NFHP 2015 National Fish Habitat Assessment

Results of the National and Regional Estuary Assessments

NOAA FISHERIES

Science & Technology

Kristan Blackhart

ECS Federal *in support of* NOAA Fisheries

Outline

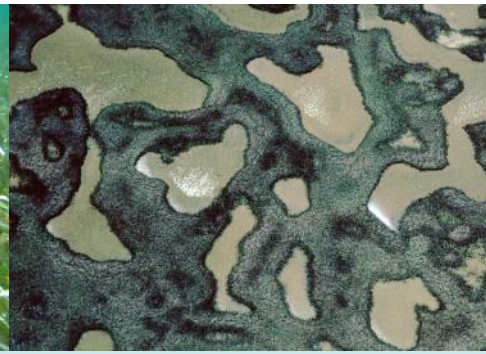
1. Background
2. National Estuary Assessment
   a) Methods
   b) Summary of Results
3. Regional Estuary Assessment – Gulf of Mexico
   a) Methods
   b) Summary of Results
4. Applying Estuary Assessments to Conservation and Management
5. Looking to 2020 – How Do We Move Forward?

Background

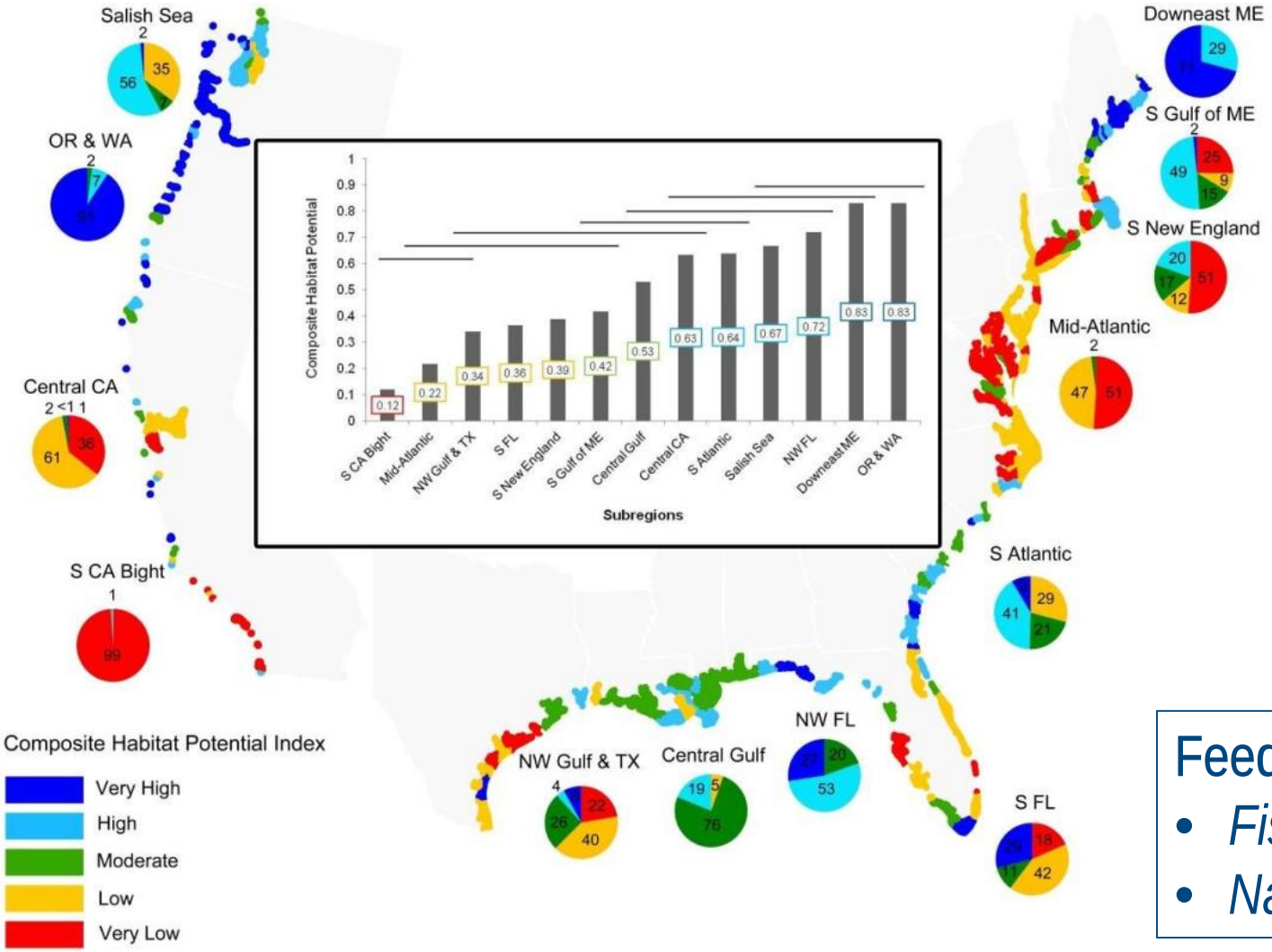
Goals of the National Coastal Assessment

- Provide national perspectives on fish habitat condition
- Build on previous efforts
- Complement and support regional assessment efforts



Review: 2010 National Estuary Assessment



Feedback

- *Fish response*
- *Natural variation*

Focus for 2015 Assessment

1. Improve analytical basis for assessment
2. Improve integration of available data
3. Be more responsive to regional science needs

REGIONAL APPROACH

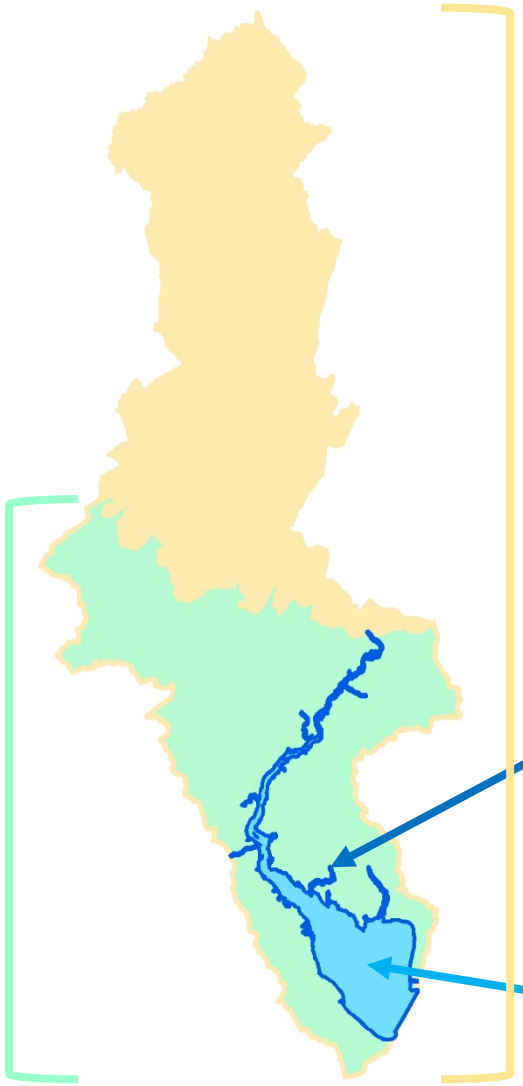
Two Coastal Products for 2015

1. Regional Estuary Assessment
   - *Covers northern Gulf of Mexico*
   - *Uses new & improved analytical methods*
   - *Incorporates available information on fish abundance*
2. National Estuary Assessment
   - *Covers contiguous U.S.*
   - *Updates results from 2010 estuary assessment*
   - *Investigates new data inputs*


National Estuary Assessment

Integrating Data to the Spatial Framework

Example: Delaware Bay



Watershed Basin

Estuarine Drainage Area (EDA)

Shoreline Buffer

Estuary

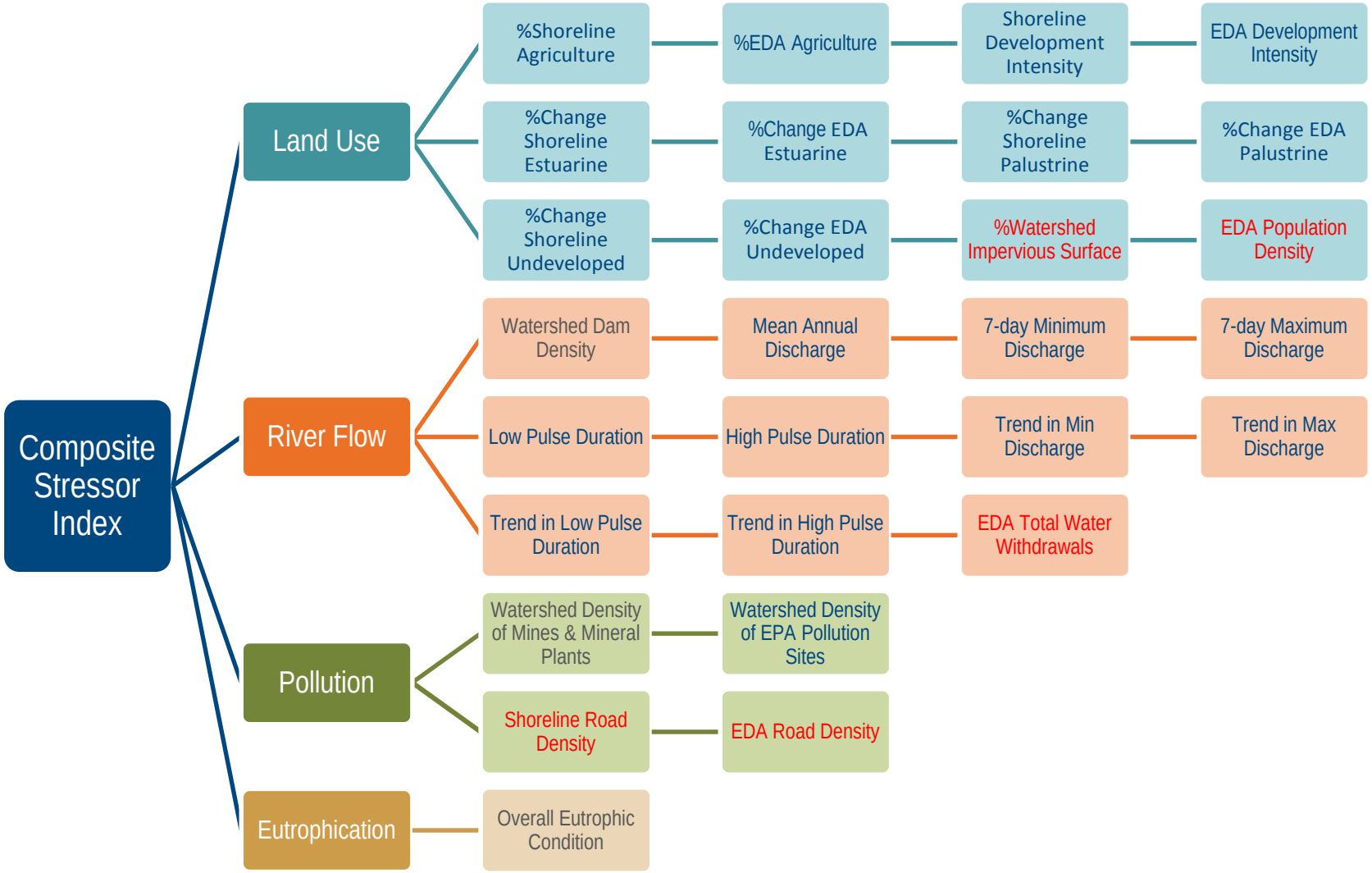
Methods Overview

Stressor Variables

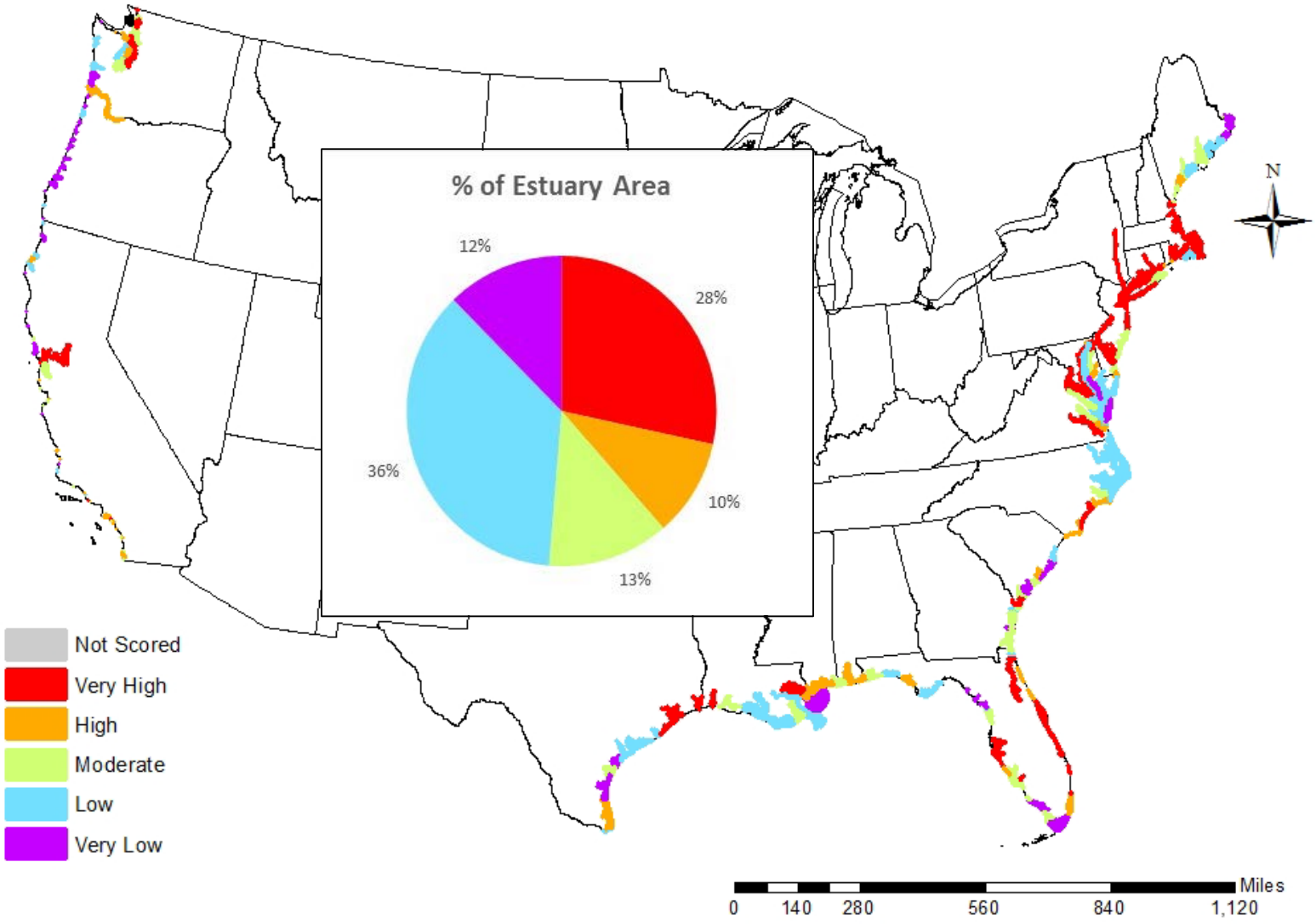
Sub-Indices of Disturbance

Composite Stressor Index

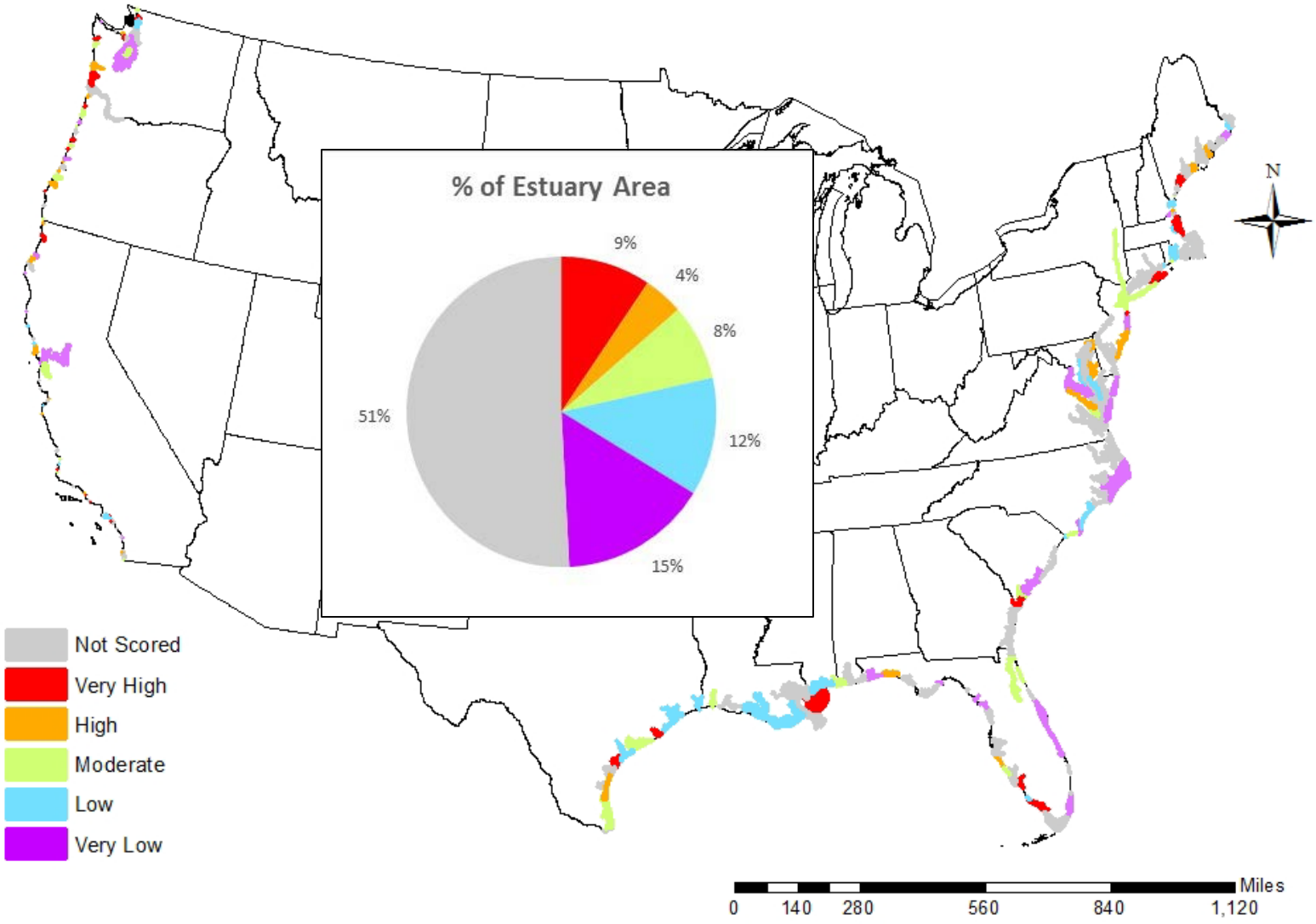
National Estuary Assessment Update



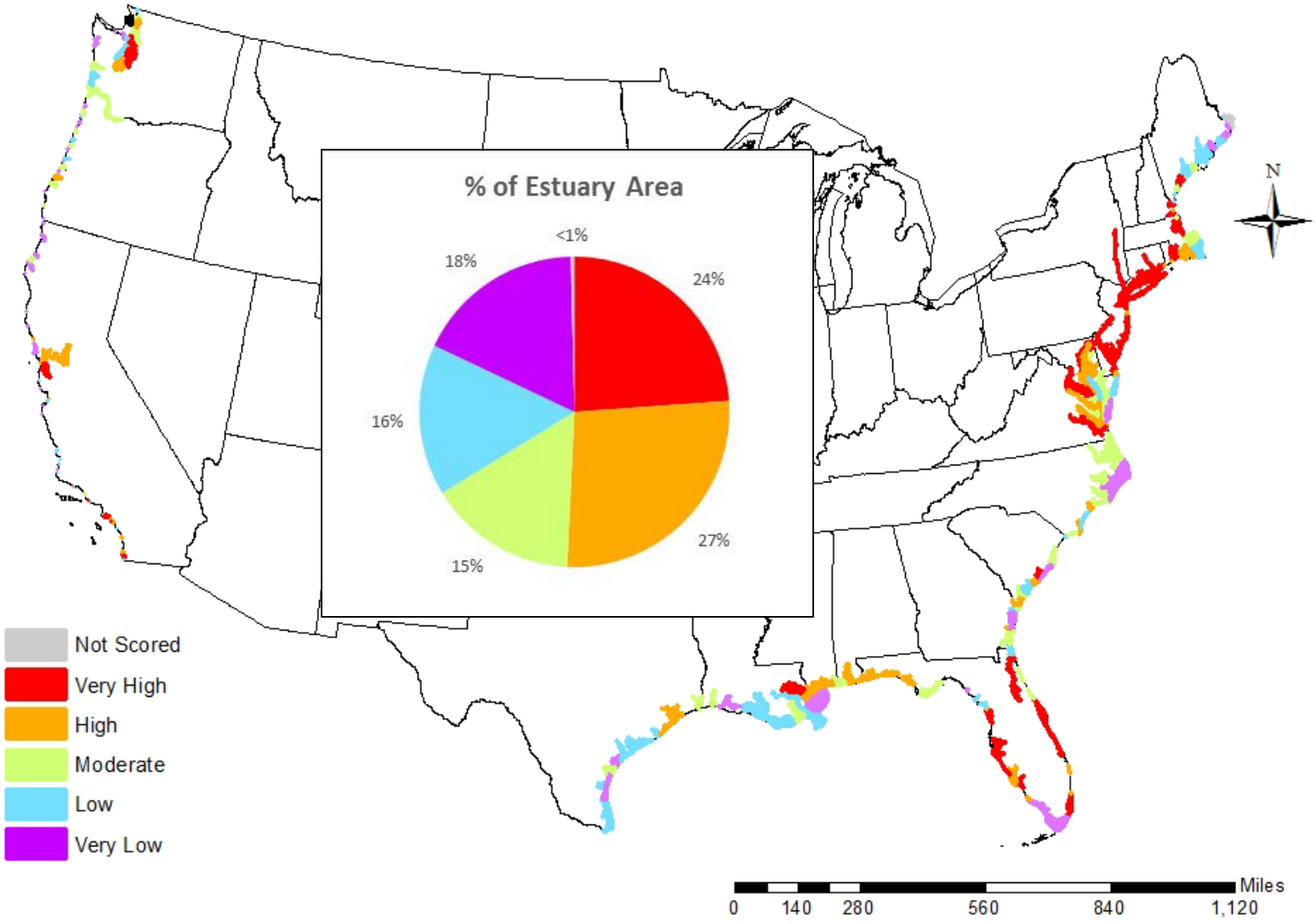
Results: Land Use Sub-Index of Disturbance



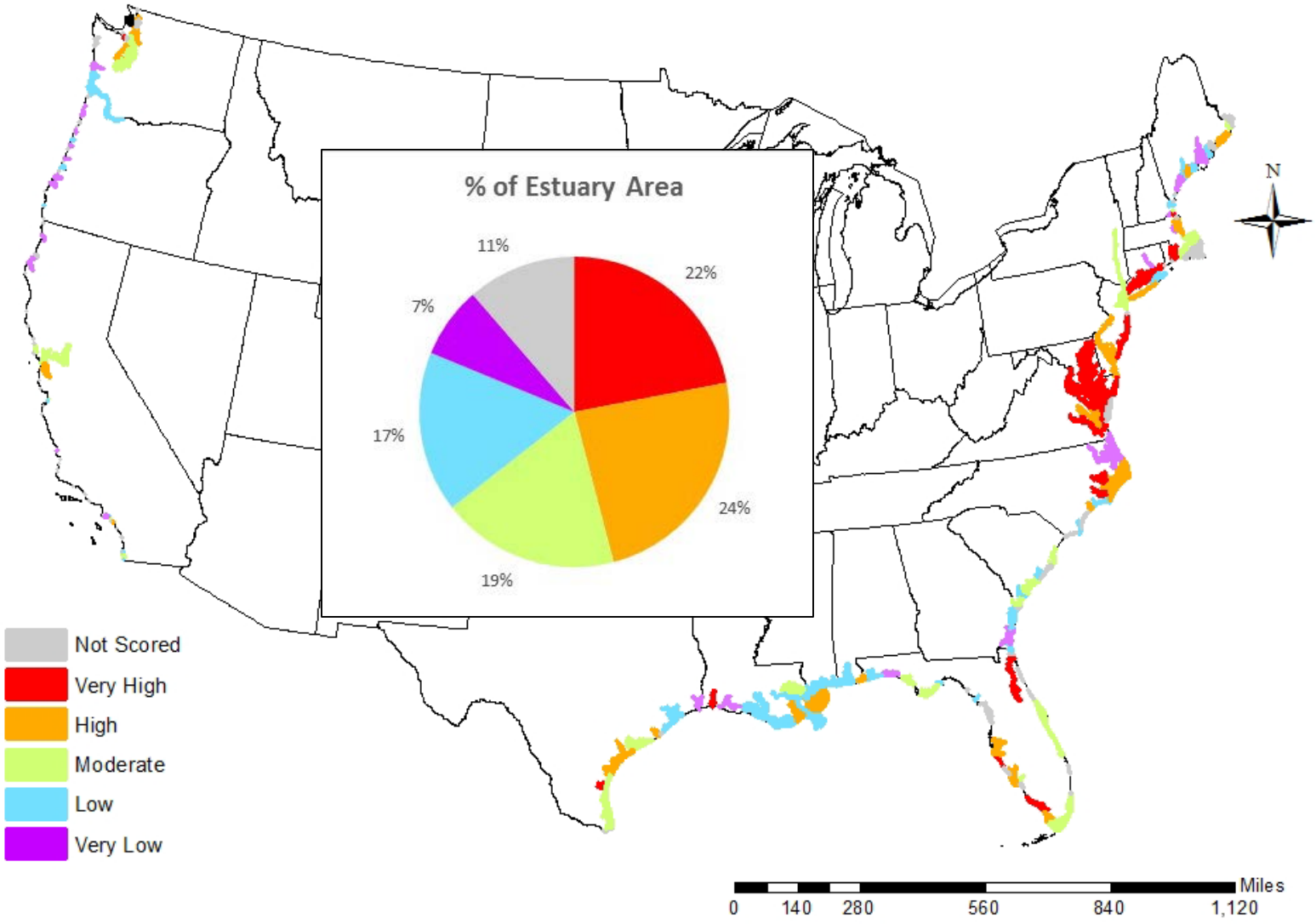
Results: River Flow Sub-Index of Disturbance



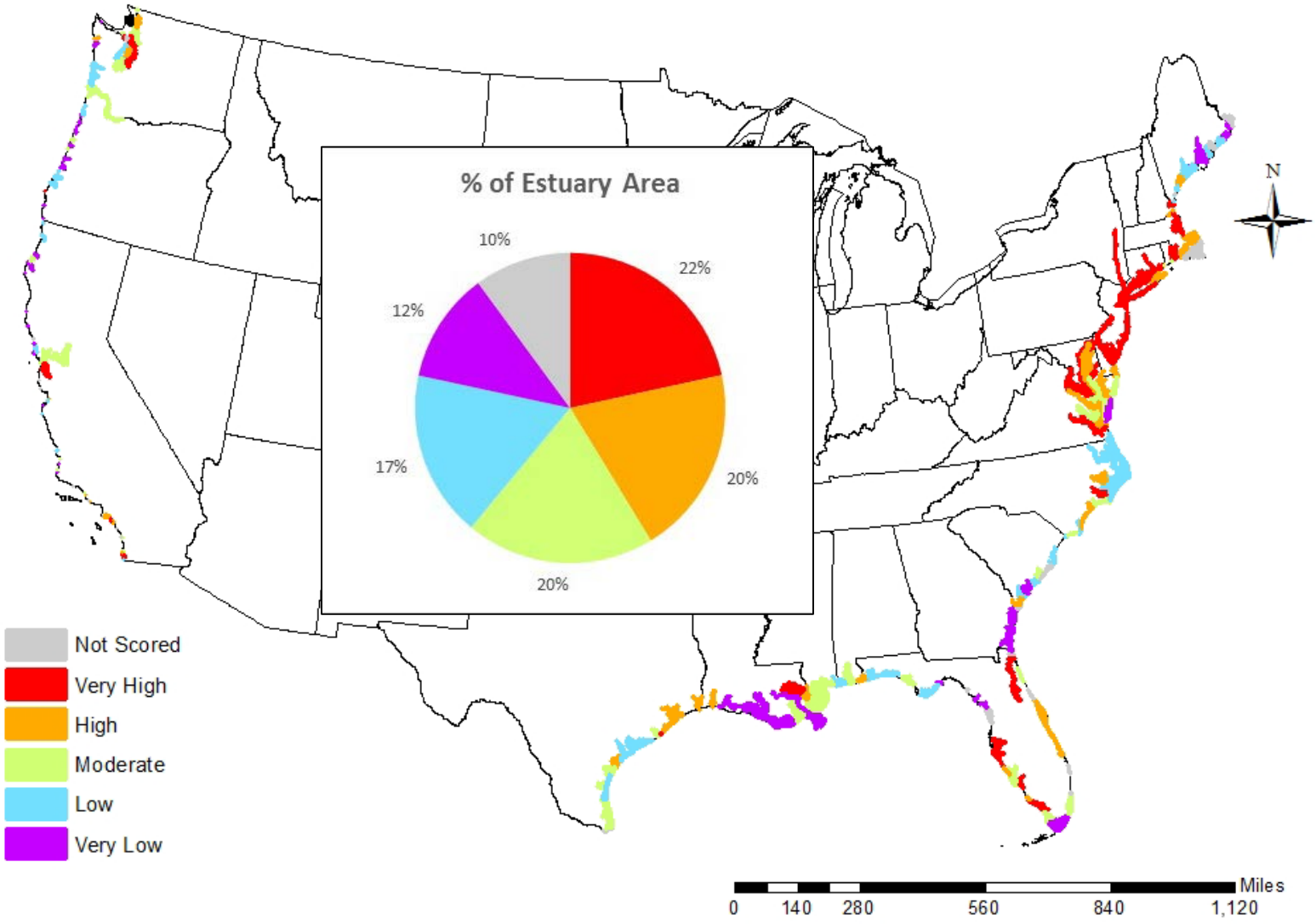
Results: Pollution Sub-Index of Disturbance



Results: Eutrophication Sub-Index of Disturbance

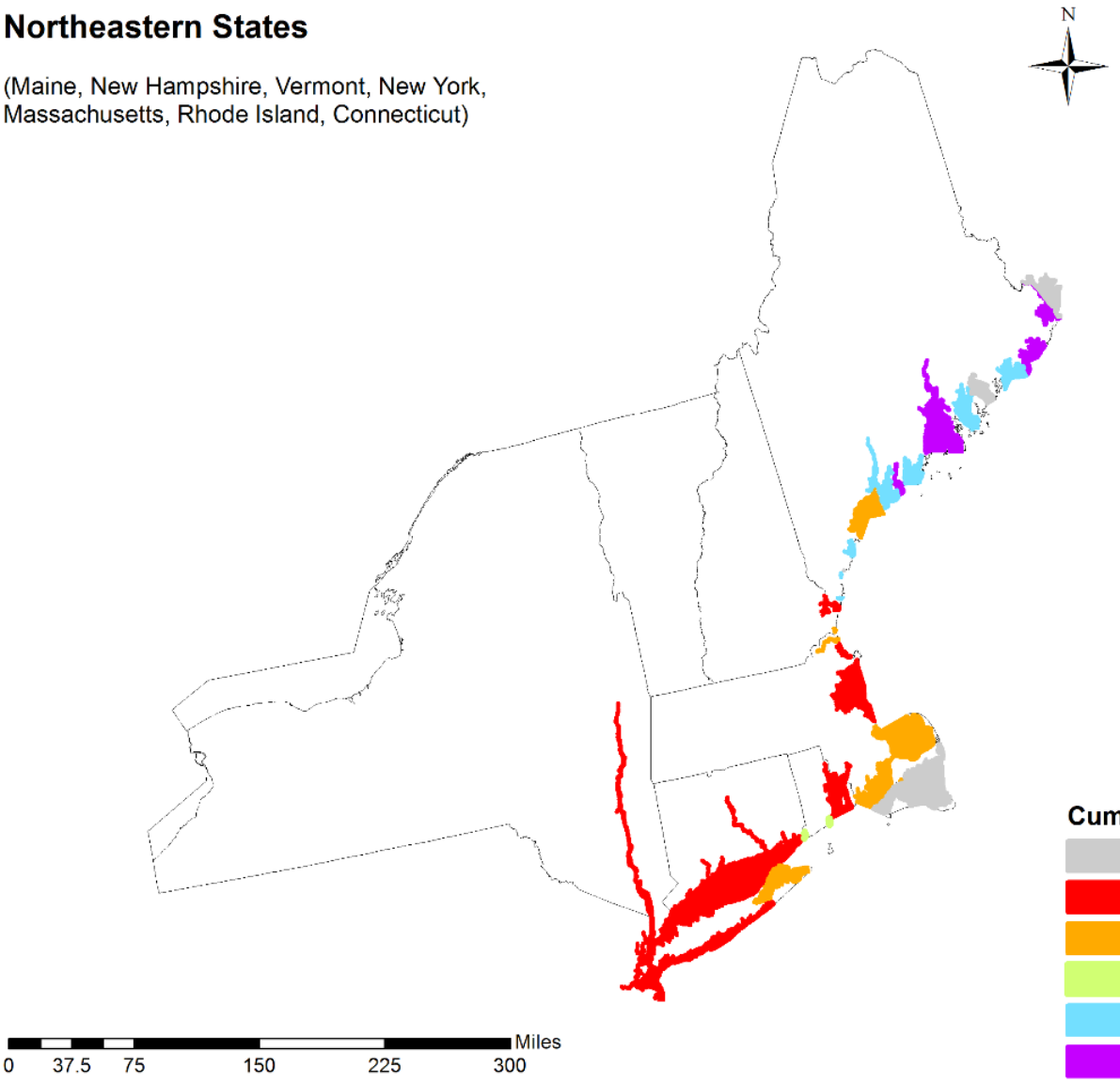


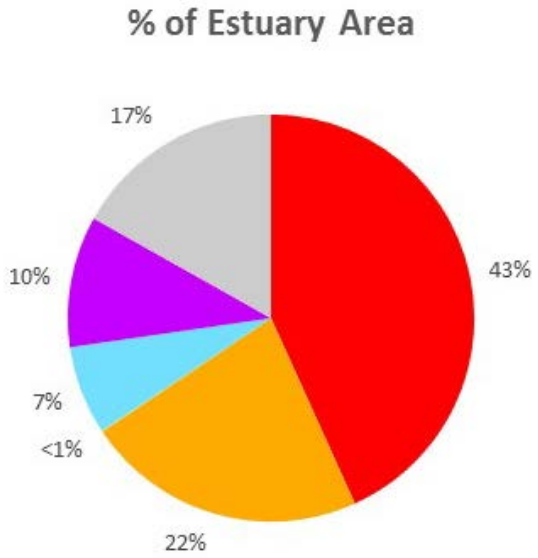
Results: Cumulative Disturbance Index



Northeastern States

(Maine, New Hampshire, Vermont, New York, Massachusetts, Rhode Island, Connecticut)



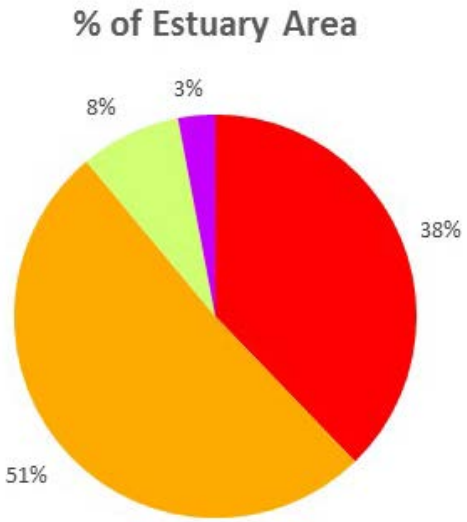


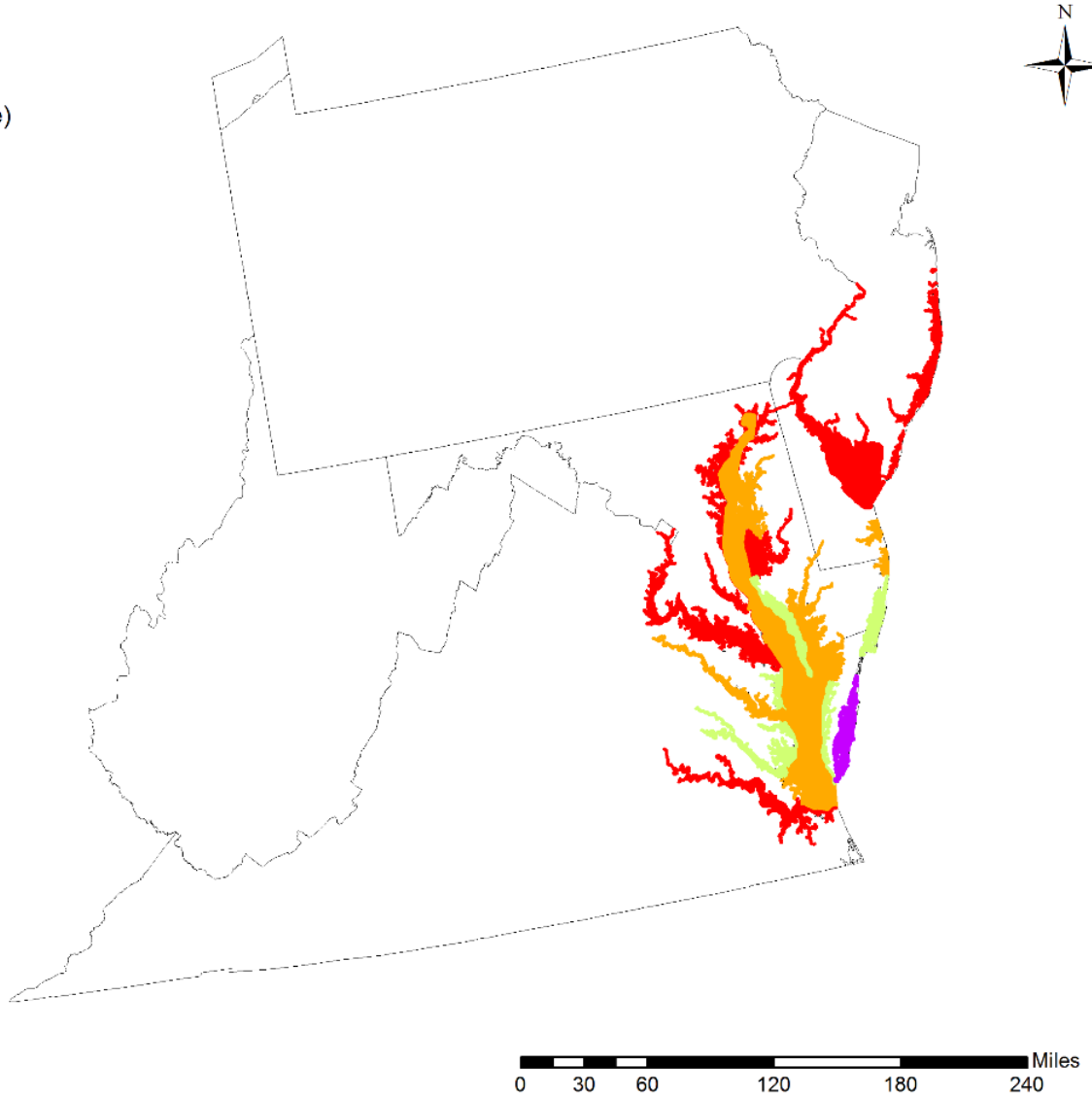
Cumulative Disturbance Index

- Not Scored
- Very High
- High
- Moderate
- Low
- Very Low

Mid-Atlantic States

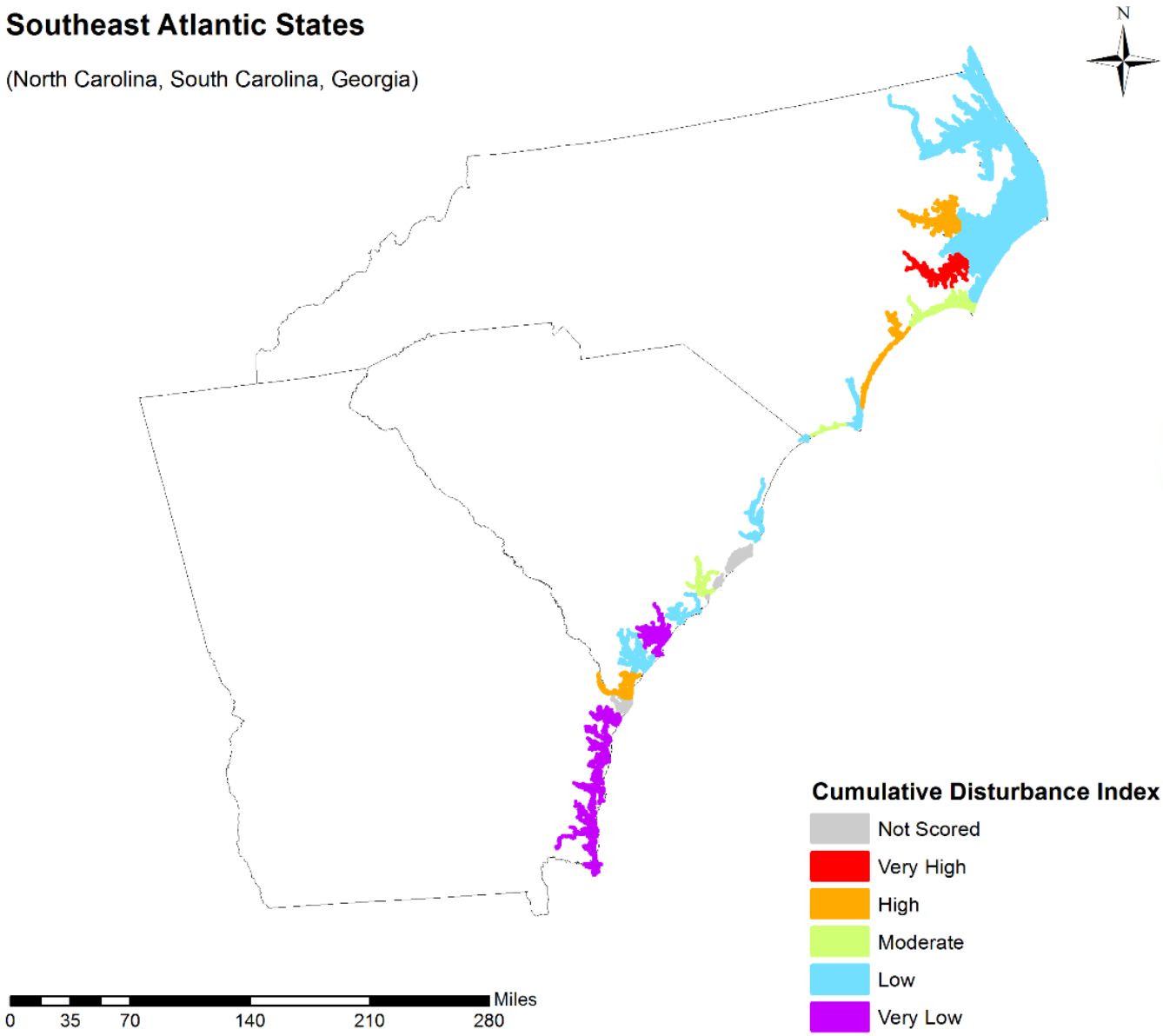
(Pennsylvania, New Jersey, West Virginia, Virginia, Maryland, Delaware)

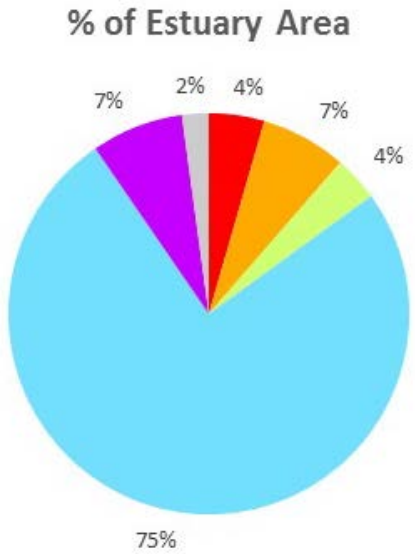




Southeast Atlantic States

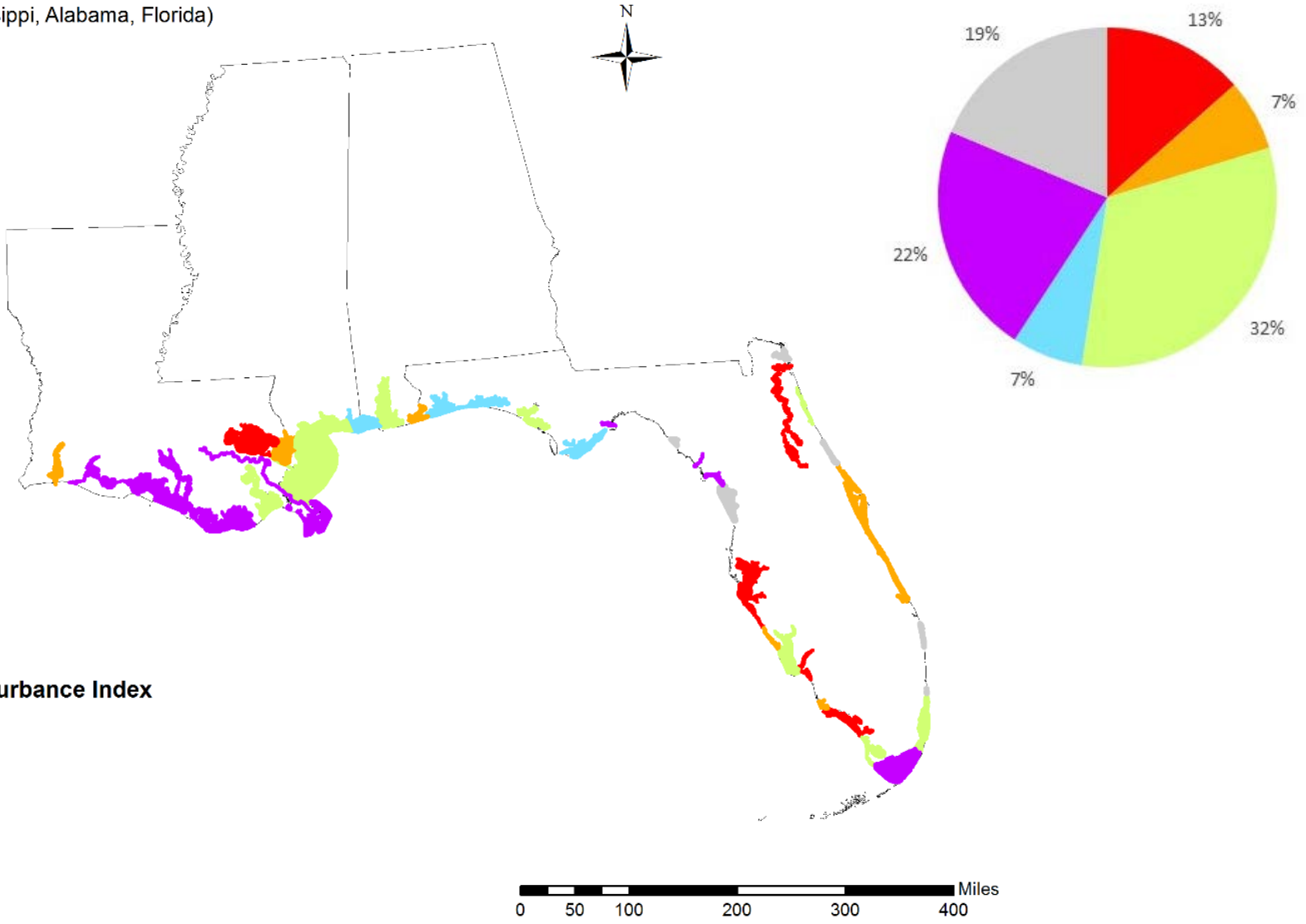
(North Carolina, South Carolina, Georgia)





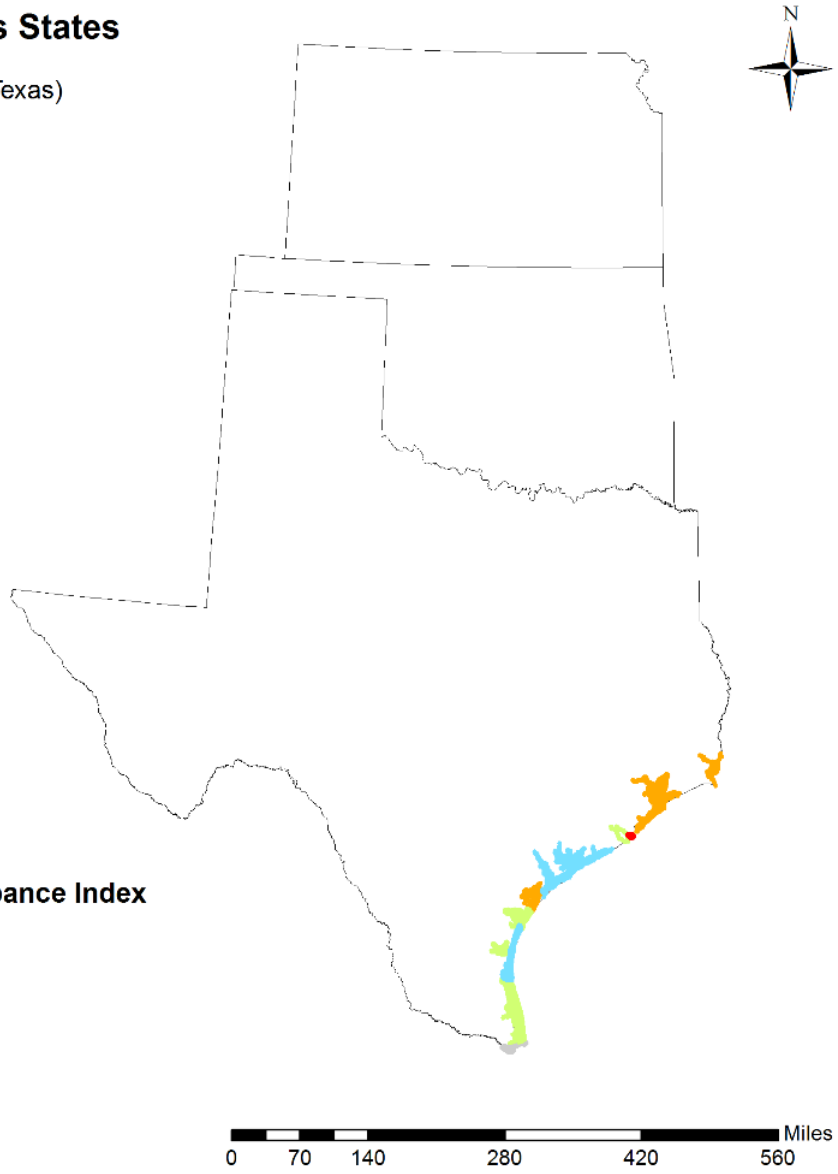
Eastern Gulf of Mexico States

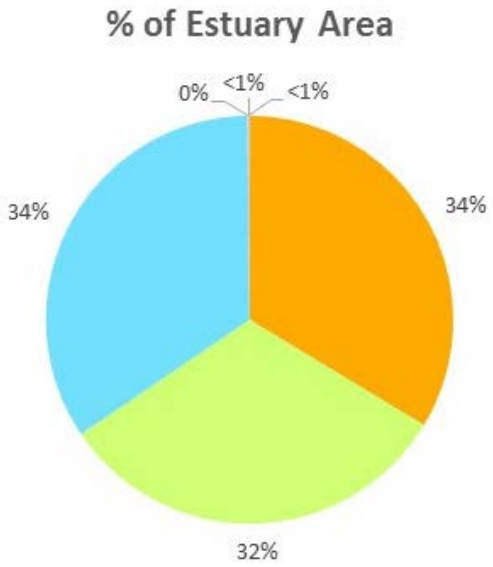
(Louisiana, Mississippi, Alabama, Florida)



Southern Plains States

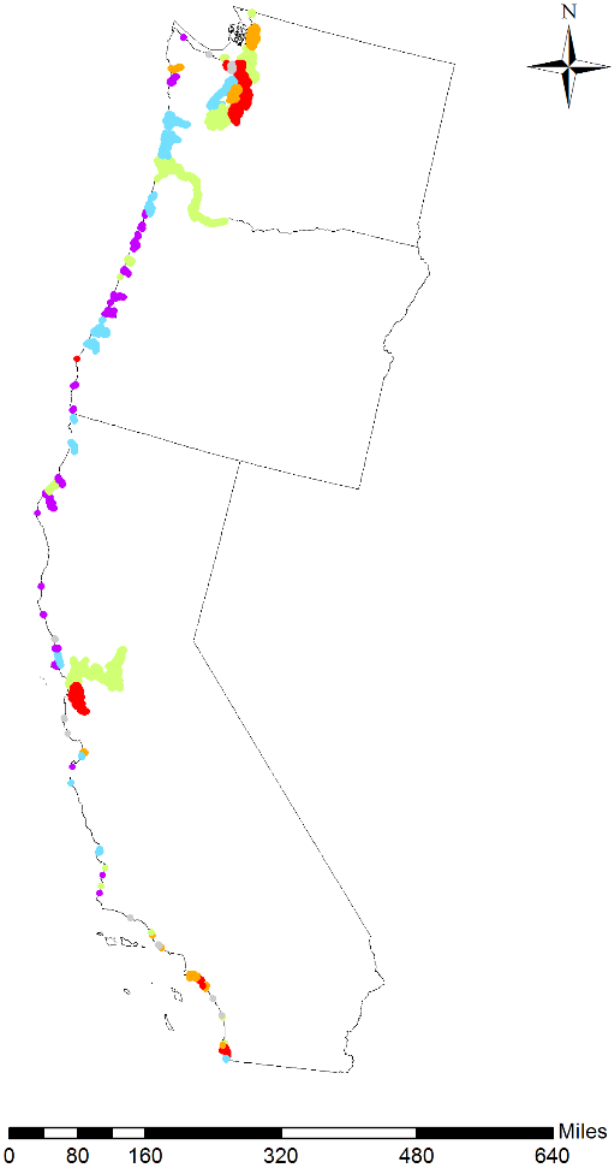
(Kansas, Oklahoma, Texas)





Pacific Coast States

(Washington, Oregon, California)



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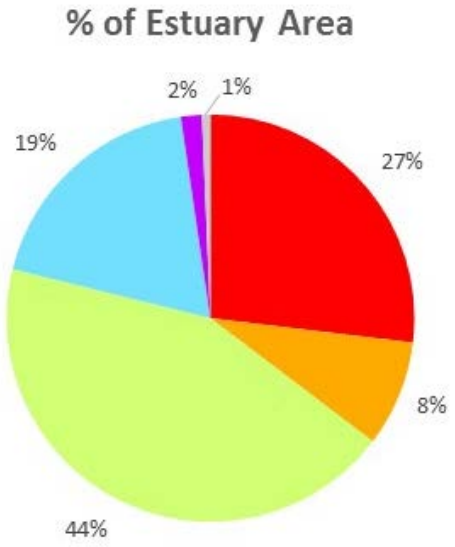


Regional Estuary Assessment
Gulf of Mexico

Gulf of Mexico Regional Estuary Assessment

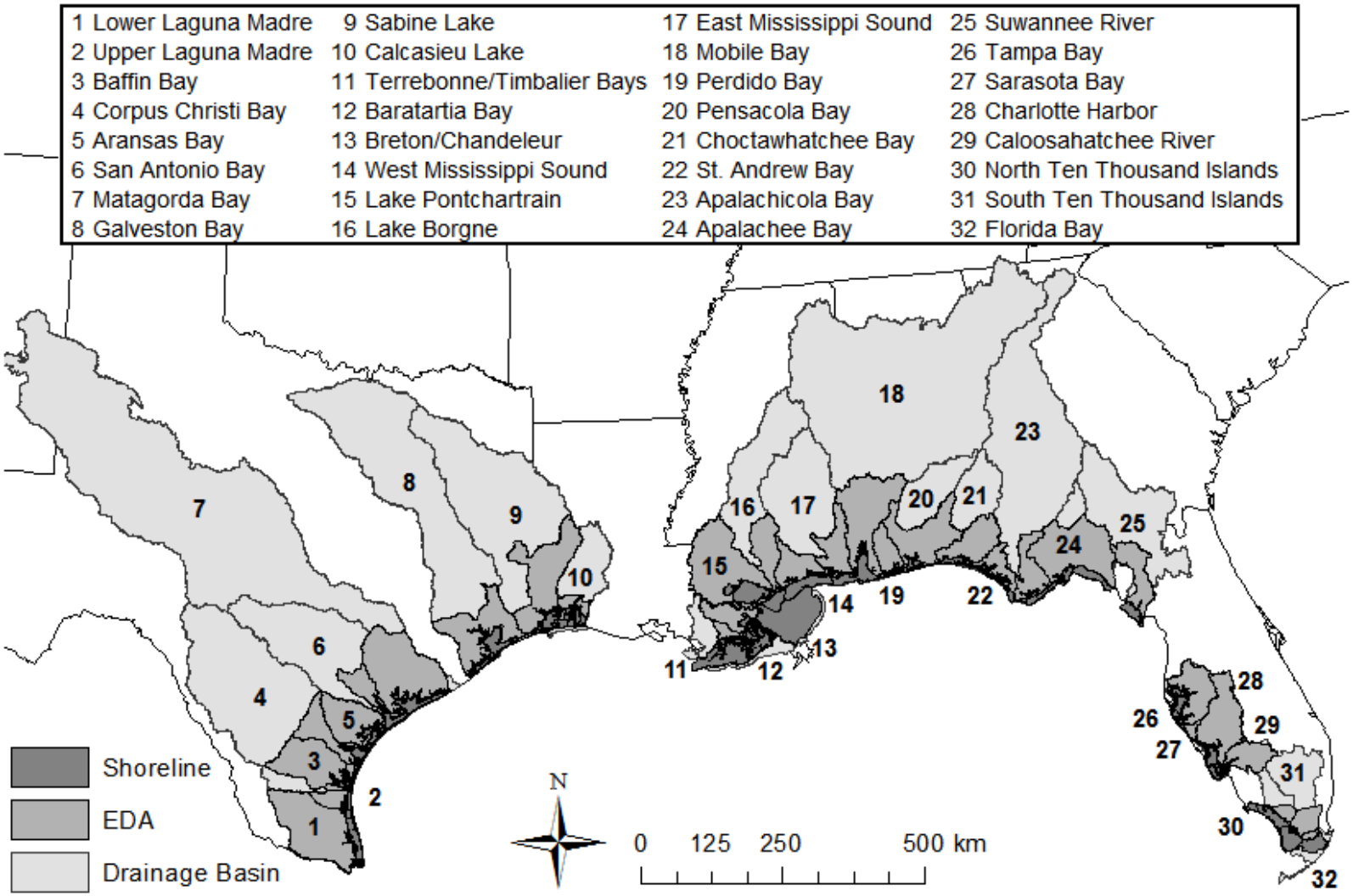
Dr. Dan Obenour,
NC State University

Jonathan Miller,
NC State University

Dr. Peter Esselman,
USGS Great Lakes
Science Center

Dr. Ibrahim
Alameddine,
American University
of Beirut

Study Area


1 Lower Laguna Madre
2 Upper Laguna Madre
3 Baffin Bay
4 Corpus Christi Bay
5 Aransas Bay
6 San Antonio Bay
7 Matagorda Bay
8 Galveston Bay
9 Sabine Lake
10 Calcasieu Lake
11 Terrebonne/Timbalier Bays
12 Baratartia Bay
13 Breton/Chandeleur
14 West Mississippi Sound
15 Lake Pontchartrain
16 Lake Borgne
17 East Mississippi Sound
18 Mobile Bay
19 Perdido Bay
20 Pensacola Bay
21 Choctawhatchee Bay
22 St. Andrew Bay
23 Apalachicola Bay
24 Apalachee Bay
25 Suwannee River
26 Tampa Bay
27 Sarasota Bay
28 Charlotte Harbor
29 Caloosahatchee River
30 North Ten Thousand Islands
31 South Ten Thousand Islands
32 Florida Bay
Shoreline
EDA
Drainage Basin
N
0 125 250 500 km

Summary of Trawl Data

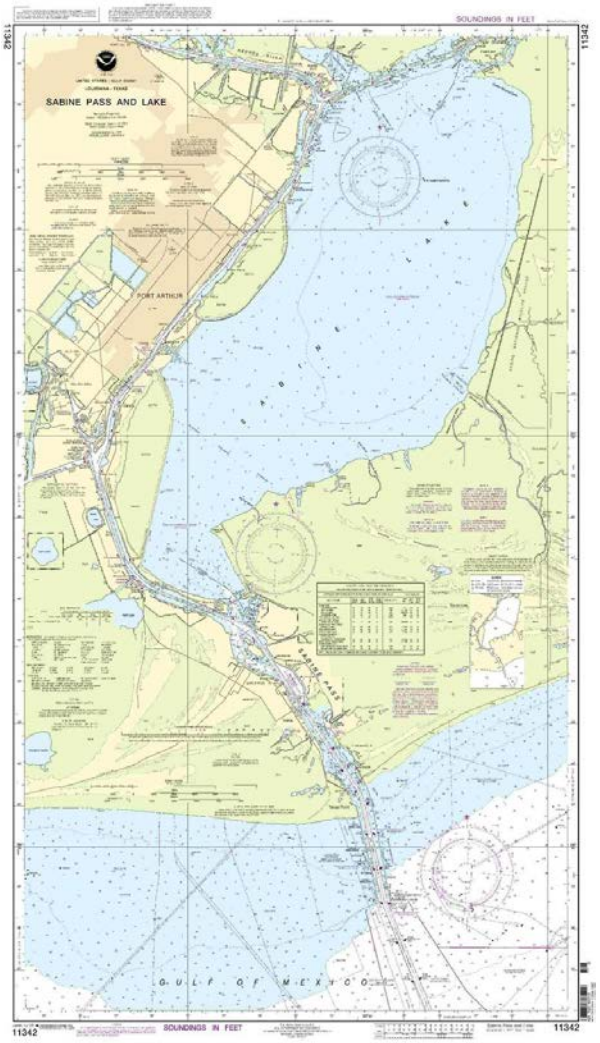
Program	# Trawls	Species Recorded	Mesh Size (mm)	Time Period
Florida	9,580	213	3.2	1991-2005
Alabama	2,620	102	9.5	1991-2006
Mississippi	708	25	6.4	1991-2005
Louisiana	23,579	209	6.4	1991-2007
Texas	33,537	488	38	1991-2009
Environmental Monitoring & Assessment Program	426	157	25	1991-1994
National Coastal Assessment	795	244	38	2000-2004

Predictors at Different Scales

Event-Level Predictors/Factors

- Values of natural predictors at the time and location of fish trawls
- Includes temperature (ºC), salinity (psu), and distance to shore (km)

Predictors at Different Scales



Estuary-Level Predictors/Stressors

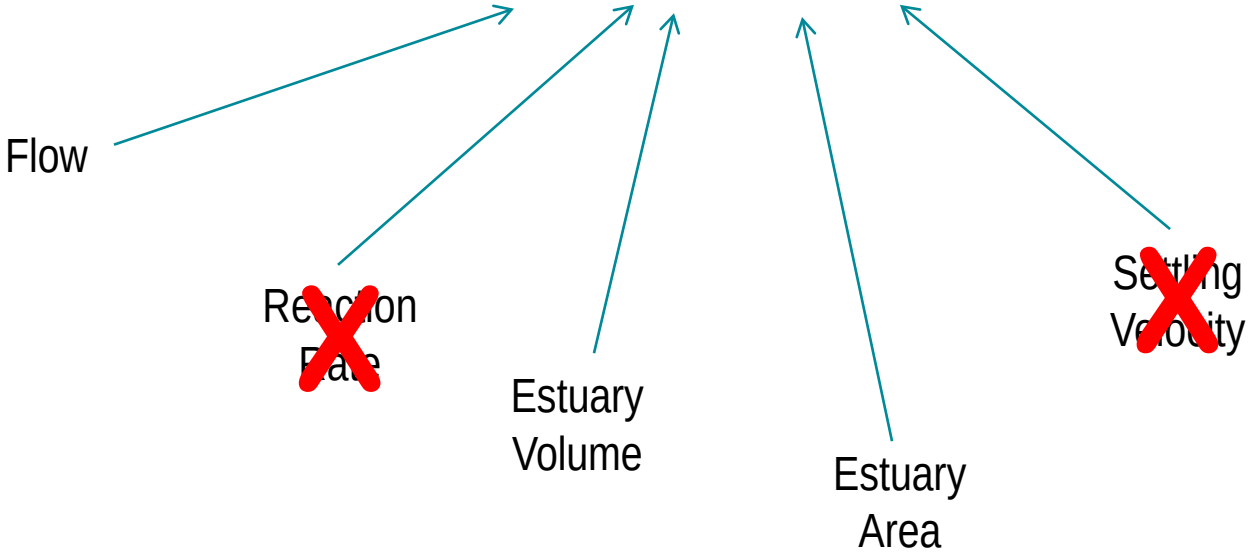
- Mostly anthropogenic: Land cover, toxic releases, nutrient loads
- Also estuary physical features (volume, area, %openess, exchange, freshwater inflow)
- Constant values for study period (year 2000)

Estuary-Level Land Use Aggregations

- "Hard" = Urban + Bare
  - High runoff events/pollutant loads
- "Agriculture" = Crop + Pasture
  - Elevated nutrient loads
- "Developed" = Hard + Agriculture
  - Human-impacted areas

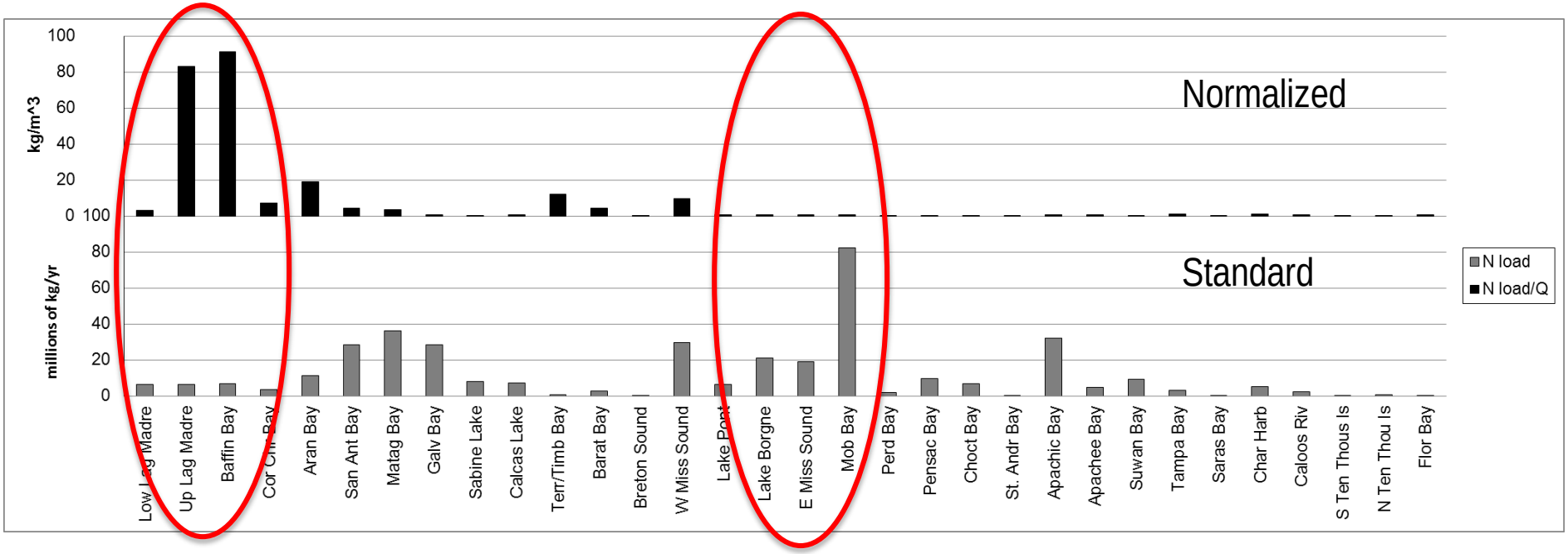
Normalizing Water Quality Predictors

$$concentration = \frac{Loading}{Q + kV + A_E v_s}$$



Effect of Normalization

- Example: nitrogen load relative to flow



Estuary-Level Stressors

Normalization Factors

A_E = Estuary Area
Q = Flow
V = Estuary Volume
Q_x = V/Exchange Rate
A_L = Land Area (%Land Use)

Estuary Variables (no normalization)
Estuary Salinity (%)
Estuary Openness (% open to sea)
Hypoxic Condition (categorical, 1-3)
Toxic Algal Condition (categorical, 1-3)
Eutrophic Condition (categorical, 1-3)

Watershed Variables	Unit	$/A_E$	$/Q$	$/V$	$/Q_x$	$/A_L$
Shoreline Urban	km^2	x				x
Shoreline Hard	km^2	x				x
Shoreline Crop	km^2	x				x
Shoreline Agriculture	km^2	x				x
Shoreline Developed	km^2	x				x
Shoreline Wetlands	km^2	x				x
EDA Urban	km^2	x	x	x	x	x
EDA Hard	km^2	x	x	x	x	x
EDA Crop	km^2	x	x	x	x	x
EDA Agriculture	km^2	x	x	x	x	x
EDA Developed	km^2	x	x	x	x	x
Basin Urban	km^2	x	x	x	x	x
Basin Hard	km^2	x	x	x	x	x
Basin Crop	km^2	x	x	x	x	x
Basin Agriculture	km^2	x	x	x	x	x
Basin Developed	km^2	x	x	x	x	x
EDA Toxic Releases	#	x	x	x	x	
EDA NPDES Sites	#	x	x	x	x	
EDA Population	#	x	x	x	x	
Basin Population	#	x	x	x	x	
N Load	kg/d	x	x	x	x	

Summary of Modeling Approach

1. Screen each estuary-level stressor one at a time

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2. Develop **multi-stressor models**, using the most significant stressors identified in the screening step

Summary of Modeling Approach

1. Screen each estuary-level stressor one at a time

2. Develop **multi-stressor models**, using the most significant stressors identified in the screening step

3. Compare actual conditions to **least disturbed condition** to assess anthropogenic impacts

Screening Model Results

Significant Anthropogenic Stressors

- %Basin Developed
- EDA Hard / Exchange Rate
- N Load / Flow
- %Shoreline Agriculture
- EDA Toxic Releases / Estuary Area

Multi-Stressor Fish Models

Example: Silver perch

$$P(y) = \text{logit}^{-1}(-3.66 + 0.02*\text{temperature} + 0.04*\text{salinity} - 0.001*\text{salinity}^2 - 0.06*\text{distance-to-shore} - 0.42*\text{EDA toxic releases}/A_E + \beta_{\text{season}} + \alpha_{\text{estuary}} + \alpha_{\text{state}} + \alpha_{\text{program}})$$

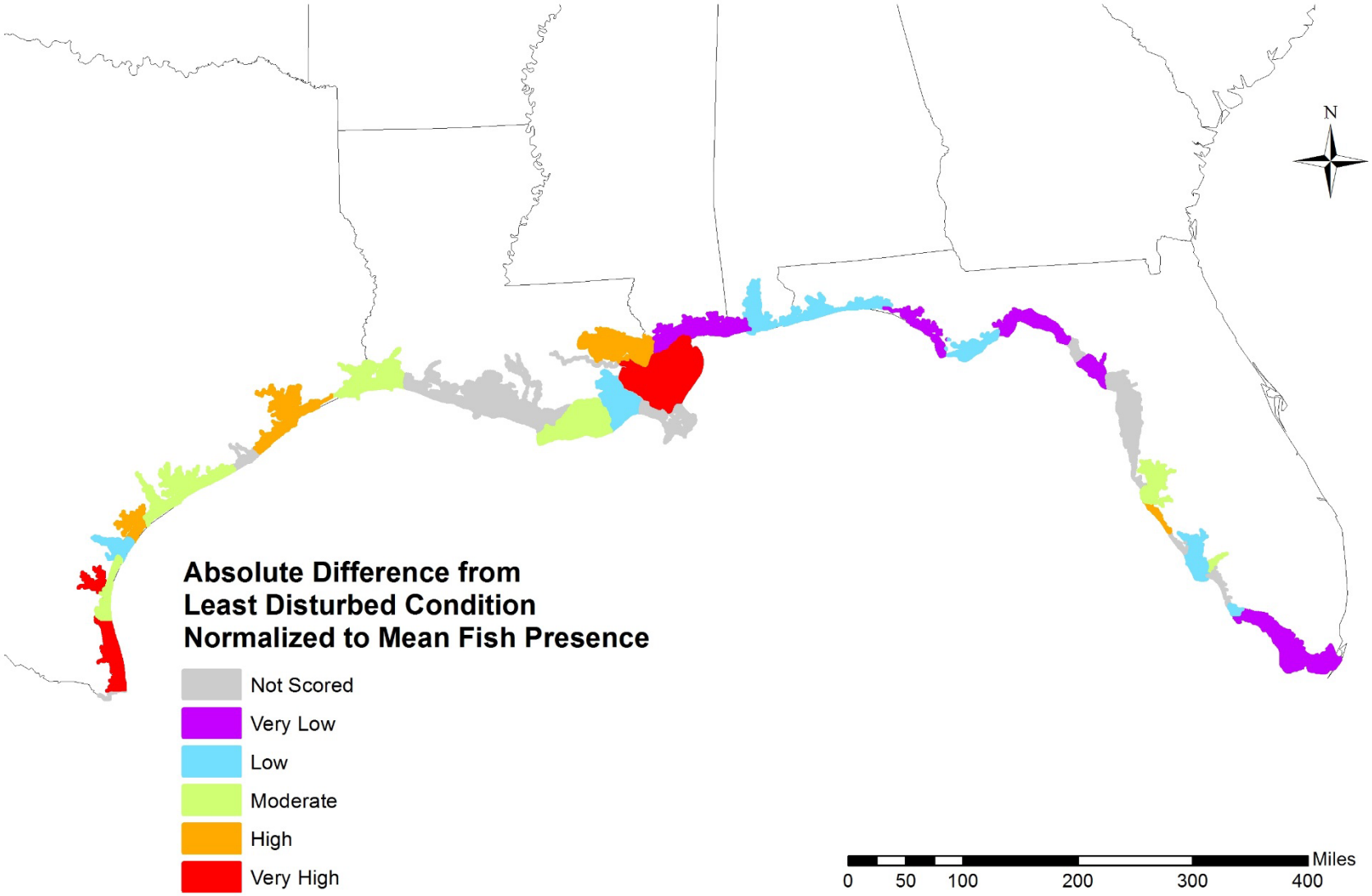
Multi-Stressor Fish Model Results

Stressor	%Species	%Negative
%Basin Developed	33	94
%Shoreline Agriculture	25	17
EDA Toxic Releases/A_E	21	80
EDA Hard/Q_x	21	70
Estuary Salinity	17	38

Least Disturbed Condition

What is the minimum observed value of stressors in the region, accounting for natural variation?

Comparing to Least Disturbed Condition



Applying Estuary Assessments to Conservation and Management

What Do the Assessments Tell Us?

1. **Estuary status** – Which estuaries are most affected by anthropogenic stress?
   - *Estuaries with the worst relative condition could be considered high priority for restoration*
   - *Estuaries in good condition may be targets for conservation*
   - *More detailed, finer-scale assessments of estuaries on both ends of the spectrum will help provide additional information to guide management actions*

What Do the Assessments Tell Us?

2. **Anthropogenic stressors** – What are the key stressors affecting estuary habitats and the species that depend on them?
   - *Estuary conservation measures must extent beyond shorelines and EDAs to be effective*
   - *Different types of development are more significant in terms of estuary habitat impacts*
   - *Scale of some available data is limiting*
   - *Food web impacts difficult to interpret*

What Do the Assessments Tell Us?

3. **Species models** – Can we use indicator species to track stressor response?

   - *Development impacts: Atlantic moonfish, bay whiff, blue catfish, white shrimp, brown shrimp, fringed flounder*
   - *Toxic releases: pink shrimp, crevalle jack, Atlantic stingray, blackcheek tonguefish, silver perch, blue crab*
   - *Some species have consistently positive responses to stressors – potential for use as indicators of poor estuary habitat condition*

What Do the assessments NOT Tell Us?

1. **Causation** – What are the mechanistic responses of populations to anthropogenic stress?
2. **Trends** – Which estuaries are improving or worsening in status?
3. **Stressor effects *within* estuaries** – How are key stressors affecting different habitat types?
4. **Absolute condition** – What is estuary status relative to pre-development reference condition?

Looking to 2020: Priority Data Gaps

How can we build on current model structure to provide more detailed results?

1. Update available data to present
   - *Support time trend analysis*
2. More trawl data from estuaries with few sampling events
   - *Improve model robustness*
3. Improved standardization of fish sampling
   - *Interstate programs important to distinguish random effects in model*
   - *Consistency in recording of physical attributes, species assemblages*
4. More expansive stressor data
   - *Some important stressors with poor coverage or unavailable at necessary scales*
   - *Enable ranking of stressors with no fish sampling*






WELCOME!!!
to the
National Fish Habitat Partnership Board's
"Through a Fish's Eye"
(National Fish Habitat Assessment Report)
Webinar

Gary E. Whelan, Peter Ruhl and Ryan Roberts
NFHP Board Staff
January 2016

NATIONAL FISH HABITAT PARTNERSHIP






Webinar Agenda

- Webinar Introduction – Gary Whelan and Ryan Roberts
- National Inland Fish Habitat Assessment – Dana Infante and Wes Daniel (Michigan State University – Board Inland Assessment Leaders)
  - Science background
  - Methods
  - Results
  - Examples of how to use the report information
- National Fish Habitat Assessment Report – Daniel Wieferich (USGS – NFHP SDC Member – Online Report Lead)
  - Tutorial on how to use the report
- Question and Answer Session

NATIONAL FISH HABITAT PARTNERSHIP

Webinar Rules

- PLEASE mute all phones
- Please use the chat box to enter questions and comments
  - Will be periodic pauses to answer questions
  - Question and answer period at the end of the webinar
  - Questions not answered will be followed up on using email

NATIONAL FISH HABITAT PARTNERSHIP






Mission:

Protect, restore and enhance the nation's fish and aquatic communities through **20 partnerships** that foster fish habitat conservation and improve the quality of life for the American people

- ***Implements voluntary and non-regulatory*** **landscape-scale fisheries conservation using the best science**
- ***Leverages*** **federal and privately raised funds to build regional partnerships**
- ***Partner Coalition*** **of 450+ agencies and organizations**

NATIONAL FISH HABITAT PARTNERSHIP

Why Do It?
National Fish Habitat Board Responsibility

- Develop national conservation goals
- Establish criteria for *Fish Habitat Partnerships*
- Measure and communicate progress
- **Produce *"Status of Fish Habitats in the United States"* report every 5 years**
  - **Partnerships produce finer level assessments**
- Increase public and private focus on aquatic habitat
- Recommend the best use of funds
- Advocate policy
- Guide Board member and staff resources

NATIONAL FISH HABITAT PARTNERSHIP

NATIONAL FISH HABITAT PARTNERSHIP

http://assessment.fishhabitat.org/

THROUGH A FISH'S EYE:
THE STATUS OF THE FISH HABITATS IN THE UNITED STATES
2015

This report summarizes the results of an unprecedented nationwide assessment of human effects on fish habitat in the rivers and estuaries of the United States. The assessment assigns a risk of current habitat degradation scores for watersheds and estuaries across the nation and within 14 sub-regions. The results also identify some of the major sources of habitat degradation.

Navigate this report by:

Report Content ▾ Region of Interest ▾

2015 National Fish Habitat Assessment Webinar

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NATIONAL FISH HABITAT PARTNERSHIP

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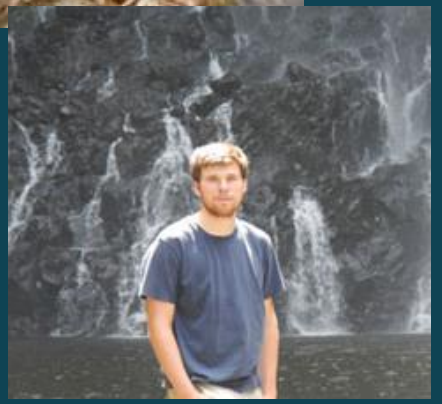
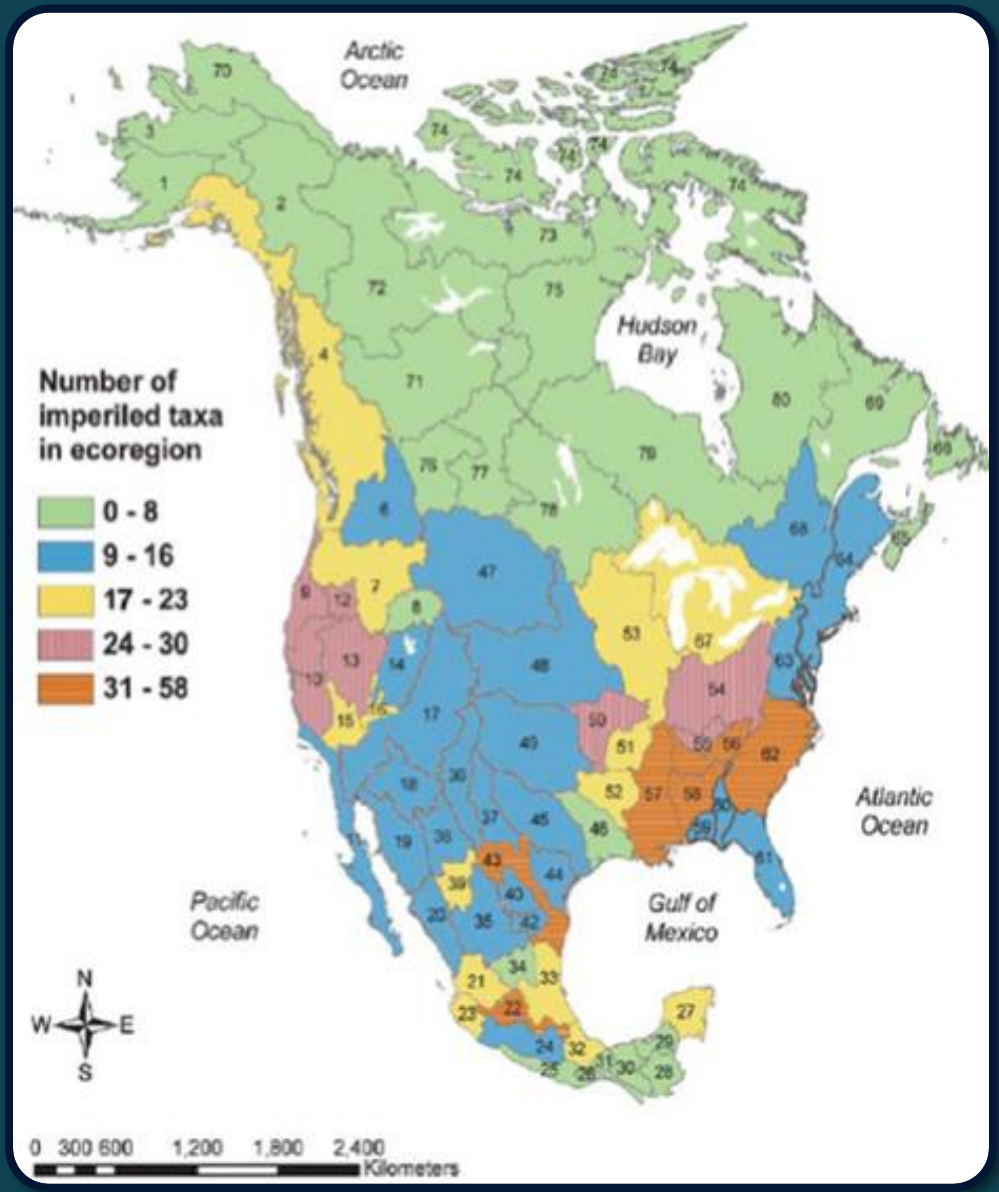


For today

- Context for inland fish habitat assessment: the landscape approach
- Inland assessment objectives and tenets guiding assessment
- *Questions*
- Methods
  - Conterminous US
  - Hawaii
  - Alaska
- *Questions*
- Assessment results
  - National-scale results
  - FHPs
  - State agencies
- *Questions*
- How to acquire and use results
- *Questions*

JELKS ET AL. 2008. FISHERIES
CONSERVATION STATUS OF IMPERILED NORTH AMERICAN FRESHWATER AND DIADROMOUS FISHES

- Of 364 fish taxa imperiled (vulnerable, threatened, endangered) in 1989 compared to 2008…
  - 56% in same condition as 1989
  - 33% in worse condition…



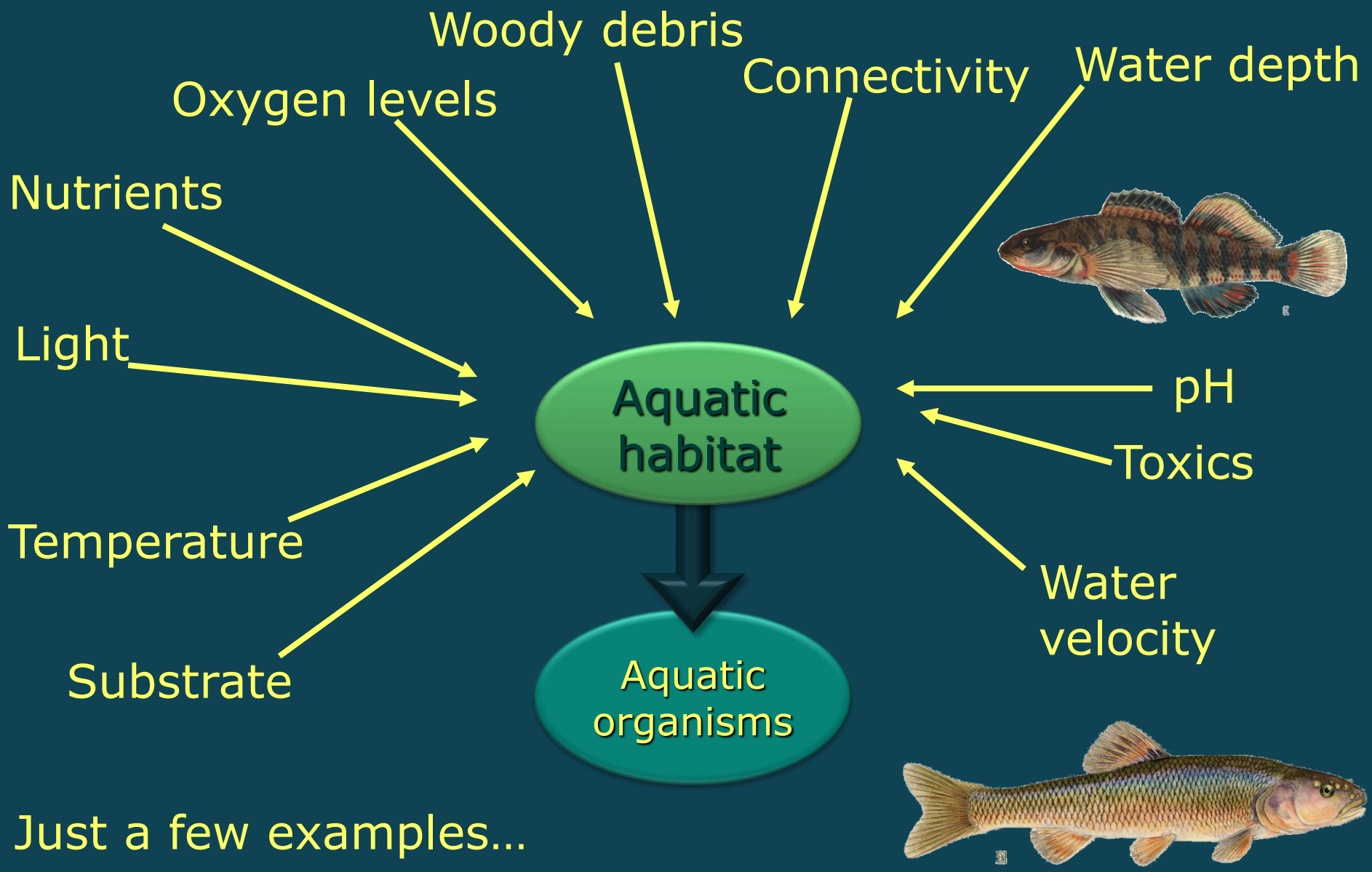
DEGRADED HABITAT IS A MAJOR THREAT TO FRESHWATER BIODIVERSITY

- Habitat degradation was leading cause of imperilment for 92% of taxa

- Degraded habitat has contributed to 71% of freshwater fish extinctions globally (Helfman 2007)

- Other organisms' declines assumed related to habitat
  - In US and Canada, 72% of mussel and 47% of crayfish taxa imperiled (Abell et al. 2000, Taylor et al. 2000)
  - 43% of stoneflies, 36% of amphibians, and 18% of dragon/damselflies imperiled in U.S. (Stein et al. 2000)

HABITAT DIRECTLY INFLUENCES TYPES OF FISHES FOUND IN SYSTEMS



Just a few examples…

LANDSCAPE APPROACH FOR UNDERSTANDING INFLUENCES ON FRESHWATER SYSTEMS (ALLAN 2004)

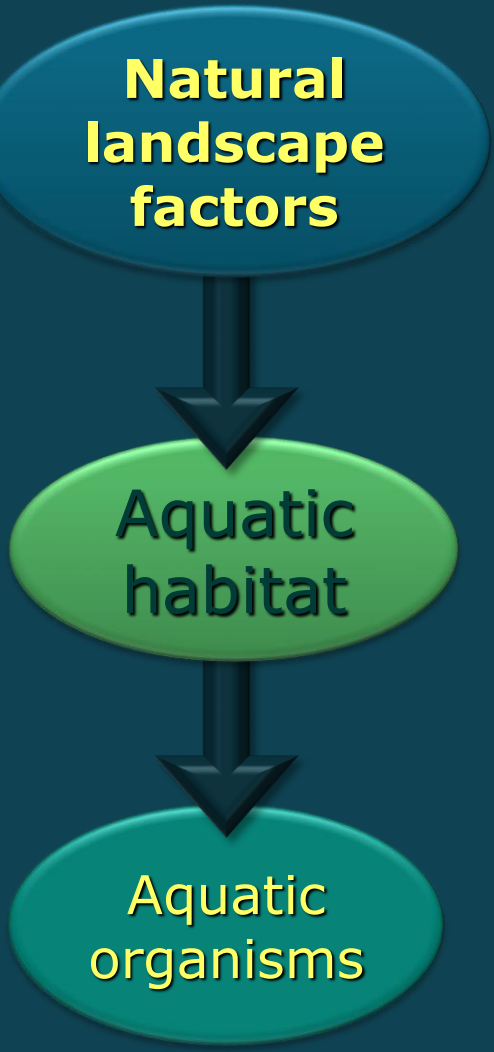
- Landscape characteristics of stream catchments affect habitat and biology via effects on habitat

- Over large spatial extents, stream habitat data may be limited, but landscape data may be available in continuous coverages

- Using landscape factors, we can approximate stream habitat conditions, identify limiting factors

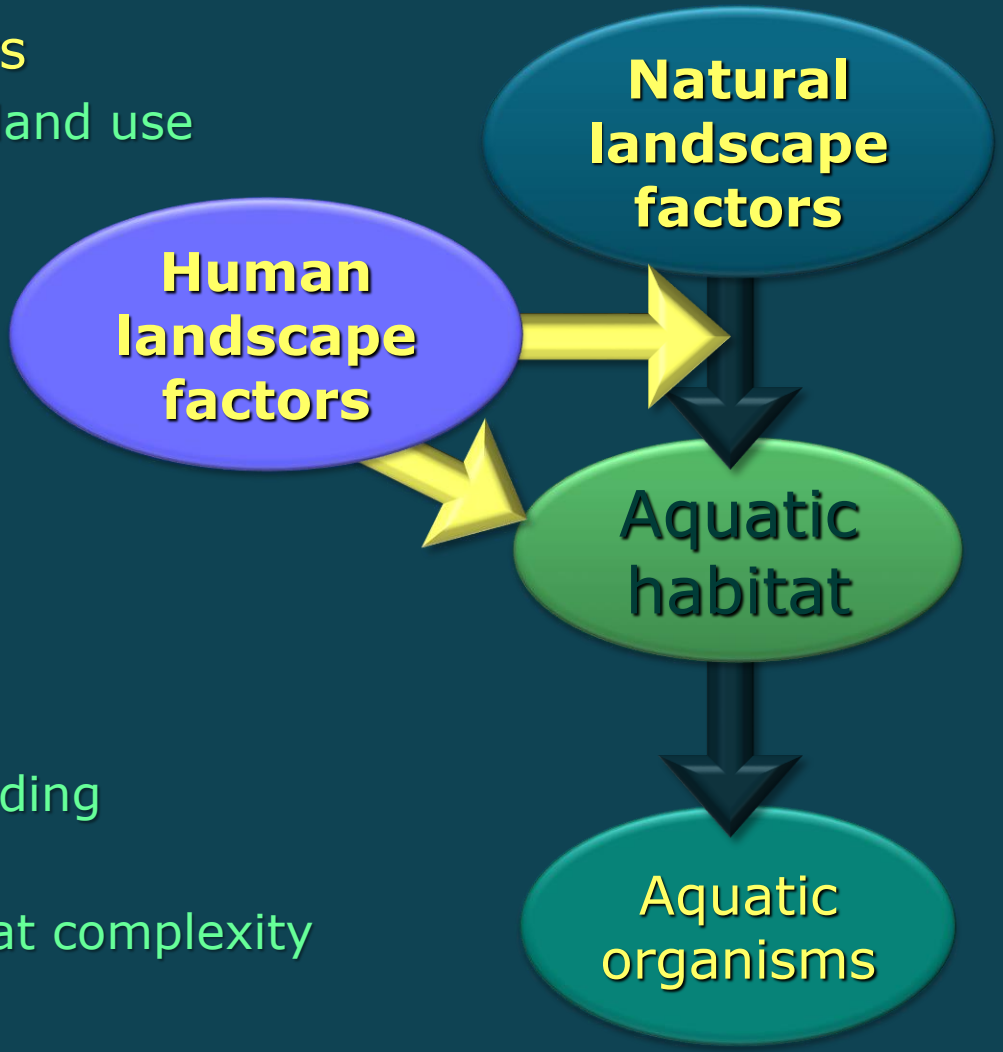
NATURAL LANDSCAPE FACTORS DETERMINE POTENTIAL BY INFLUENCING STREAM HABITAT, ORGANISMS

- Natural landscape factors
  - Climate
  - Geology
  - Topography
  - Natural land cover
- Stream habitat
  - Hydrologic and thermal regimes
  - Sediment loading
  - Nutrient dynamics
  - Physical structure



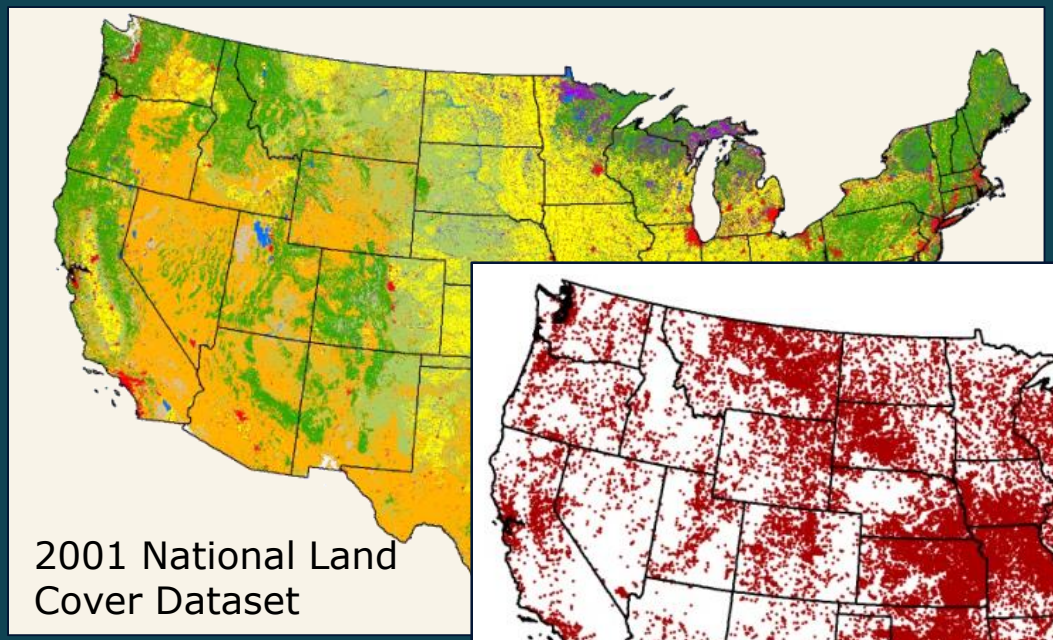
HUMAN LANDSCAPE FACTORS CHANGE POTENTIAL (ALTER PROCESSES AND HABITAT FACTORS)

- Human landscape factors
  - Urban and agricultural land use
  - Roads
  - Dams, barriers affecting stream connectivity
- Stream habitat
  - Altered hydrologic and thermal regimes
  - Increased sediment loading
  - Excess nutrients
  - Reduced physical habitat complexity

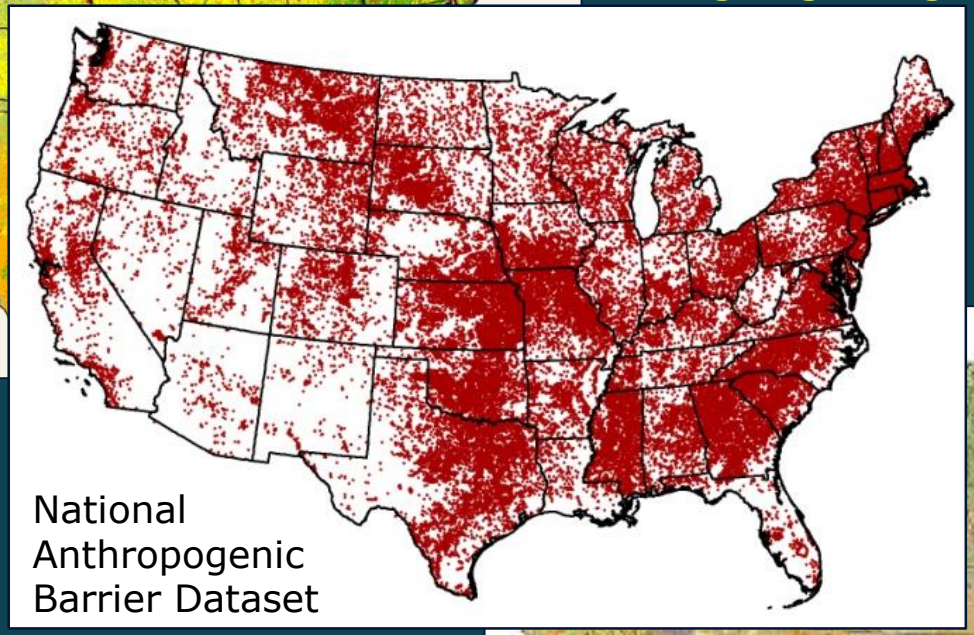


THANK YOU GIS! INFORMATION AVAILABLE FOR ALL LOCATIONS ACROSS LARGE REGIONS

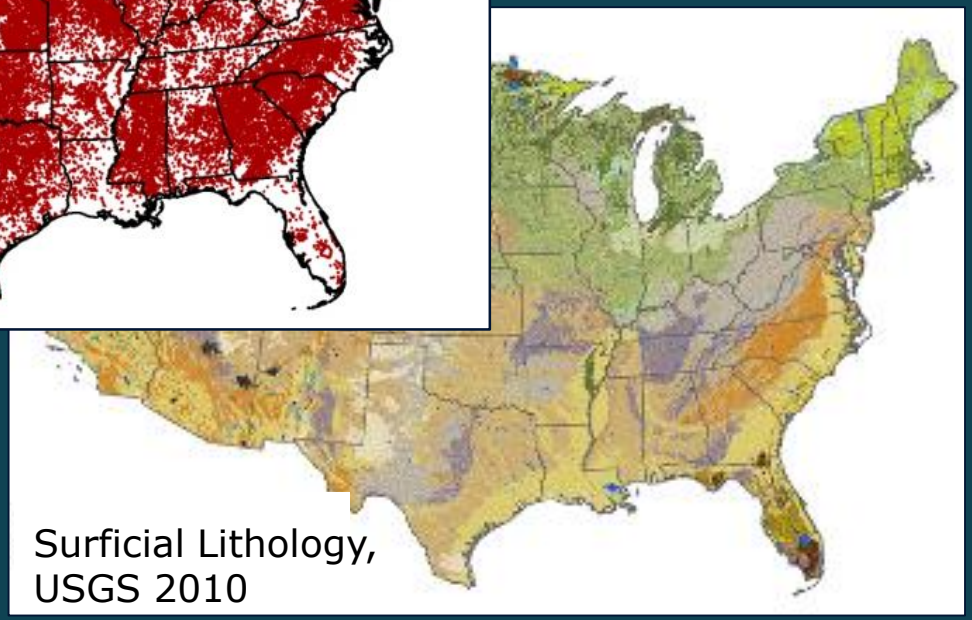
- GIS data do not replace site-specific knowledge
- Local studies are important for informing selection of data, highlighting mechanisms



2001 National Land Cover Dataset



National Anthropogenic Barrier Dataset



Surficial Lithology, USGS 2010

- GIS data can provide comprehensive, comparable estimates of conditions over large areas

INLAND ASSESSMENT OBJECTIVES AND TENETS GUIDING THE WORK

Objectives

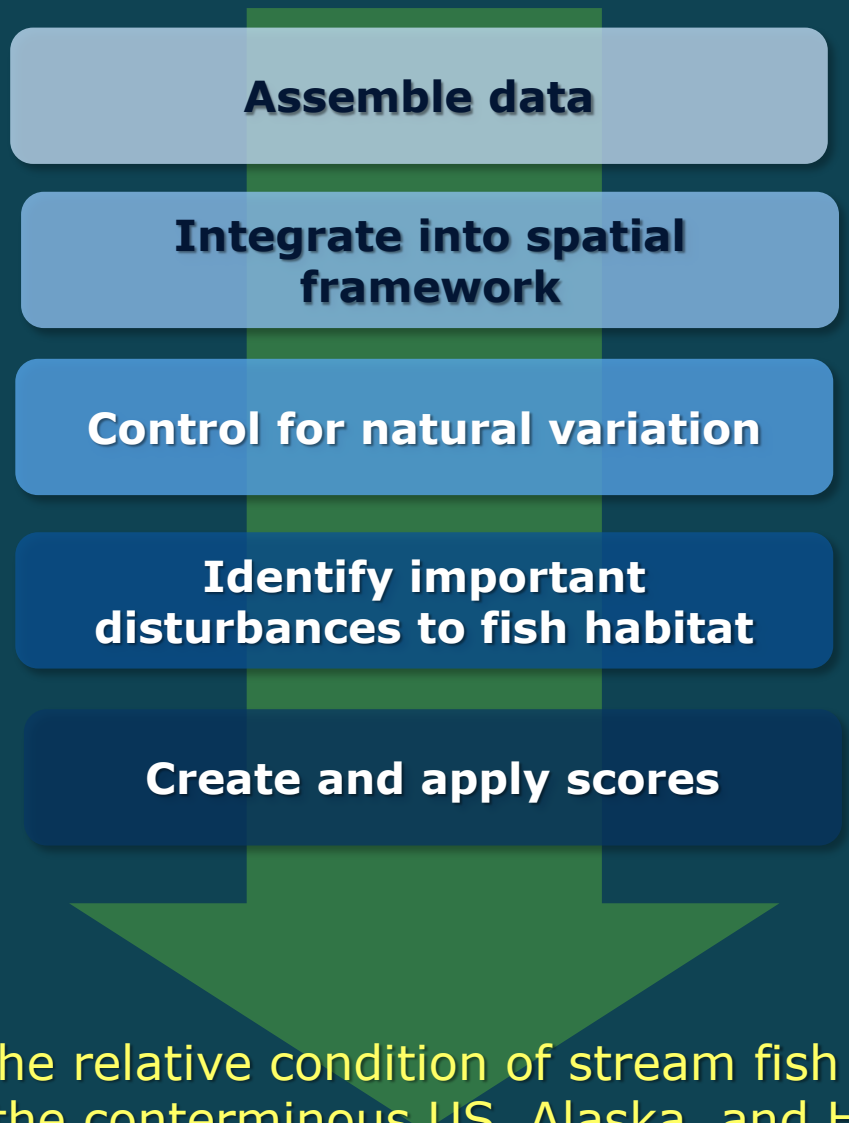
1. Assess fish habitat condition in all rivers of the conterminous United States, Alaska, and Hawaii; generate assessment scores that provide consistent and comparable information everywhere
2. Identify most limiting disturbances to stream fish habitats

Underlying tenets

- Due to limitations in habitat data nationally, assessment should follow a landscape approach
- Natural and anthropogenic landscape factors used should represent important controls on fishes
- Data (and results) should be attributed to publically available set of spatial units (i.e., spatial framework) to facilitate data sharing and use
- Assessments for conterminous US, Alaska, and Hawaii will be conducted differently due to differences in spatial frameworks and data regionally

QUESTIONS ON LANDSCAPE APPROACH OR ASSESSMENT OBJECTIVES?

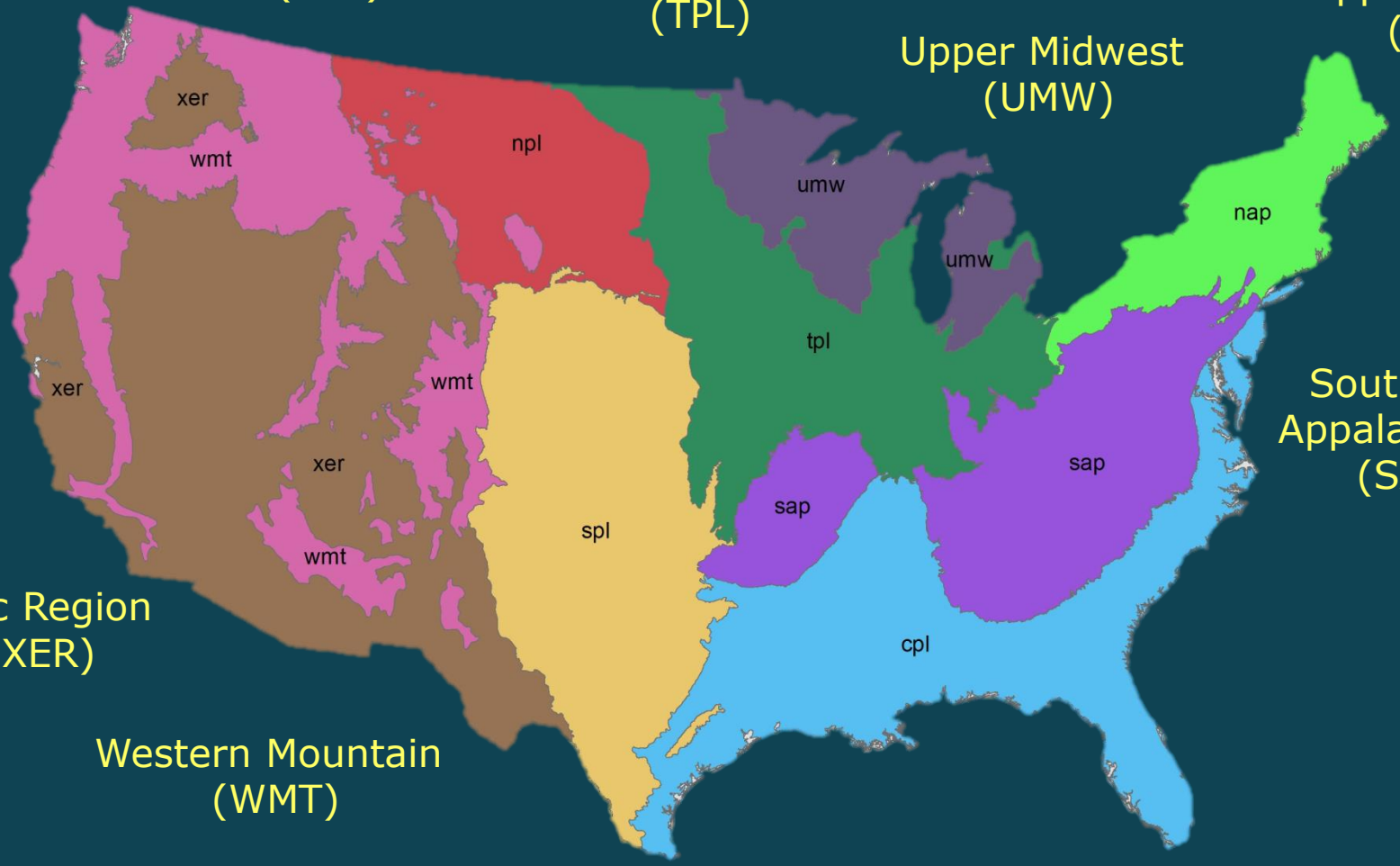
KEY ELEMENTS OF 2015 ASSESSMENT APPROACH



What is the relative condition of stream fish habitats across the conterminous US, Alaska, and Hawaii?

1. CONTERMINOUS US METHODS

CONTERMINOUS US ECOREGIONS



FISH ASSEMBLAGE DATA: CONTERMINOUS US

1. The data set included 39,375 stream reaches with fish data
2. Fishes were collected with single-pass electrofishing using standardized methods (many data from federal and state programs, some museums provided data)
3. Collected since 1990
4. Were collected with the goal of obtaining a representative sample of the entire fish community (vs. sampling targeting specific species)
5. Data quality was evaluated using a four-step QA/QC procedure

IDENTIFYING DISTURBANCES TO FISH HABITAT: CONTERMINOUS US

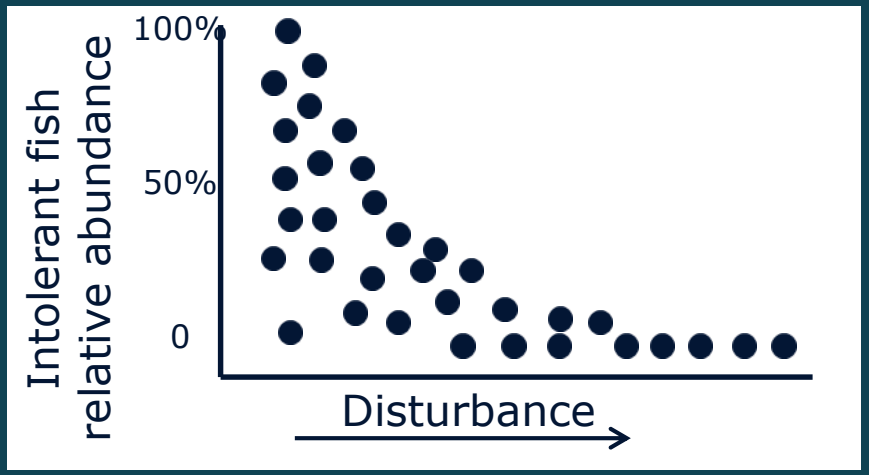
- Assertion: fish responses to human landscape disturbances should reflect habitat condition
- Trait metrics (vs. taxonomic summaries) across large ecoregions for assessment
- Multiple fish trait metrics
  - Habitat, reproductive strategies, and feeding guilds (Frimpong fish trait matrix)
  - EPA intolerant metric developed from literature
- Selected metrics responsive to human landscape disturbance for each WSA ecoregion following selection approach of Stoddard et al. (2008)

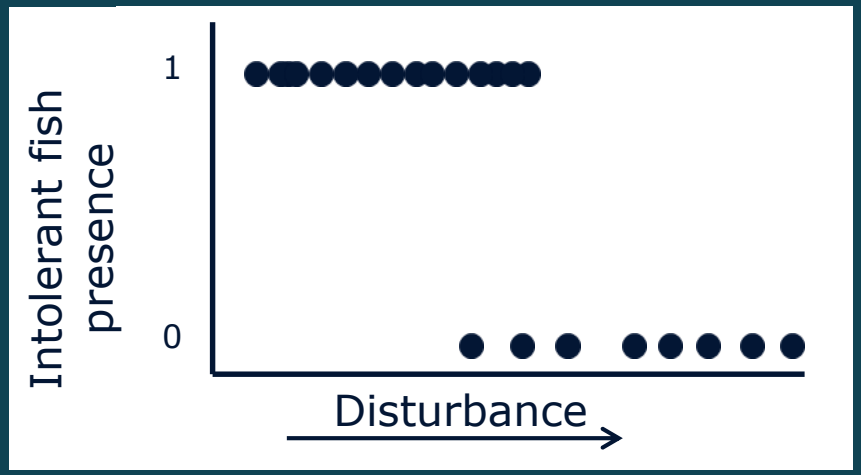
Selection approach
Calculated fish metrics
Zero test
Metric range
Reproducibility
Sensitivity test
Redundancy check

We also created a game fish species metric and SGCN metric… we have tested disturbances against these metrics also

FISH ASSEMBLAGE DATA: CONTERMINOUS US

Why use relative abundance data instead of presence/absence data?

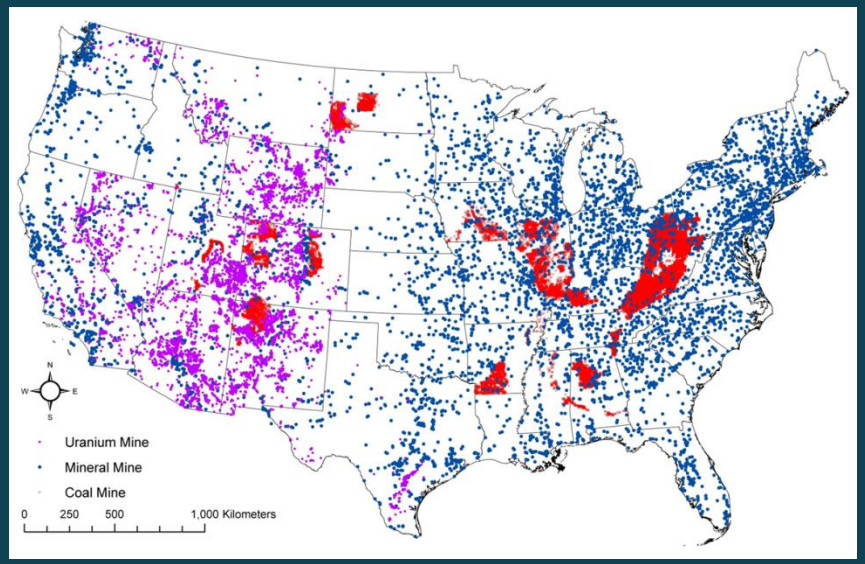




Better indicator of changing fish assemblages with disturbance

LANDSCAPE DISTURBANCE DATA: CONTERMINOUS US

1. Ecologically meaningful for assessing fish habitat
2. Consistent across the conterminous US
3. Sufficient spatial resolution that data could be used to distinguish among network catchment units



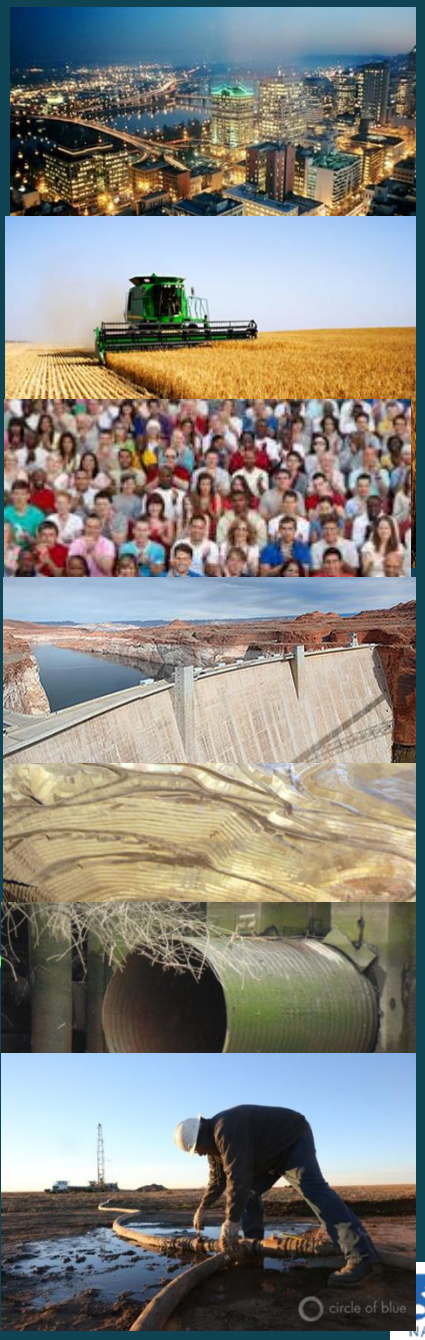
Coal, mineral, and uranium mines

2006 national land cover dataset

LANDSCAPE DISTURBANCE DATA:
CONTERMINOUS US

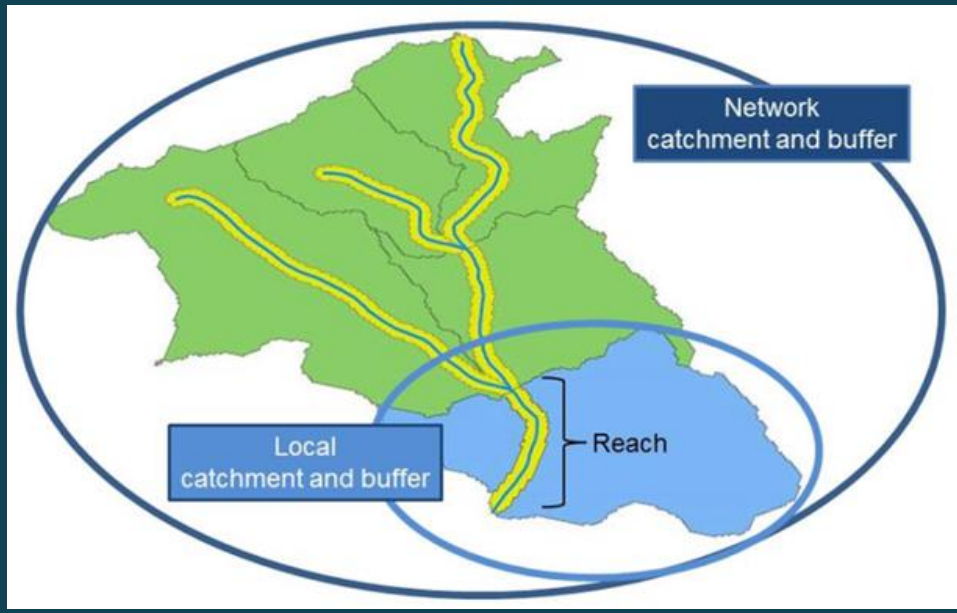
Open/low intensity urban land use (%)*
Medium intensity urban land use (%)*
High intensity urban land use (%)*
Impervious surface (%)*
Pasture/hay land use (%)*
Cultivated crops land use (%)*
Population density (#/km^2)
Road length (m/km^2)*
Road crossings (#/km^2)*
Dams and fragmentation metrics (#/km^2)*
Mines (Mineral, Coal*, Uranium*) (#/km^2)
Toxics release inventory sites (#/km^2)
National pollution discharge elimination system sites (#/
EPA superfund national priorities sites (#/km^2)
Water withdrawal (MGY)*
Nutrient and sediment pollution (kg/km/yr)*

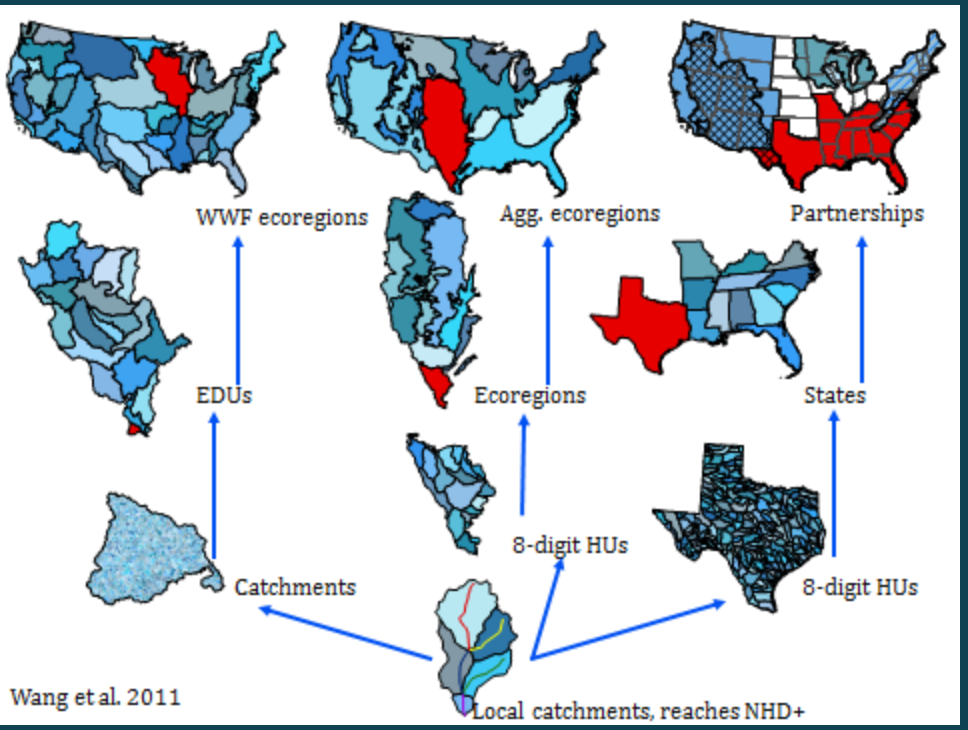
*updated or new from 2010



SPATIAL FRAMEWORK:
CONTERMINOUS US

- Smallest unit is a stream reach (NHDPlusV1 vs. NHDPlusV2)
- Many other spatial units available
- Crosswalk between NHDPlusV1 and NHDPlusV2 currently available





SPATIAL SCALES USED TO CREATE ASSESSMENT SCORES

- Local catchment
- Network catchment
- Local 90m buffer
- Network 90m buffer

- Data attribution to various spatial units provides a wealth of information currently used in multiple efforts

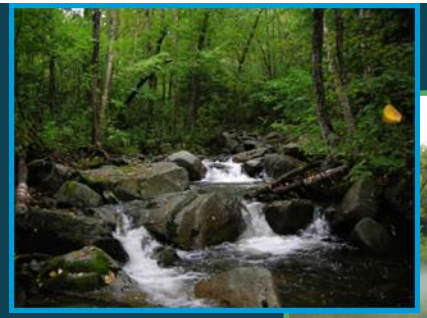
CONTROLLING FOR NATURAL VARIATION: CONTERMINOUS US

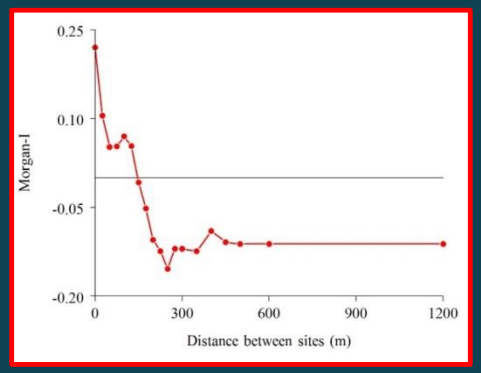
1. Constrained analyses within 9 ecoregions

2. Grouped sites into stream size classes
   Creeks (<100 km2)
   Rivers (>100 km2)

3. Accounted for spatial autocorrelation

4. Used boosted regression to remove influence from natural variables known to be important to fishes (Daniel et al. 2015)





Assemble data

Integrate into spatial framework

Control for natural variation

Identify important disturbances to fish habitat

Create and apply scores

Spatial Analysis in Macroecology (SAM) V4.0

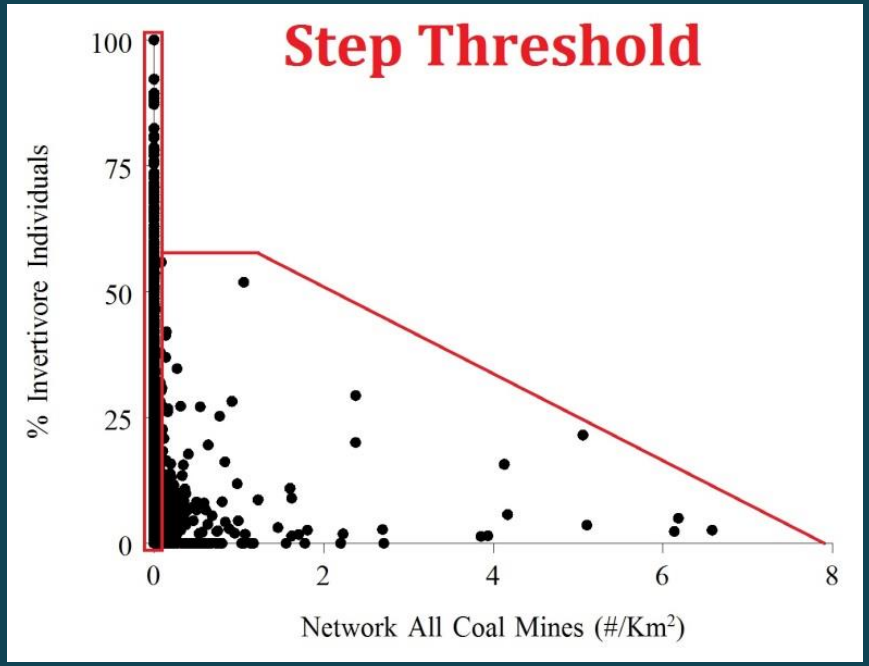
NATIONAL FISH HABITAT PARTNERSHIP

IDENTIFYING DISTURBANCES TO FISH HABITAT: CONTERMINOUS US

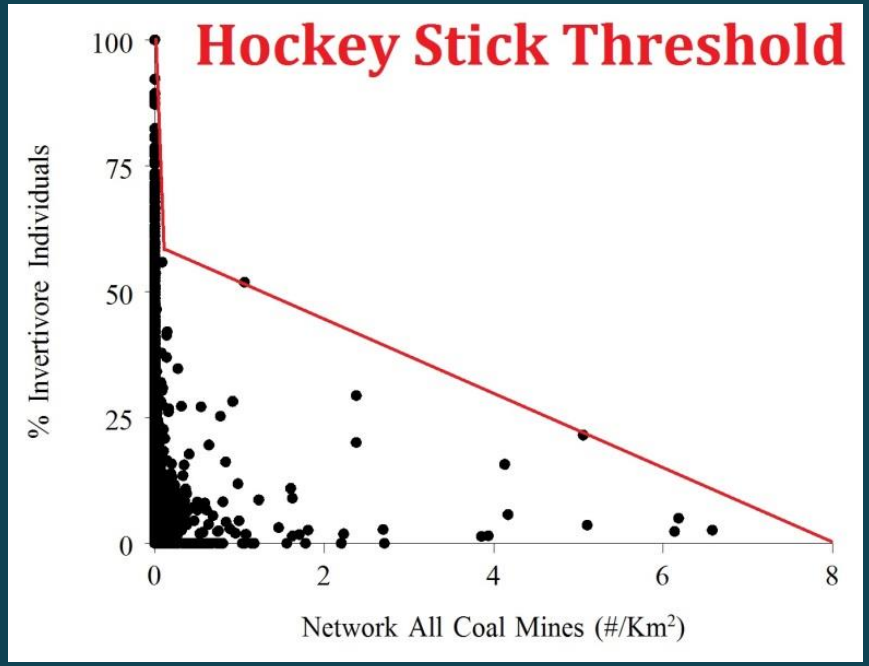
With increasing disturbance, we expect decreasing biological condition. For important disturbances affecting condition, we tested for non-linear, threshold responses…

IDENTIFYING DISTURBANCES TO FISH HABITAT: THRESHOLD DETECTION, DANIEL ET AL. (2015)

TITAN (Baker and King 2010)
Change-point analysis with indicator analysis



R code Segmented (Muggeo 2013)
Piecewise regression



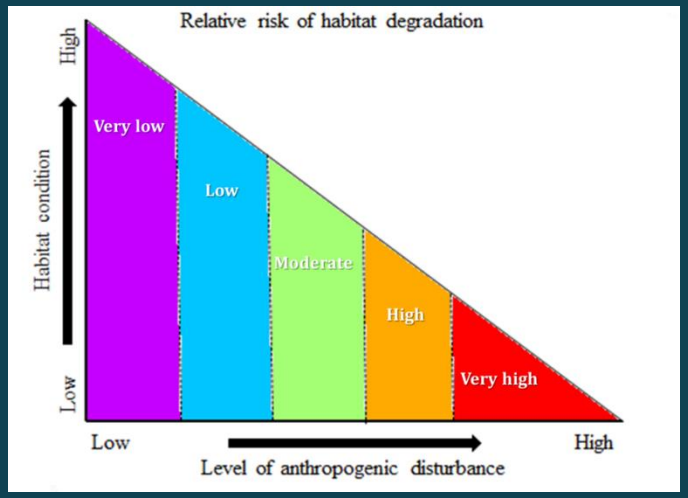
To be considered a significant threshold
- Both techniques had to be significant
- Threshold points had to overlap within ≤ 5% error rate

- 20,412 thresholds analyzed – <u>scores based on significant thresholds</u>

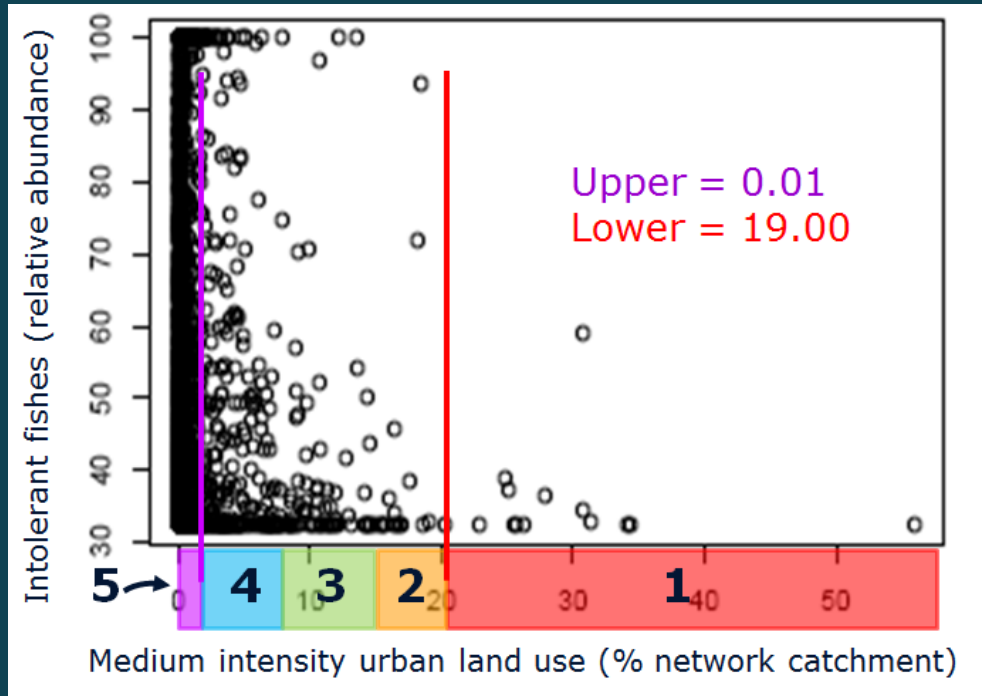
DETERMINING SCORES: LEVELS IDENTIFIED FOR EACH FISH METRIC AND EACH LANDSCAPE DISTURBANCE WITH SIGNIFICANT THRESHOLD

1. In each ecoregion, fish metrics tested against human landscape disturbances in various spatial extents

2. For each fish metric and each disturbance with a significant threshold, "levels" associated with condition were identified



- Best condition: Identified by threshold analyses
- Worst condition: "Plateau point" (indicating worst condition) identified visually
- Mid-range classes: Identified by equal breaks in the range between best and worst condition



CONDITION VALUES TO CONDITION SCORES FOR REACHES FOR INDIVIDUAL BIOLOGICAL METRICS

Actual reach condition values

Biometric 2

Reach	Low urban (%)	Pasture(%)	Coal mines (#/km^2)	Road Crossings (#/km^2)
112	7.89	10.2	0.001	0.15
113	2.40	0.00	0.00	1.02

Condition score for each reach

- This approach allows us to identify most limiting disturbance to a reach

Biometric 2

Reach	Low urban (%)	Pasture(%)	Coal mines (#/km^2)	Road Crossings (#/km^2)
112	3	5	5	4
113	4	N/A	N/A	2

Most limiting score for each biological metric, for each spatial extent

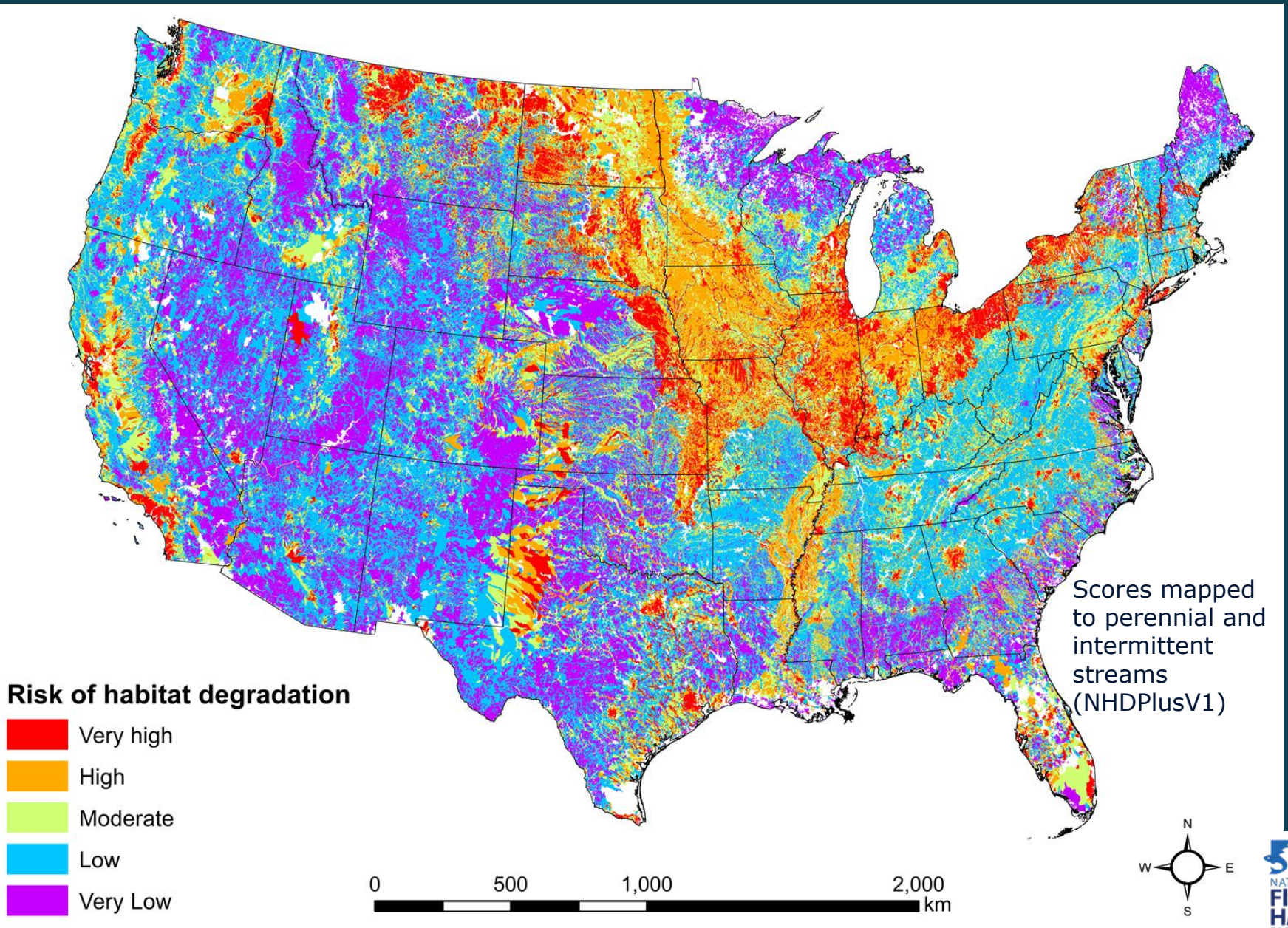
Reach	Biometric 1	Biometric 2	Biometric 3	Avg. HCI
112	4	3	4	3.66
113	3	2	4	3.00

CREATING THE CUMULATIVE HABITAT CONDITION SCORE

	Habitat condition index				
	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5
Local catchment	1.5	5.0	4.8	4.9	3.6
Local buffer	3.8	5.0	3.9	4.9	2.2
Network catchment	1.5	5.0	4.8	4.5	1.0
Network buffer	3.8	5.0	3.9	3.7	3.5
Cumulative Habitat Condition Index	1.5	5.0	3.9	3.7	1.0

Minimum HCI score generated for a given stream reach is assumed to reflect stream reach's maximum biological potential and therefore serves as the CHCI for that stream reach

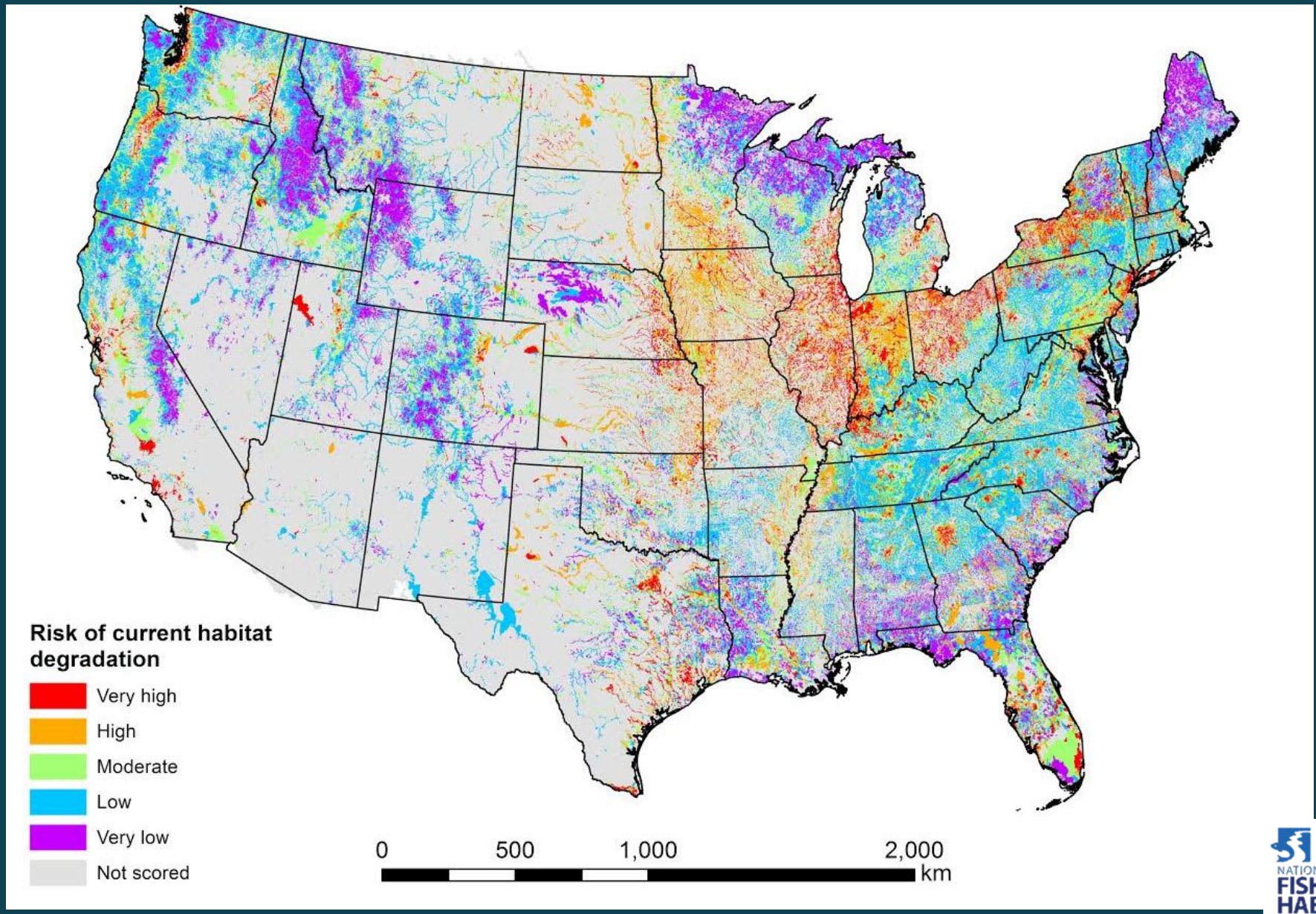
2015 ASSESSMENT OF STREAM FISH HABITATS FOR THE CONTERMINOUS UNITED STATES



Scores mapped to perennial and intermittent streams (NHDPlusV1)

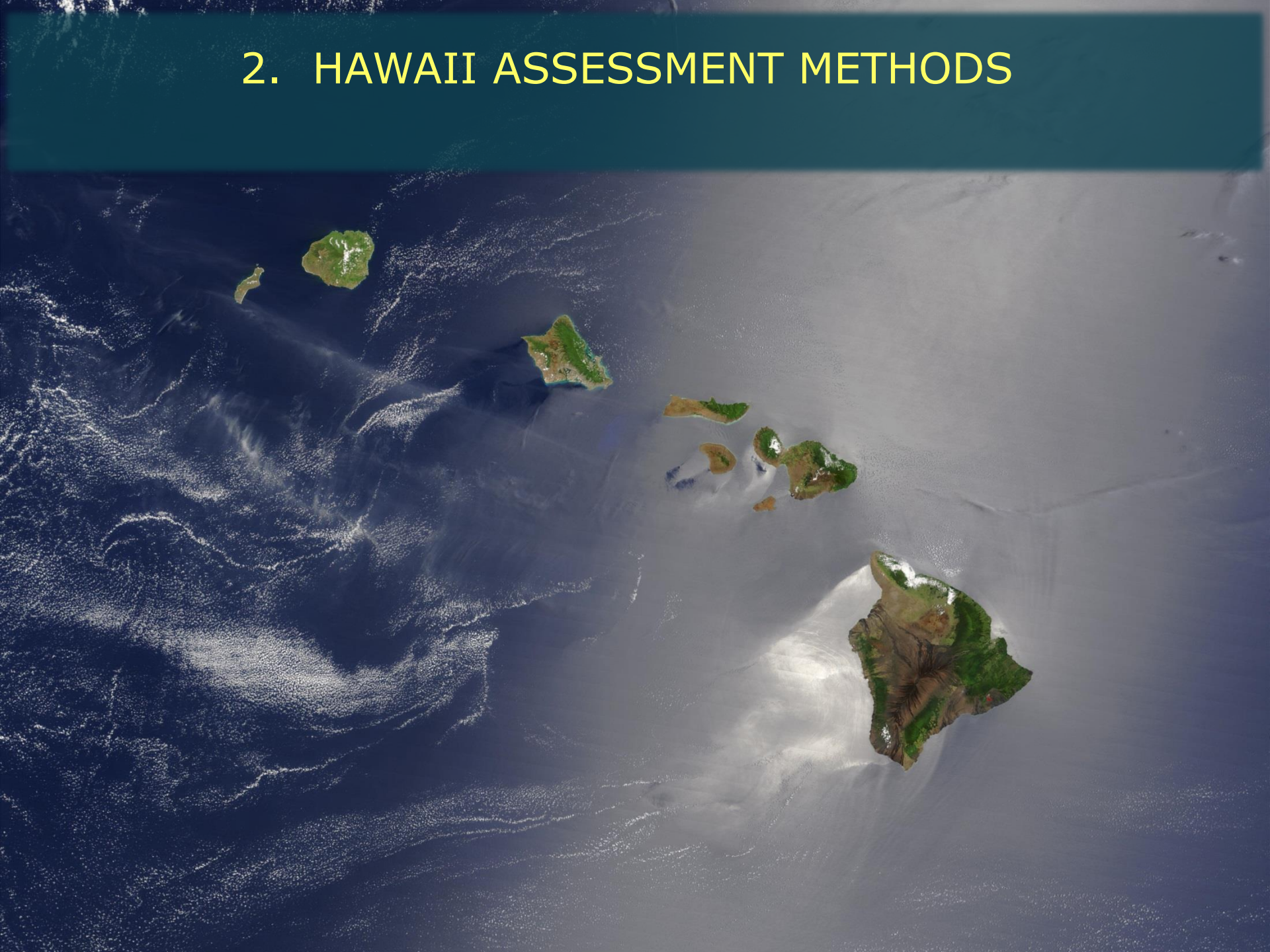
NATIONAL FISH HABITAT PARTNERSHIP

PERENNIAL STREAMS ONLY



NATIONAL FISH HABITAT PARTNERSHIP

2. HAWAII ASSESSMENT METHODS



STREAM ORGANISM DATASET

- Presence/absence data (1992-2010) of 9 taxa
  - Native taxa only
  - Most amphidromous
- Provided by Hawaii DAR and HFHP
- ~10% of perennial stream reaches

LANDSCAPE DISTURBANCE DATA: HAWAII

With input from HFHP, identified 20 landscape disturbances to Hawaii stream habitat

Index	Description	Units	Source/currentness
Urban	Developed (Open)	%	CCAP 2005-2011
Urban	Developed (Impervious surfaces)	%	CCAP 2005-2011
Urban	Population density	#/km^2	NOAA 2010
Urban	Length of utility pipelines	m/km^2	USGS 1983
Urban	Length of roads	m/km^2	TIGER Roads 2014
Urban	Golf courses	%	Hawaii OP 1993
Point Source	Quarries	#/km^2	USGS 2003
Point Source	Sites from the Superfund National Priorities List (NPL) from the Compensation and Liability Information System (CERCLIS)	#/km^2	EPA 2014
Point Source	Majors from the Permit Compliance System (PCS)	#/km^2	EPA 2014
Point Source	Number of sites from the Toxics Release Inventory (TRI) Program	#/km^2	EPA 2014
Point Source	The total number of underground injection wells within a watershed	#/km^2	Hawaii DOH 2010

Red = updated variables for 2015

LANDSCAPE DISTURBANCE DATA: HAWAII

With input from HFHP, identified 20 landscape disturbances to Hawaii stream habitat

Index	Description	Units	Source/currentness
Former Plantation	Land that was at one time pineapple production	%	Office of Planning 1989
Former Plantation	Land that was at one time sugarcane production	%	Hawaii OP 1989
Fragmentation	Number of road crossings	#/km^2	TIGER Roads 2014
Fragmentation	Dams present on stream/rivers	#/km^2	ACOE 2010
Fragmentation	Total number of ditch intersections with streams	#/km^2	NHD 24k 1983
Ditch	Total length of ditches within catchment	m/km^2	USGS 2004
Agriculture	Pasture/hay	%	CCAP 2005-2011
Agriculture	Cultivated crops	%	CCAP 2005-2011
303D	303D stream with measured TMDL	%	EPA 2006

Red = updated variables for 2015

SPATIAL FRAMEWORK: HAWAII

Based on the HFHP stream layer

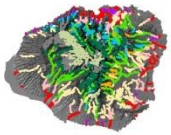
- Modified NHD 1:24,000 (Tingley et al. in prep.)

Aggregated data into local, network, and downstream main channel catchments

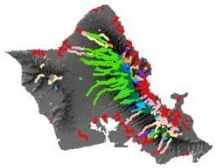
ASSESSMENT APPROACH

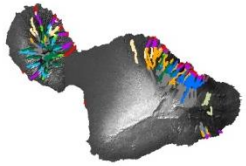
1. Assemble data
2. Integrate into spatial framework
3. Control for natural variation
4. Identify important disturbances to fish habitat
5. Create and apply scores

CONTROLLING FOR NATURAL VARIATION: HAWAII



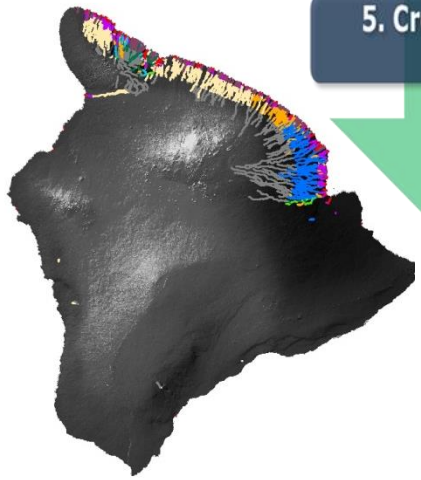
- All stream reaches classified into groupings
- Groupings determined by natural landscape factors and associations with distributions of stream organisms





Stream classes

- 13 classes identified indicating different "ecological potential"
- Tingley III, R. W., D. M. Infante, R. A. Mackenzie, Y-P. Tsang, A. Cooper. In preparation. Influences of natural landscape factors on tropical stream organisms: An ecological classification of Hawaiian Island streams. Hydrobiologia.



IDENTIFYING DISTURBANCES TO FISH HABITAT

1. Tested for relationships between species presence and disturbances in each stream reach class using logistic regression

2. Disturbances that were found to be important controls on species distributions were "upweighted" in assessment scoring process

ASSESSMENT APPROACH

1. Assemble data
2. Integrate into spatial framework
3. Control for natural variation
4. Identify important disturbances to fish habitat
5. Create and apply scores

CREATING THE CUMULATIVE HABITAT CONDITION SCORE: HAWAII

Hawaii assessment follows a risk-based approach (Danz et al. 2007, Esselman et al. 2011)

Steps:

1. Standardized individual disturbances in multiple spatial extents (55 variables)

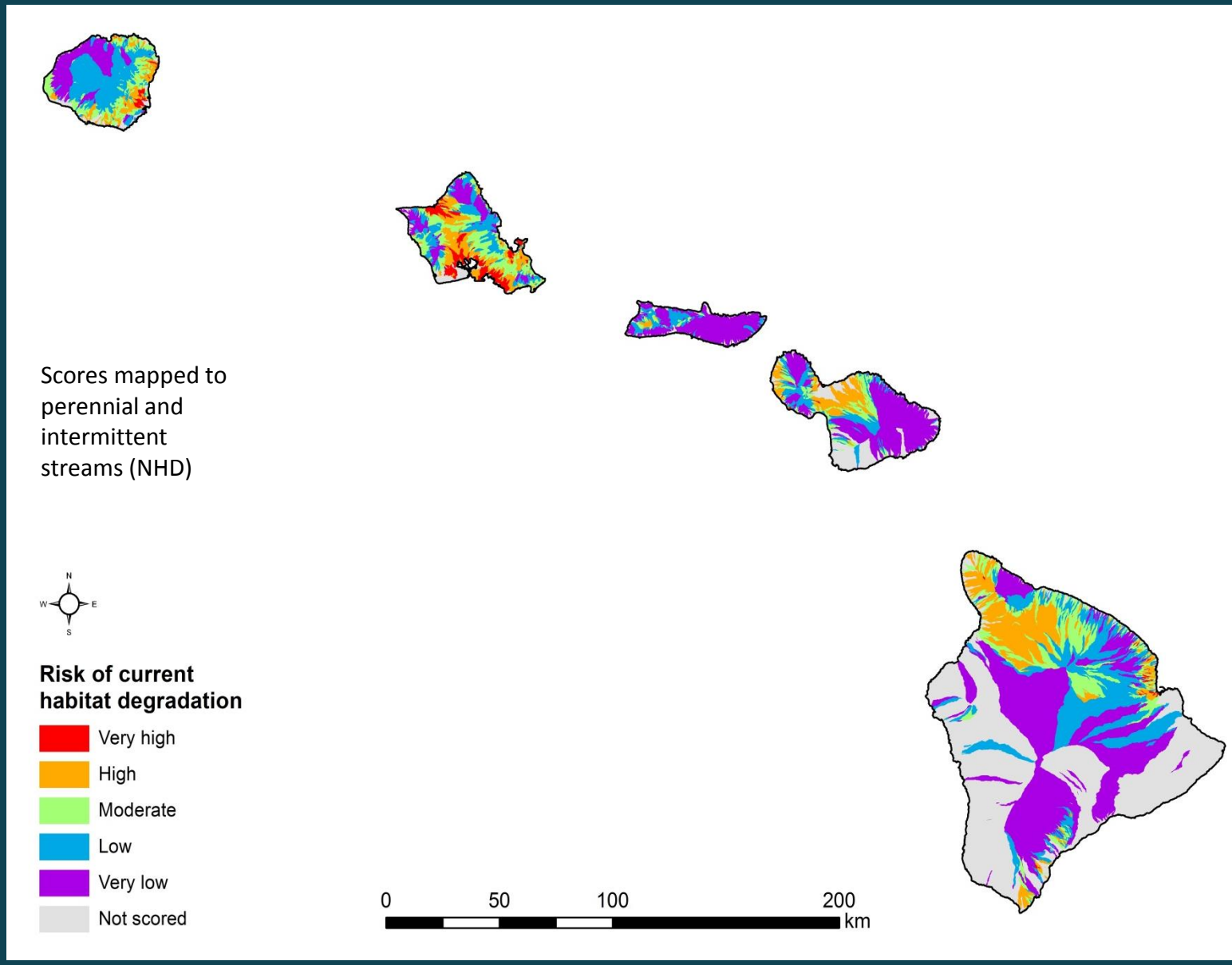
2. Up-weighted individual disturbances based on logistic regression results

3. Grouped disturbances into similar categories, summed disturbances in categories to create disturbance sub-indices

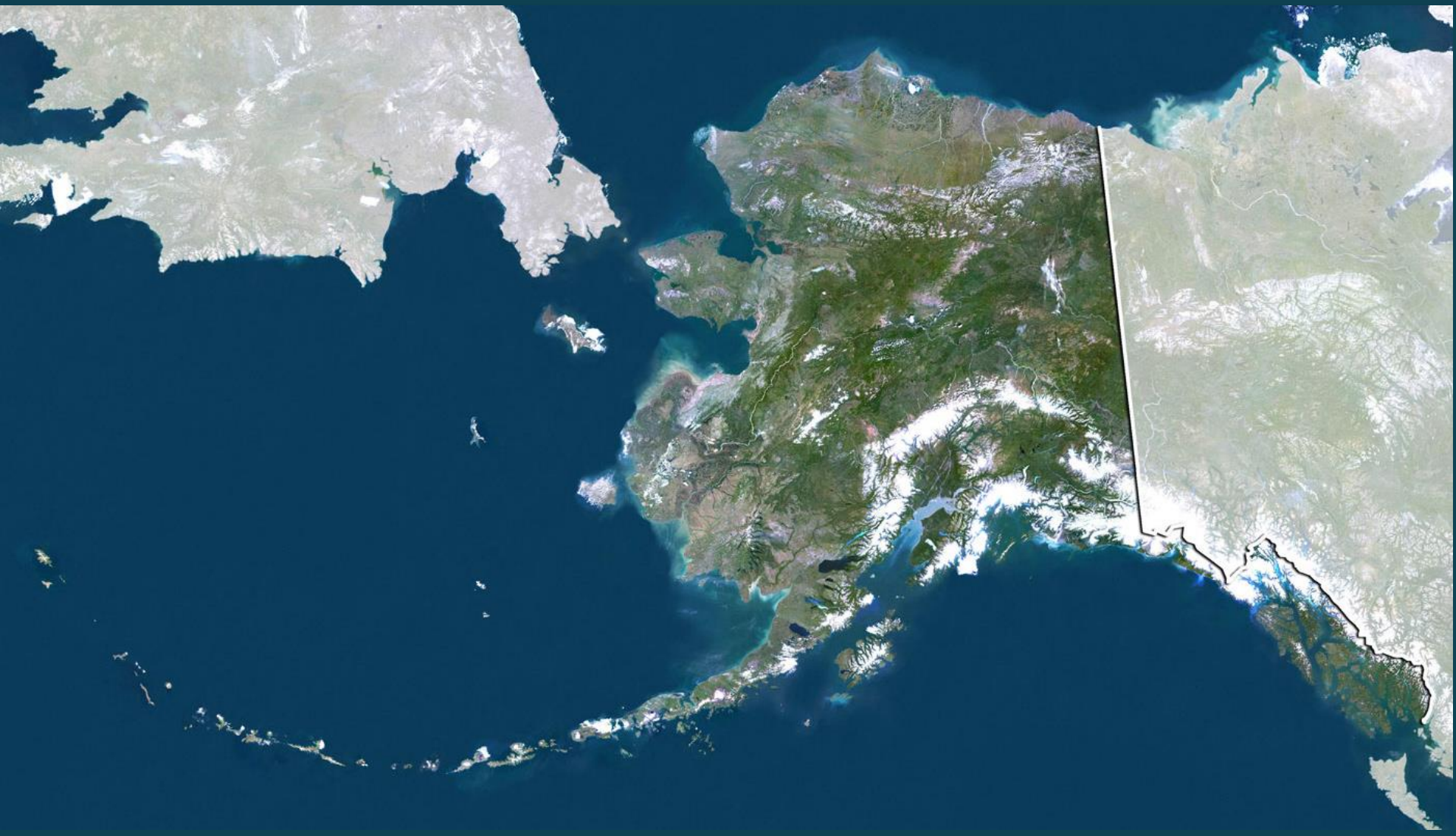
4. Summed sub-indices within spatial extents
   - Local, network, and downstream catchment

5. Standardized and summed spatial extent indices
   - Cumulative Habitat Condition Index

2015 ASSESSMENT OF STREAM FISH HABITATS FOR HAWAII



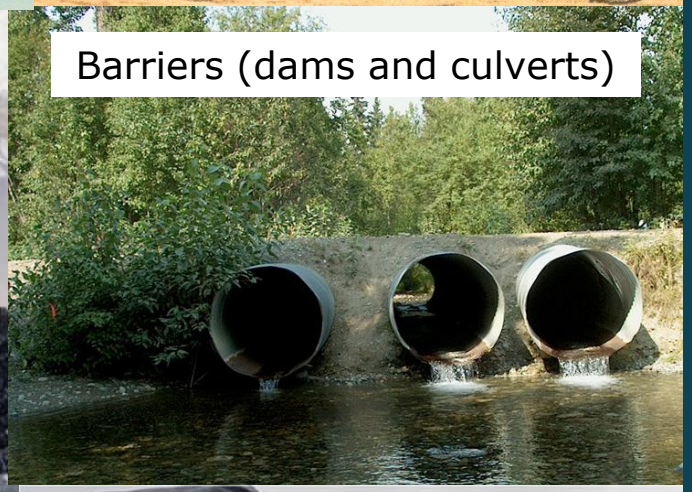
3. ALASKA ASSESSMENT METHODS

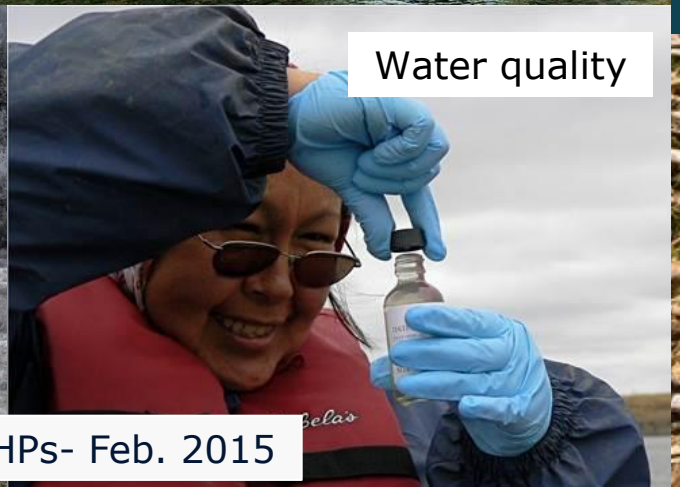


LANDSCAPE DISTURBANCE DATA: ALASKA

ASSESSMENT APPROACH

1. Assemble data
2. Integrate into spatial framework
3. Control for natural variation
4. Identify important disturbances to fish habitat
5. Create and apply scores



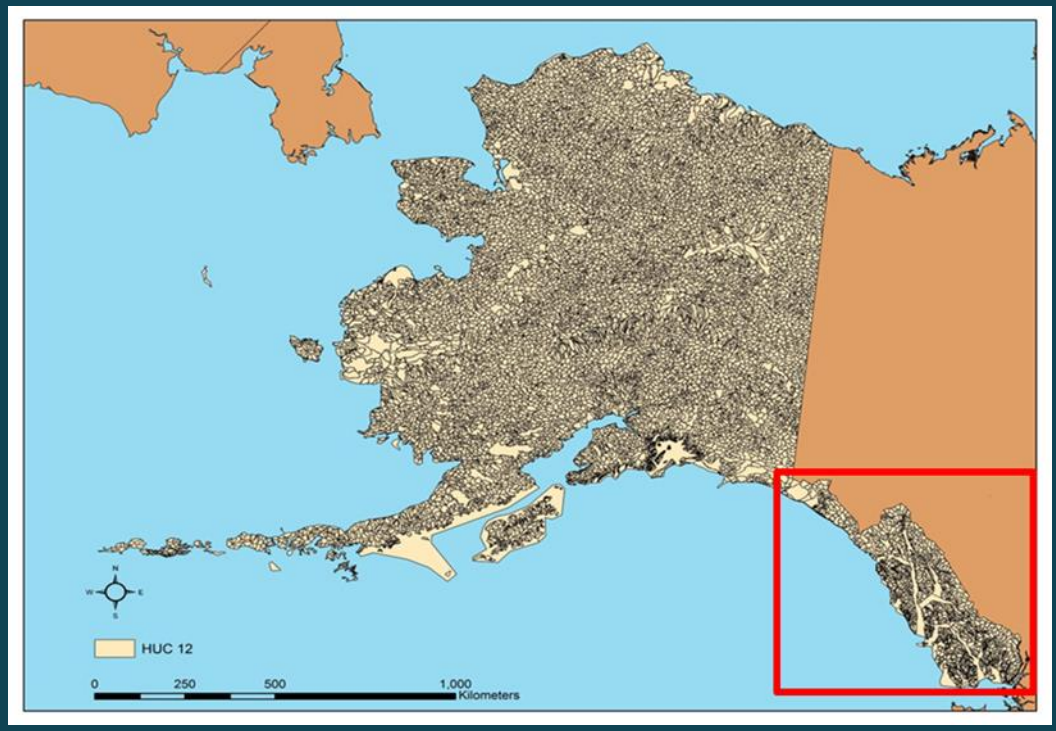


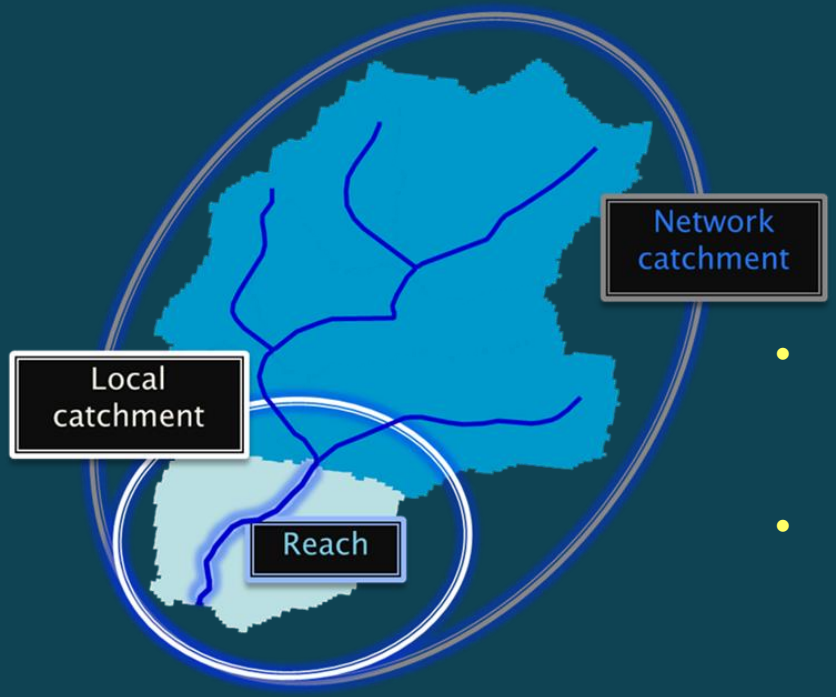
Forest harvest
in Southeast assessment only

Reviewed by FHPs- Feb. 2015

SPATIAL FRAMEWORK:
GREATER ALASKA

- HUC-12 watersheds for greater Alaska
- 12,825 HUC-12 watersheds





Spatial framework described in Wang et al. (2011)

SPATIAL FRAMEWORK:
SOUTHEAST ALASKA

- Local catchments created for southeast Alaska (worked conducted by Jared Ross)
- Each stream reach had information summarized in two spatial extents (local and network catchments)

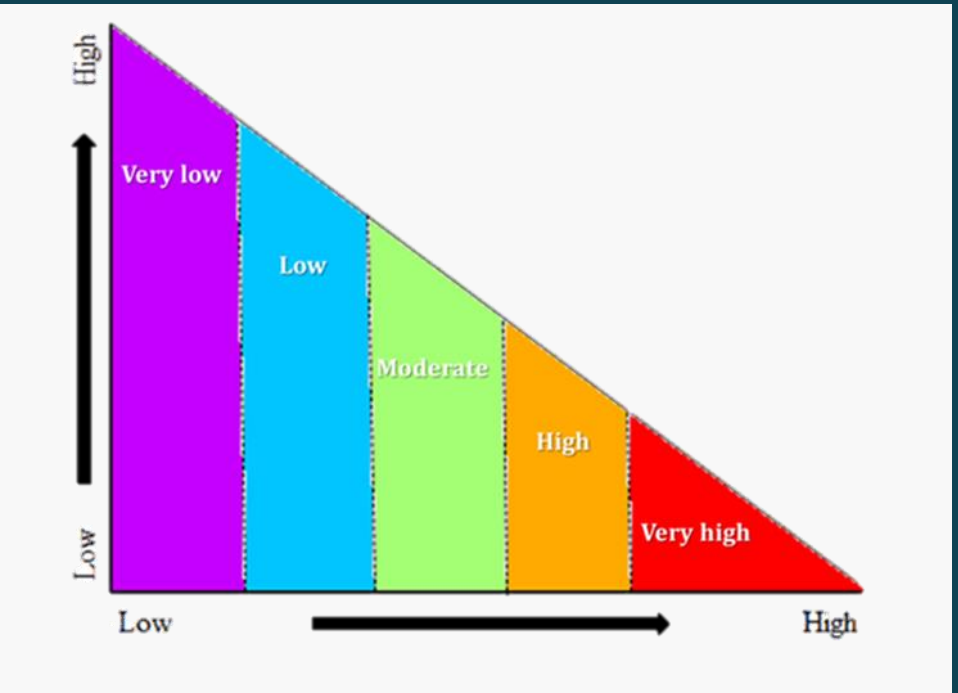
6 DISTURBANCE SUBINDICES

Based off: Danz et al. (2007), Esselman et al. (2011)

urban	agriculture	water quality	barriers	infrastructure	active mines
Population density **Urban open space** **Urban low intensity** **Urban medium** **Urban high intensity**	**Pasture/hay** **Cultivated crops** **Forest harvest***	**Nat. Poll. Dis. System** **Toxic release sites** **Contaminated sites 303(d)**	**Dam density** **Non-dam barriers (grey and red culverts)**	**Road density** **Railroad density** **Pipeline density** **Landing strips /airports**	**Active mines (without prospector locations)*** **Major mines of AK**

Each stress class index was normalized between 0-1

Cumulative Disturbance Index was summed from six indexes

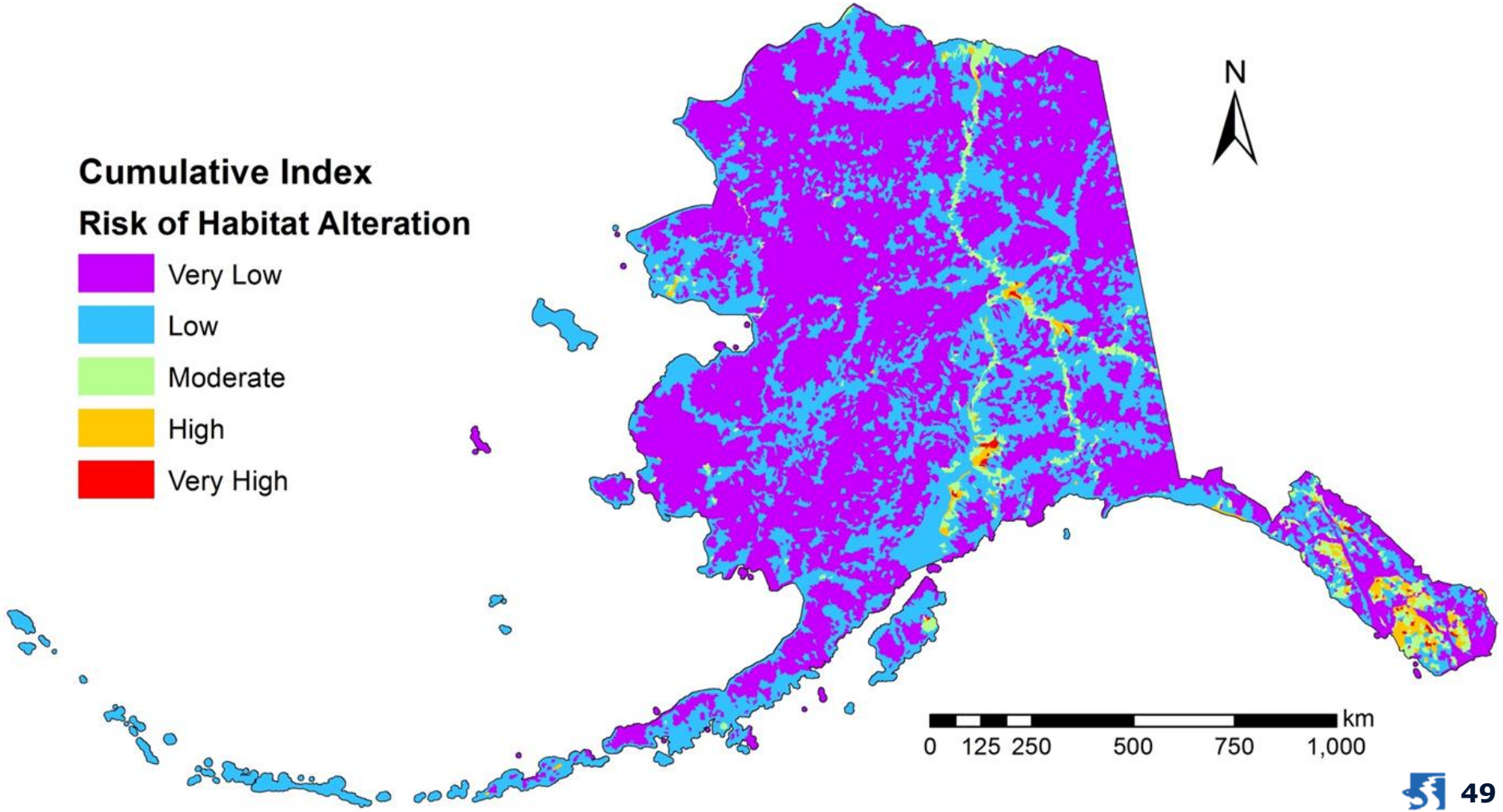


- Use of Jenk's Natural Breaks to create Disturbance Index Classes
- Same method used in Conterminous US

* = unique variables for Southeast assessment

48 NATIONAL FISH HABITAT PARTNERSHIP

2015 ASSESSMENT OF STREAM FISH HABITATS FOR ALASKA



QUESTIONS ON METHODS FOR CONTERMINOUS US, HAWAII, OR ALASKA?

TYPES OF RESULTS FROM 2015 ASSESSMENT

1. Natural and anthropogenic disturbance data attributed to common spatial framework

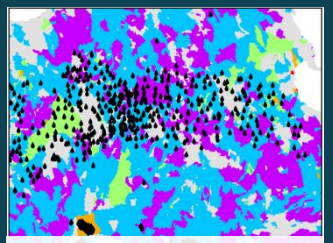
2. Cumulative habitat condition indices
   - Subindices specific to disturbances for Hawaii and Alaska
3. Habitat condition indices specific to various spatial extents

4. Most limiting disturbance to fish habitats
5. Conterminous US scores developed specifically for game fishes and Species of Greatest Conservation Need

6. Regional scores developed for specific fish metrics

USING ASSESSMENT RESULTS

Scores with other information to enhance conservation decisions

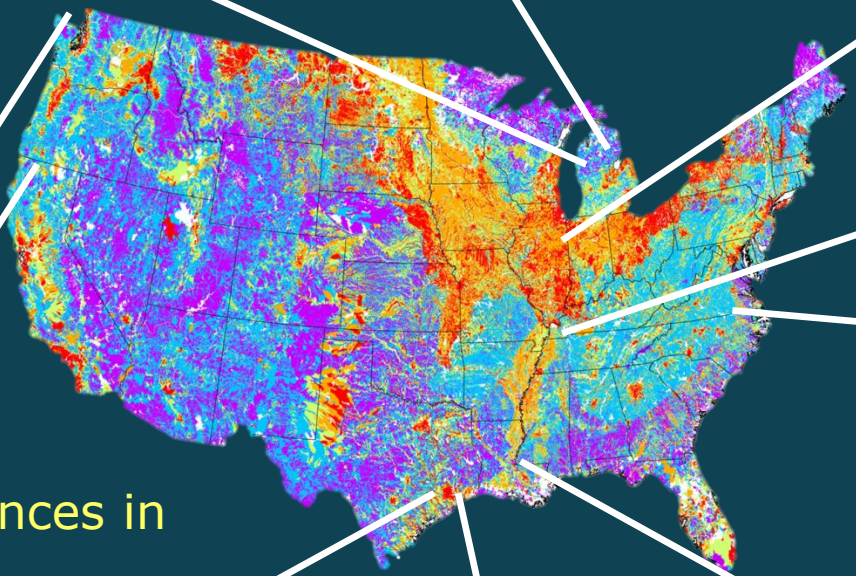


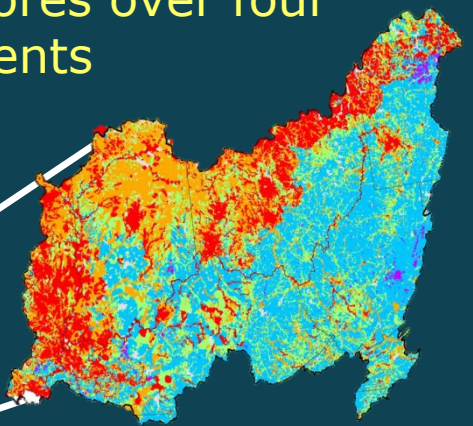
Oil and gas wells

Cumulative condition scores, disturbance indices, scores over four spatial extents

Scores tailored to specific groups of fishes

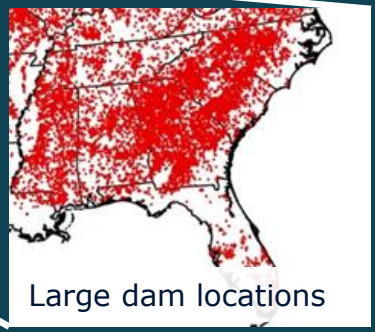
Coastal Cutthroat Trout



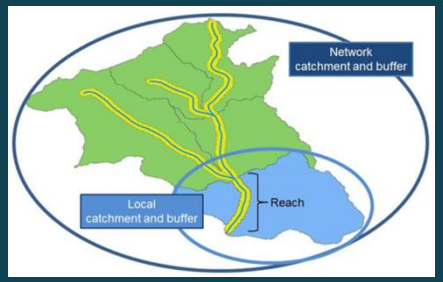


Ohio River Basin

Most limiting disturbances in four spatial extents



Large dam locations



Houston, TX

Ready to use GIS data in catchments and buffers

NATIONAL FISH HABITAT PARTNERSHIP

PRESENTING ASSESSMENT RESULTS

1. National-scale presentation of information (focus on conterminous US)

2. Partnership results

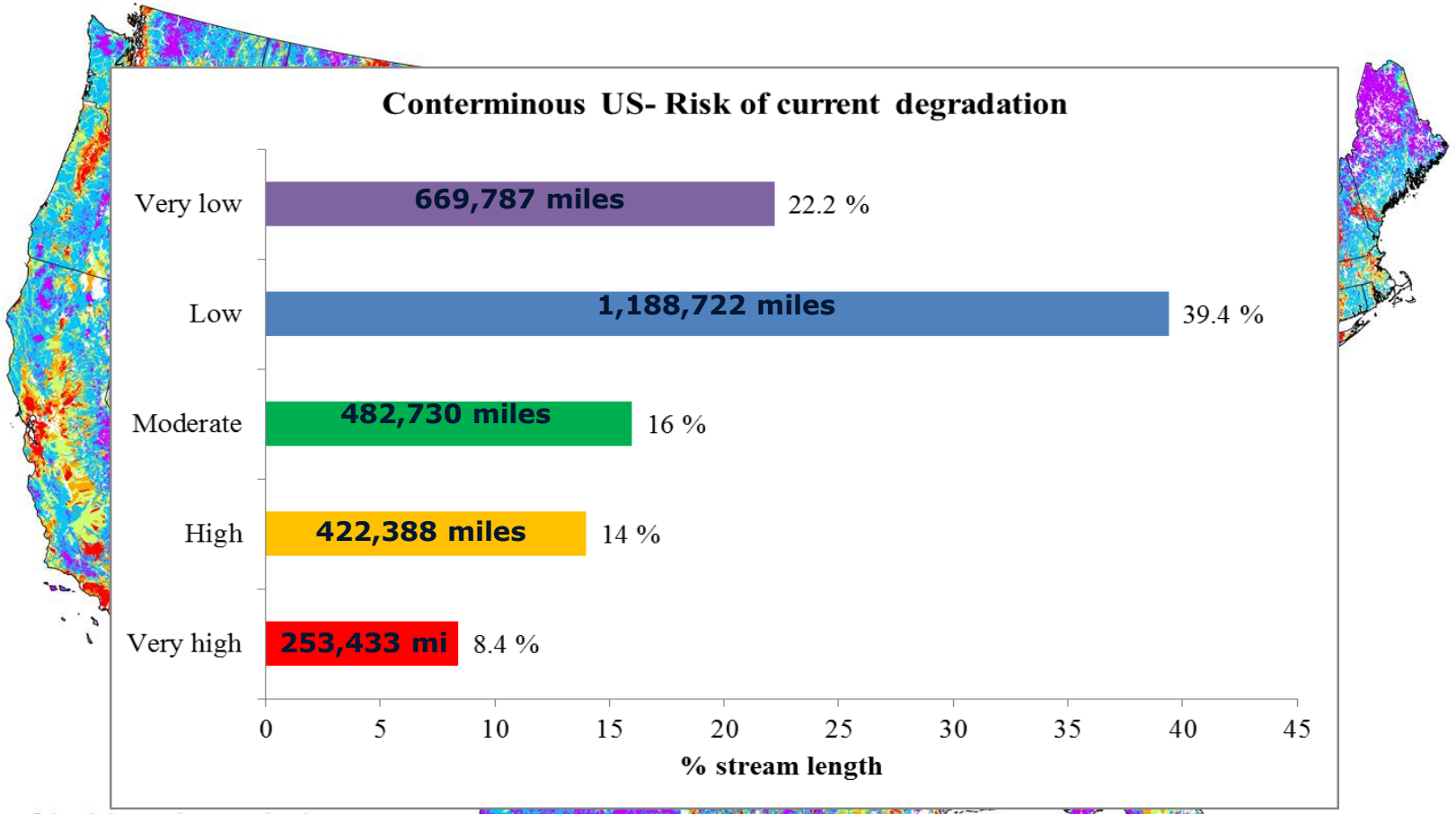
3. State and regional results

- Due to the diversity of information generated through the assessment process, next slides should be considered examples only

- Many, many options for using assessment results and data to support decision-making on where and how to prioritize actions to conserve fish habitats

1. NATIONAL-SCALE RESULTS: CONTERMINOUS US, HAWAII, AND ALASKA

2015 ASSESSMENT OF STREAM FISH HABITATS FOR THE CONTERMINOUS UNITED STATES



Risk of habitat degradation

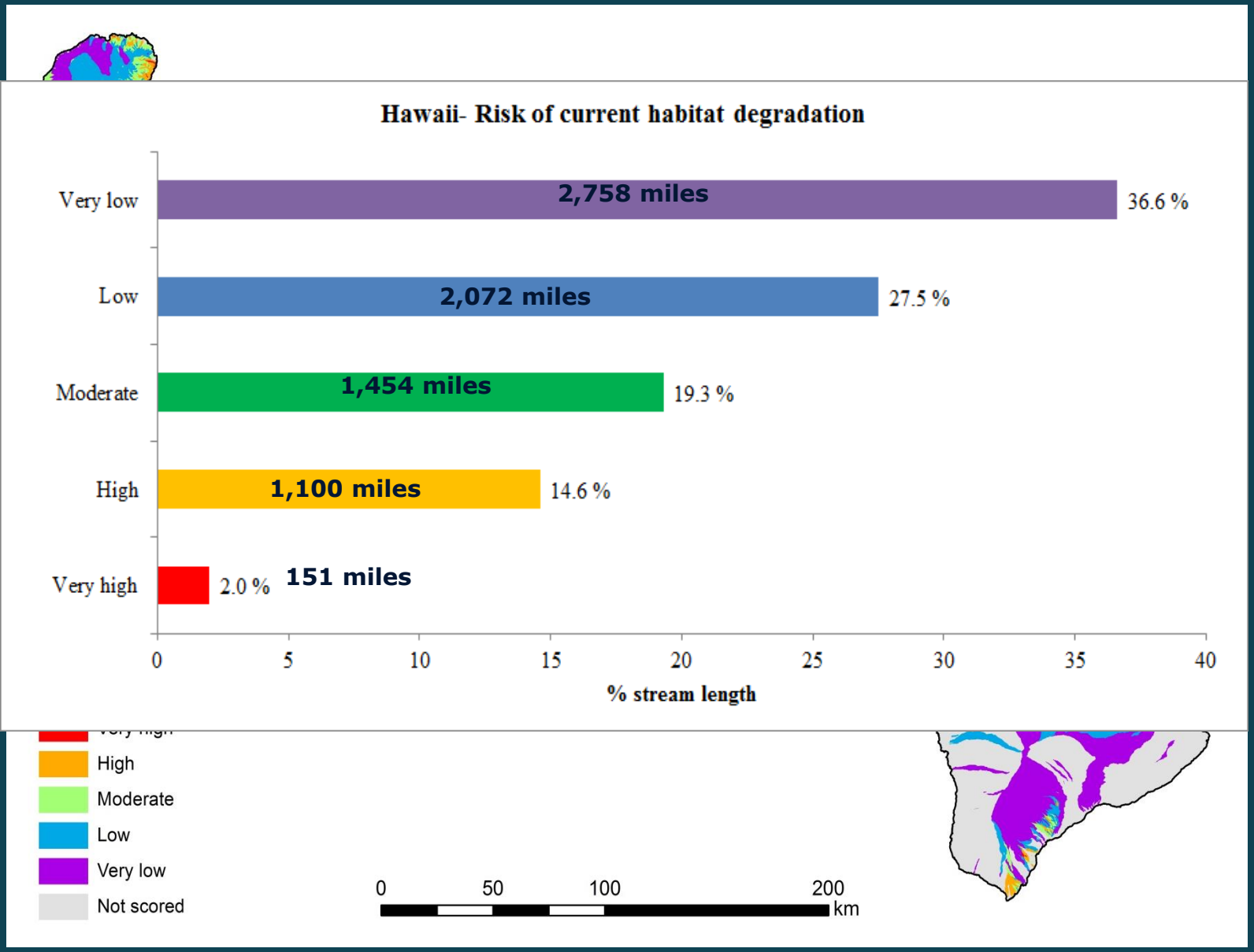
- Very high
- High
- Moderate
- Low
- Very Low

0 500 1,000 2,000 km

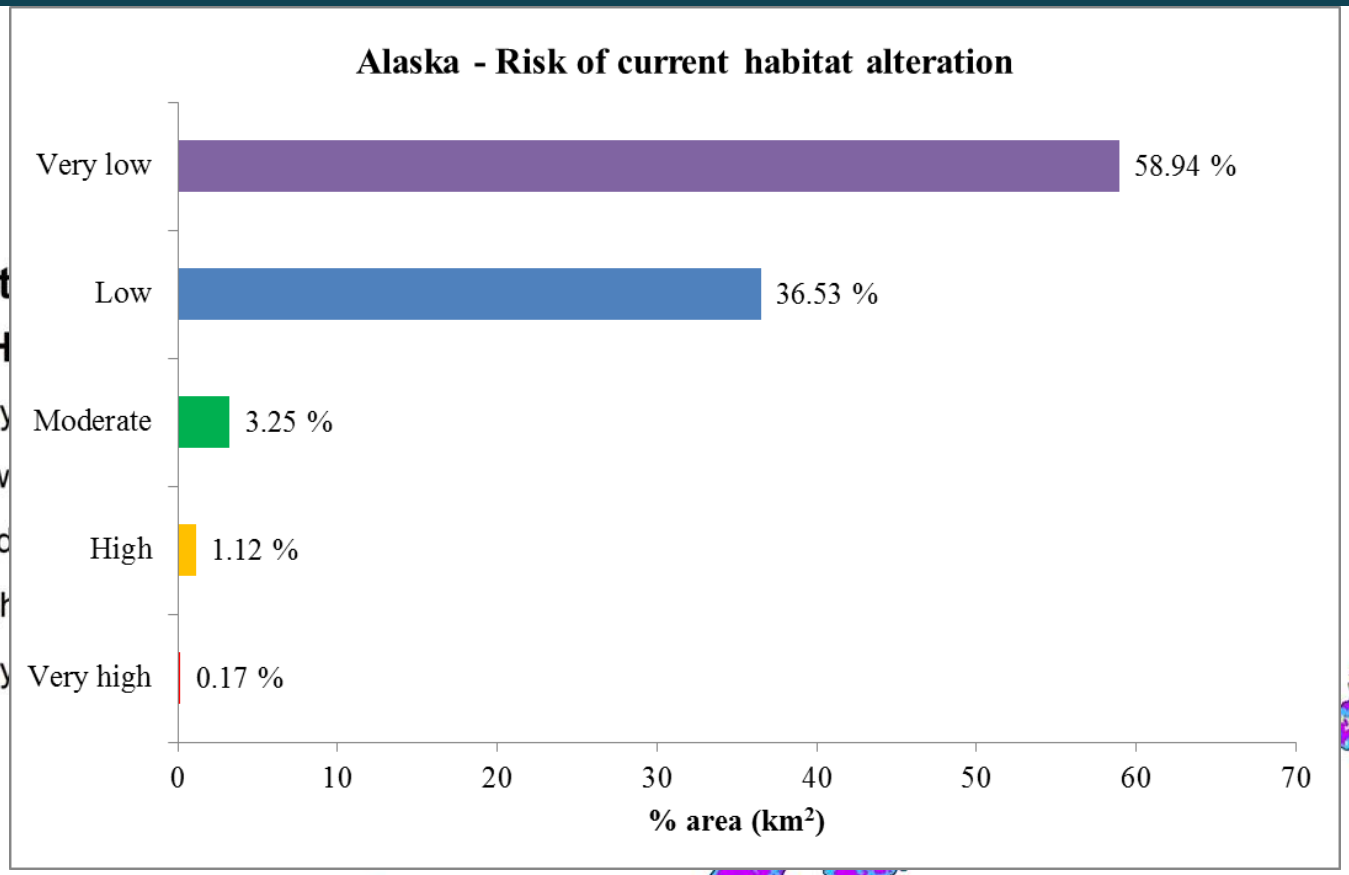
N W E S

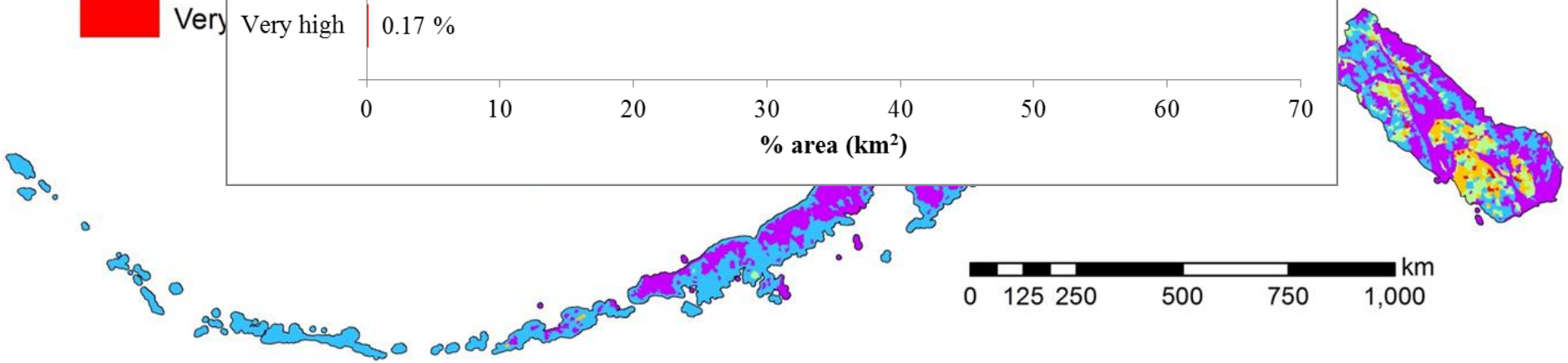
NATIONAL FISH HABITAT PARTNERSHIP

2015 ASSESSMENT OF STREAM FISH HABITATS FOR HAWAII

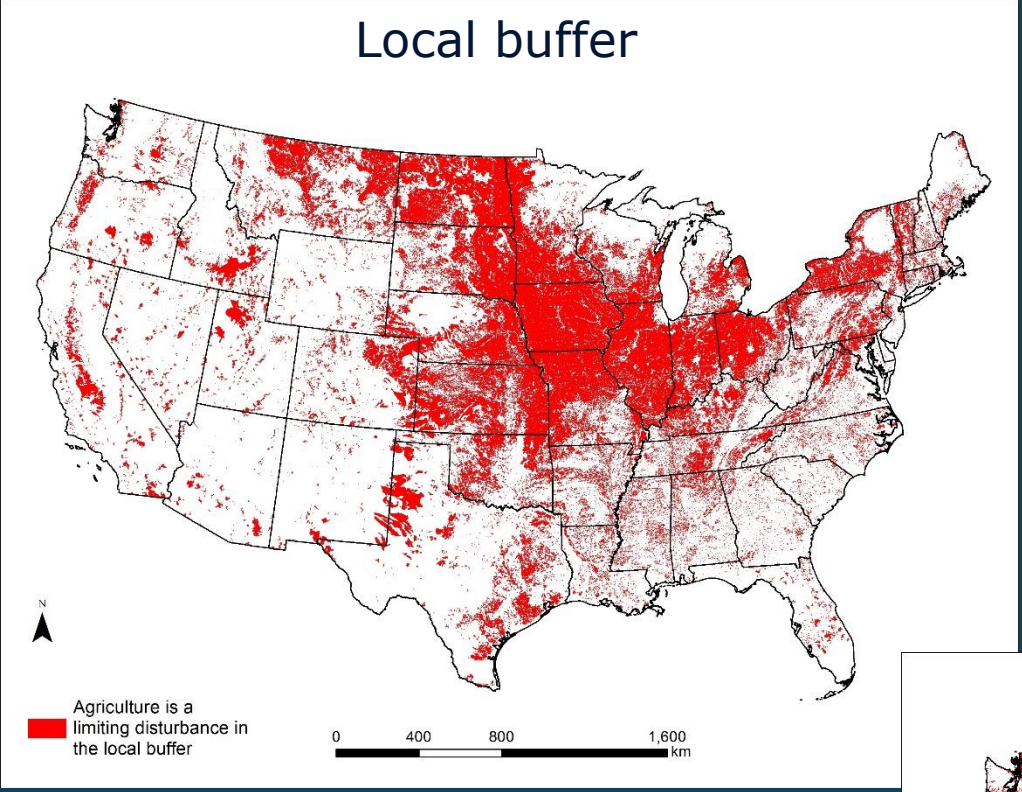


2015 ASSESSMENT OF STREAM FISH HABITATS FOR ALASKA





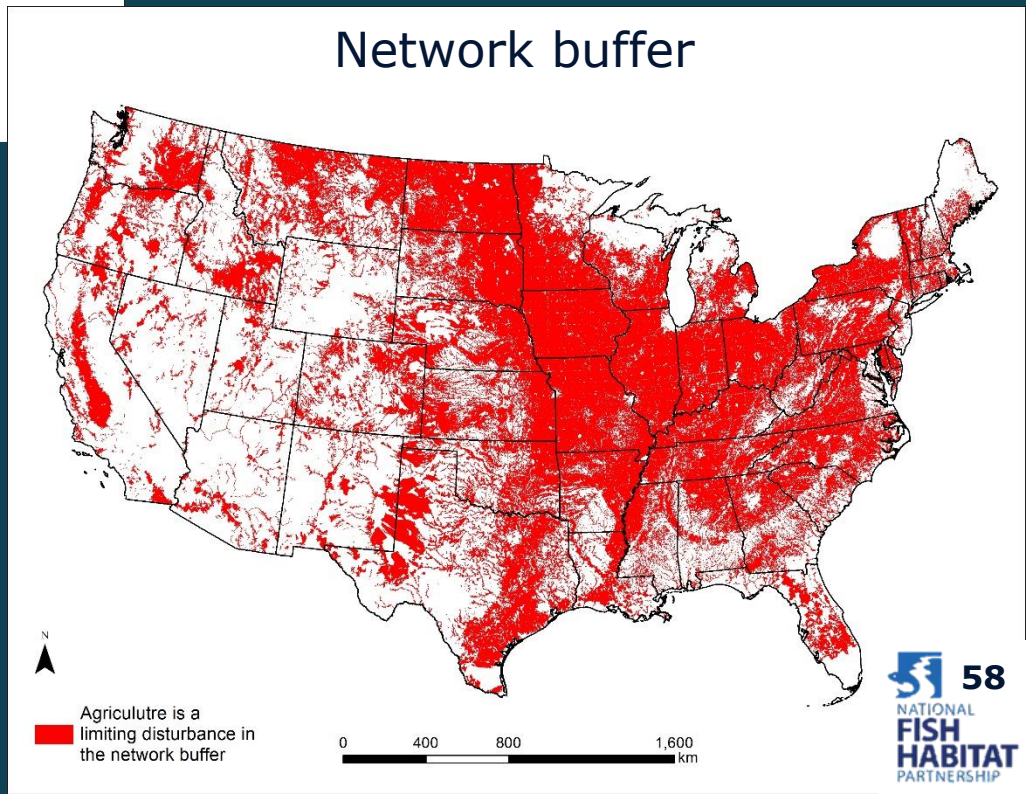
Local buffer



Agriculture as a limiting disturbance in local and network stream buffers

Limiting disturbance = any disturbance that results in a stream reach not being in the best condition class

Network buffer



NATIONAL FISH HABITAT PARTNERSHIP

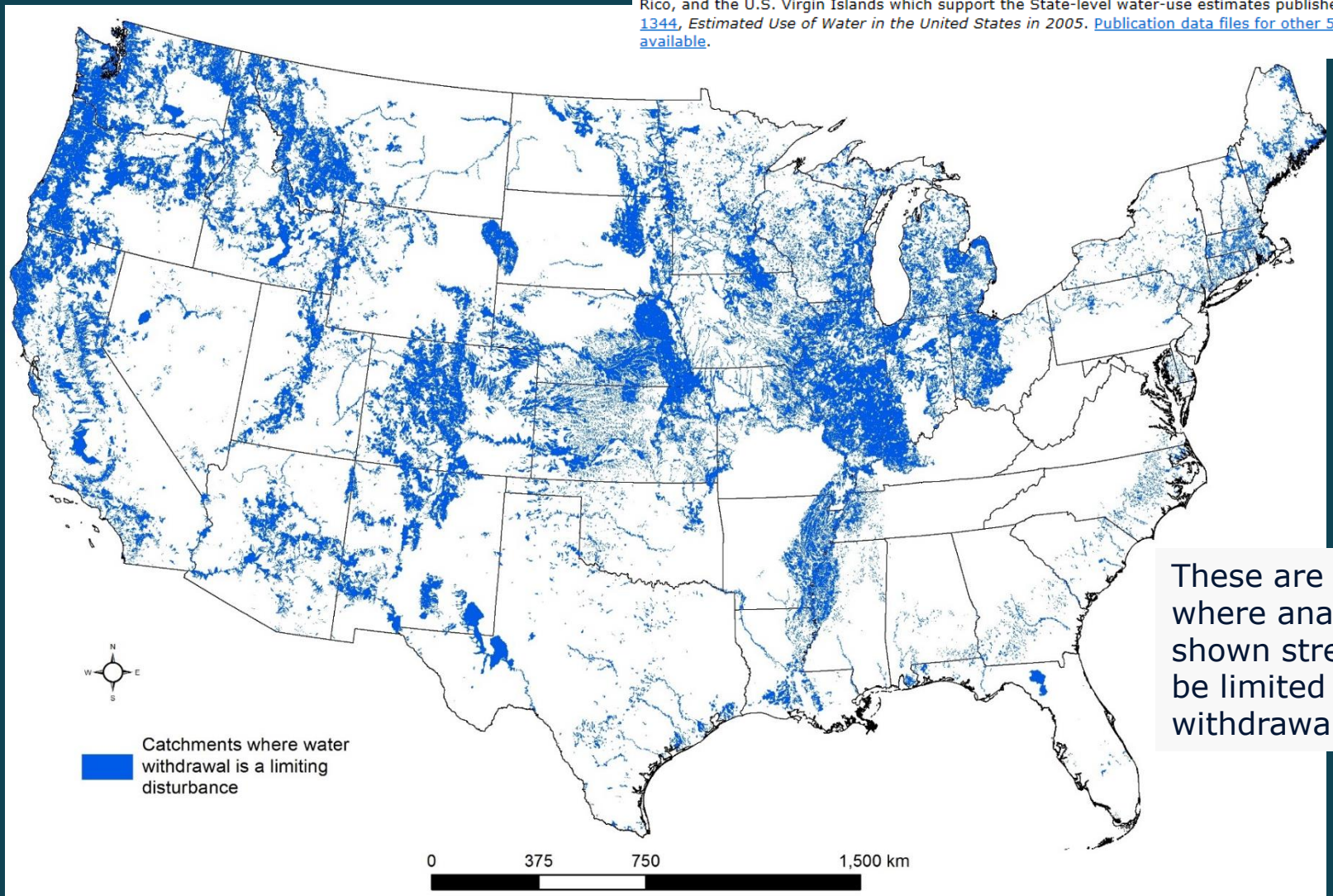
WATER WITHDRAWALS AS A LIMTING DISTURBANCE TO FISH HABITAT

http://water.usgs.gov/watuse/data/2005/index.html

Estimated Use of Water in the United States County-Level Data for 2005

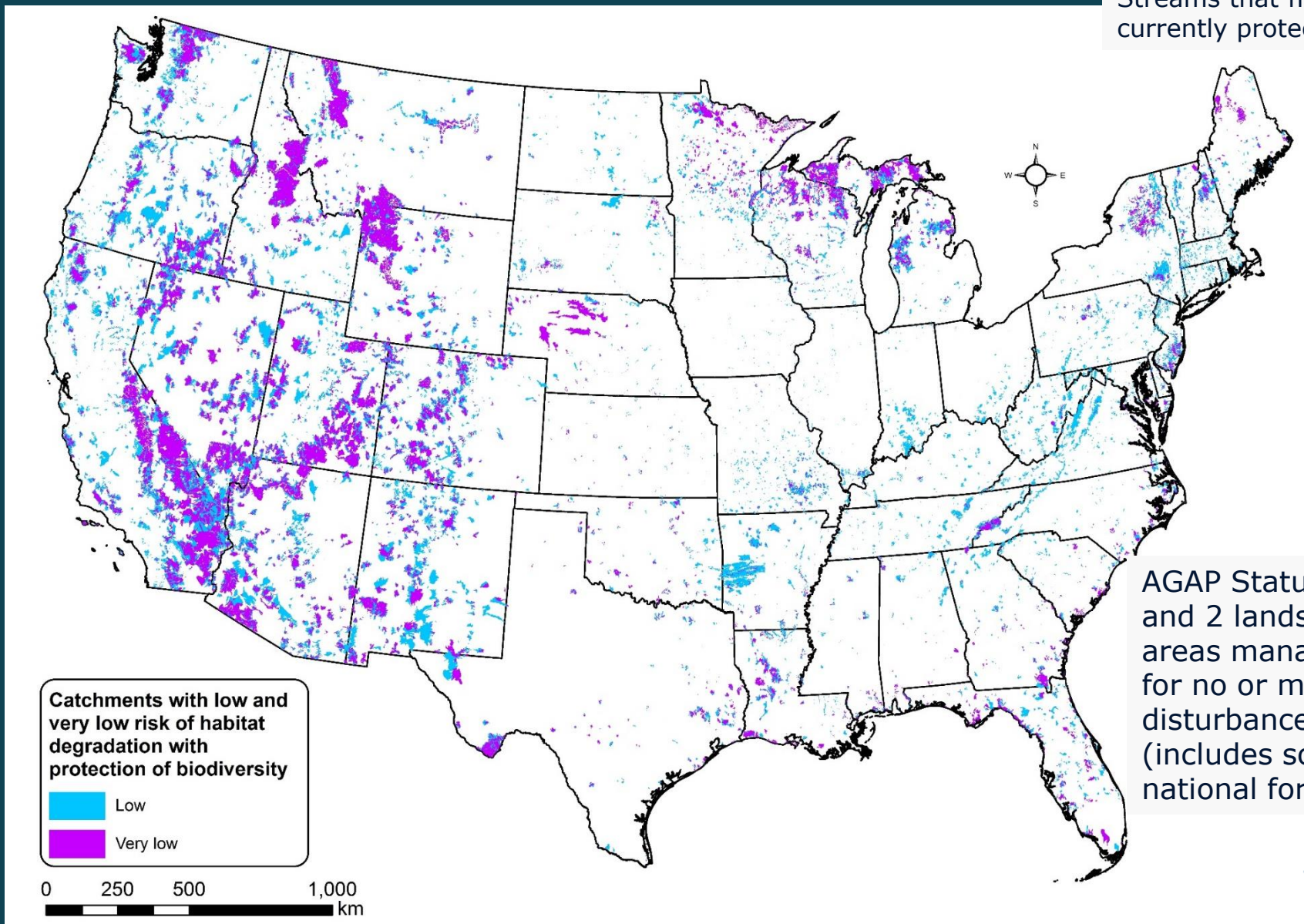
The current best estimates of county, State, and national water-use data may be downloaded from the National Water Information System Web (NWISWeb) interface, Water Data for the Nation, by selecting the Water Use button or data category pull-down. Data on NWISWeb may have been revised from previous publications such as Circular 1344.

These data files present water-use estimates by county for the United States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands which support the State-level water-use estimates published in USGS Circular 1344, *Estimated Use of Water in the United States in 2005*. Publication data files for other 5-year reports are also available.

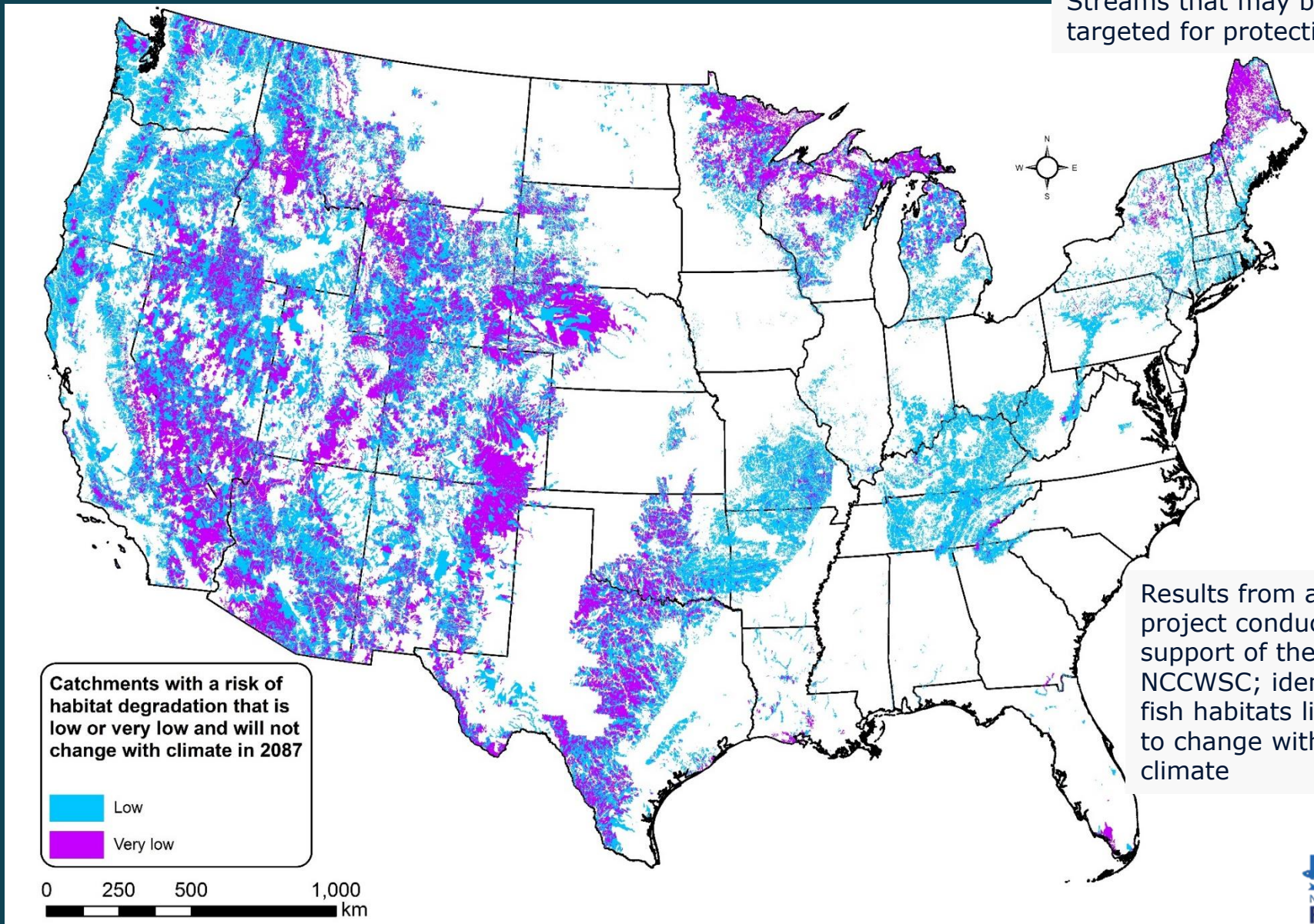


These are locations where analyses have shown streams may be limited by withdrawals

LOW RISK OF HABITAT DEGRADATION AND LARGE AMOUNTS OF PROTECTED LANDS IN CATCHMENTS



LOW RISK OF HABITAT DEGRADATION AND NOT LIKELY TO CHANGE WITH CLIMATE BY 2087



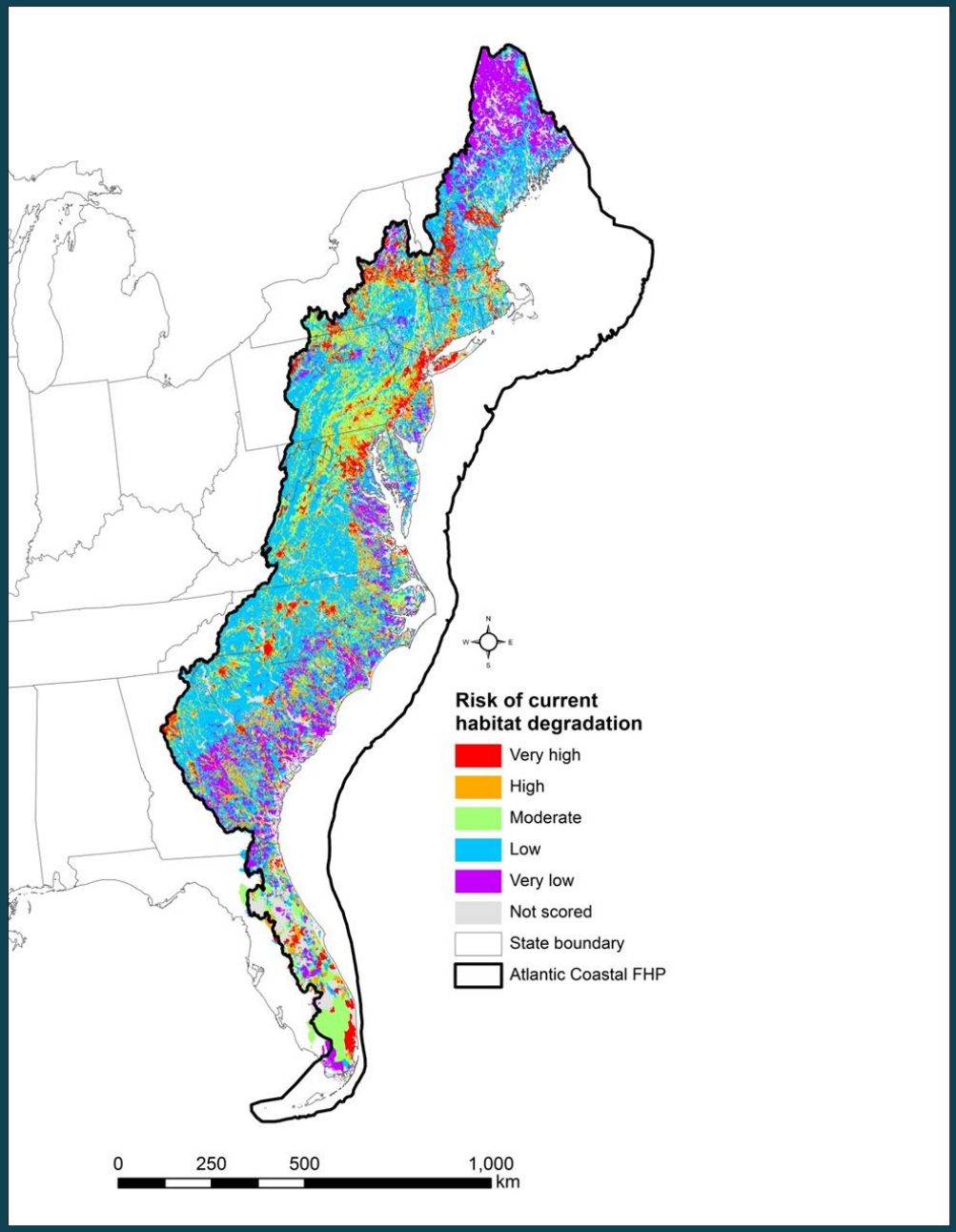
Streams that may be targeted for protection

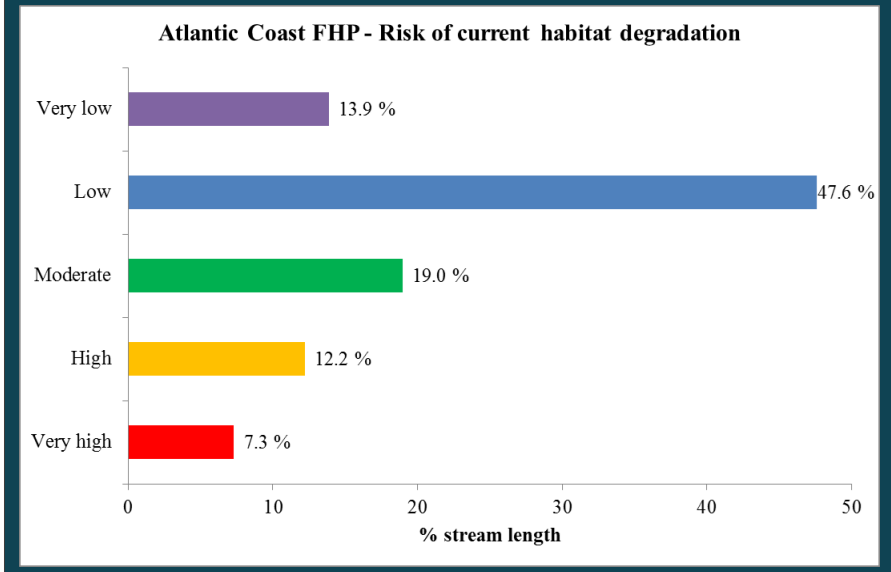
Results from a project conducted in support of the NCCWSC; identified fish habitats likely to change with climate

NATIONAL FISH HABITAT PARTNERSHIP

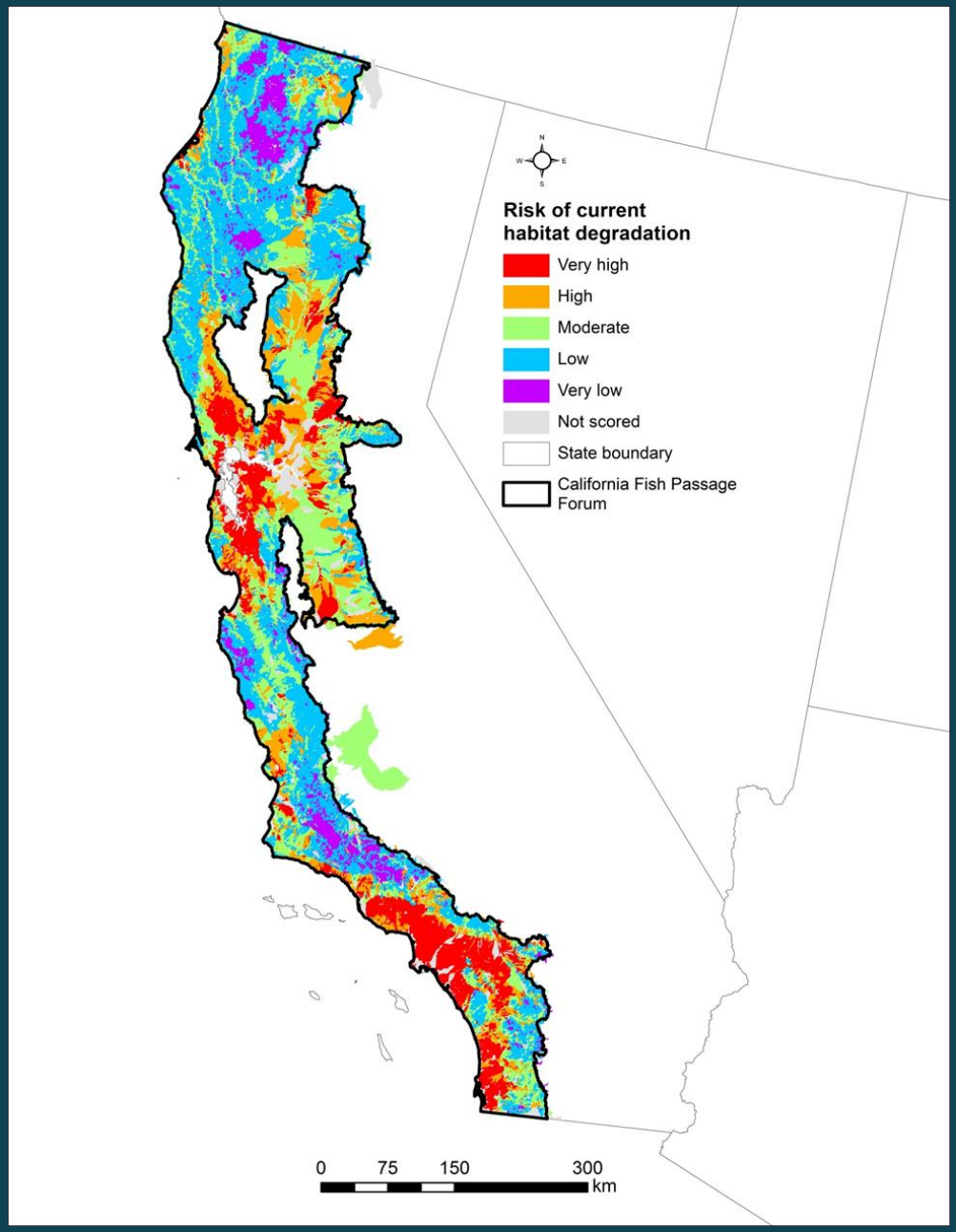
2. PARTNERSHIP-LEVEL RESULTS

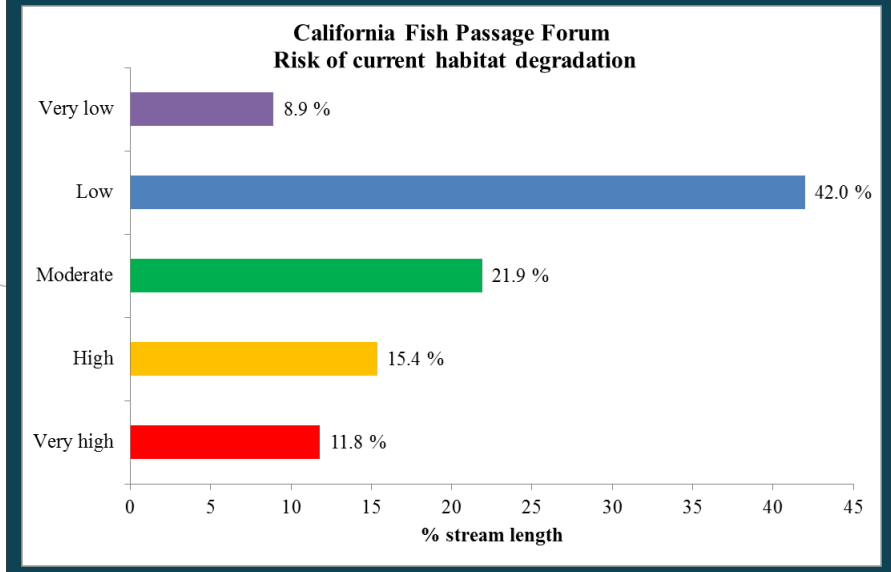
ATLANTIC COAST FISH HABITAT PARTNERSHIP



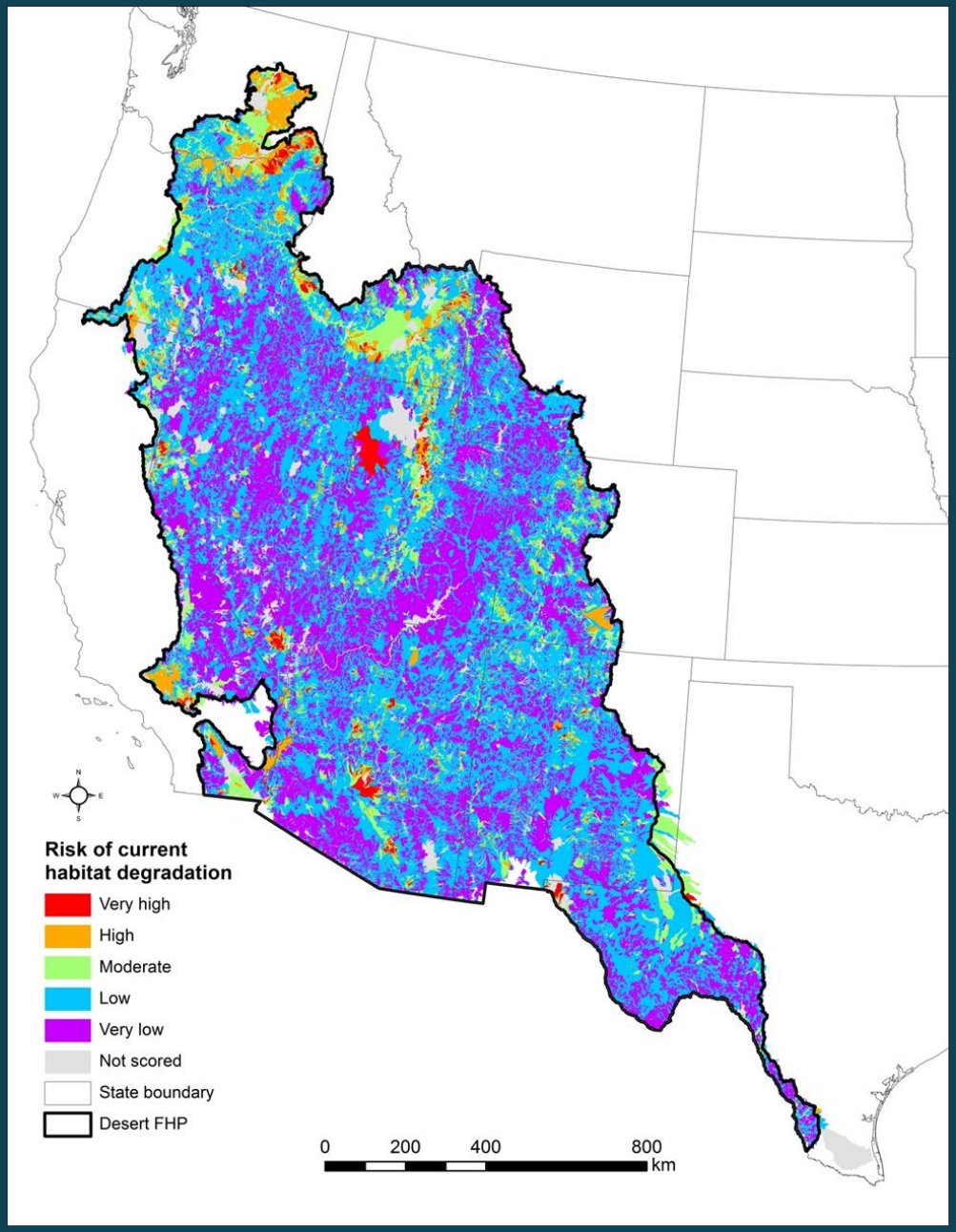


CALIFORNIA FISH PASSAGE FORUM

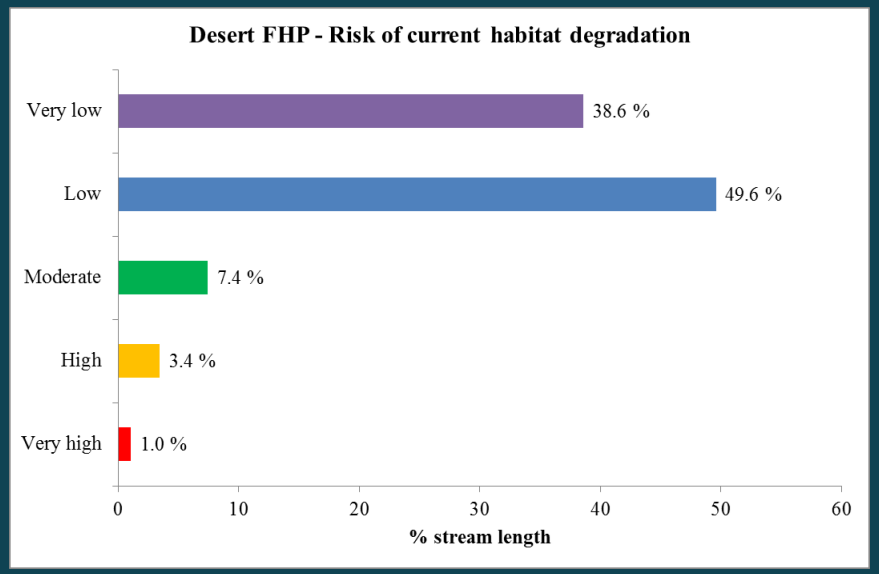




DESERT FISH HABITAT PARTNERSHIP

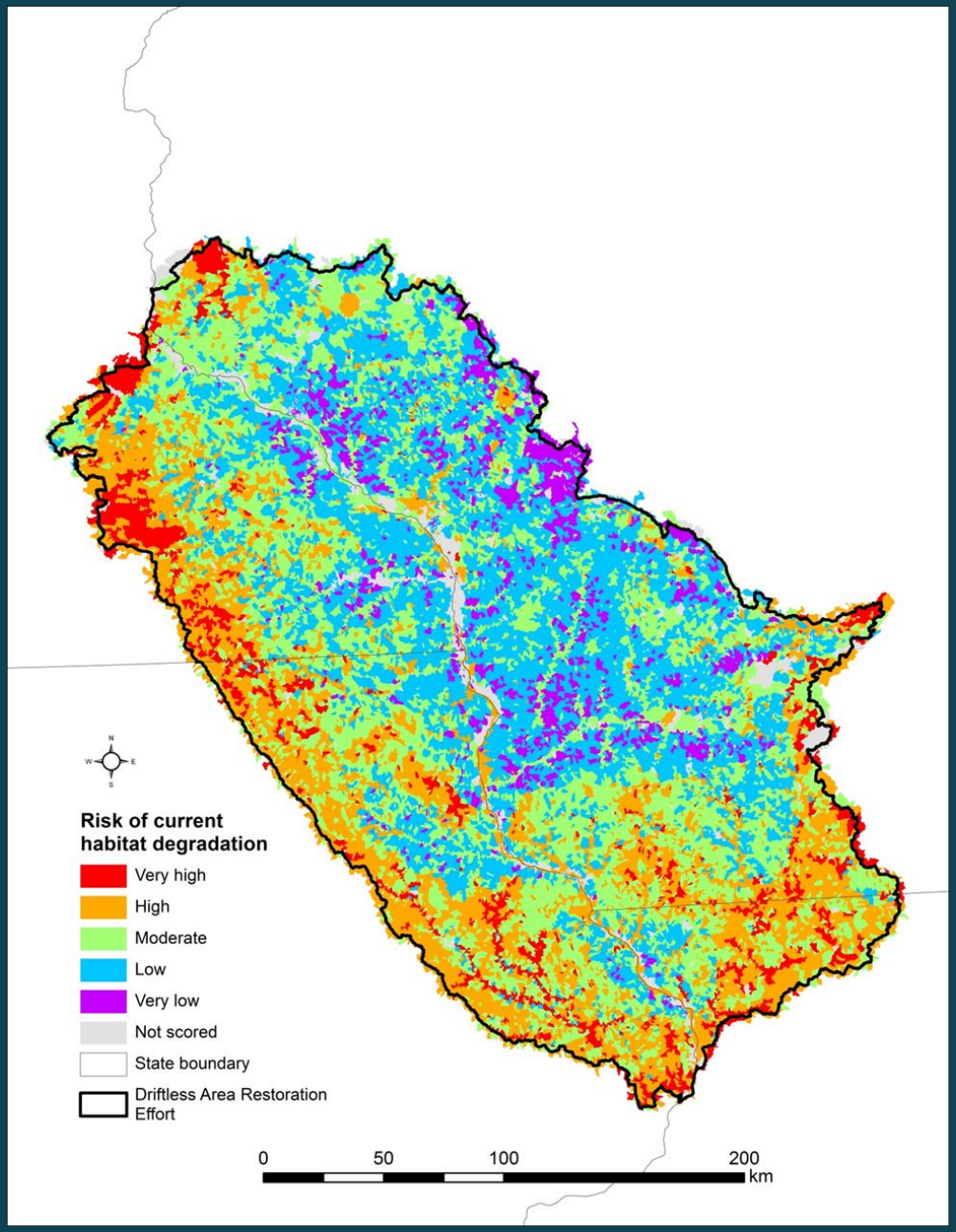


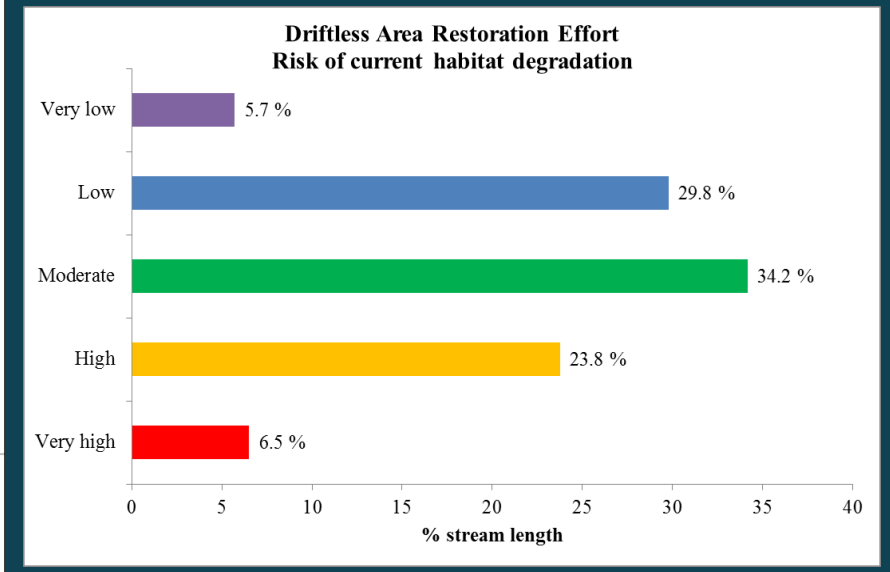
DESERT FISH HABITAT PARTNERSHIP



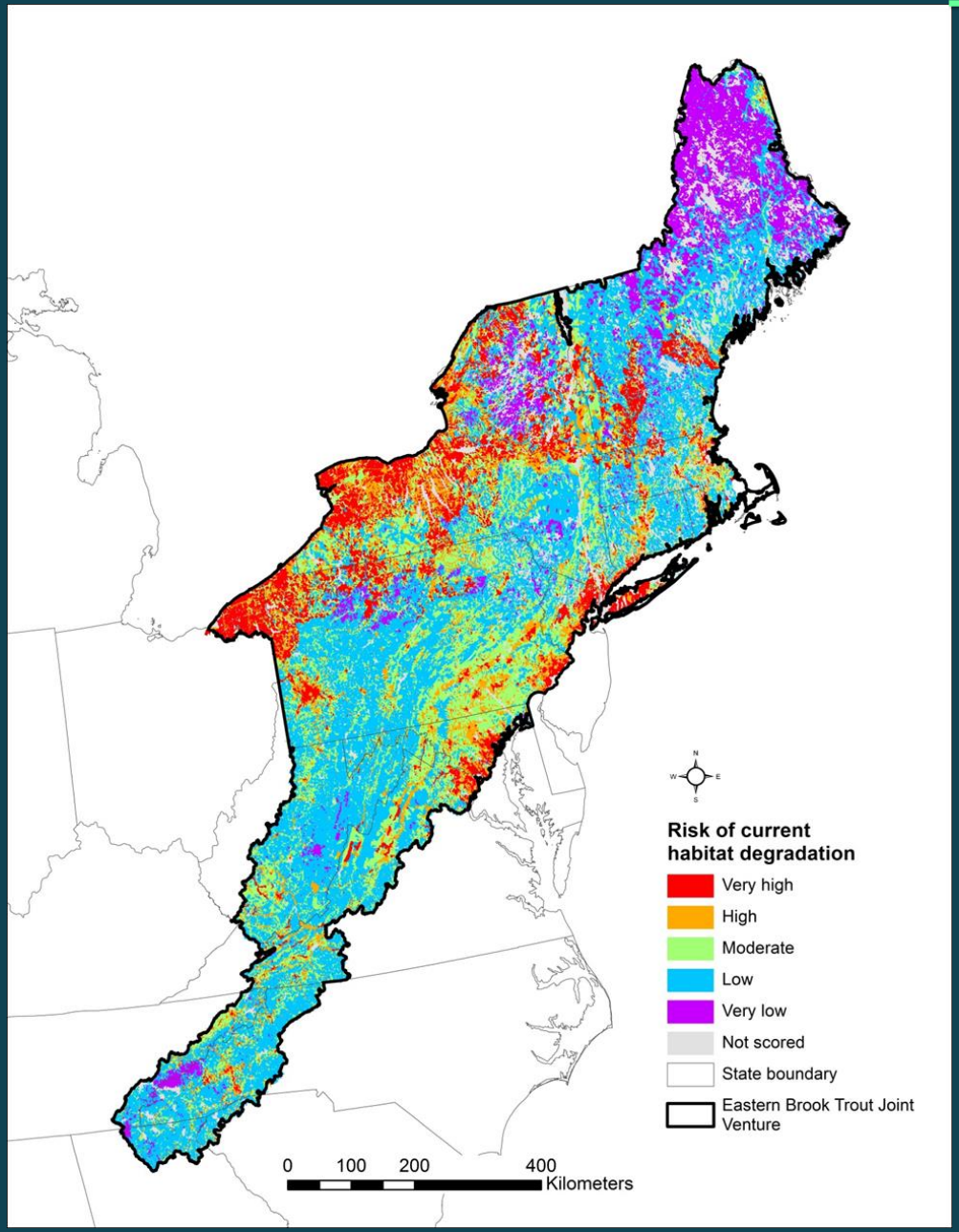
NATIONAL FISH HABITAT PARTNERSHIP

DRIFTLESS AREA RESTORATION EFFORT

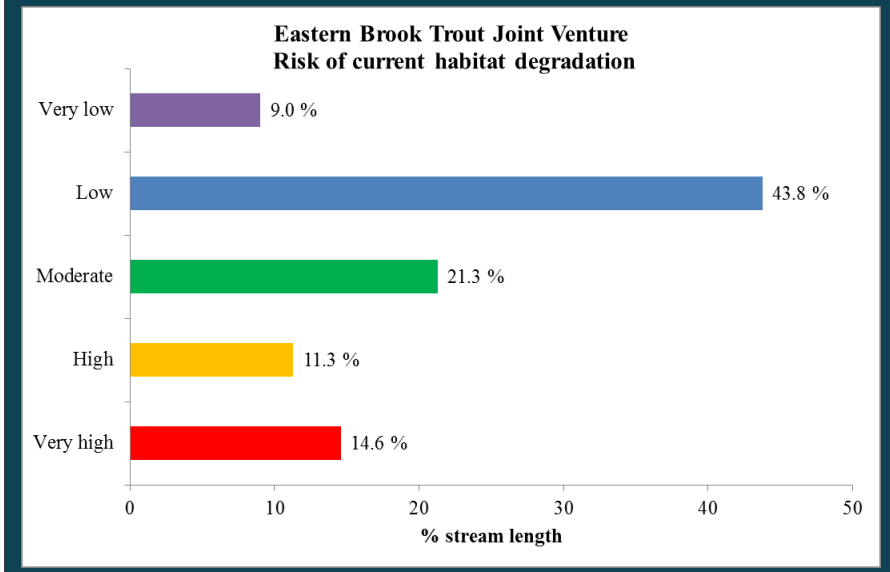




EASTERN BROOK TROUT JOINT VENTURE

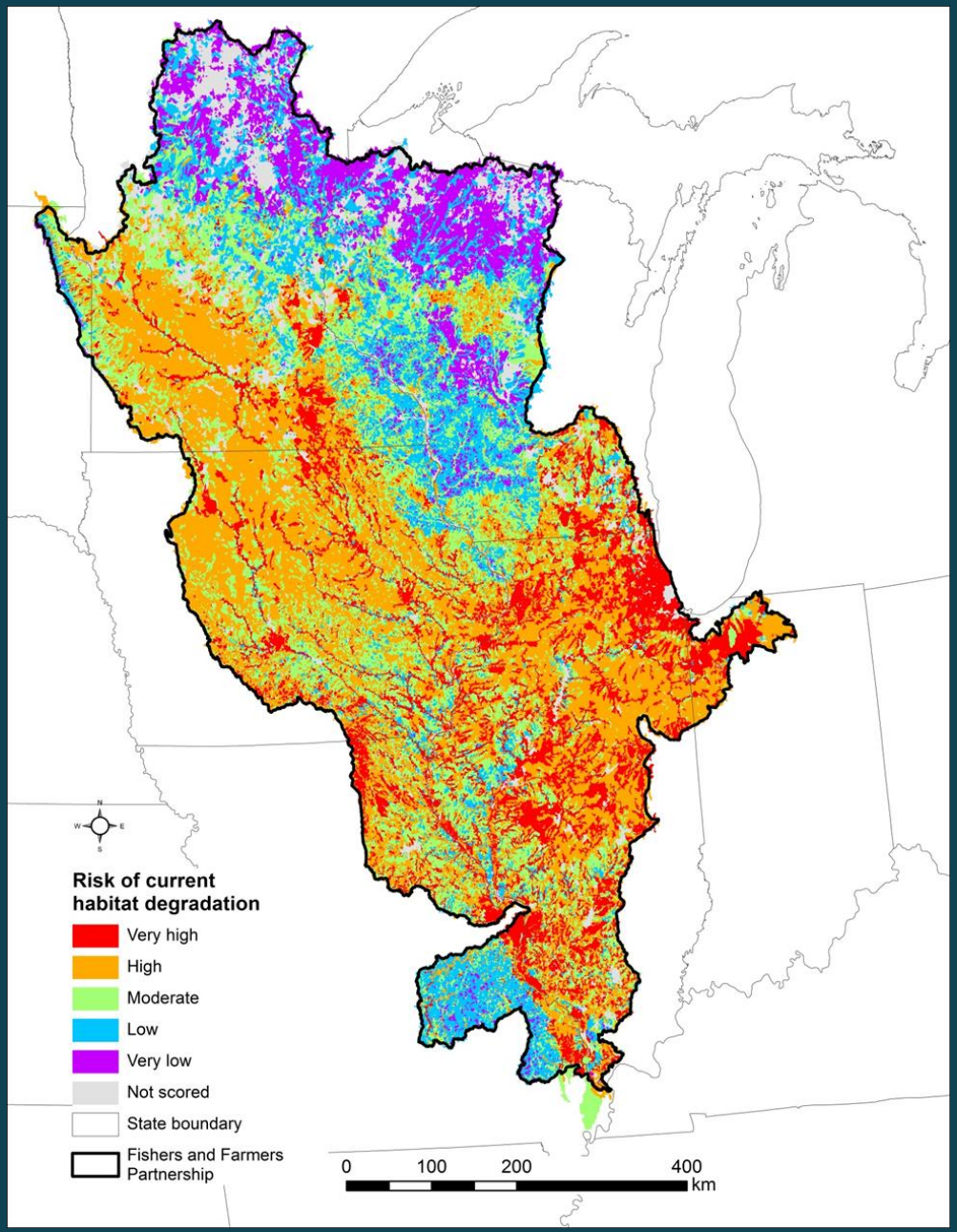


Eastern Brook Trout
JOINT VENTURE
A Fish Habitat Partnership

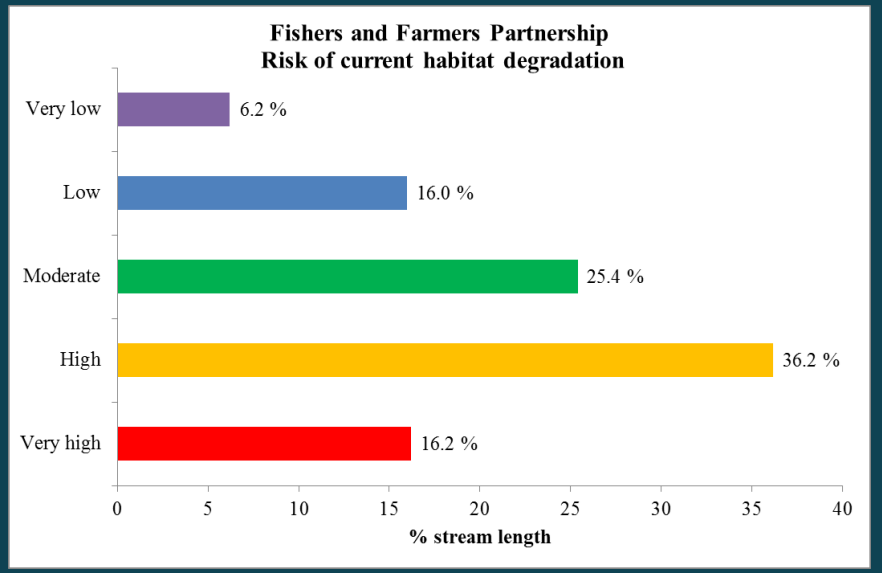


NATIONAL FISH HABITAT PARTNERSHIP

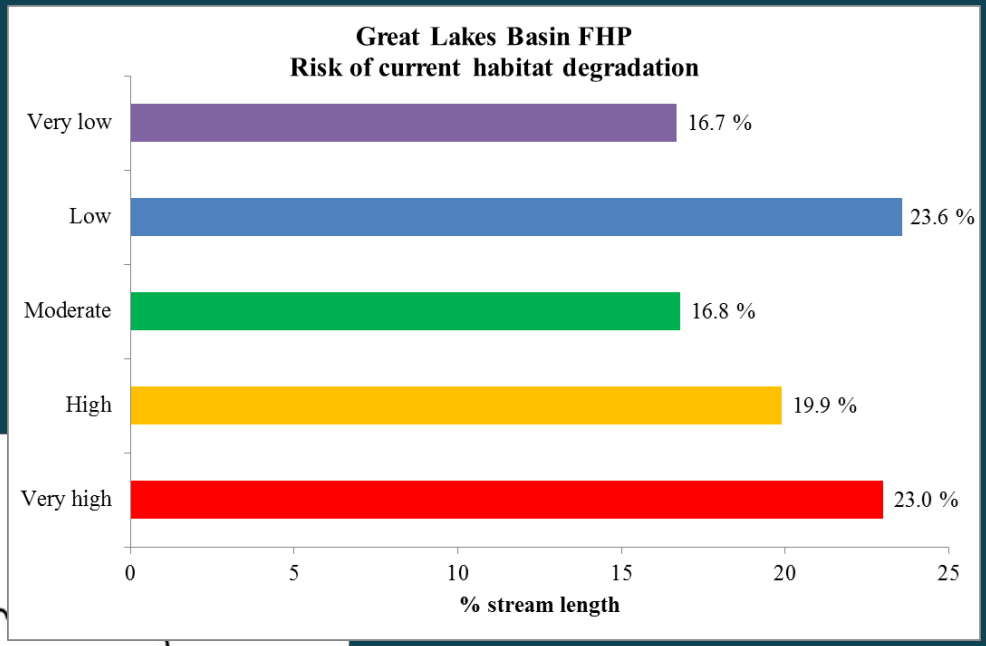
FISHERS AND FARMERS PARTNERSHIP

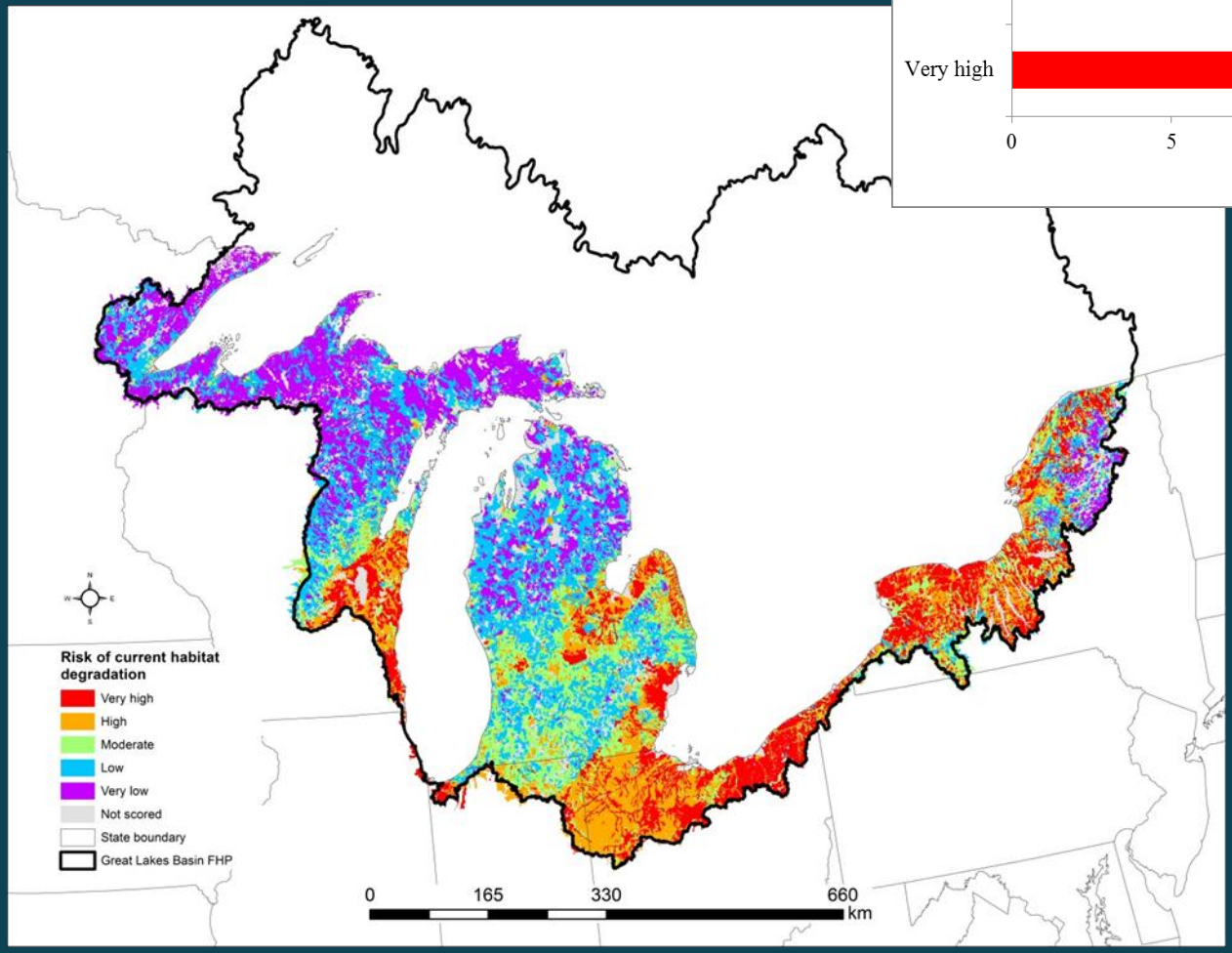


Fishers & Farmers Partnership for the Upper Mississippi River Basin



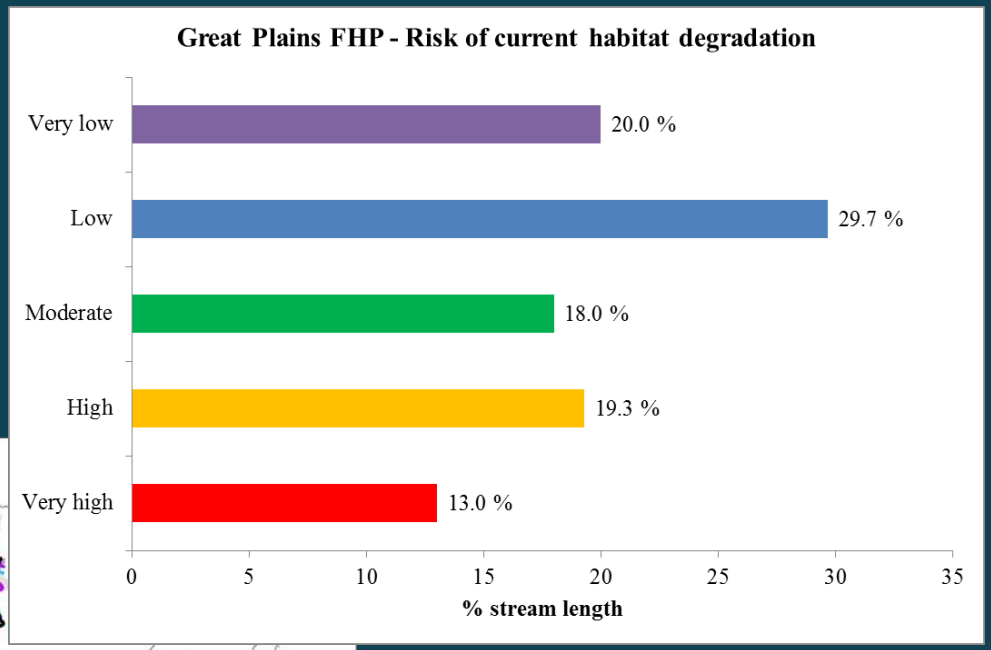
GREAT LAKES BASIN FISH HABITAT PARTNERSHIP

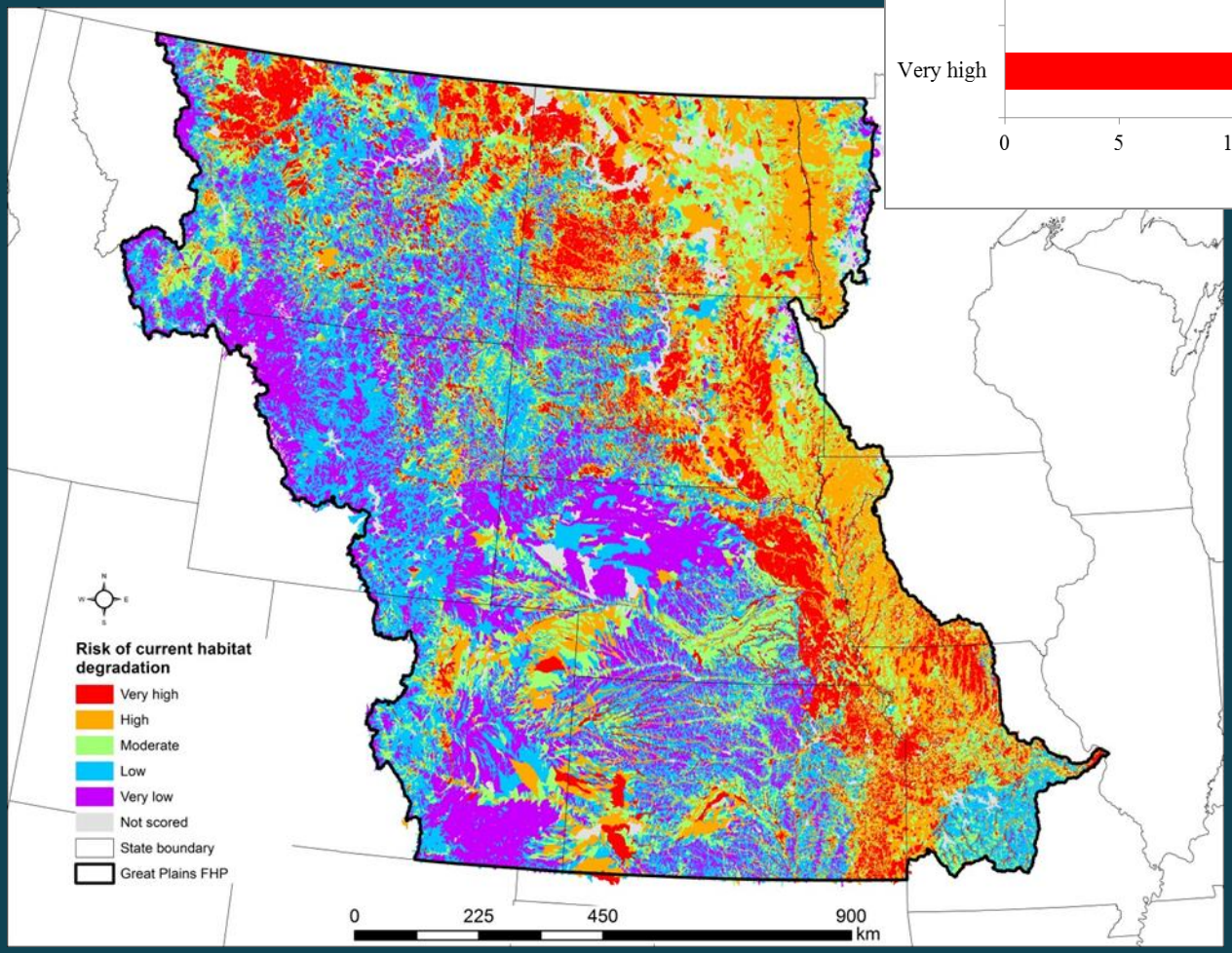




GREAT LAKES BASIN FISH HABITAT PARTNERSHIP

GREAT PLAINS FISH HABITAT PARTNERSHIP



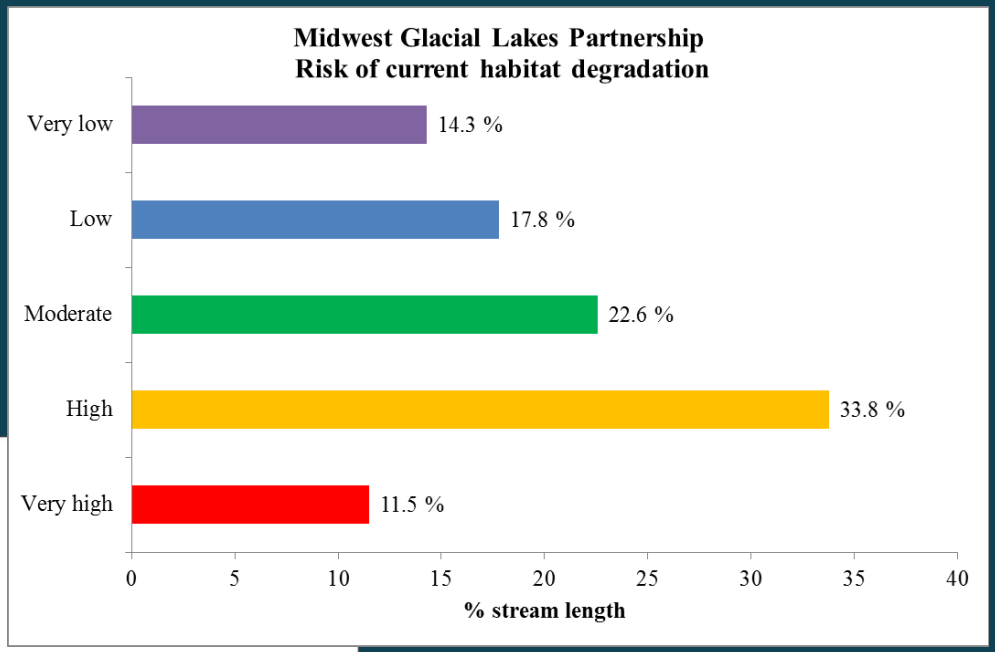


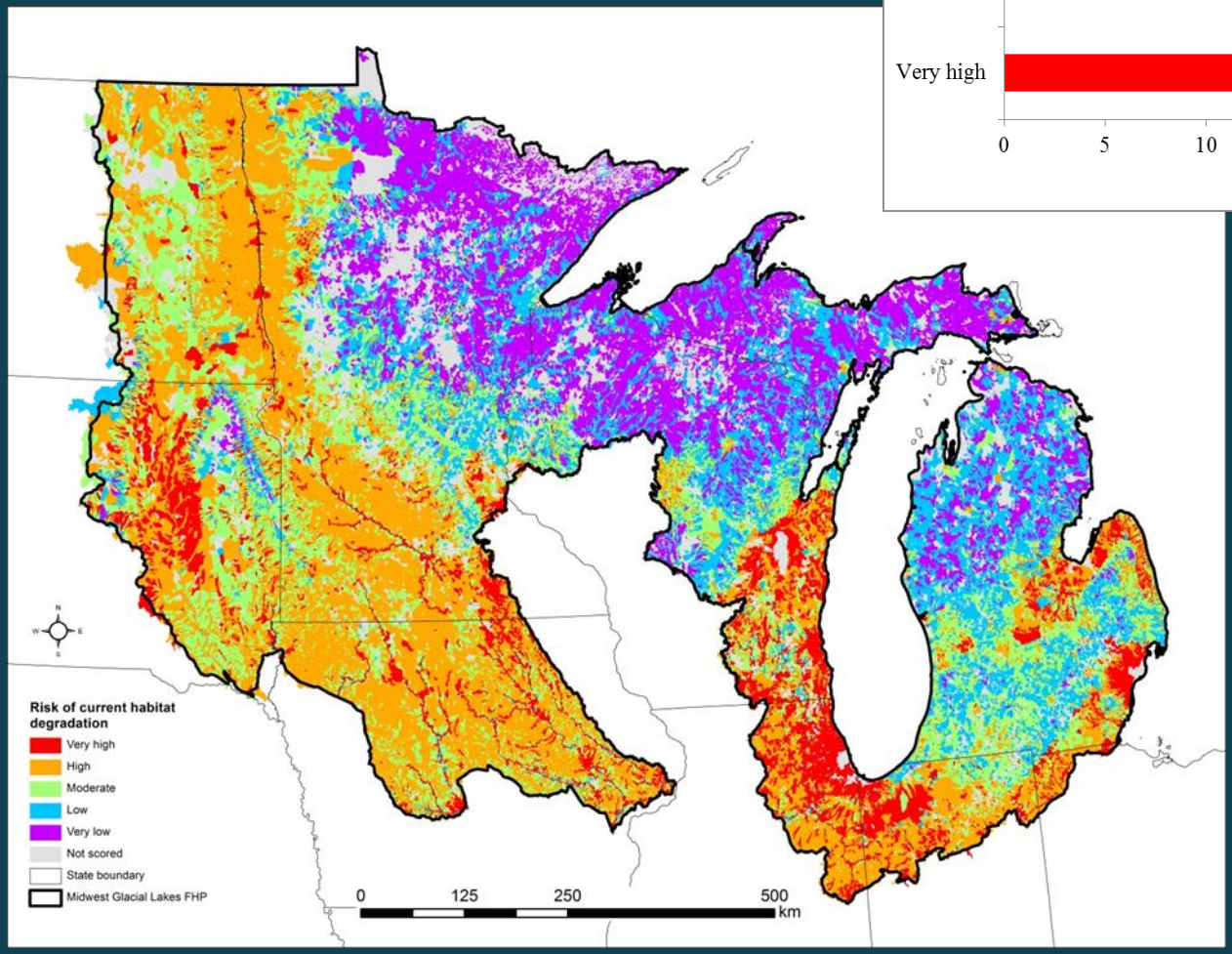
Great Plains

Fish Habitat Partnership

NATIONAL FISH HABITAT PARTNERSHIP

MIDWEST GLACIAL LAKES PARTNERSHIP

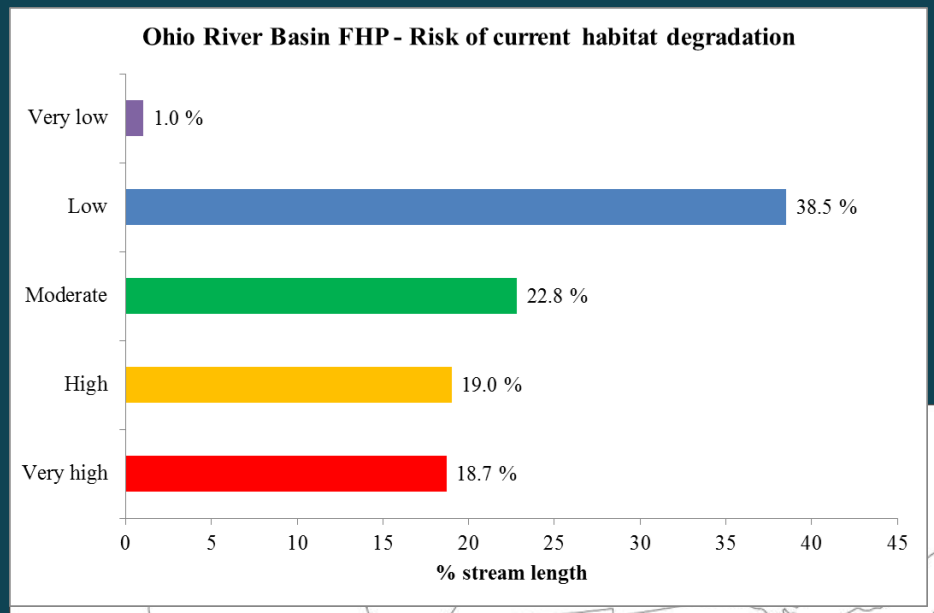


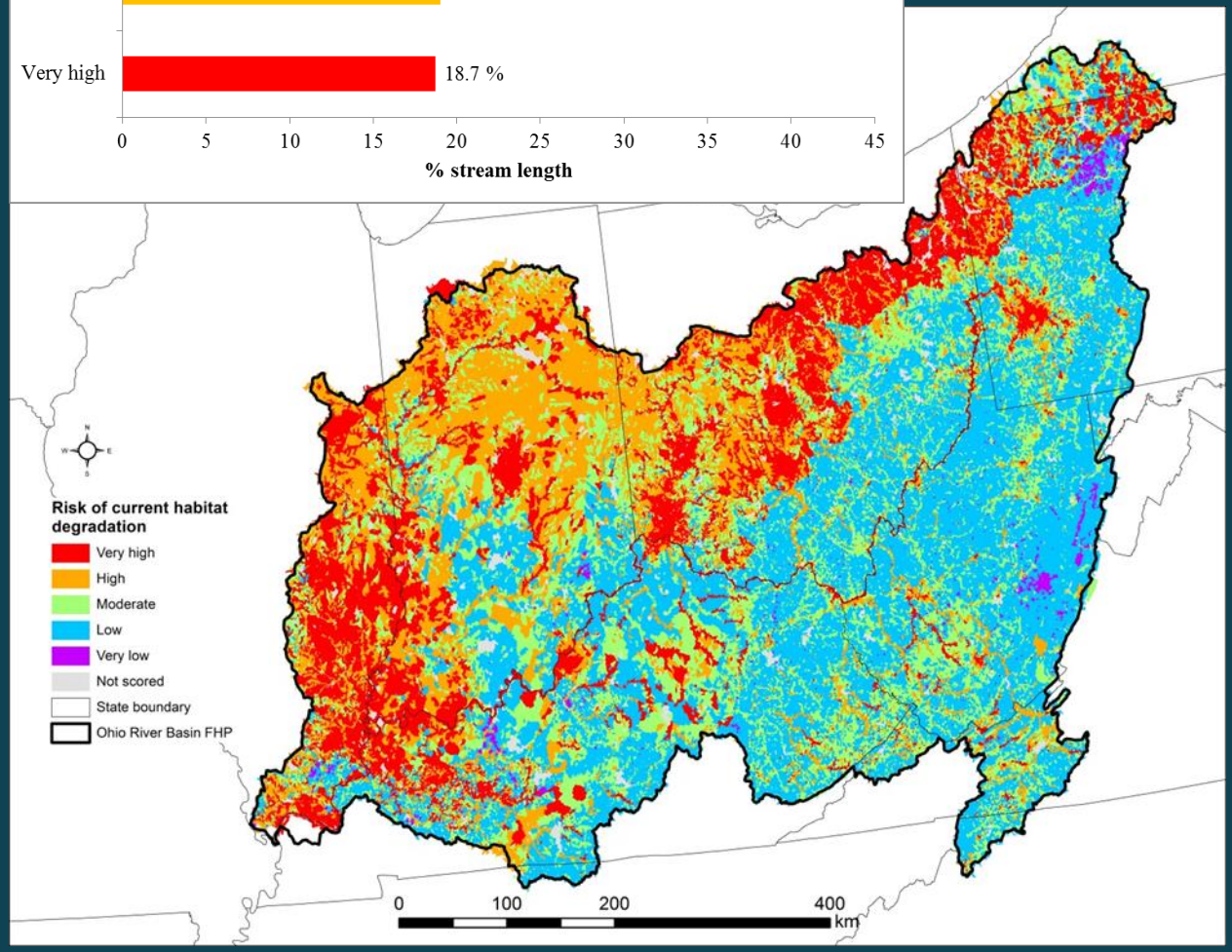


MIDWEST GLACIAL LAKES Partnership

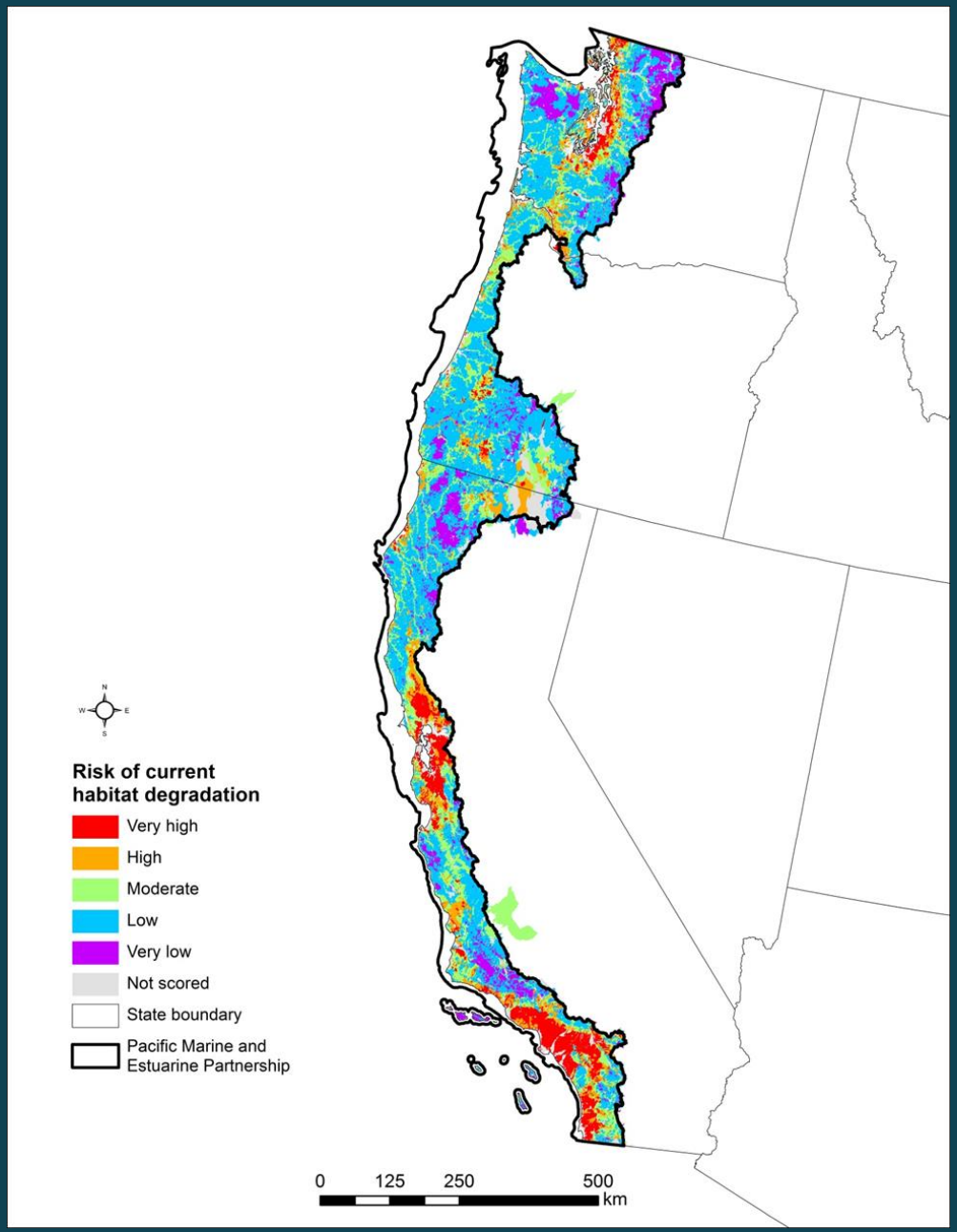
NATIONAL FISH HABITAT PARTNERSHIP

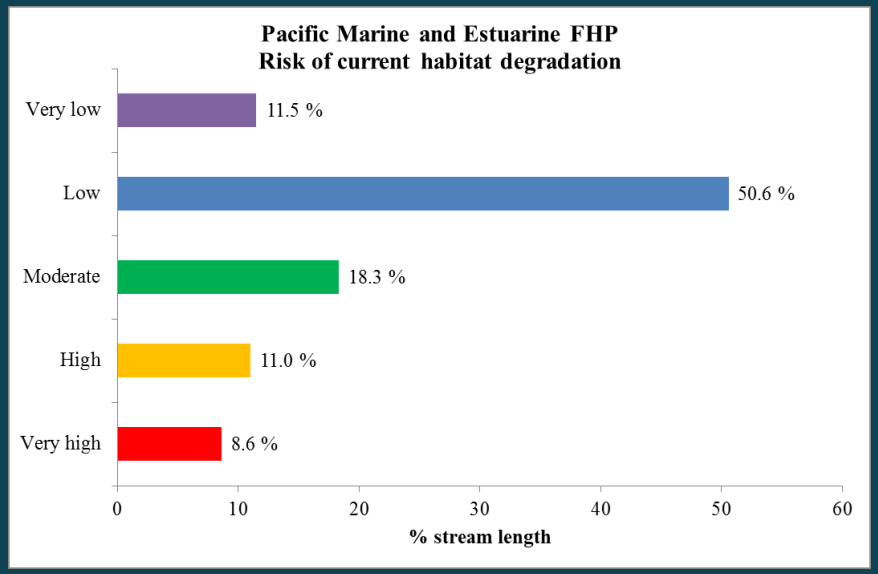
OHIO RIVER BASIN FISH HABITAT PARTNERSHIP



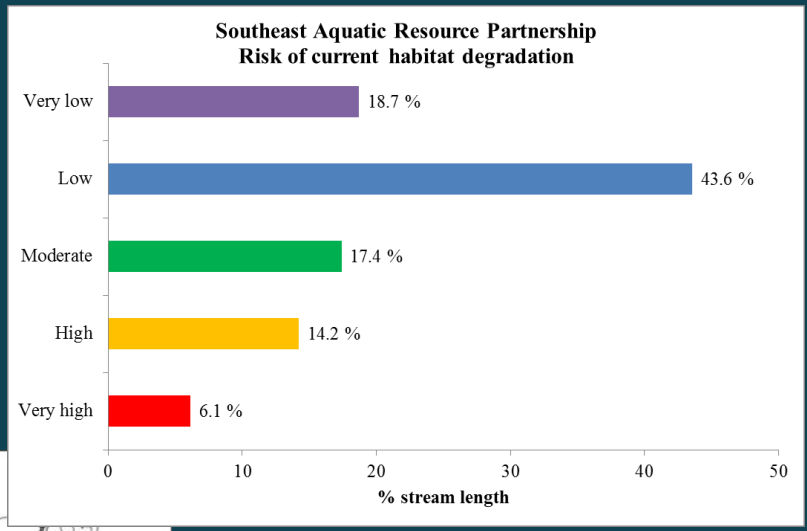


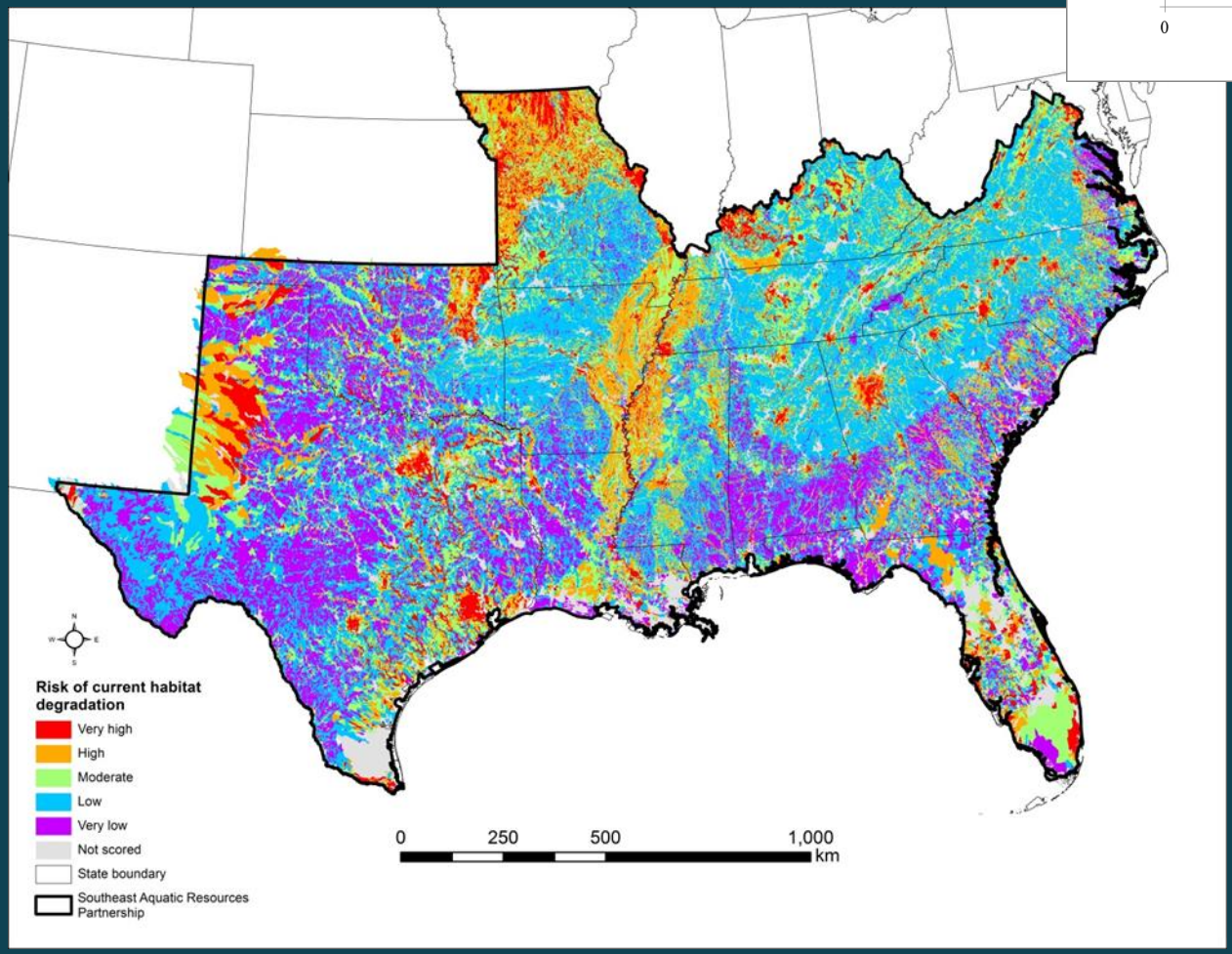
PACIFIC MARINE AND ESTUARINE FISH HABITAT PARTNERSHIP





SOUTHEAST AQUATIC RESOURCES PARTNERSHIP

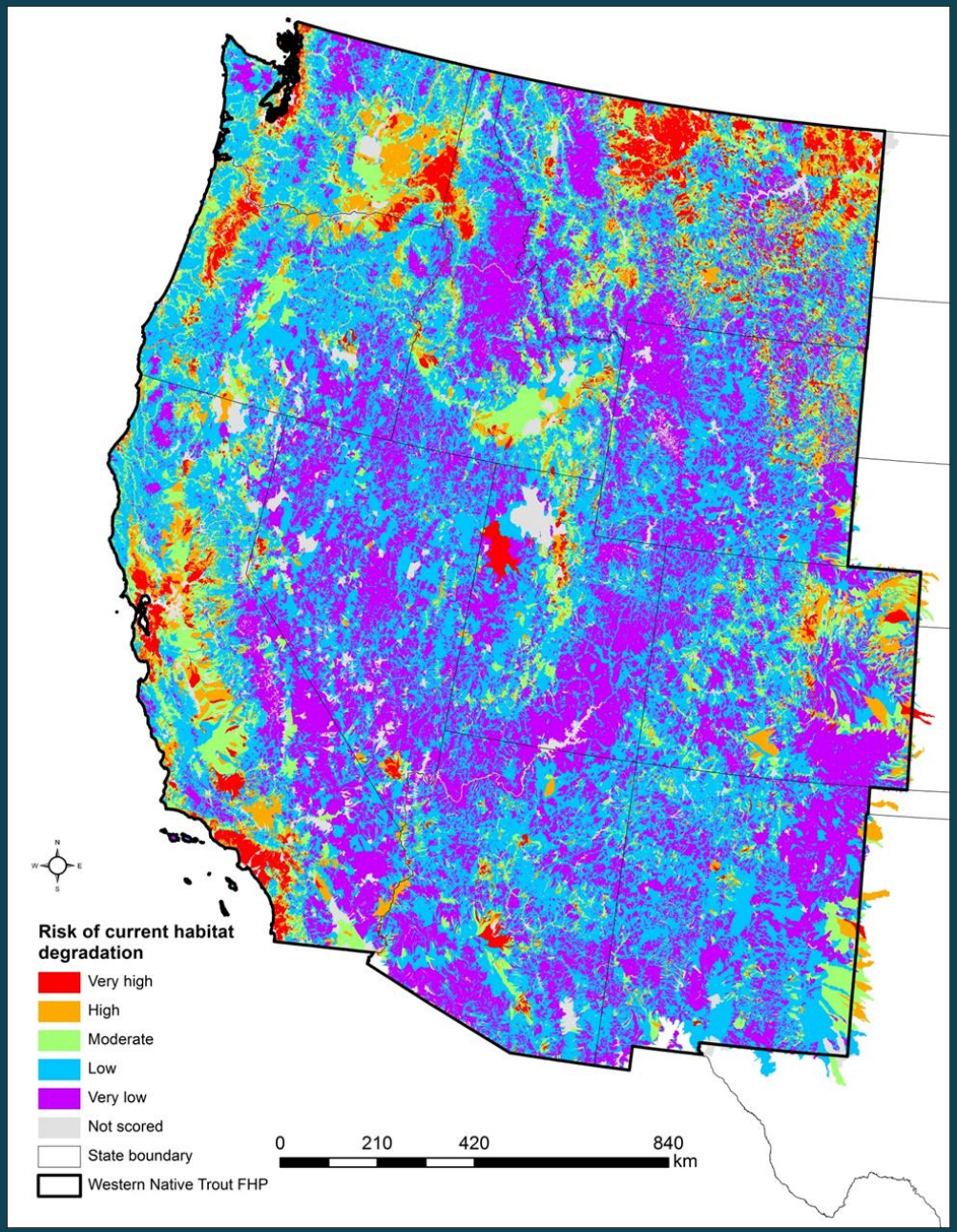




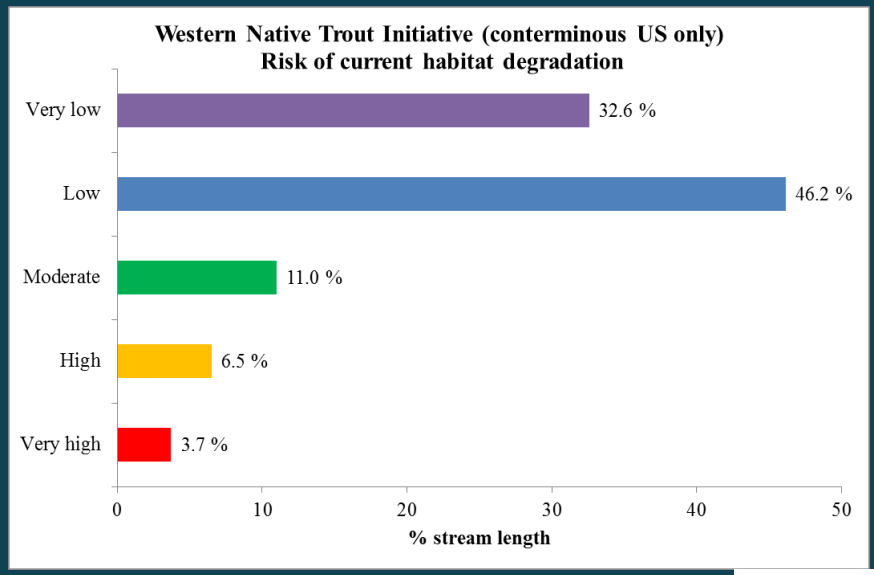
SOUTHEAST AQUATIC RESOURCES PARTNERSHIP
SARP

NATIONAL FISH HABITAT PARTNERSHIP

WESTERN NATIVE TROUT INITIATIVE

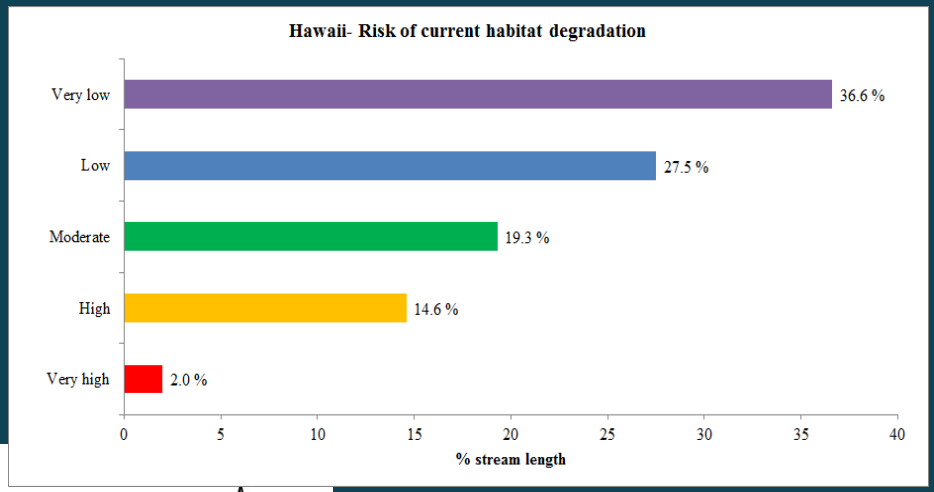


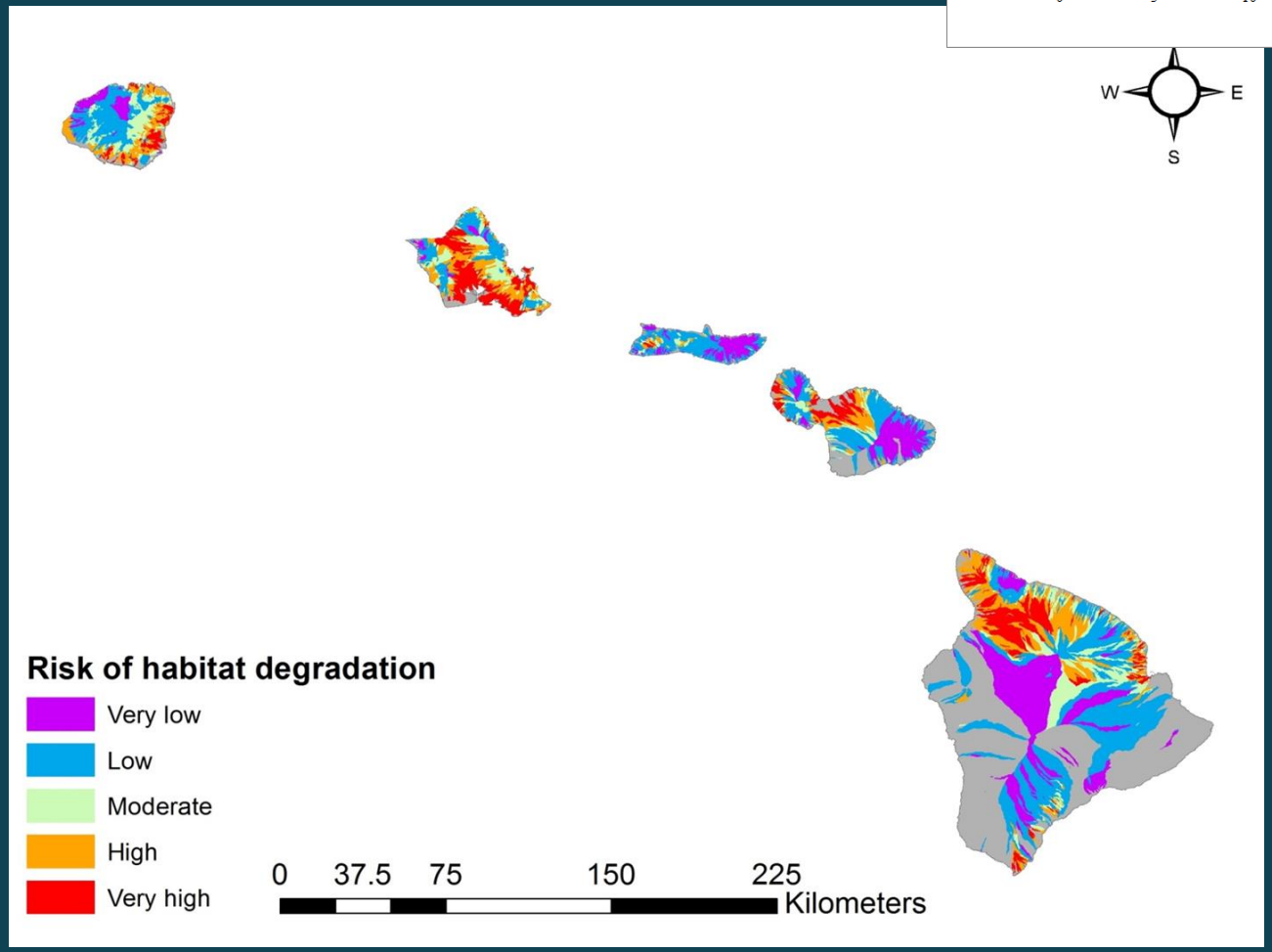
WESTERN NATIVE TROUT INITIATIVE



NATIONAL FISH HABITAT PARTNERSHIP

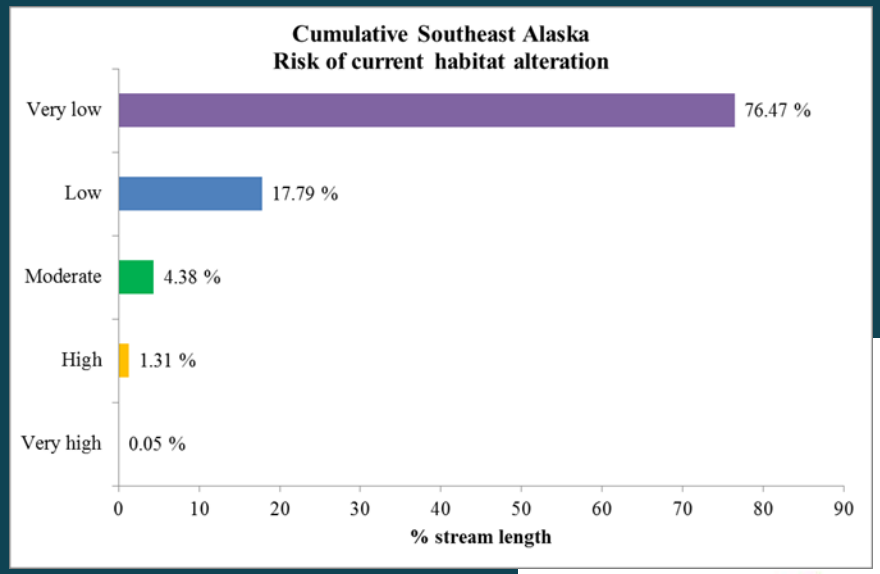
HAWAII FISH HABITAT PARTNERSHIP



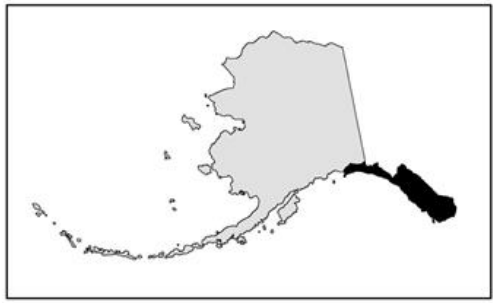


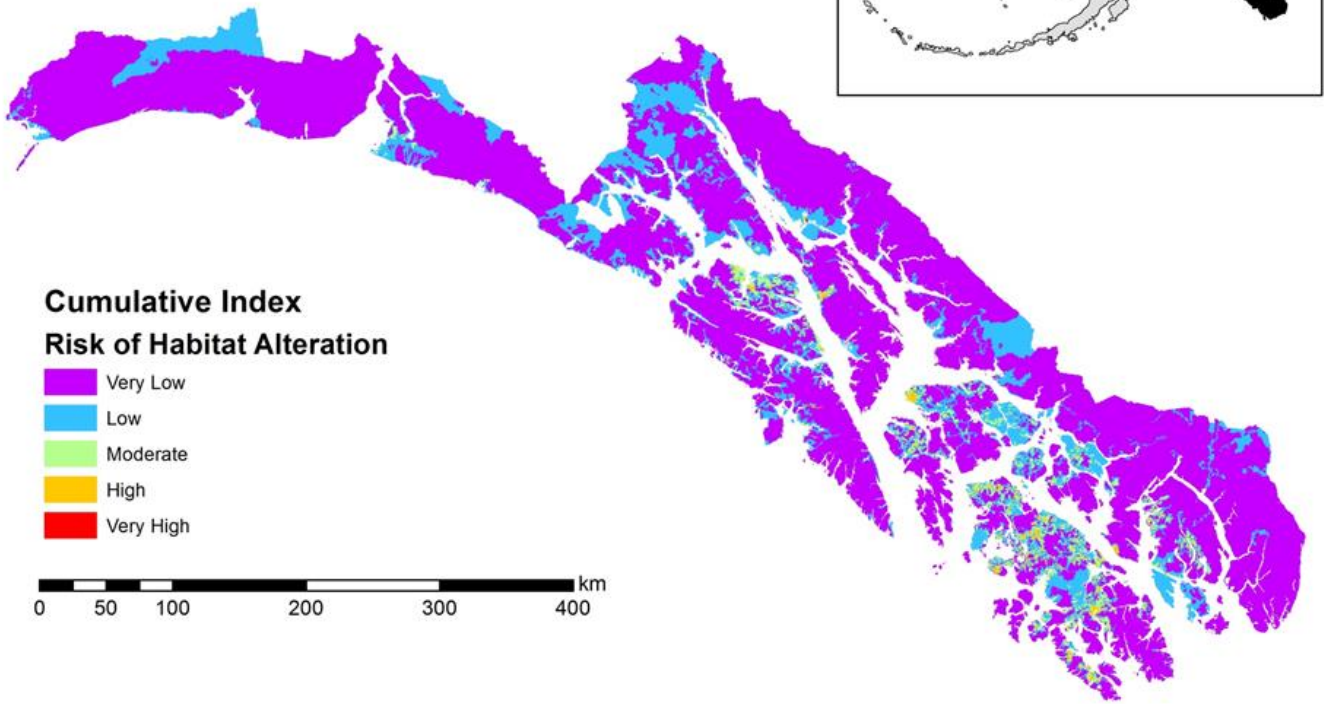
HAWAII FISH HABITAT PARTNERSHIP

SOUTHEAST ALASKA FISH HABITAT PARTNERSHIP

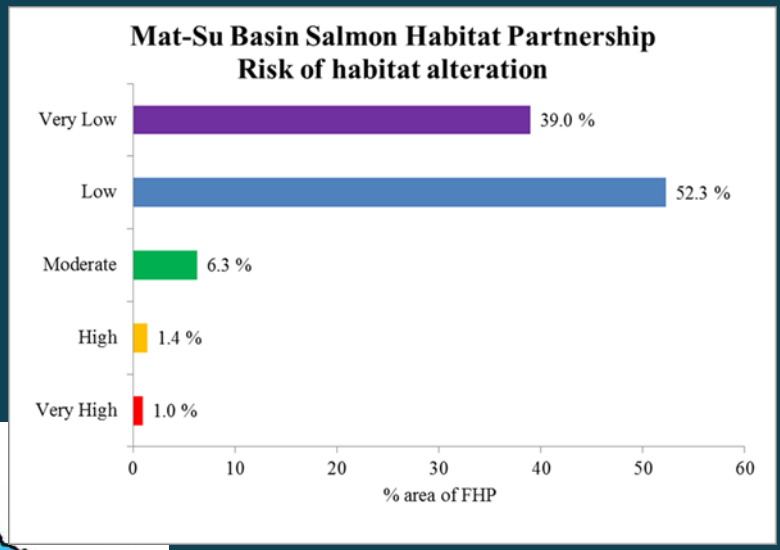


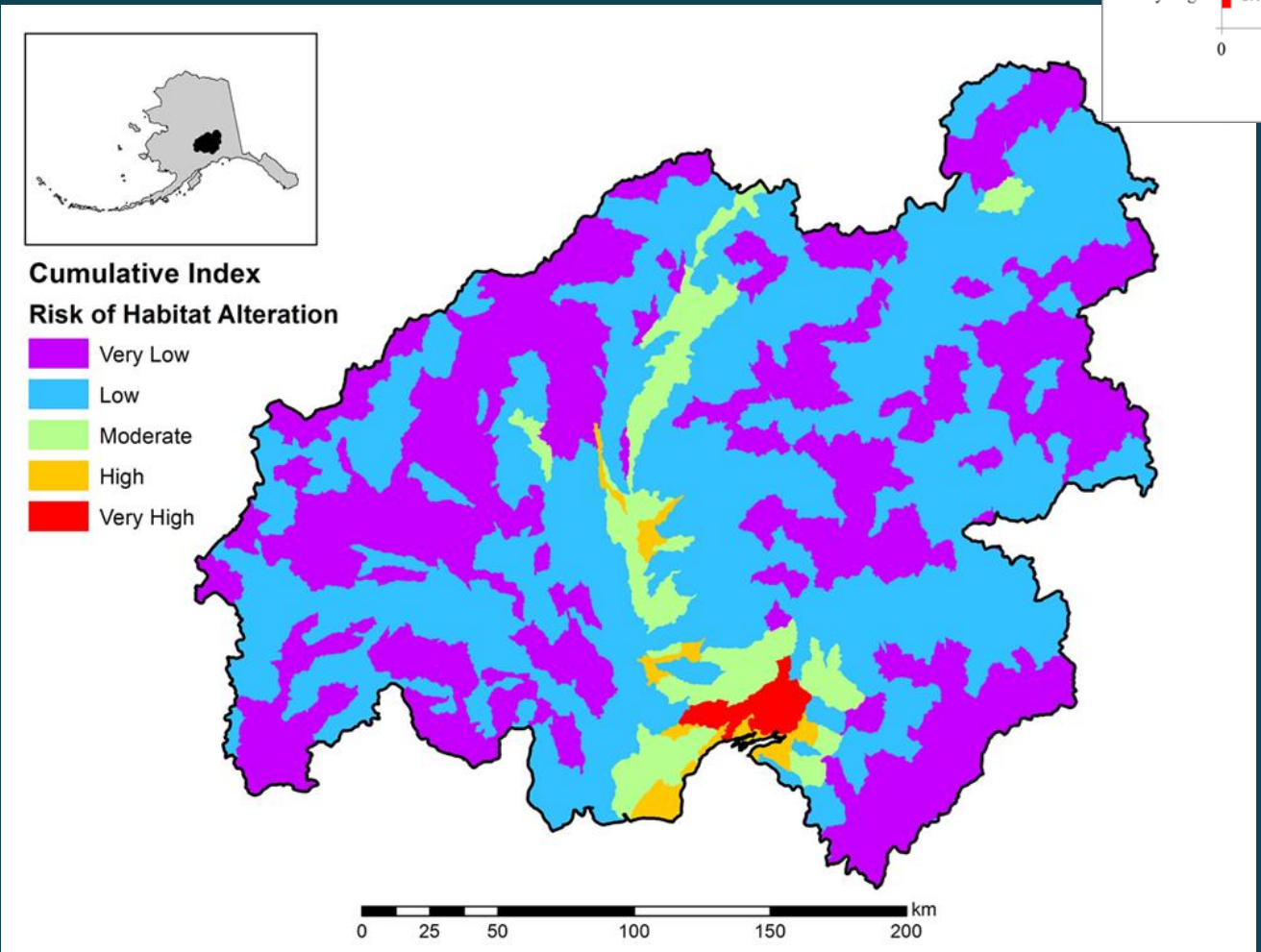
SOUTHEAST ALASKA FISH HABITAT PARTNERSHIP





MAT-SU BASIN SALMON HABITAT PARTNERSHIP

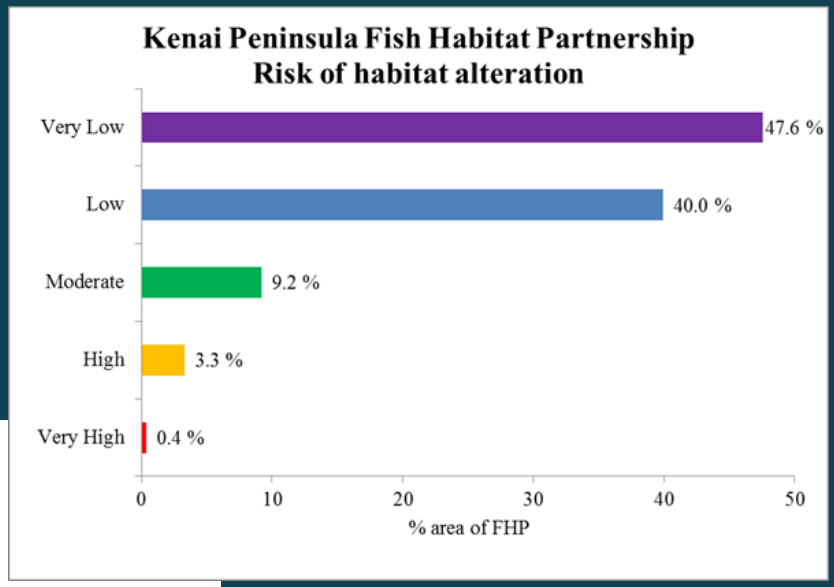


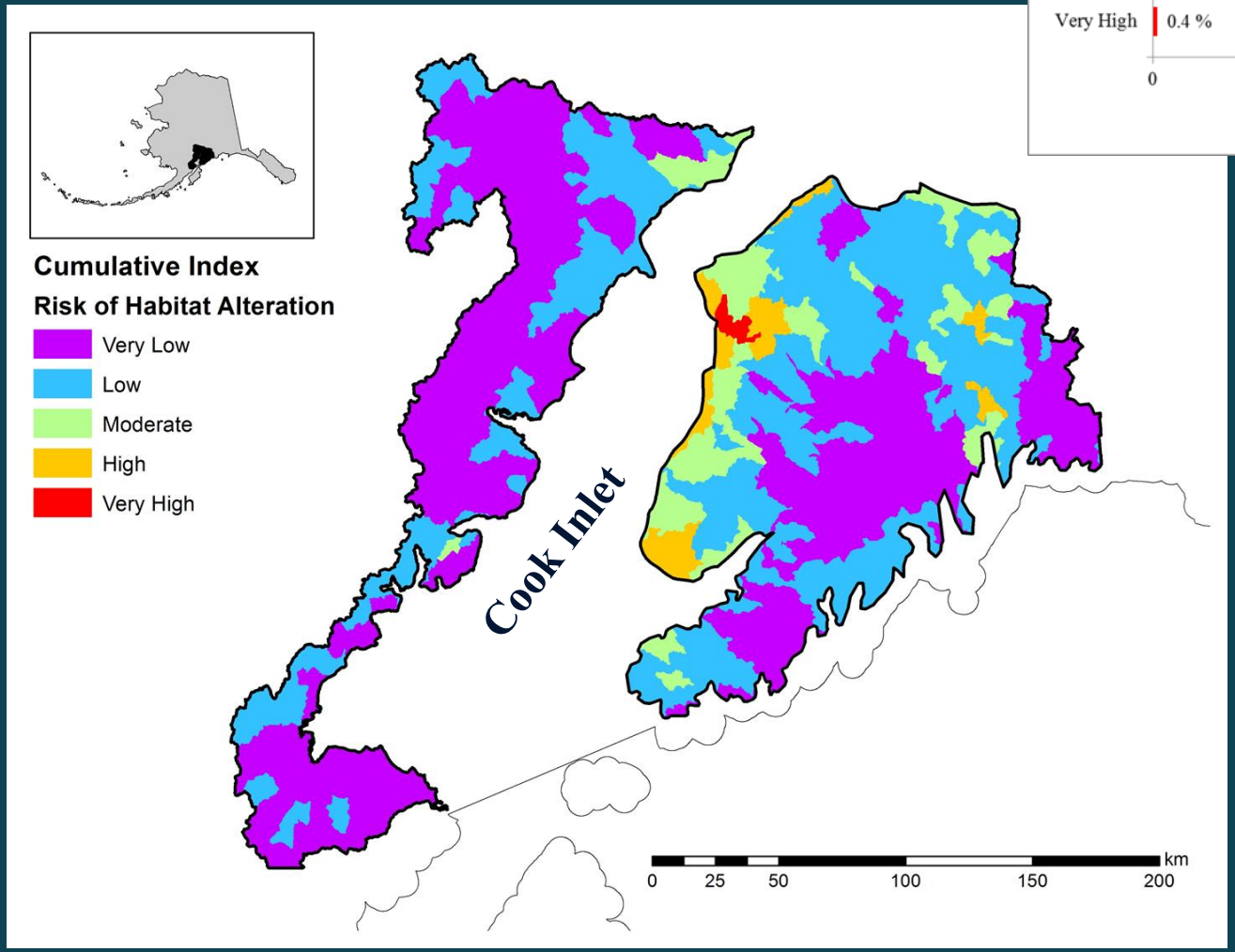


Mat-Su Basin Salmon Habitat Partnership
working for thriving fish, healthy habitats, and vibrant communities in the Mat-Su Basin

NATIONAL FISH HABITAT PARTNERSHIP

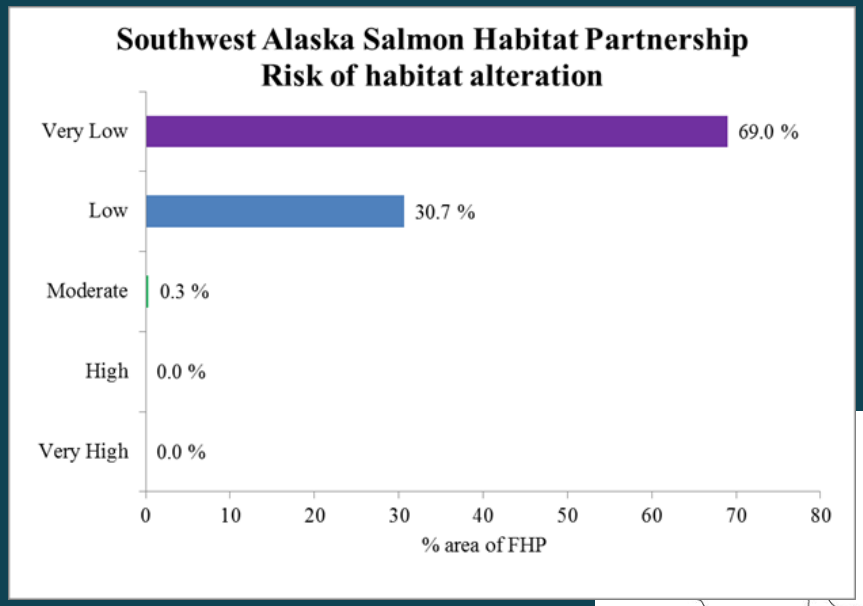
KENAI PENINSULA FISH HABITAT PARTNERSHIP

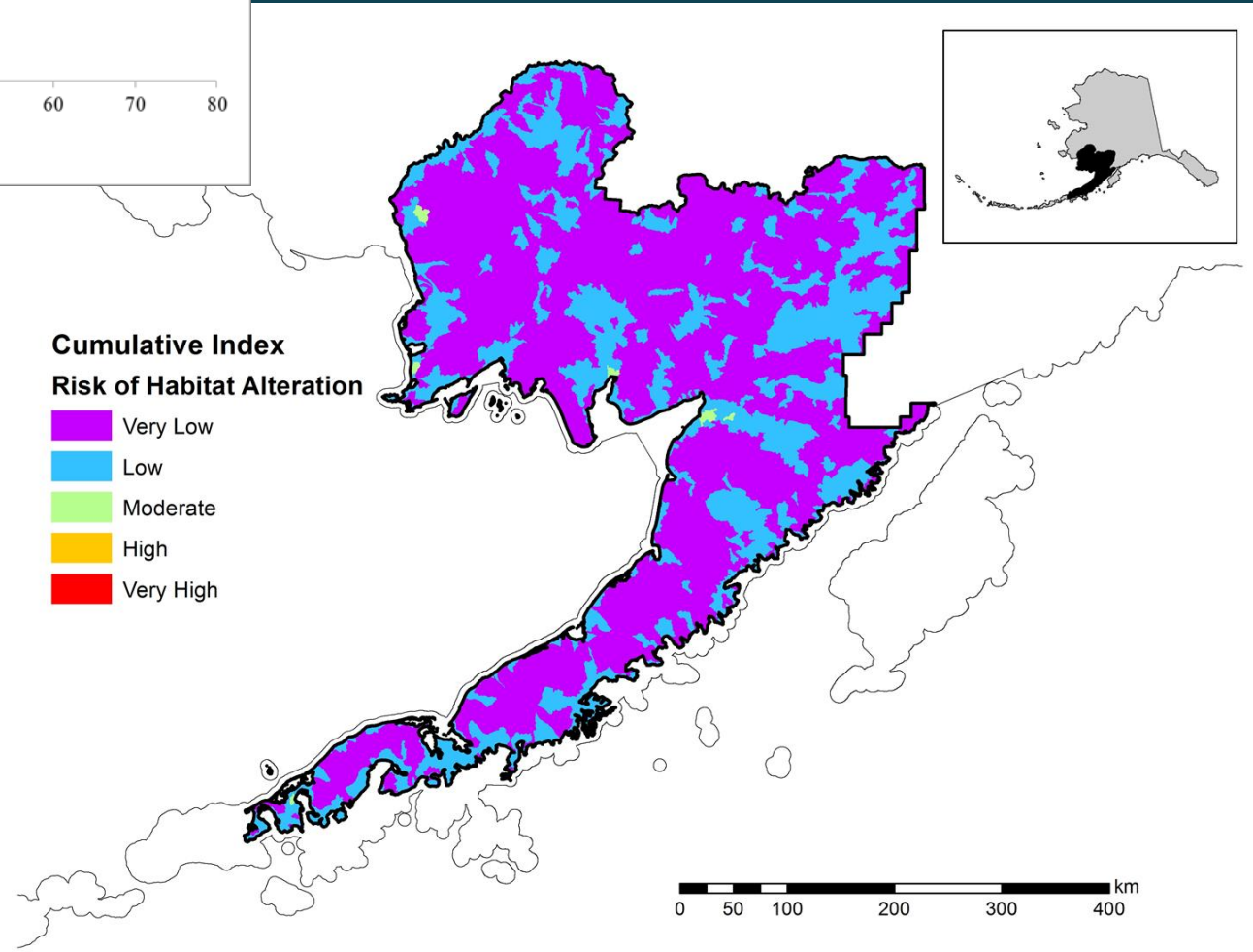




KENAI PENINSULA FISH HABITAT PARTNERSHIP

SOUTHWEST ALASKA SALMON HABITAT PARTNERSHIP





FISH HABITAT PARTNERSHIPS NOT SHOWN

RESERVOIR FISHERIES HABITAT PARTNERSHIP

NATIONAL FISH HABITAT PARTNERSHIP

LIMITING, SEVERE, AND PERVASIVE DISTURBANCES TO FISH HABITAT

Limiting disturbances: Any disturbances that results in a stream reach not being in the best condition class

Severe disturbances (a subset of pervasive disturbances): Disturbances associated with stream reaches with high or very high risk of habitat degradation (red and orange color groups)

Pervasive disturbances: The most common disturbances based on total stream length in a given region

MOST LIMITING DISTURBANCES TO FISH HABITAT IN THE MIDWEST GLACIAL LAKES PARTNERSHIP

- Top five overall most limiting disturbances to all stream reaches across all spatial extents (ranked highest first):

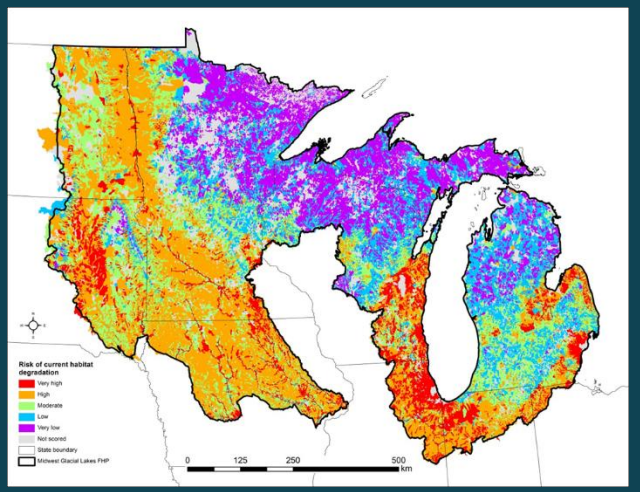
  Crop land use

  Pasture and hay land use

  Population density

  Road crossing density

  Low intensity urban land use



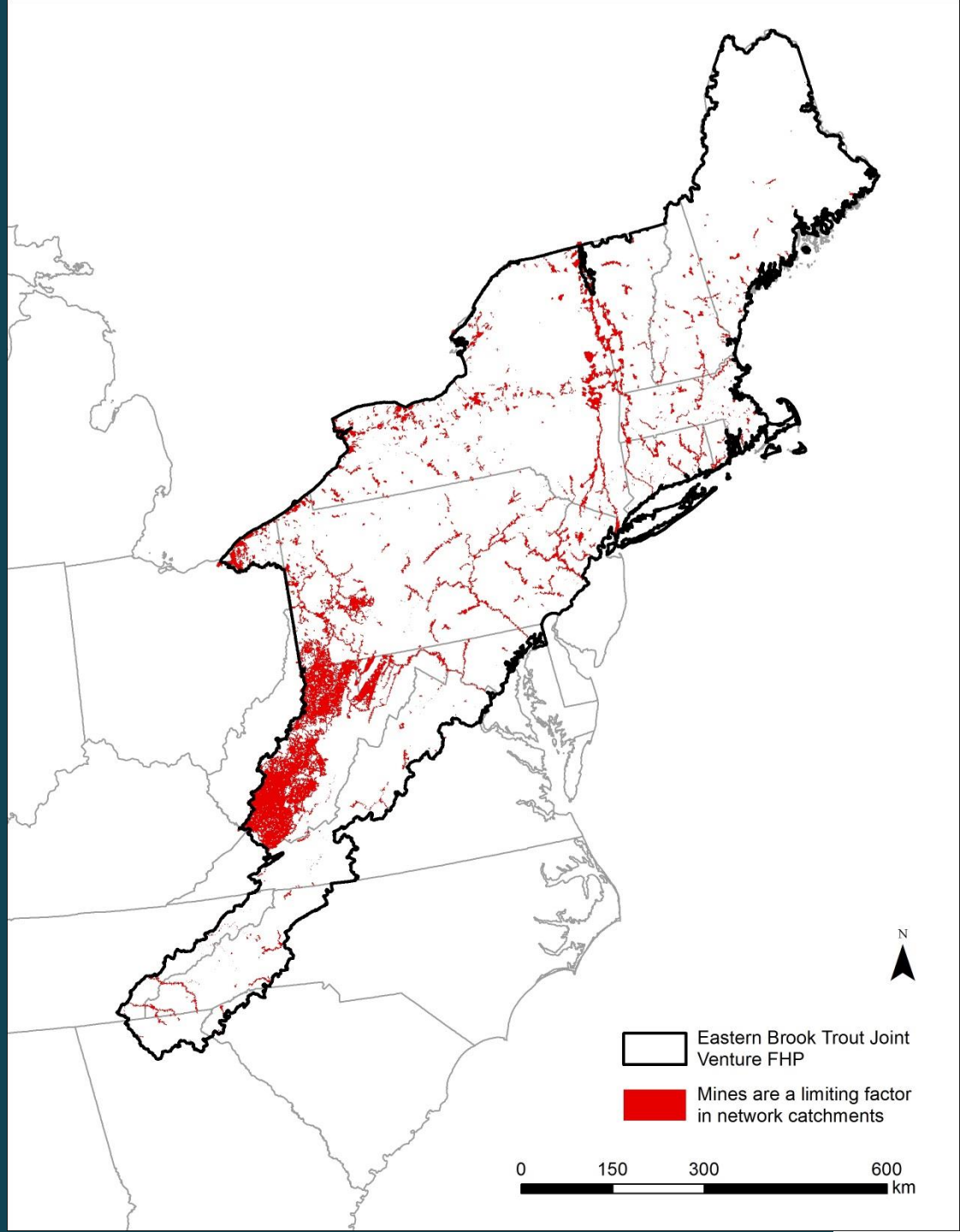
- Water withdrawals from agriculture and water withdrawals from industrial sources comprise the sixth and ninth (respectively) highest limiting disturbances in the region. If these categories were combined, water withdrawals would be the third most limiting disturbance to stream reaches in this MWGL FHP

MIDWEST GLACIAL LAKES Partnership

NATIONAL FISH HABITAT PARTNERSHIP

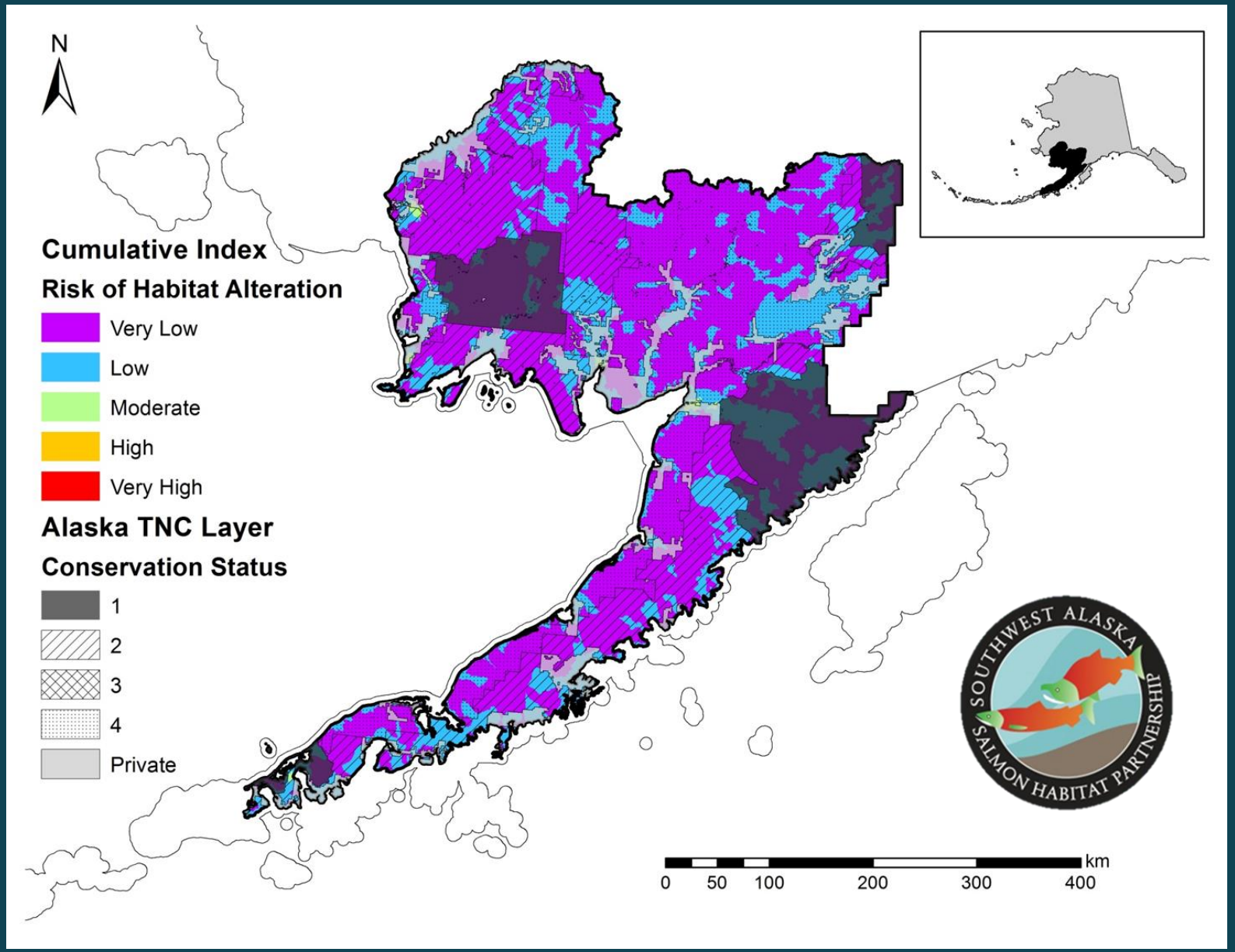
MINES (COAL AND MINERAL) AS THE MOST LIMITING DISTURBANCE TO FISH HABITAT IN THE EASTERN BROOK TROUT JOINT VENTURE

Eastern Brook Trout
JOINT VENTURE
A Fish Habitat Partnership



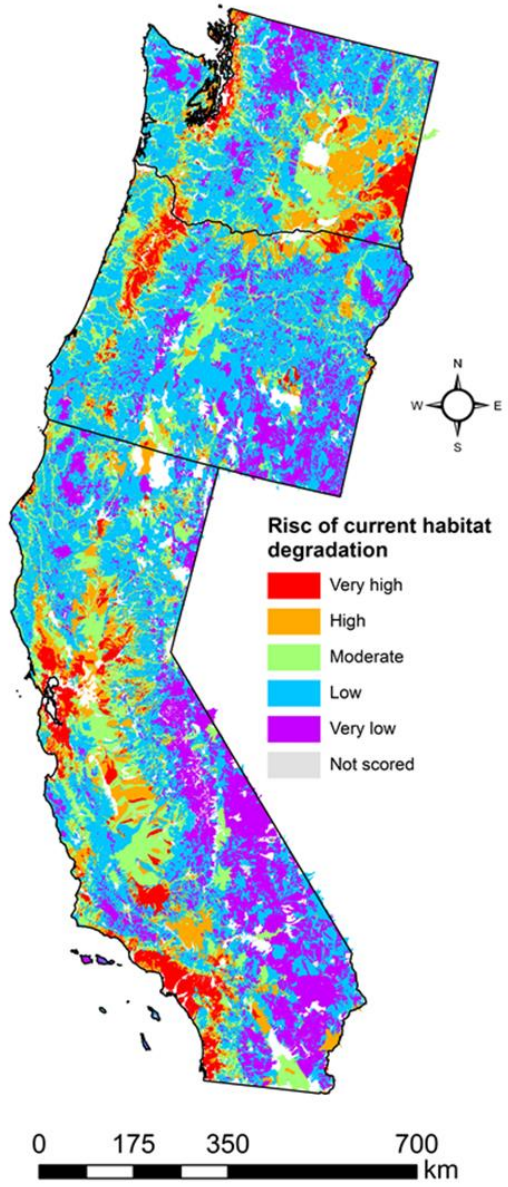
PARTNERSHIP RESULTS WITH OTHER LAYERS

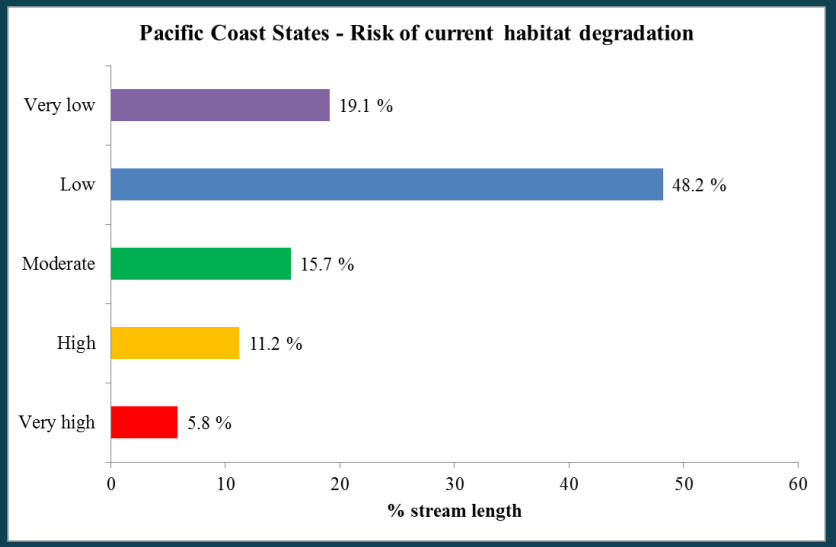
ALASKA ASSESSMENT RESULTS WITH TNC CONSERVATION LANDS



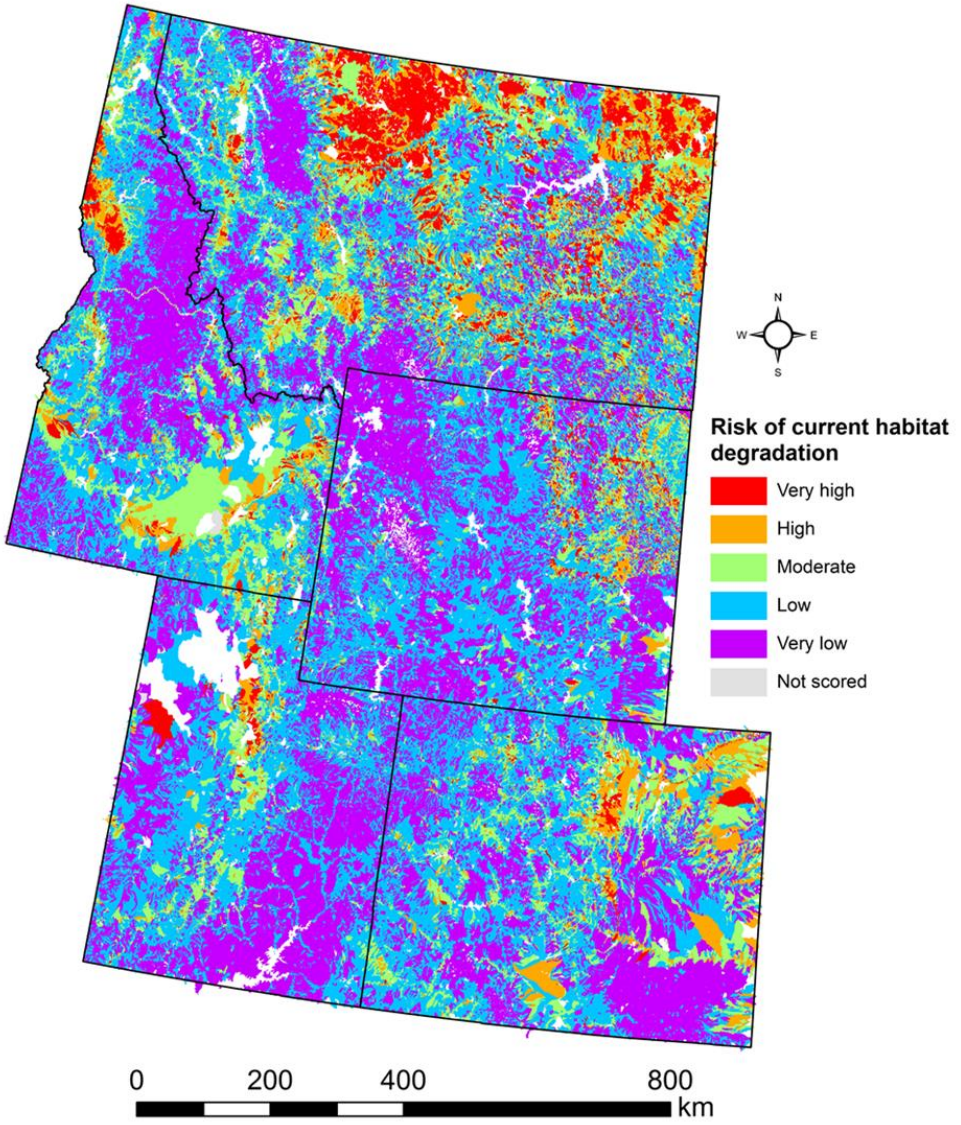
3. STATE AND REGIONAL RESULTS

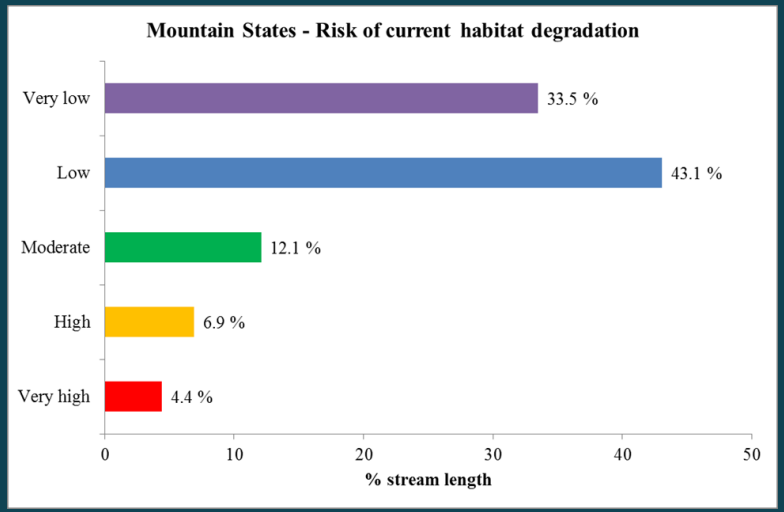
PACIFIC COAST STATES



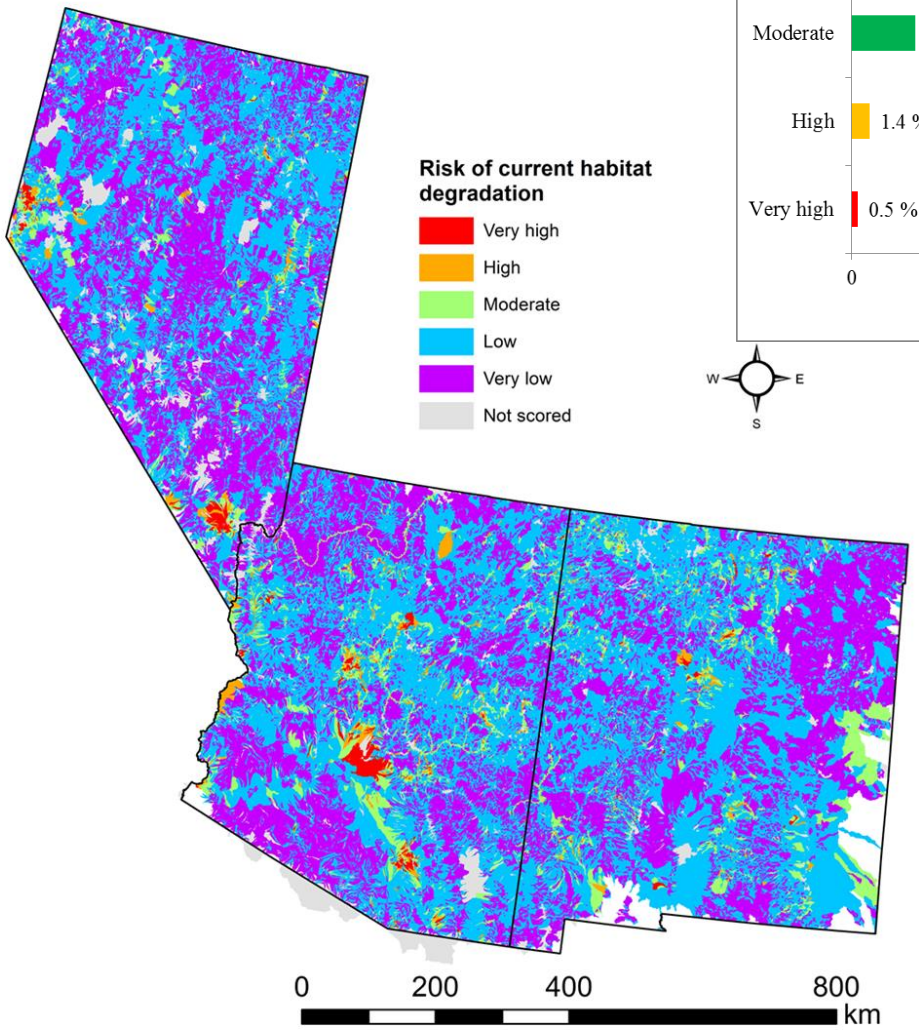


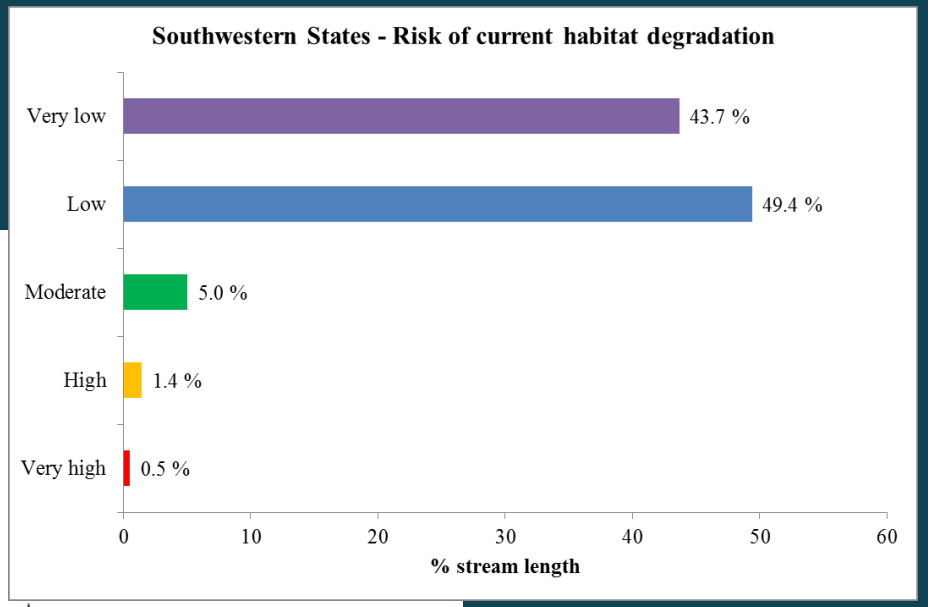
MOUNTAIN STATES



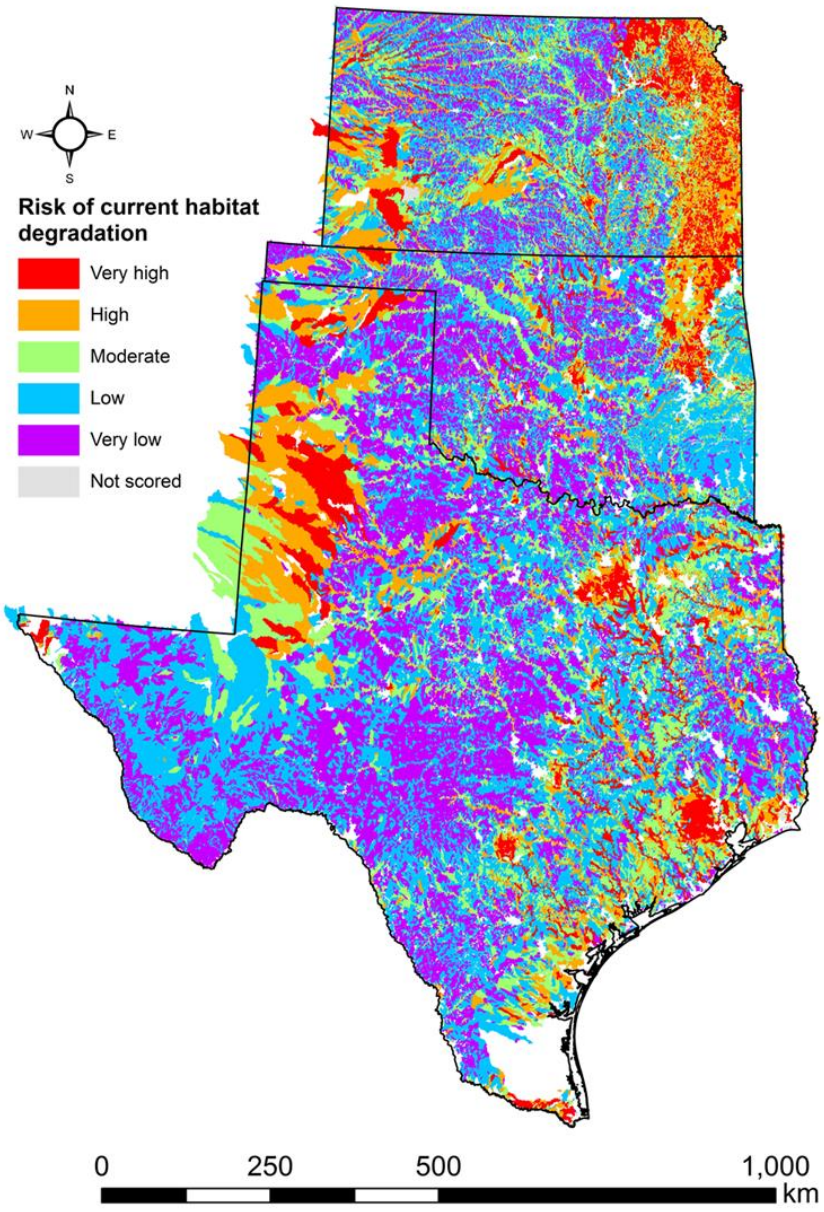


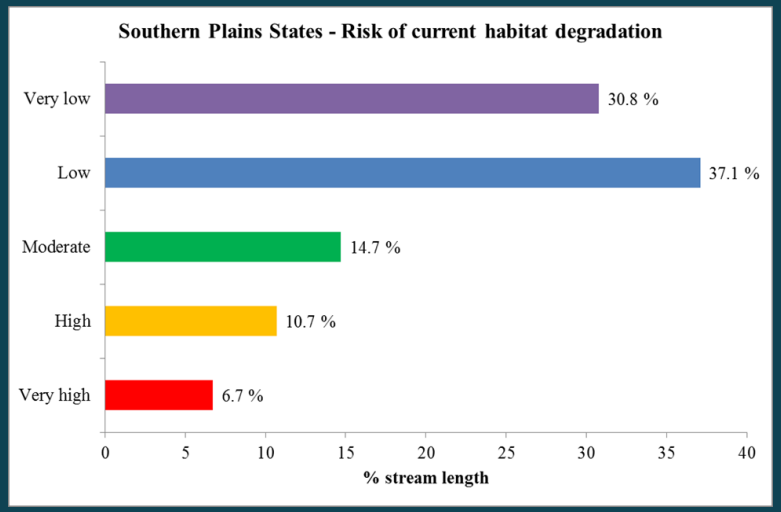
SOUTHWESTERN STATES



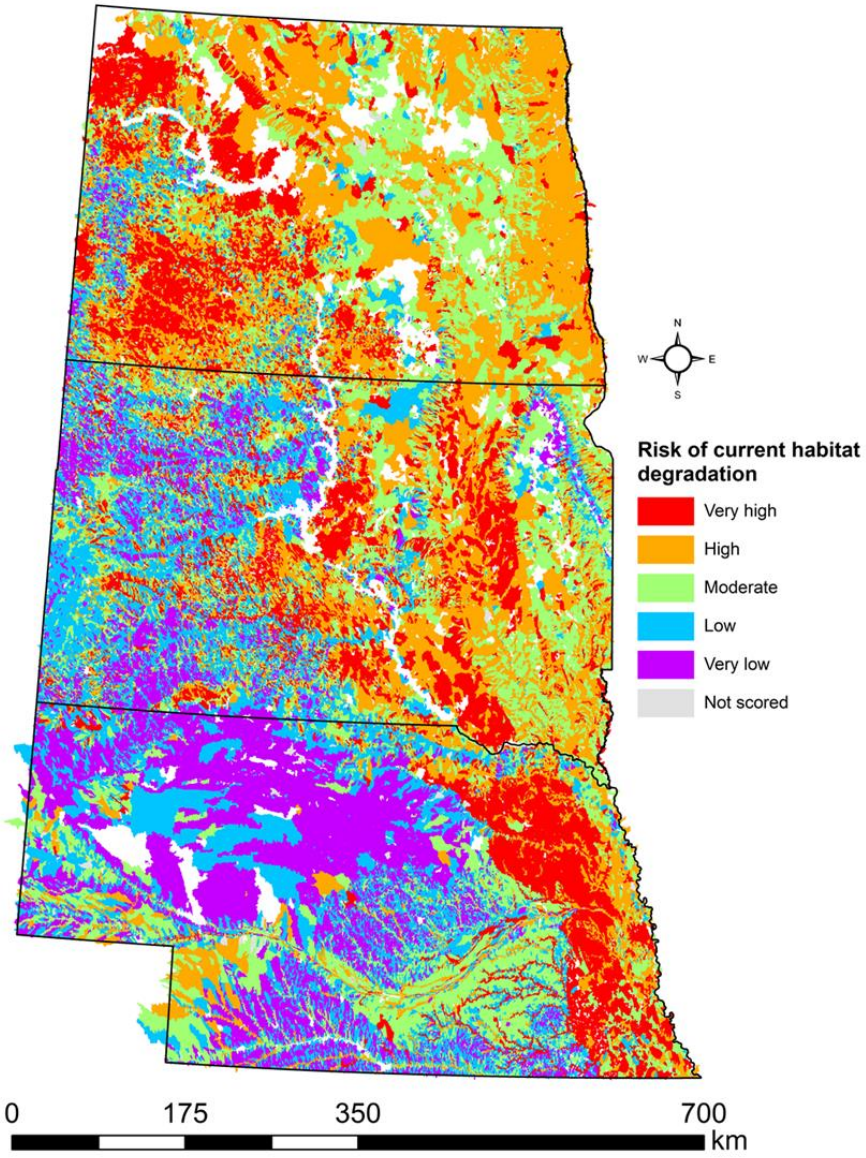


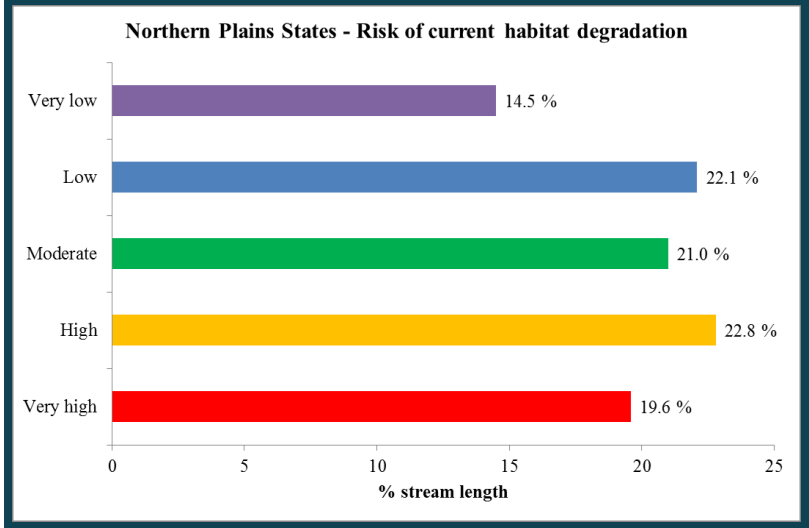
SOUTHERN PLAINS STATES



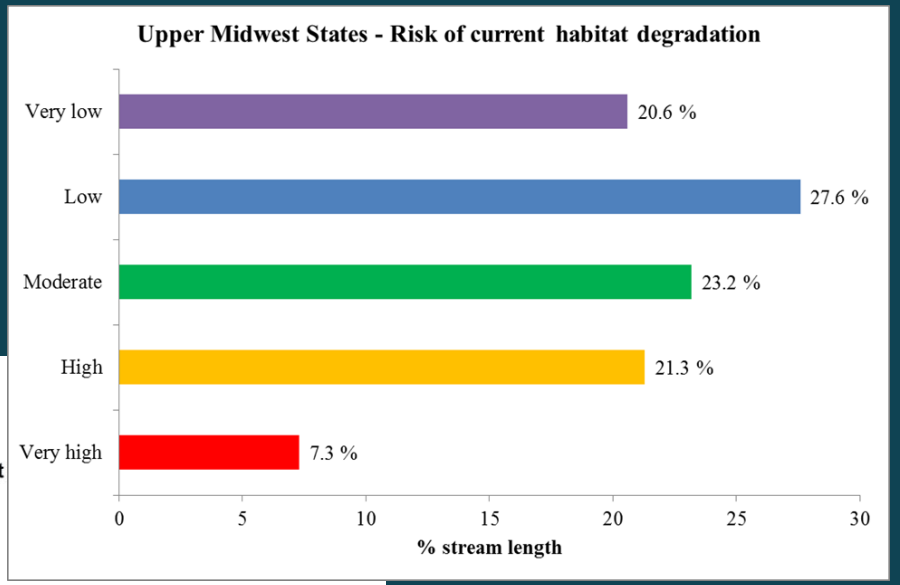


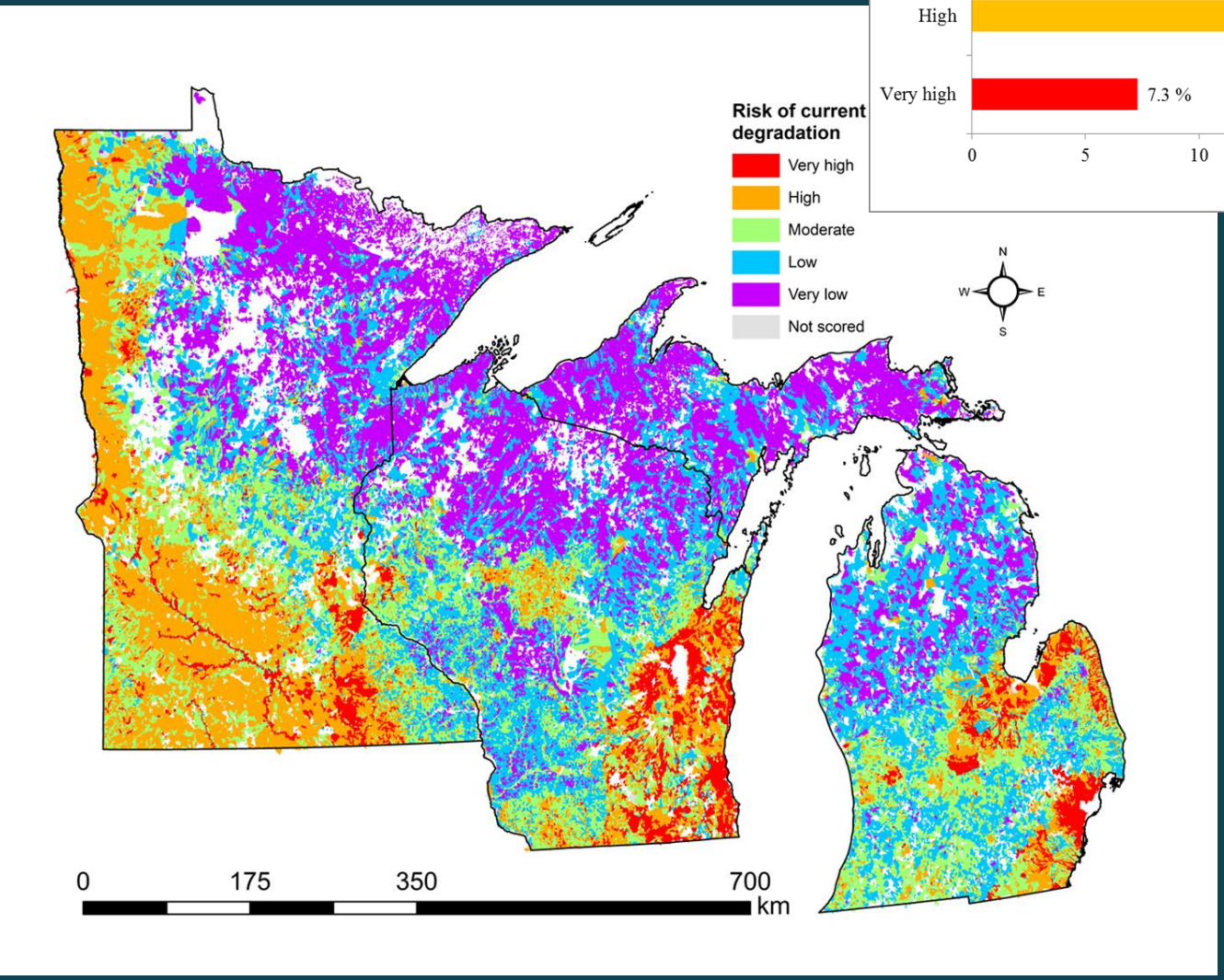
NORTHERN PLAINS STATES



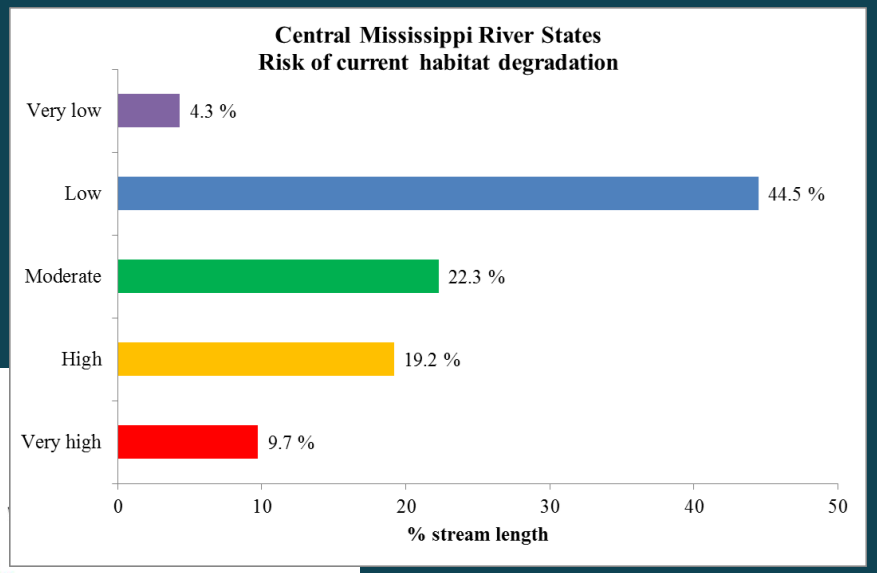


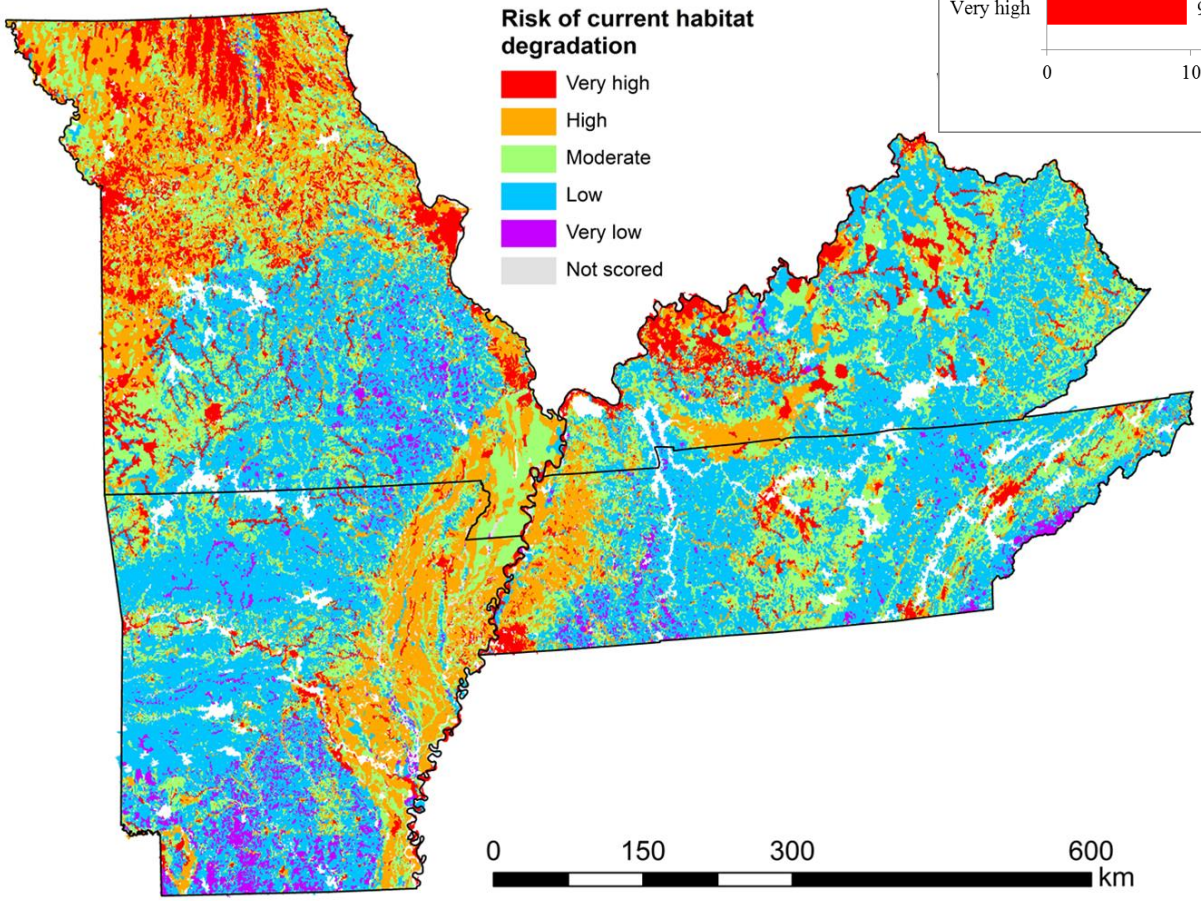
UPPER MIDWEST STATES



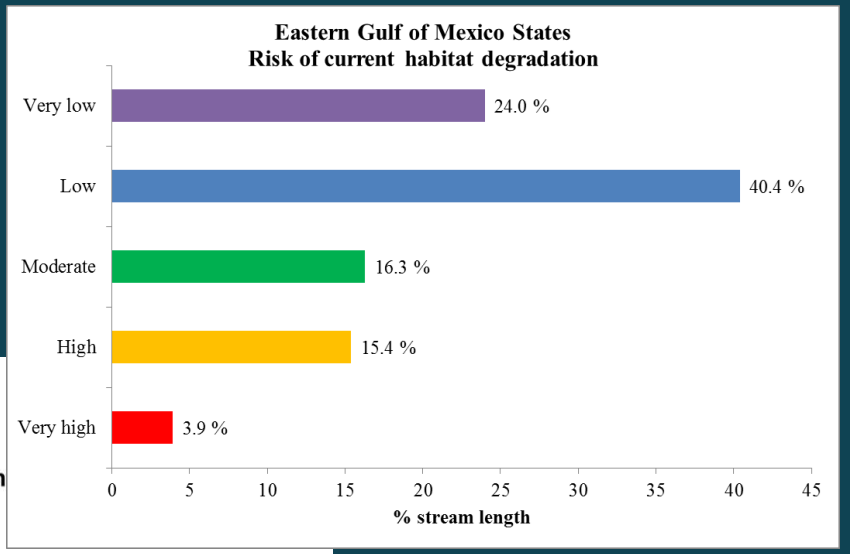


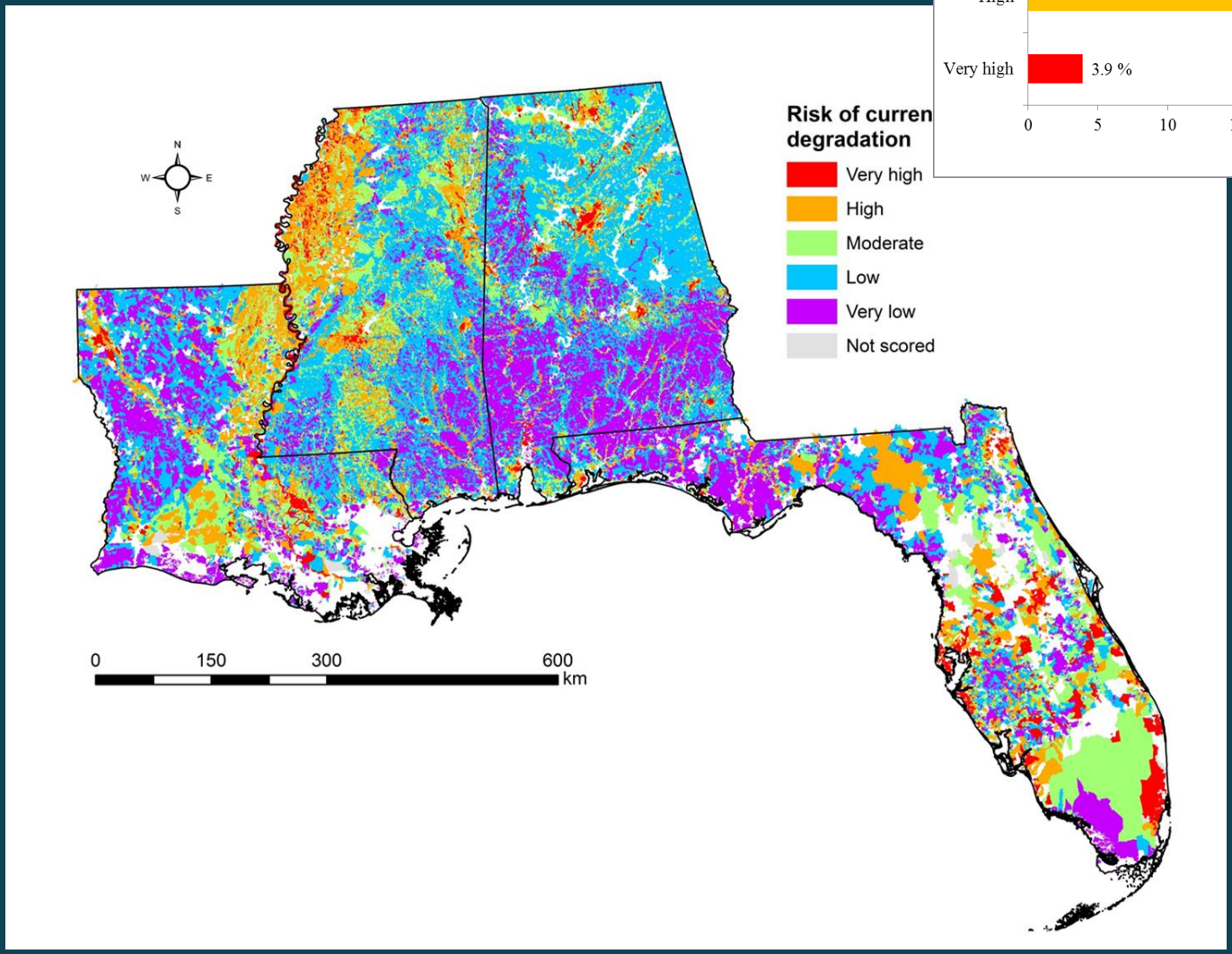
CENTRAL MISSISSIPPI STATES



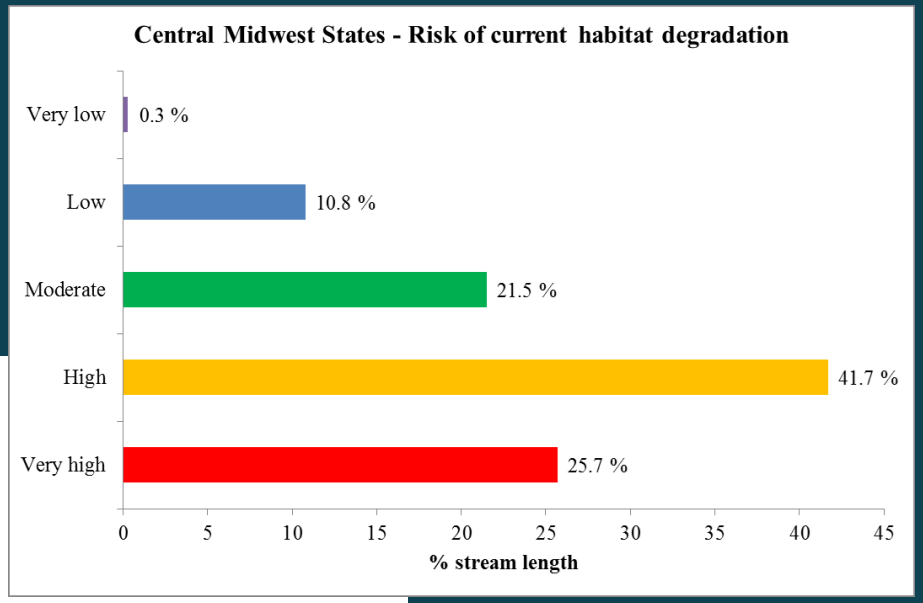


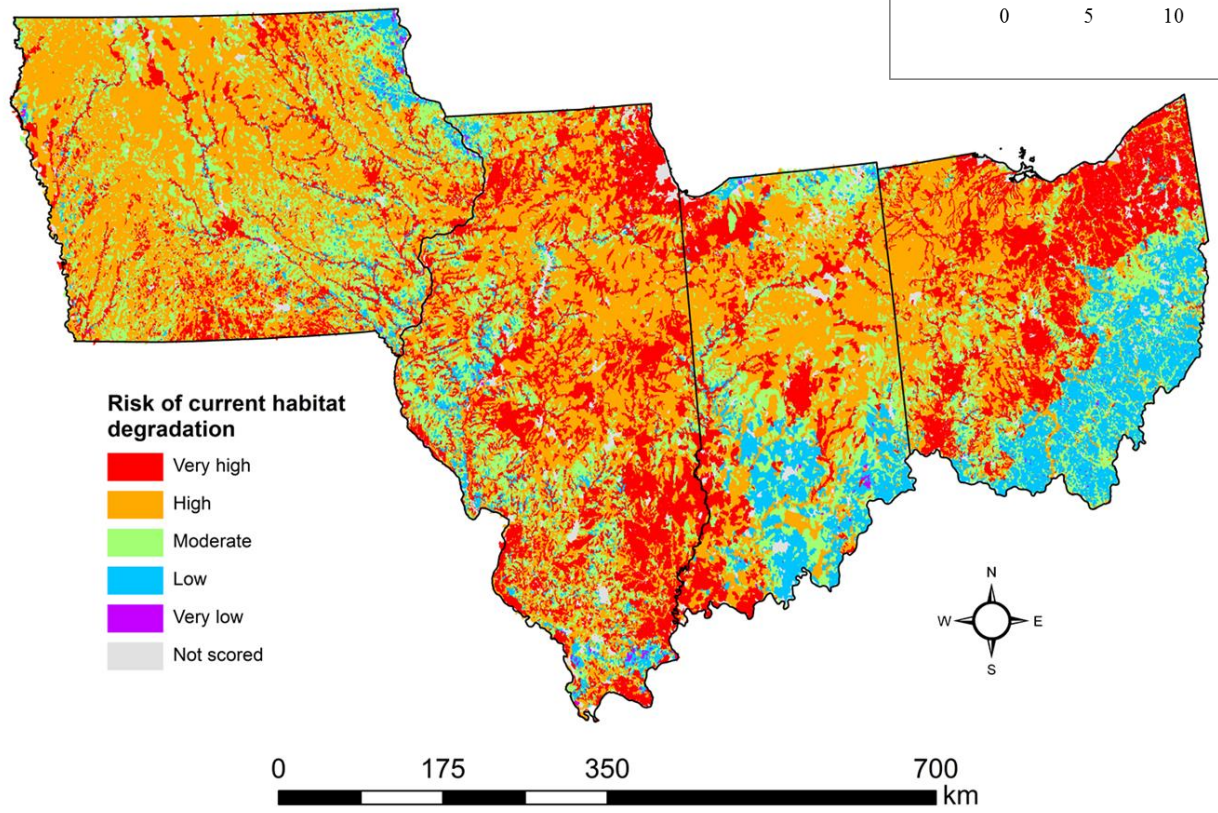
EASTERN GULF OF MEXICO STATES



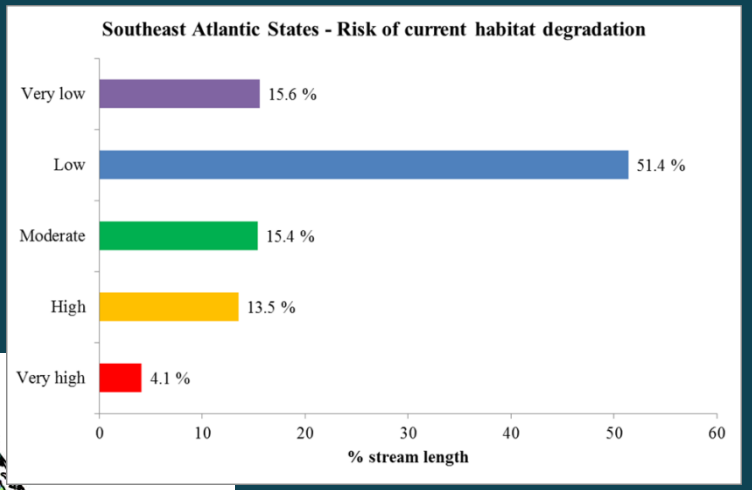


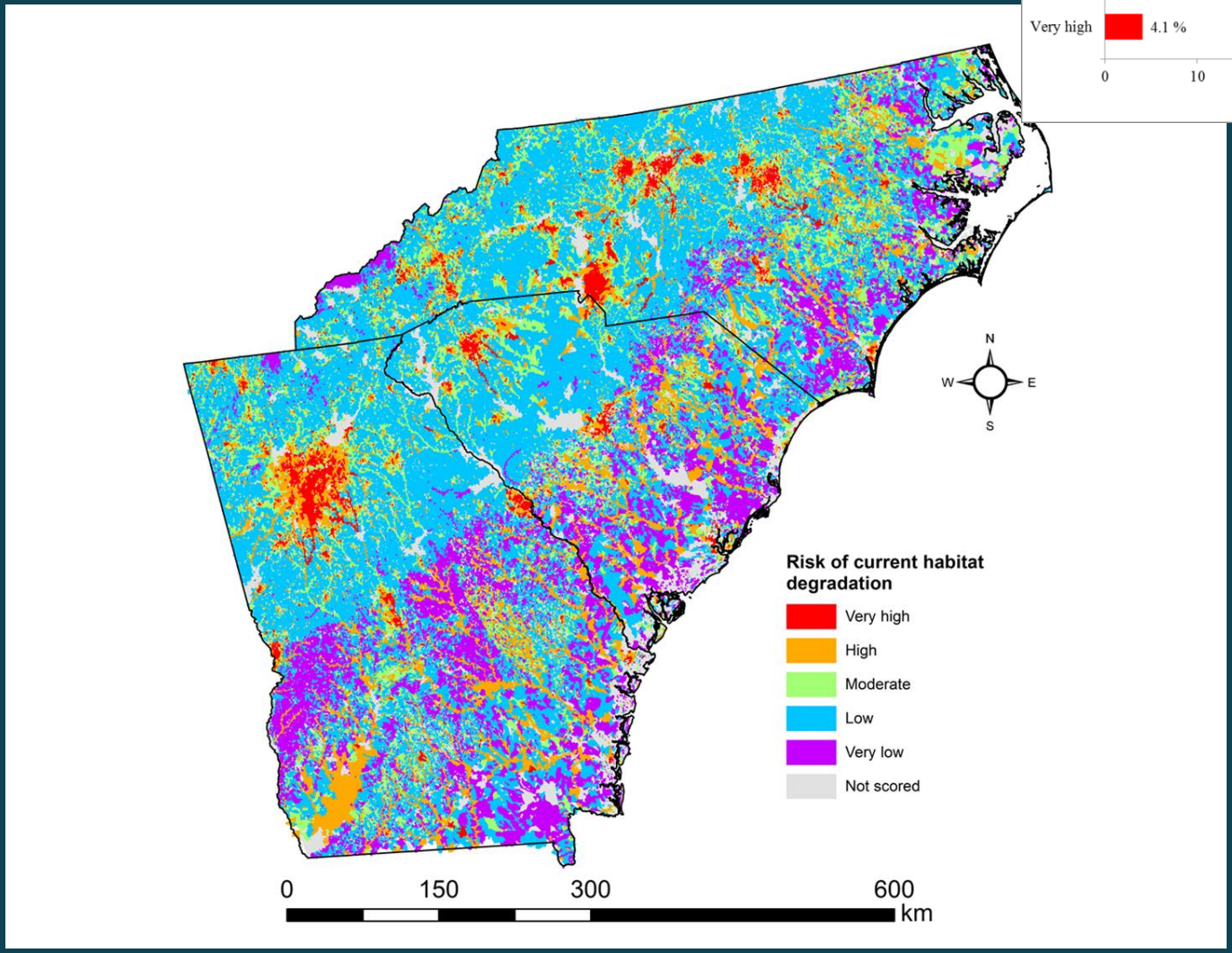
CENTRAL MIDWEST STATES



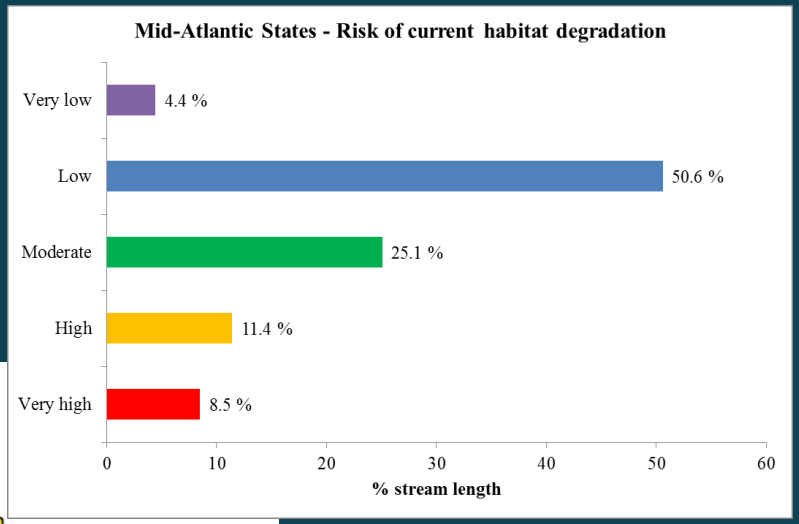


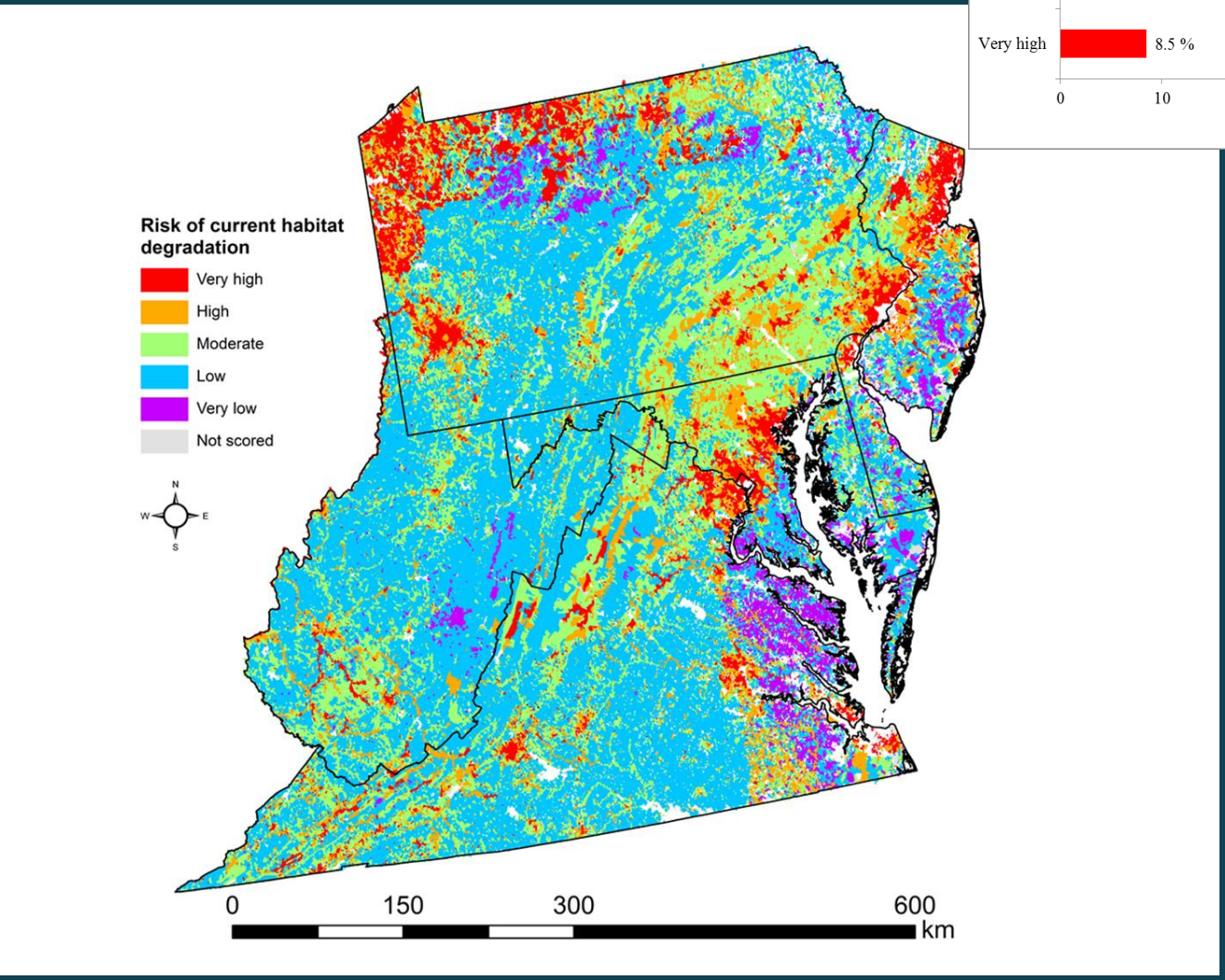
SOUTHEAST ATLANTIC STATES



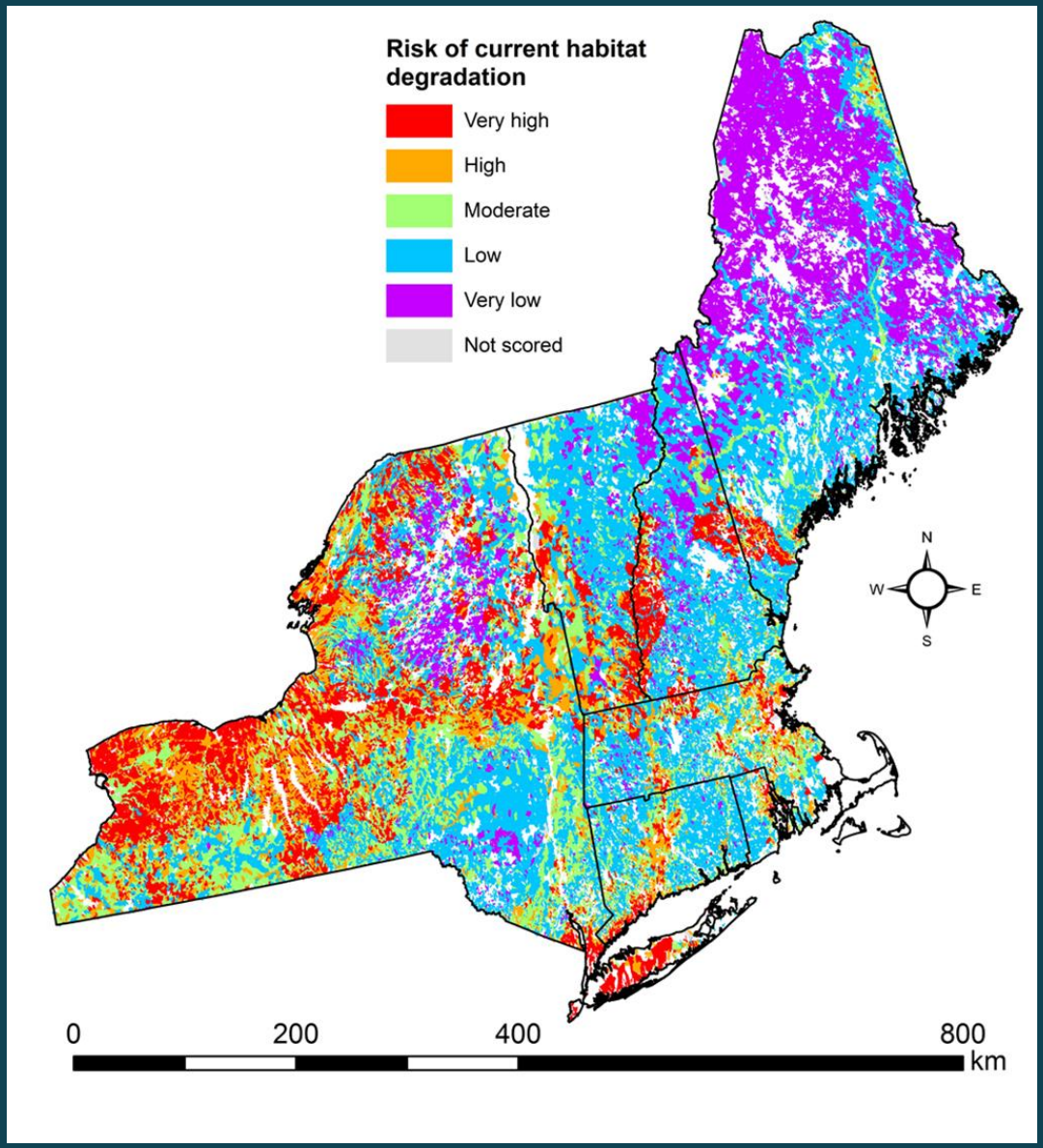


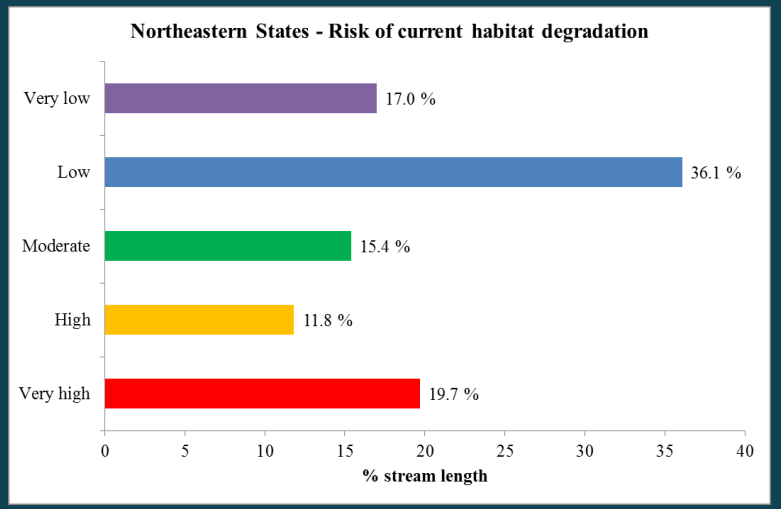
MID-ATLANTIC STATES



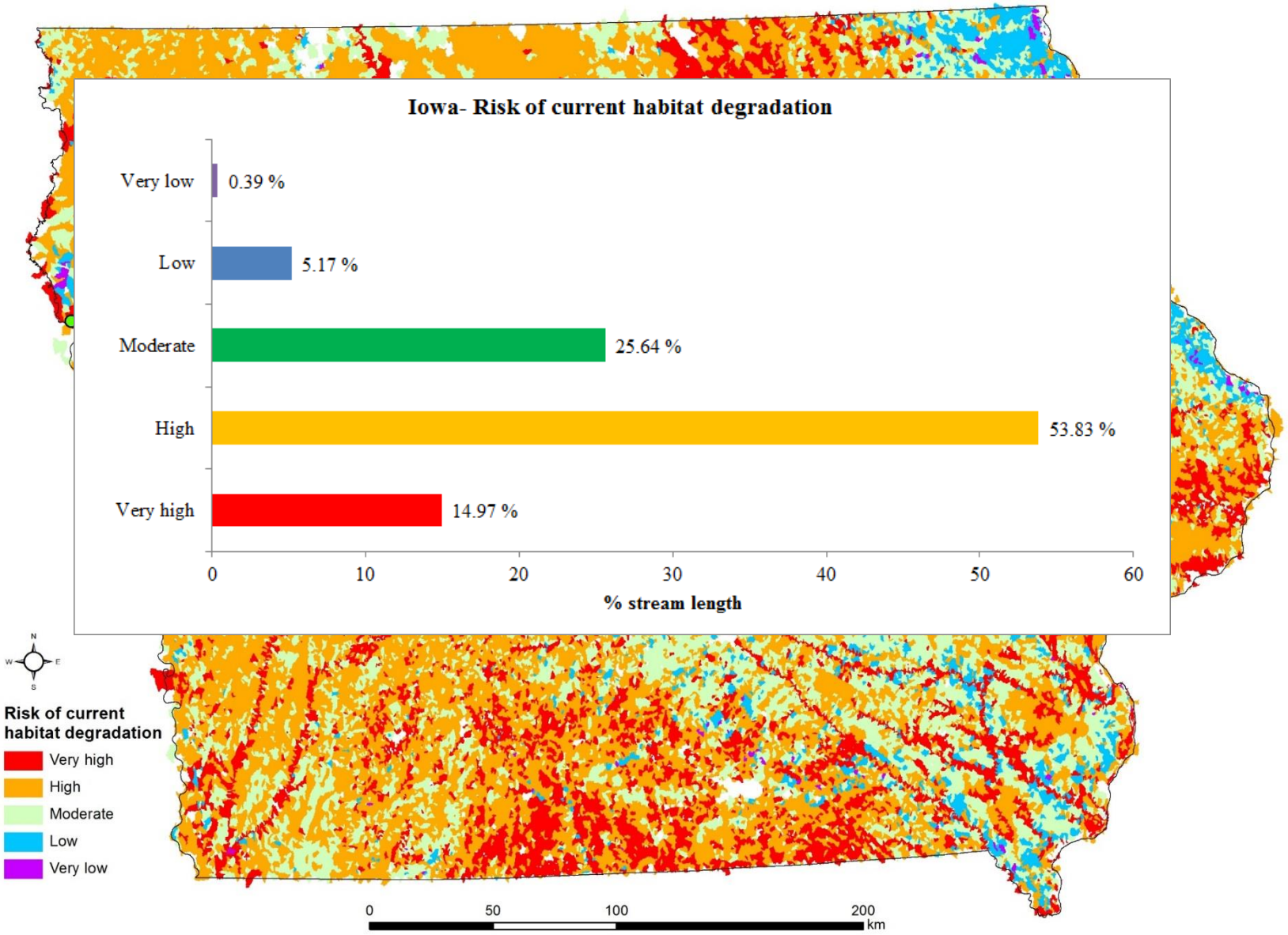


NORTHEASTERN STATES



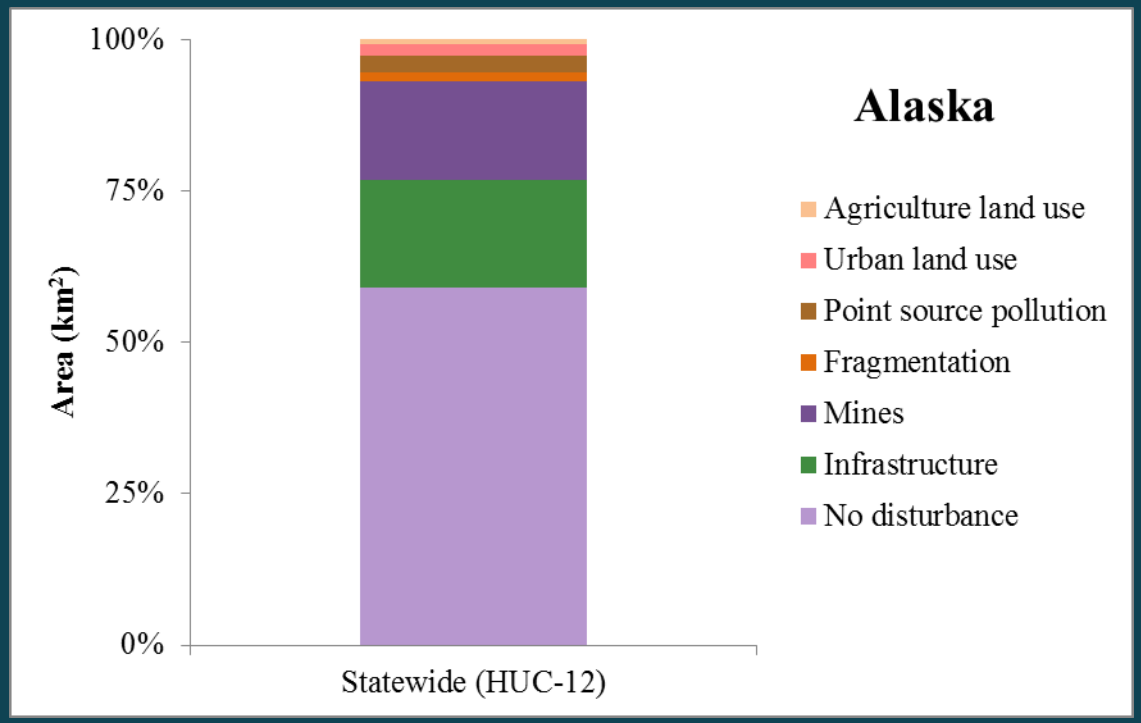


2015 ASSESSMENT OF STREAM FISH HABITATS IOWA

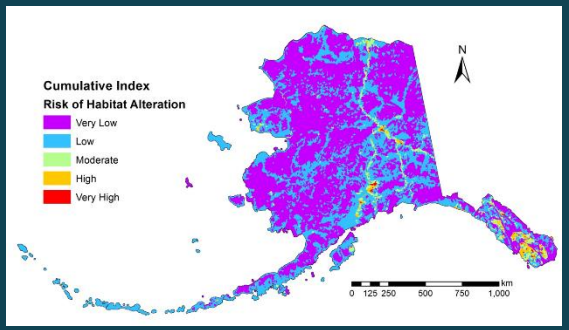


Alaska's total area (in HUC-12) at highest risk of alteration from each sub-index of disturbance

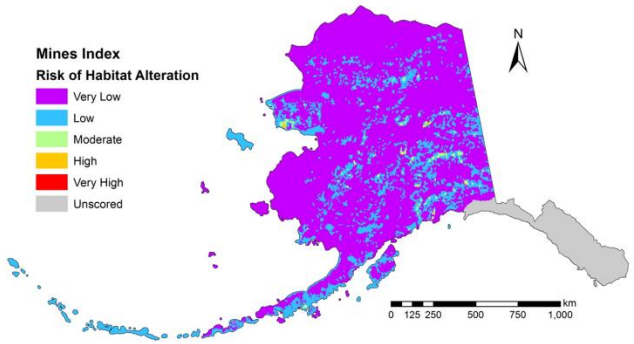
Alaska 2015	No disturbance	infrastructure	mines	point source pollution	urban	fragmentation	agriculture
%	58.94	17.92	16.12	2.85	1.94	1.52	0.71



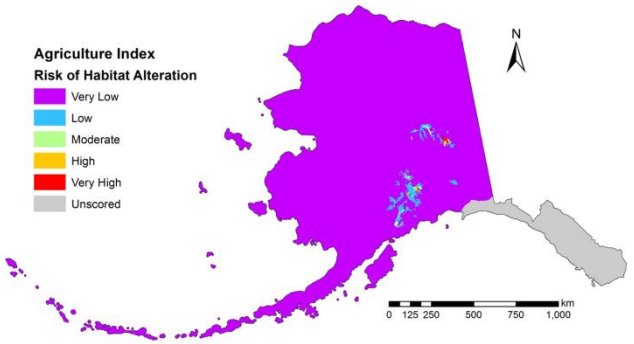
Based on statewide HUC-12s



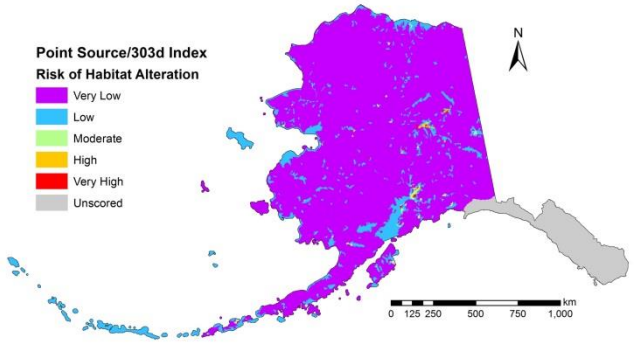
SIX ALASKA SUB-INDEXES OF DISTURBANCE



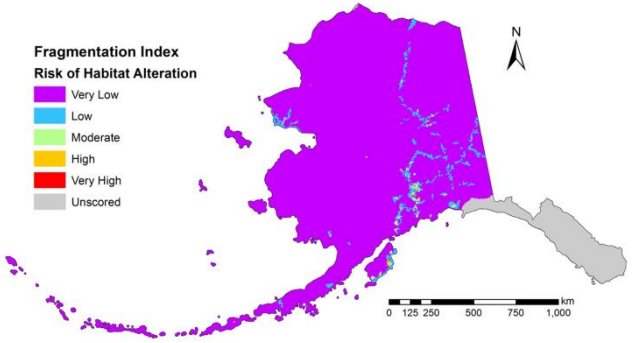
Mines



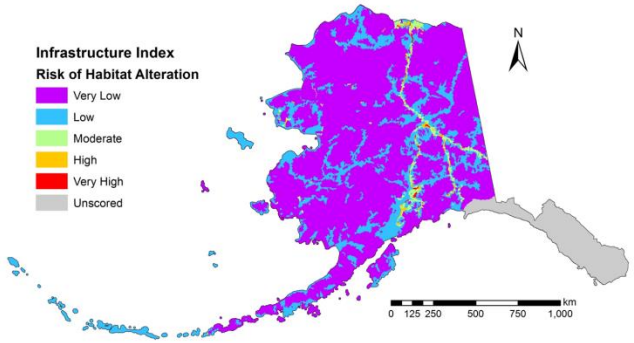
Agriculture



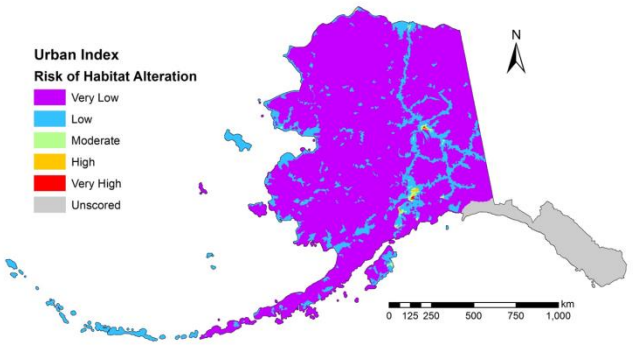
Point source



Fragmentation

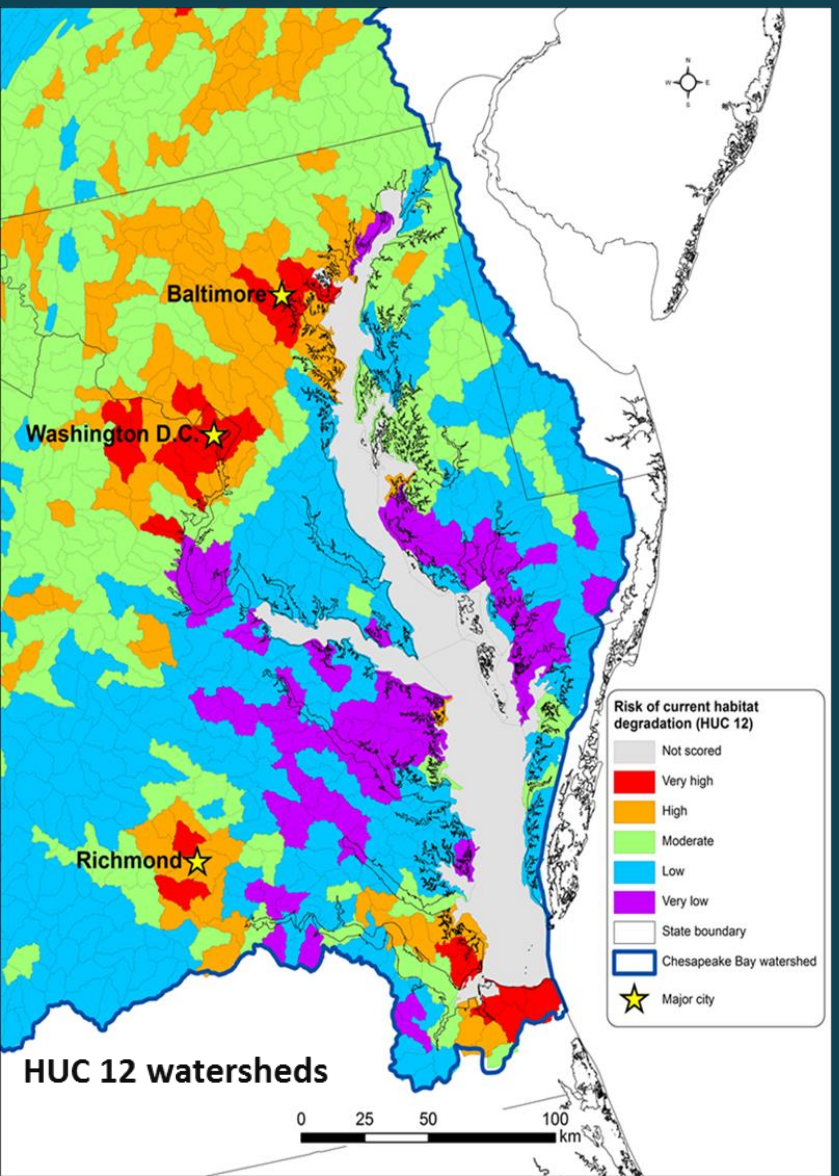


Infrastructure



Urban

ENHANCING CONSERVATION ACTIONS IN THE CHESAPEAKE BAY BASIN

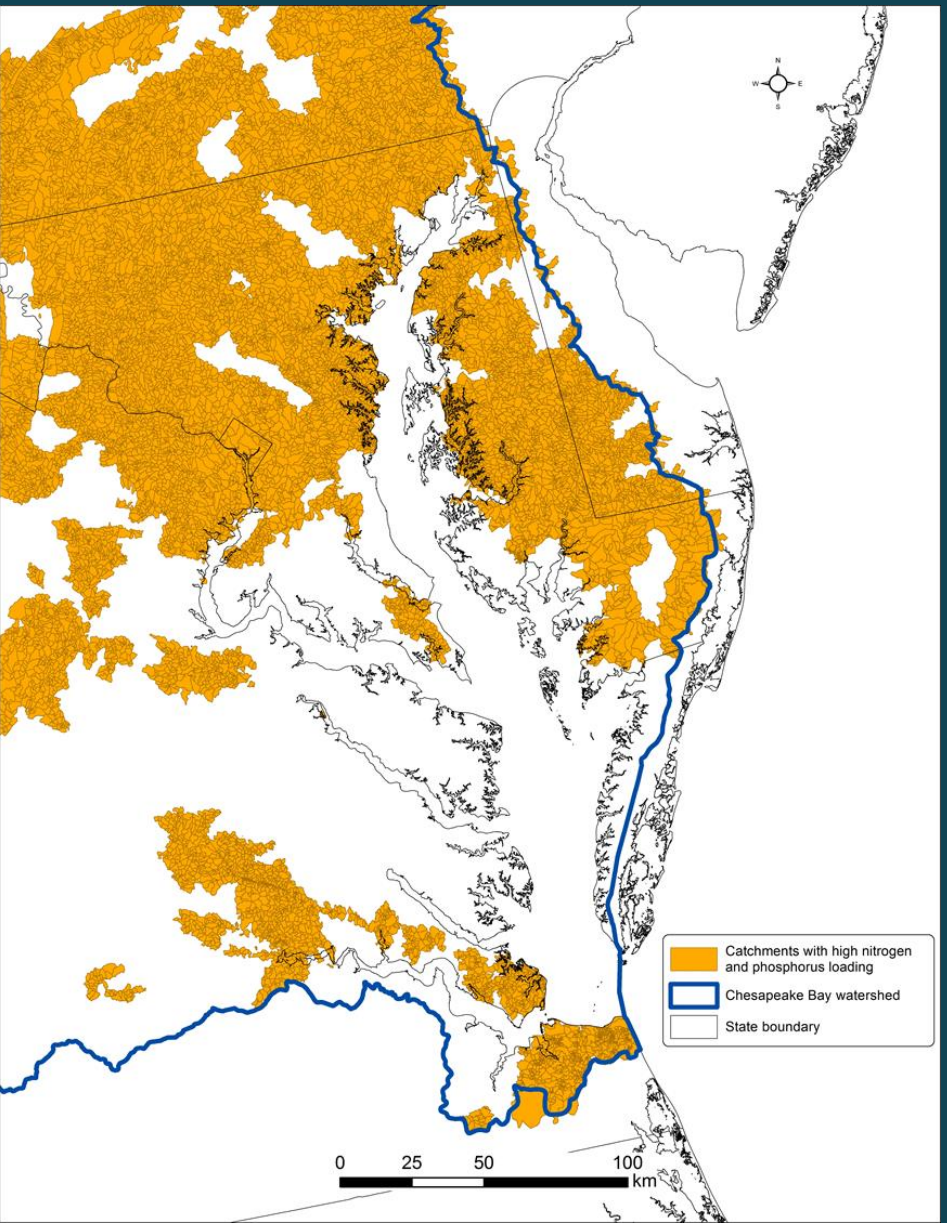


What are limiting disturbances to fish habitat in the Chesapeake Bay basin?

- Agriculture (pasture/hay)
- Urbanization
- Mining (coal and mineral)
- Nutrients (N and P)

- Results vary regionally, by spatial extent

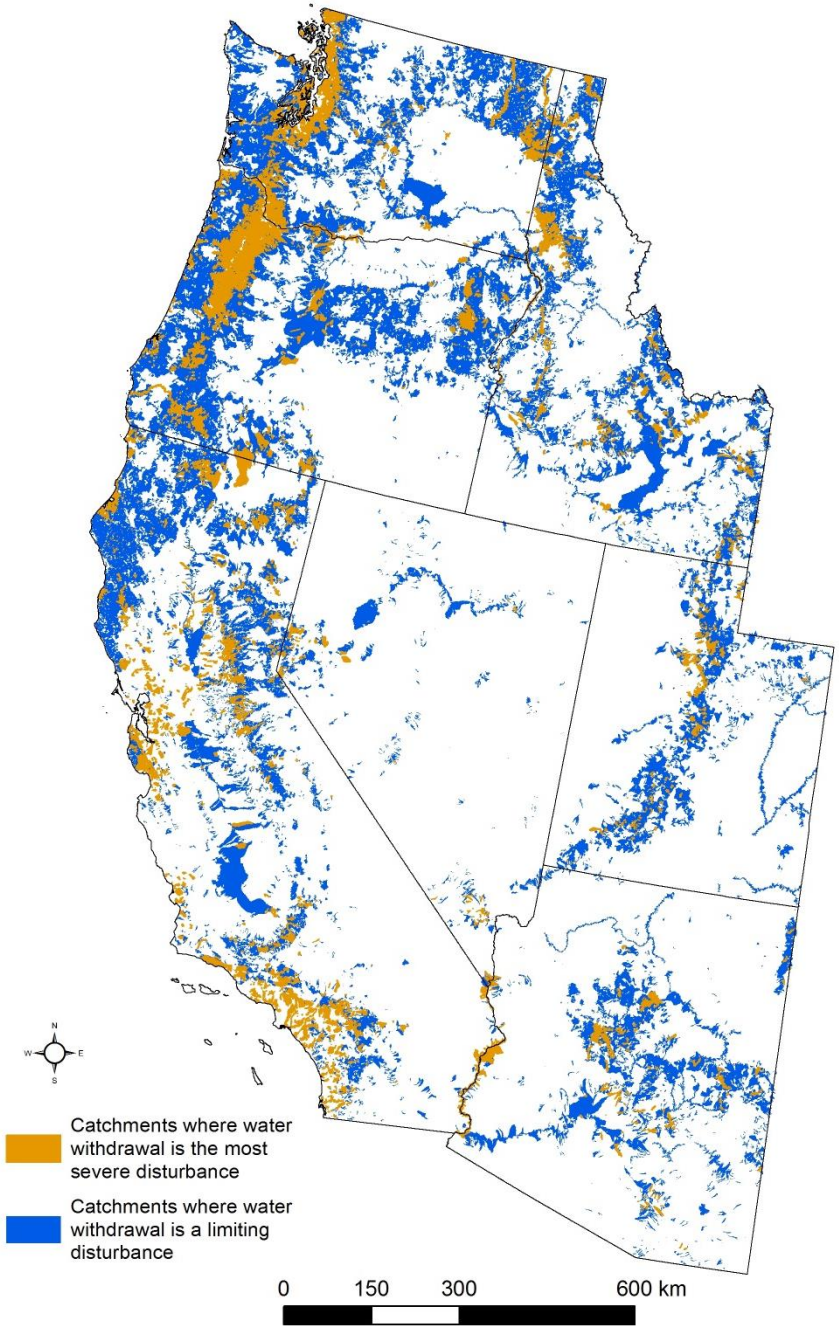
ENHANCING CONSERVATION ACTIONS IN THE CHESAPEAKE BAY BASIN



Which watersheds have the highest nutrient loadings in the Chesapeake Bay basin?

- Highlighted local catchments have both nitrogen and phosphorus loadings above identified threshold points associated with negative fish responses
- Data are from USGS SPARROW 1992

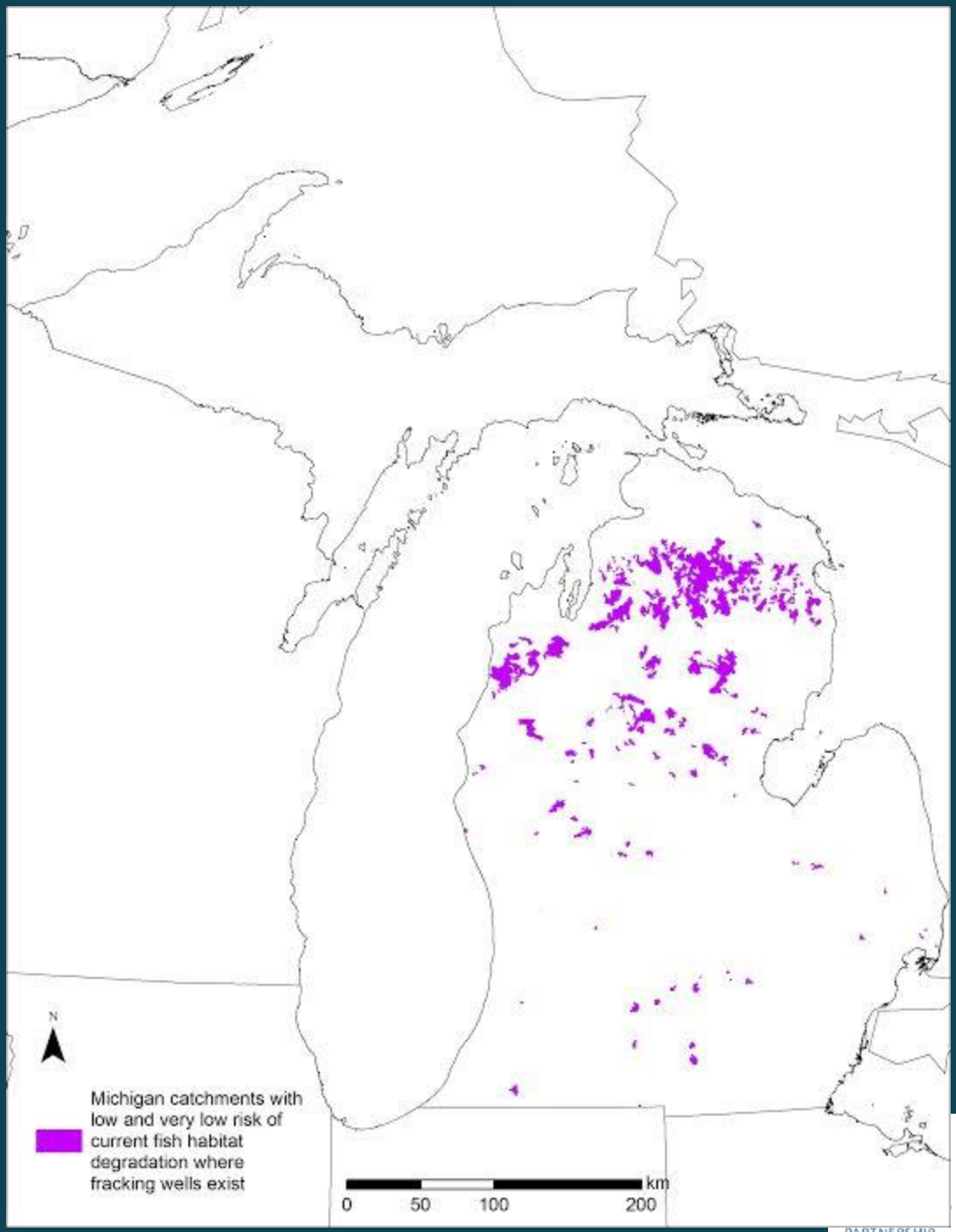
WATER WITHDRAWALS AS A LIMITING OR SEVERE DISTURBANCE TO FISH HABITAT



Limiting disturbance: Takes scores away from best available condition, 5's

Severe disturbance: Puts scores in two lowest condition classes, 1's or 2's

FRACKING LOCATIONS IN MICHIGAN'S CATCHMENTS THAT ARE AT LOW OR VERY LOW RISK OF FISH HABITAT DEGRADATION



ENHANCING CONSERVATION PLANNING FOR HAWAIIAN STREAMS UNDER CURRENT AND FUTURE THREATS

Ralph Tingley, Dana Infante, Yin Phan Tsang, Arthur Cooper, Kyle Herreman

Goal: Generate a set of maps that indicate areas of high conservation value under current and future conditions to inform on-the-ground conservation

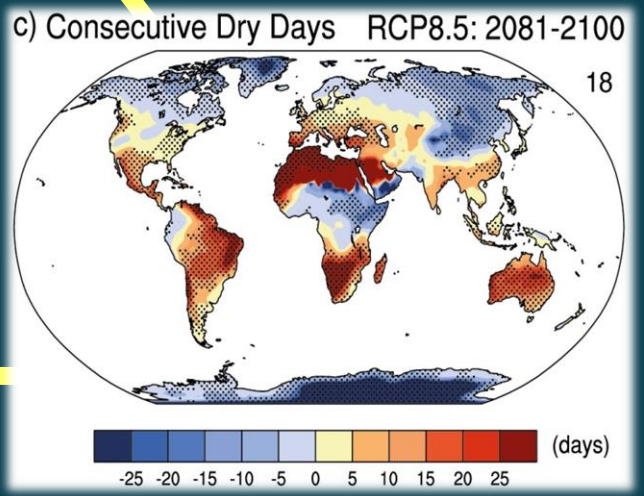
HAWAII FISH HABITAT PARTNERSHIP

An example for conservation planning…

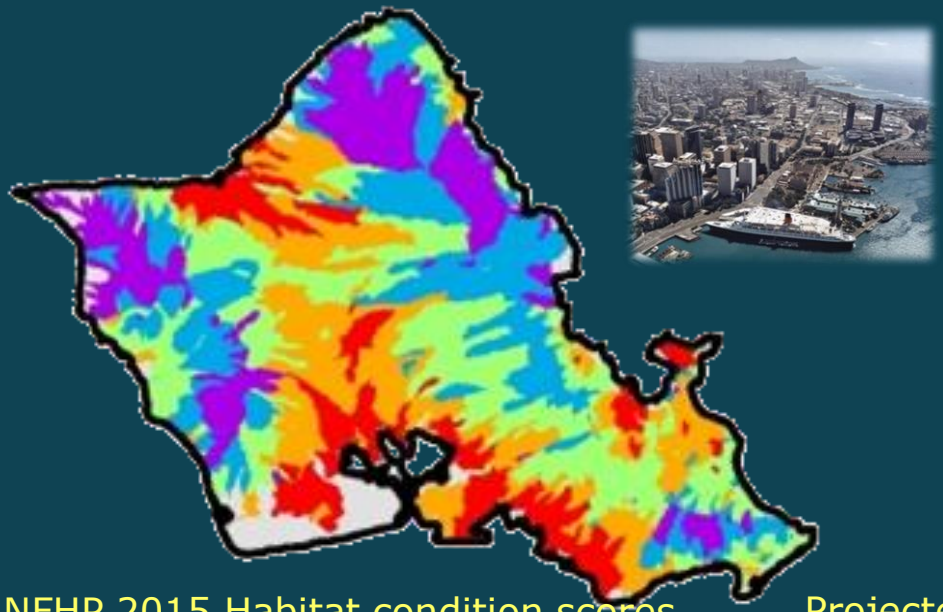
CURRENT AND FUTURE THREATS TO HAWAIIAN STREAMS

Anthropogenic disturbances have resulted in reduced stream habitat condition

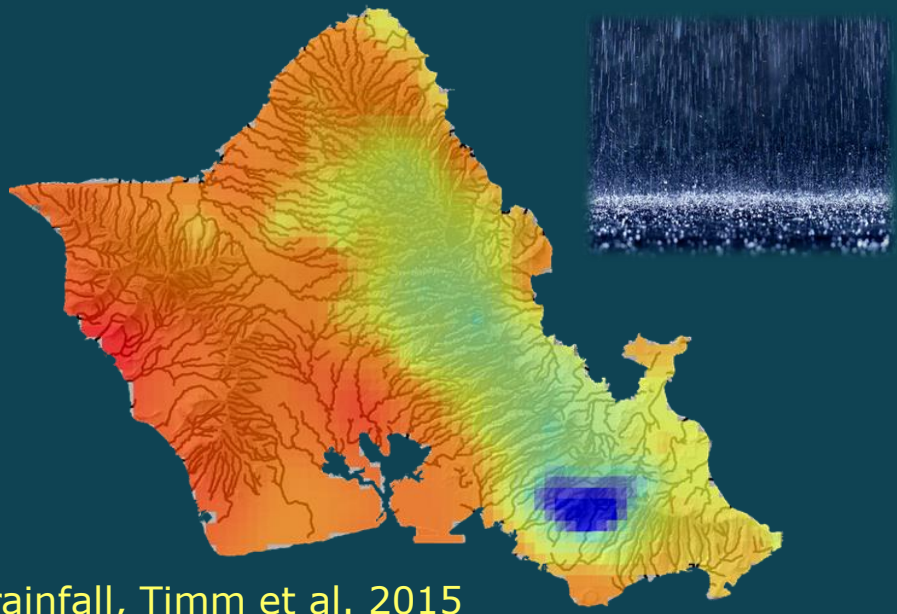
Climate change likely to degrade stream habitat further



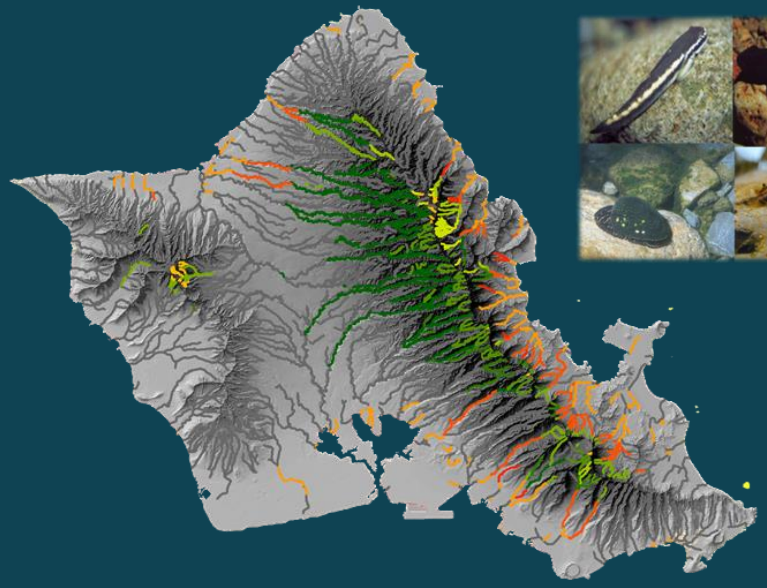
STATEWIDE DATASETS CREATED TO AID IN PLANNING



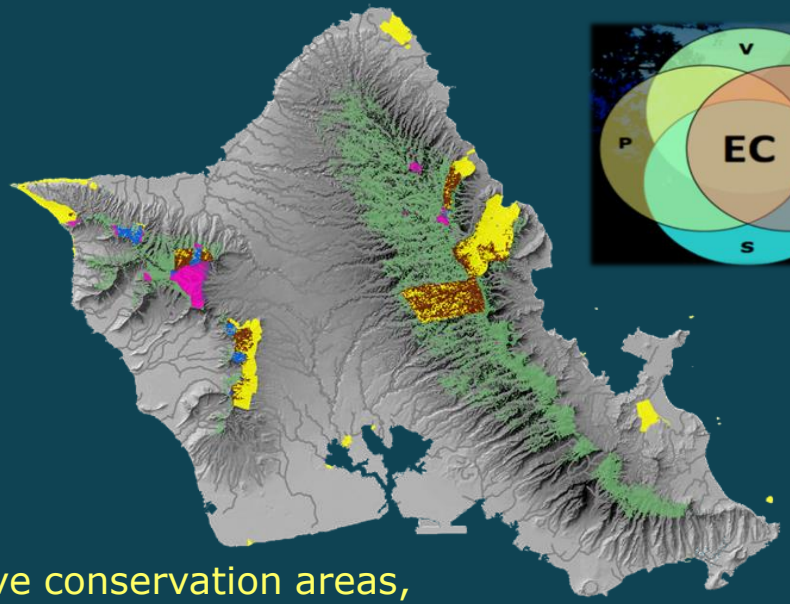
NFHP 2015 Habitat condition scores



Projected rainfall, Timm et al. 2015



Stream reach types, Tingley et al. in prep

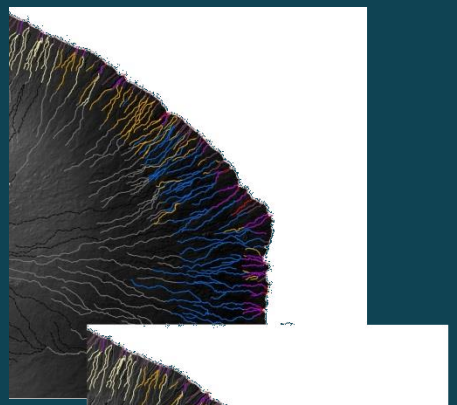


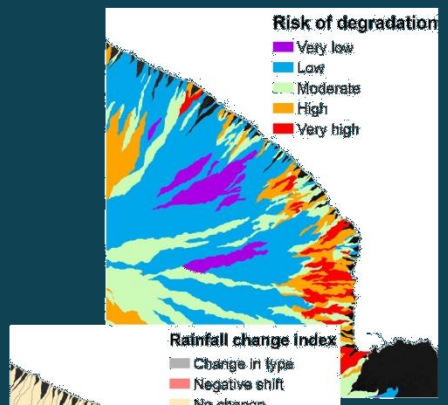
Effective conservation areas,
http://www.hawaiiconservation.org; Price et al. 2012

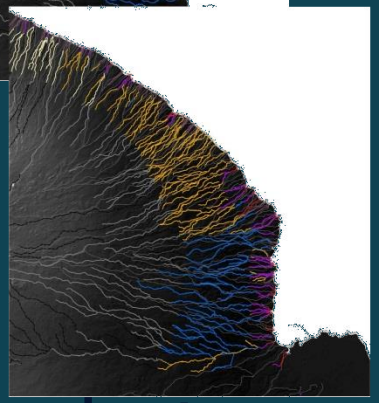
IDENTIFYING LARGE AREAS OF THE LANDSCAPE THAT SHARE DESIRED CRITERIA TO AID IN PLANNING (Zonation, Marxan)

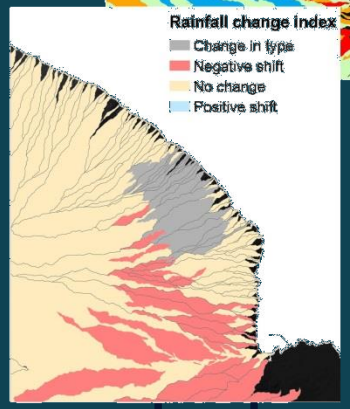
Current stream types

Future stream types



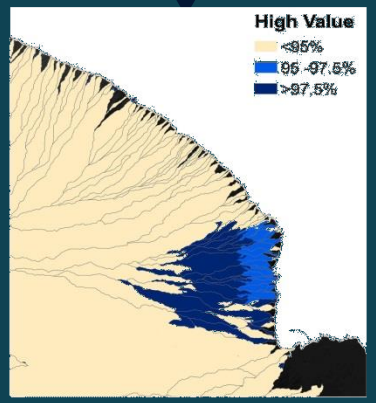






Current Habitat Condition Index

Rainfall change index

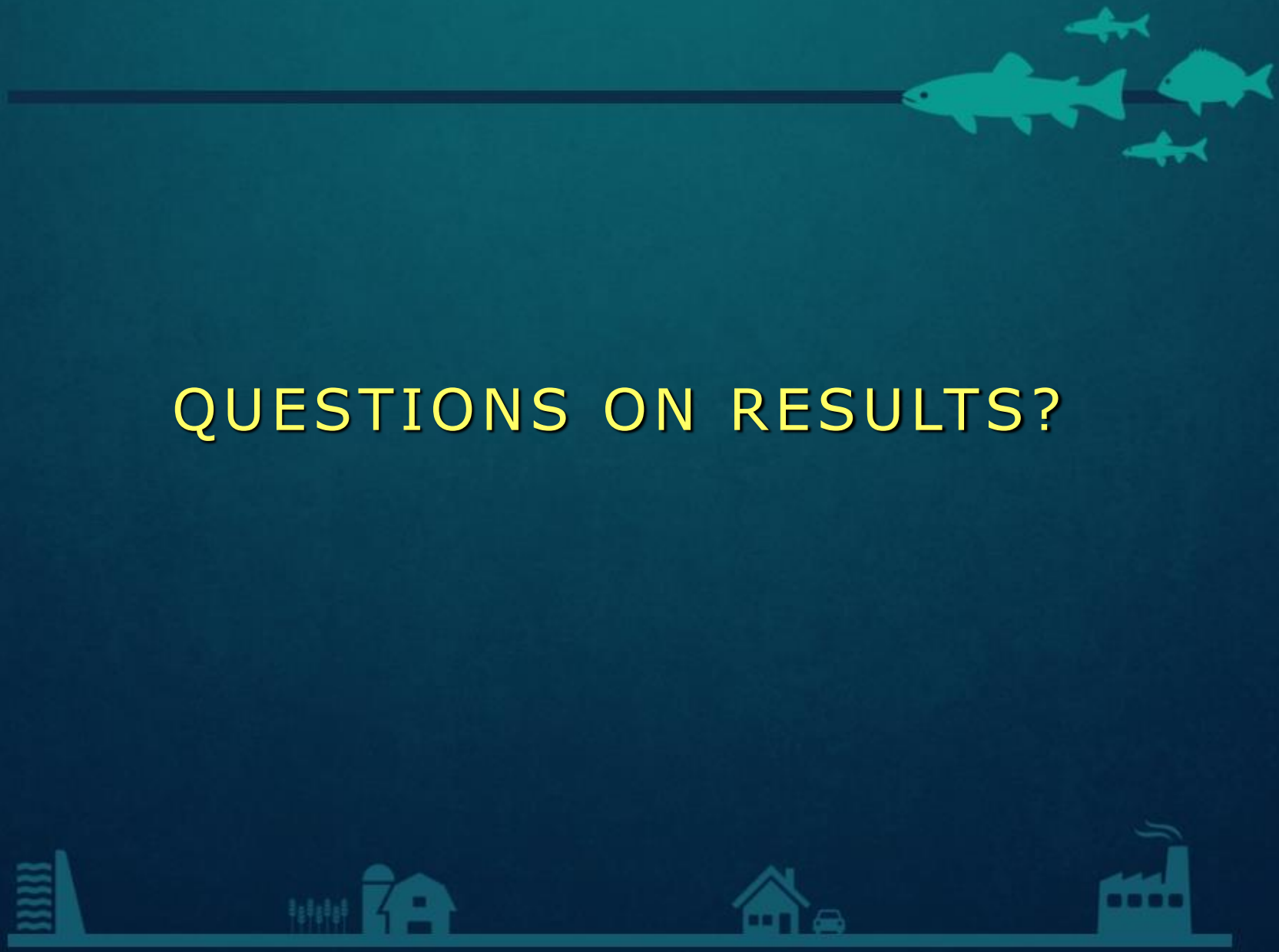


Generate multiple maps at multiple time steps for comparison

Assess overlap with effective conservation areas and priority catchments

NATIONAL FISH HABITAT PARTNERSHIP

QUESTIONS ON RESULTS?



ACQUIRING AND USING ASSESSMENT RESULTS

- Assessment results indicate which stream habitats may be limited as well as factors that may be responsible
- Results can be used alone or with other information to support decision making
- Many, many questions can be asked with these data (our presentation highlighted a few examples)
- Results are spatial and can be mapped
  - Data, scores, limiting disturbances are available at the stream reach scale of the NHDPlusV1
  - Information can also be summarized in other spatial units (HUC watersheds)
- We can help you use results in support of questions that you would like to ask

SOME OF THE GROUPS USING DATA AND RESULTS

Federal Agencies/Initiatives
EPA
IJC
NOAA
NOAA Coral Reef Ecosystem Division
NOAA Pacific Islands Regional Office
NOAA National Marine Fisheries Service
USFS
USGS Middleton
USGS Missouri Cooperative Fish and Wildlife Research Unit
USGS Reston
USGS Ohio Water Science Center
Fishers and Farmers FHP
SARP
SEACAP / SARP
Southwest Aquatics
Appalachian LCC
State Agencies
Hawaii Department of Health Environmental Planning Office
Michigan Department of Natural Resources
Michigan Department of Natural Resources - IFR
MSUE Michigan Natural Features Inventory
South Carolina DNR
Nonprofit
Huron River Water Council
The Nature Conservancy Eastern Resource Office
The Nature Conservancy Great Lakes Office

Universities
Iowa State University
Kansas State University
Michigan State University
Notre Dame
Penn State University
Southern Illinois University
University of California Santa Cruz
University of Hawaii Manoa
University of Michigan
University of Missouri
University of Montana
University of Southern Mississippi
University of Texas at Austin
University of Wisconsin
Consultants
Cadmus Group
Downstream Strategies
Martin Environmental/Sealaska
Parham & Associates Environmental Consulting, LLC
Rushing Rivers
Tetra Tech

TAKE HOME POINTS

- Nothing else like this: national scale assessment tailored to response of fish species response
- Gives a national picture of fish habitat condition; landscape-scale results are seamless across the conterminous US
- Can be used to answer questions at regional, state, or local scales
- Other data sets can be easily integrated with our results because of the spatial framework
- Using the assessment will lead to improvements; will identify what we don't know, help guide future decisions (proof of concept in 2009 vs. 2010 vs. 2015)
- We can help you use results in support of questions that you would like to ask

THANK YOU!!!

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- Michigan Department of Natural Resources
- Many, many data contributors…

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