

System for Mapping and Predicting Species of Concern

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COLLEGE of
NATURAL RESOURCES
UtahStateUniversity



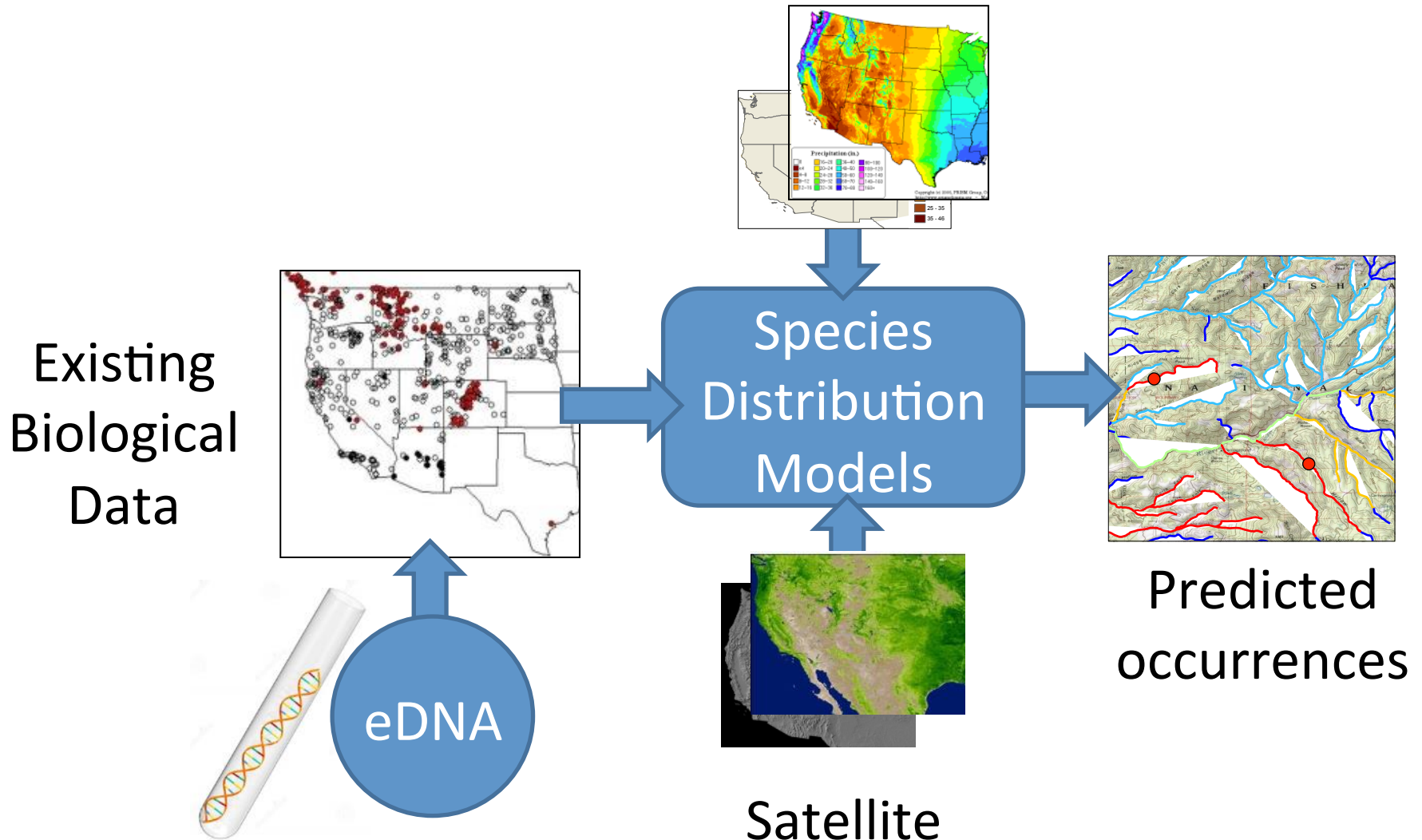
National Petroleum Reserve - Alaska



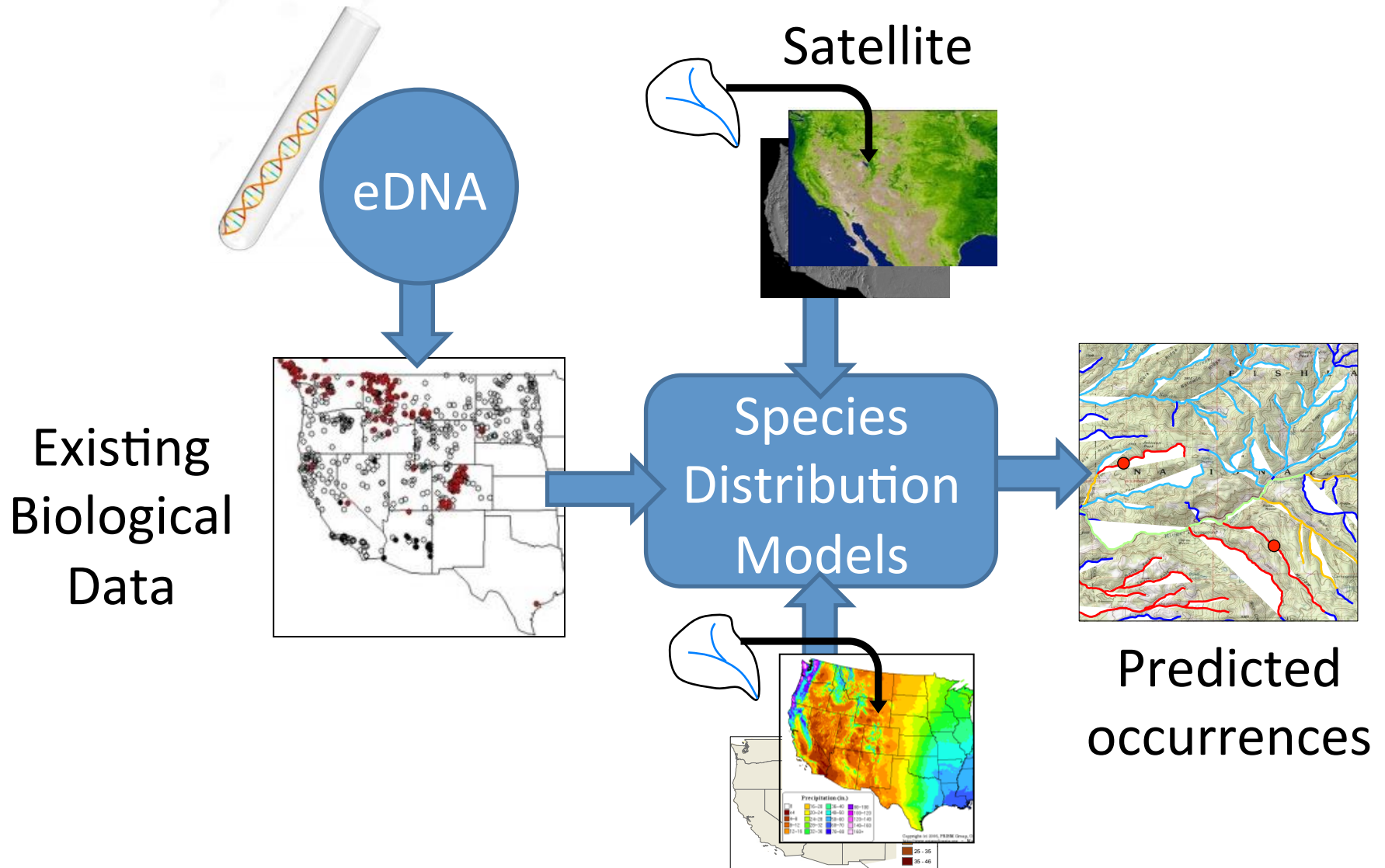
23 million acres
1000s of miles of streams
Being rapidly developed



System for Mapping and Predicting Species of Concern



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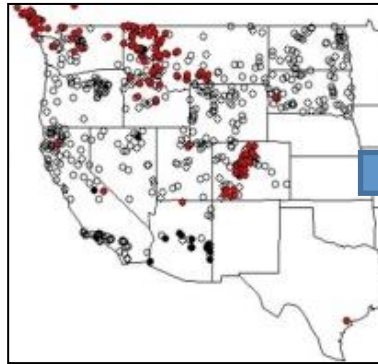


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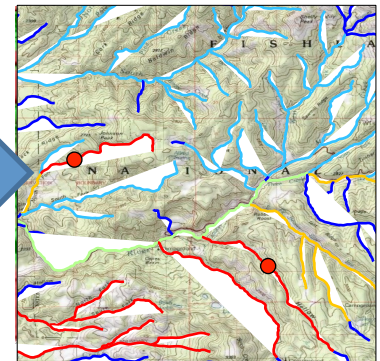
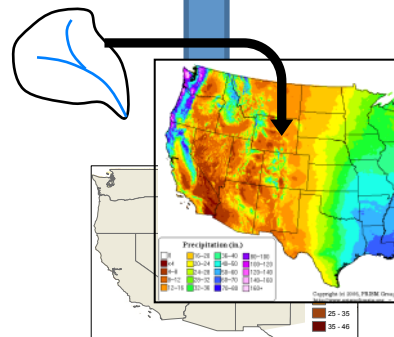
Application for natural resource managers to:

- 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

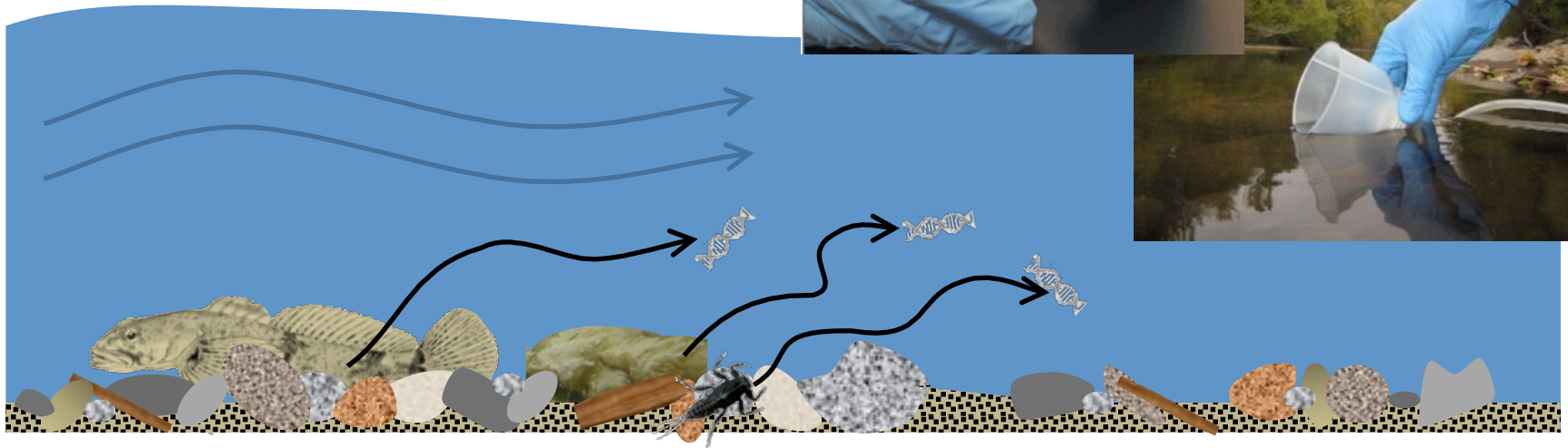
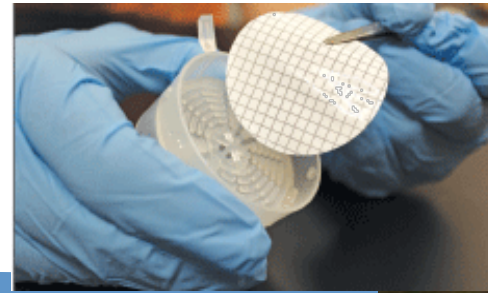


Predicted
occurrences

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Environmental DNA :

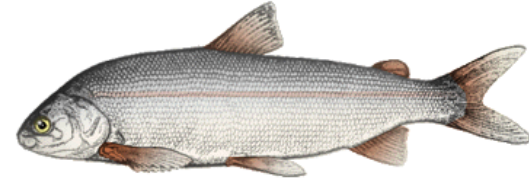
- Detection rates 80-96%
- Faster & cheaper sampling (< 60 min, <\$30/sample)
- COI assessed using qPCR



Develop & apply eDNA assays



Burbot
(*Lota lota*)



Broad Whitefish
(*Coregonus nasus*)



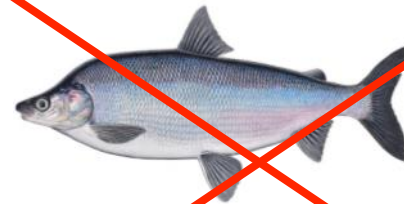
N. Pike
(*Esox lucius*)



Least Cisco
(*Coregonus sardinella*)



Arctic Grayling
(*Thymallus arcticus*)

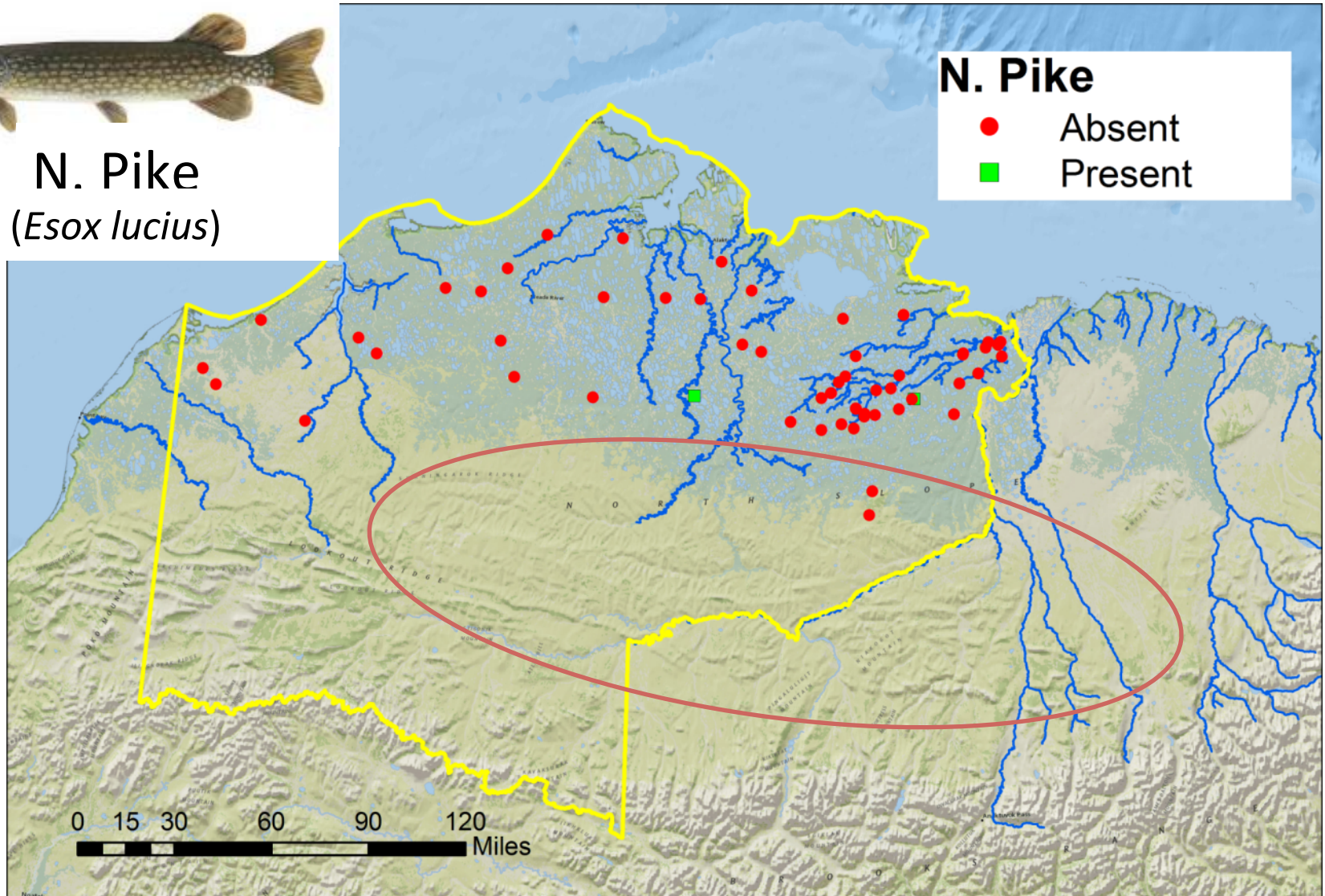


Humpback Whitefish
(*Coregonus pidschian*)

Develop & apply eDNA assays



N. Pike
(*Esox lucius*)



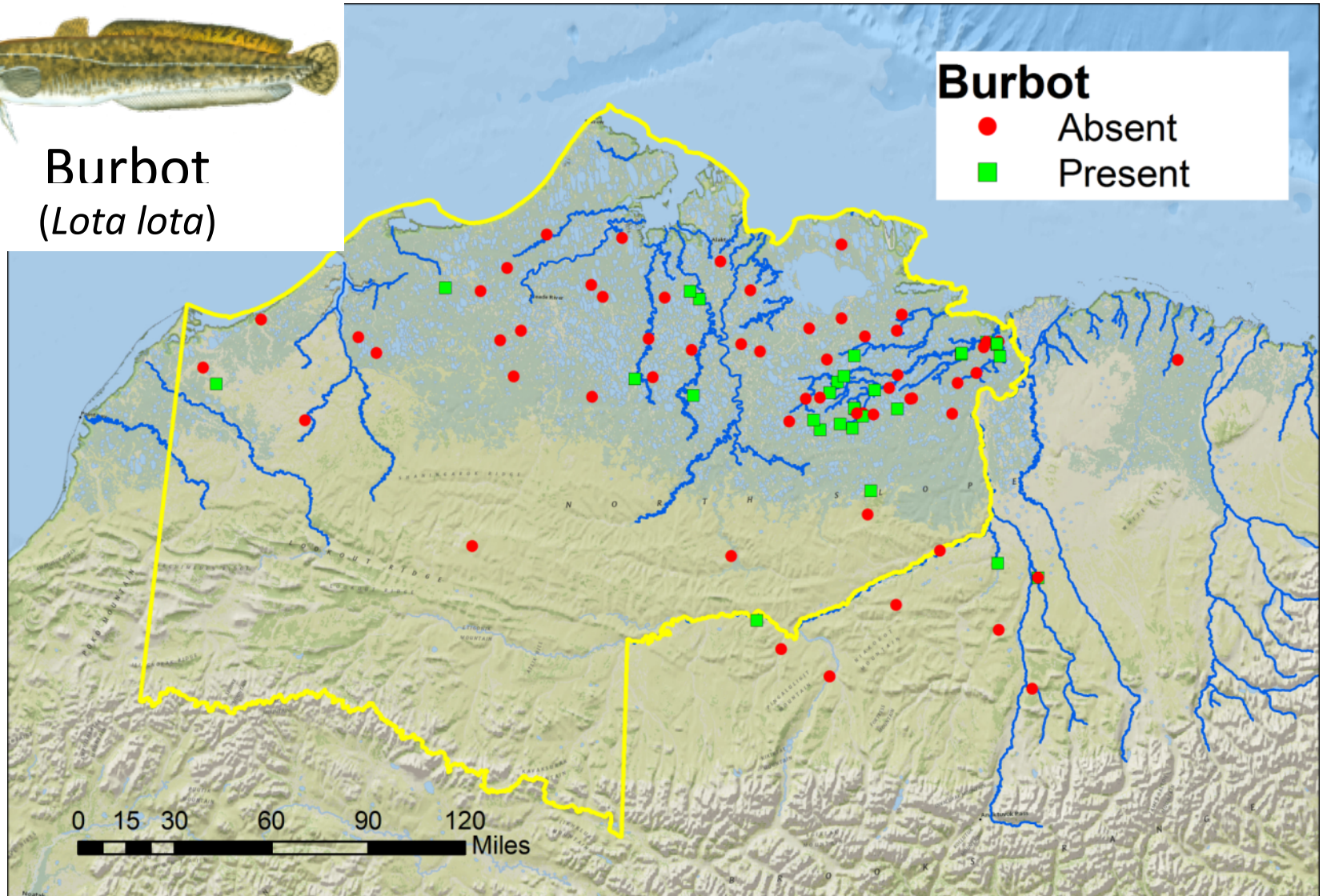
Develop & apply eDNA assays



Burbot
(*Lota lota*)

Burbot

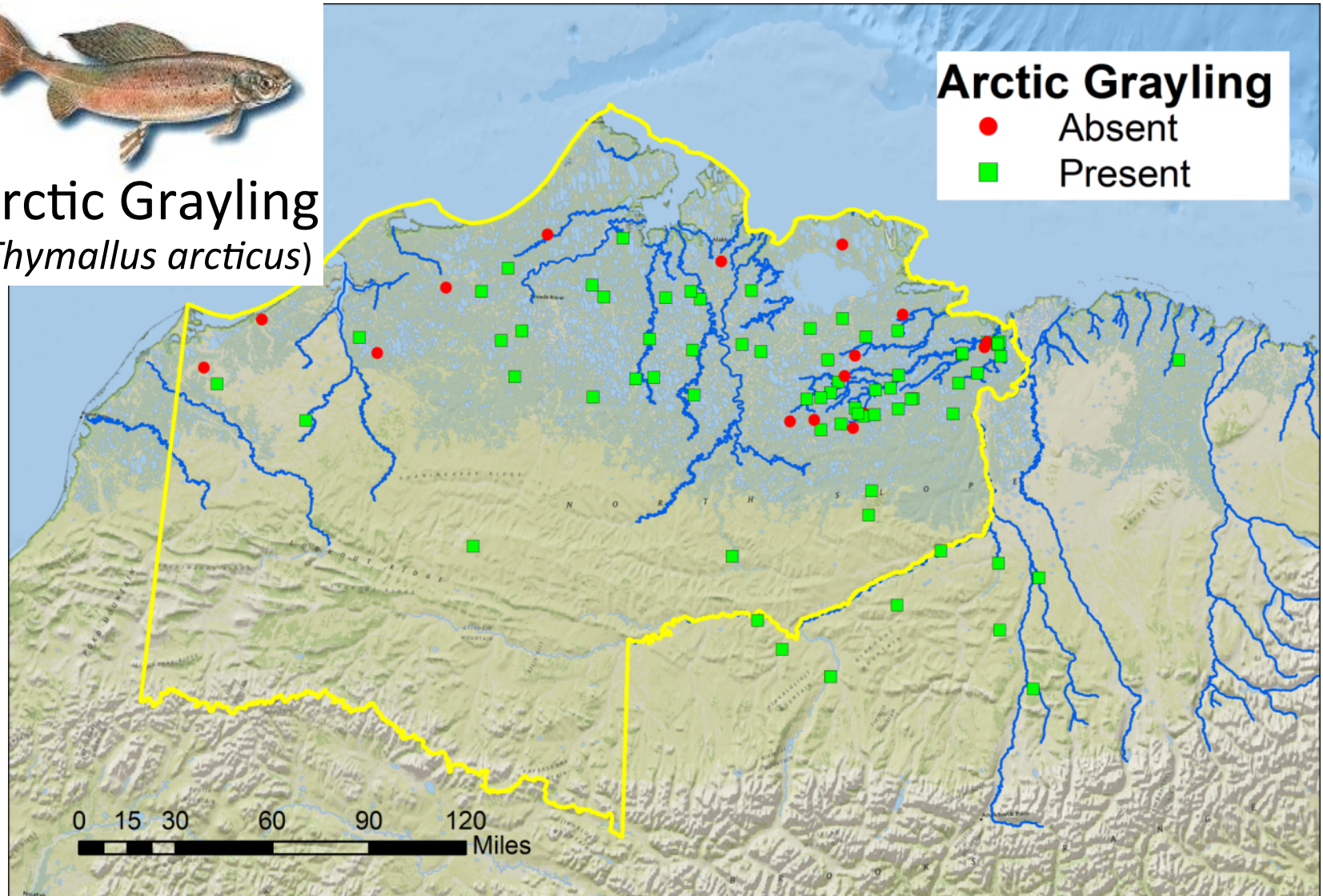
- Absent
- Present



Develop & apply eDNA assays



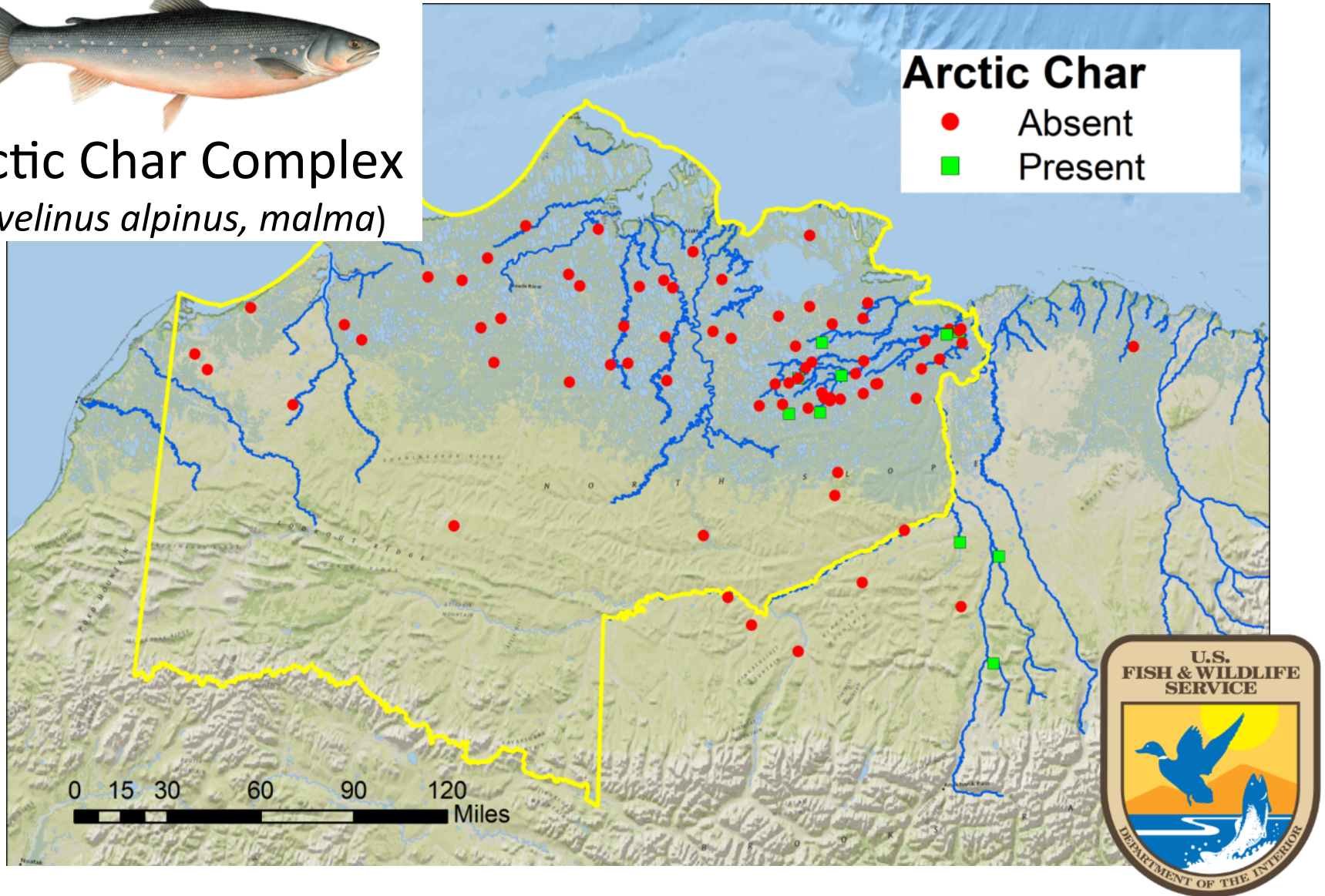
Arctic Grayling
(*Thymallus arcticus*)



Develop & apply eDNA assays

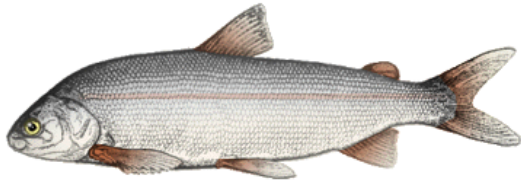


Arctic Char Complex
(*Salvelinus alpinus, malma*)



Develop & apply eDNA assays

A tail of two fish...



Broad Whitefish
(*Coregonus nasus*)



Least Cisco
(*Coregonus sardinella*)



Develop & apply eDNA assays

Currently running assays developed by USFS for:

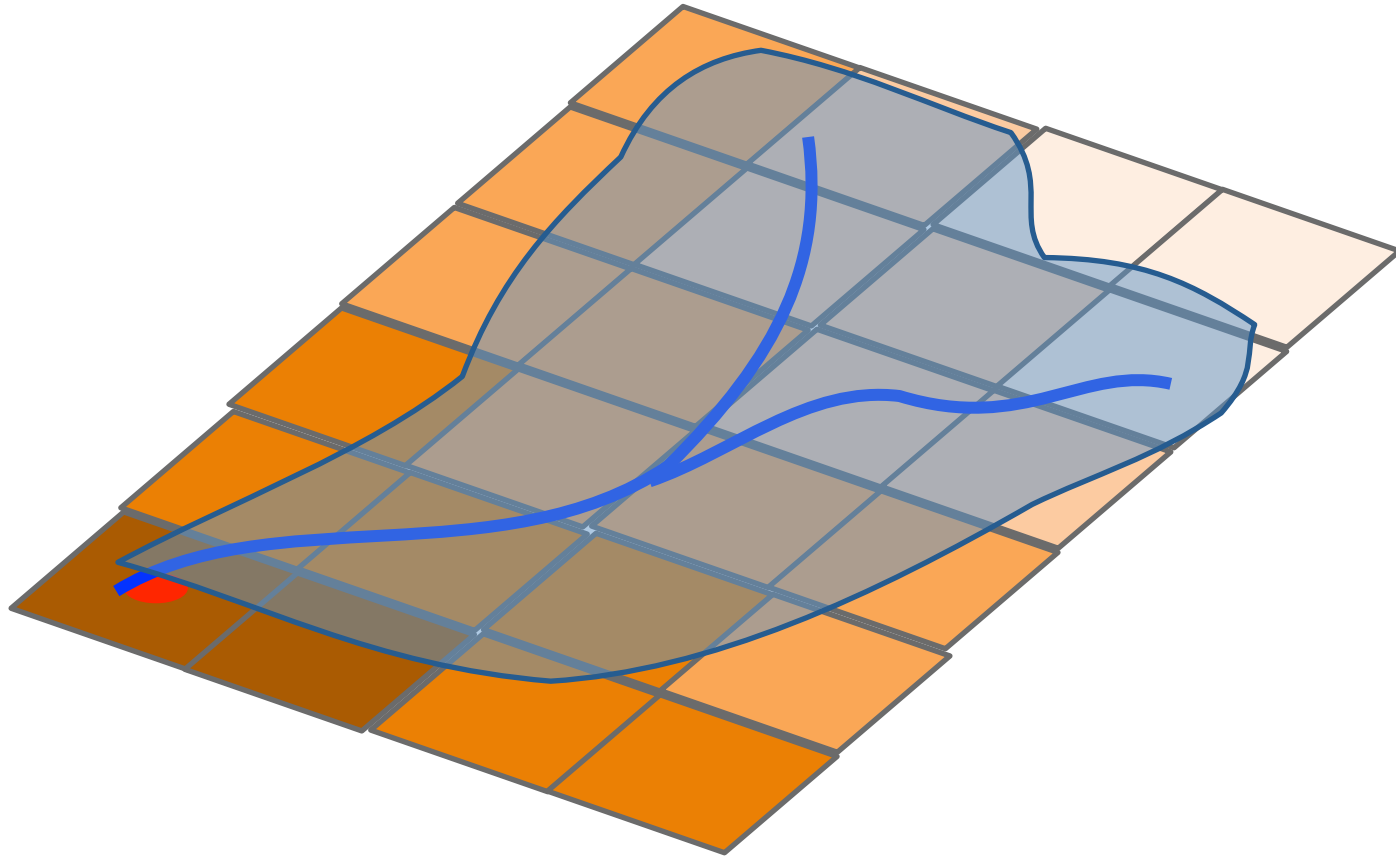


Chinook Salmon
(*Oncorhynchus tshawytscha*)

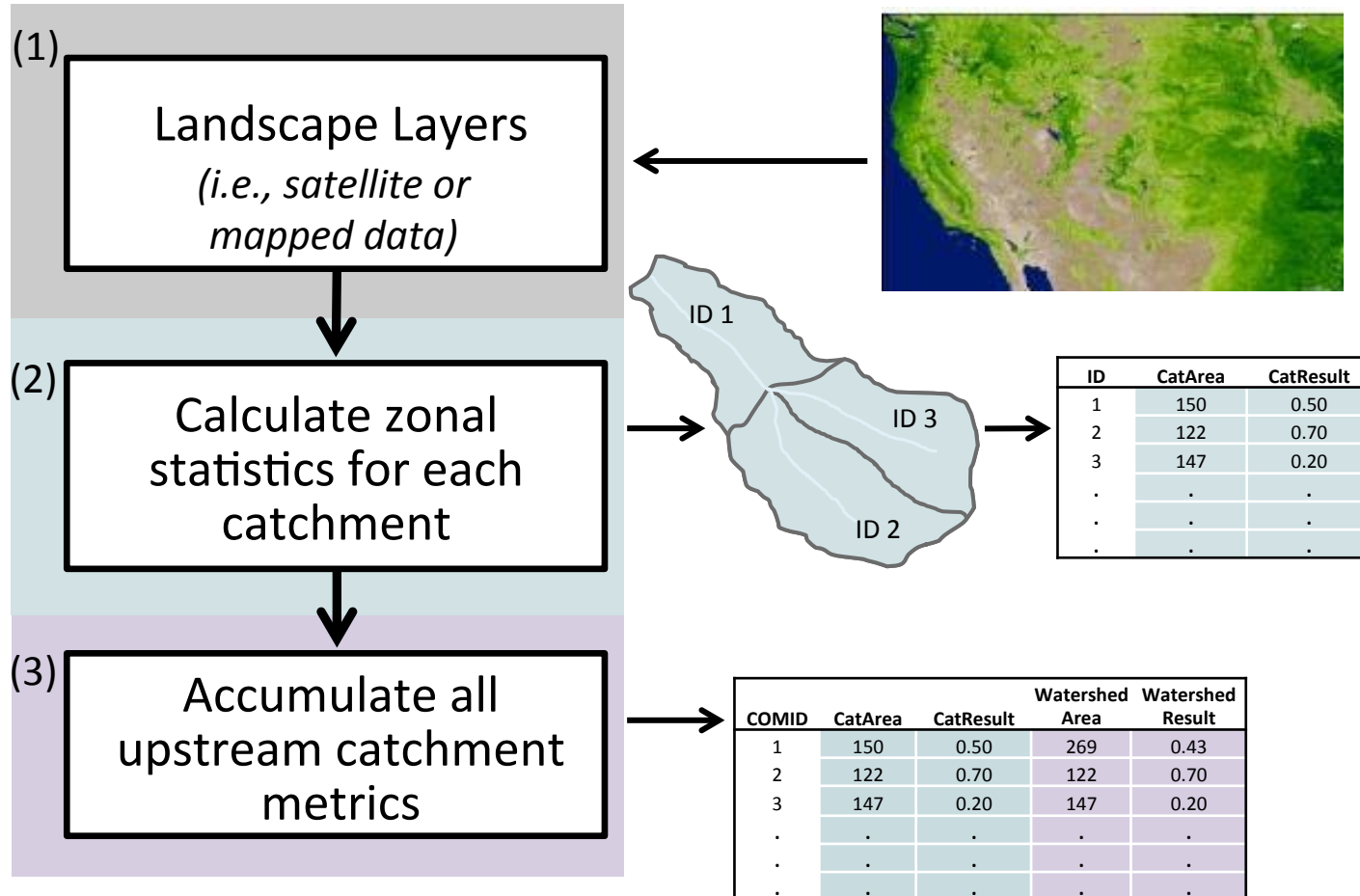


Chum Salmon
(*Oncorhynchus keta*)

Watershed Earth Observations



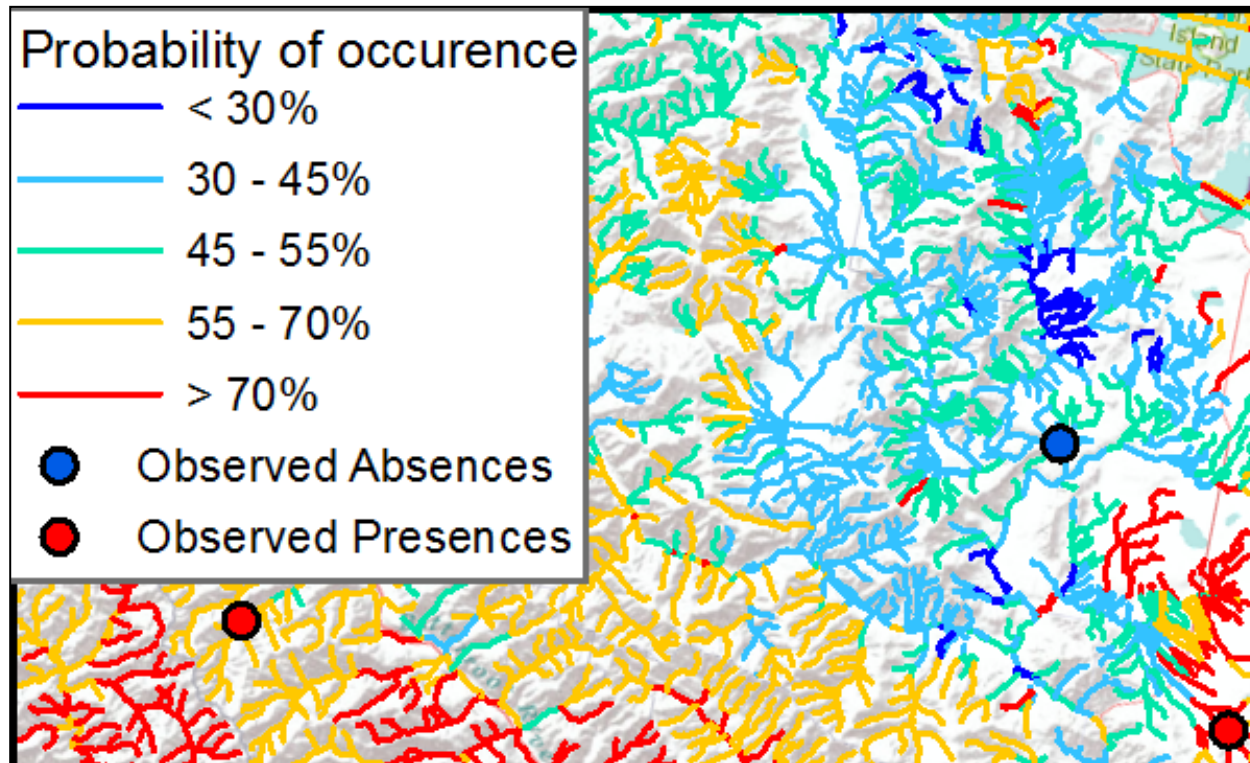
Watershed Earth Observations



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

Watershed Earth Observations

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



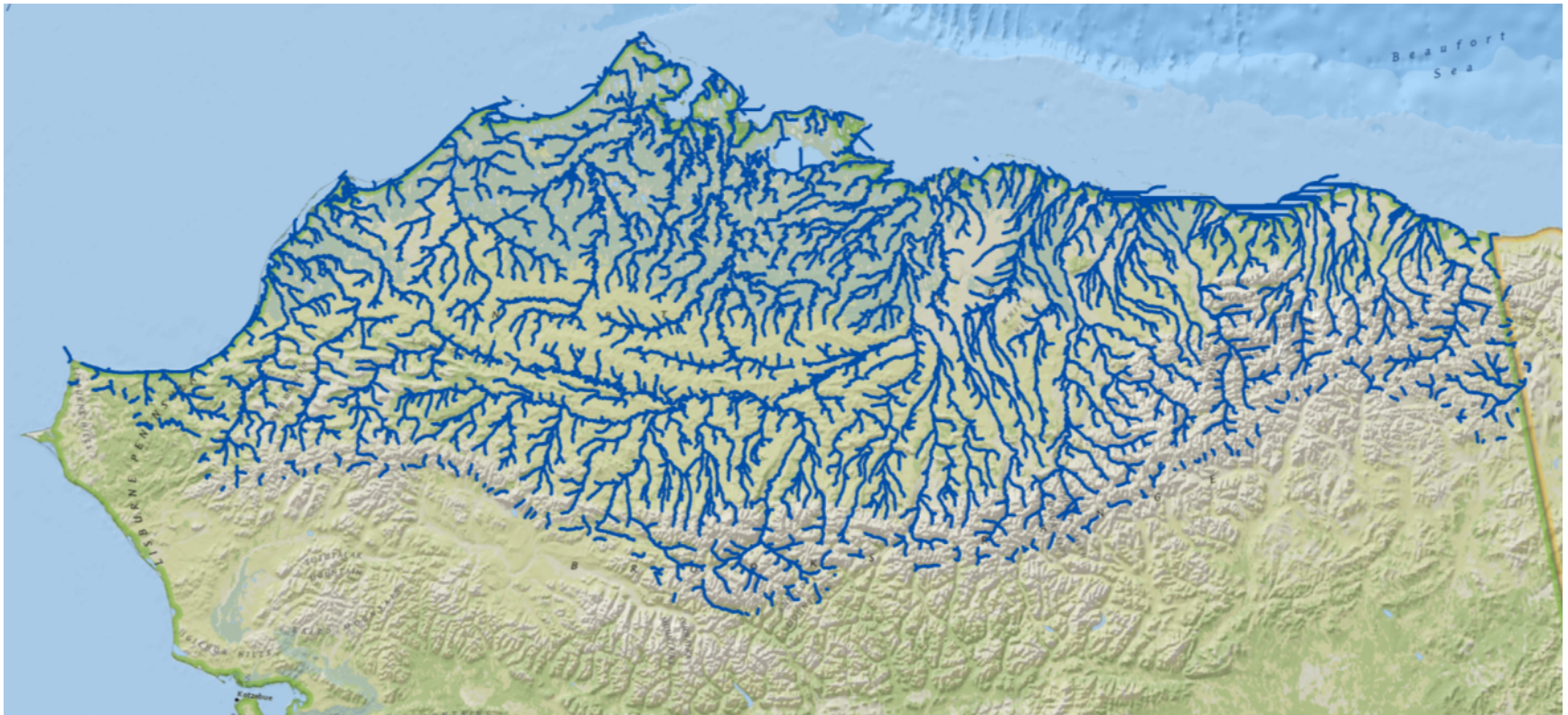
Watershed Earth Observations

Build a National Hydrologic Dataset Plus “knockoff” for North Slope



Watershed Earth Observations

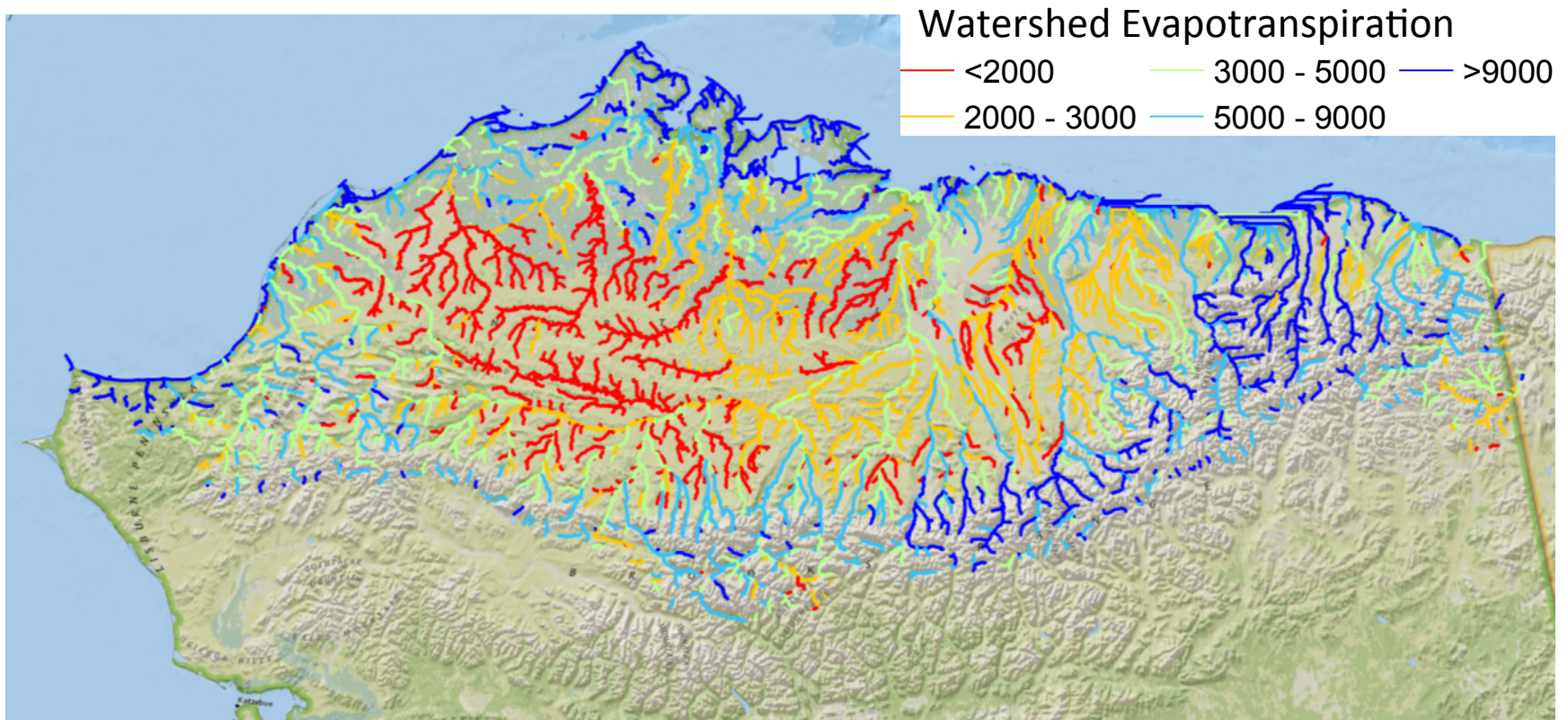
Build a National Hydrologic Dataset Plus “knockoff” for North Slope
4000 river segments with associated watersheds



Watershed Earth Observations

Apply to Earth observation data using StreamCat

Example: MODIS Evapotranspiration



Watershed Earth Observations

Static Predictors

**Percent Lakes
Unfrozen (SAR)**

Drainage Area

Stream Slope

Soil Characteristics

**Vegetation Type
(Landsat)**

Thermokarst Activity

Dynamic Predictors

Active Layer Thickness (SAR)

Evapotranspiration (MODIS)

**Land Surface Temperature
(MODIS)**

EVI/NDVI/LAI/GPP (MODIS)

Fire Activity (MODIS)

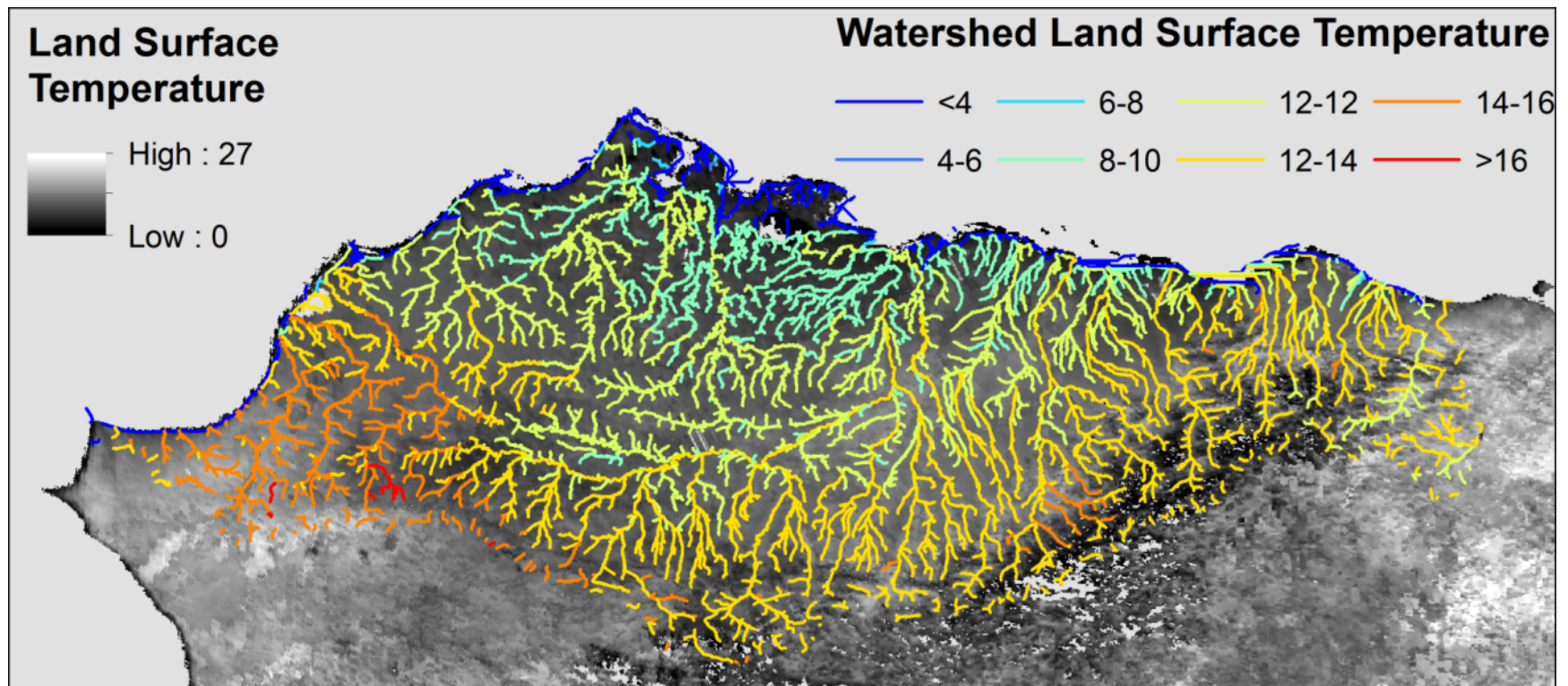
Oil & Gas Development

Snow cover (MODIS)

Watershed Earth Observations

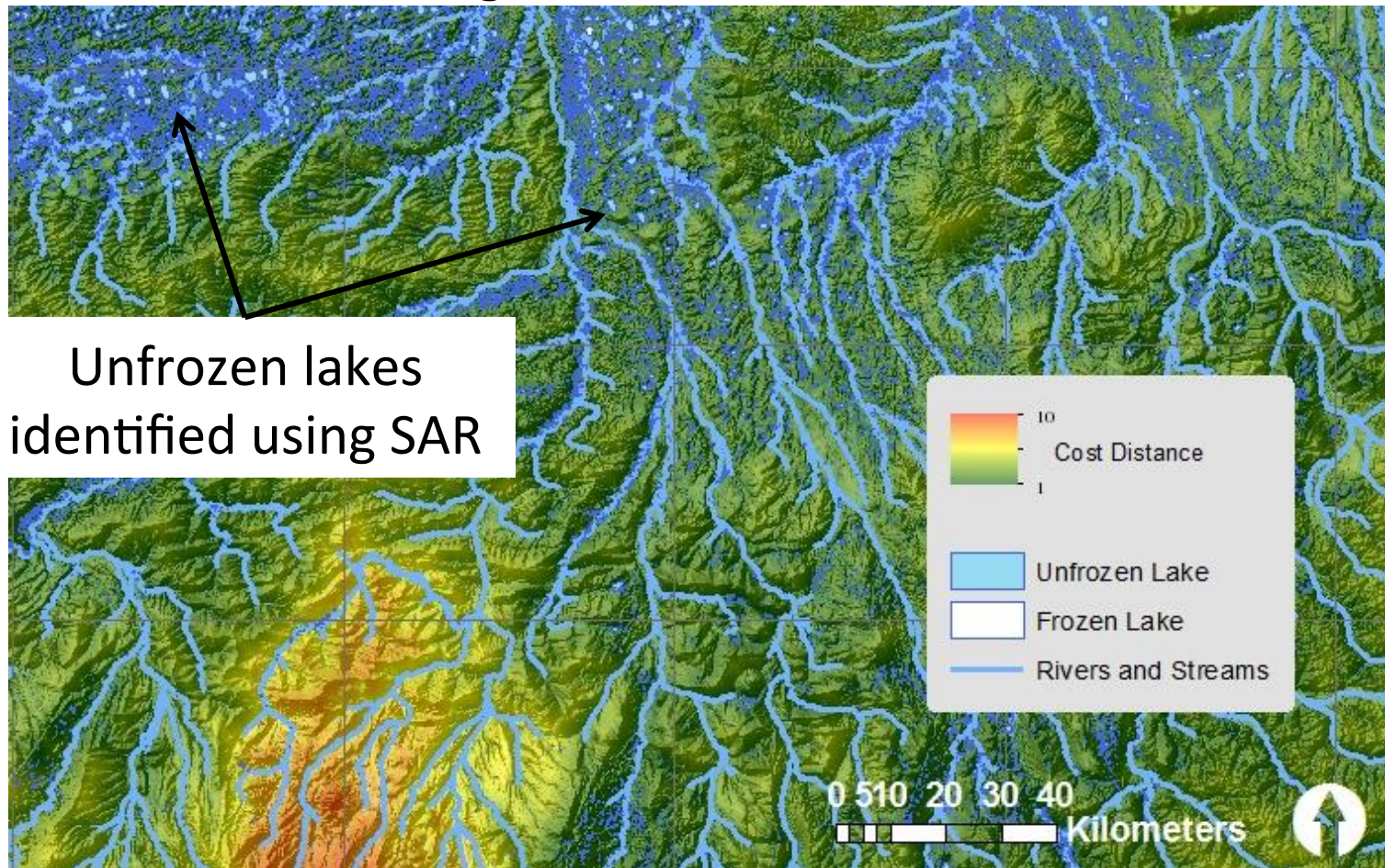
Apply to temporal Earth observation data using StreamCat

Example: MODIS Land Surface Temperature



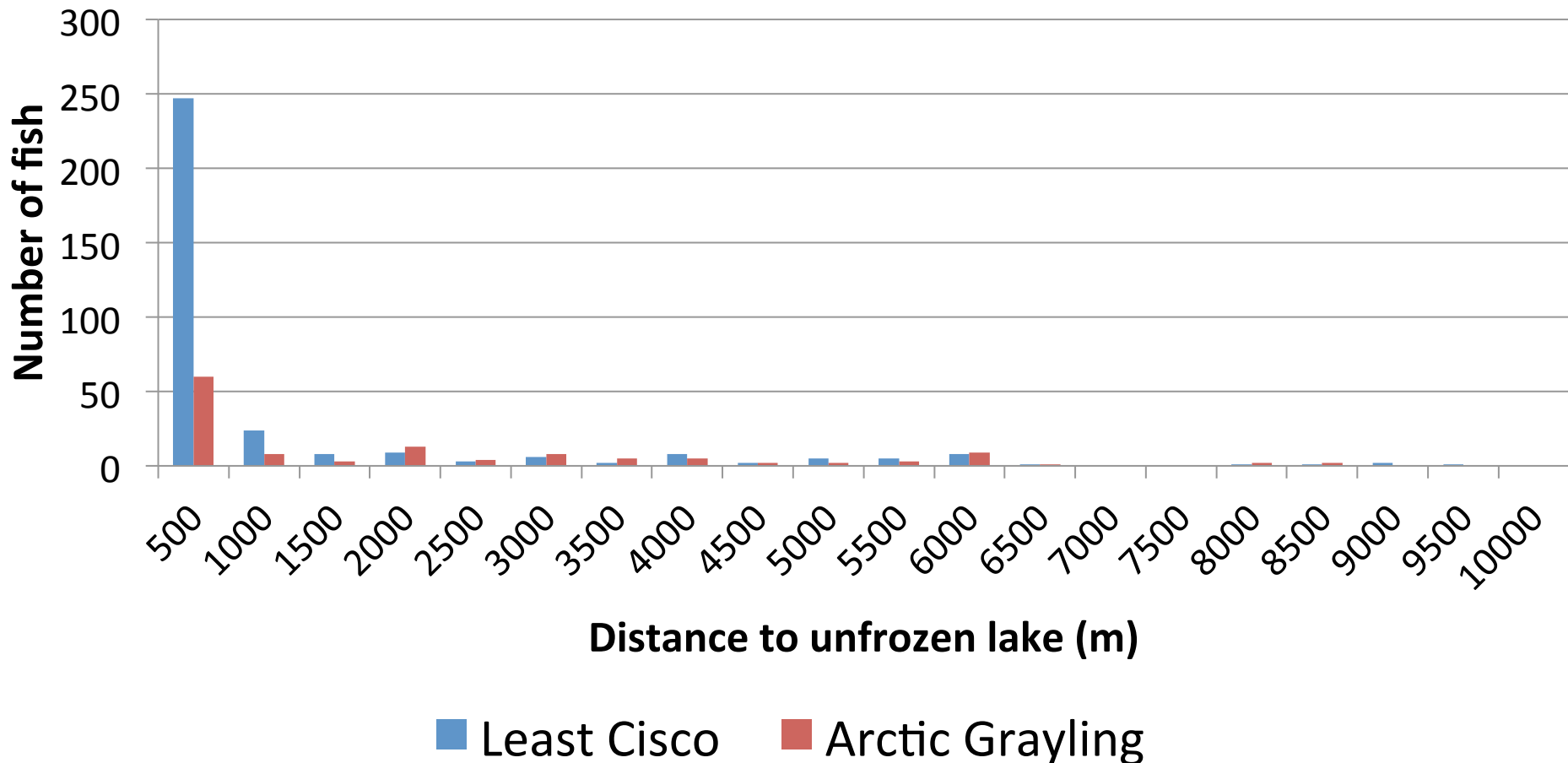
Watershed Earth Observations

Characterize the connectivity of rivers to lakes that remain partly unfrozen in winter using cost-distance rasters



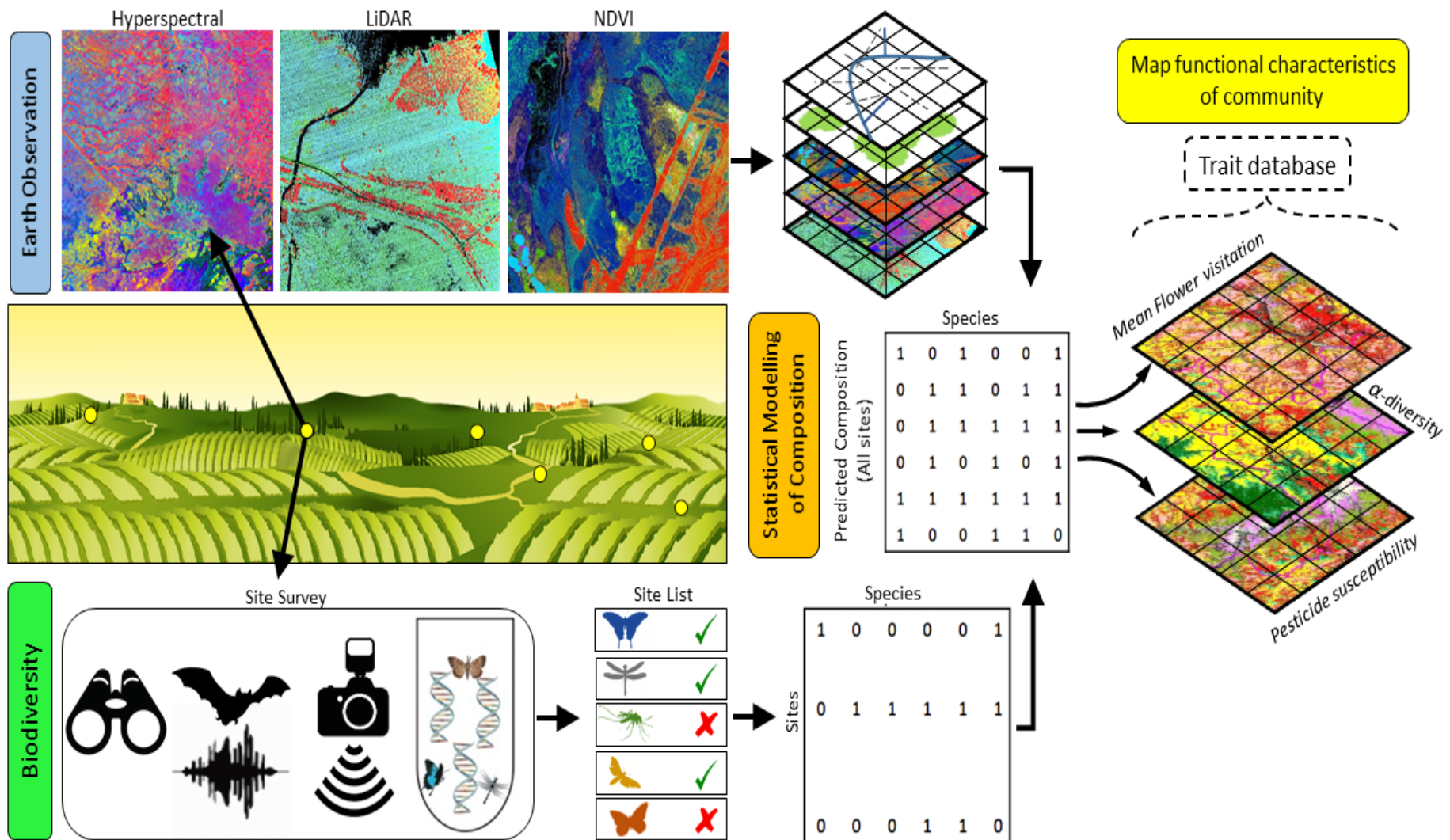
Watershed Earth Observations

Characterize the connectivity of rivers to lakes that remain partly unfrozen in winter using cost-distance rasters



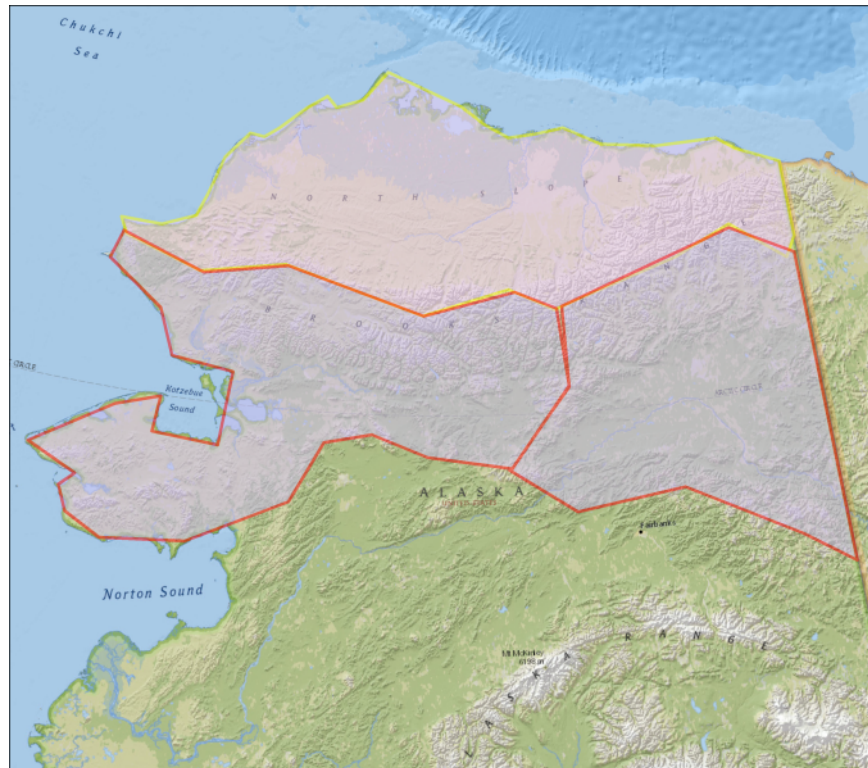
Connecting Earth Observation to Biodiversity and Ecosystems,

Bush et al., *in press*, Nature Ecology & Evolution



Next Steps

1. Complete species distribution models
2. Develop & test user interface
3. Expand to other parts of Alaska



Questions