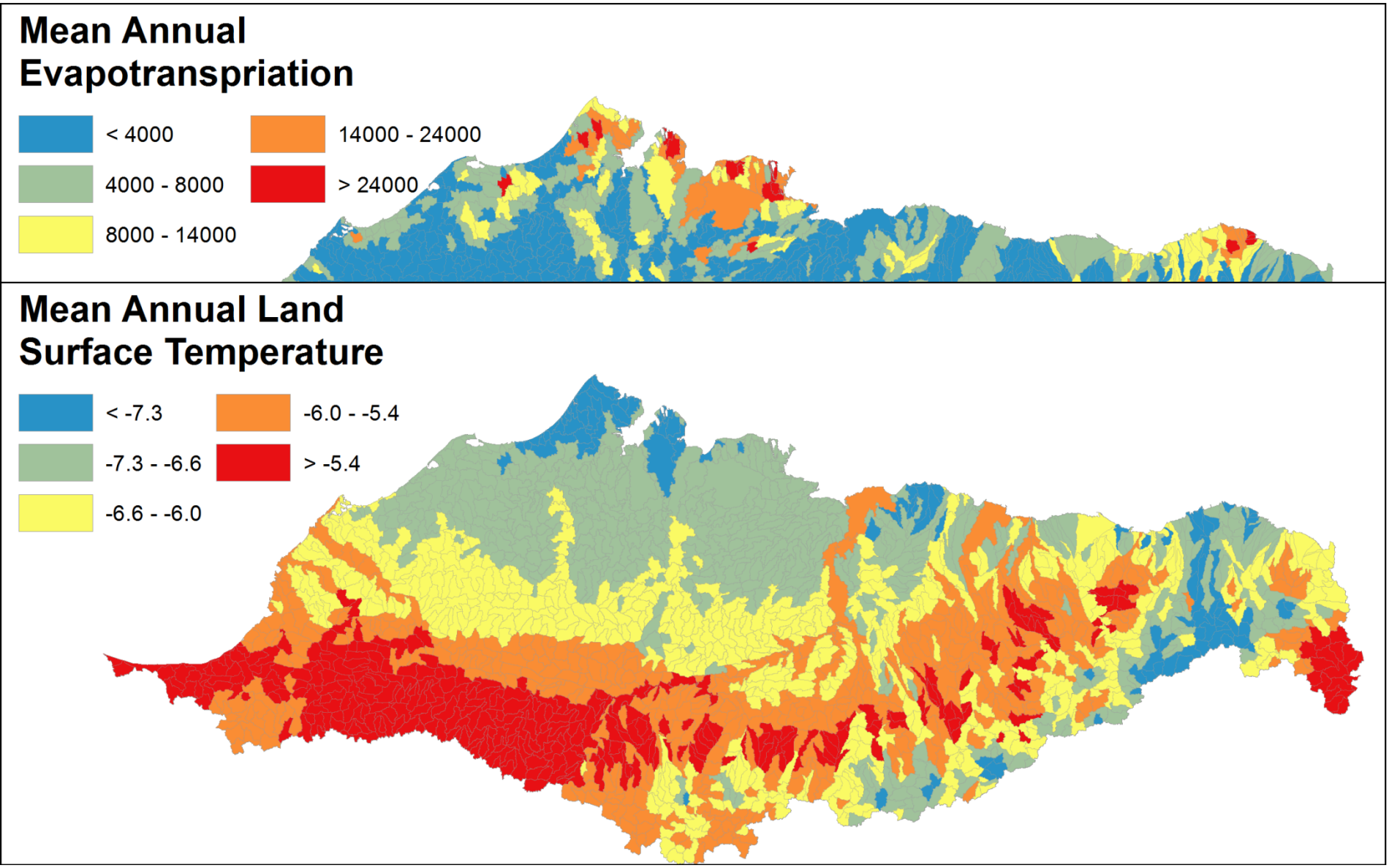
| Dynamic Predictors |
| --- |
| Active Layer Thickness (InSAR) |
| Evapotranspiration (MODIS) |
| Land Surface Temperature (MODIS) |
| EVI/NDVI/LAI/GPP (MODIS) |
| Fire Activity (MODIS) |
| Soil Moisture (SMAP) |
| Oil & Gas Development |

# Task: Extract spatial/temporal predictor data

| Static Predictors |
| --- |
| Percent Lakes Unfrozen (SAR) |
| Drainage Area |
| Stream Slope |
| Soil Characteristics |
| Vegetation Type (Landsat) |
| Thermokarst Activity |

| Dynamic Predictors |
| --- |
| Active Layer Thickness (InSAR) |
| Evapotranspiration (MODIS) |
| Land Surface Temperature (MODIS) |
| EVI/NDVI/LAI/GPP (MODIS) |
| Fire Activity (MODIS) |
| Soil Moisture (SMAP) |
| Oil & Gas Development |

# Task: Extract spatial/temporal predictor data



# Next Steps

1. Collect additional eDNA samples (summer 16)
2. Complete eDNA primer & probe development (summer 16)
3. Develop species distribution models (JUN 16 – APR 17)
   - Expecting additional BLM presence/absence data
   - Expecting data from 120 additional sites from NPS/USGS
4. Develop & test user interface/website prototype (OCT 16 – APR 17)
5. Apply future climate & development scenarios to species distribution models (JUN 17)

# Thanks to

Matthew Varner
Matthew Whitman

S.J. & JESSIE E. QUINNEY
COLLEGE of
NATURAL RESOURCES
UtahStateUniversity

Karen Mock
Torrey Rodgers
Chuck Hawkins

Amber Bethe

Amber Ruggerio

# Questions