Appendix 1. Species considered but not included in ranking or habitat modeling

1	Lithobates clamitans	green frog	Amphibian
2	Exopalaemon modestus	Siberian prawn	Crustacean
3	Faxonius sanbornii	sanborn crayfish	Crustacean
4	Faxonius virilis	virile crayfish	Crustacean
5	Didymosphenia geminata	Didymo	Diatom
6	Ameiurus melas	black bullhead	Fish
7	Ameiurus natalis	yellow bullhead	Fish
8	Ameiurus nebulosus	brown bullhead	Fish
9	Esox americanus vermiculatus	American pickerel	Fish
10	Esox lucius	northern pike	Fish
11	Lepomis macrochirus	bluegill	Fish
12	Chelydra serpentina	common snapping turtle	Reptile
13	Trachemys scripta elegans	red-eared slider	Reptile
14	Trachemys scripta scripta	yellow-bellied slider	Reptile

Data Sources:

GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Appendix 2. Freshwater Aquatic Invasive Species Assessment

Information for all species included in invasiveness ranking and habitat suitability modeling. For each species, the Alaska occurrence records, occurrence records from outside Alaska, and the species Invasiveness Risk Ranking is reported. The likely pathways are also indicated for each species with a definition and icon for the pathway. Next, a habitat suitability map with three thresholds and species occurrence map is plotted. The shading represents the number of models that predicted suitable habitat across HUC8 subbasins. The habitat suitability models are then organized by HUC4 region and plotted sequentially by HUC number. A map of the HUC4 regions of Alaska is provided for reference. Finally, the habitat suitability model response curves and variable importance for each species is plotted. A summary of relevant pathways relevant to Alaska is presented in the final table.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Alosa sapidissima** *Common Name* **American Shad**

Alaska Occurrence Records: species occurrences found in Alaska - **26**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) - **1091**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool (Very High, High, or Moderate) -**High**[4]

Potential Vectors:

In State Transfer

Natural Migration

Importation and Release

Species Group:

Fish

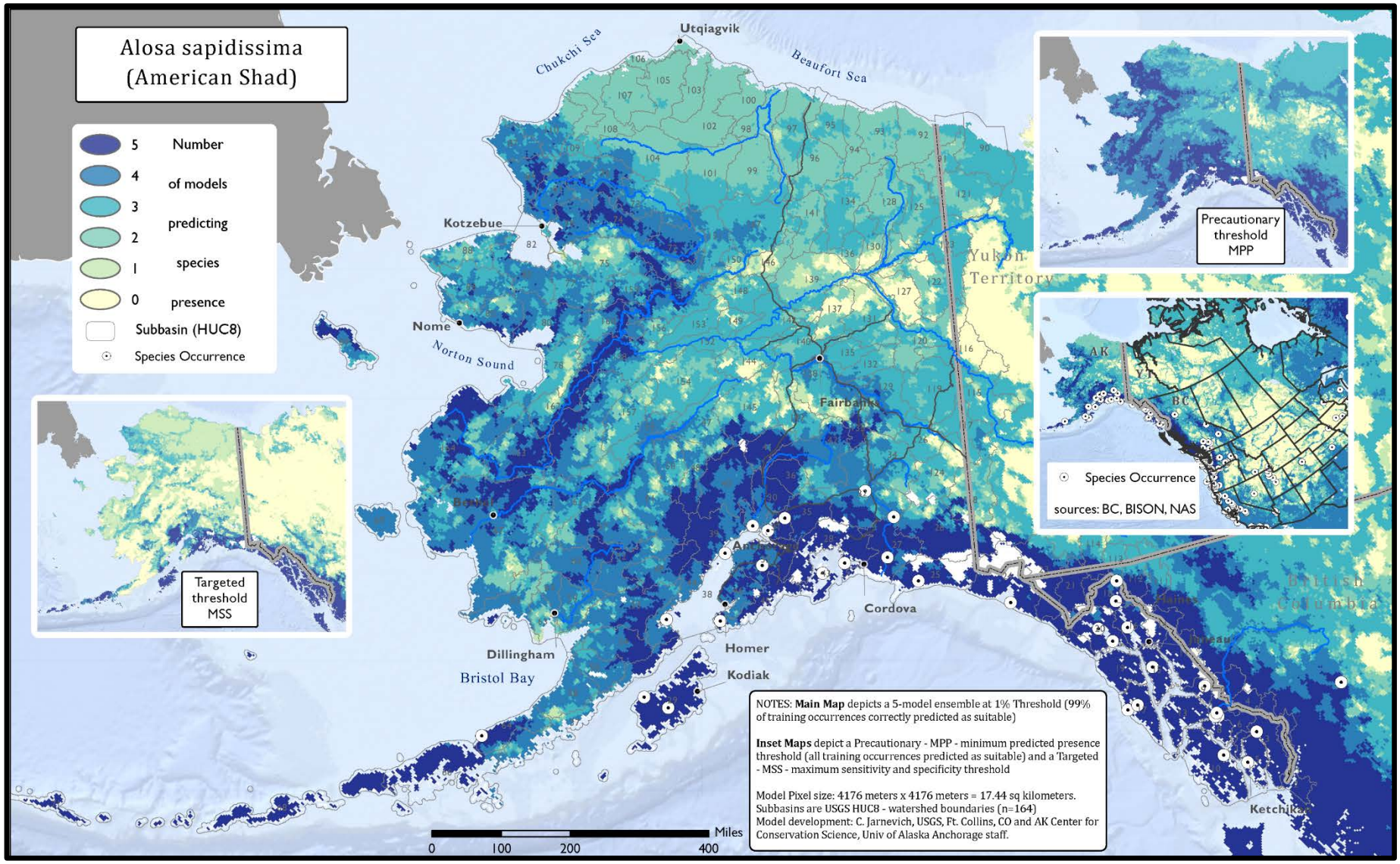
Data Sources:

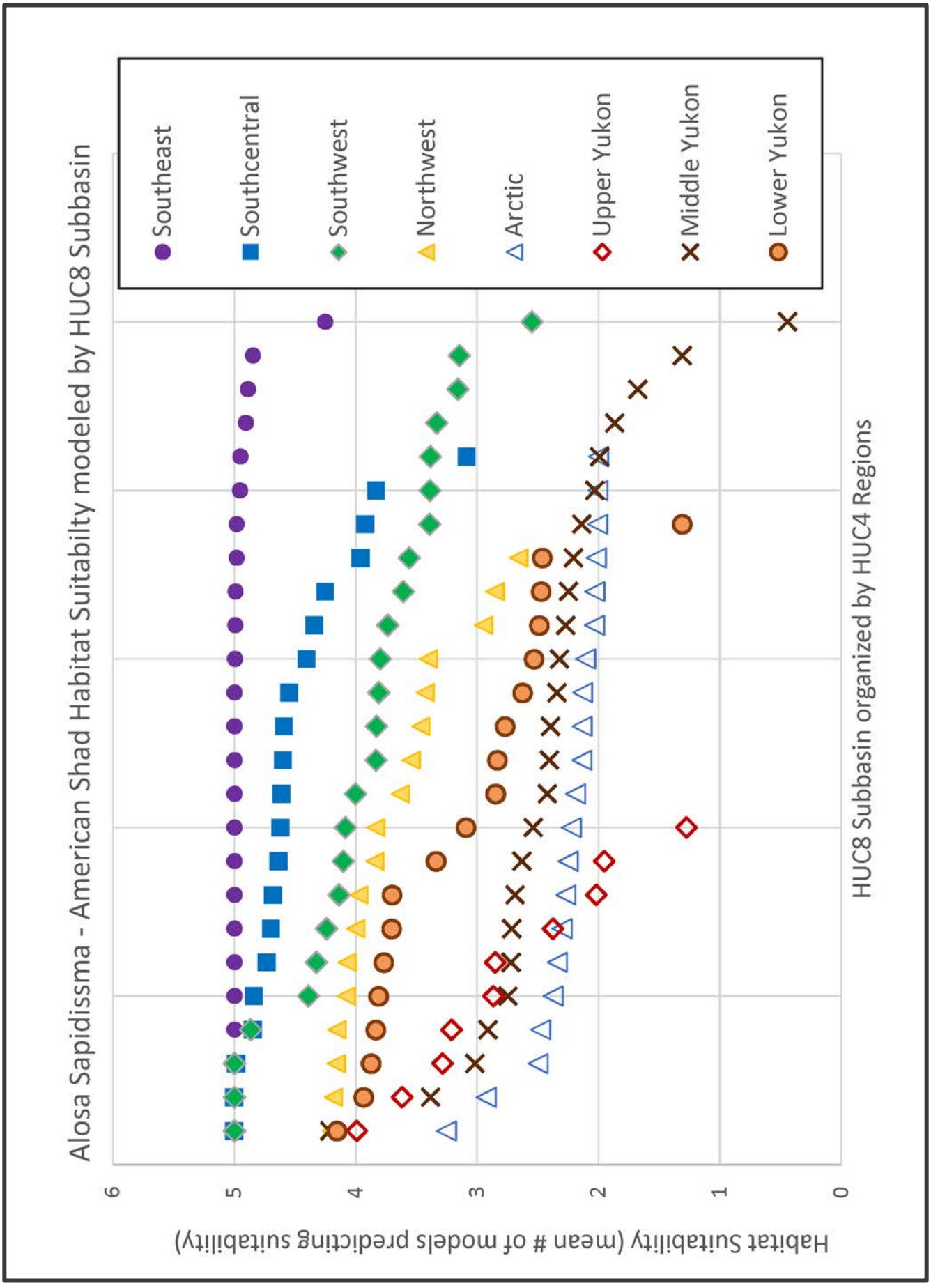
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

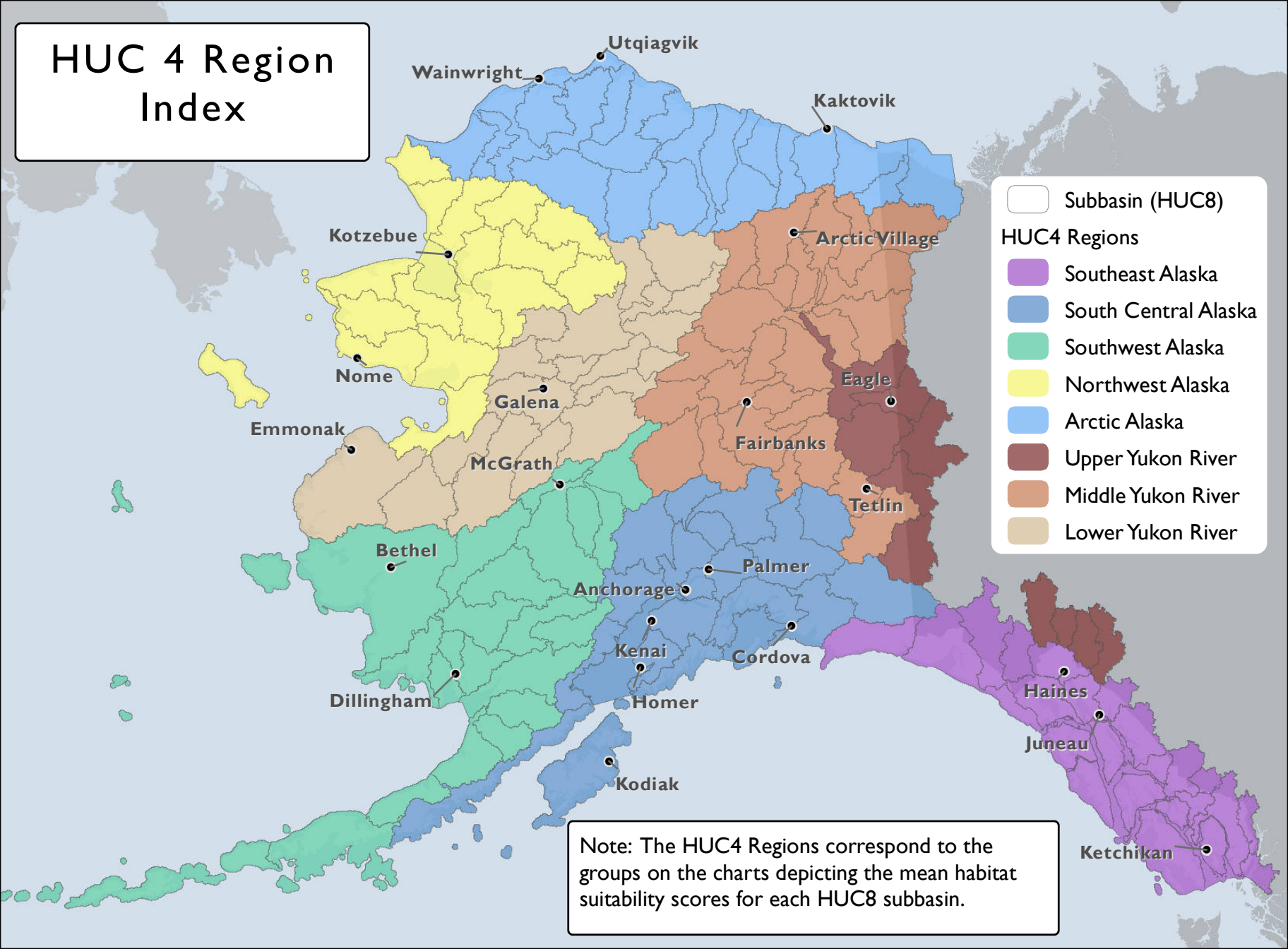
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Alosa sapidissima
(American Shad)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Species Occurrence
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon
Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Ketchikan
British
Columbia
Precautionary
threshold
MPP
Targeted
threshold
MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0
100
200
400
NOTES: **Main Map** depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Alosa Sapidissma - American Shad Habitat Suitabilty modeled by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
6
5
4
3
2
1
0
Habitat Suitability (mean # of models predicting suitability)
HUC8 Subbasin organized by HUC4 Regions

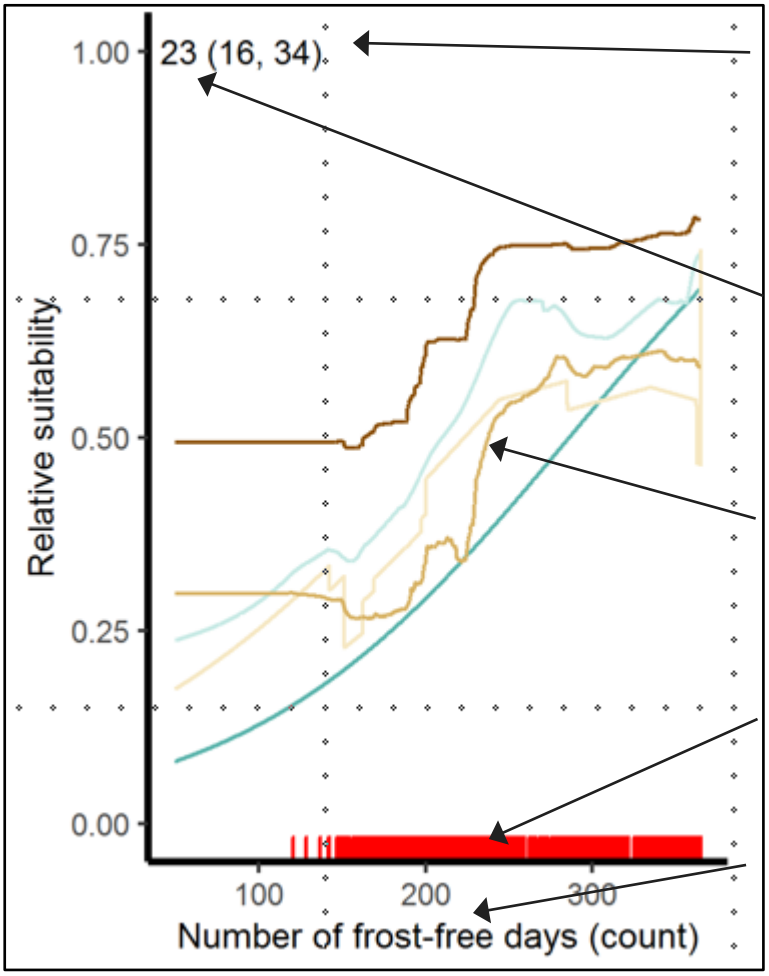
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

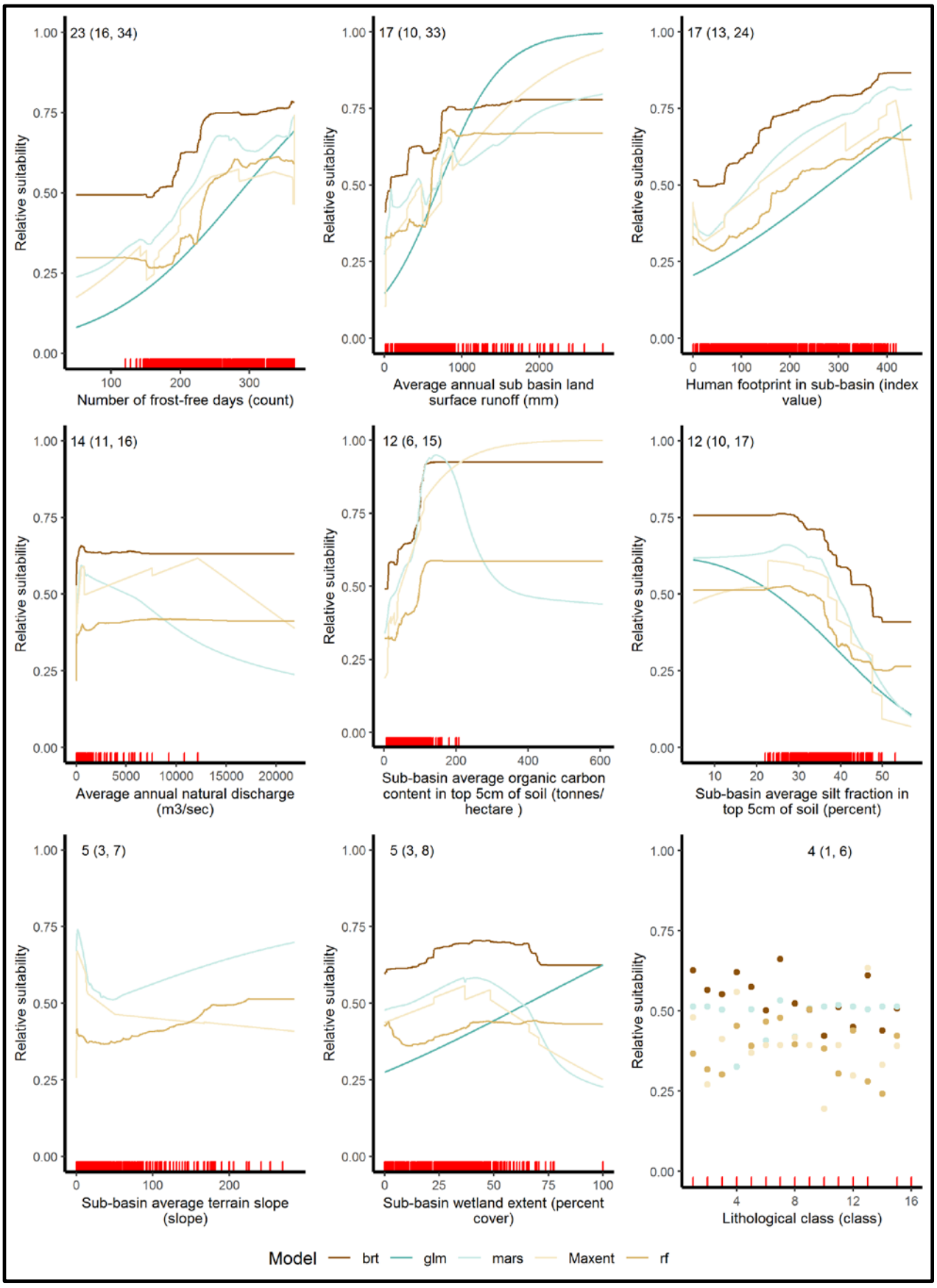
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


23 (16, 34)
Number of frost-free days (count)
17 (10, 33)
Average annual sub basin land surface runoff (mm)
17 (13, 24)
Human footprint in sub-basin (index value)
14 (11, 16)
Average annual natural discharge (m3/sec)
12 (6, 15)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
12 (10, 17)
Sub-basin average silt fraction in top 5cm of soil (percent)
5 (3, 7)
Sub-basin average terrain slope (slope)
5 (3, 8)
Sub-basin wetland extent (percent cover)
4 (1, 6)
Lithological class (class)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Carassius auratus** *Common Name* **Goldfish**

Alaska Occurrence Records: species occurrences found in Alaska - 2[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United states and British Columbia, Canada) – **2546**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Aquarium Release

Species Group:

Fish

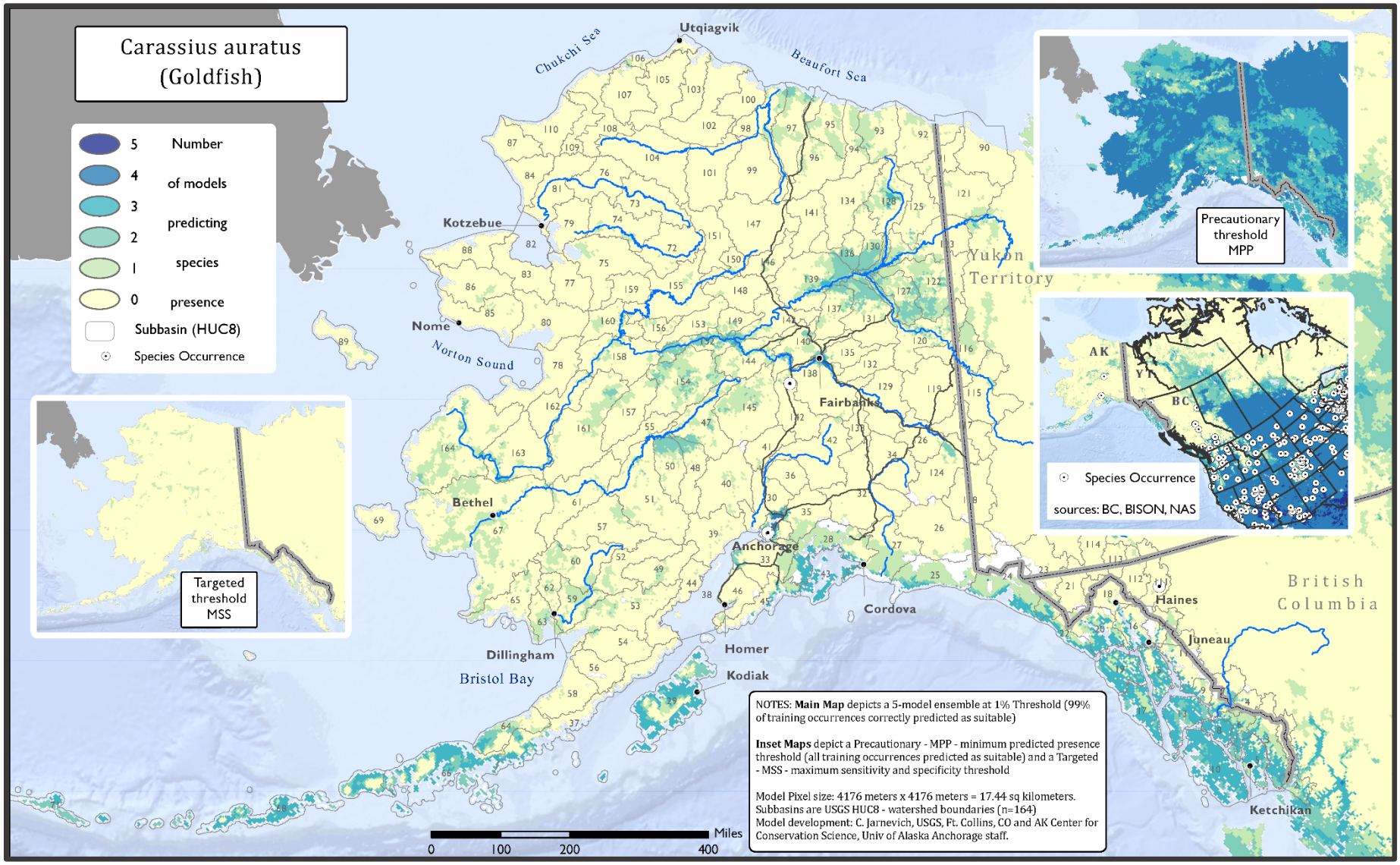
Data Sources:

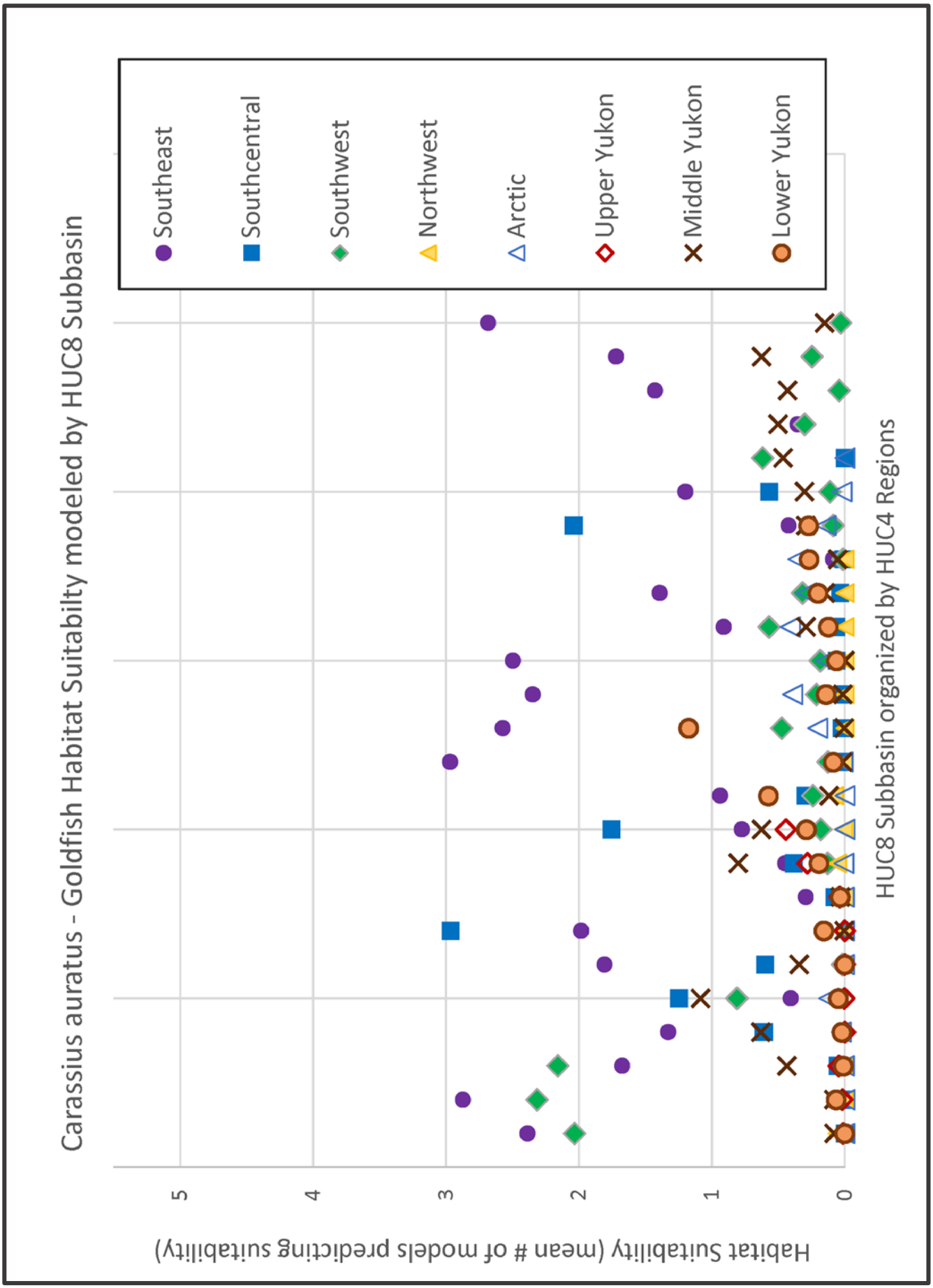
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

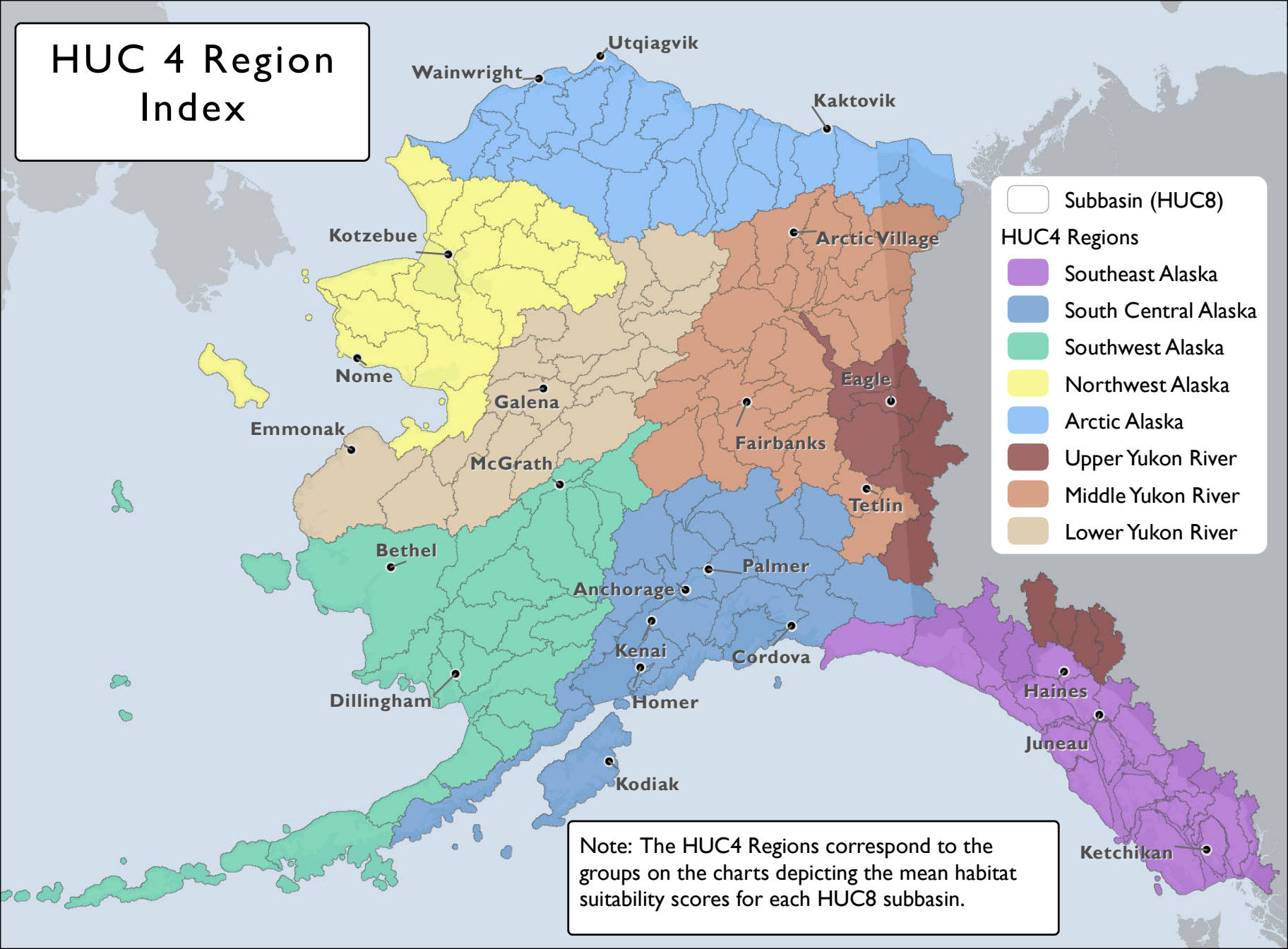
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Carassius auratus
(Goldfish)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Species Occurrence
Targeted threshold MSS
Precautionary threshold MPP
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Haines
Juneau
Ketchikan
British Columbia
Dillingham
Bristol Bay
Homer
Kodiak
Miles
0
100
200
400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Carassius auratus - Goldfish Habitat Suitability modeled by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

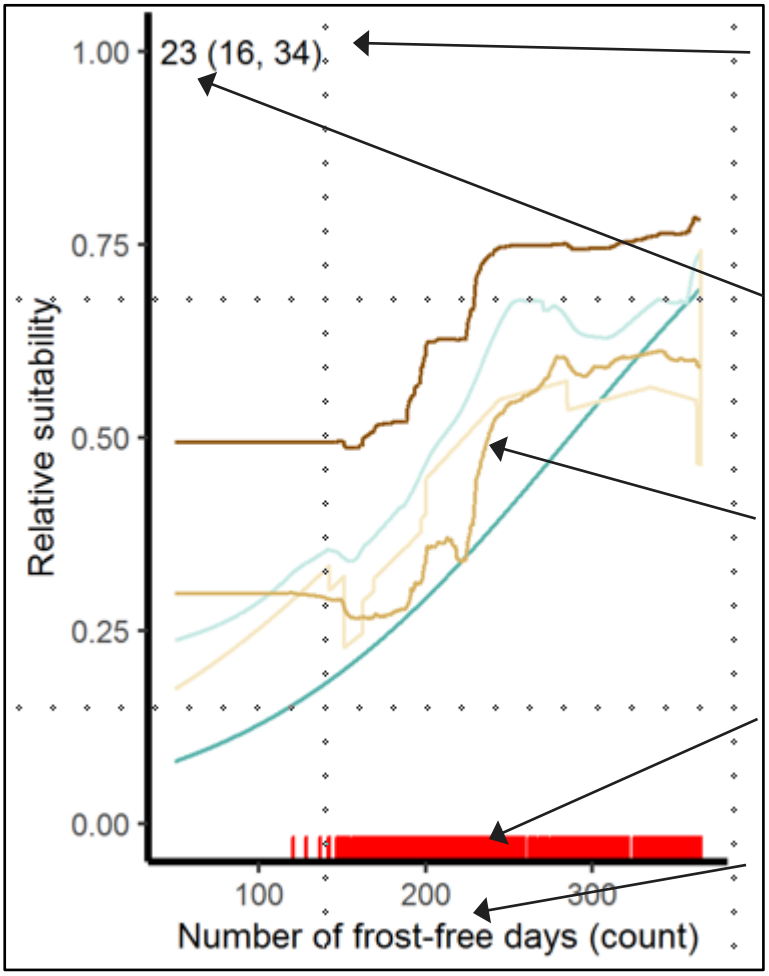
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

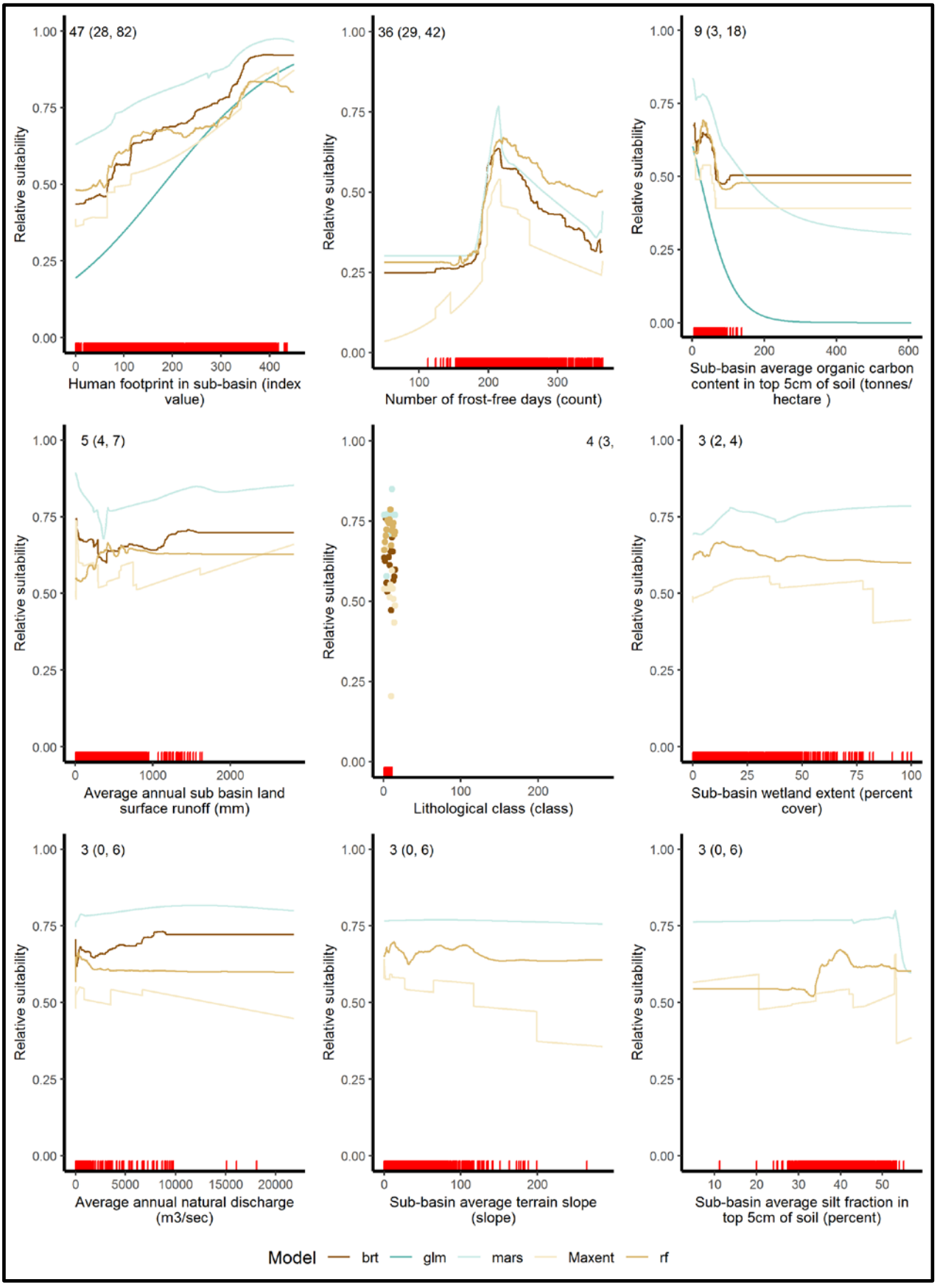
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


47 (28, 82)
Relative suitability
Human footprint in sub-basin (index value)
36 (29, 42)
Number of frost-free days (count)
9 (3, 18)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
5 (4, 7)
Average annual sub basin land surface runoff (mm)
4 (3,
Lithological class (class)
3 (2, 4)
Sub-basin wetland extent (percent cover)
3 (0, 6)
Average annual natural discharge (m3/sec)
3 (0, 6)
Sub-basin average terrain slope (slope)
3 (0, 6)
Sub-basin average silt fraction in top 5cm of soil (percent)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Channa argus** *Common Name* **Northern Snakehead**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **3167**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

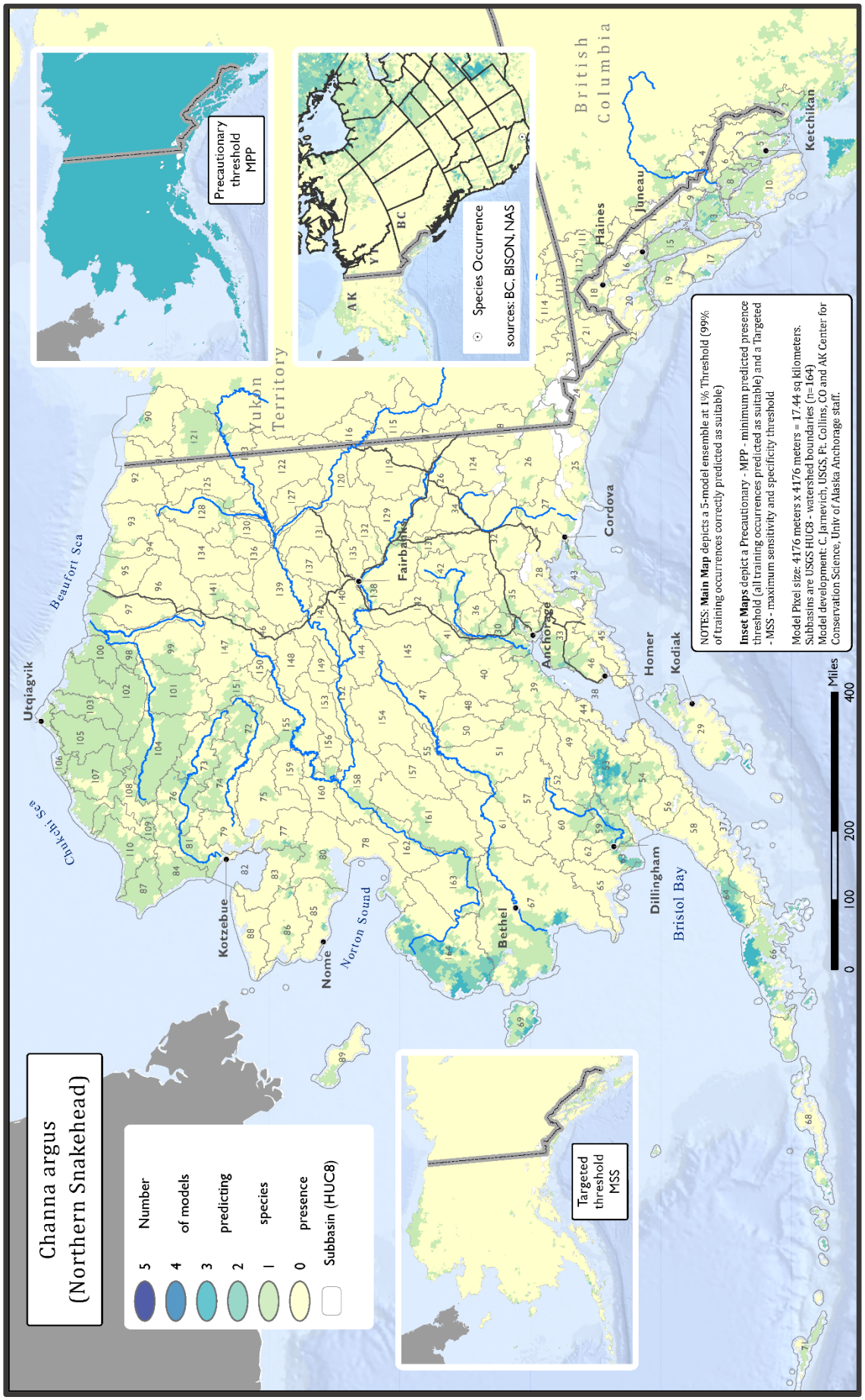
Data Sources:

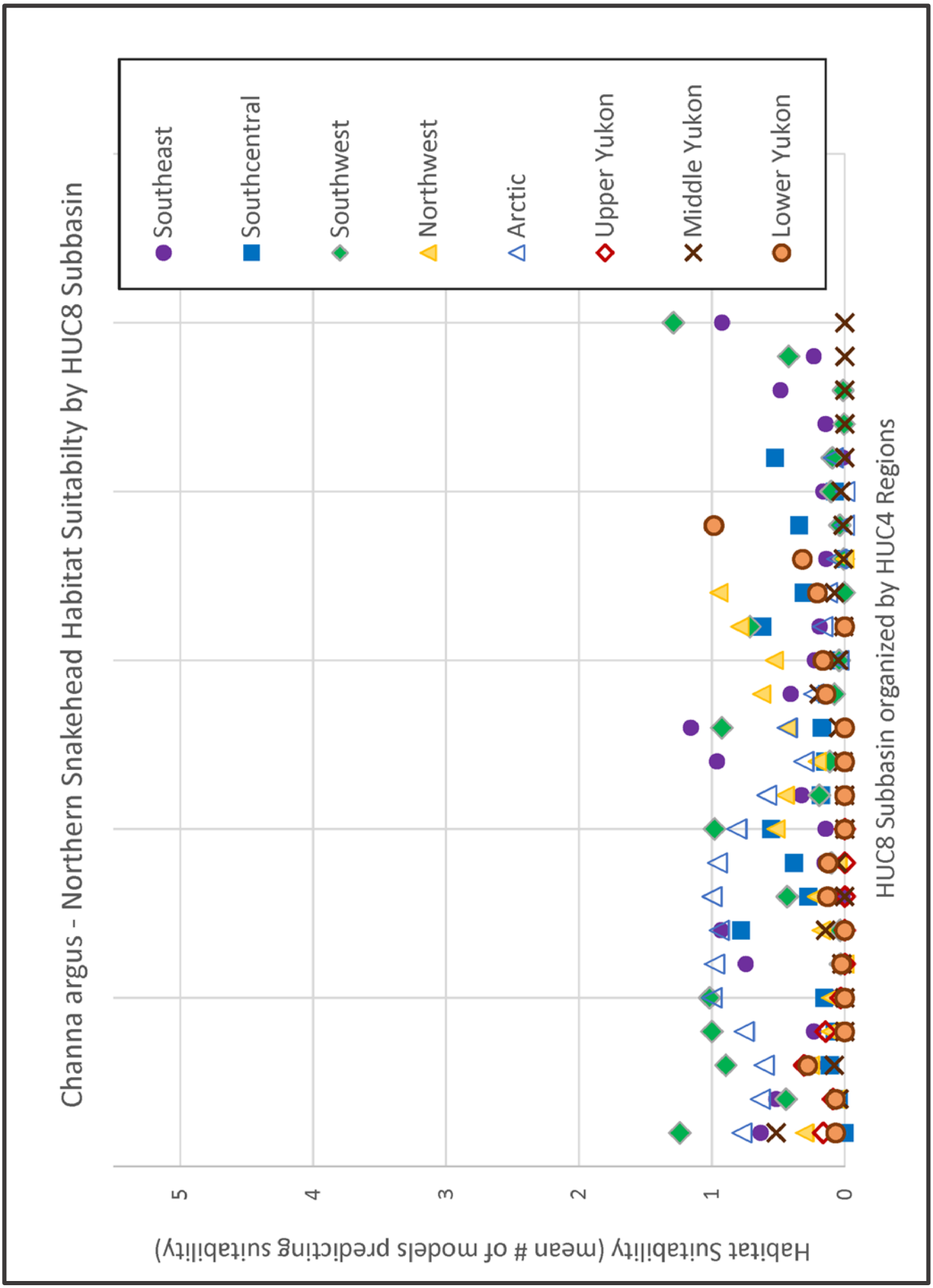
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

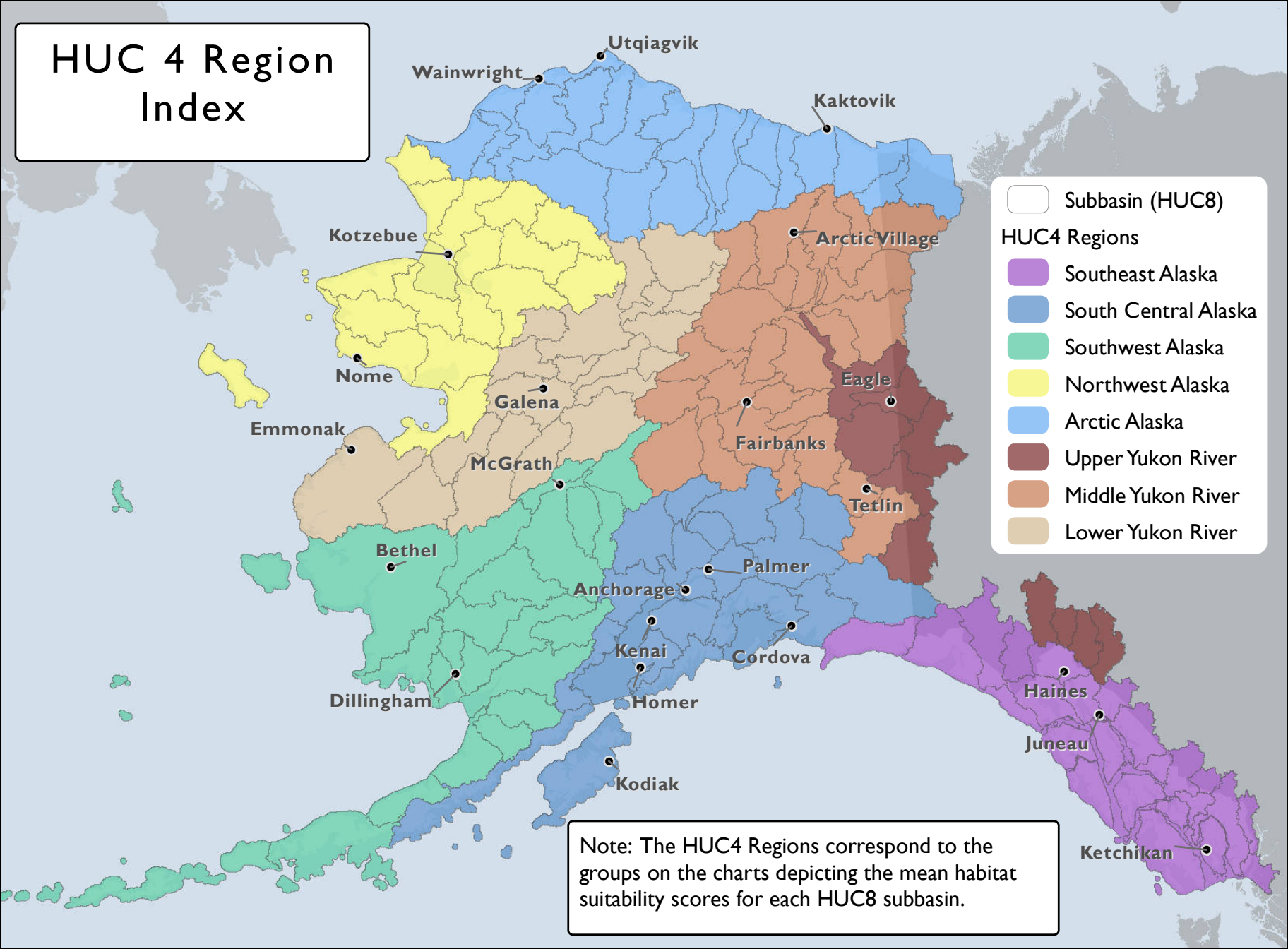
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Channa argus
(Northern Snakehead)
Number of models predicting species presence
5
4
3
2
1
0
Subbasin (HUC8)
Precautionary threshold MPP
Targeted threshold MSS
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0
100
200
400
Yukon Territory
British Columbia
Beaufort Sea
Chukchi Sea
Norton Sound
Bristol Bay
Utqiagvik
Kotzebue
Nome
Bethel
Dillingham
Fairbanks
Anchorage
Cordova
Homer
Kodiak
Haines
Juneau
Ketchikan


Channa argus - Northern Snakehead Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

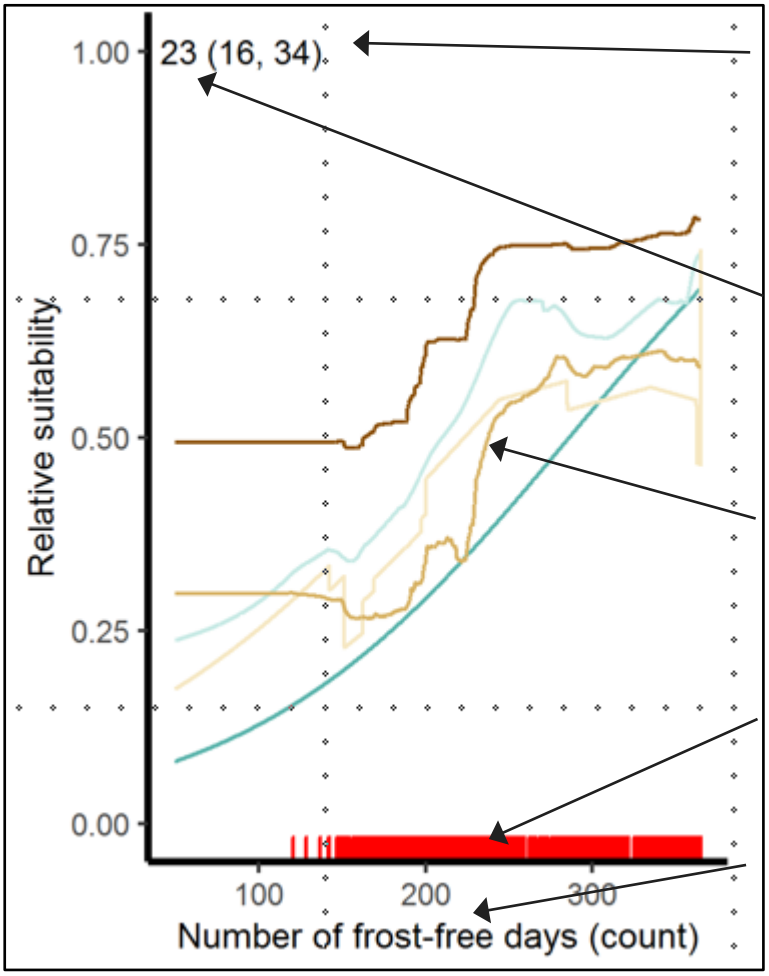
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

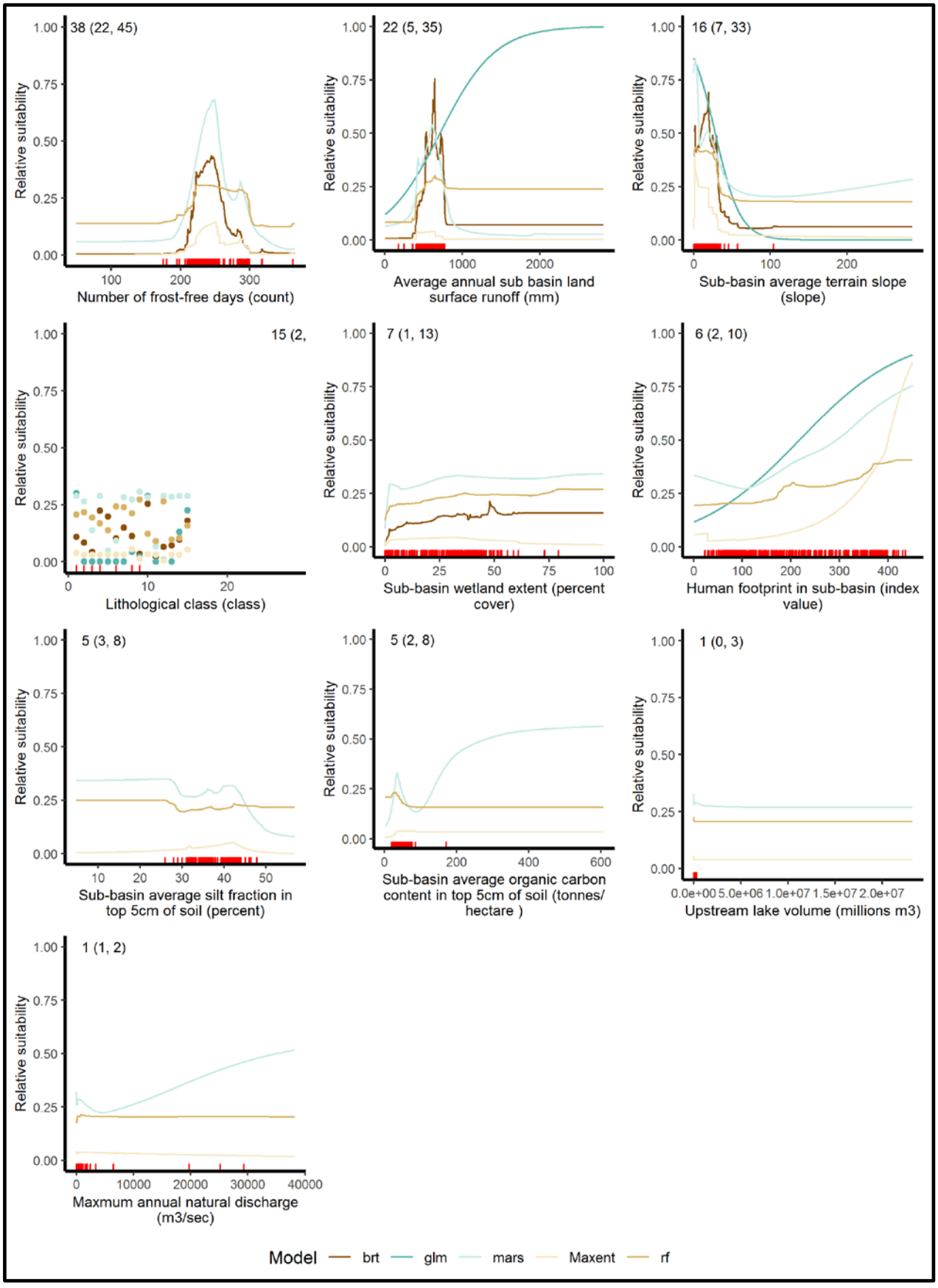
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


38 (22, 45)
Number of frost-free days (count)
22 (5, 35)
Average annual sub basin land surface runoff (mm)
16 (7, 33)
Sub-basin average terrain slope (slope)
15 (2,
Lithological class (class)
7 (1, 13)
Sub-basin wetland extent (percent cover)
6 (2, 10)
Human footprint in sub-basin (index value)
5 (3, 8)
Sub-basin average silt fraction in top 5cm of soil (percent)
5 (2, 8)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
1 (0, 3)
Upstream lake volume (millions m3)
1 (1, 2)
Maxmum annual natural discharge (m3/sec)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Corbicula fluminea** *Common Name* **Asian clam**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **11778**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Mollusk

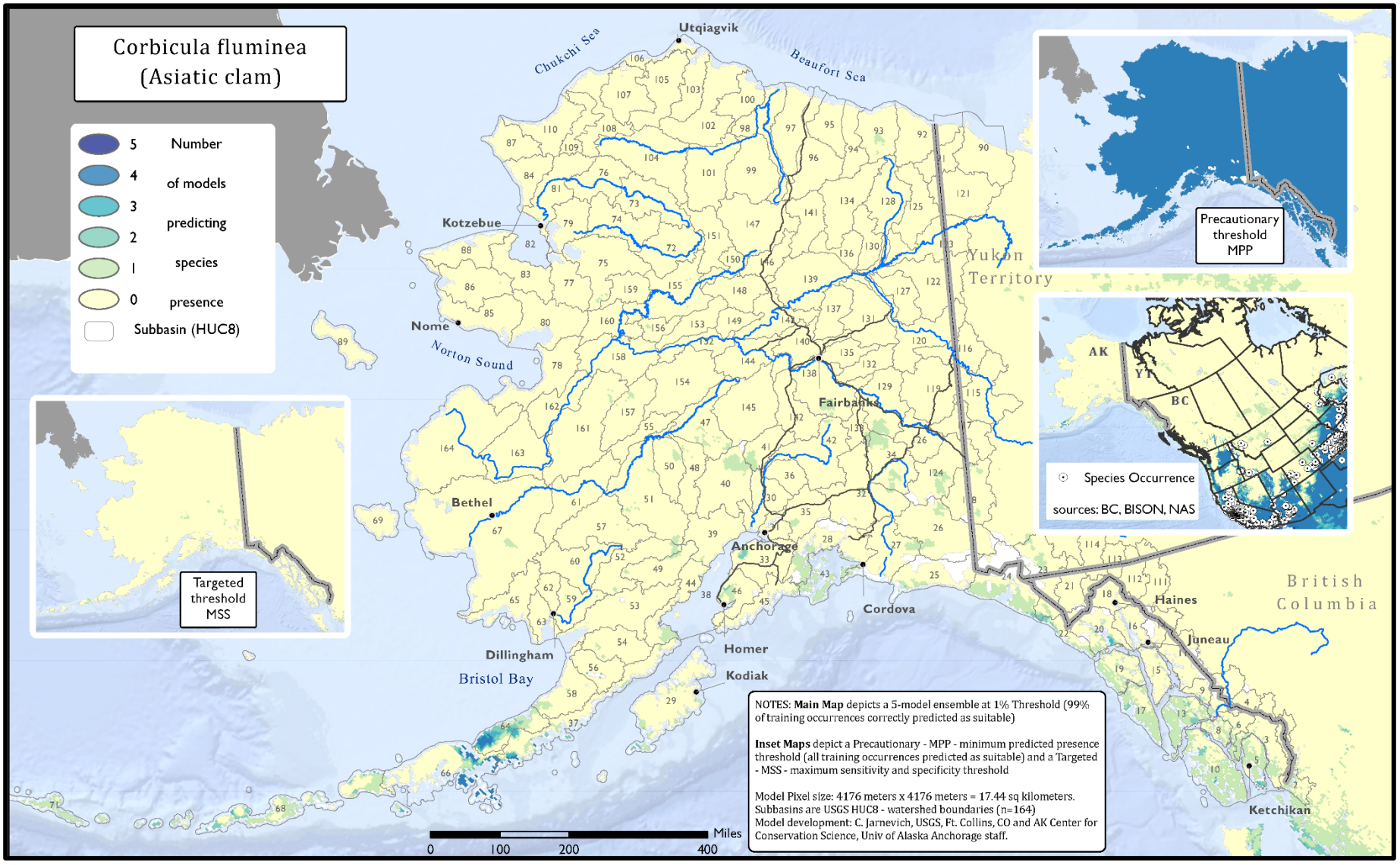
Data Sources:

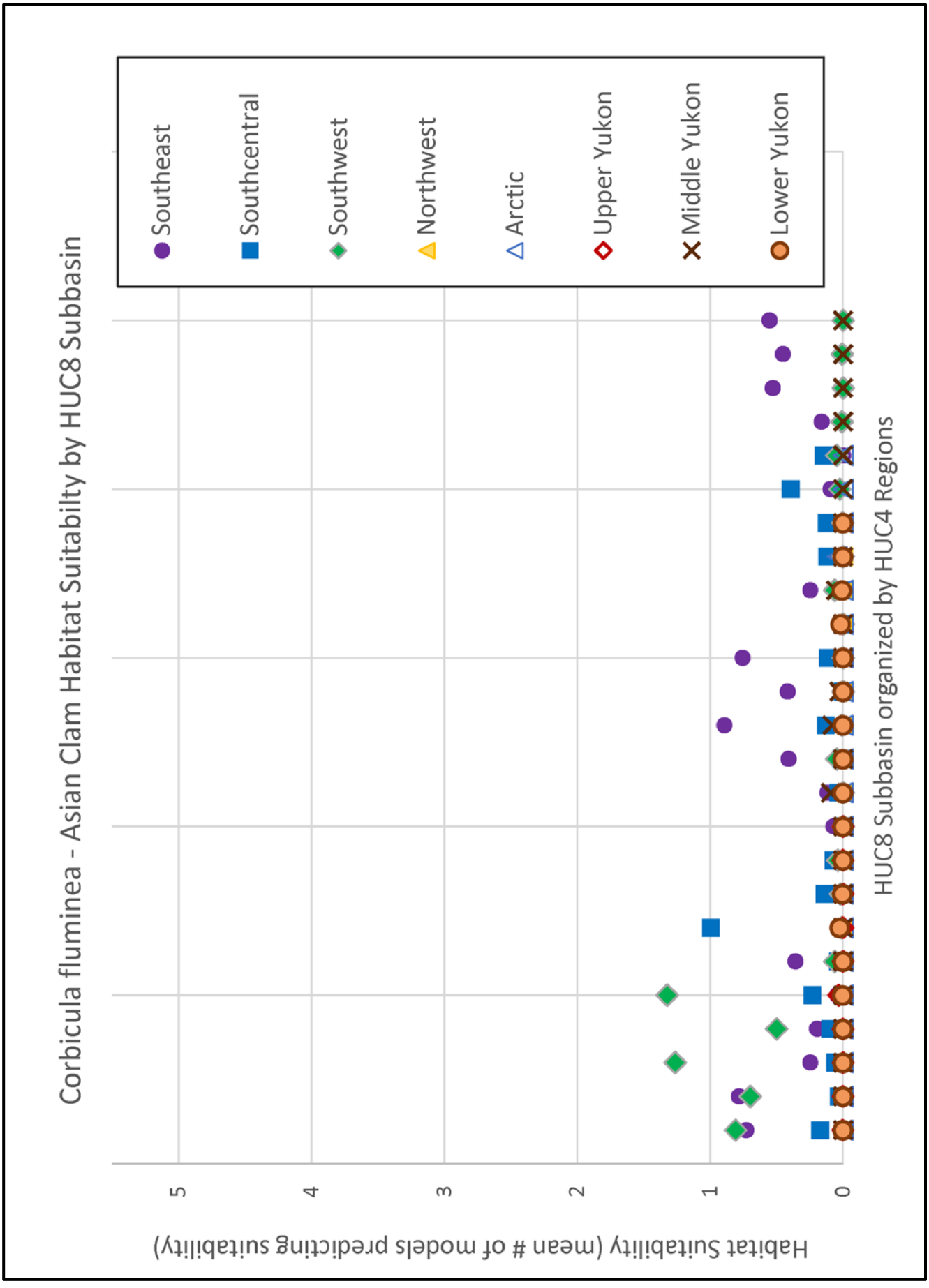
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

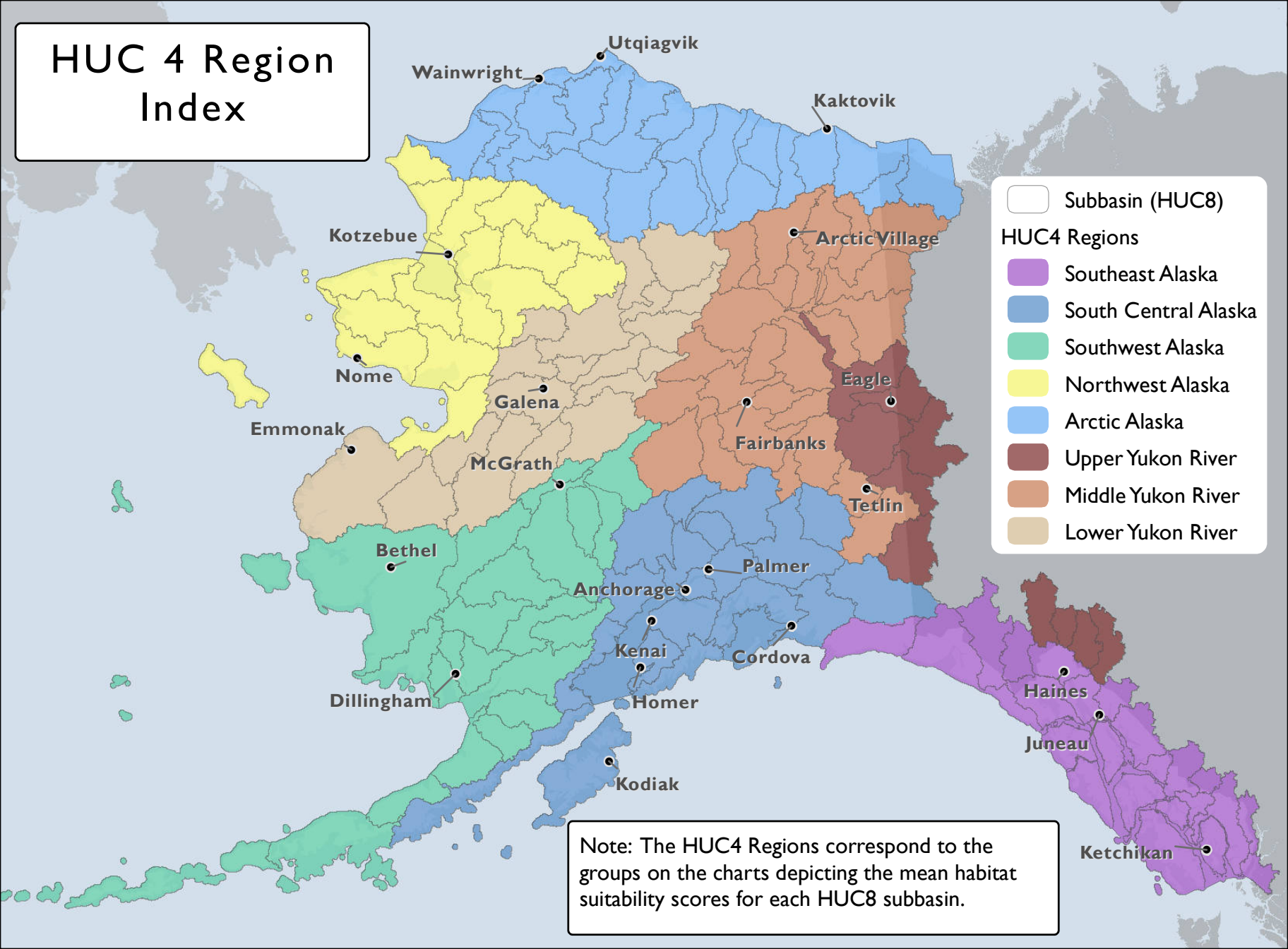
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Corbicula fluminea
(Asiatic clam)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Bethel
Dillingham
Bristol Bay
Fairbanks
Anchorage
Cordova
Homer
Kodiak
Yukon Territory
British Columbia
Haines
Juneau
Ketchikan
Miles
0
100
200
400
Targeted threshold MSS
Precautionary threshold MPP
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Corbicula fluminea - Asian Clam Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

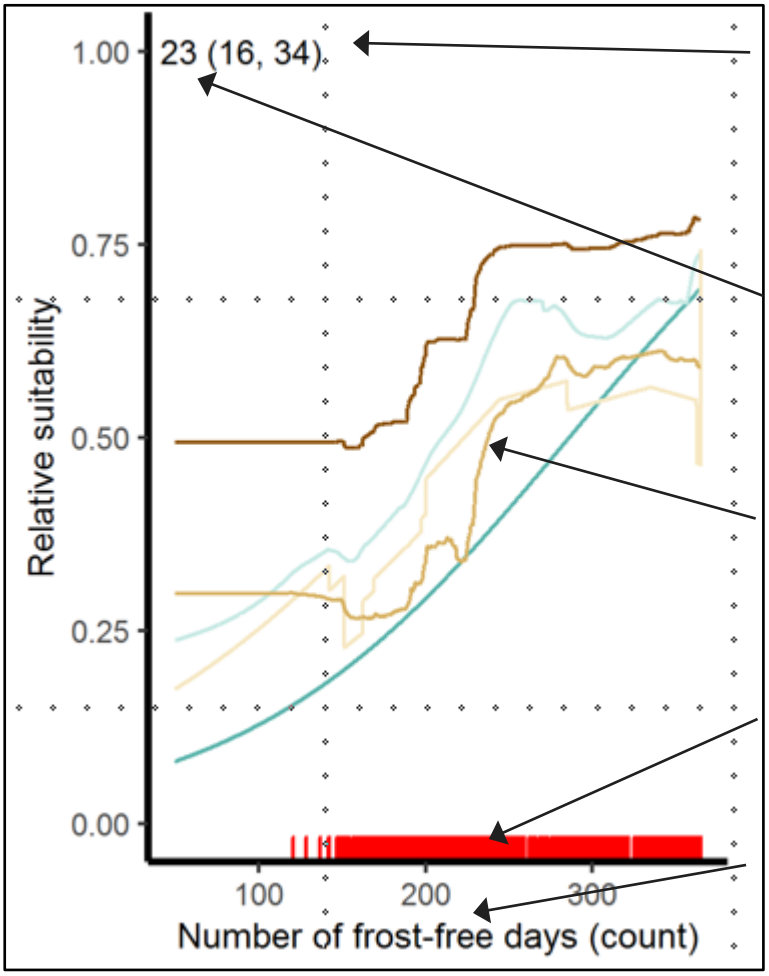
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

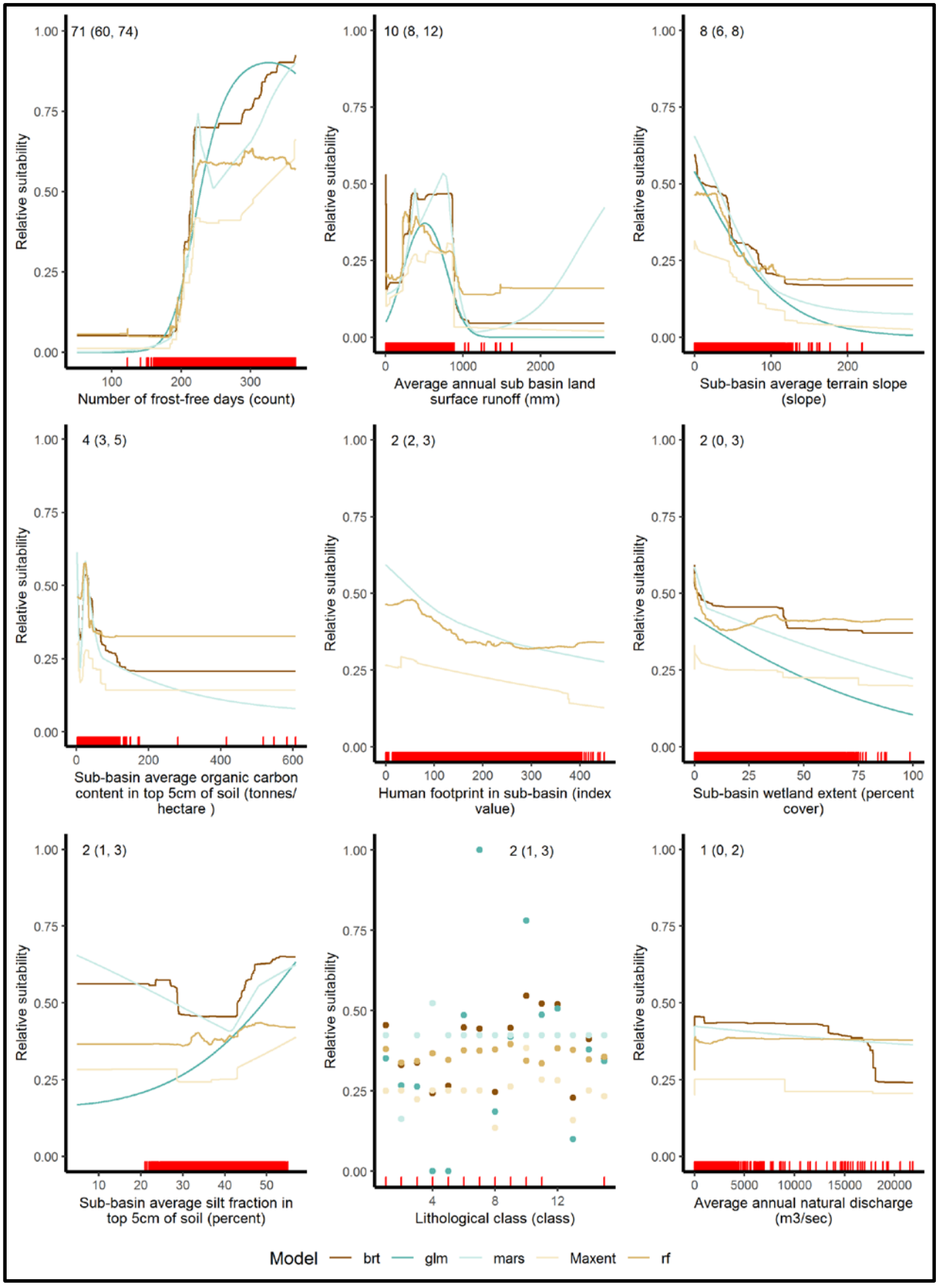
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


71 (60, 74)
Number of frost-free days (count)
10 (8, 12)
Average annual sub basin land surface runoff (mm)
8 (6, 8)
Sub-basin average terrain slope (slope)
4 (3, 5)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
2 (2, 3)
Human footprint in sub-basin (index value)
2 (0, 3)
Sub-basin wetland extent (percent cover)
2 (1, 3)
Sub-basin average silt fraction in top 5cm of soil (percent)
2 (1, 3)
Lithological class (class)
1 (0, 2)
Average annual natural discharge (m3/sec)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Cyprinus carpio** *Common Name* **Common Carp**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **28,154**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

In State Transfer

Importation and Release

Species Group:

Fish

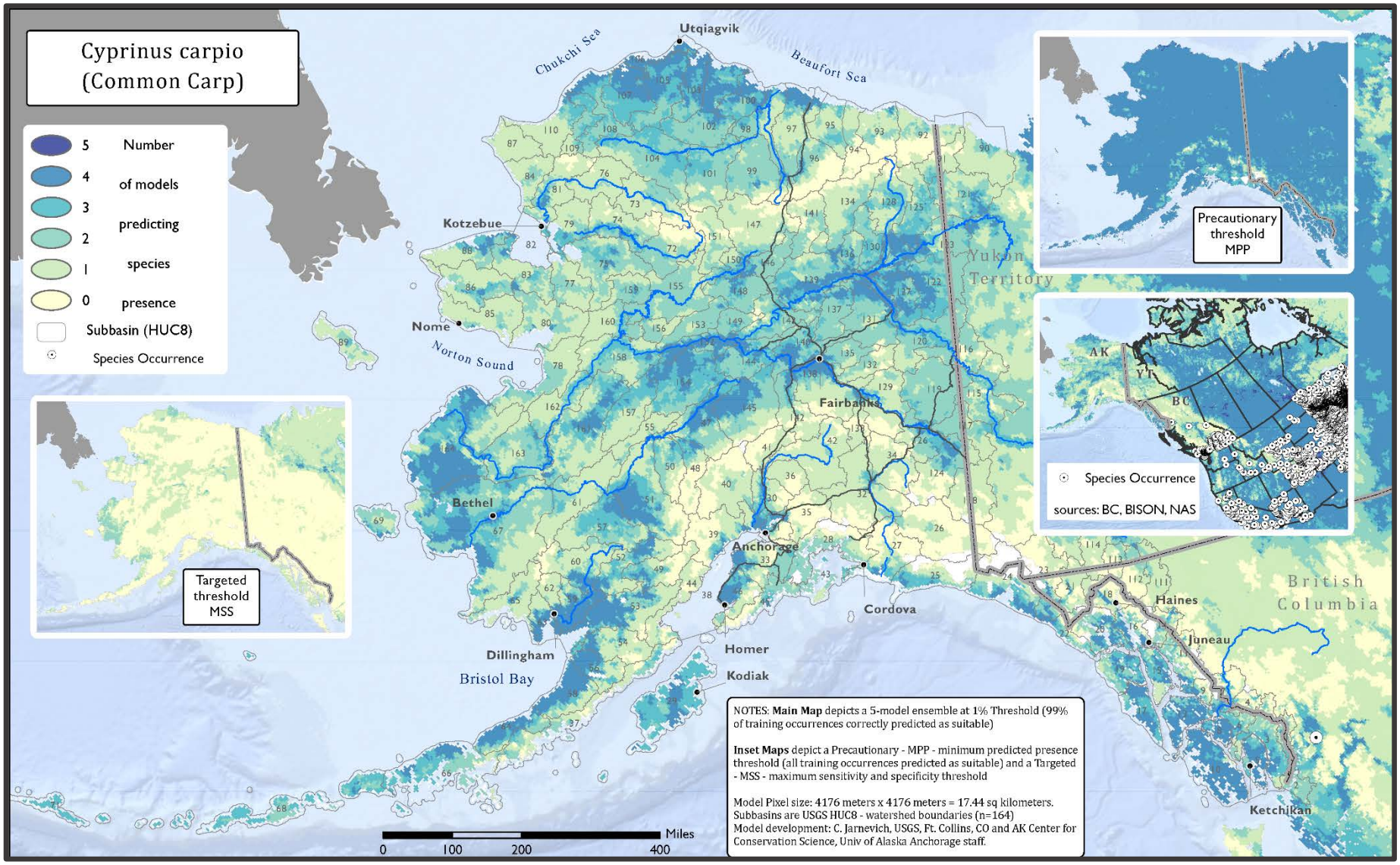
Data Sources:

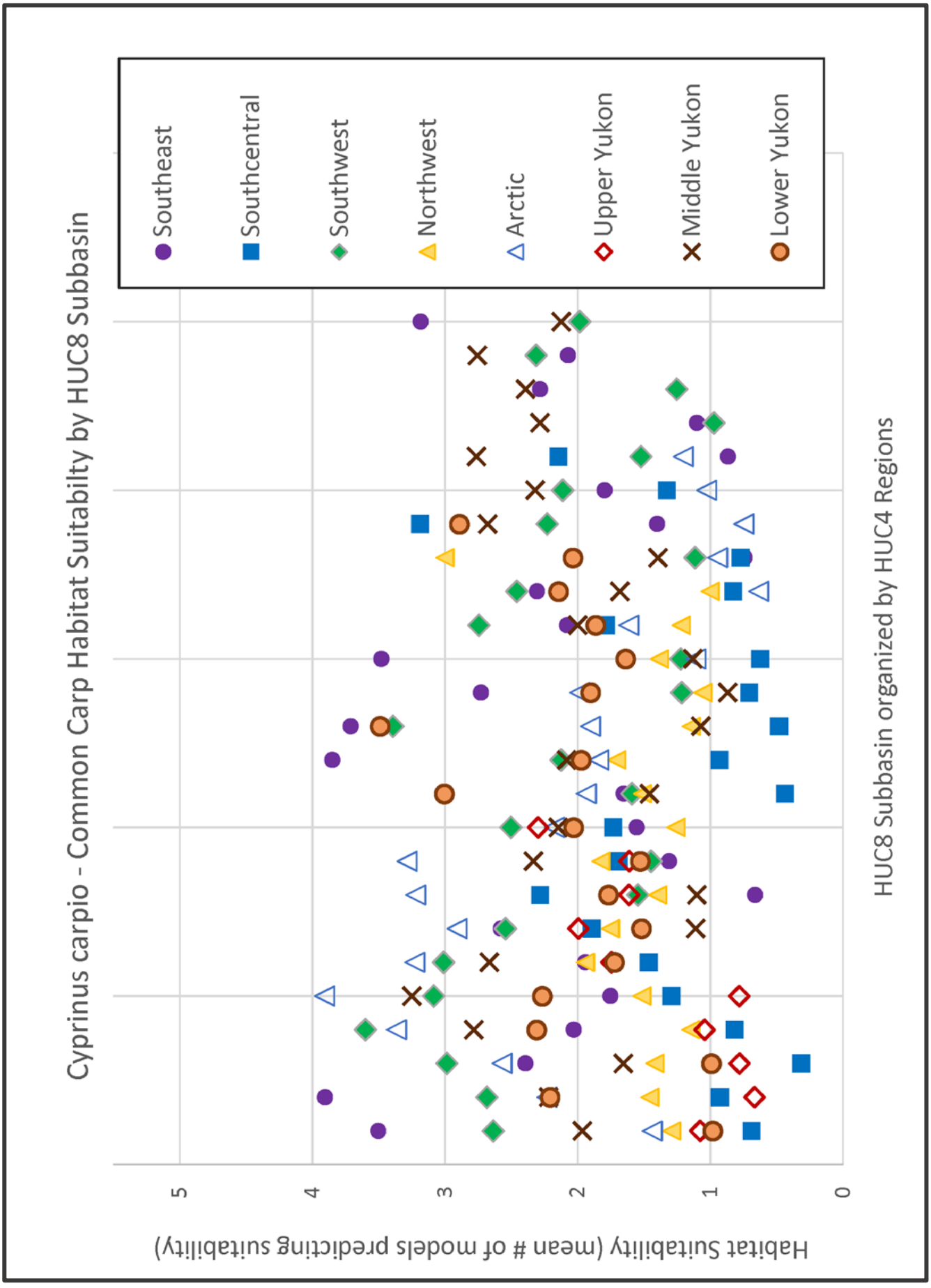
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

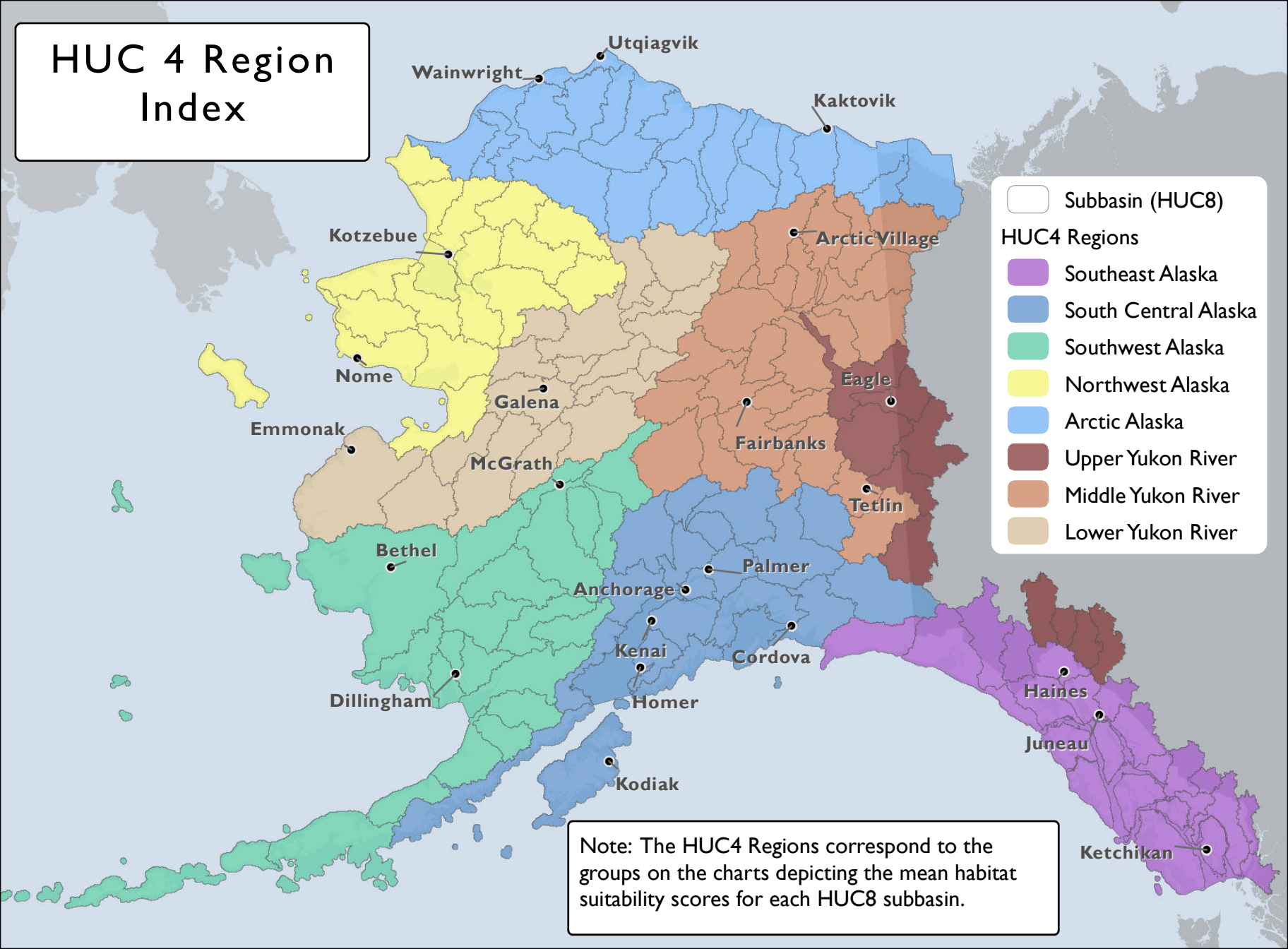
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Cyprinus carpio
(Common Carp)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Species Occurrence
Targeted threshold MSS
Precautionary threshold MPP
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
British Columbia
Ketchikan
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Cyprinus carpio - Common Carp Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

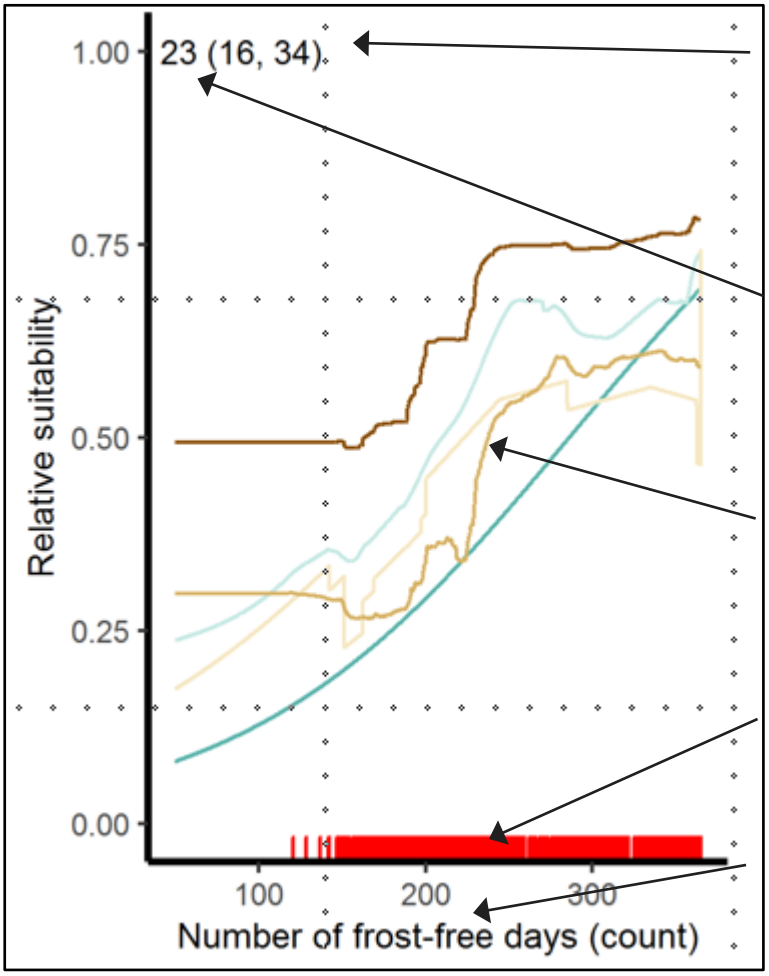
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

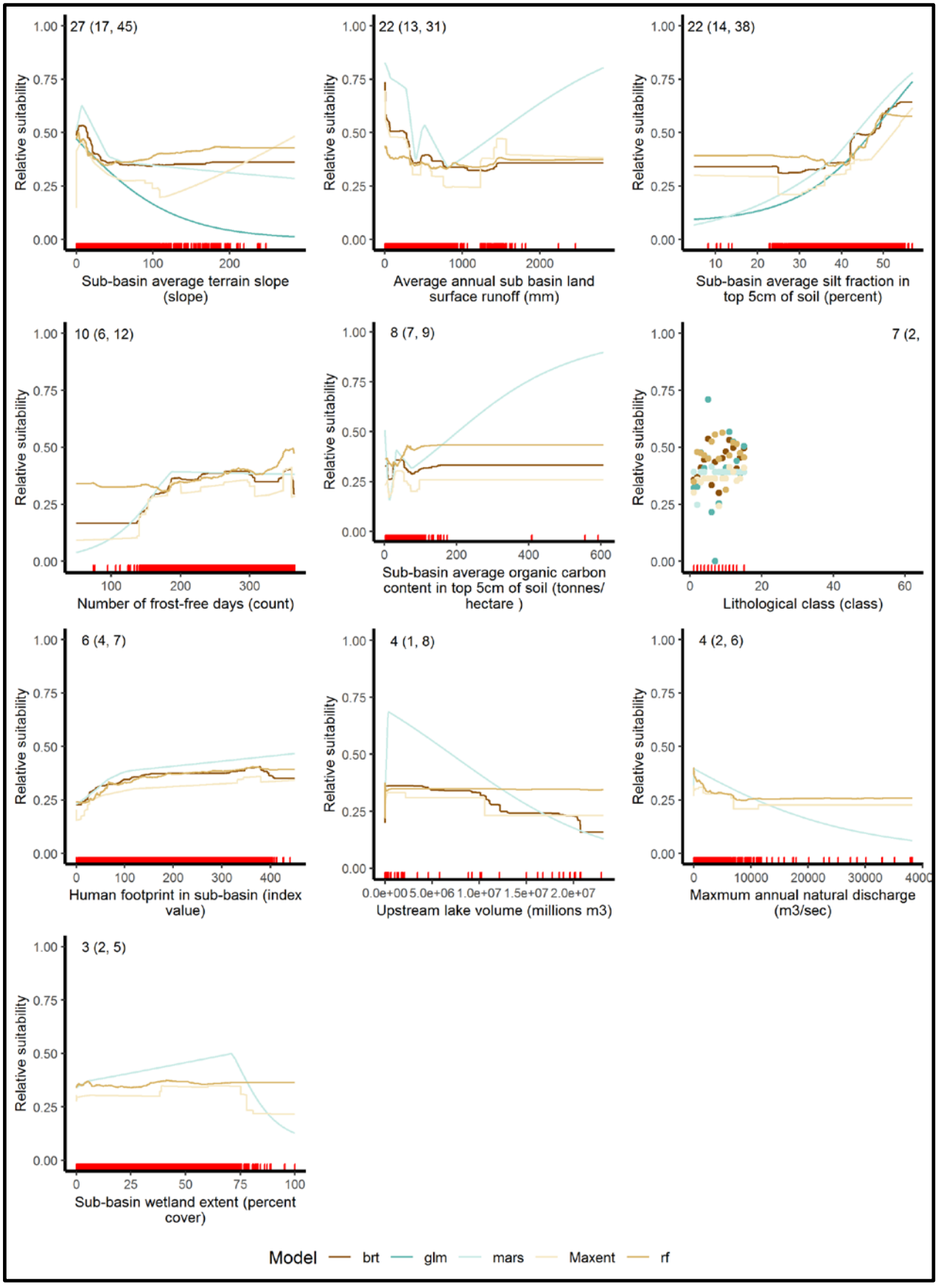
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


27 (17, 45)
Sub-basin average terrain slope (slope)
22 (13, 31)
Average annual sub basin land surface runoff (mm)
22 (14, 38)
Sub-basin average silt fraction in top 5cm of soil (percent)
10 (6, 12)
Number of frost-free days (count)
8 (7, 9)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
7 (2,
Lithological class (class)
6 (4, 7)
Human footprint in sub-basin (index value)
4 (1, 8)
Upstream lake volume (millions m3)
4 (2, 6)
Maxmum annual natural discharge (m3/sec)
3 (2, 5)
Sub-basin wetland extent (percent cover)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Dreissena bugensis** *Common Name* **Quagga Mussel**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1079**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Mollusk

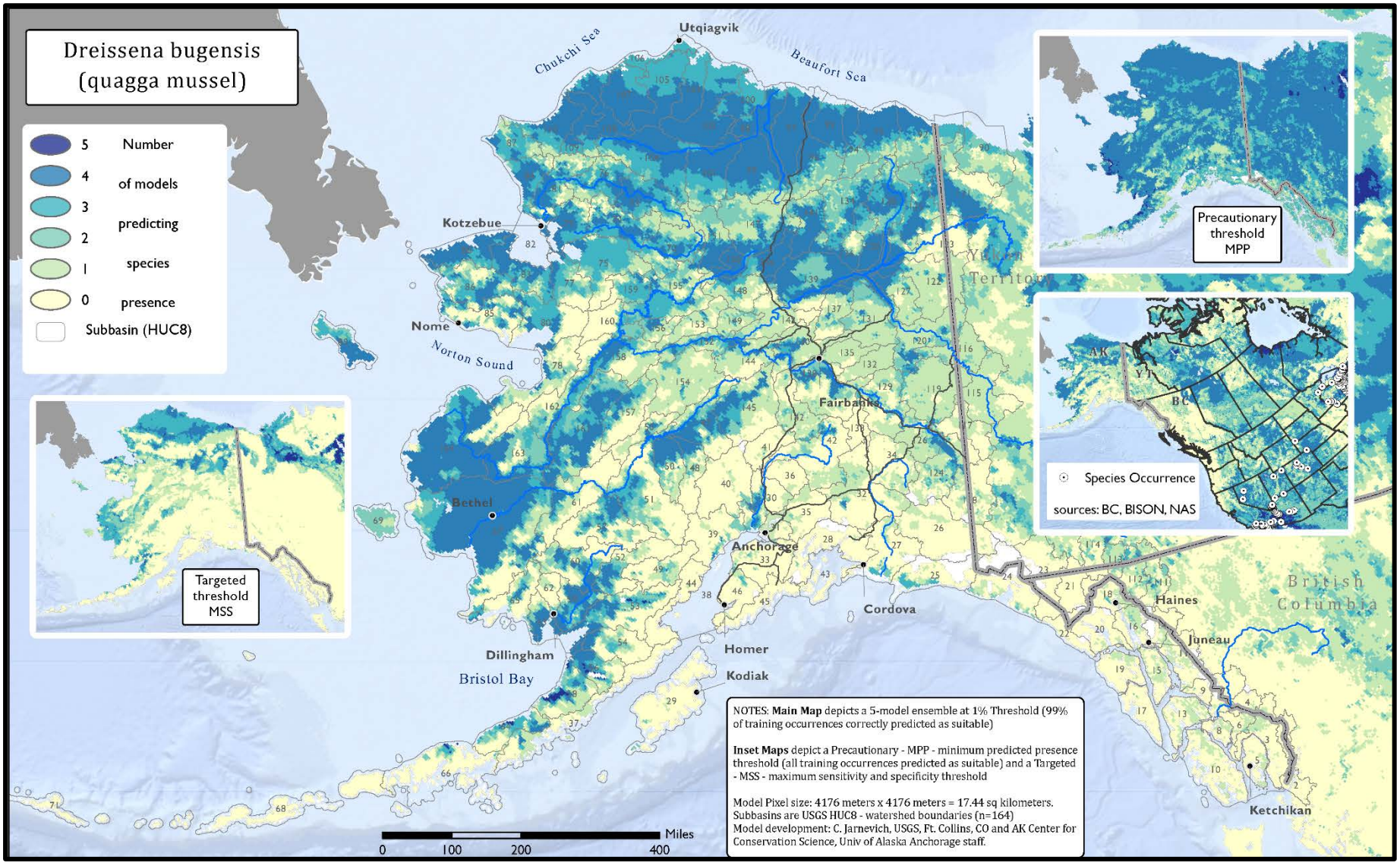
Data Sources:

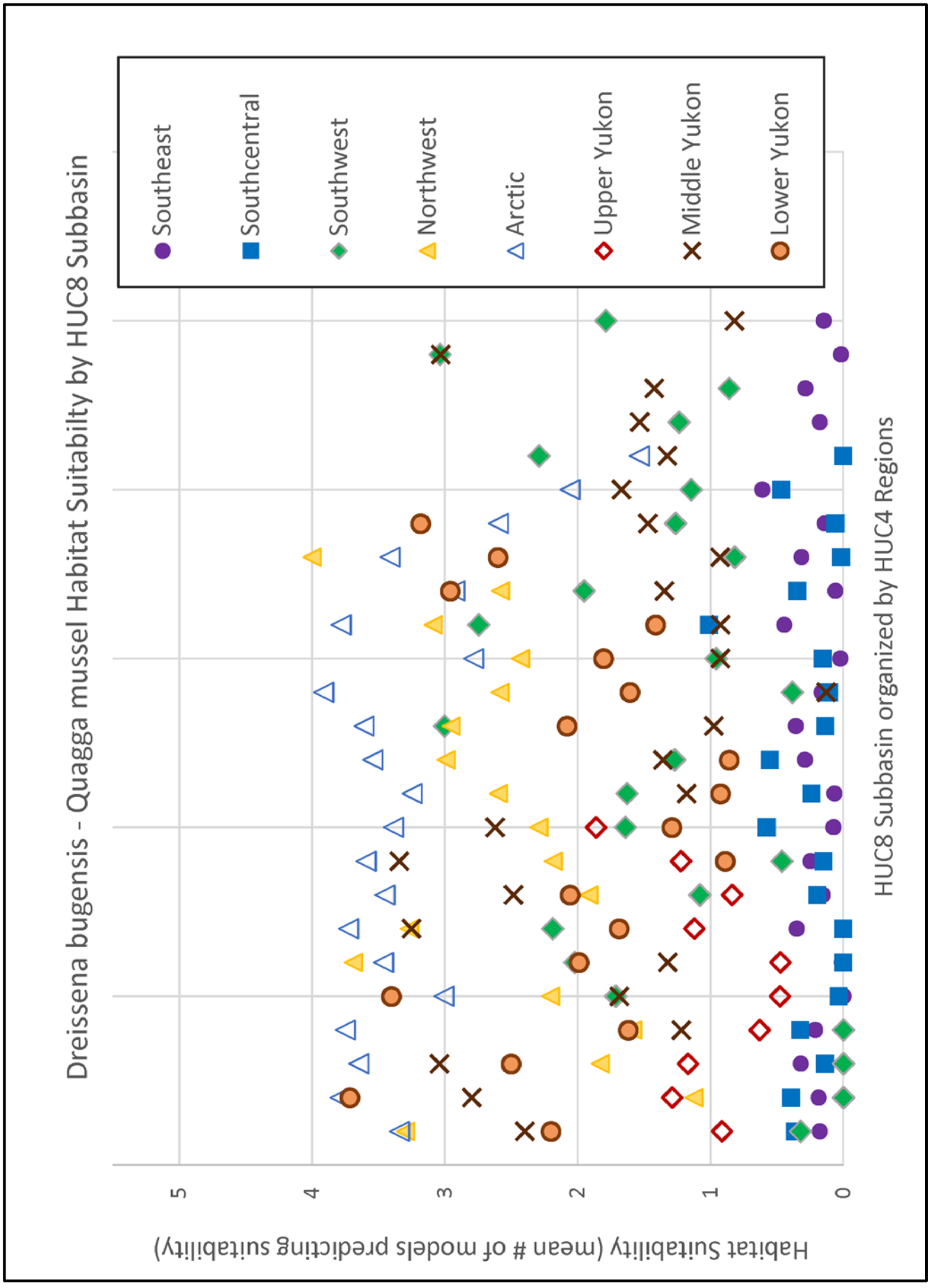
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

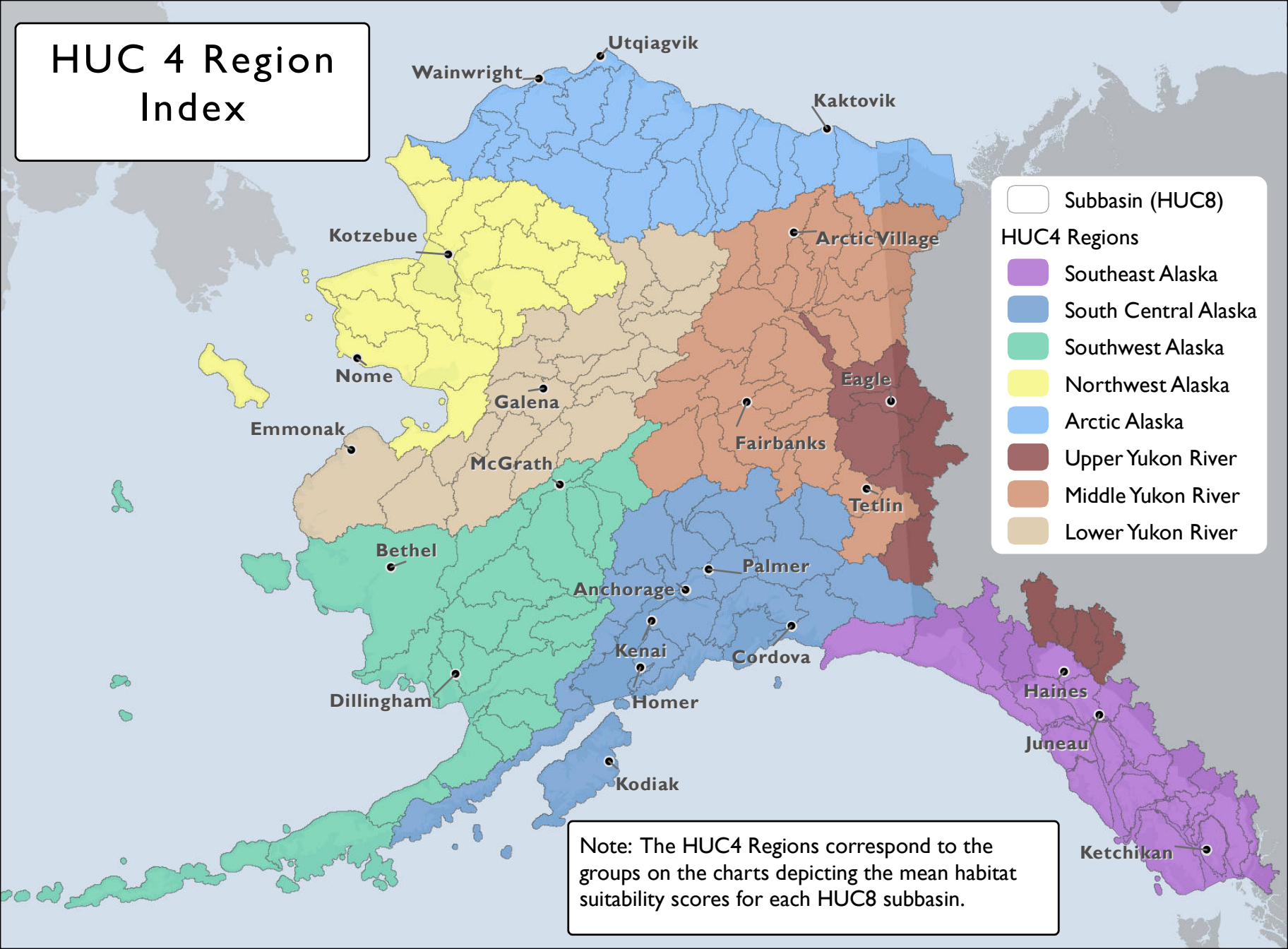
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Dreissena bugensis
(quagga mussel)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Bethel
Fairbanks
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Yukon Territory
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Dreissena bugensis - Quagga mussel Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

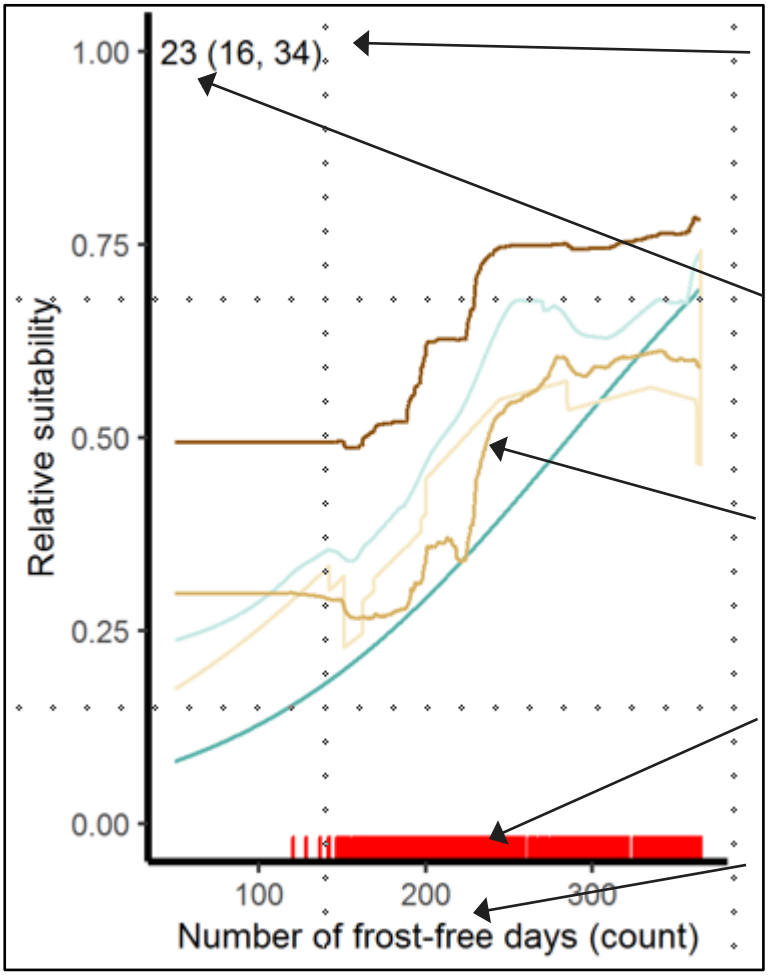
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

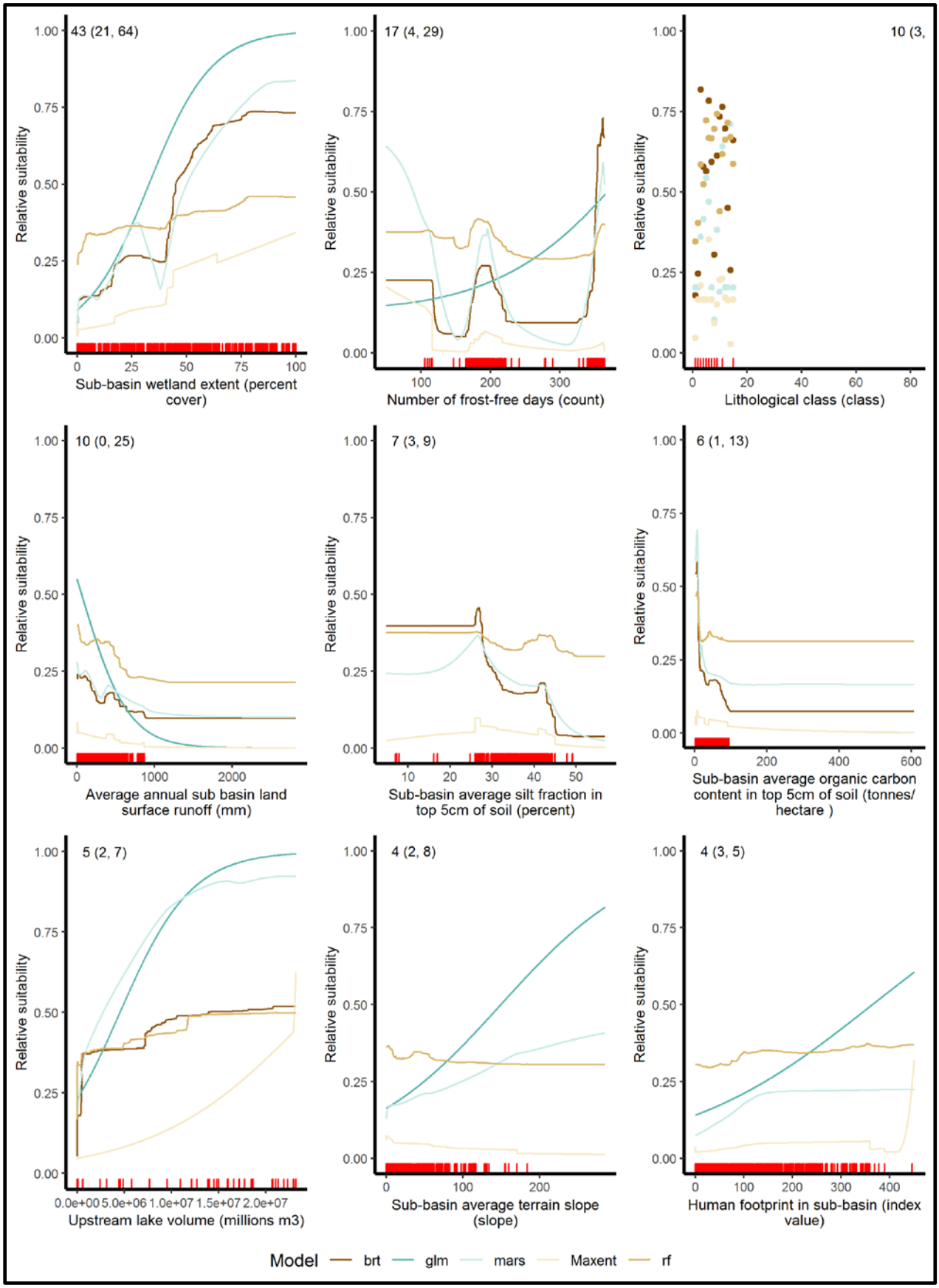
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


43 (21, 64)
Relative suitability
Sub-basin wetland extent (percent cover)
17 (4, 29)
Number of frost-free days (count)
10 (3,
Lithological class (class)
10 (0, 25)
Average annual sub basin land surface runoff (mm)
7 (3, 9)
Sub-basin average silt fraction in top 5cm of soil (percent)
6 (1, 13)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
5 (2, 7)
Upstream lake volume (millions m3)
4 (2, 8)
Sub-basin average terrain slope (slope)
4 (3, 5)
Human footprint in sub-basin (index value)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Dreissena polymorpha** *Common Name* **Zebra Mussel**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1079**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Mollusk

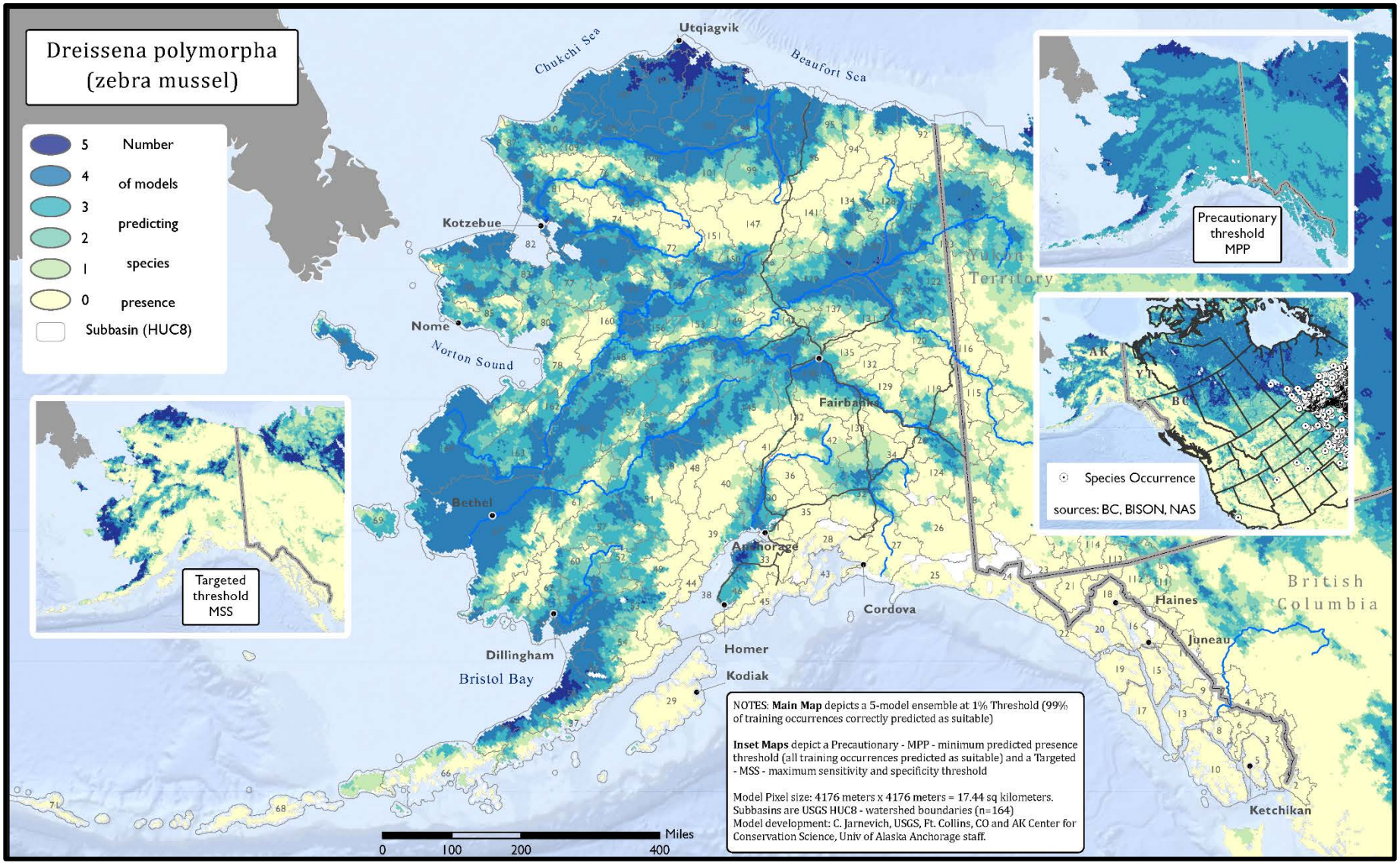
Data Sources:

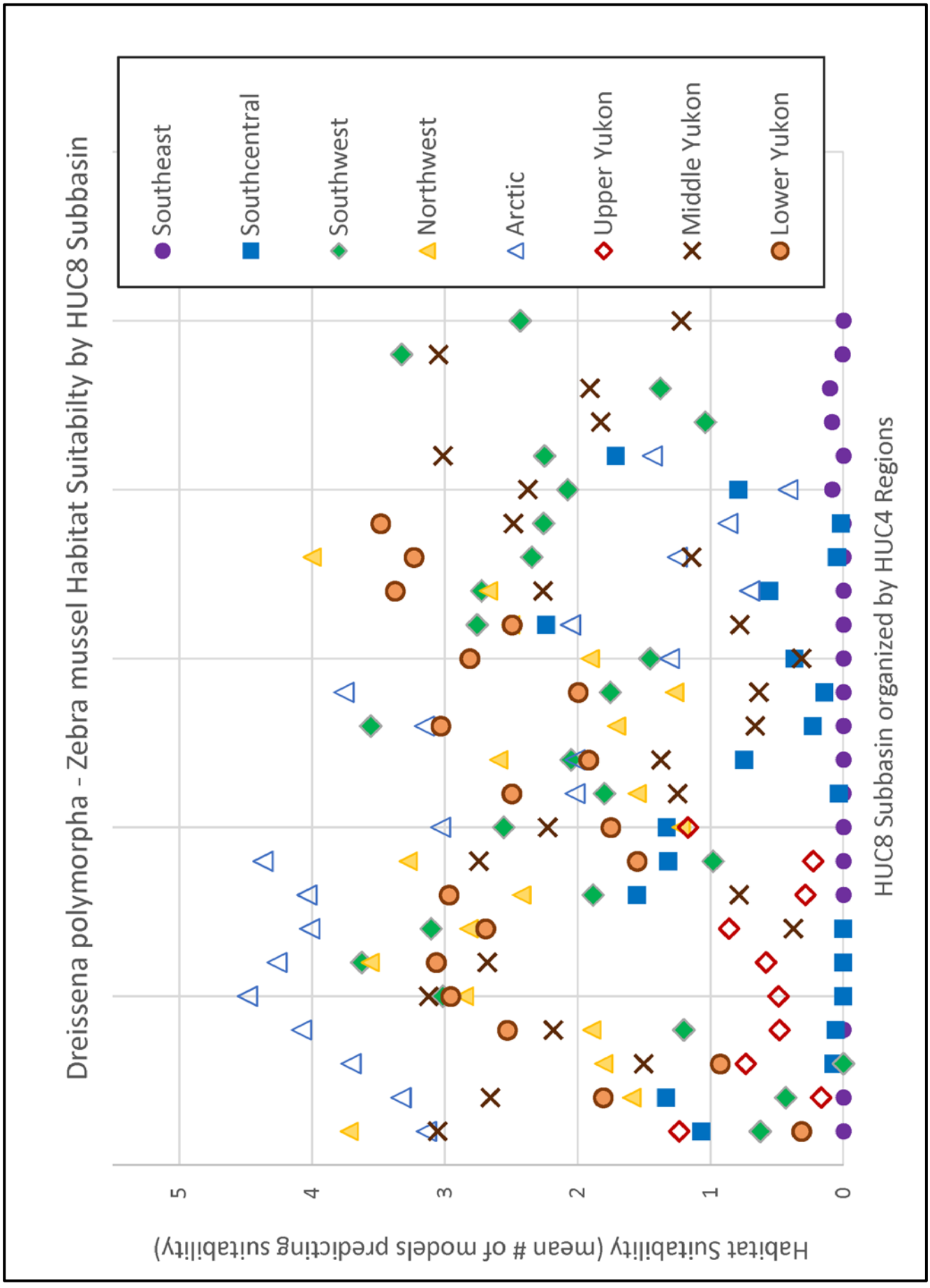
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

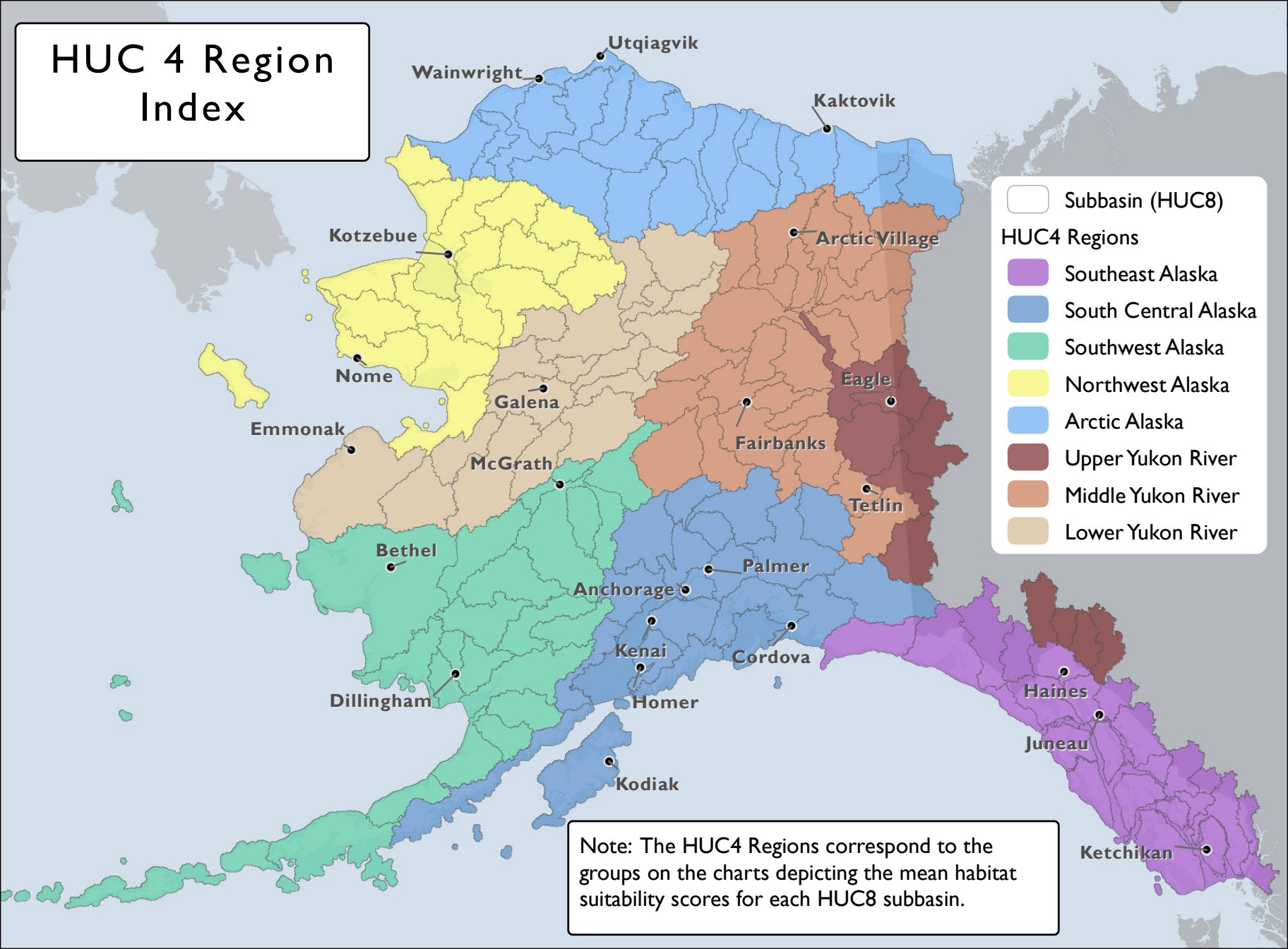
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Dreissena polymorpha
(zebra mussel)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0 100 200 400


Dreissena polymorpha - Zebra mussel Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

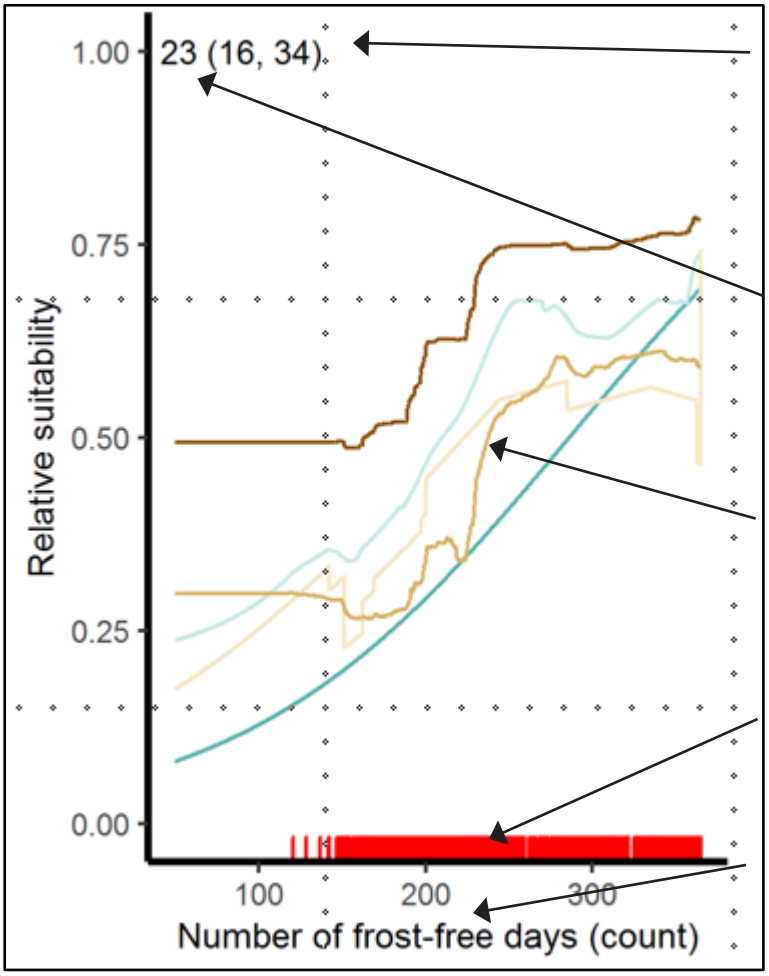
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

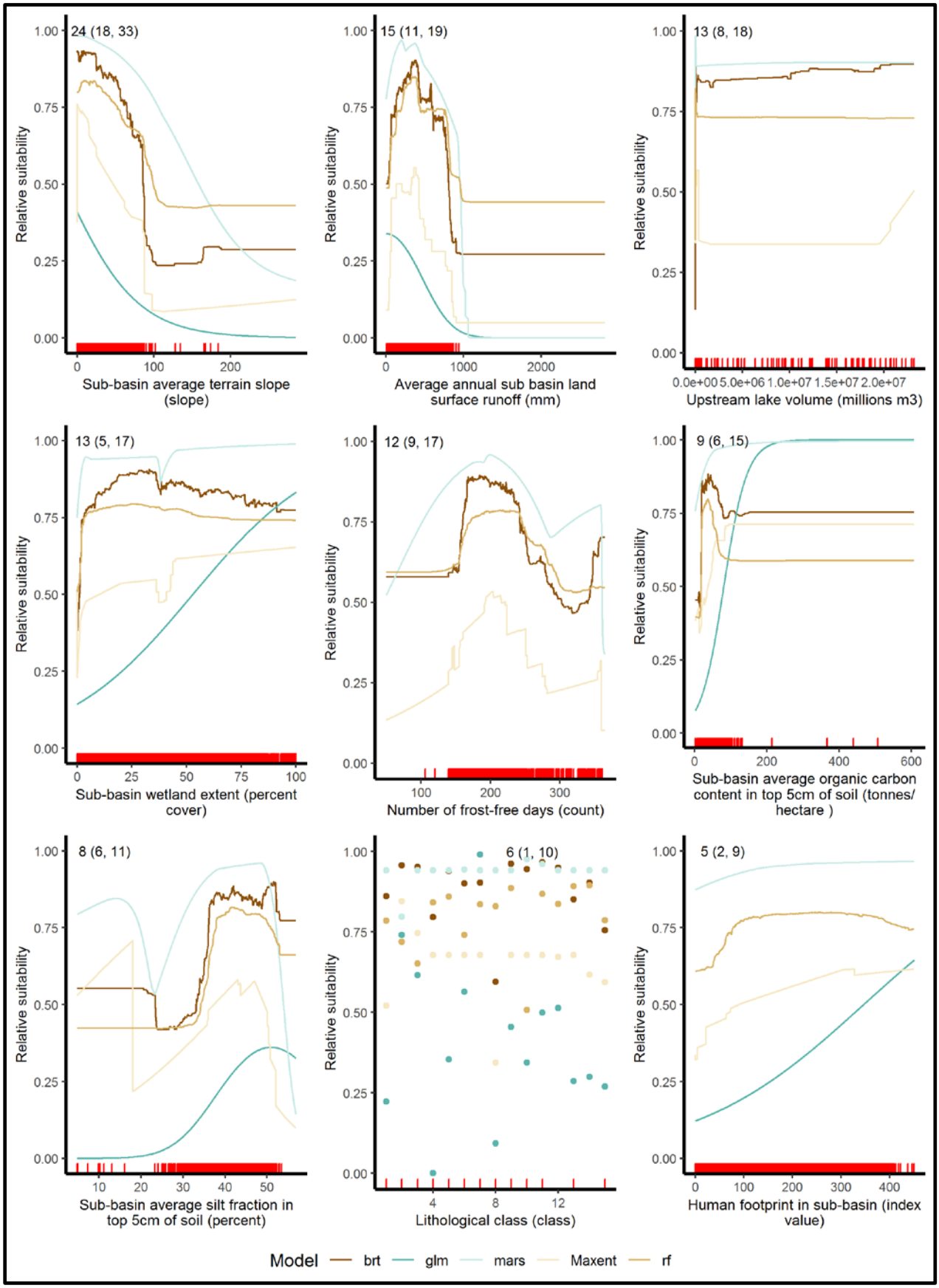
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


24 (18, 33)
Relative suitability
Sub-basin average terrain slope (slope)
15 (11, 19)
Average annual sub basin land surface runoff (mm)
13 (8, 18)
Upstream lake volume (millions m3)
13 (5, 17)
Sub-basin wetland extent (percent cover)
12 (9, 17)
Number of frost-free days (count)
9 (6, 15)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
8 (6, 11)
Sub-basin average silt fraction in top 5cm of soil (percent)
6 (1, 10)
Lithological class (class)
5 (2, 9)
Human footprint in sub-basin (index value)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Esox masquinongy** *Common Name* **Muskellunge**

Alaska Occurrence Records: species occurrences found in Alaska - **1**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 states and British Columbia, Canada) - **213**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Importation and Release

Popular sport fishing target species, could be introduced intentionally

Species Group:

Fish

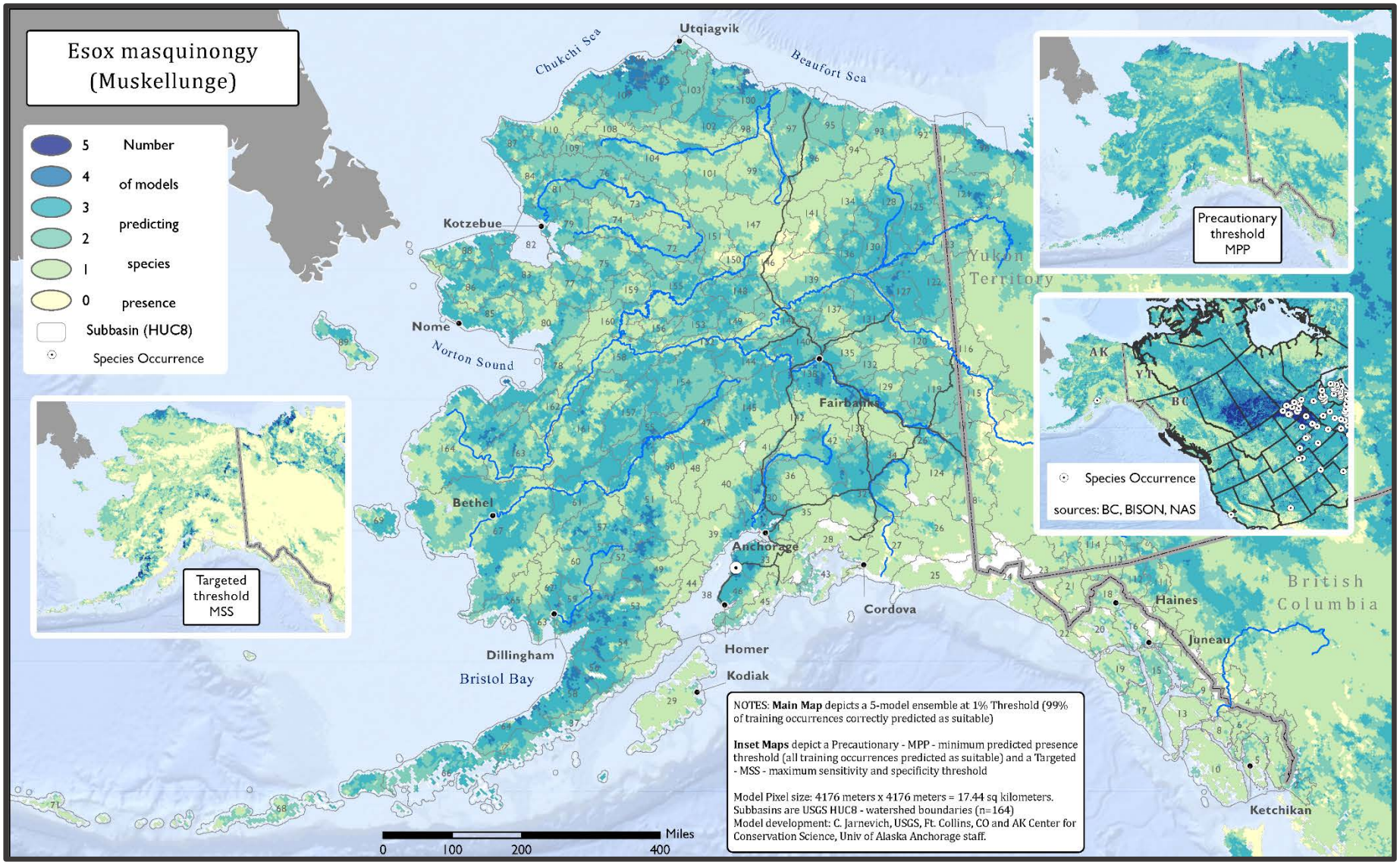
Data Sources:

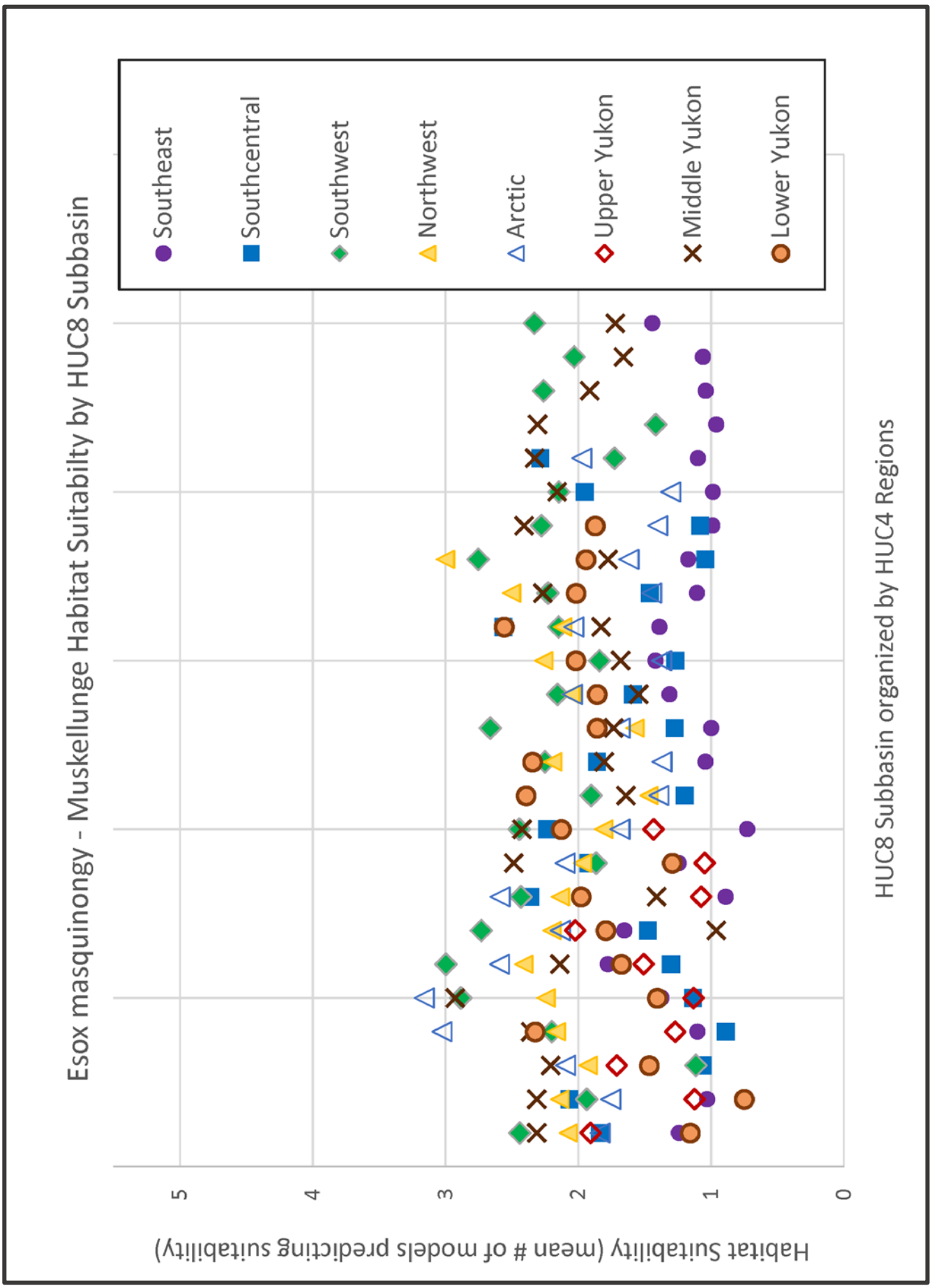
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

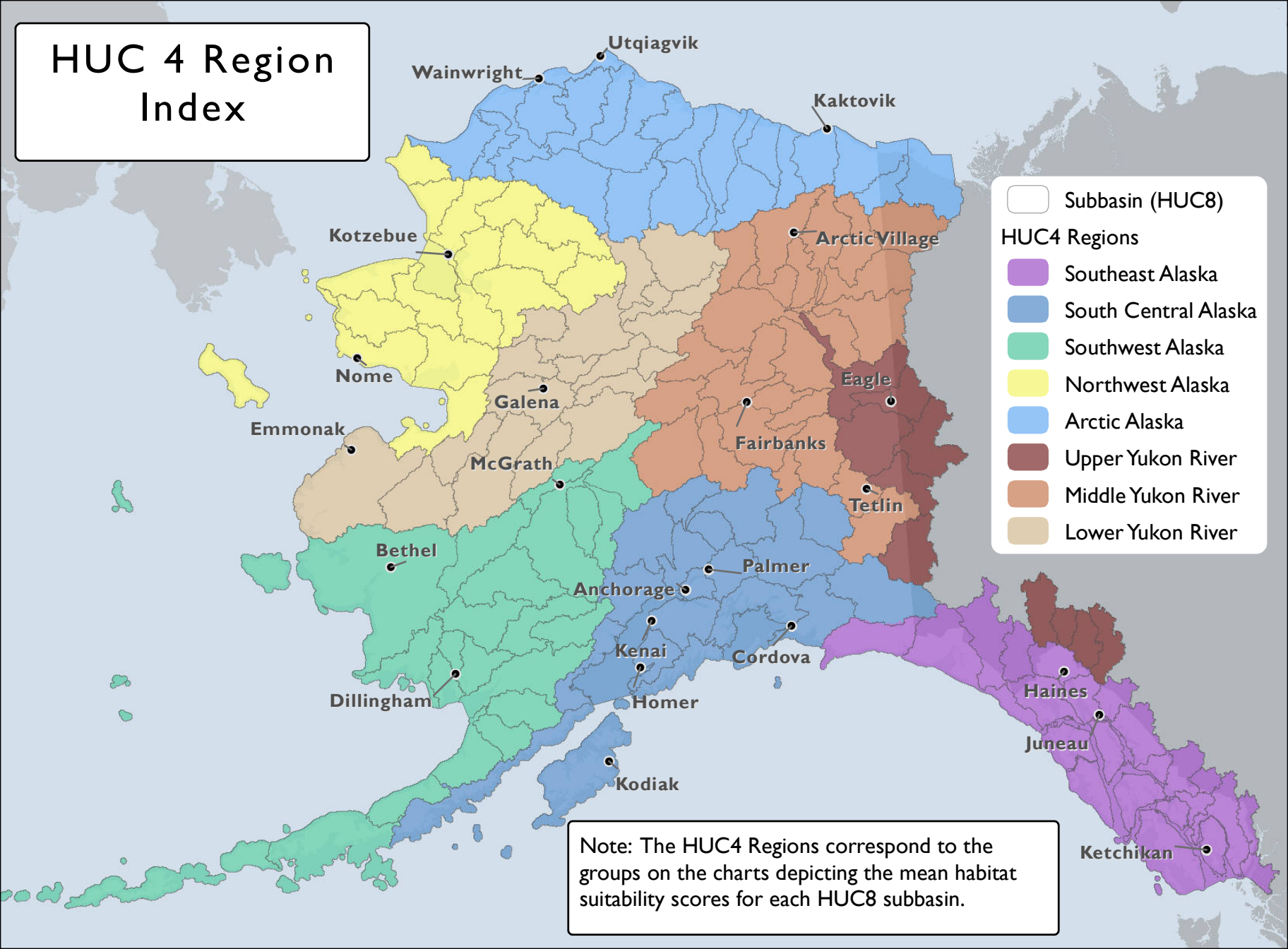
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Esox masquinongy
(Muskellunge)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Species Occurrence
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon
Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British
Columbia
Precautionary
threshold
MPP
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Targeted
threshold
MSS
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0
100
200
400


Esox masquinongy - Muskellunge Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

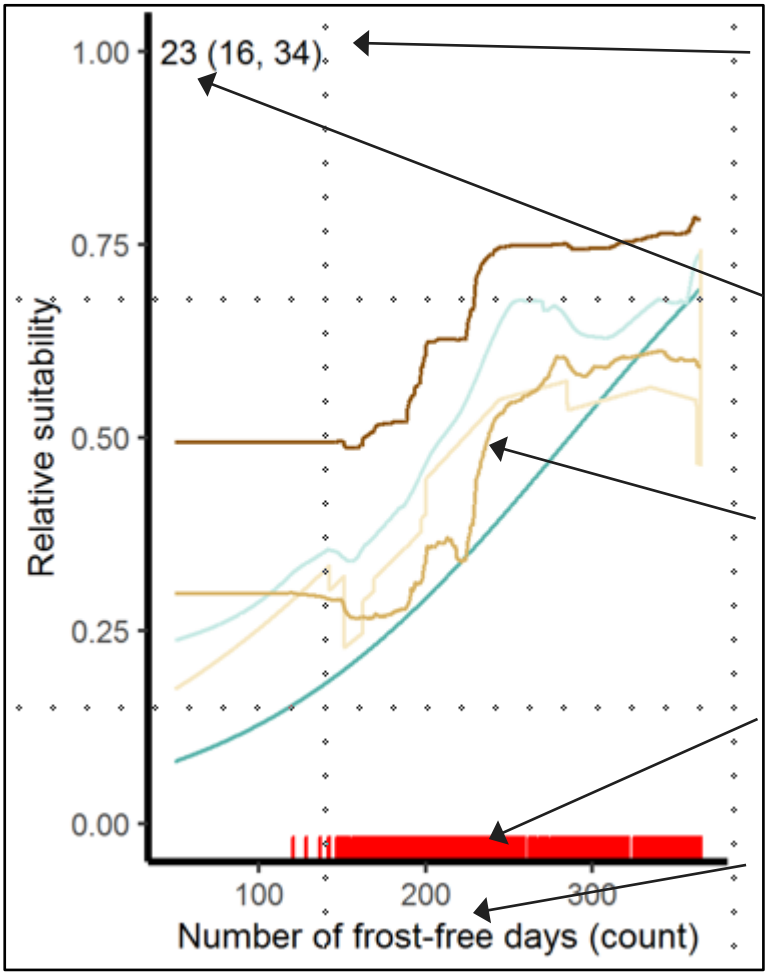
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

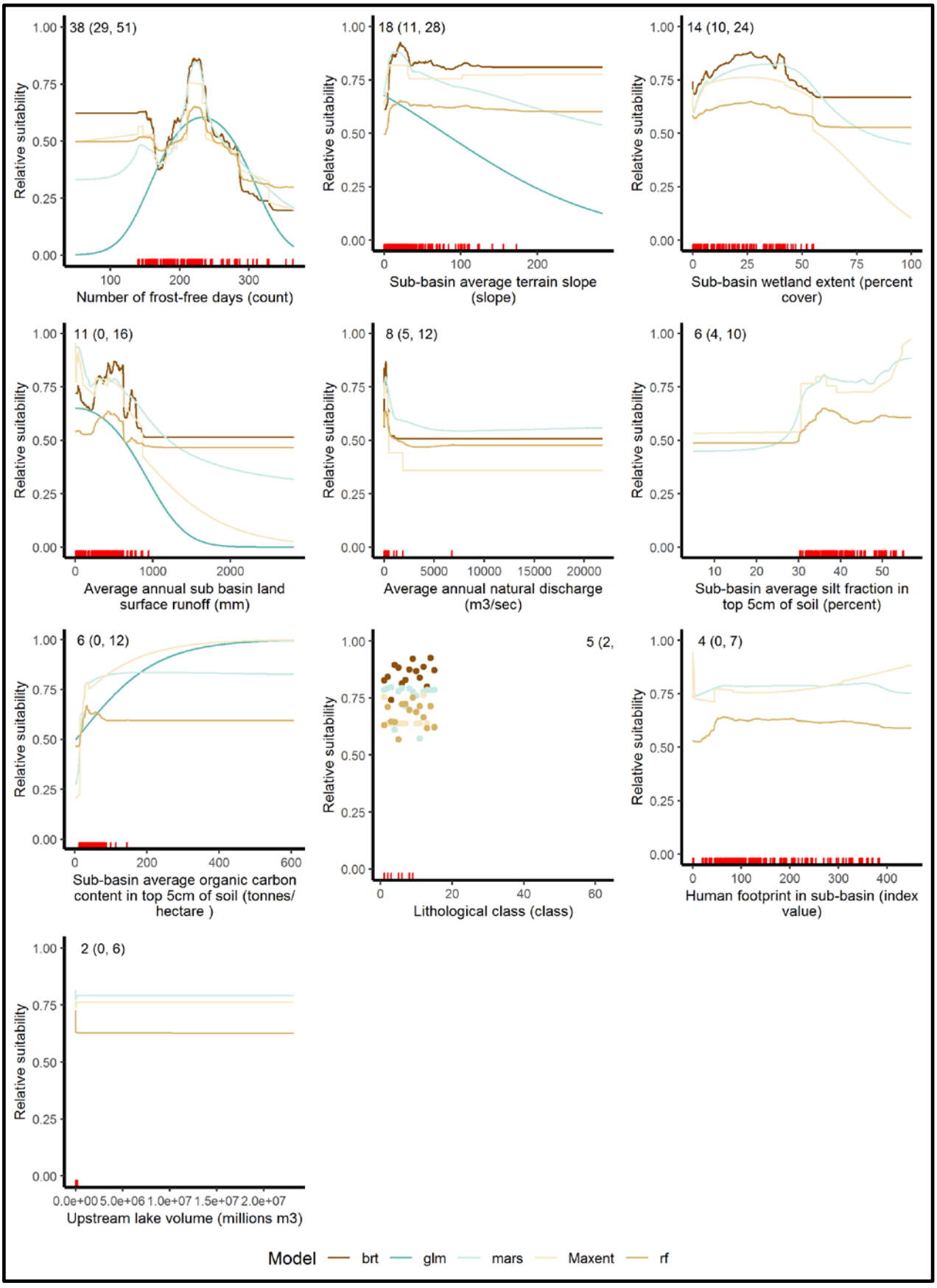
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


38 (29, 51)
Relative suitability
Number of frost-free days (count)
18 (11, 28)
Sub-basin average terrain slope (slope)
14 (10, 24)
Sub-basin wetland extent (percent cover)
11 (0, 16)
Average annual sub basin land surface runoff (mm)
8 (5, 12)
Average annual natural discharge (m3/sec)
6 (4, 10)
Sub-basin average silt fraction in top 5cm of soil (percent)
6 (0, 12)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
5 (2,
Lithological class (class)
4 (0, 7)
Human footprint in sub-basin (index value)
2 (0, 6)
Upstream lake volume (millions m3)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Gambusia holbrooki** *Common* **Eastern Mosquitofish**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **34**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

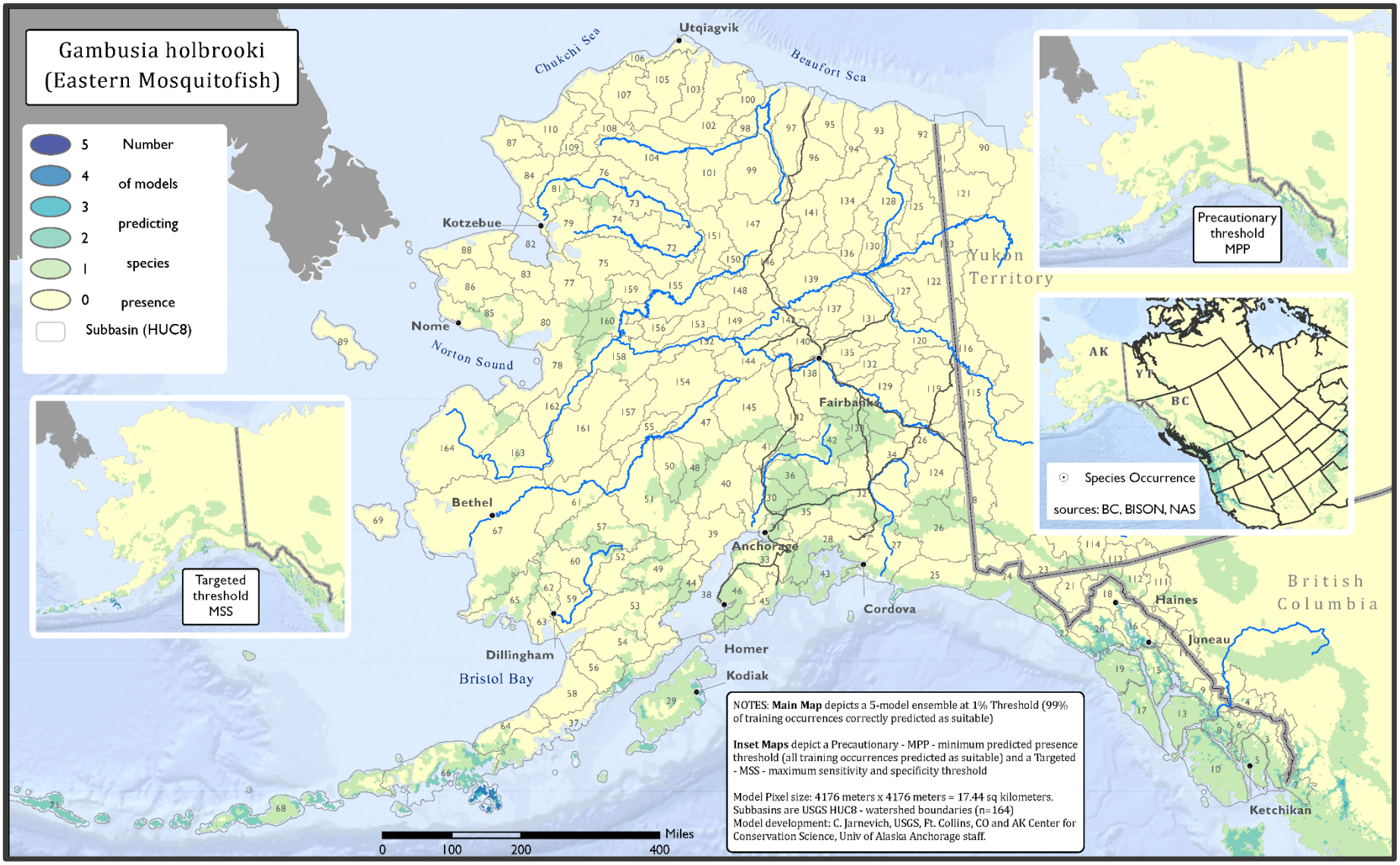
Data Sources:

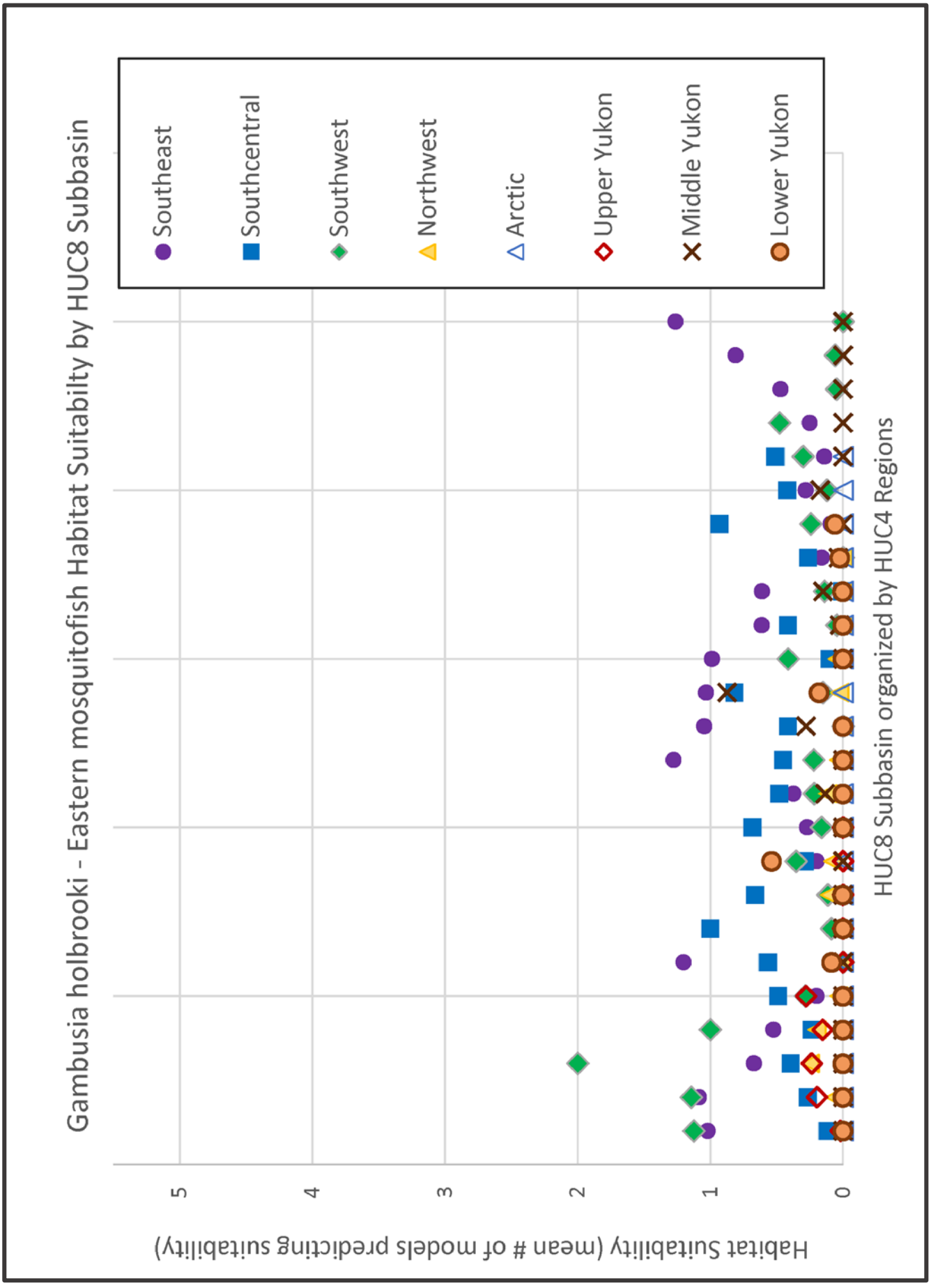
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

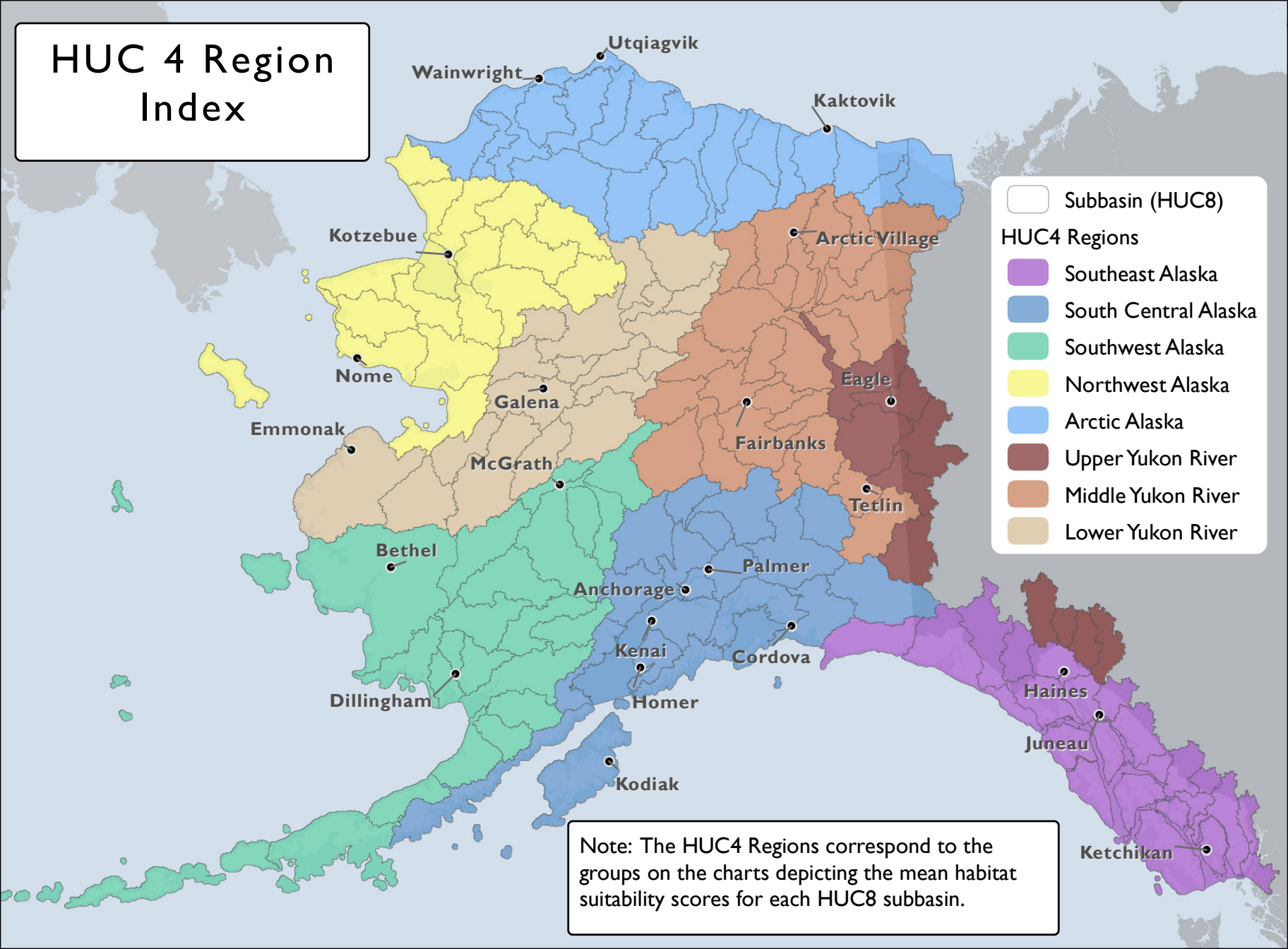
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Gambusia holbrooki
(Eastern Mosquitofish)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Gambusia holbrooki - Eastern mosquitofish Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

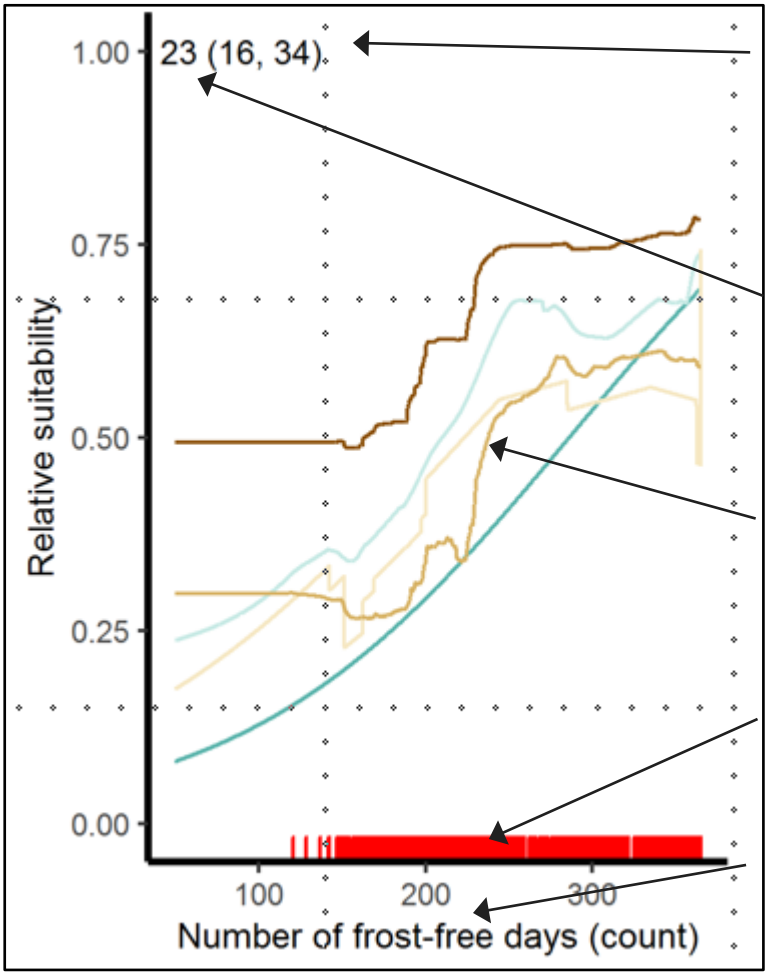
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

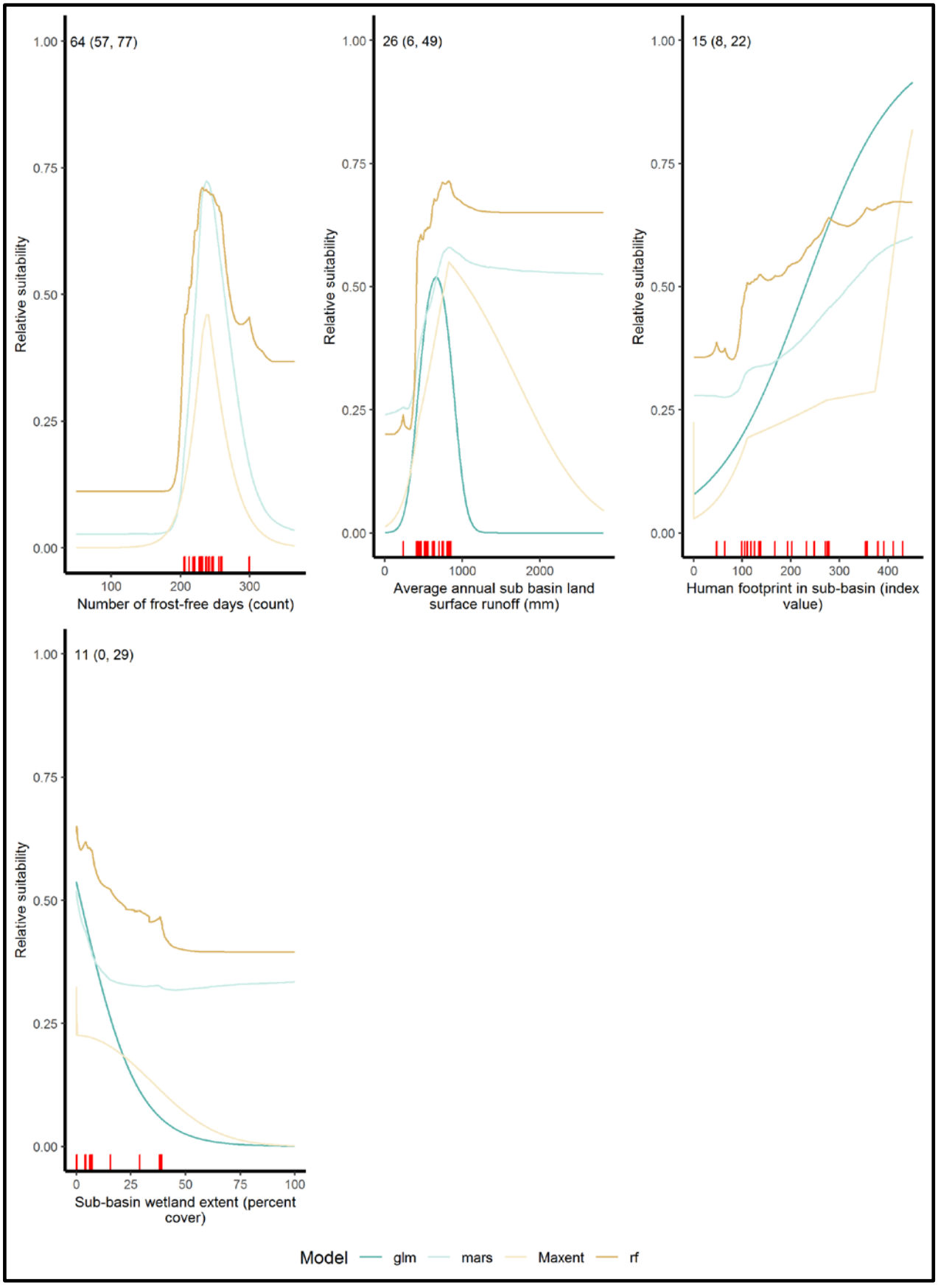
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


64 (57, 77)
26 (6, 49)
15 (8, 22)
11 (0, 29)
Relative suitability
1.00
0.75
0.50
0.25
0.00
Number of frost-free days (count)
Average annual sub basin land surface runoff (mm)
Human footprint in sub-basin (index value)
Sub-basin wetland extent (percent cover)
Model
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Ictalurus punctatus** *Common Name* **Channel Catfish**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1829**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Importation and Release

Species Group:

Fish

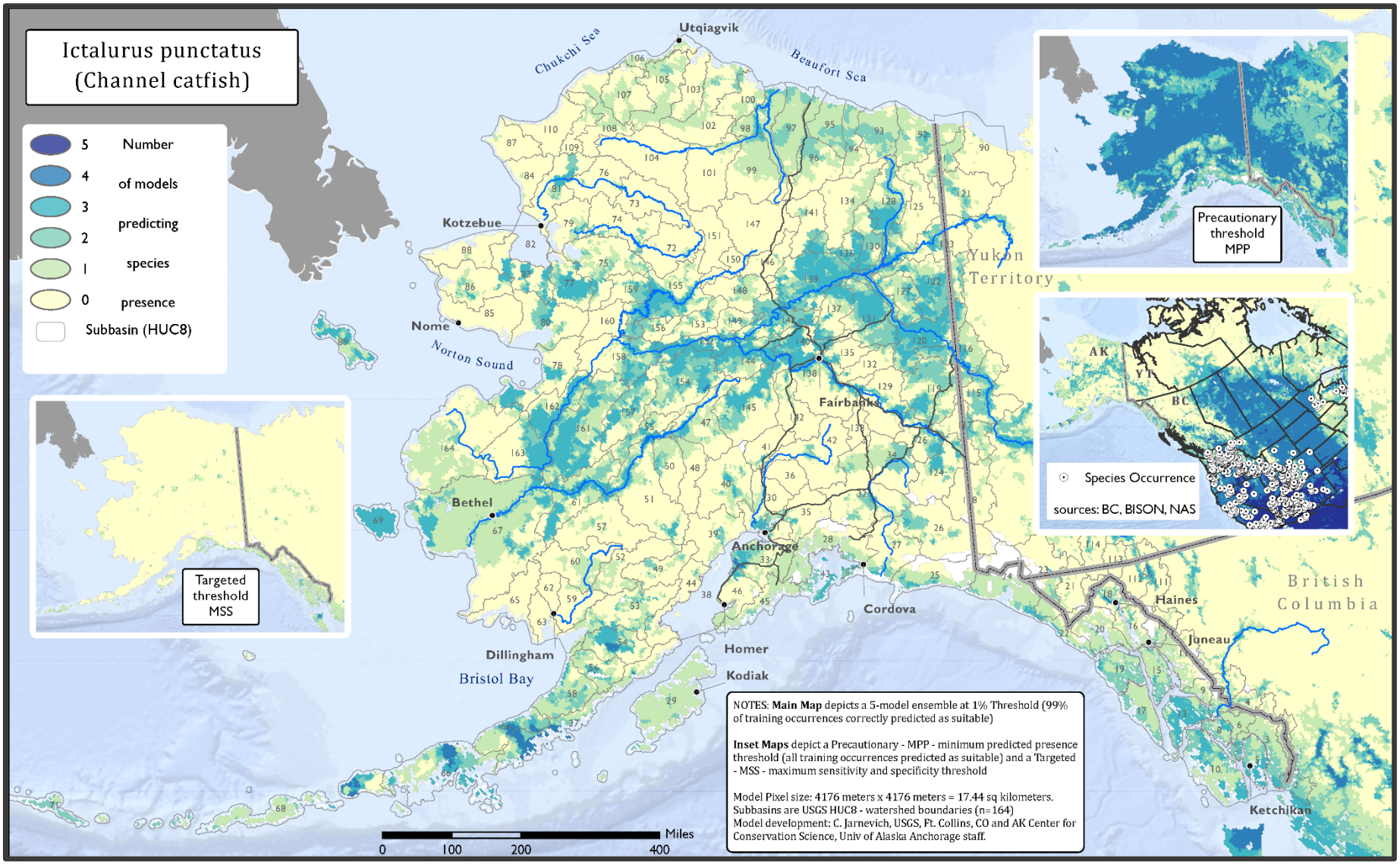
Data Sources:

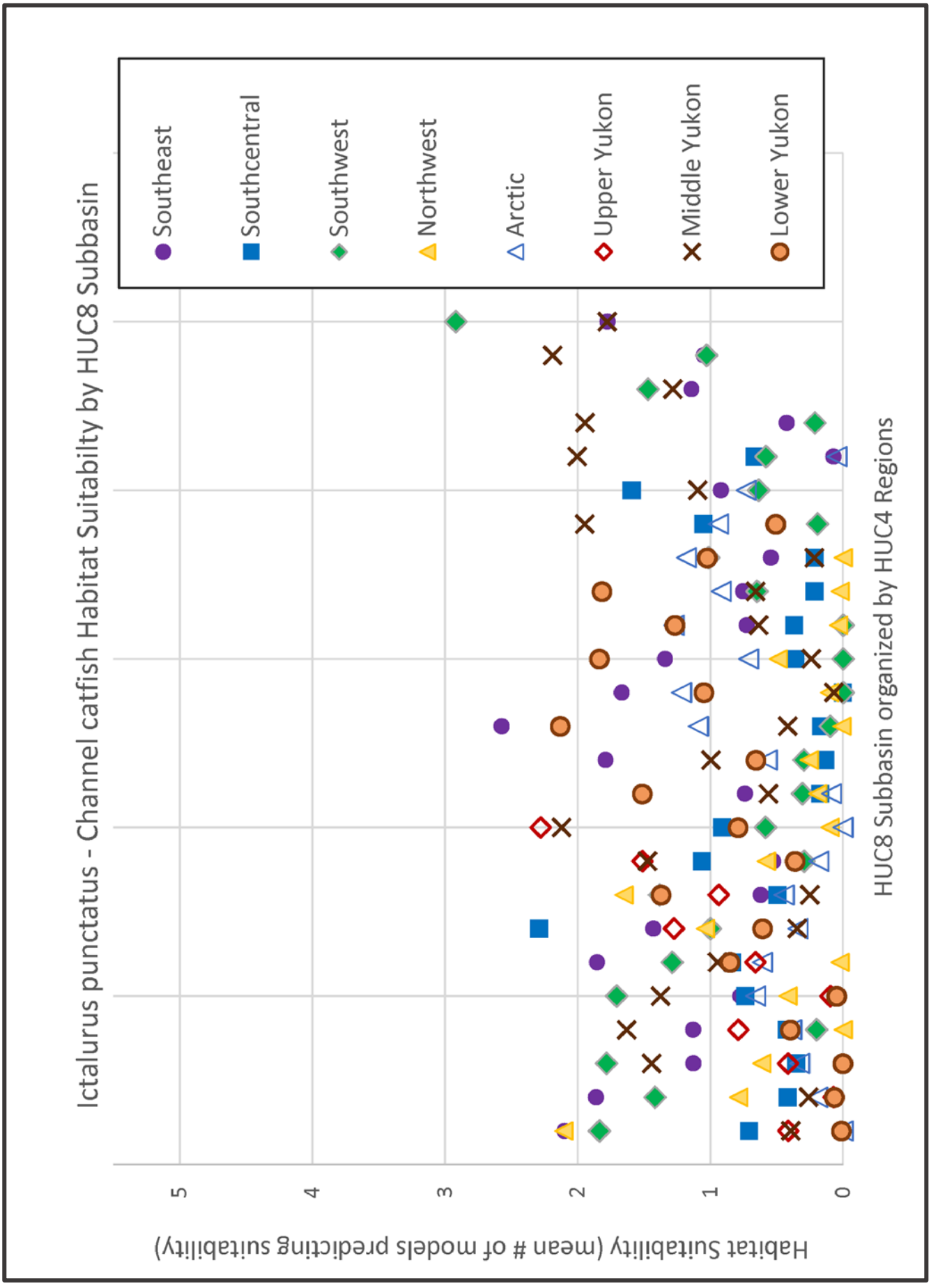
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

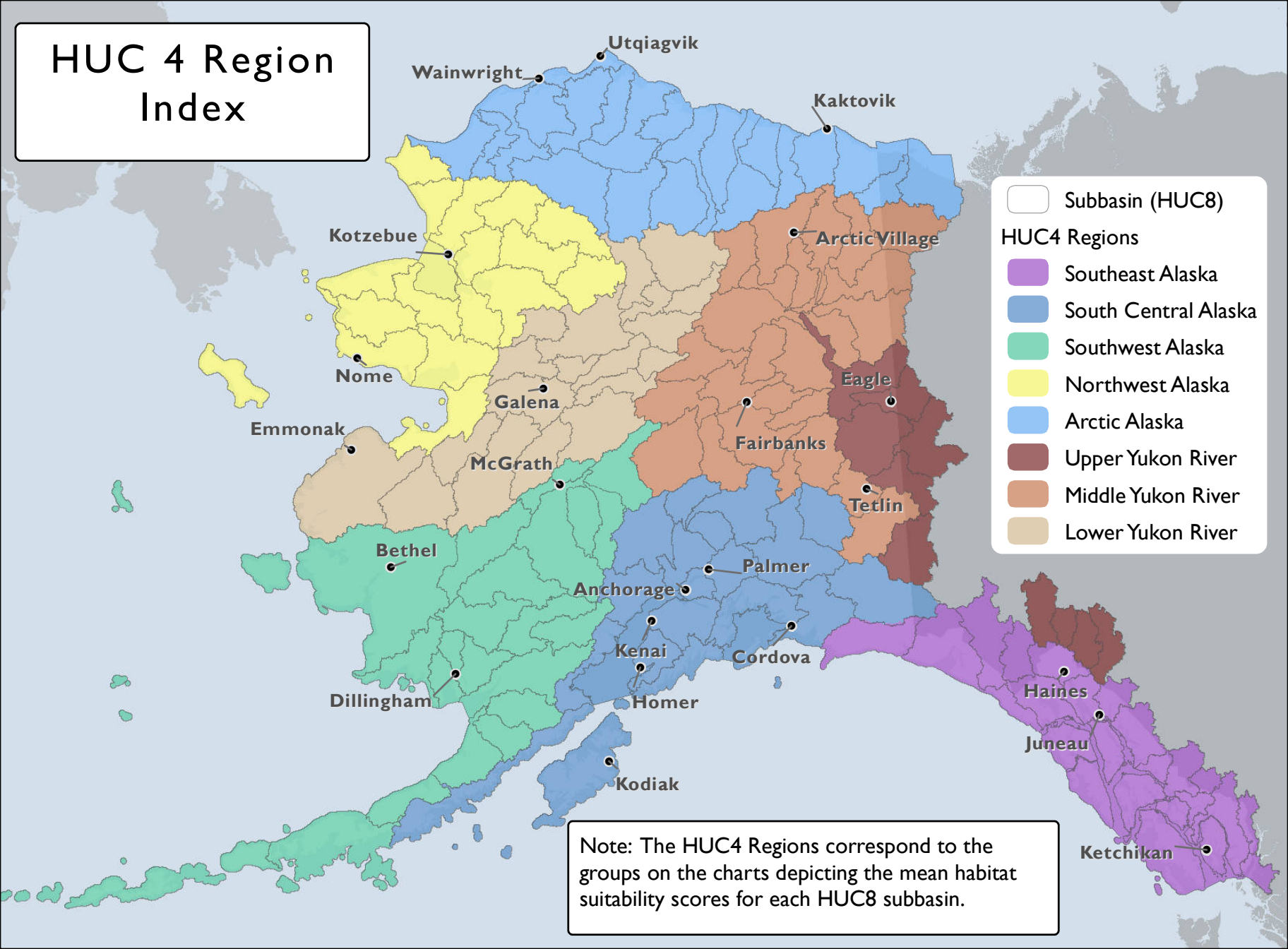
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Ictalurus punctatus
(Channel catfish)
5 Number
4 of models
3 predicting
2
1 species
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
AK
YT
BC
Precautionary threshold MPP
Species Occurrence
sources: BC, BISON, NAS
Targeted threshold MSS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Ictalurus punctatus - Channel catfish Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

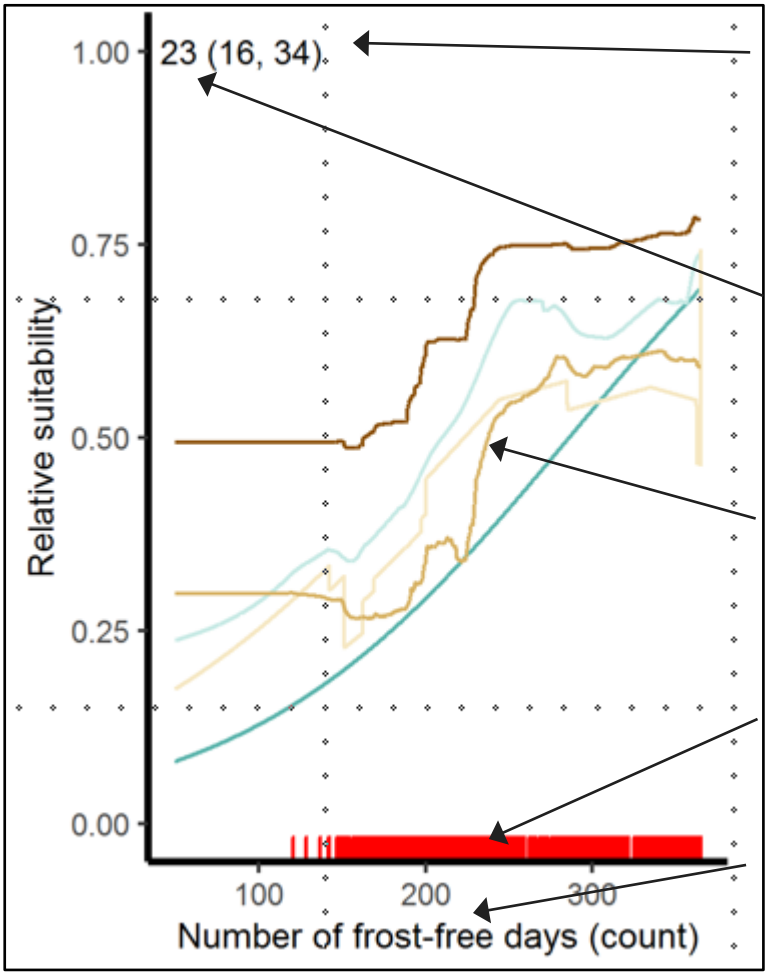
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

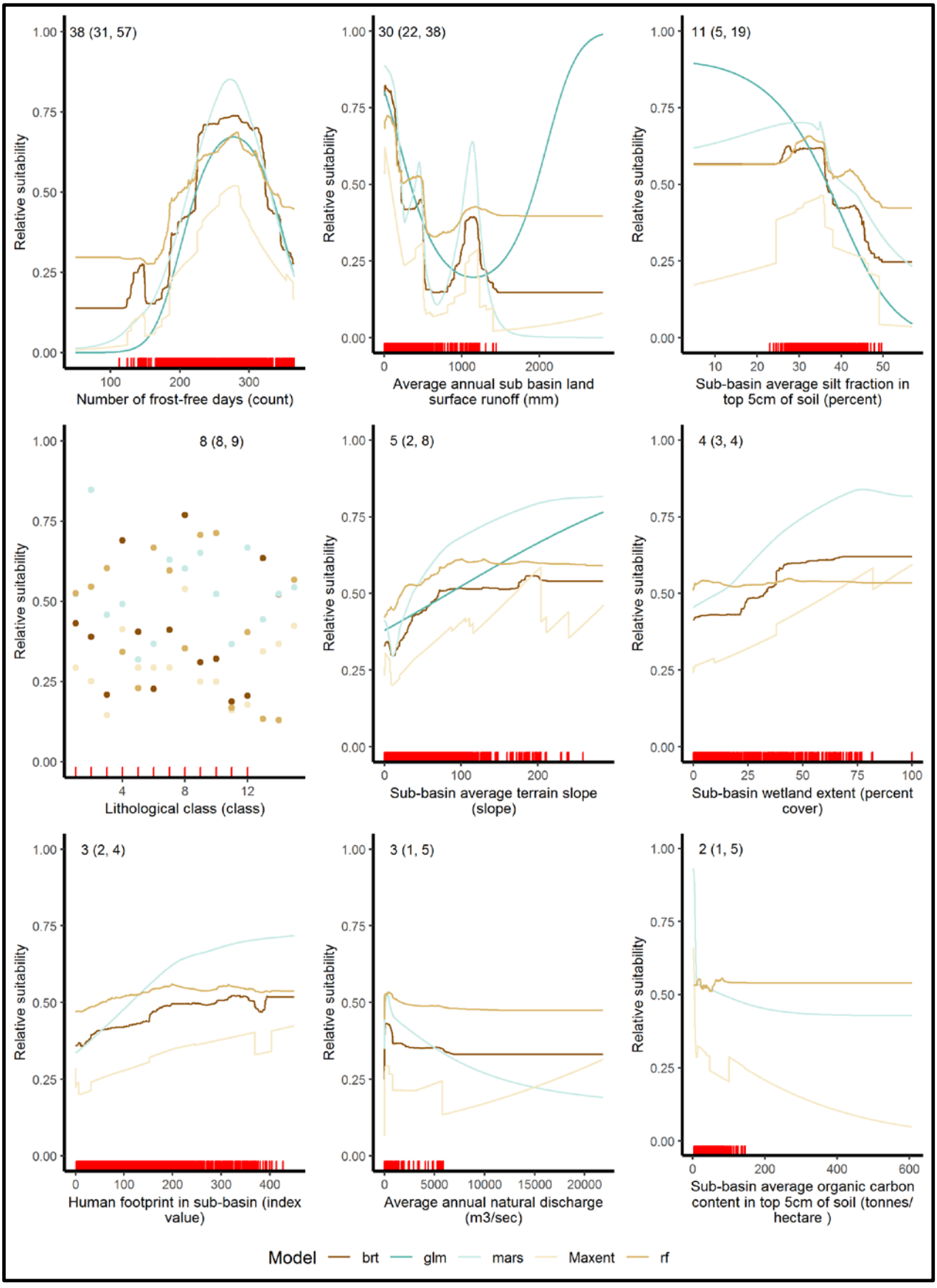
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


38 (31, 57)
Number of frost-free days (count)
30 (22, 38)
Average annual sub basin land surface runoff (mm)
11 (5, 19)
Sub-basin average silt fraction in top 5cm of soil (percent)
8 (8, 9)
Lithological class (class)
5 (2, 8)
Sub-basin average terrain slope (slope)
4 (3, 4)
Sub-basin wetland extent (percent cover)
3 (2, 4)
Human footprint in sub-basin (index value)
3 (1, 5)
Average annual natural discharge (m3/sec)
2 (1, 5)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Lepomis gibbosus** *Common Name* **Pumpkinseed**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1815**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **High**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

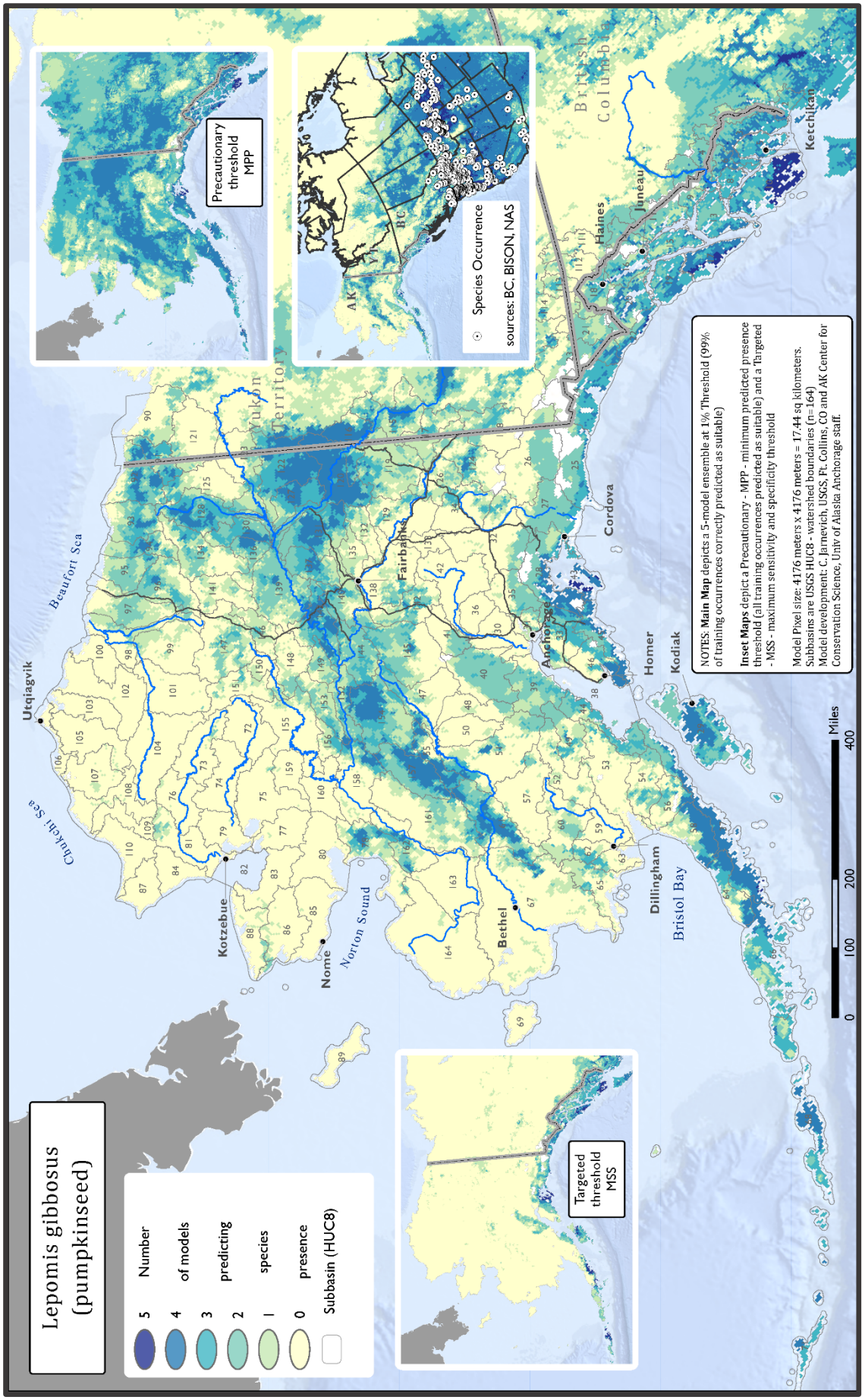
Data Sources:

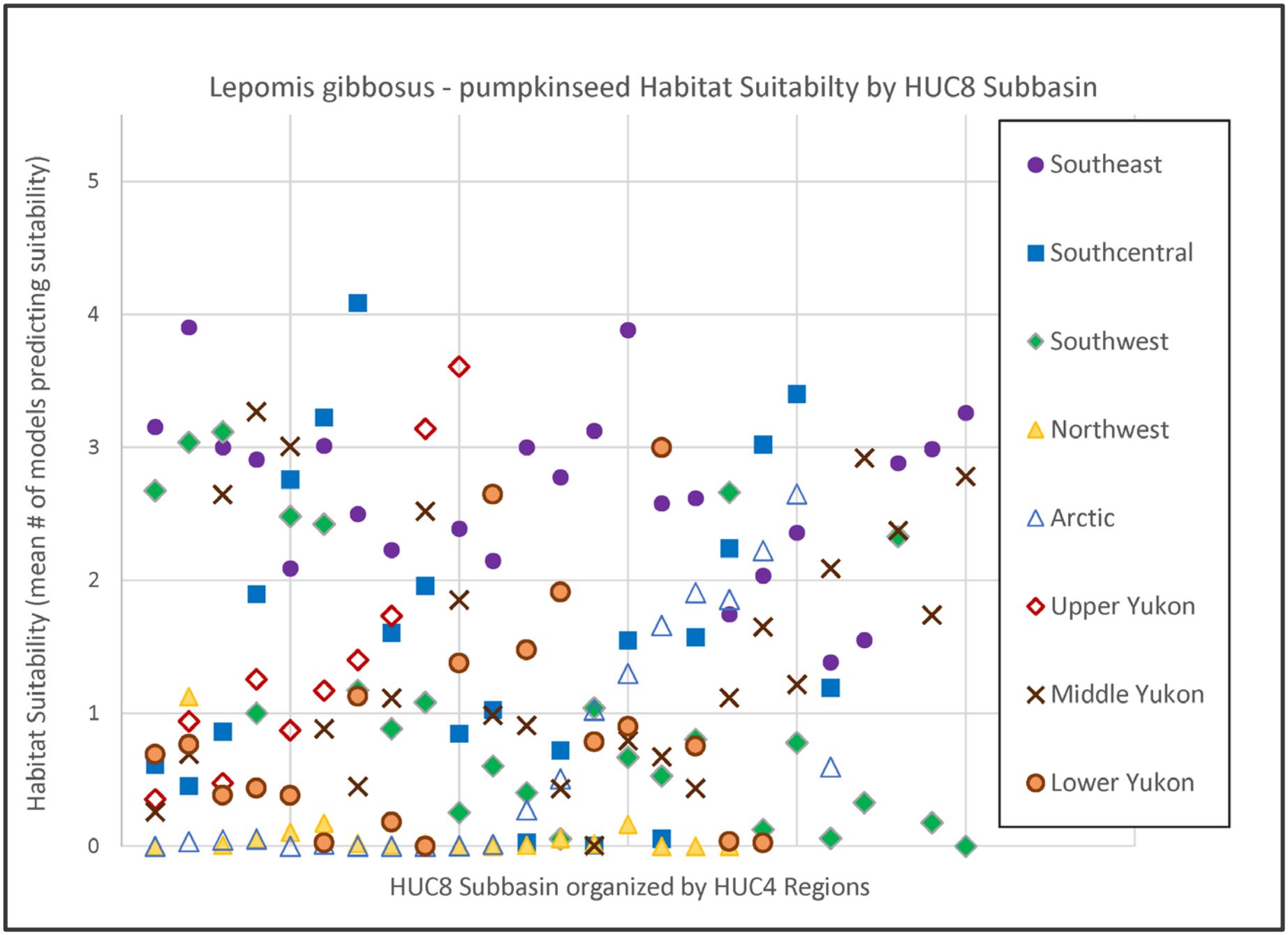
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

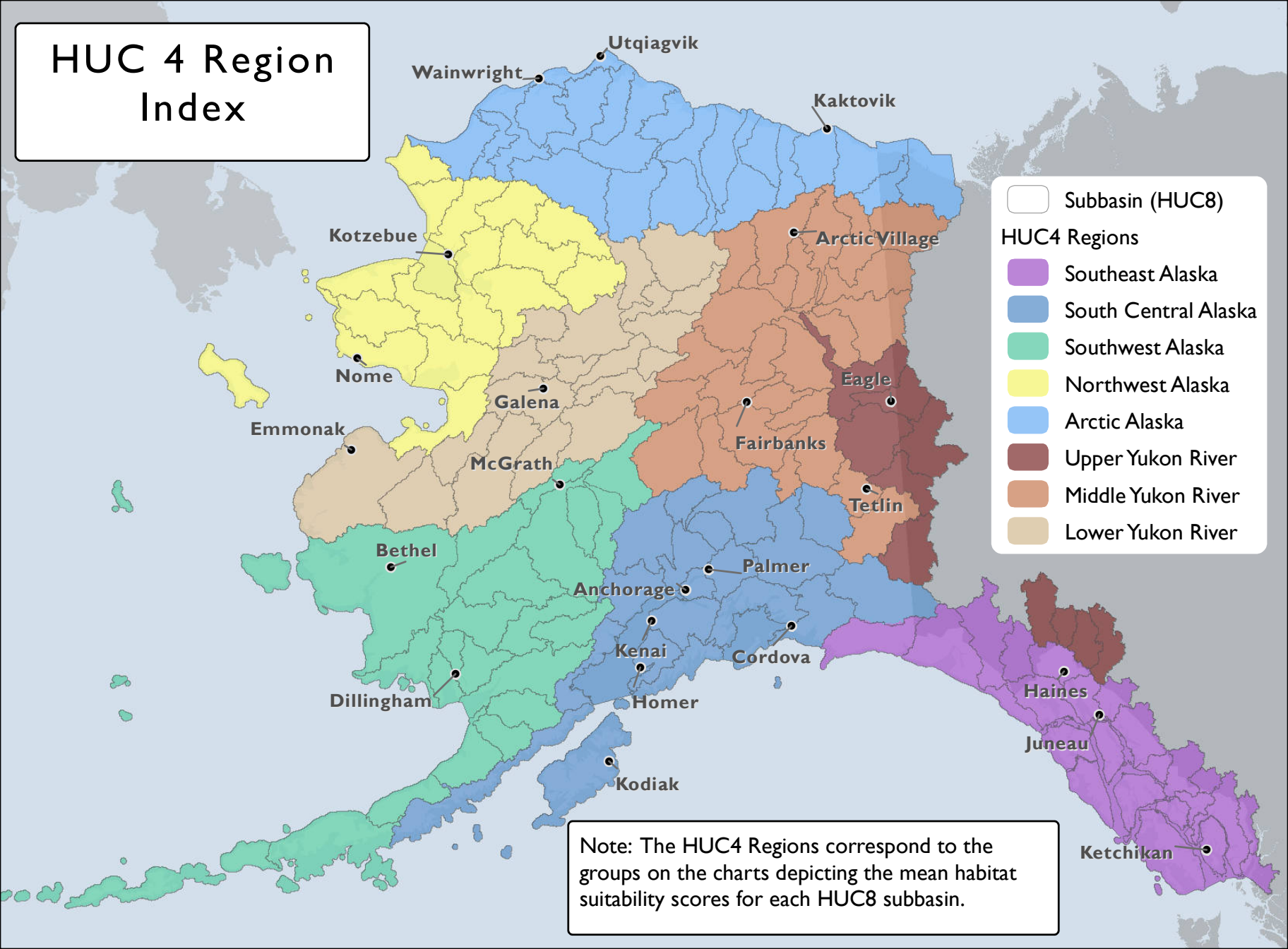
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Lepomis gibbosus (pumpkinseed)
Number of models predicting species presence
5
4
3
2
1
0
Subbasin (HUC8)
Precautionary threshold MPP
Targeted threshold MSS
Species Occurrence
sources: BC, BISON, NAS
AK
BC
YT
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0
100
200
400
Utqiagvik
Beaufort Sea
Chukchi Sea
Kotzebue
Nome
Norton Sound
Bethel
Fairbanks
Yukon Territory
Anchorage
Cordova
Haines
Juneau
Ketchikan
Homer
Kodiak
Dillingham
Bristol Bay


Lepomis gibbosus - pumpkinseed Habitat Suitabilty by HUC8 Subbasin
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon

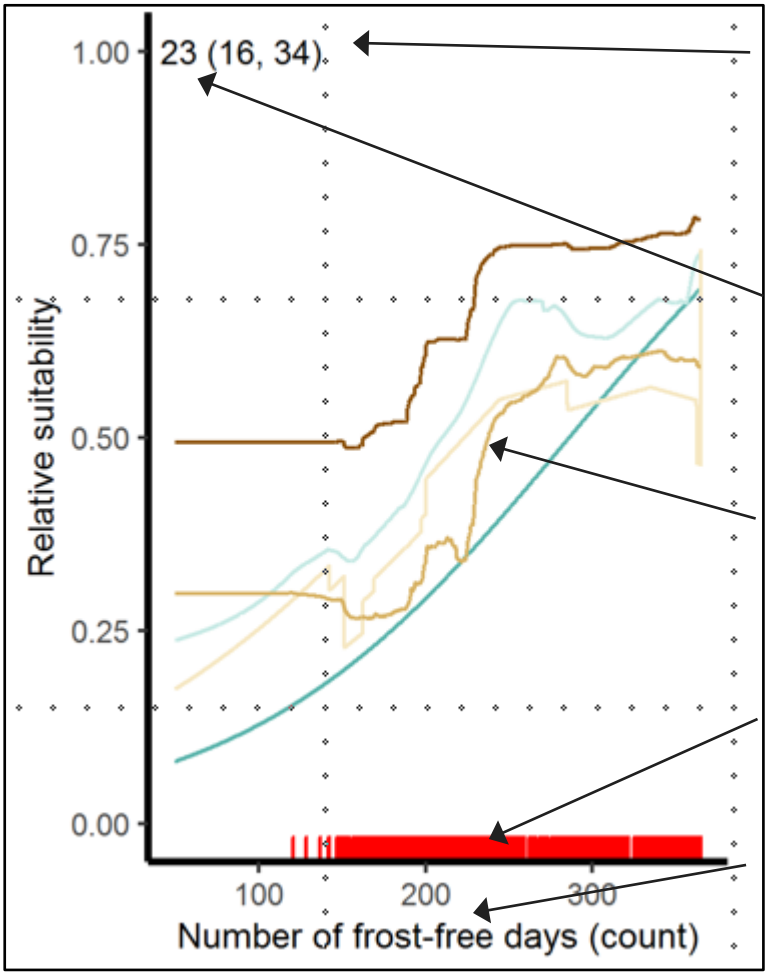
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

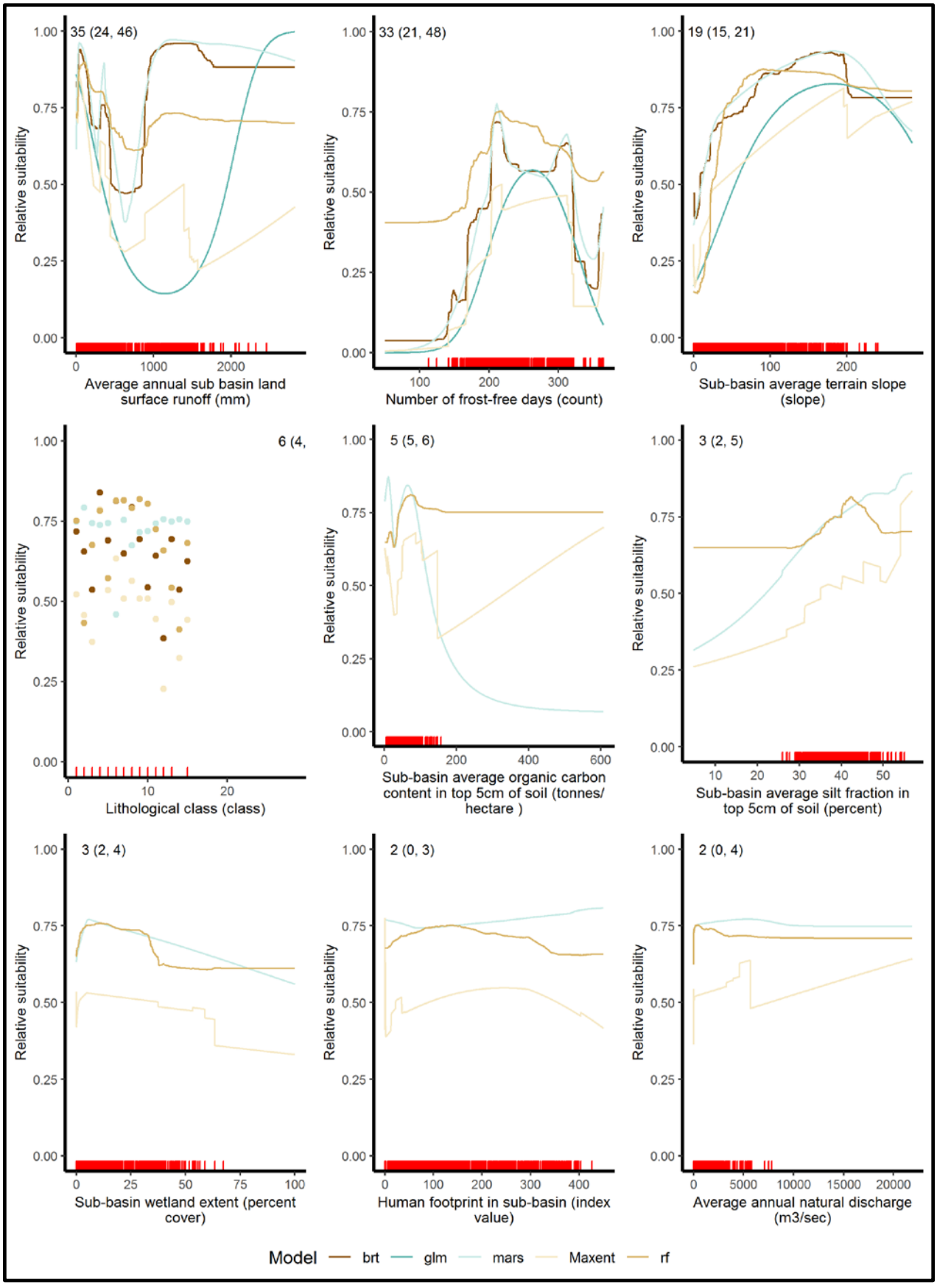
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


35 (24, 46)
33 (21, 48)
19 (15, 21)
6 (4,
5 (5, 6)
3 (2, 5)
3 (2, 4)
2 (0, 3)
2 (0, 4)
Relative suitability
Average annual sub basin land surface runoff (mm)
Number of frost-free days (count)
Sub-basin average terrain slope (slope)
Lithological class (class)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Sub-basin average silt fraction in top 5cm of soil (percent)
Sub-basin wetland extent (percent cover)
Human footprint in sub-basin (index value)
Average annual natural discharge (m3/sec)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Lithobates catesbeianus** *Common* **American Bullfrog**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **286**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **High Risk**[4]

Potential Vectors:

Aquarium Release

Species Group:

Amphibian

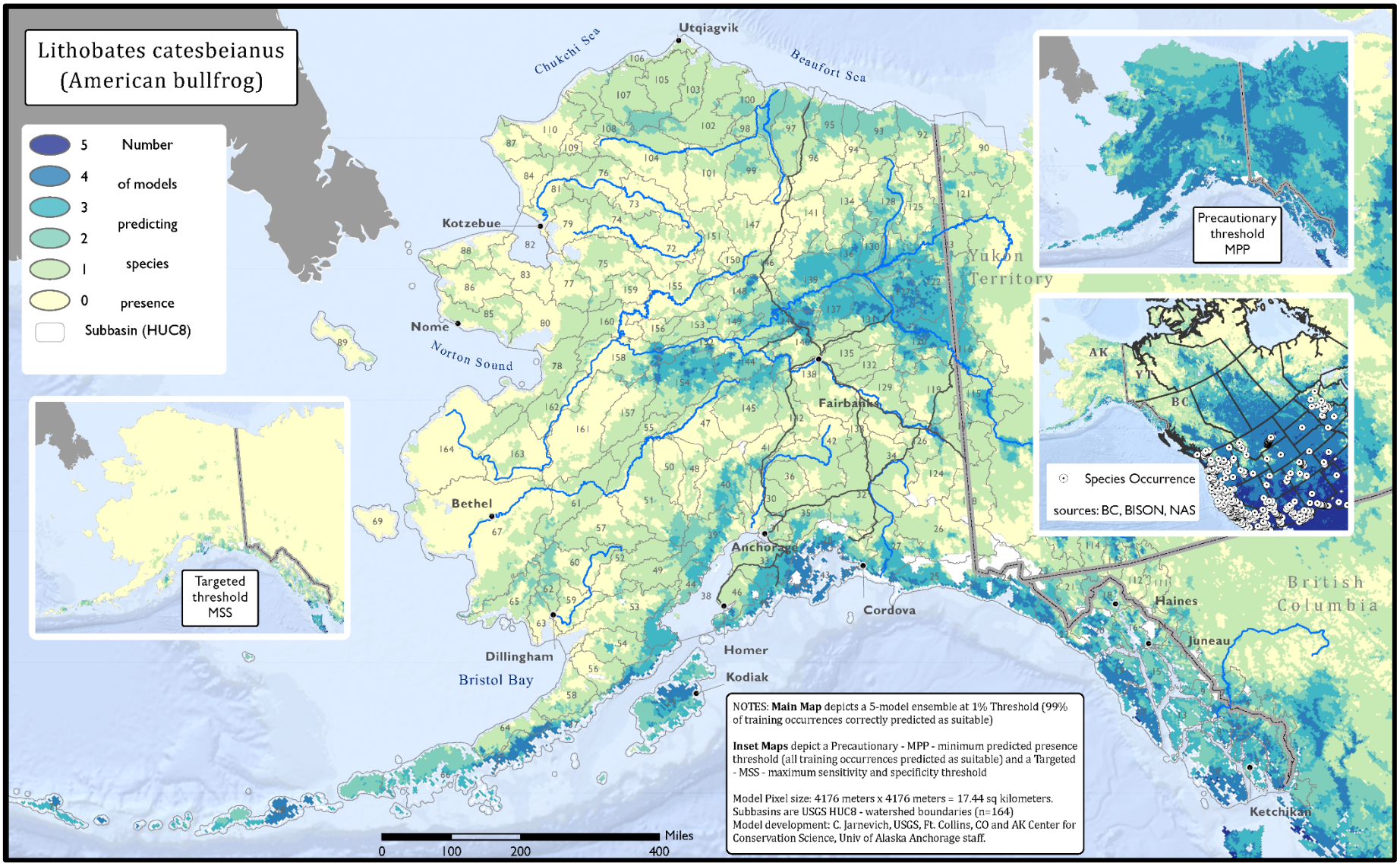
Data Sources:

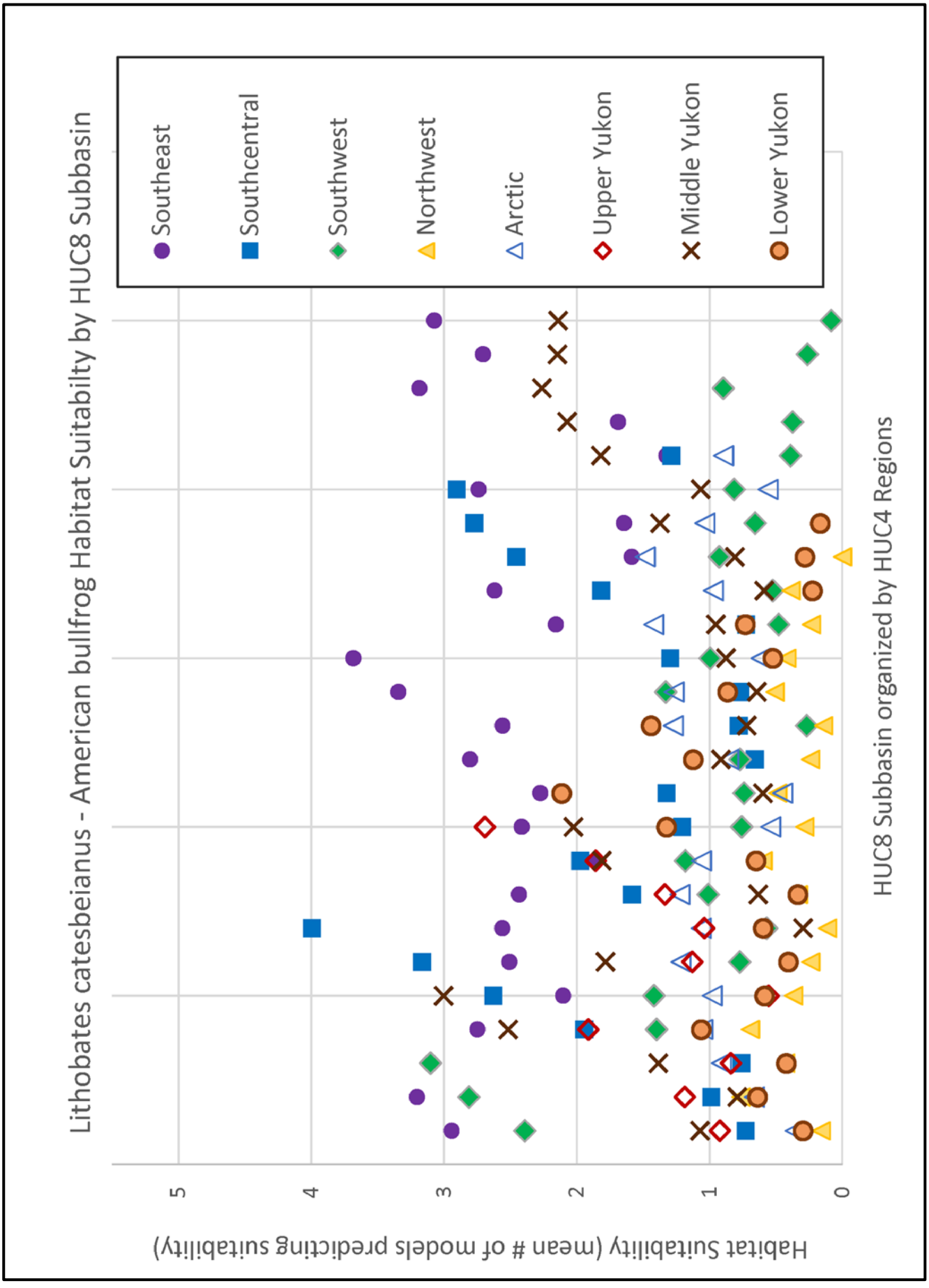
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

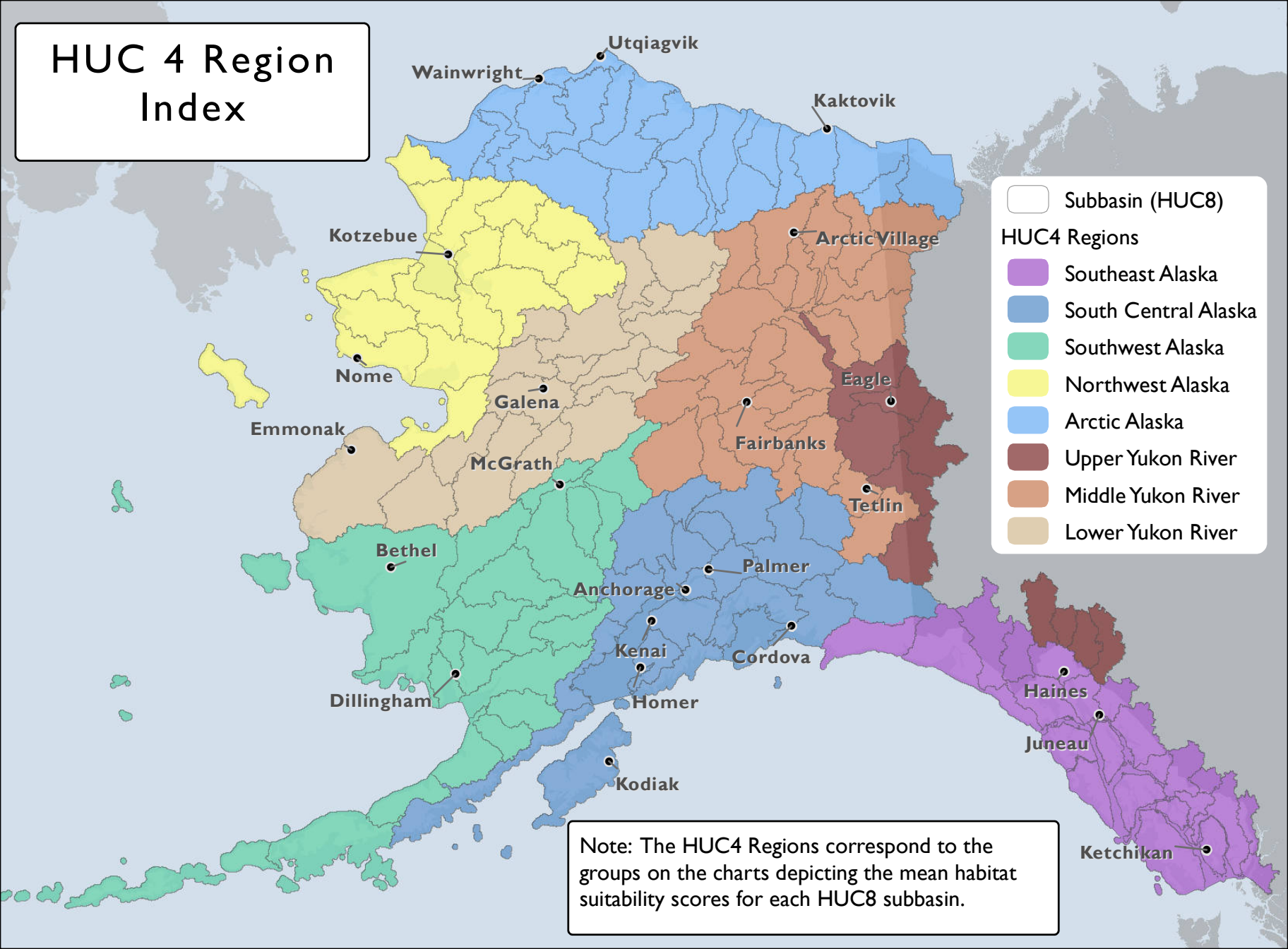
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Lithobates catesbeianus
(American bullfrog)
5 Number
4 of models
3 predicting
2 species
1 species
0 presence
Subbasin (HUC8)
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Lithobates catesbeianus - American bullfrog Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

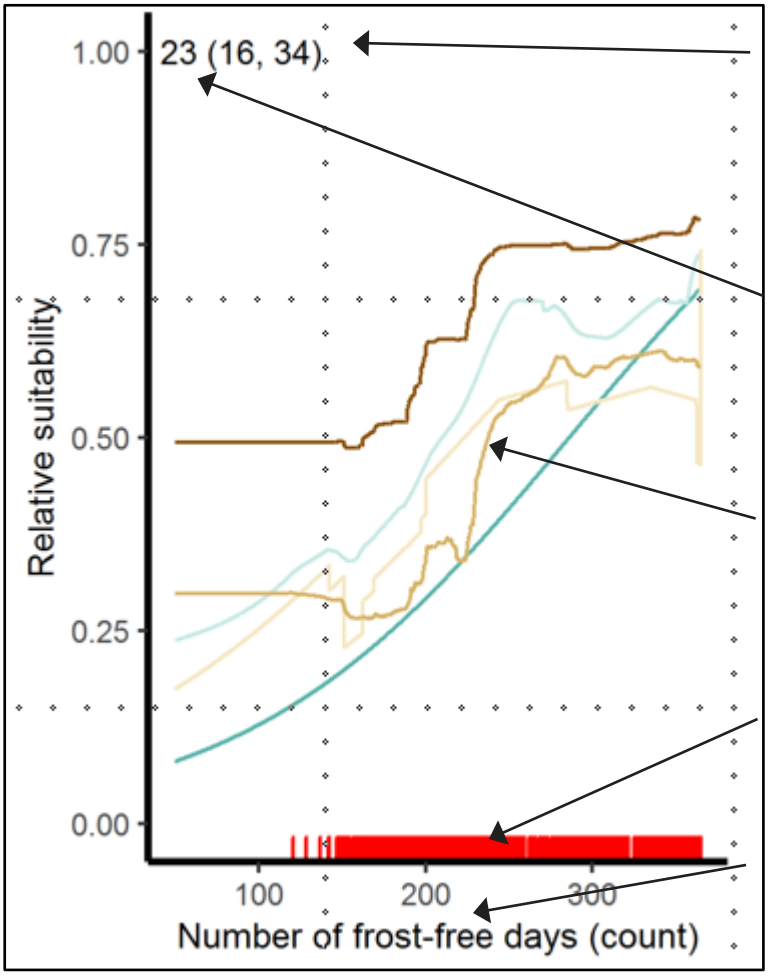
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

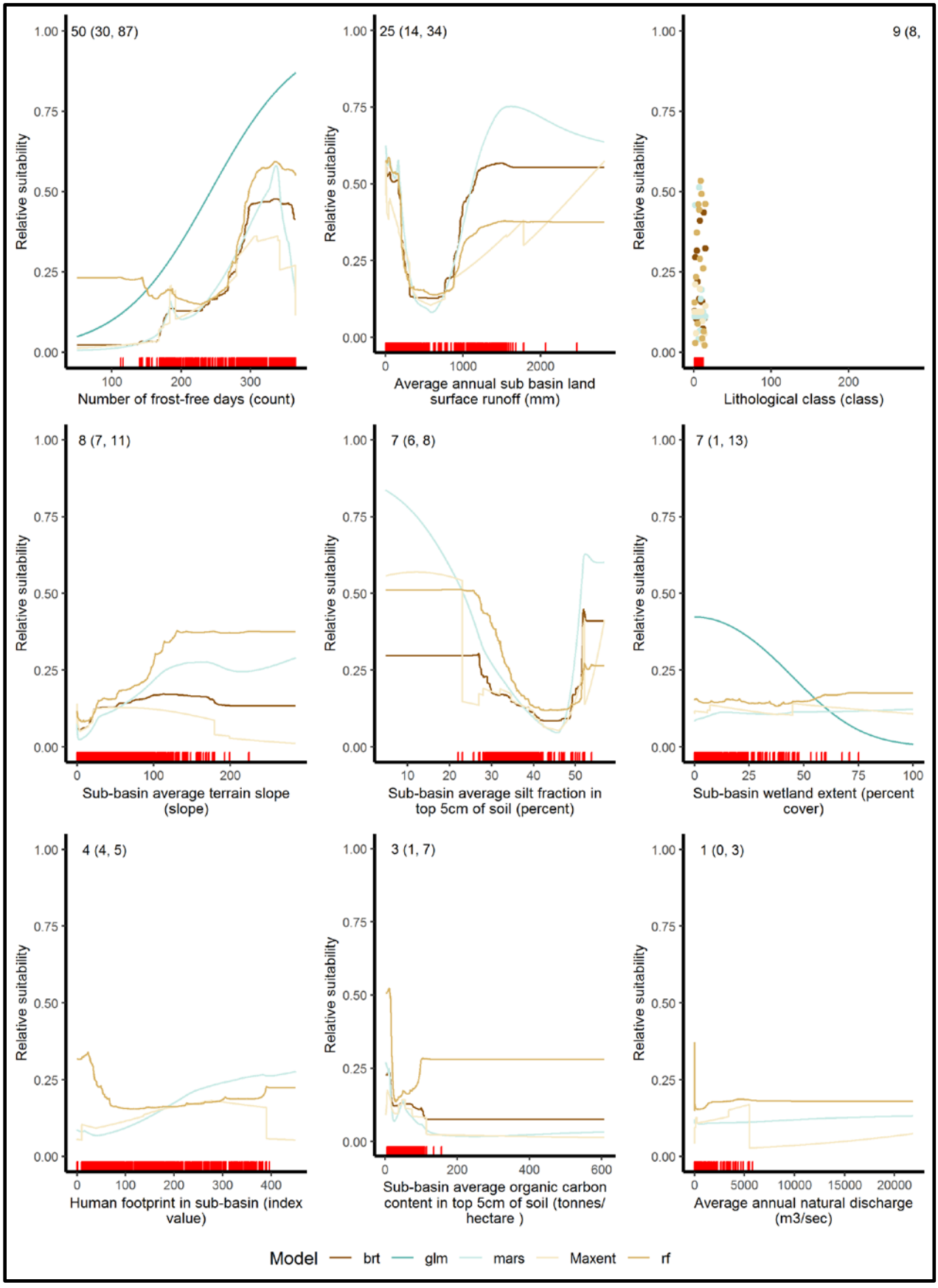
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


50 (30, 87)
Number of frost-free days (count)
25 (14, 34)
Average annual sub basin land surface runoff (mm)
9 (8,
Lithological class (class)
8 (7, 11)
Sub-basin average terrain slope (slope)
7 (6, 8)
Sub-basin average silt fraction in top 5cm of soil (percent)
7 (1, 13)
Sub-basin wetland extent (percent cover)
4 (4, 5)
Human footprint in sub-basin (index value)
3 (1, 7)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
1 (0, 3)
Average annual natural discharge (m3/sec)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Micropterus dolomieu** *Common Name* **Smallmouth Bass**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **3964**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

In State Transfer

Importation and Release

Species Group:

Fish

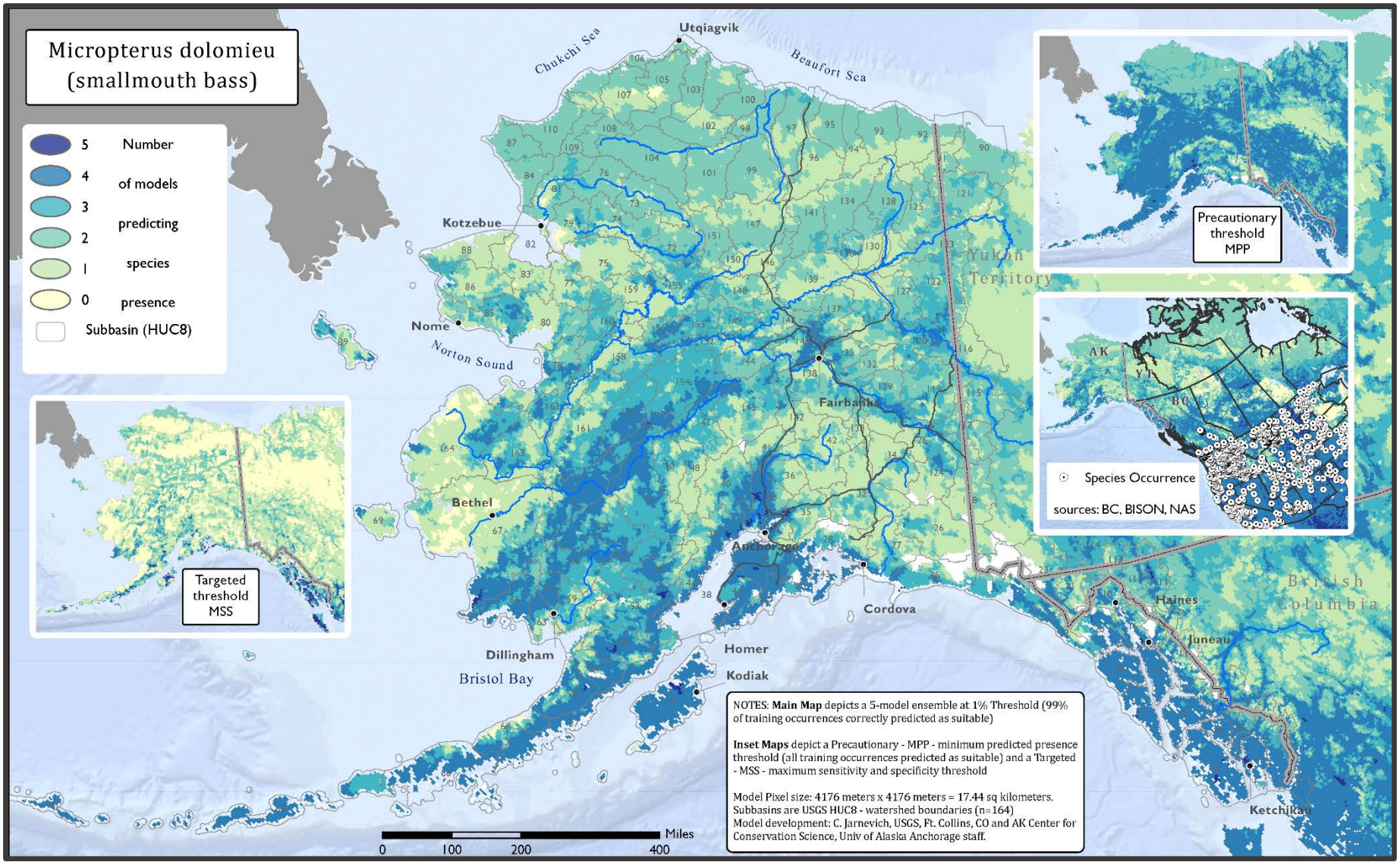
Data Sources:

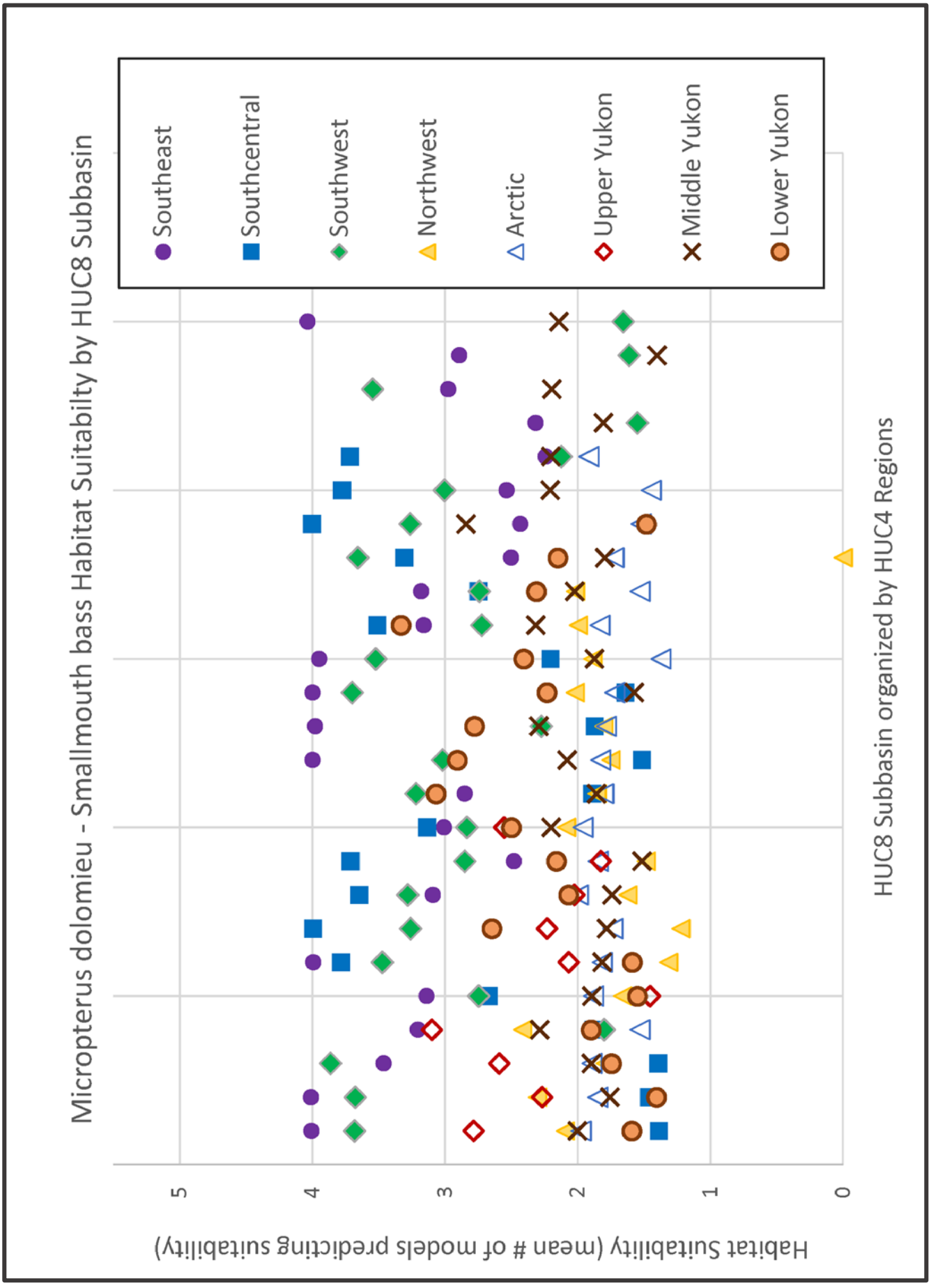
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

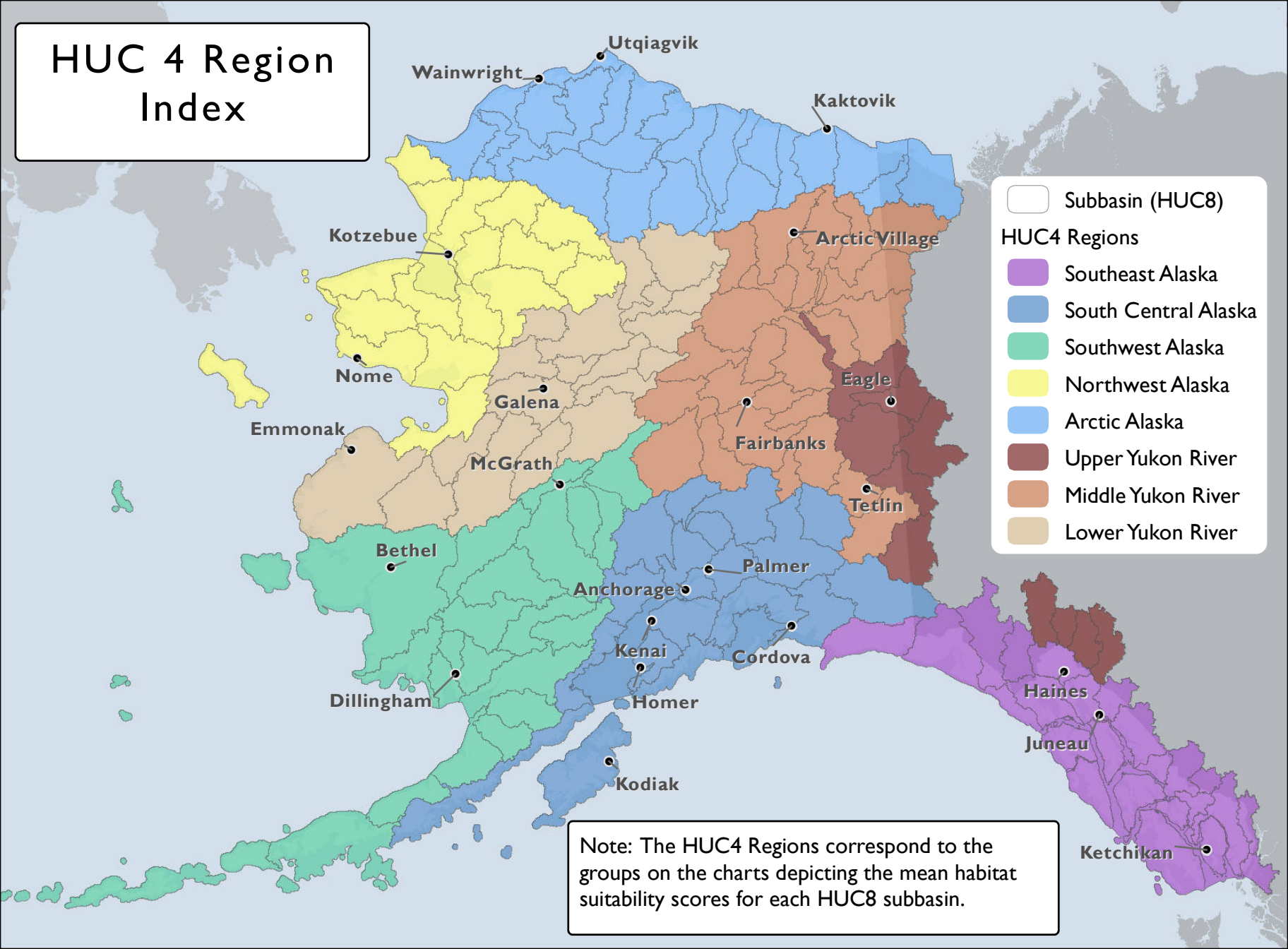
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Micropterus dolomieu
(smallmouth bass)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Micropterus dolomieu - Smallmouth bass Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

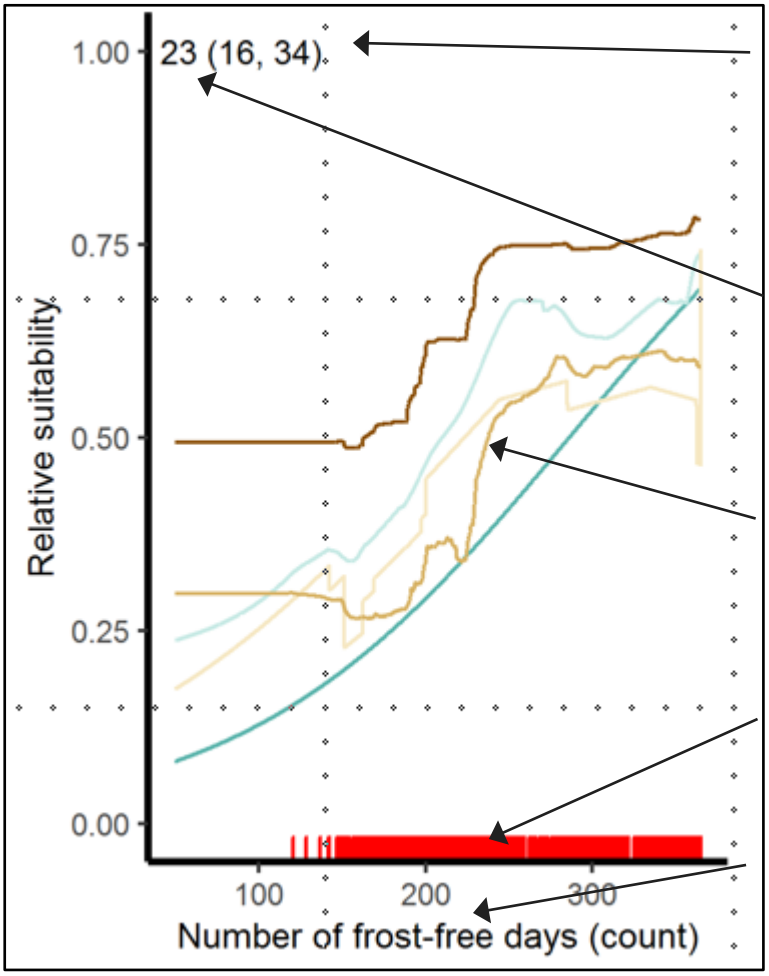
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

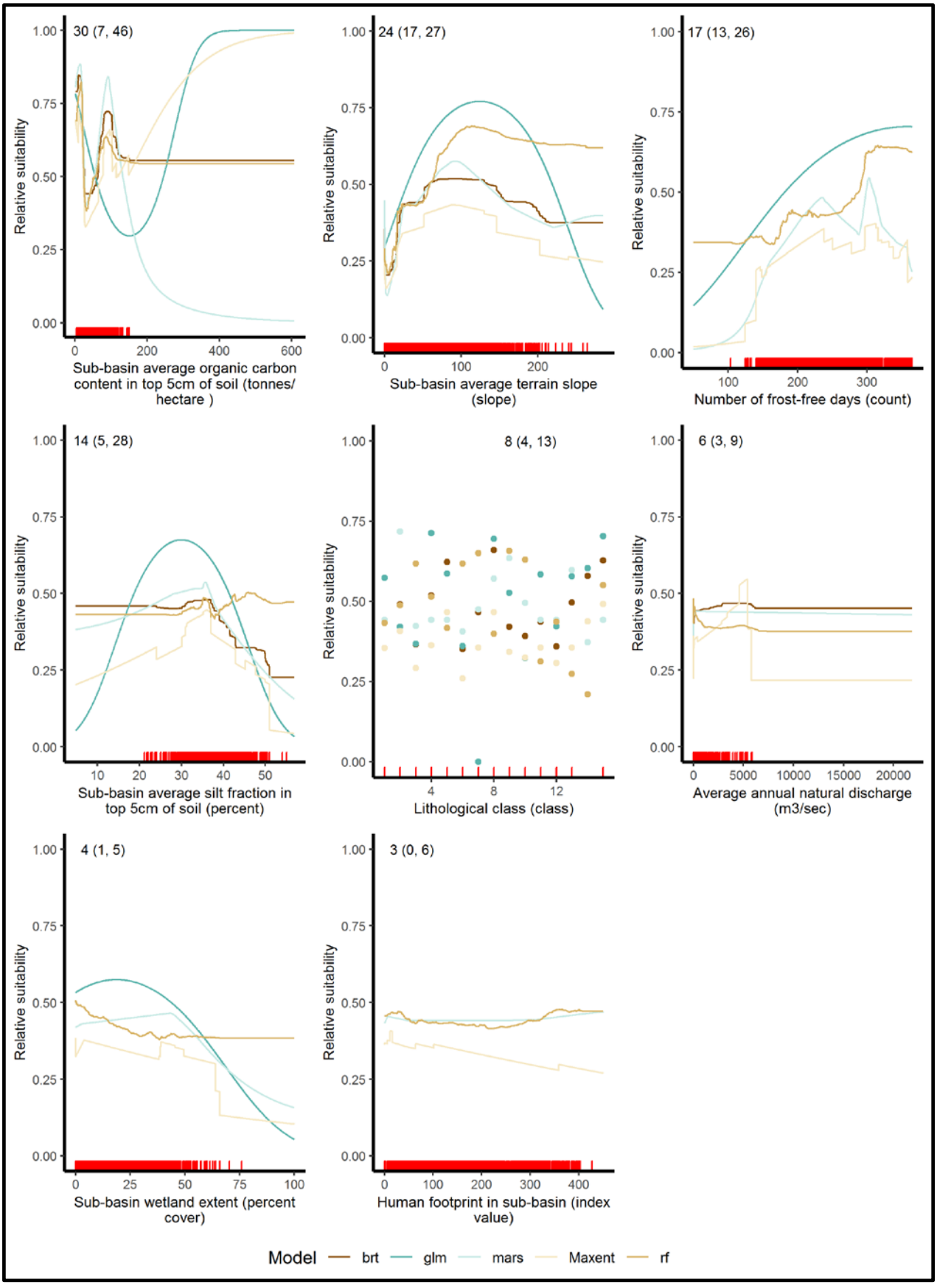
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


30 (7, 46)
24 (17, 27)
17 (13, 26)
14 (5, 28)
8 (4, 13)
6 (3, 9)
4 (1, 5)
3 (0, 6)
Relative suitability
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Sub-basin average terrain slope (slope)
Number of frost-free days (count)
Sub-basin average silt fraction in top 5cm of soil (percent)
Lithological class (class)
Average annual natural discharge (m3/sec)
Sub-basin wetland extent (percent cover)
Human footprint in sub-basin (index value)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Micropterus salmoides** *Common* **Largemouth Bass**

Alaska Occurrence Records: species occurrences found in Alaska - **1**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **7746**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

In State Transfer

Importation and Release

Species Group:

Fish

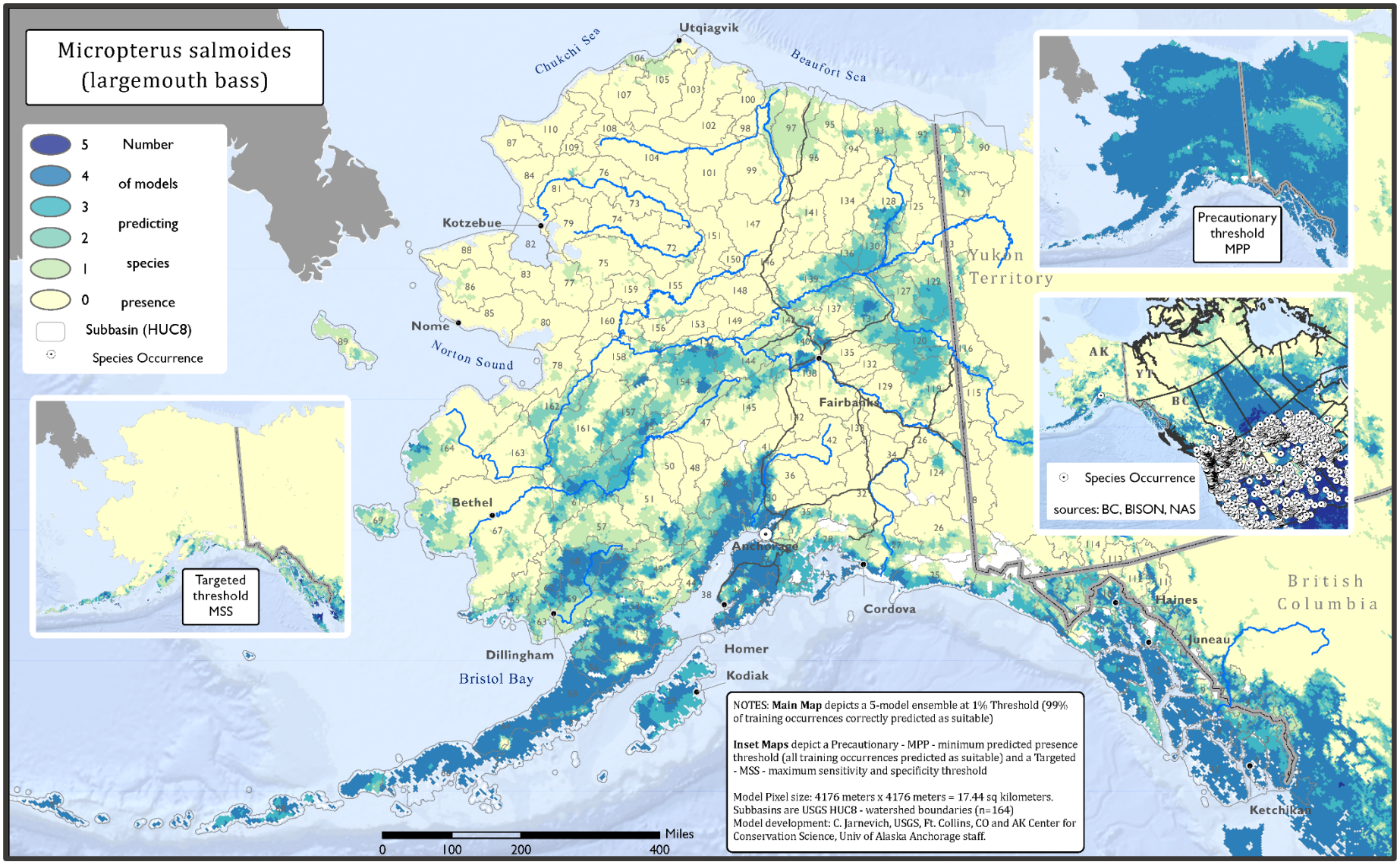
Data Sources:

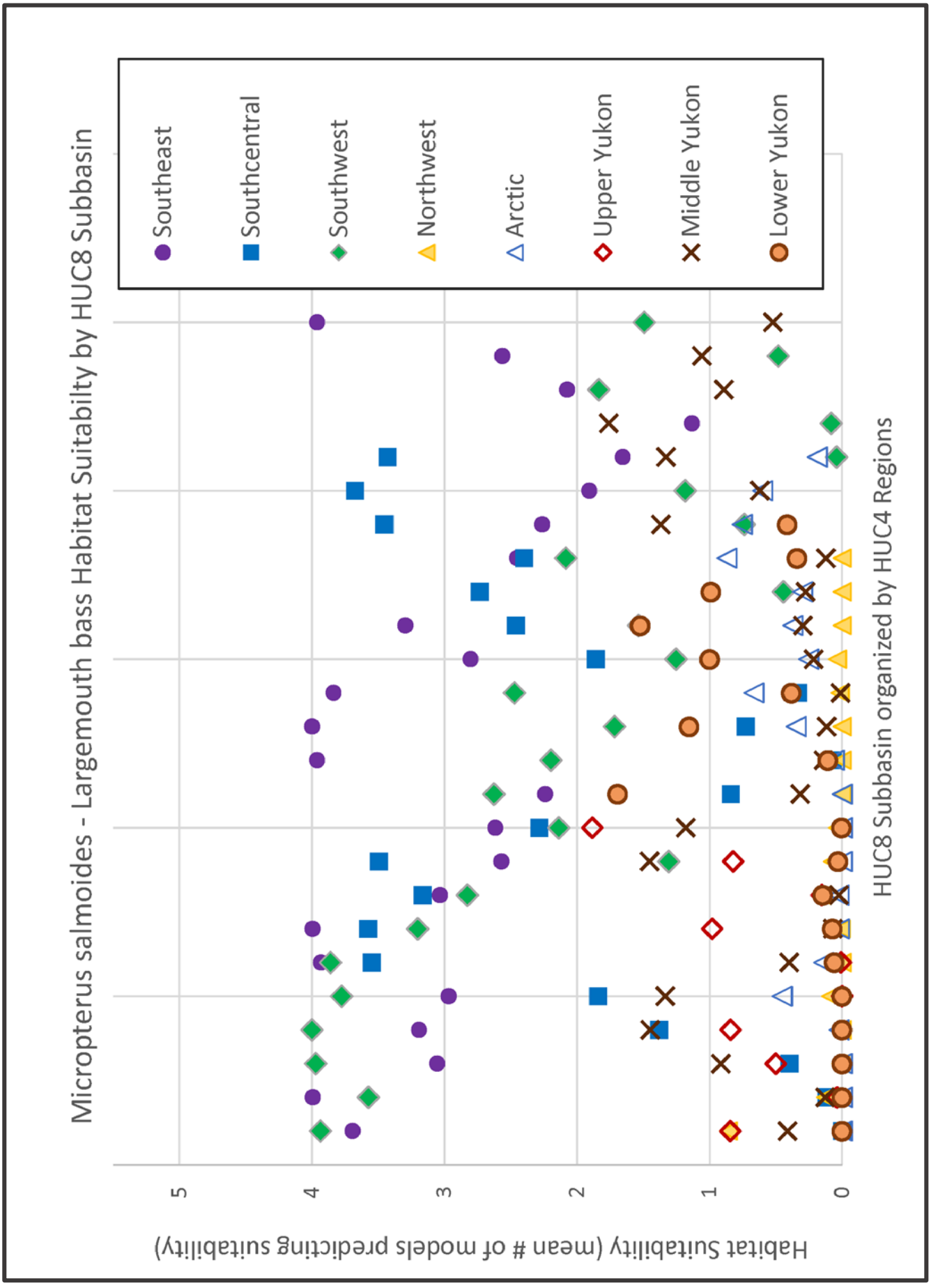
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

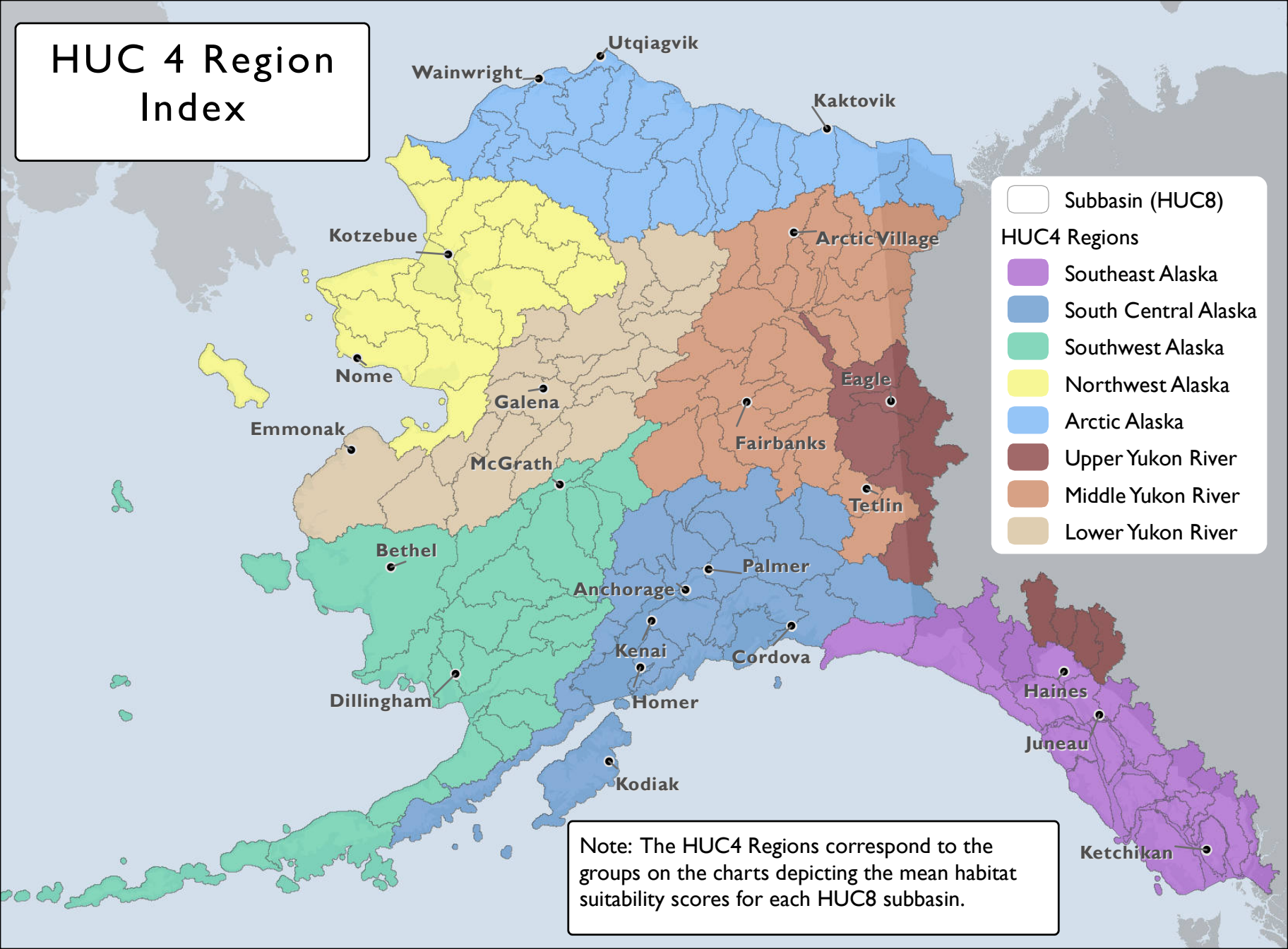
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Micropterus salmoides
(largemouth bass)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Species Occurrence
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Micropterus salmoides - Largemouth bass Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

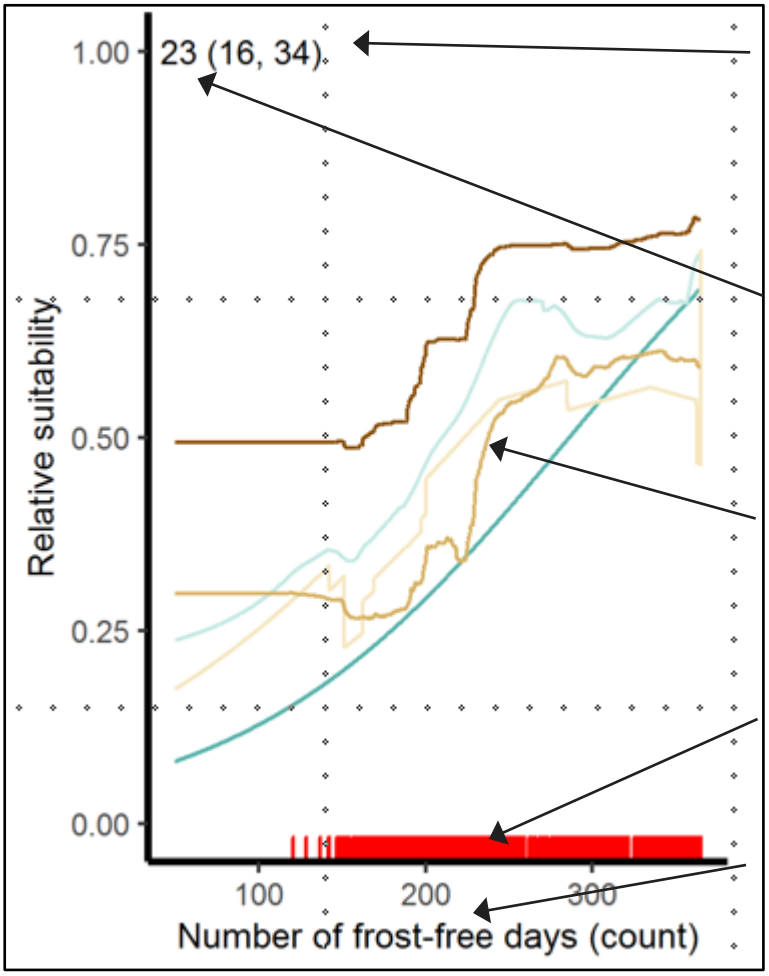
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

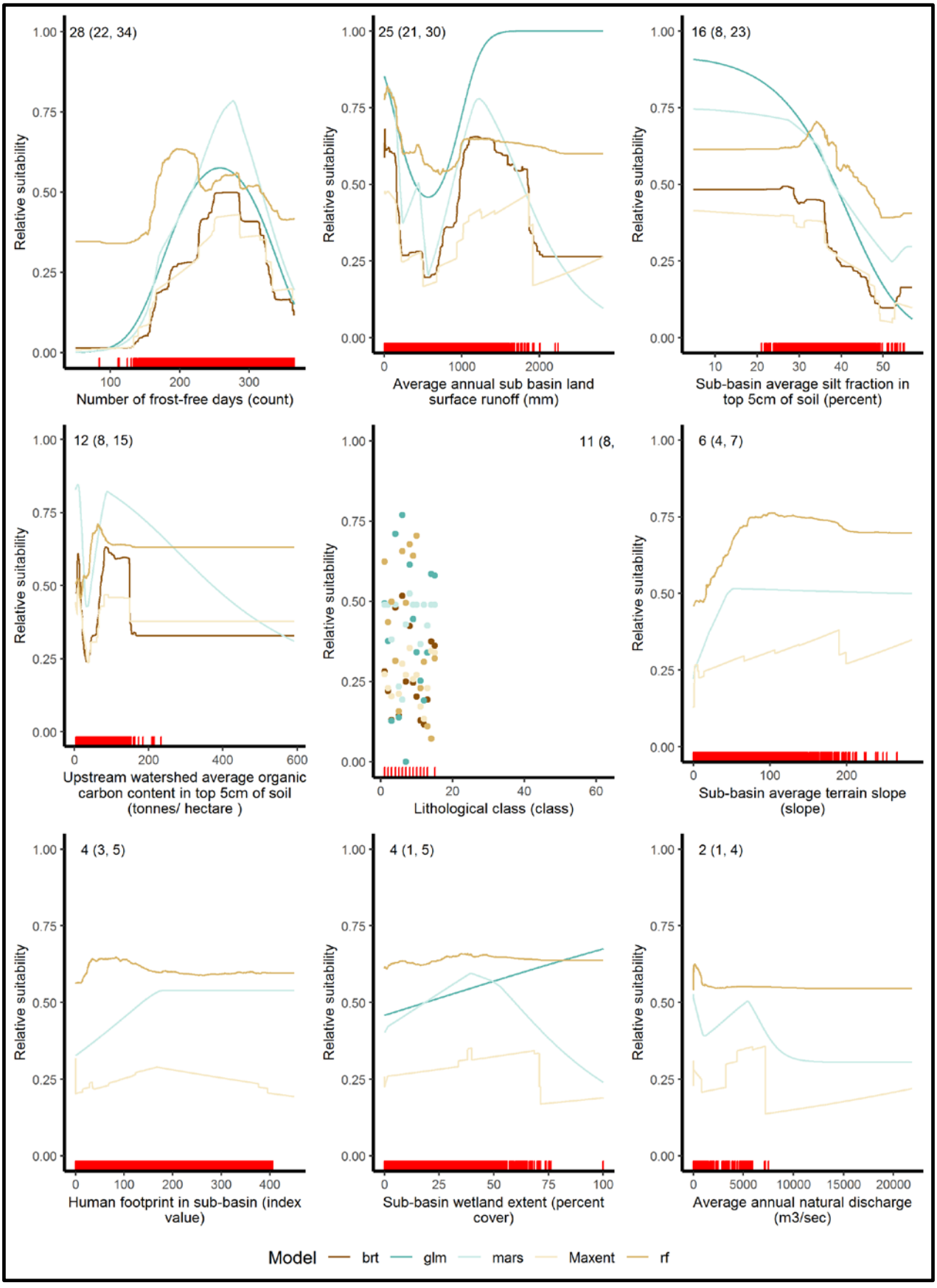
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


28 (22, 34)
Relative suitability
Number of frost-free days (count)
25 (21, 30)
Average annual sub basin land surface runoff (mm)
16 (8, 23)
Sub-basin average silt fraction in top 5cm of soil (percent)
12 (8, 15)
Upstream watershed average organic carbon content in top 5cm of soil (tonnes/ hectare)
11 (8,
Lithological class (class)
6 (4, 7)
Sub-basin average terrain slope (slope)
4 (3, 5)
Human footprint in sub-basin (index value)
4 (1, 5)
Sub-basin wetland extent (percent cover)
2 (1, 4)
Average annual natural discharge (m3/sec)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Morone americana** *Common Name* **White Perch**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1198**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

In State Transfer

Importation and Release

Species Group:

Fish

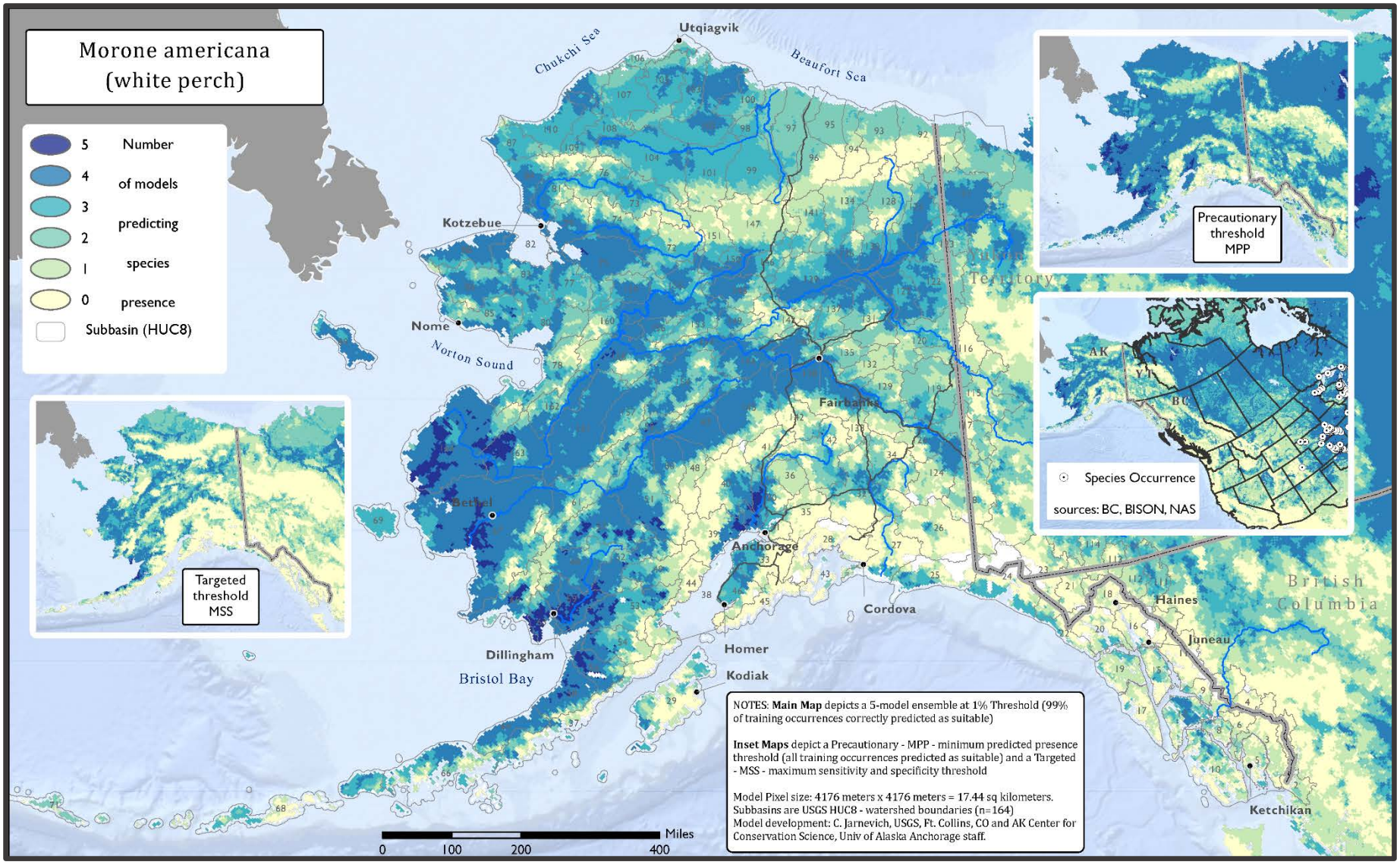
Data Sources:

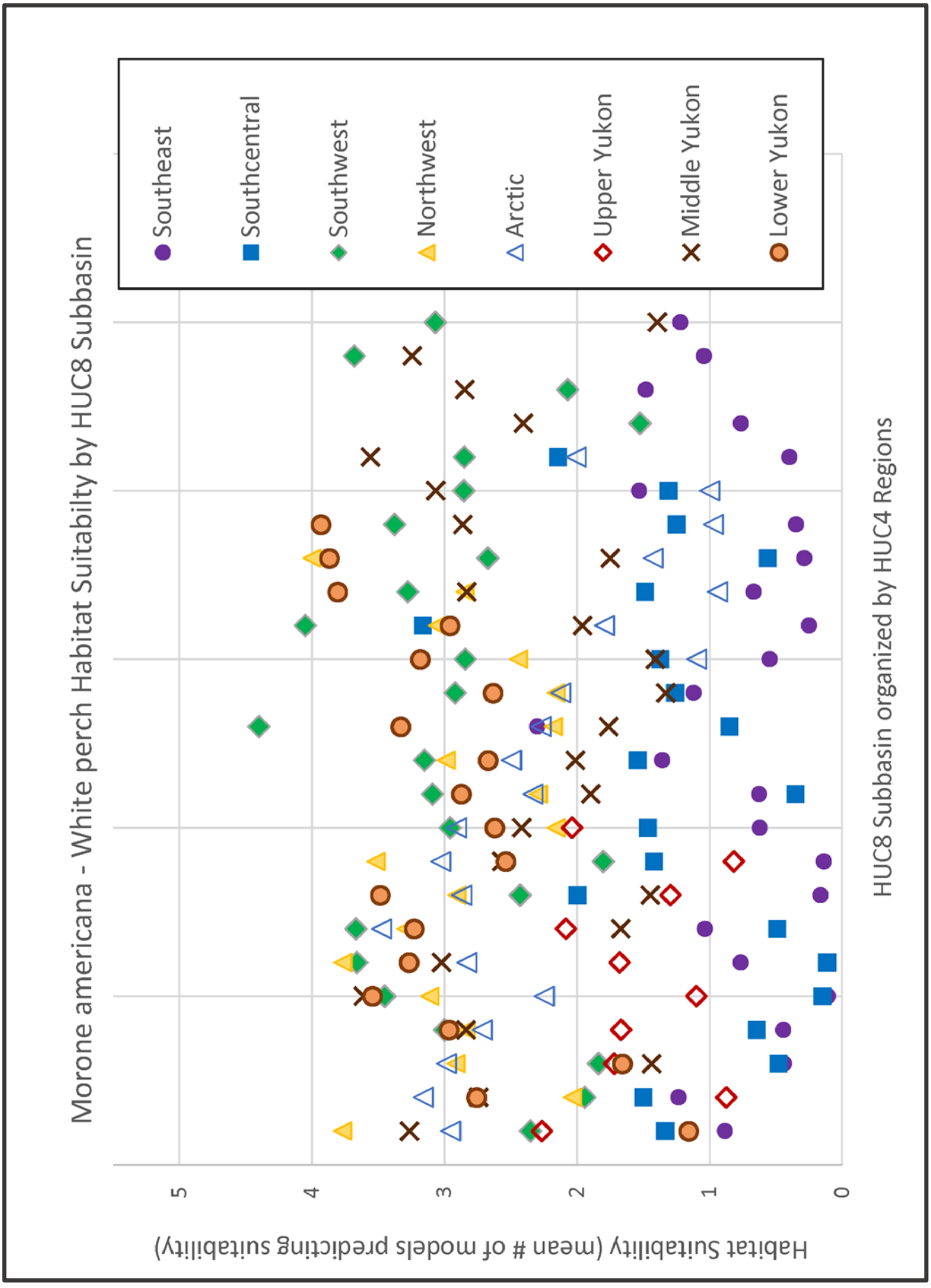
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

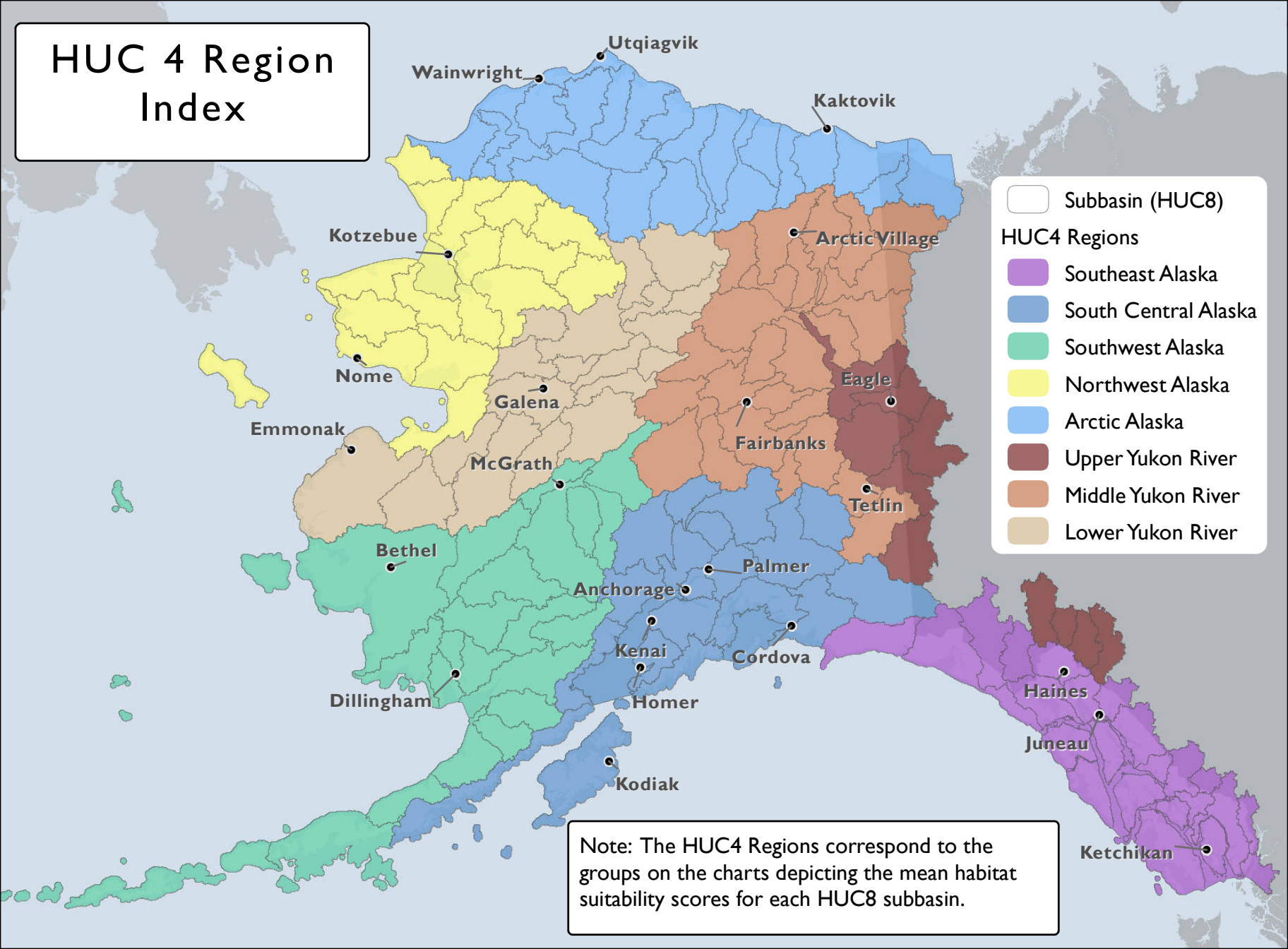
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Morone americana
(white perch)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Yukon Territory
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Morone americana - White perch Habitat Suitability by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

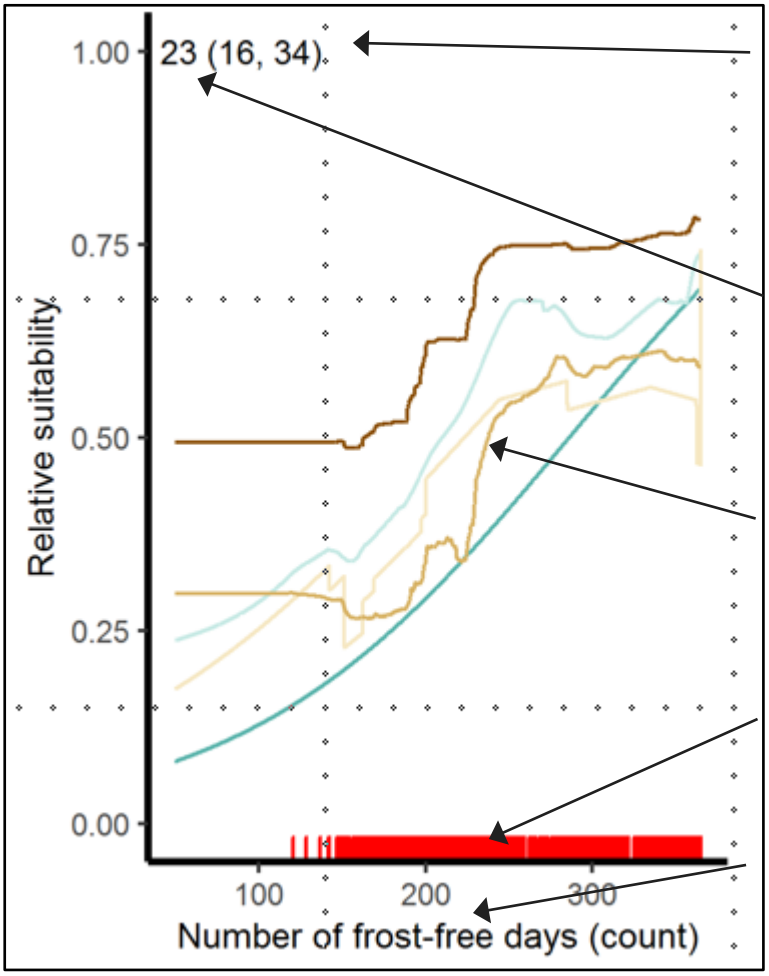
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

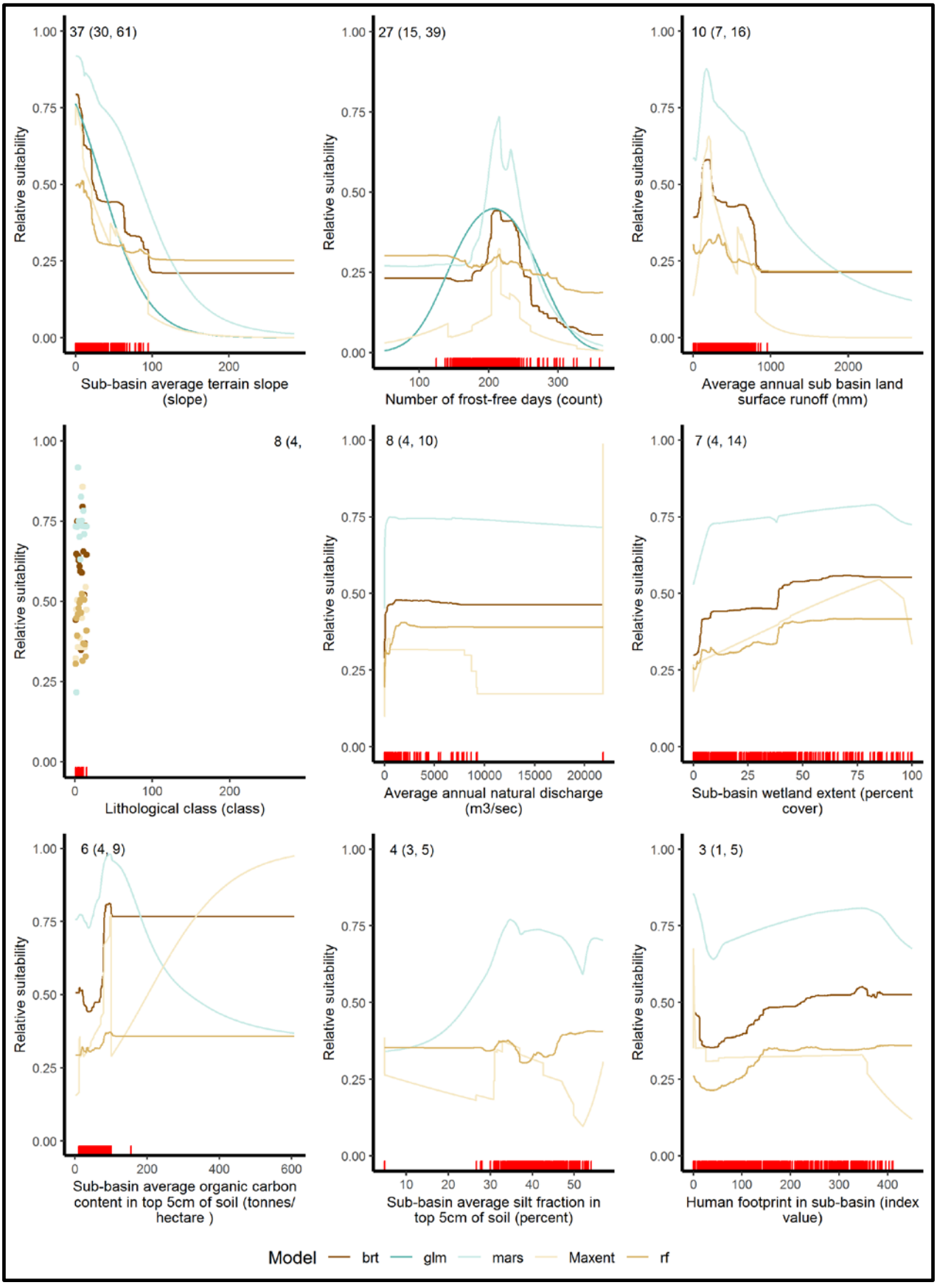
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


37 (30, 61)
27 (15, 39)
10 (7, 16)
8 (4,
8 (4, 10)
7 (4, 14)
6 (4, 9)
4 (3, 5)
3 (1, 5)
Relative suitability
Sub-basin average terrain slope (slope)
Number of frost-free days (count)
Average annual sub basin land surface runoff (mm)
Lithological class (class)
Average annual natural discharge (m3/sec)
Sub-basin wetland extent (percent cover)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Sub-basin average silt fraction in top 5cm of soil (percent)
Human footprint in sub-basin (index value)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Mysis diluviana** *Common Name* **Mysid Crustacean**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **39**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Crustacean

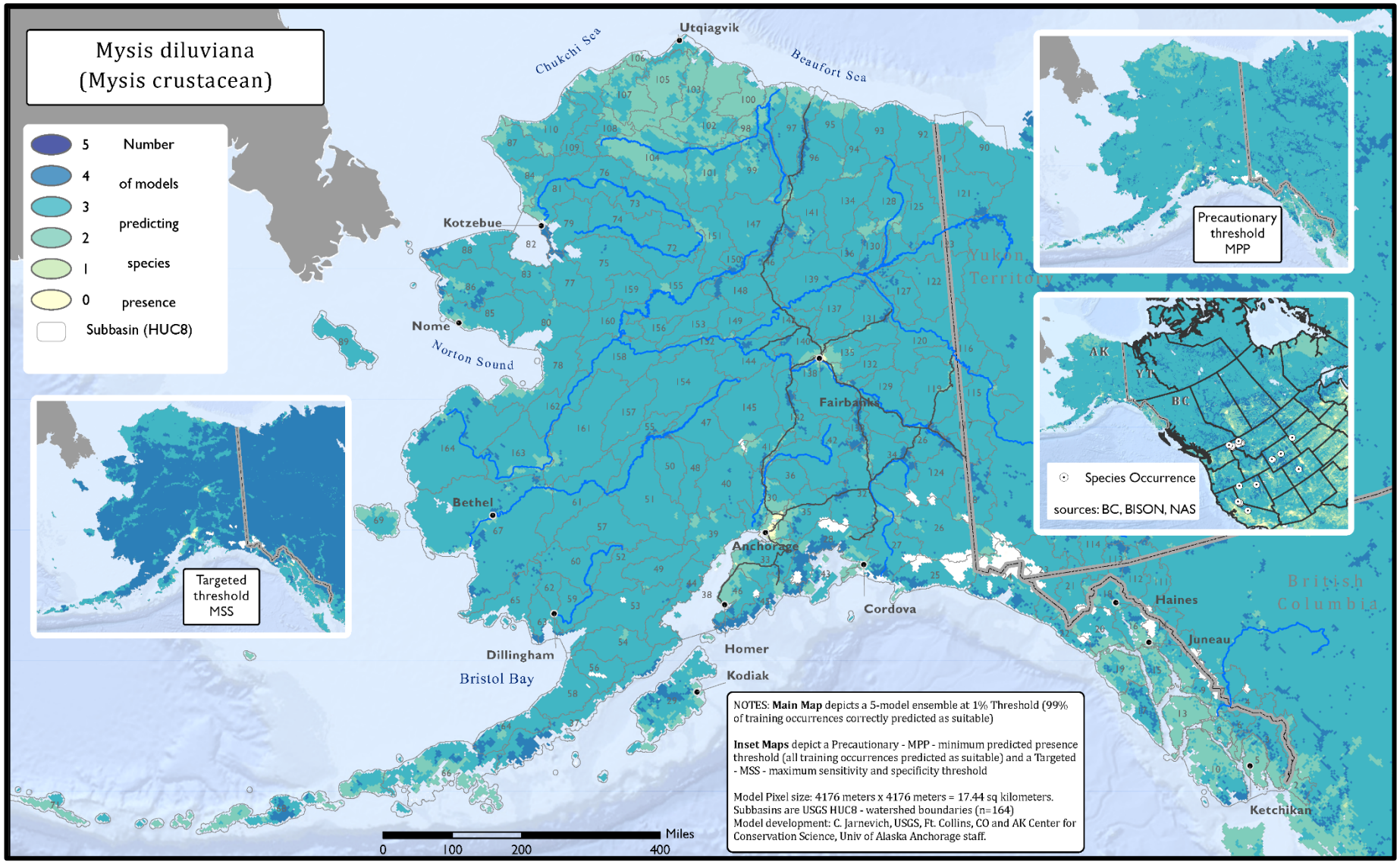
Data Sources:

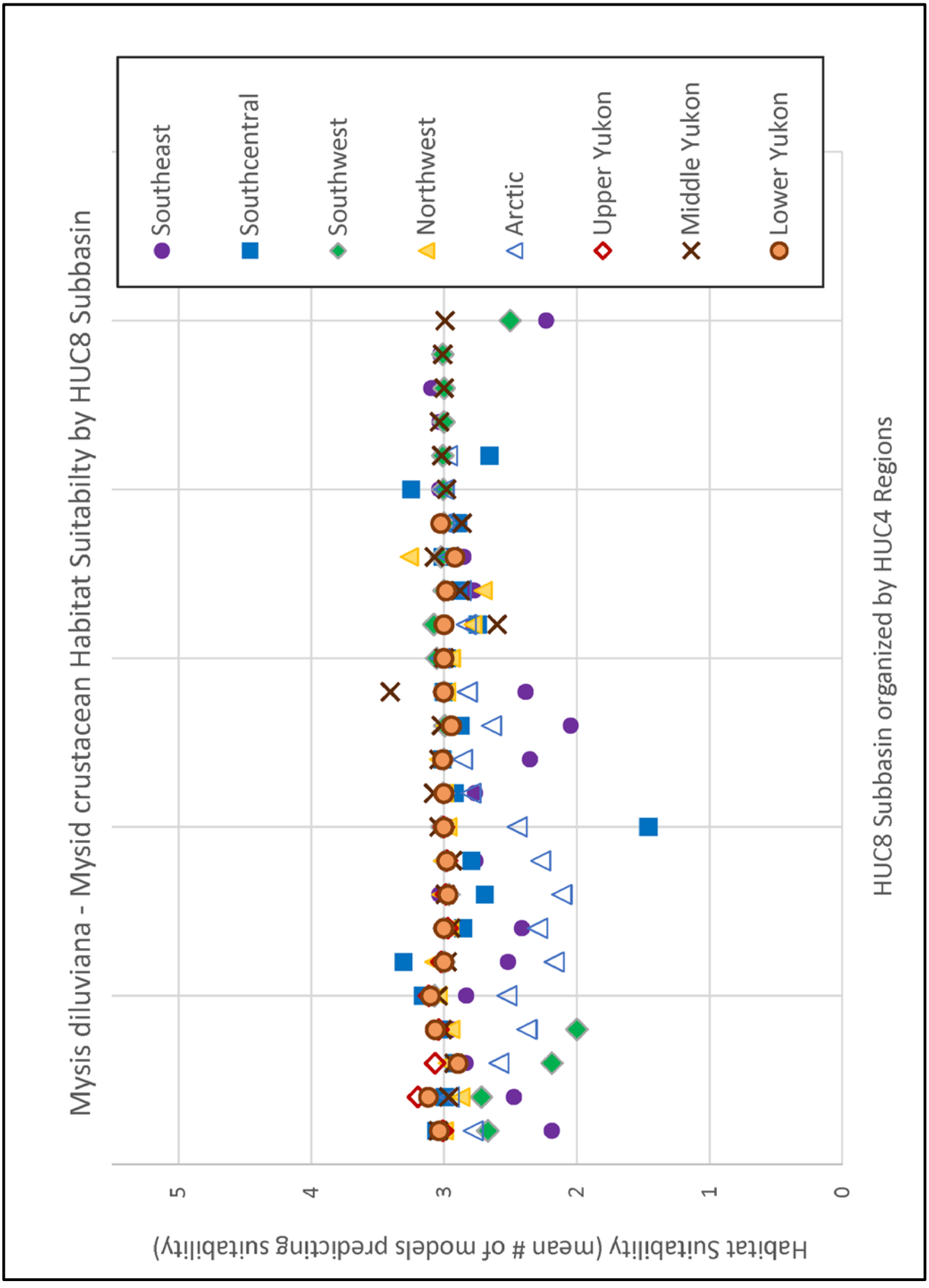
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

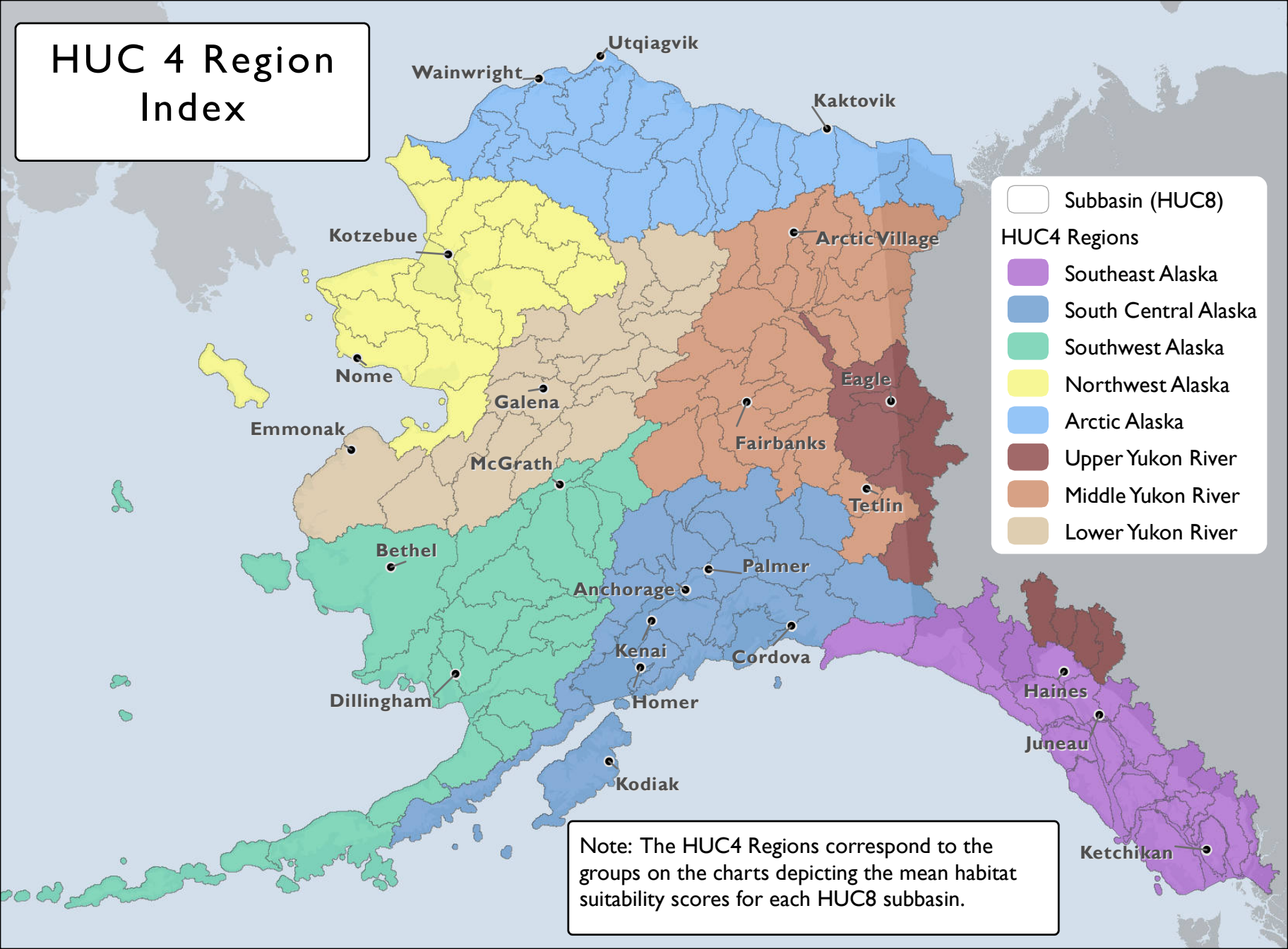
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Mysis diluviana
(Mysis crustacean)
5 Number
4 of models
3 predicting
2 species
1 presence
0
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Haines
Juneau
Ketchikan
British Columbia
Dillingham
Bristol Bay
Homer
Kodiak
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Mysis diluviana - Mysid crustacean Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
5
4
3
2
1
0
Habitat Suitability (mean # of models predicting suitability)
HUC8 Subbasin organized by HUC4 Regions

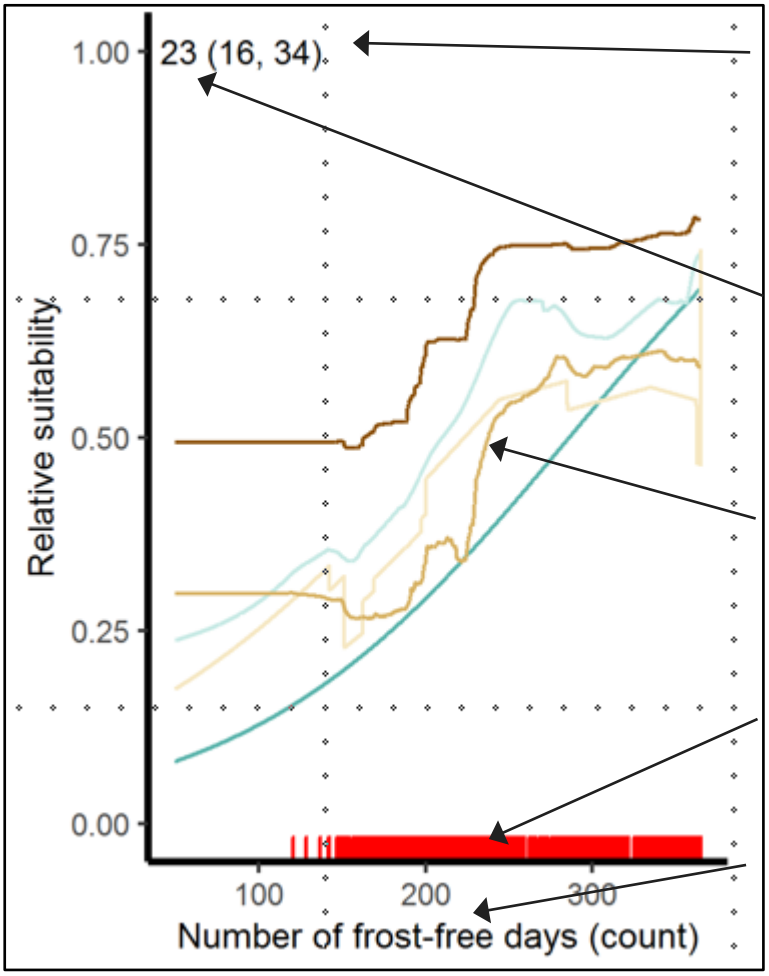
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

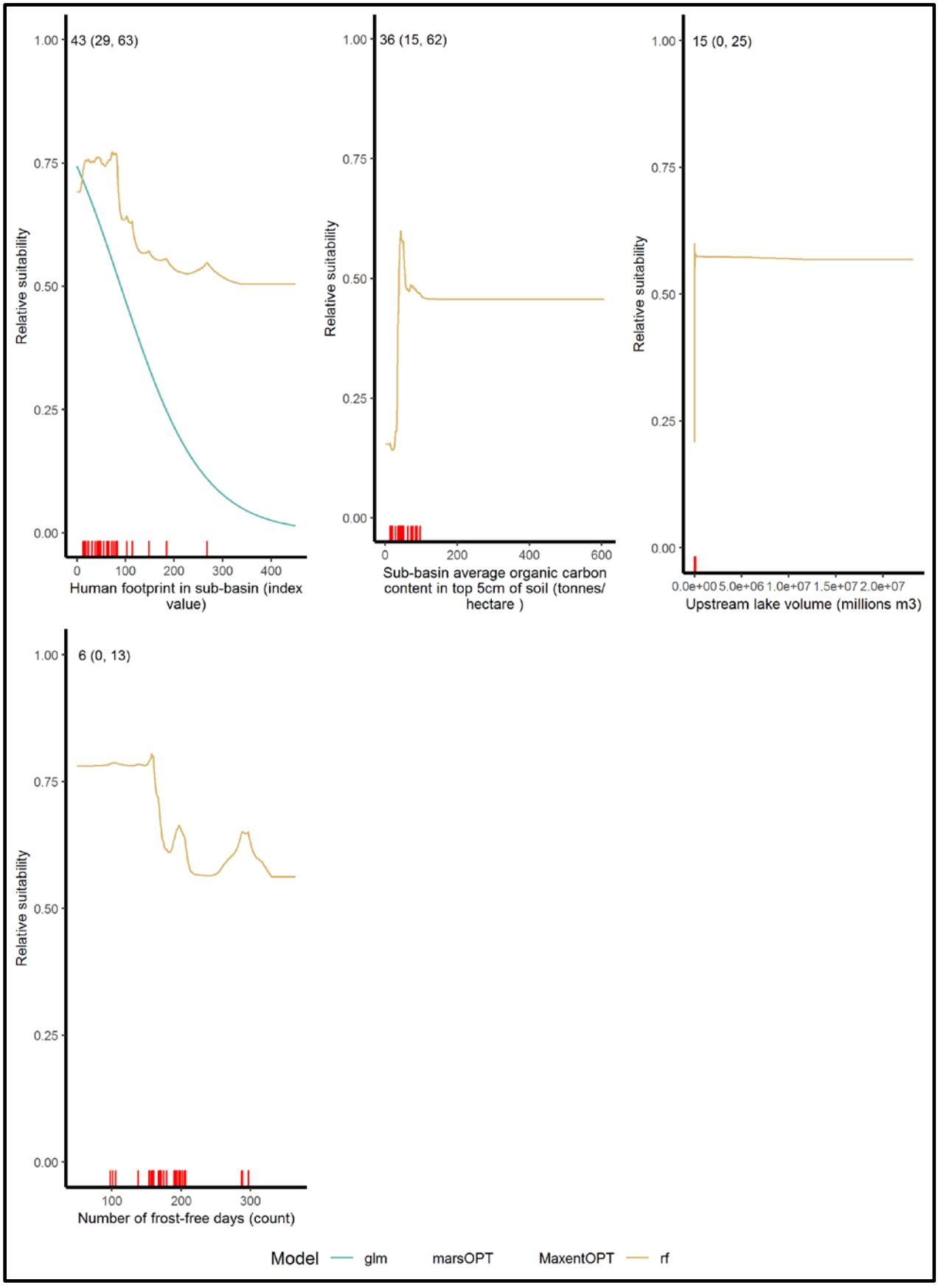
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


43 (29, 63)
Relative suitability
1.00
0.75
0.50
0.25
0.00
0
100
200
300
400
Human footprint in sub-basin (index value)
36 (15, 62)
Relative suitability
0
200
400
600
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
15 (0, 25)
Relative suitability
0.0e+00
5.0e+06
1.0e+07
1.5e+07
2.0e+07
Upstream lake volume (millions m3)
6 (0, 13)
Relative suitability
100
200
300
Number of frost-free days (count)
Model
glm
marsOPT
MaxentOPT
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Notemigonus crysoleucas** *Common Name* **Golden Shiner**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **337**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

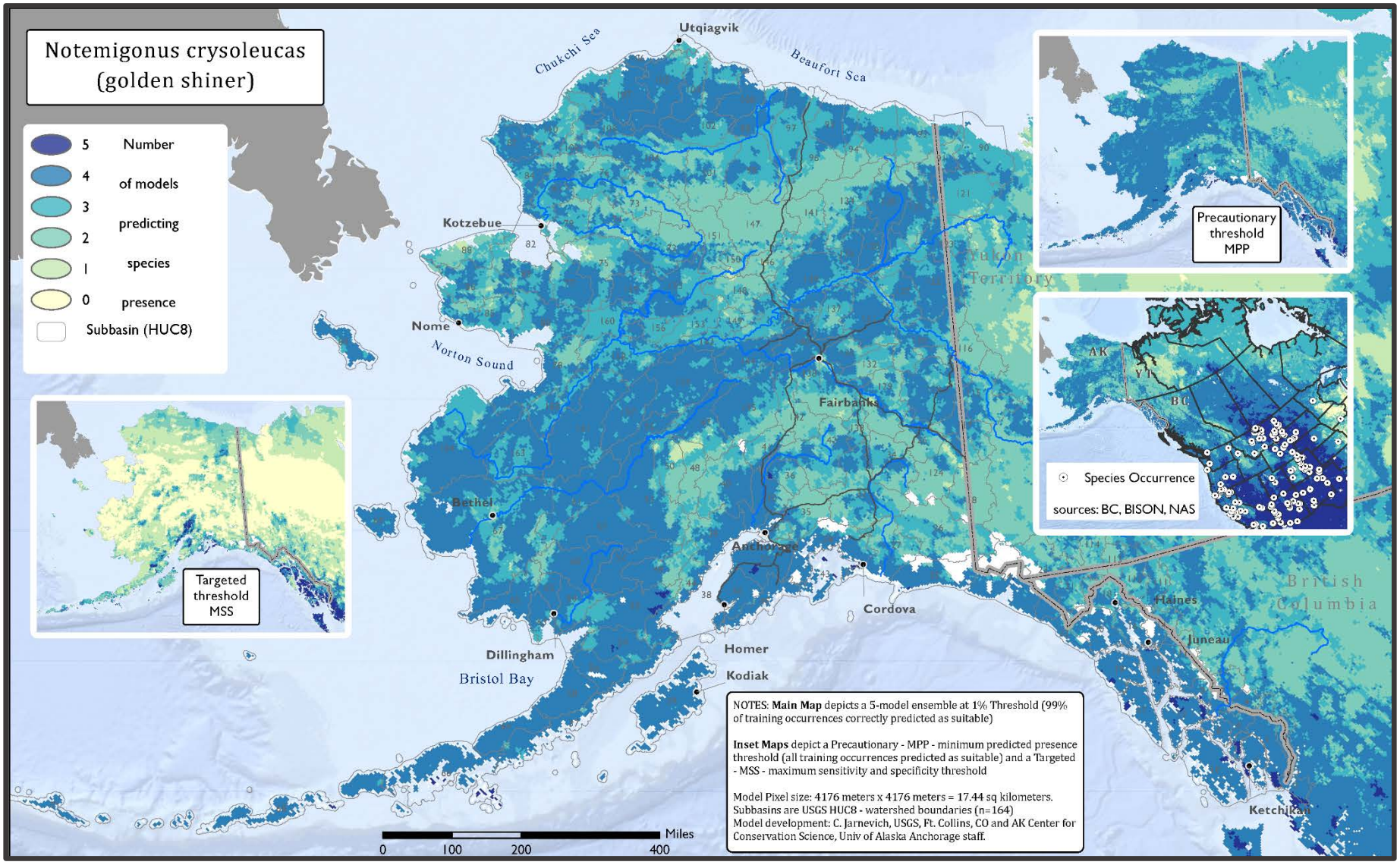
Data Sources:

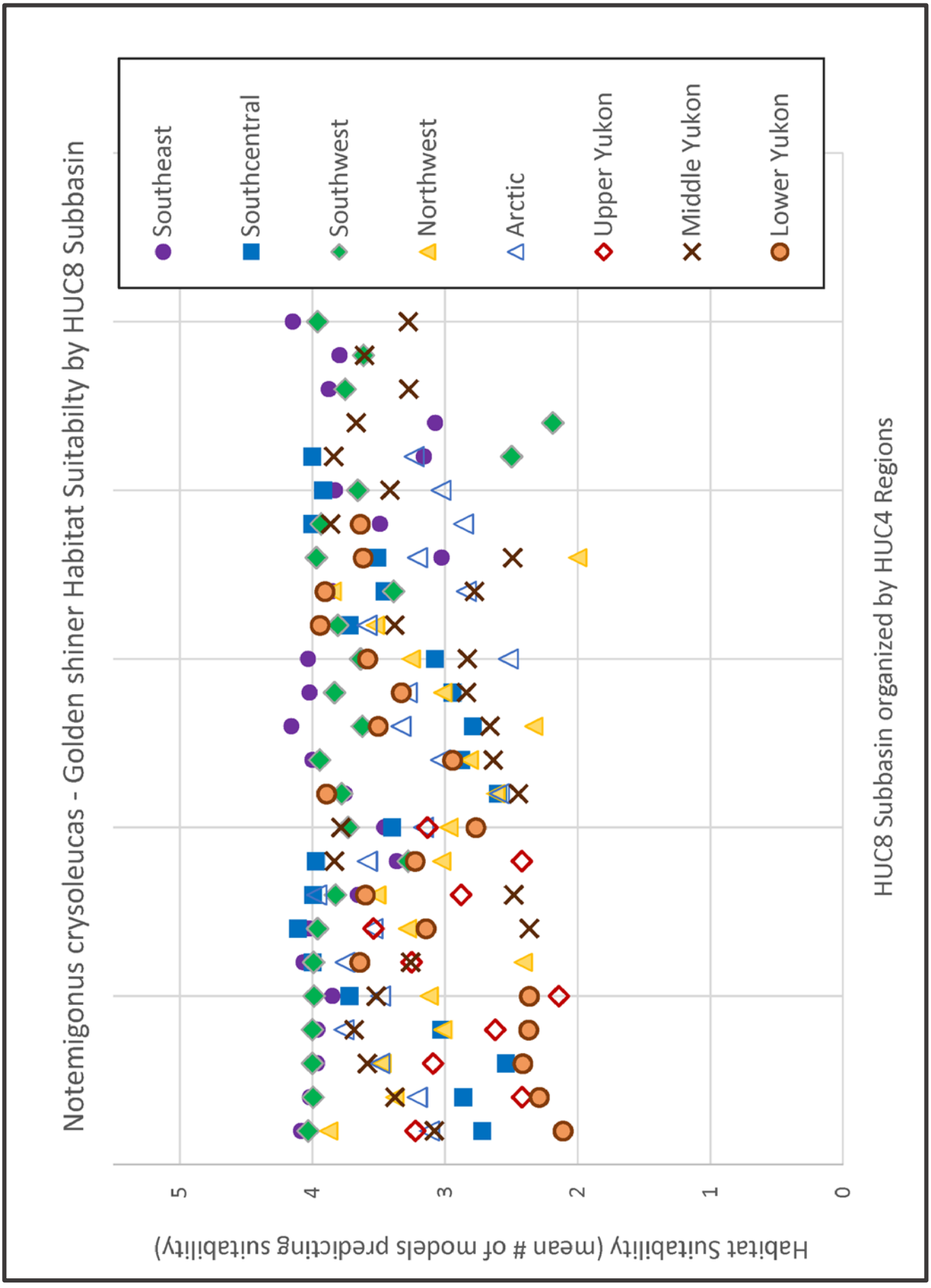
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

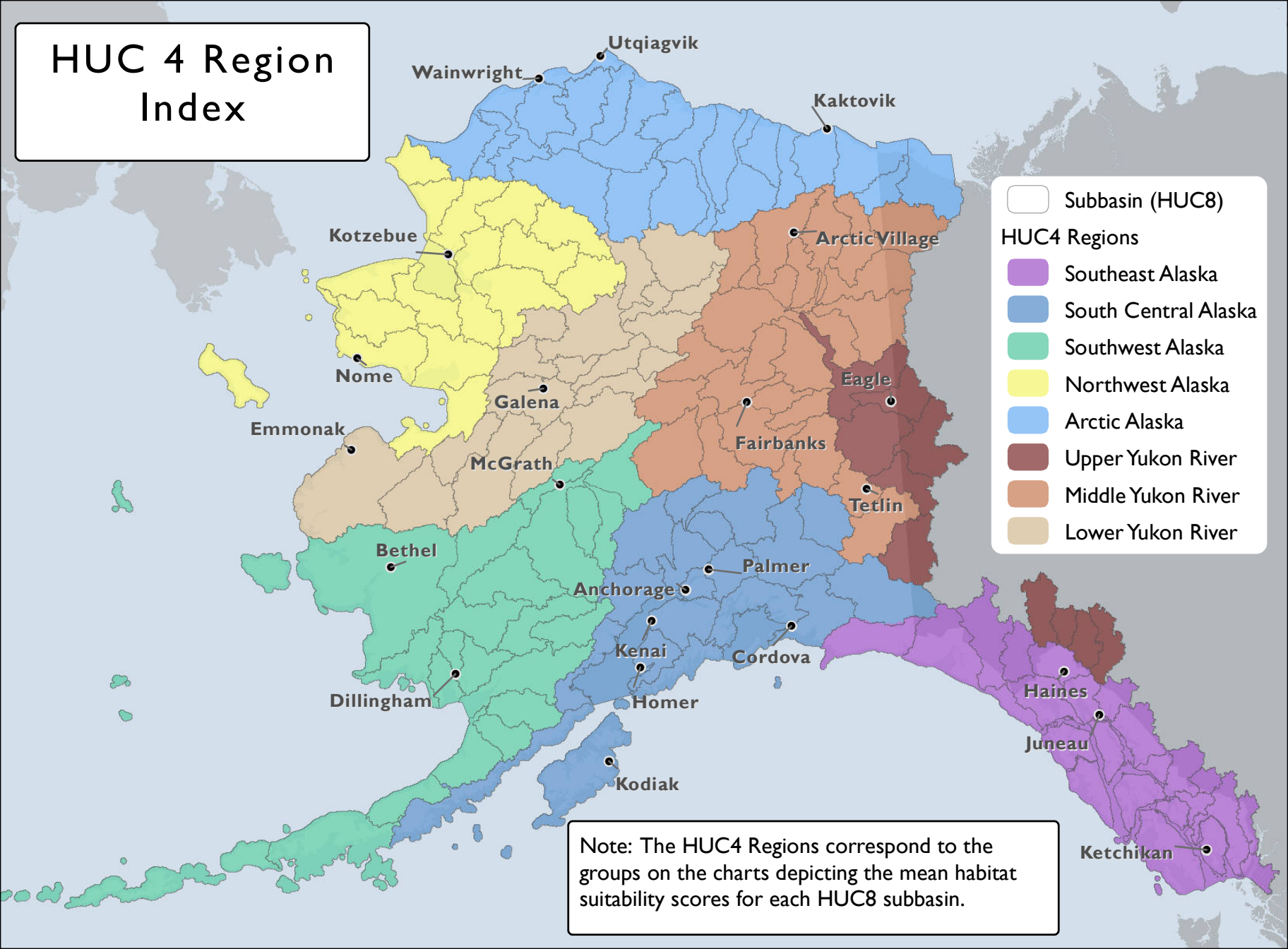
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Notemigonus crysoleucas
(golden shiner)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
Yukon Territory
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Miles
0
100
200
400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Notemigonus crysoleucas - Golden shiner Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
5
4
3
2
1
0
Habitat Suitability (mean # of models predicting suitability)
HUC8 Subbasin organized by HUC4 Regions

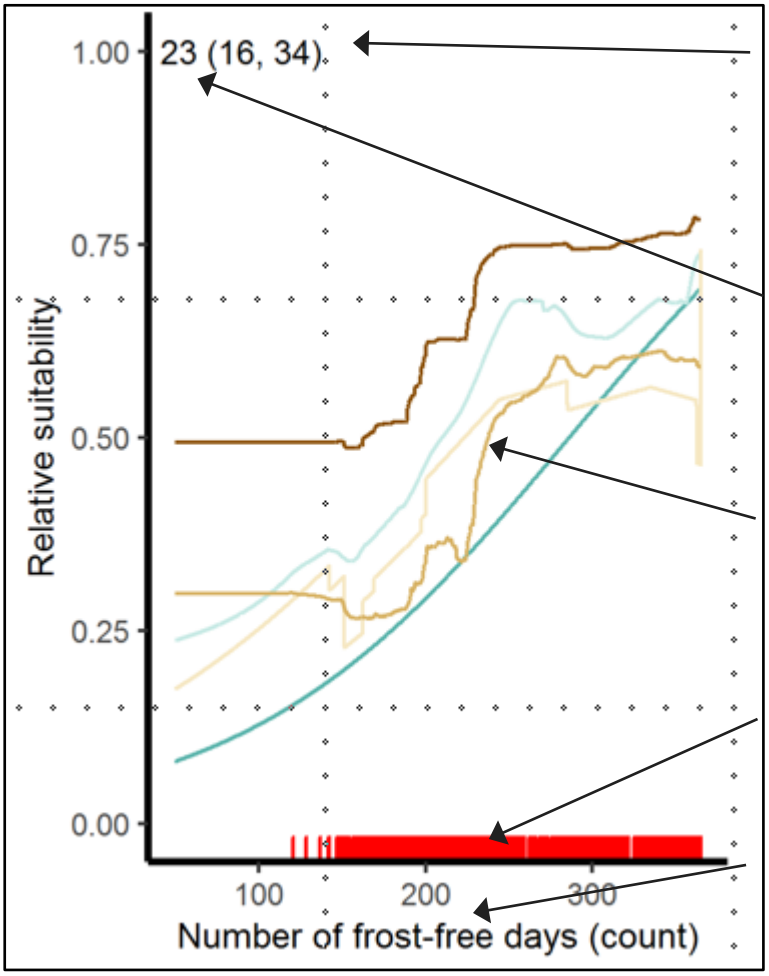
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

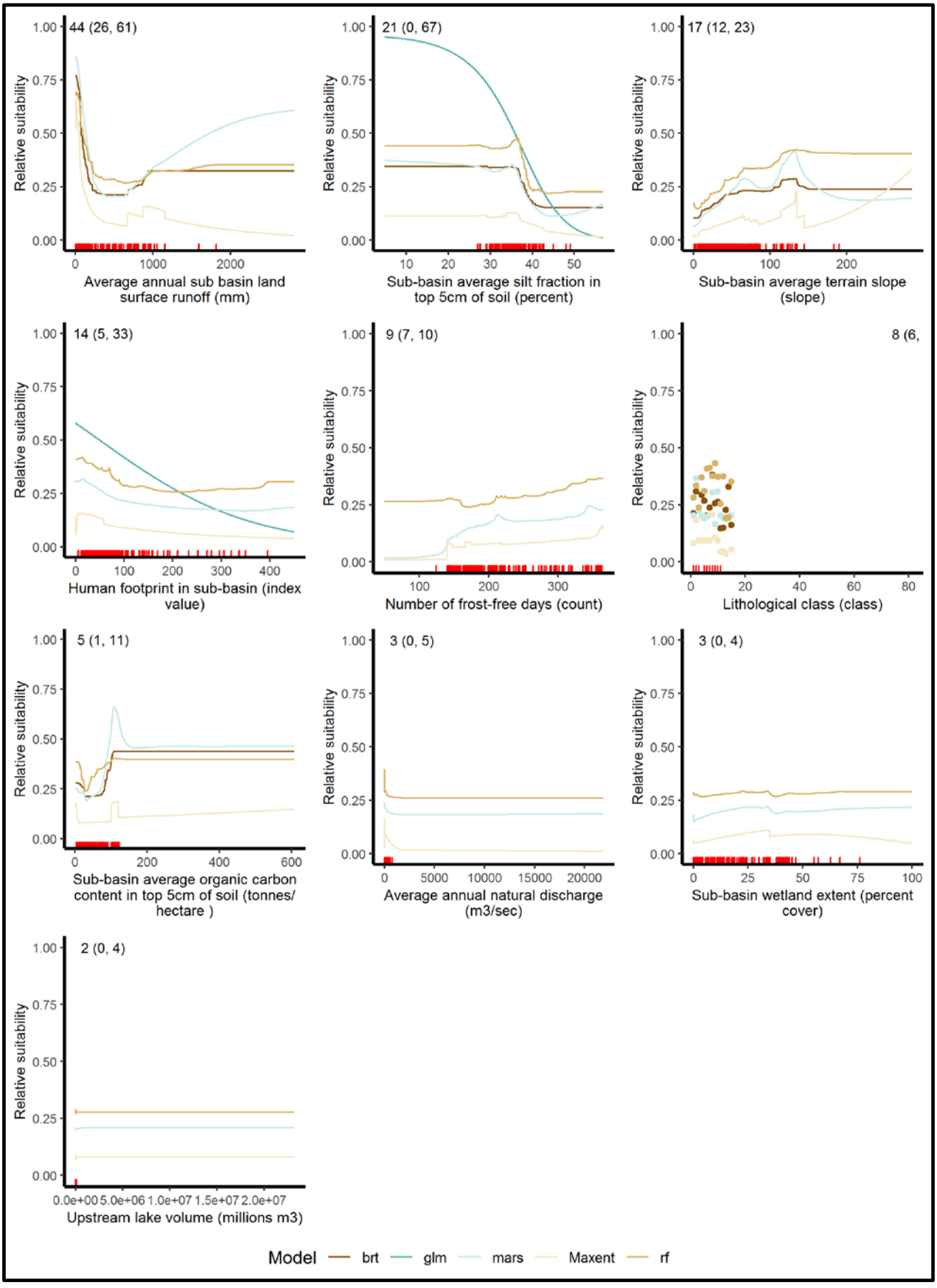
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


44 (26, 61)
Average annual sub basin land surface runoff (mm)
21 (0, 67)
Sub-basin average silt fraction in top 5cm of soil (percent)
17 (12, 23)
Sub-basin average terrain slope (slope)
14 (5, 33)
Human footprint in sub-basin (index value)
9 (7, 10)
Number of frost-free days (count)
8 (6,
Lithological class (class)
5 (1, 11)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
3 (0, 5)
Average annual natural discharge (m3/sec)
3 (0, 4)
Sub-basin wetland extent (percent cover)
2 (0, 4)
Upstream lake volume (millions m3)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Pacifastacus leniusculus** *Common Name* **Signal Crayfish**

Alaska Occurrence Records: species occurrences found in Alaska - **25**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **32**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Crustacean

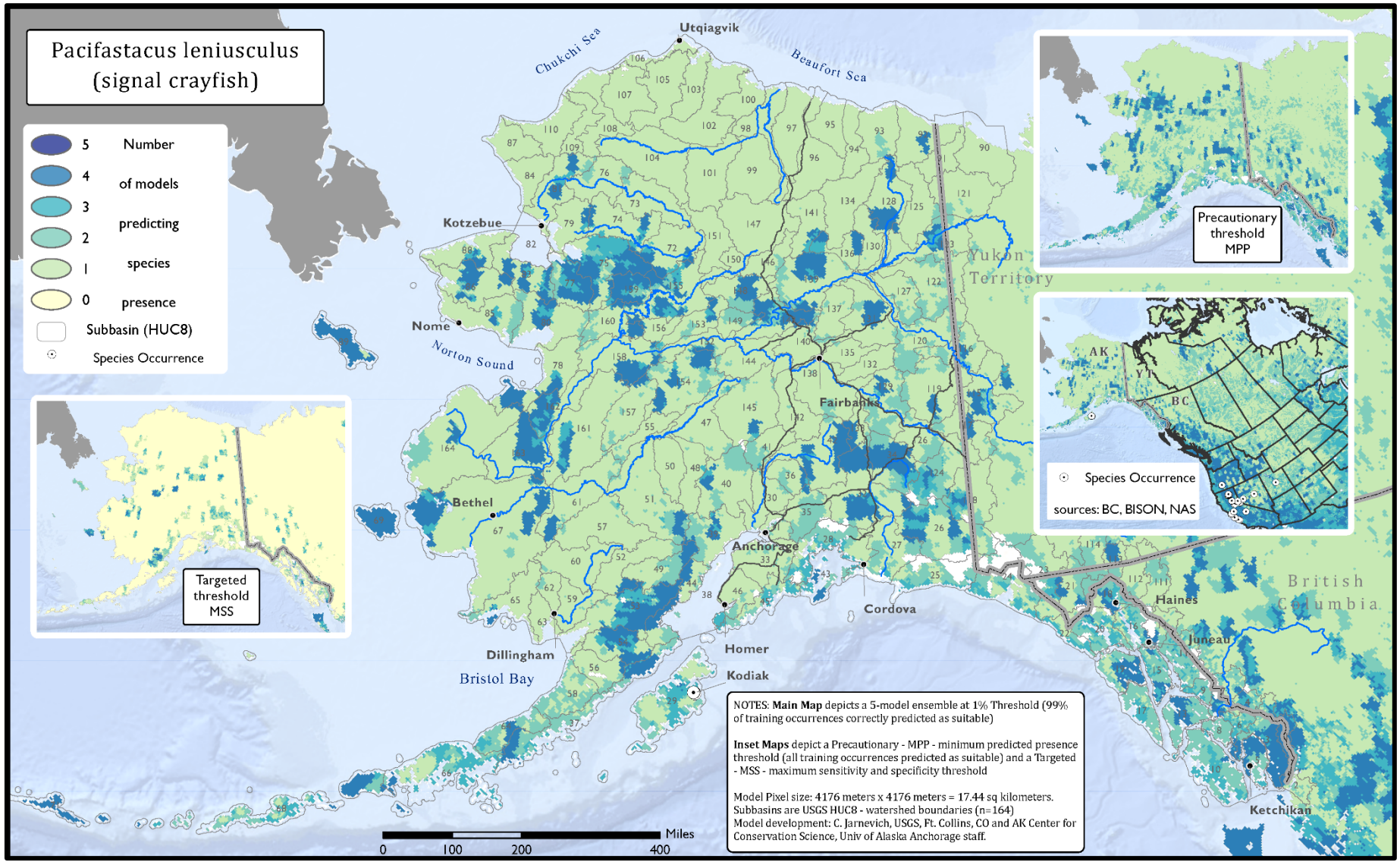
Data Sources:

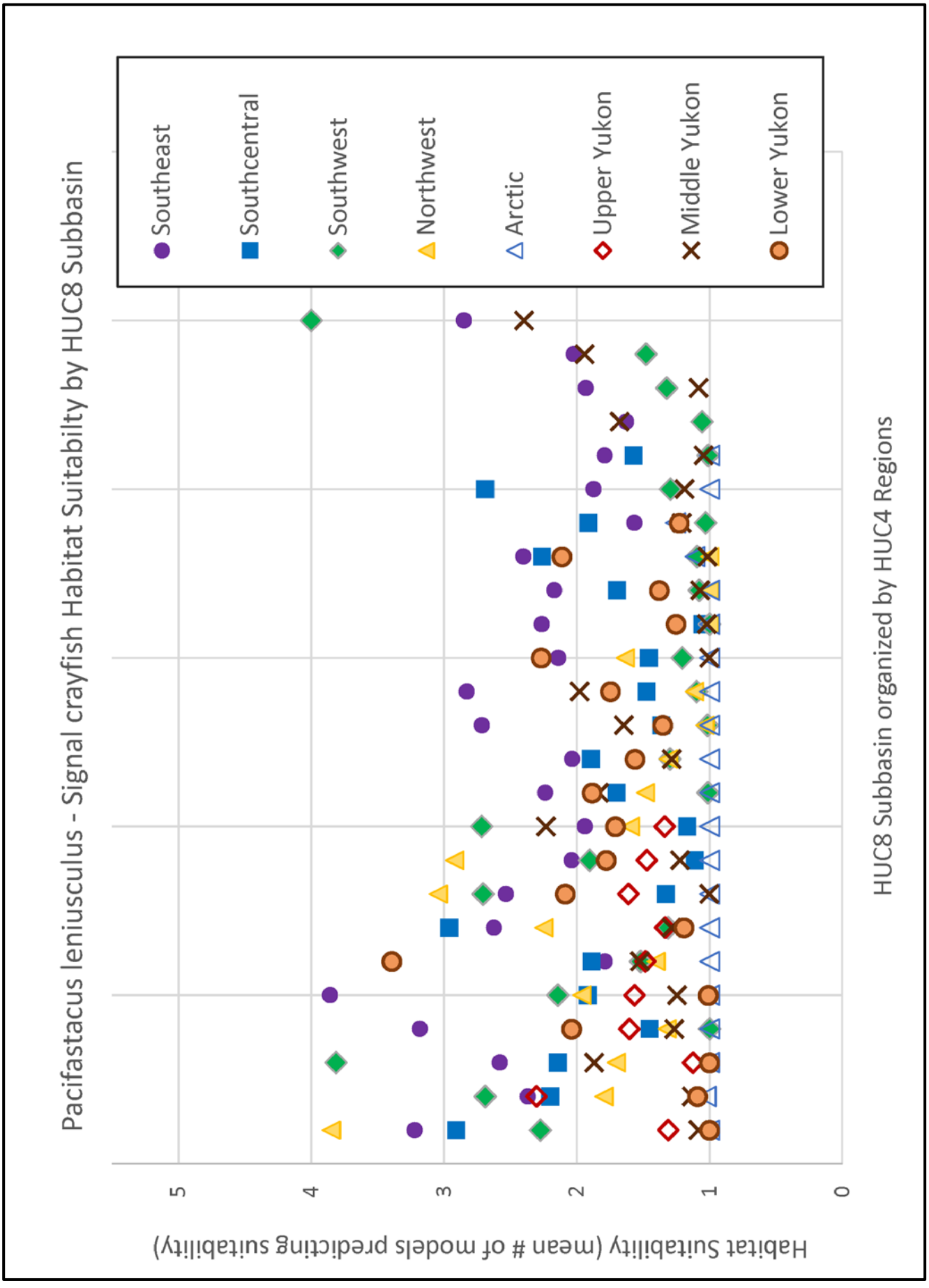
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

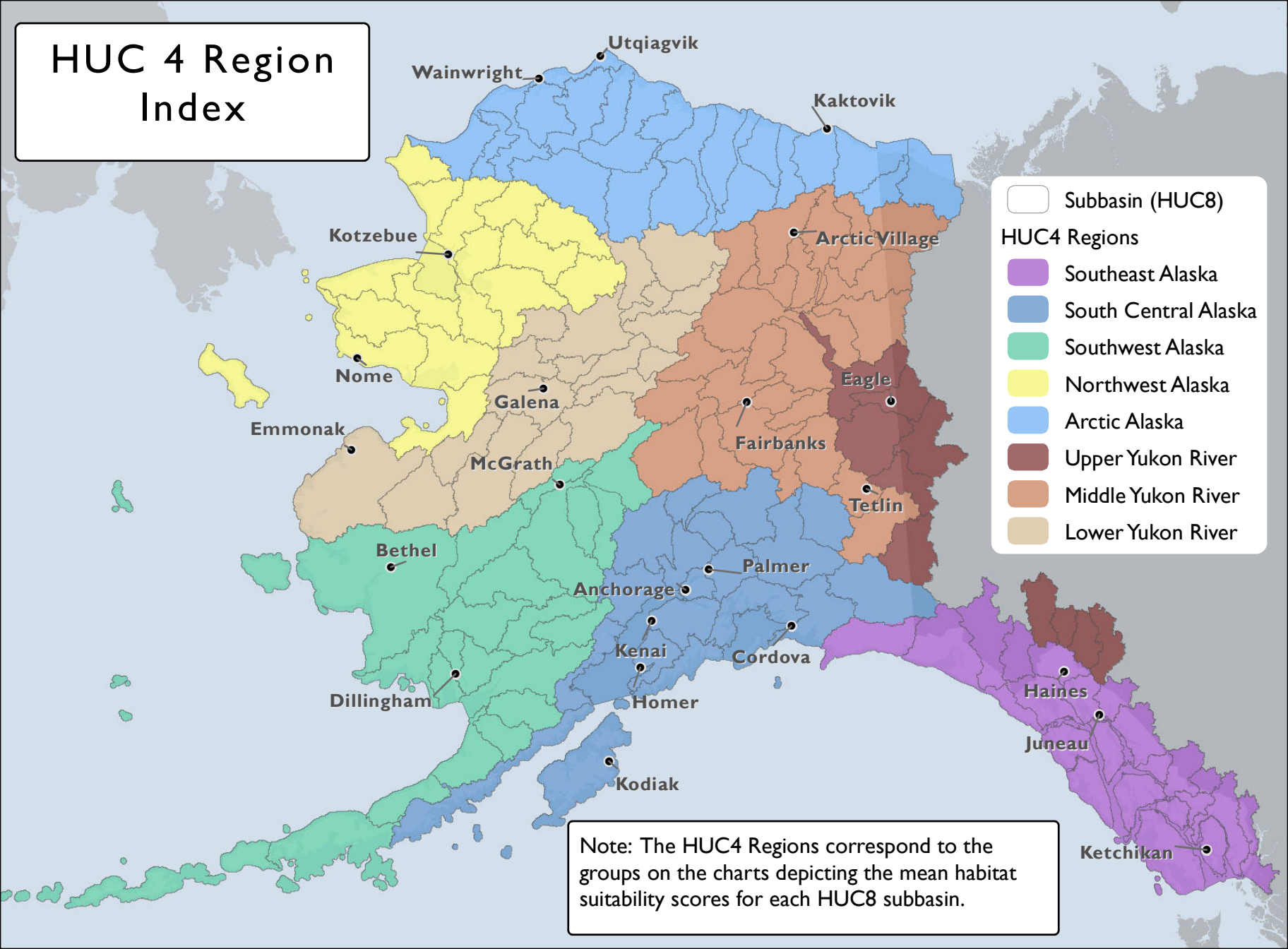
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Pacifastacus leniusculus
(signal crayfish)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Species Occurrence
Targeted threshold MSS
Precautionary threshold MPP
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Haines
Juneau
Ketchikan
British Columbia
Dillingham
Bristol Bay
Homer
Kodiak
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Pacifastacus leniusculus - Signal crayfish Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

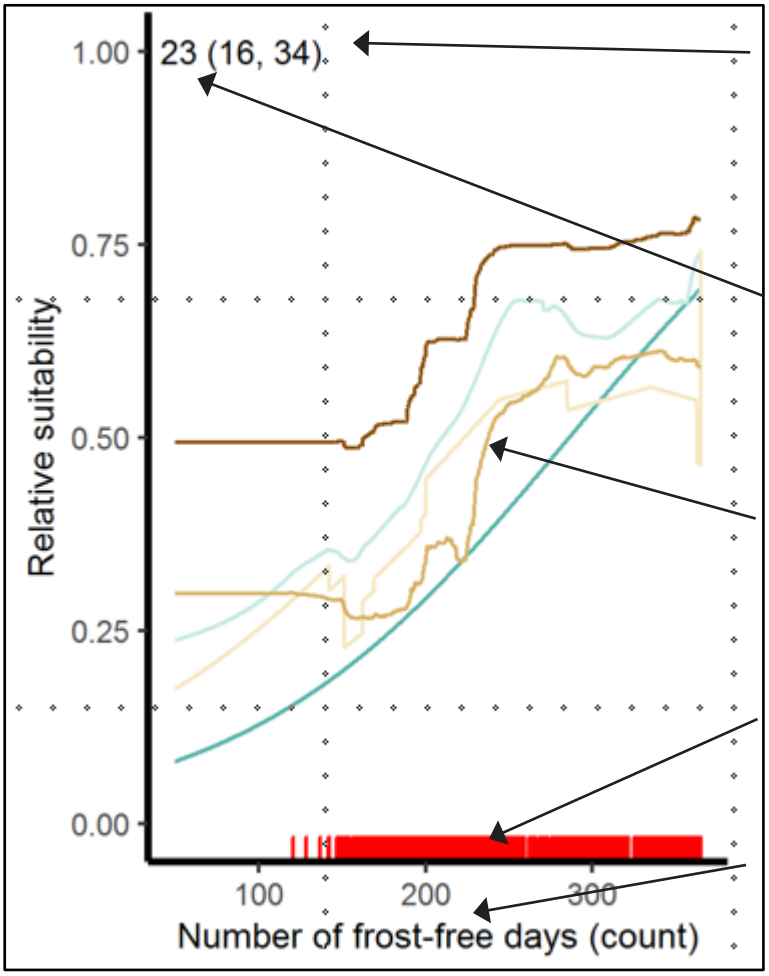
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

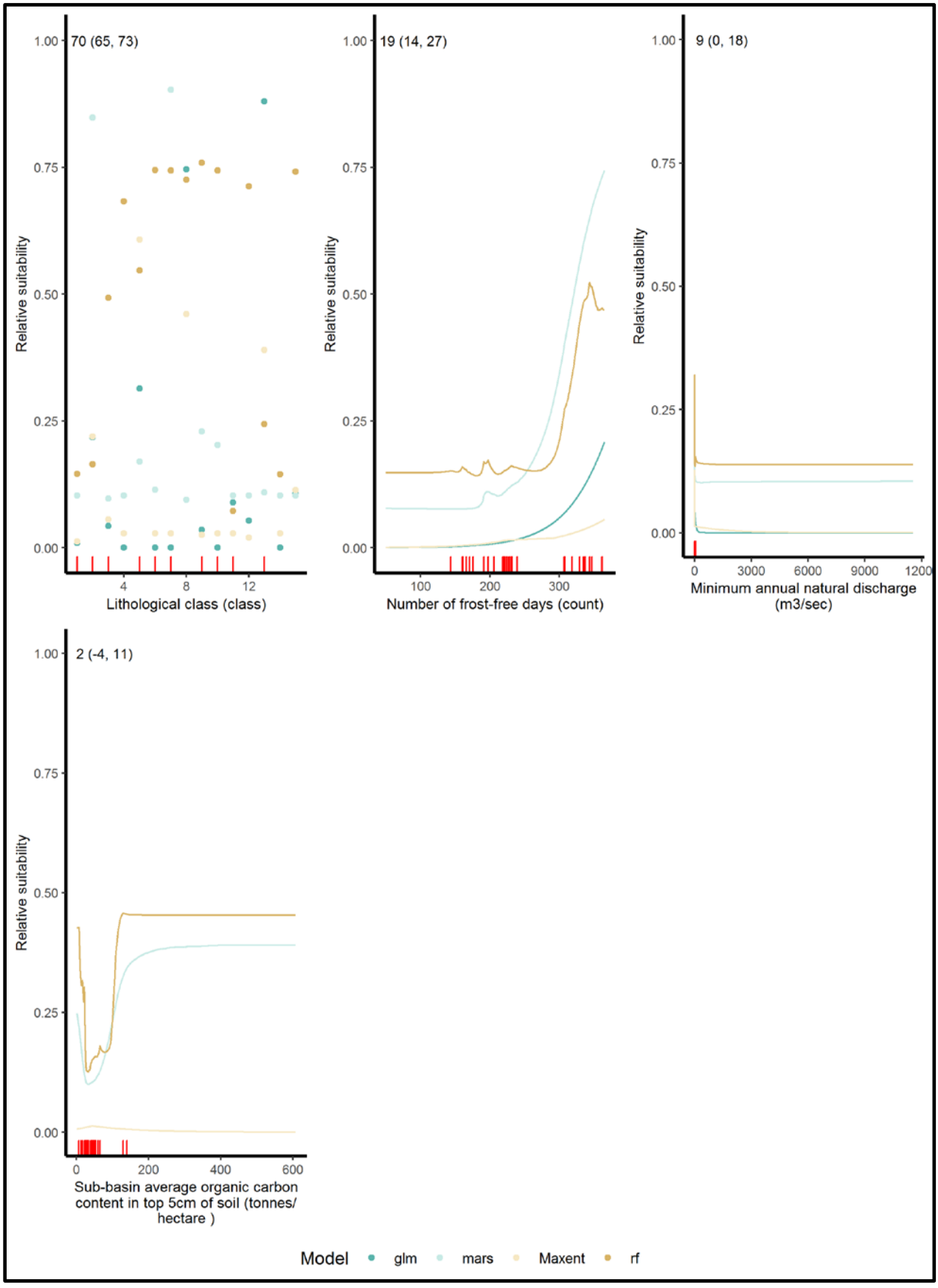
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


70 (65, 73)
19 (14, 27)
9 (0, 18)
2 (-4, 11)
Relative suitability
1.00
0.75
0.50
0.25
0.00
Lithological class (class)
Number of frost-free days (count)
Minimum annual natural discharge (m3/sec)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Model
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Pectinatella magnifica** *Common* **Magnificent Bryozoan**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **123**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Invertebrate

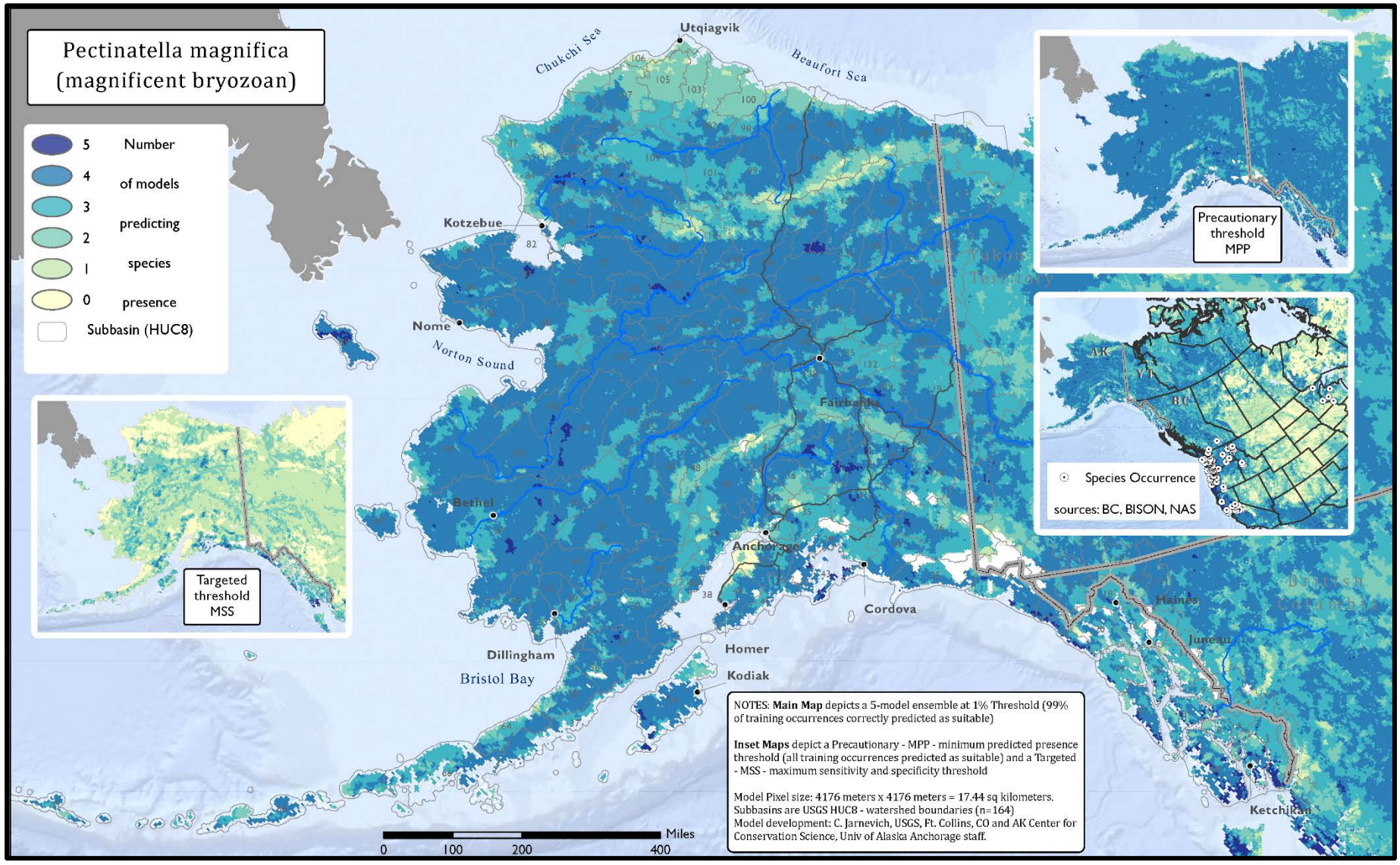
Data Sources:

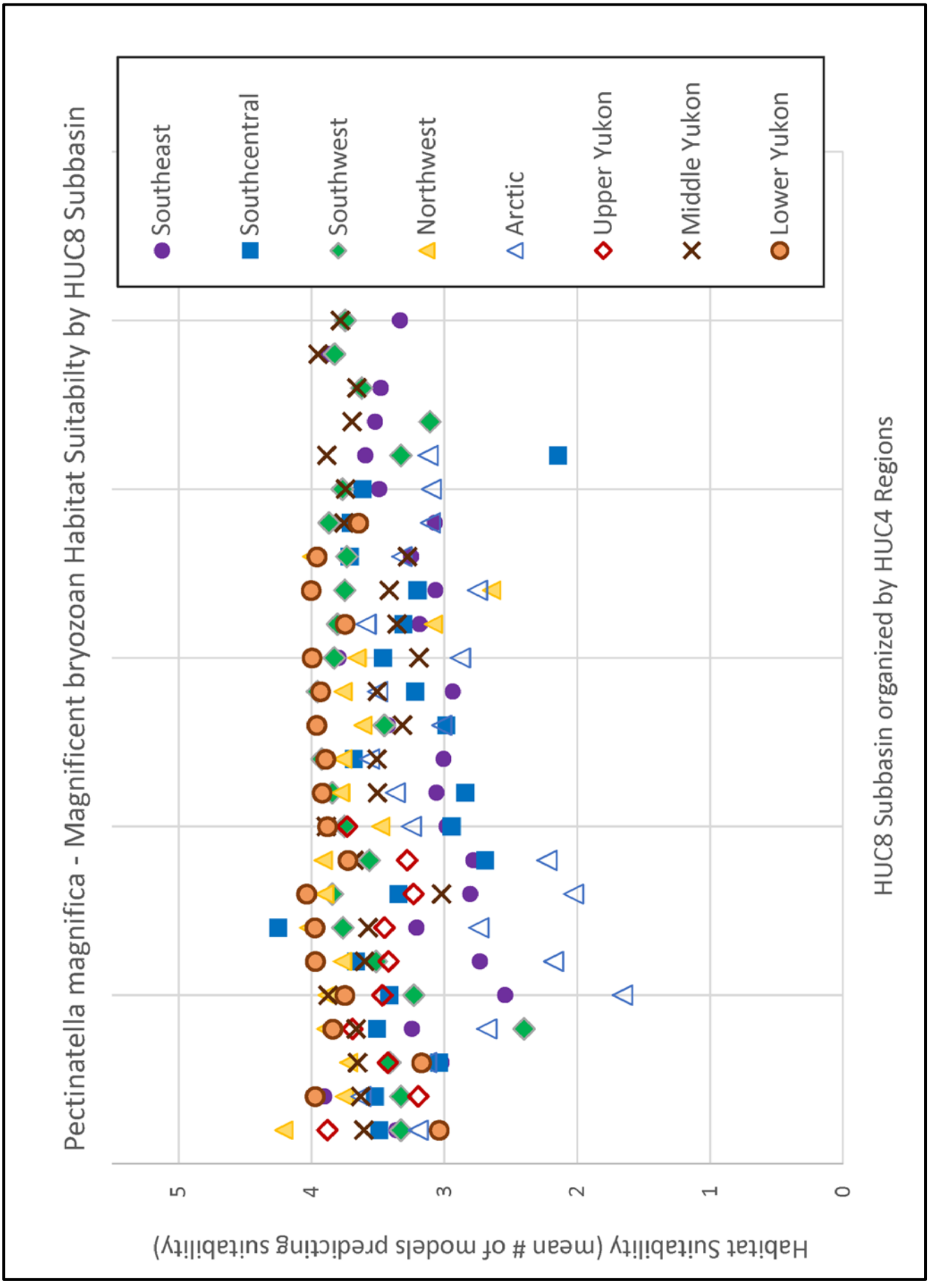
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

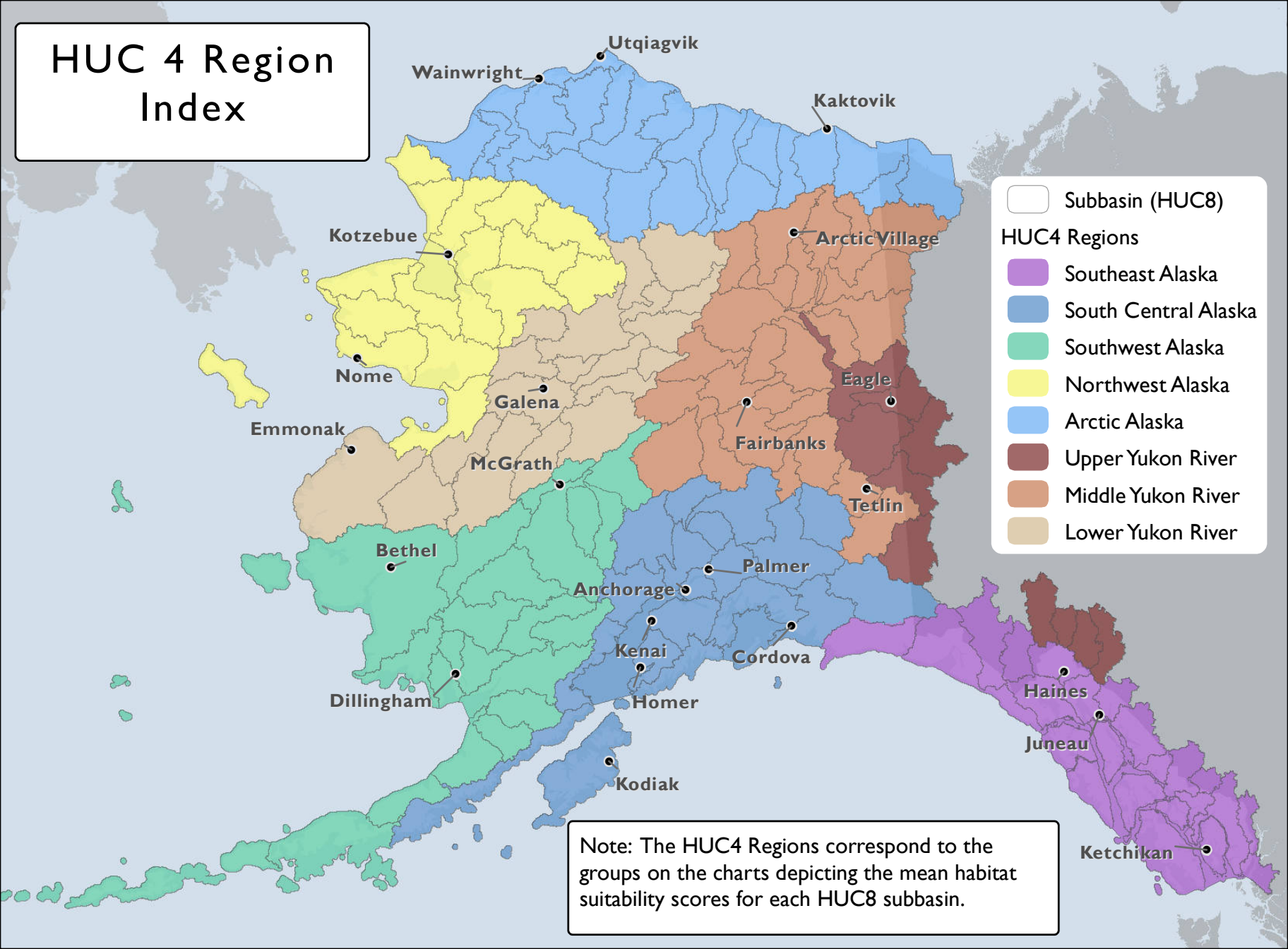
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Pectinatella magnifica
(magnificent bryozoan)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
Yukon Territory
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Pectinatella magnifica - Magnificent bryozoan Habitat Suitability by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

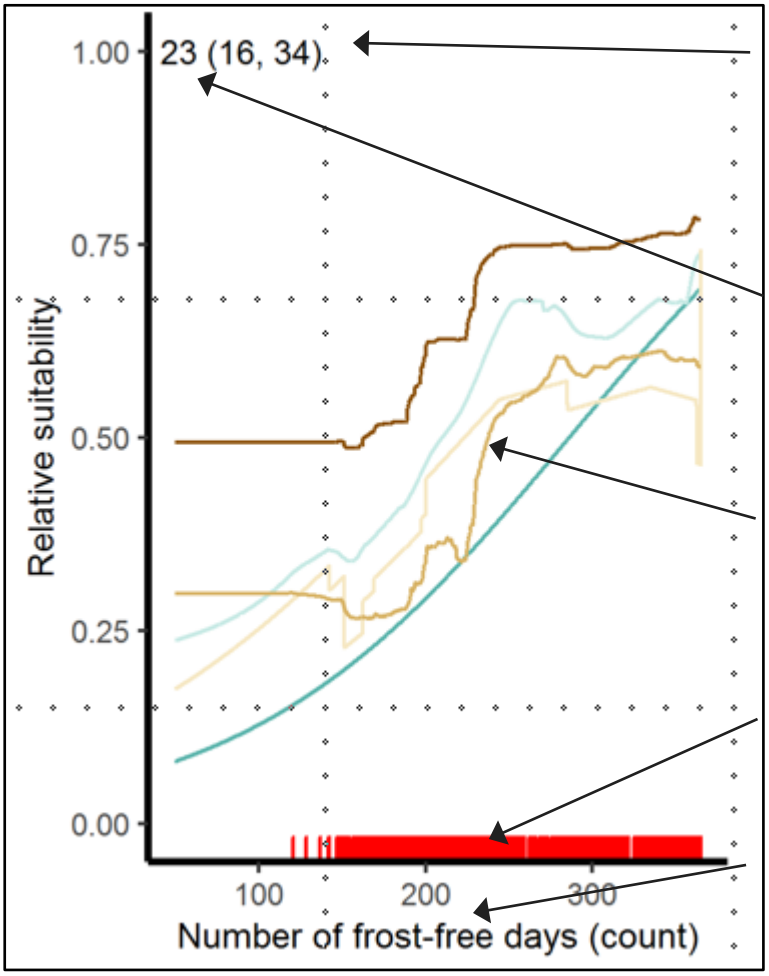
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

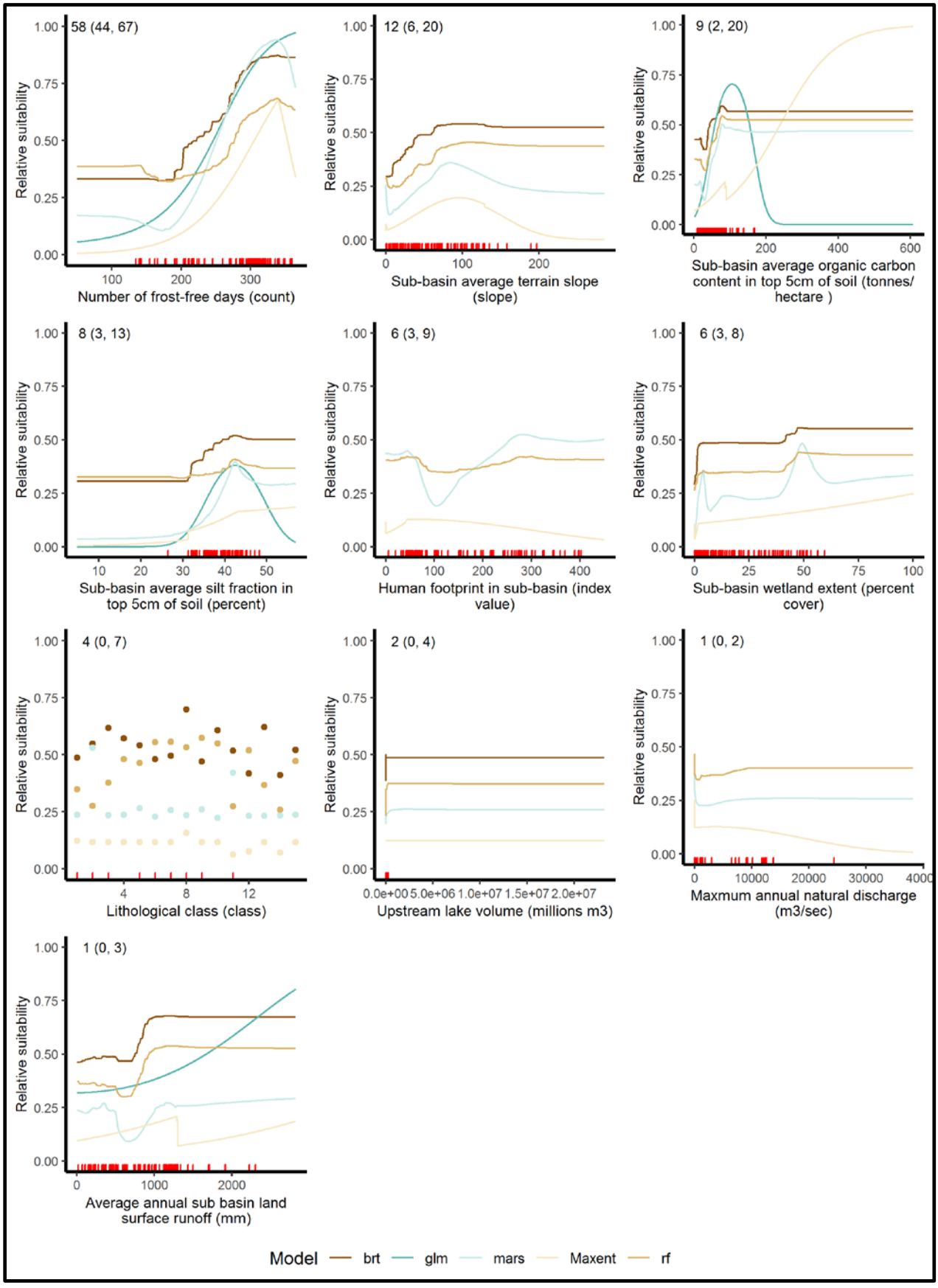
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


58 (44, 67)
Relative suitability
Number of frost-free days (count)
12 (6, 20)
Sub-basin average terrain slope (slope)
9 (2, 20)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
8 (3, 13)
Sub-basin average silt fraction in top 5cm of soil (percent)
6 (3, 9)
Human footprint in sub-basin (index value)
6 (3, 8)
Sub-basin wetland extent (percent cover)
4 (0, 7)
Lithological class (class)
2 (0, 4)
Upstream lake volume (millions m3)
1 (0, 2)
Maxmum annual natural discharge (m3/sec)
1 (0, 3)
Average annual sub basin land surface runoff (mm)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Perca flavescens** *Common Name* **Yellow Perch**

Alaska Occurrence Records: species occurrences found in Alaska - **1**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **2543**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

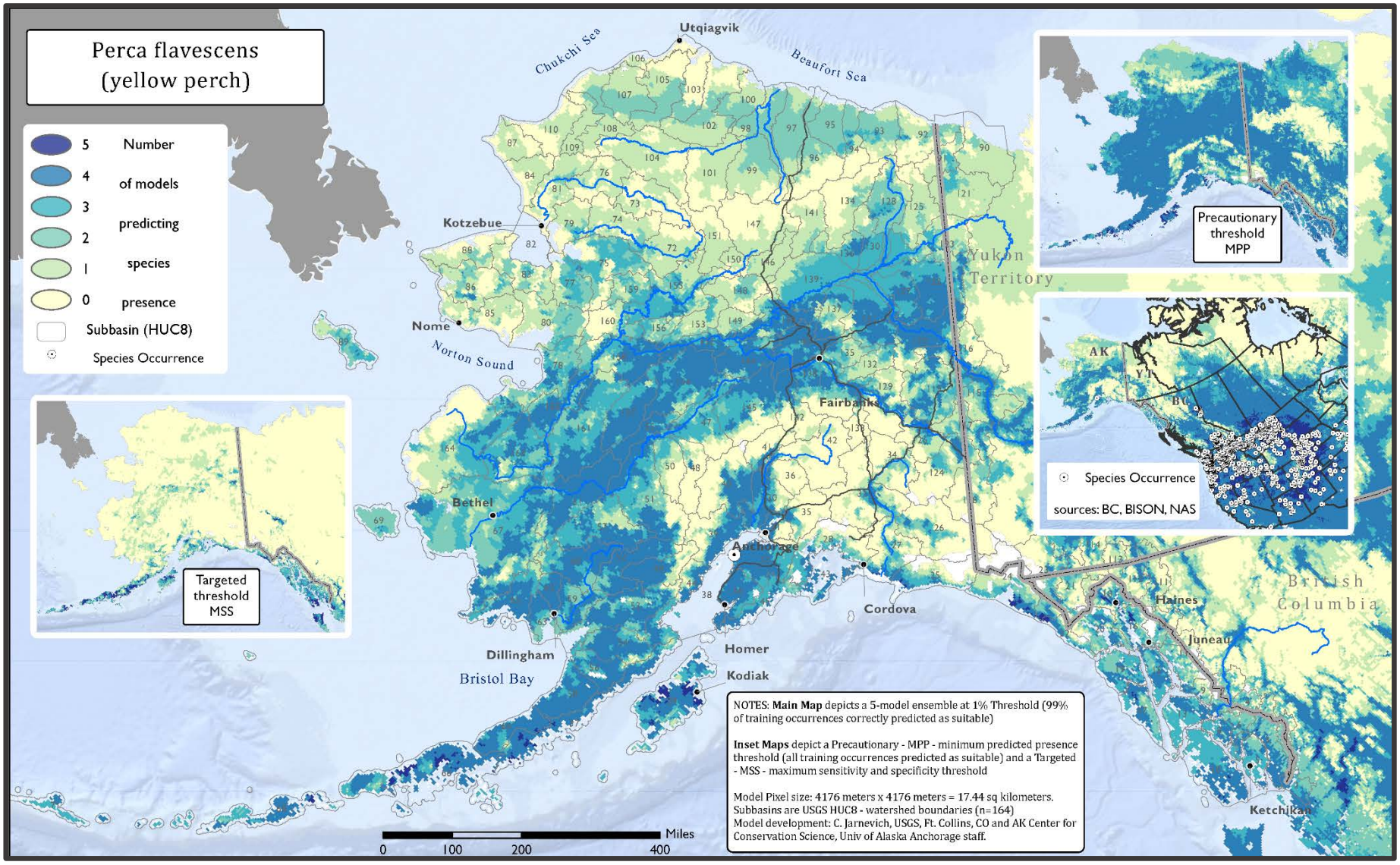
Data Sources:

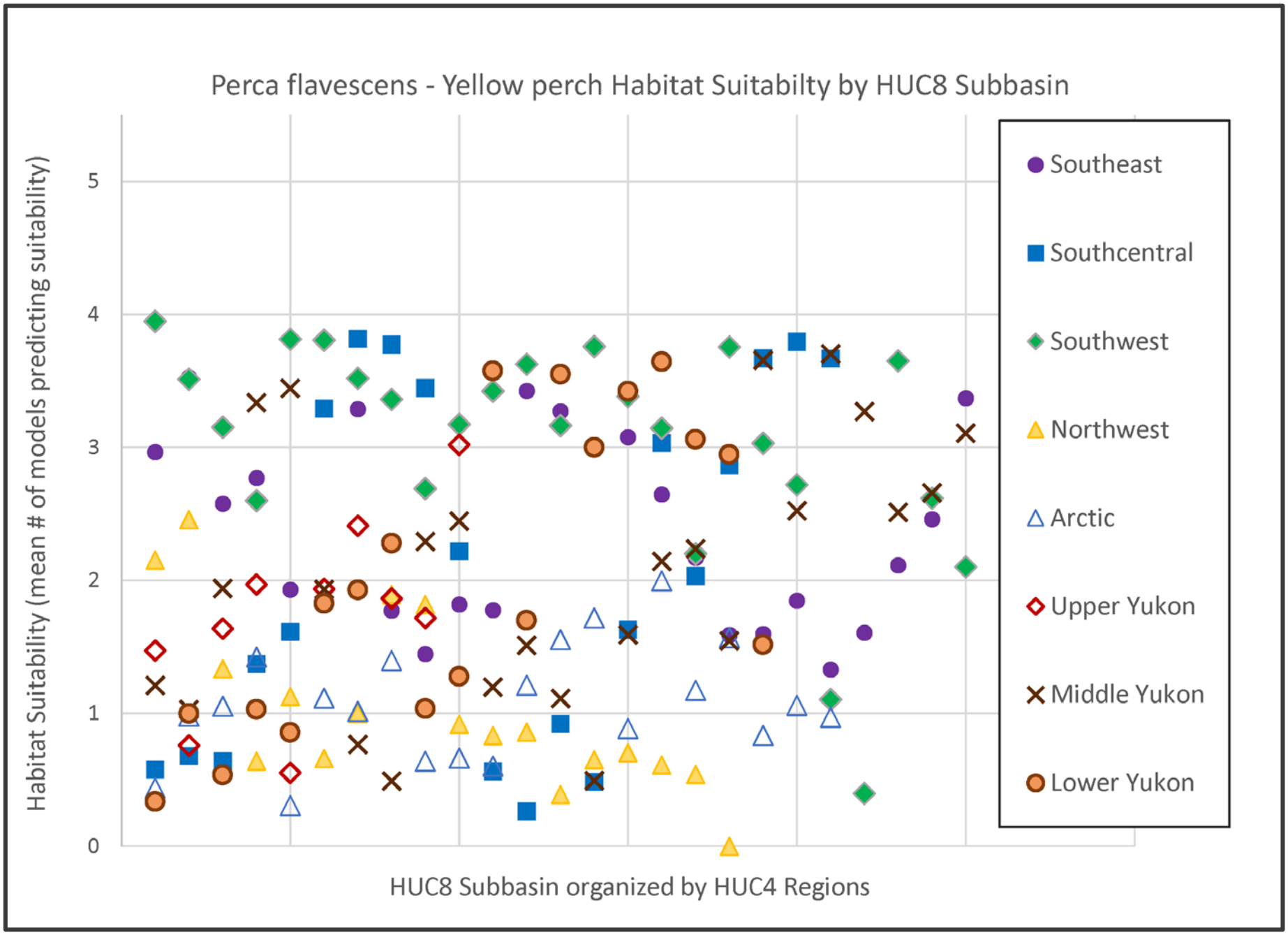
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

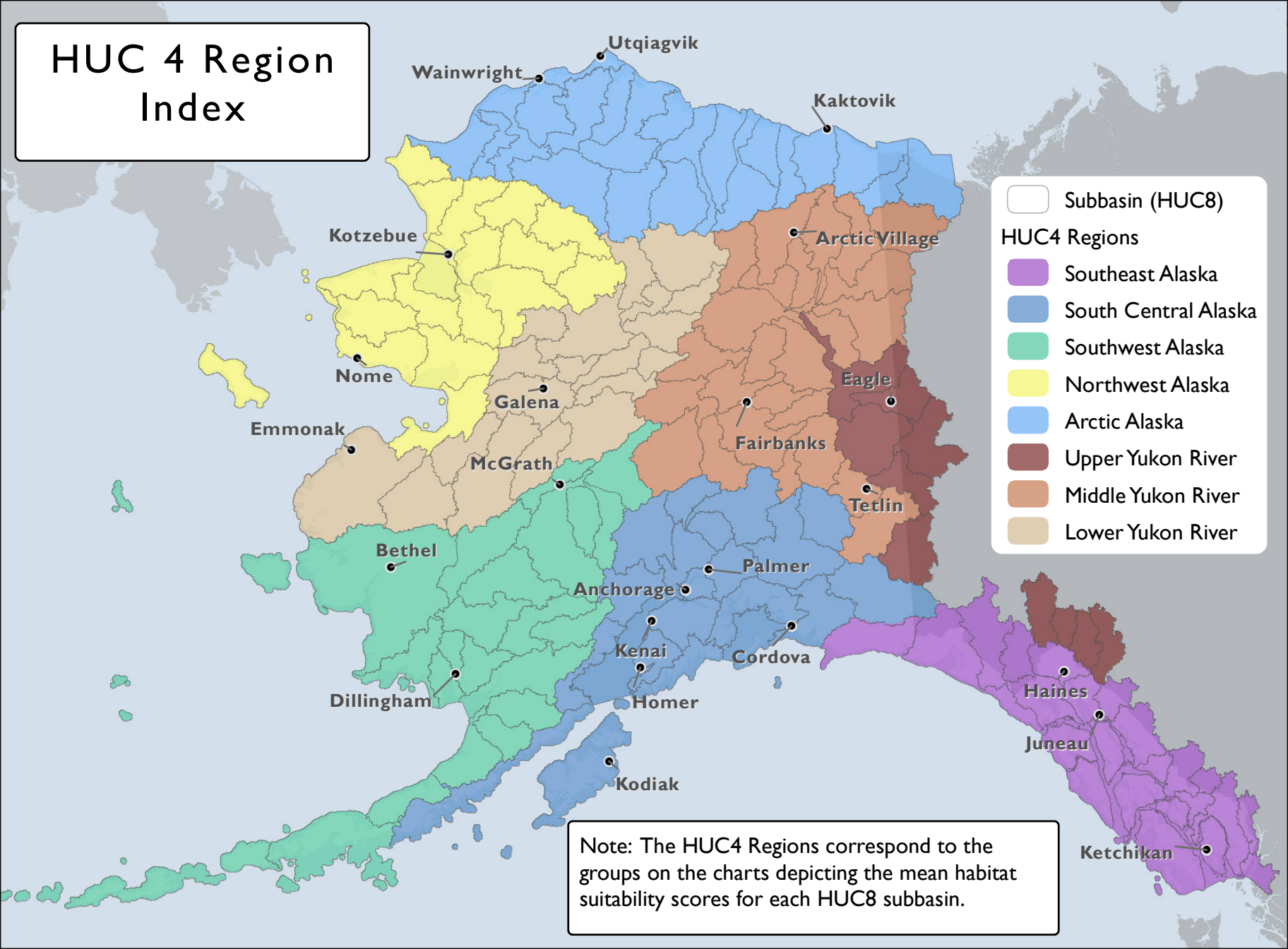
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Perca flavescens
(yellow perch)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Species Occurrence
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon
Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British
Columbia
Precautionary
threshold
MPP
Targeted
threshold
MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0
100
200
400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Perca flavescens - Yellow perch Habitat Suitabilty by HUC8 Subbasin
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon

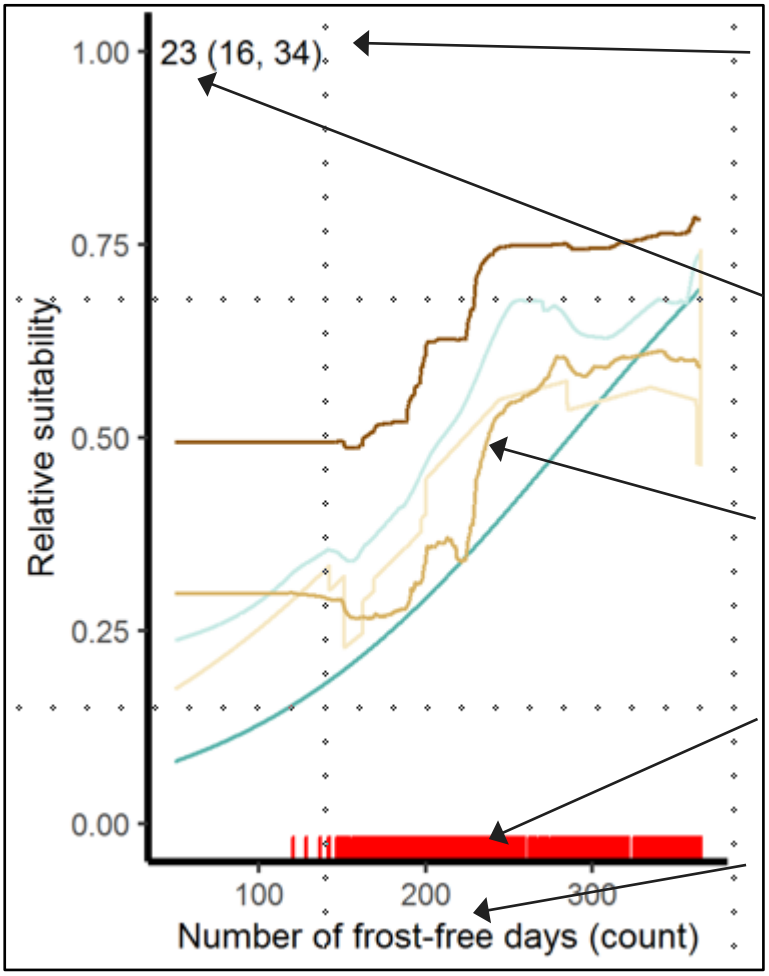
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

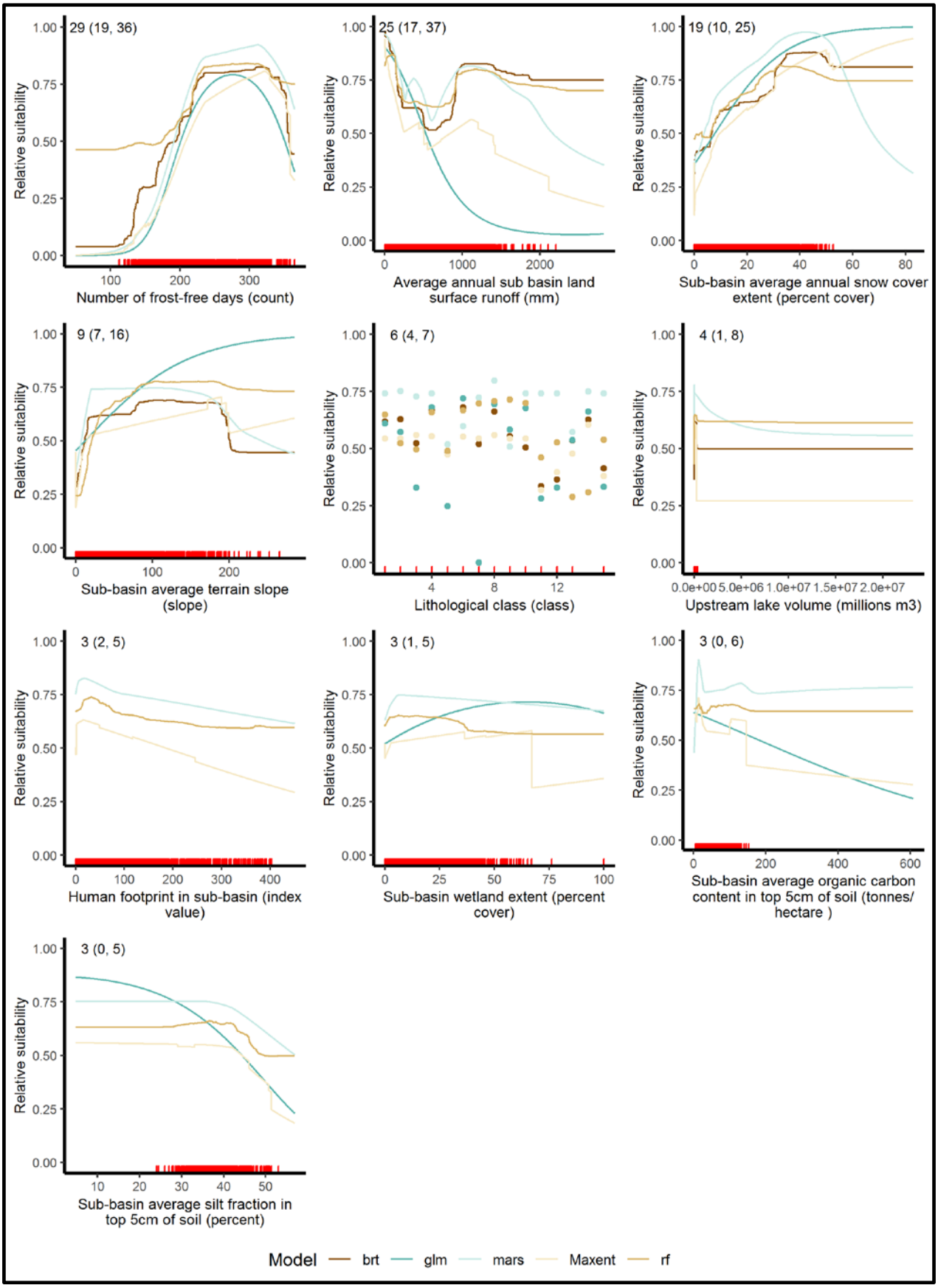
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


29 (19, 36)
Number of frost-free days (count)
25 (17, 37)
Average annual sub basin land surface runoff (mm)
19 (10, 25)
Sub-basin average annual snow cover extent (percent cover)
9 (7, 16)
Sub-basin average terrain slope (slope)
6 (4, 7)
Lithological class (class)
4 (1, 8)
Upstream lake volume (millions m3)
3 (2, 5)
Human footprint in sub-basin (index value)
3 (1, 5)
Sub-basin wetland extent (percent cover)
3 (0, 6)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
3 (0, 5)
Sub-basin average silt fraction in top 5cm of soil (percent)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Pimephales promelas** *Common Name* **Fathead Minnow**

Alaska Occurrence Records: species occurrences found in Alaska - **1**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **506**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **High**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

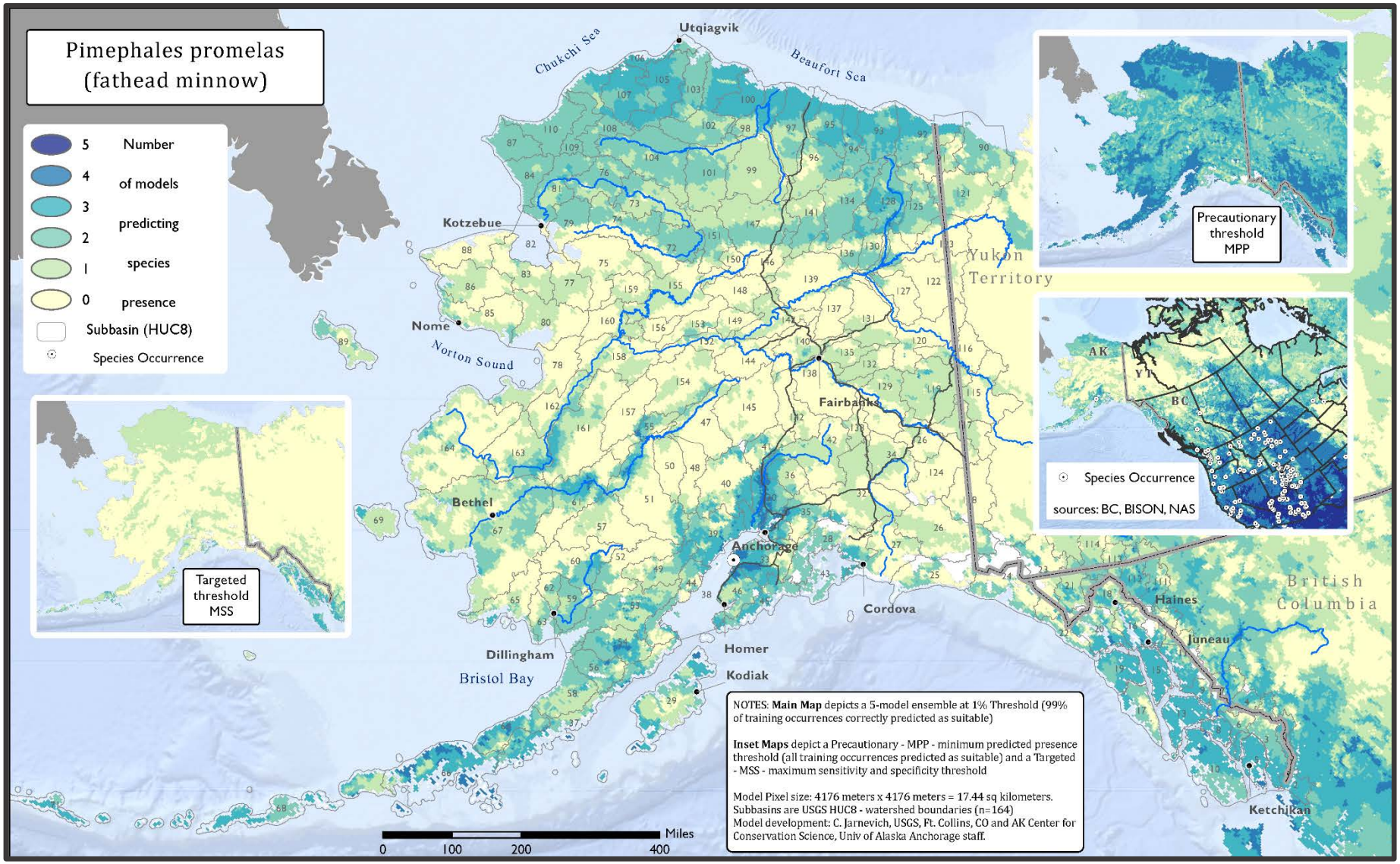
Data Sources:

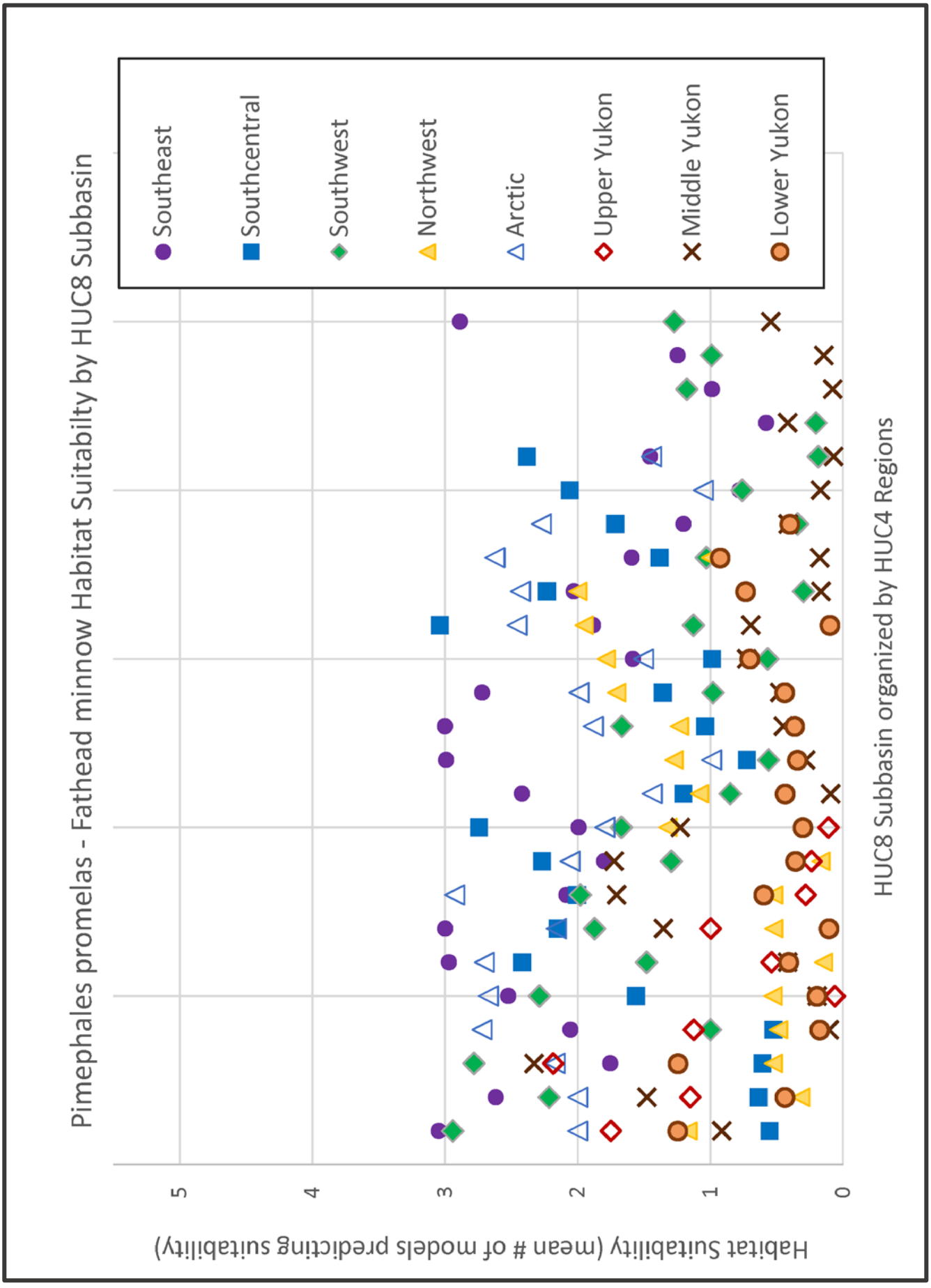
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

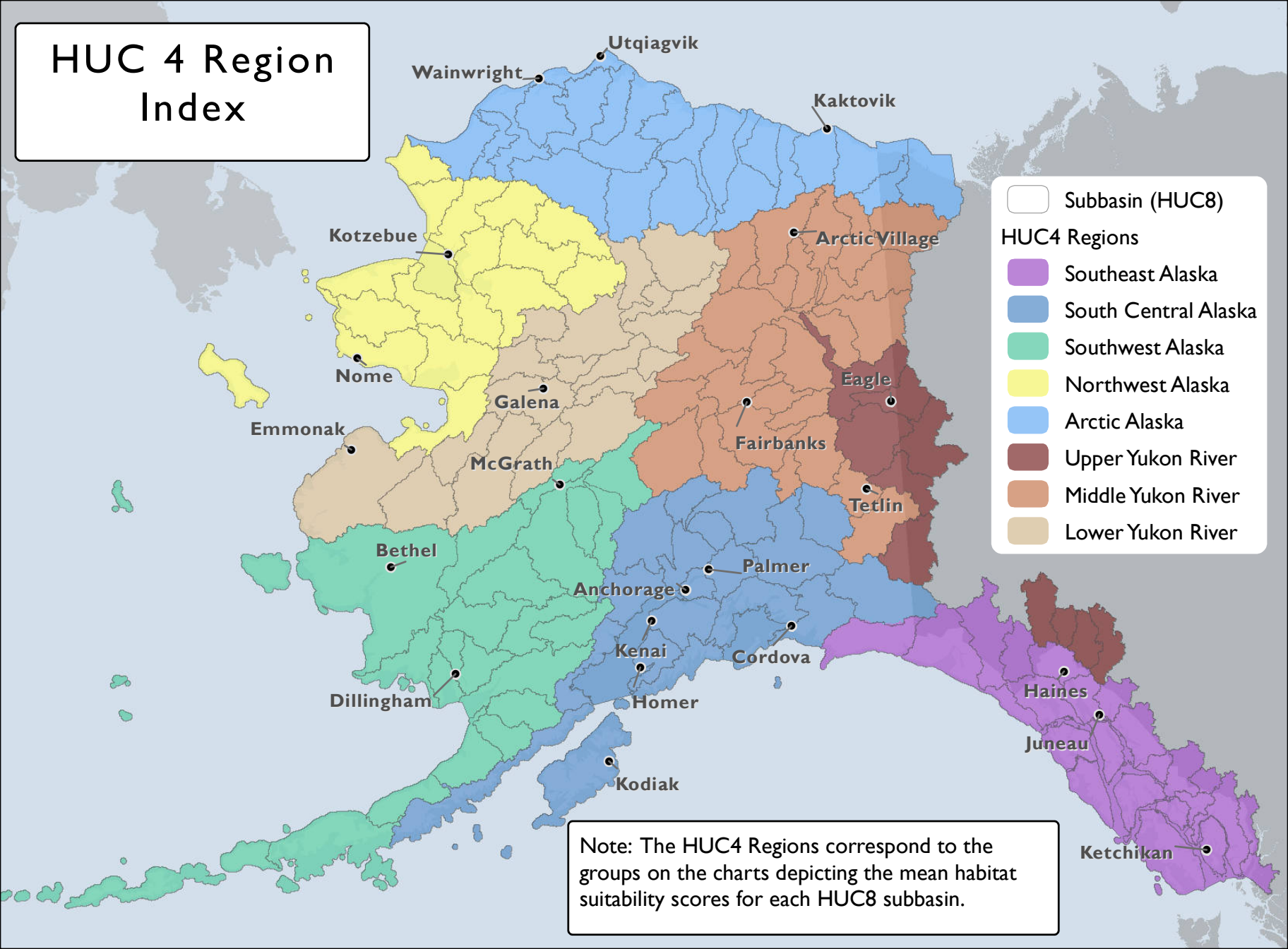
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Pimephales promelas
(fathead minnow)
5
4
3
2
1
0
Number
of models
predicting
species
presence
Subbasin (HUC8)
Species Occurrence
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon
Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British
Columbia
Precautionary
threshold
MPP
Targeted
threshold
MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0
100
200
400


Pimephales promelas - Fathead minnow Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

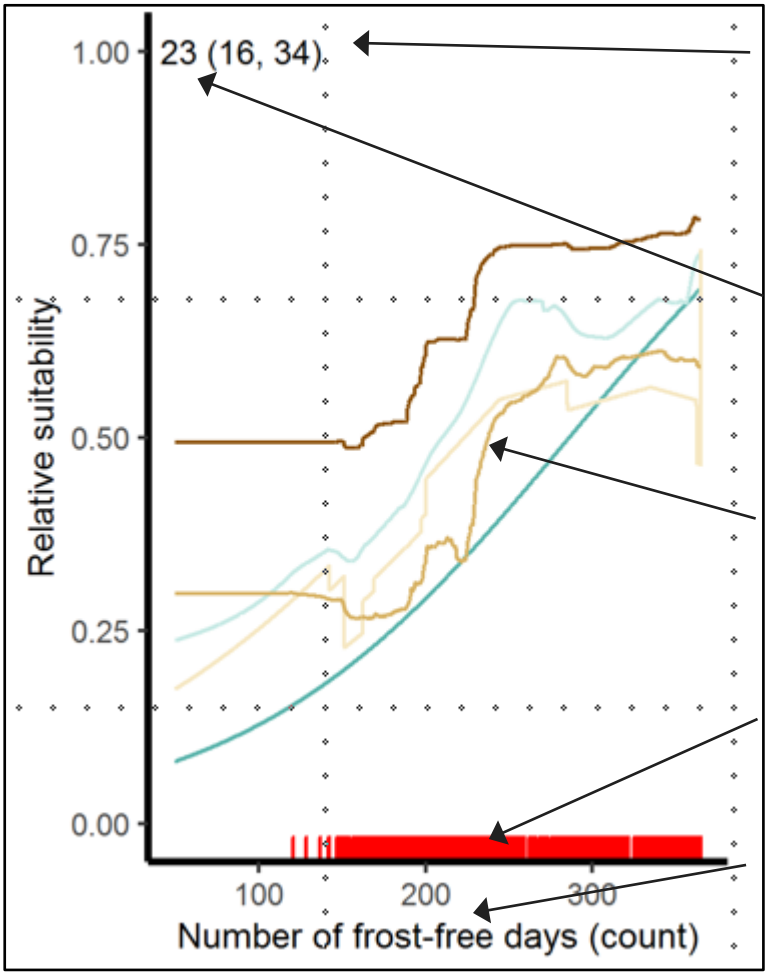
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

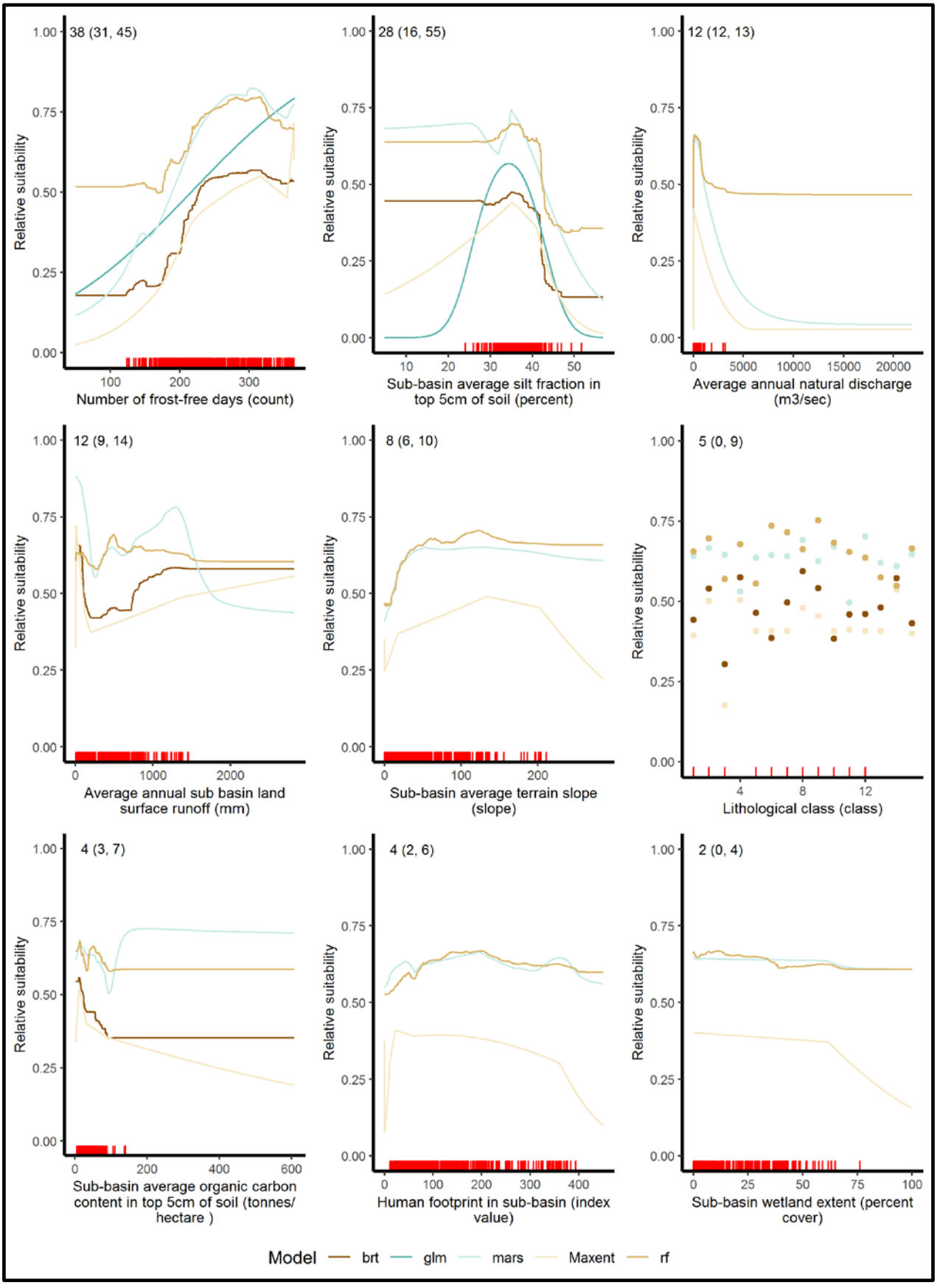
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


38 (31, 45)
Relative suitability
Number of frost-free days (count)
28 (16, 55)
Sub-basin average silt fraction in top 5cm of soil (percent)
12 (12, 13)
Average annual natural discharge (m3/sec)
12 (9, 14)
Average annual sub basin land surface runoff (mm)
8 (6, 10)
Sub-basin average terrain slope (slope)
5 (0, 9)
Lithological class (class)
4 (3, 7)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
4 (2, 6)
Human footprint in sub-basin (index value)
2 (0, 4)
Sub-basin wetland extent (percent cover)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Pomoxis nigromaculatus** *Common Name* **Black Crappie**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **2416**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

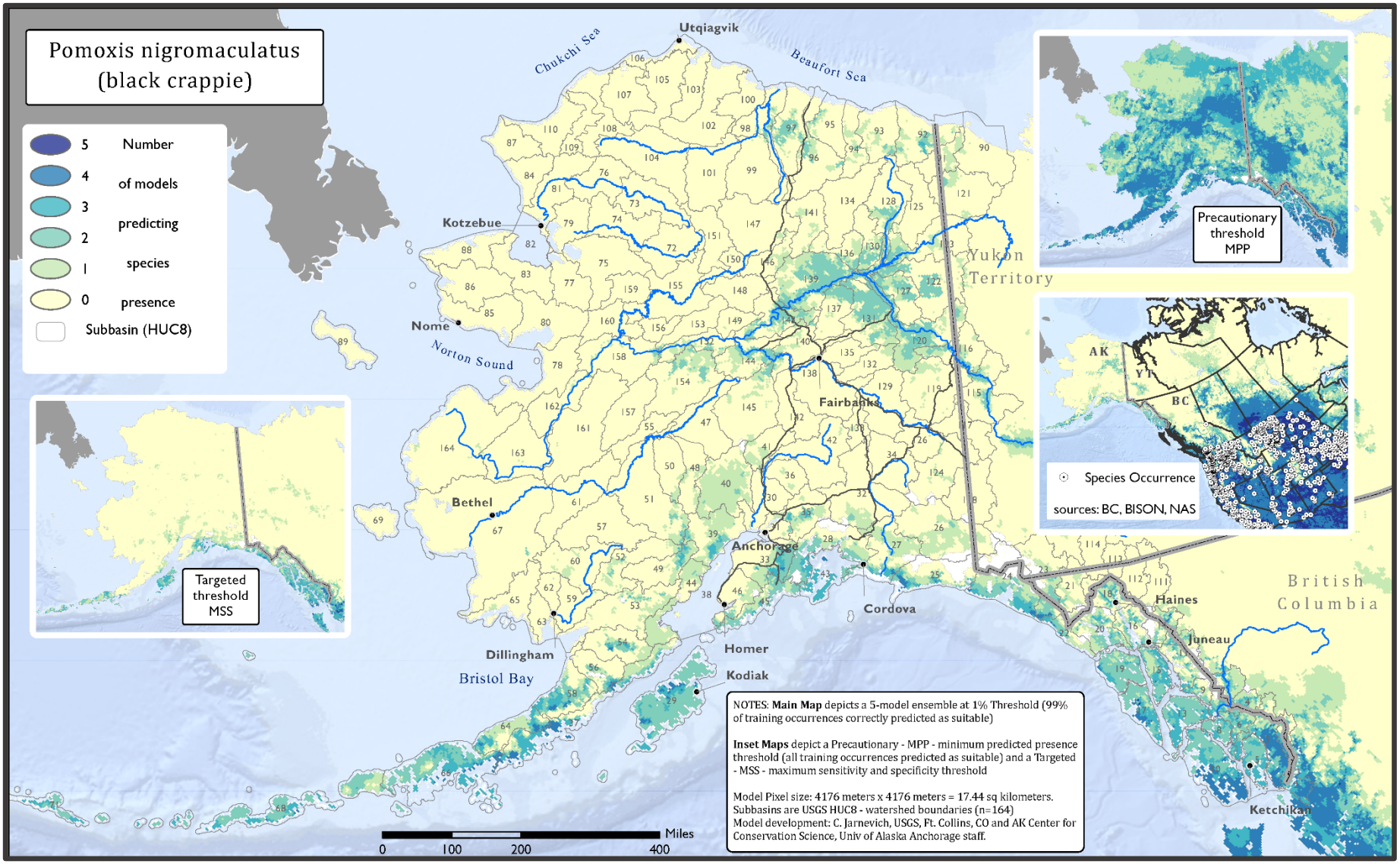
Data Sources:

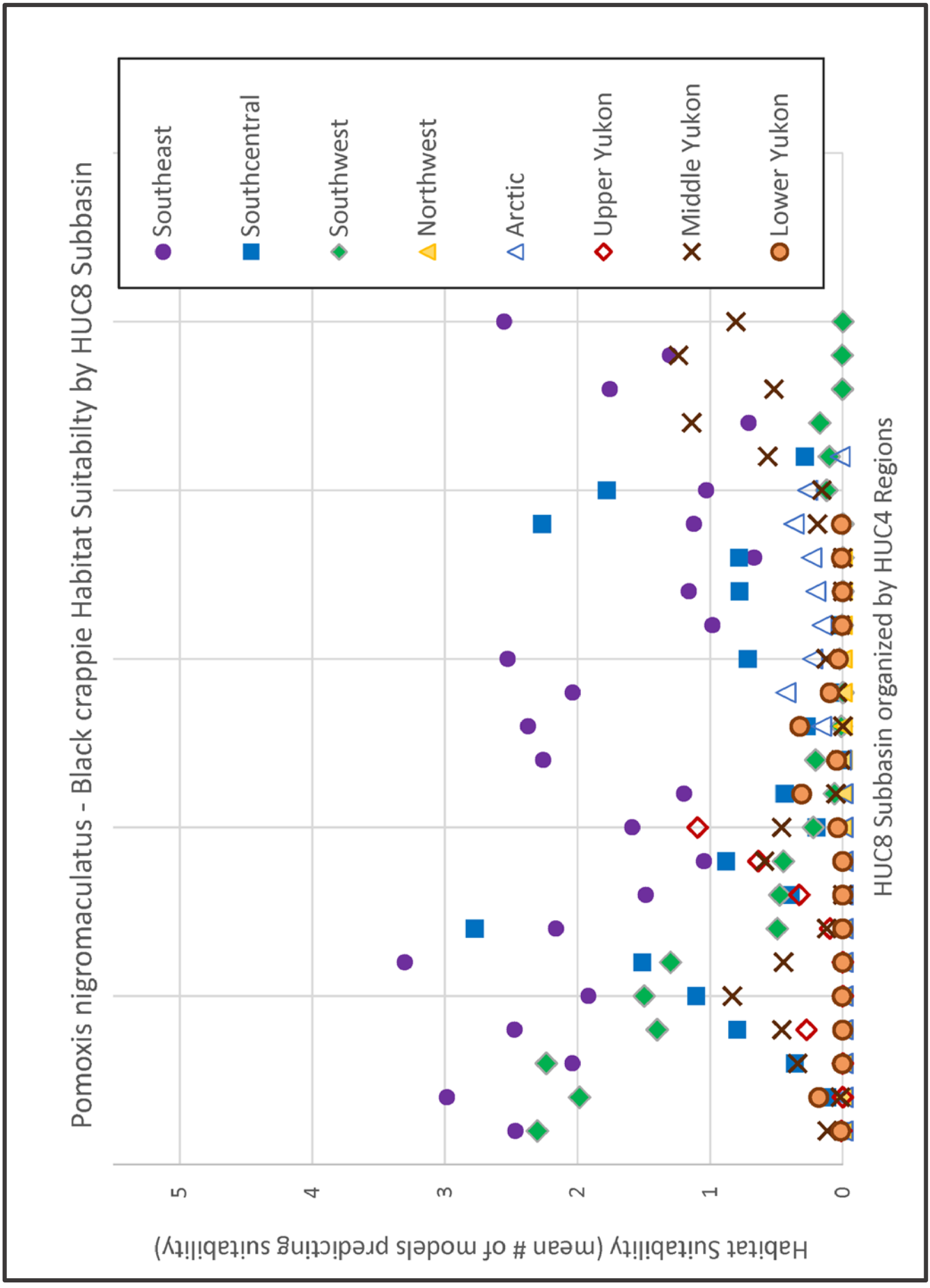
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

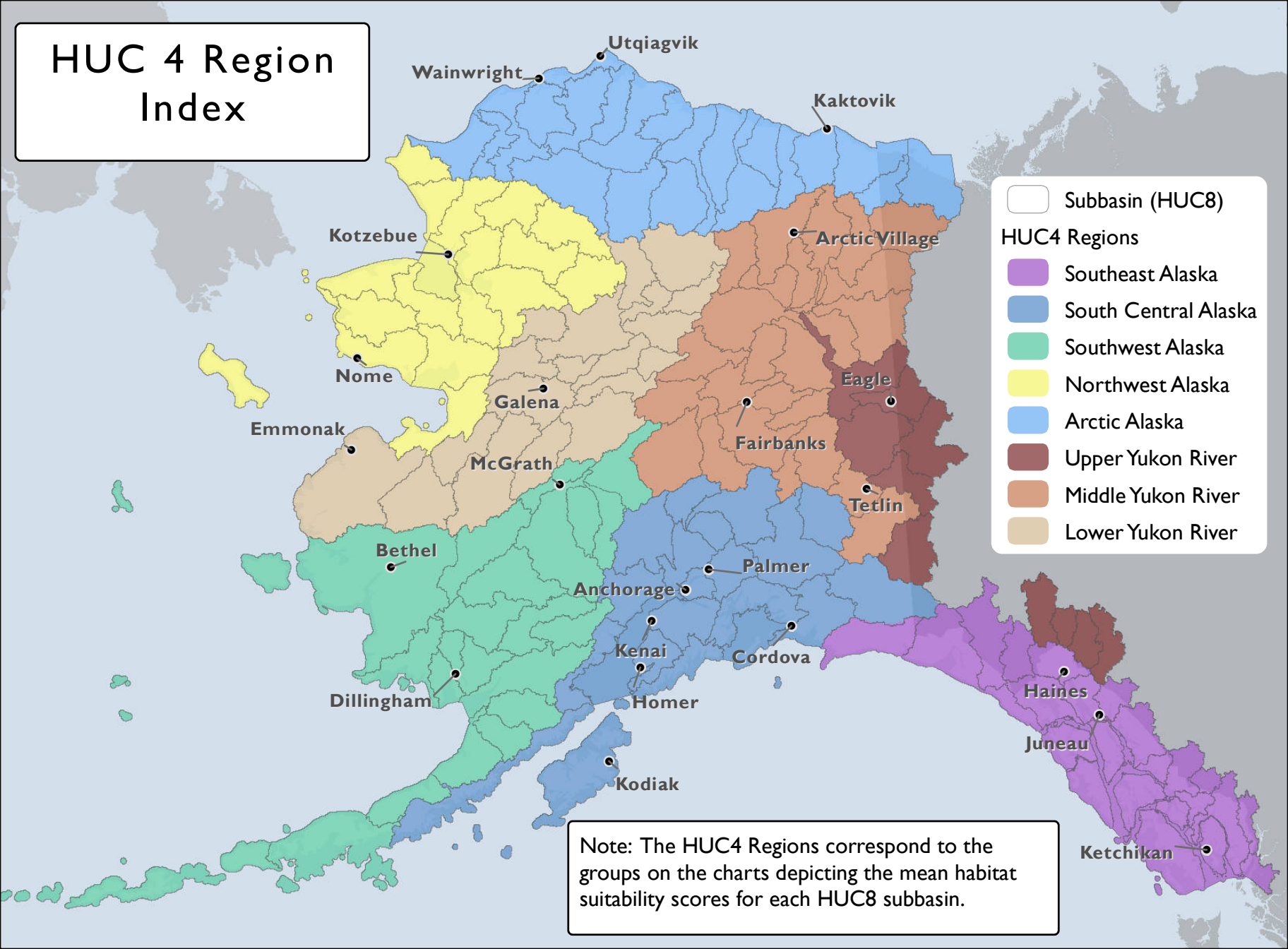
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Pomoxis nigromaculatus
(black crappie)
5
4
3
2
1
0
Number of models predicting species presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0
100
200
400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Pomoxis nigromaculatus - Black crappie Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

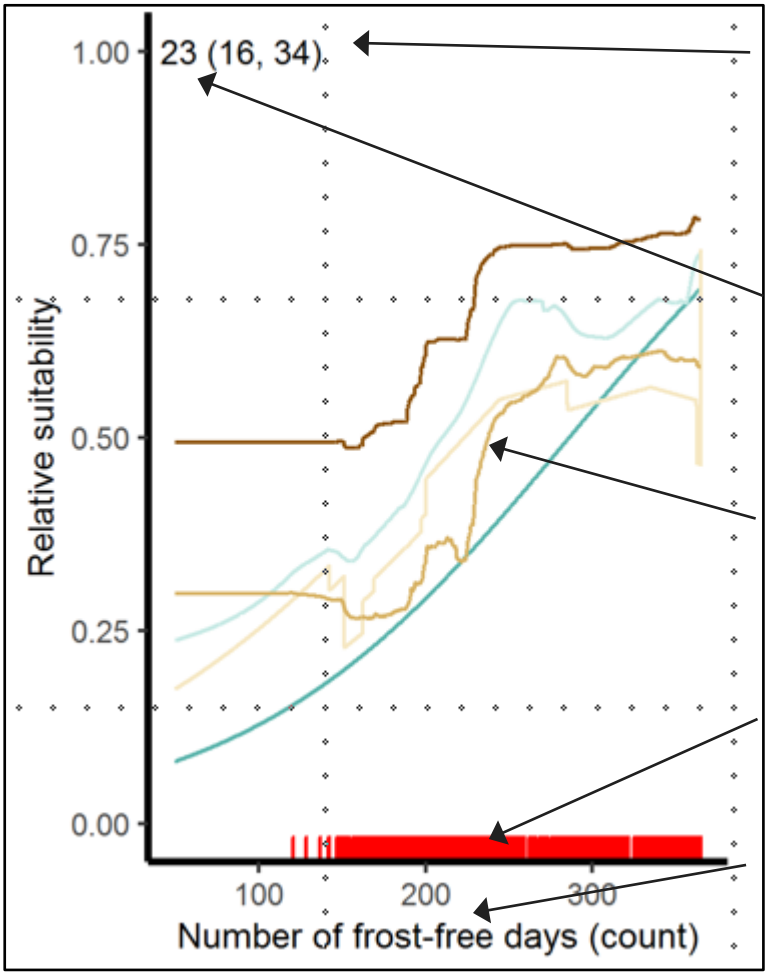
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

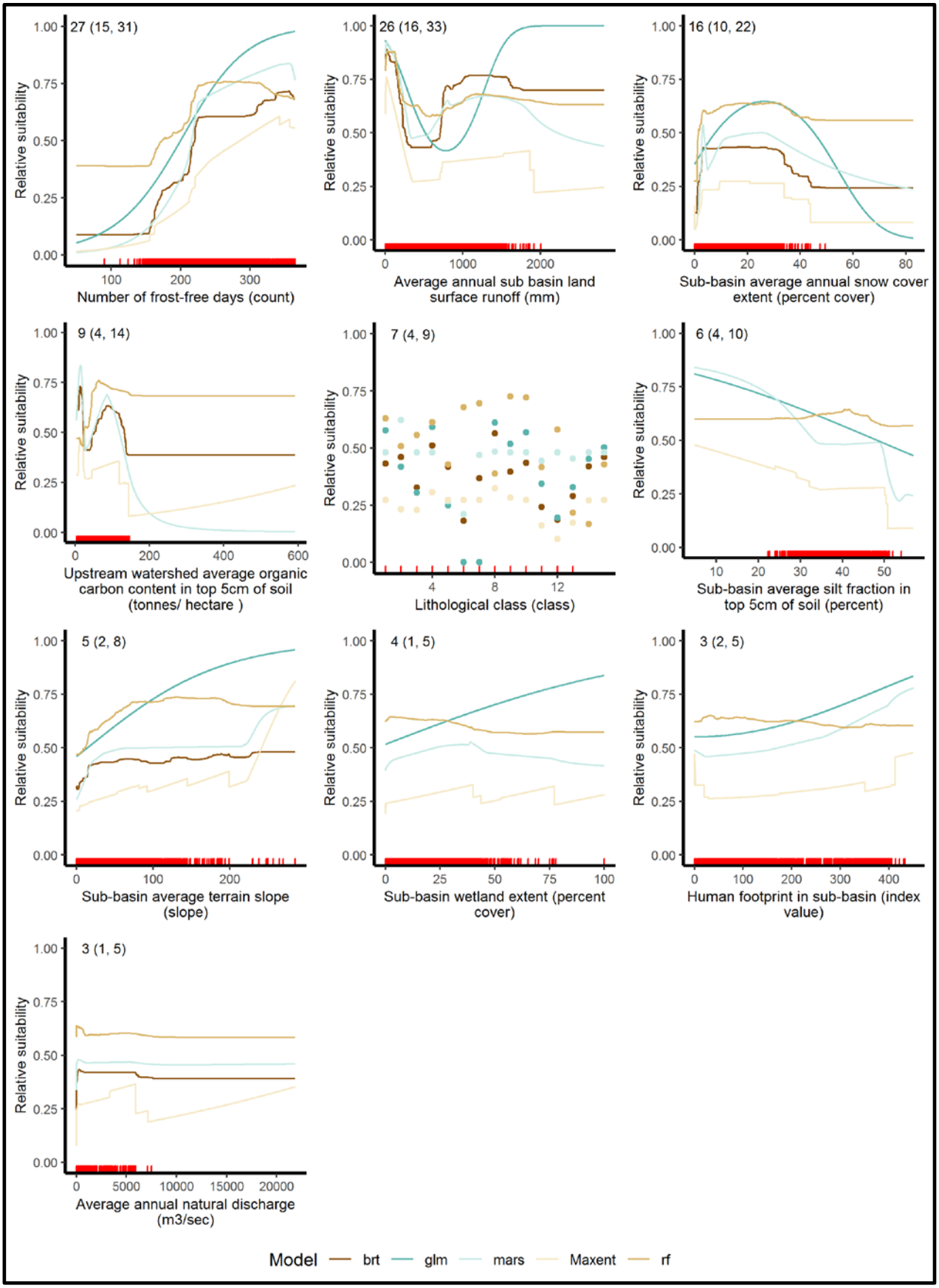
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


27 (15, 31)
Number of frost-free days (count)
26 (16, 33)
Average annual sub basin land surface runoff (mm)
16 (10, 22)
Sub-basin average annual snow cover extent (percent cover)
9 (4, 14)
Upstream watershed average organic carbon content in top 5cm of soil (tonnes/ hectare)
7 (4, 9)
Lithological class (class)
6 (4, 10)
Sub-basin average silt fraction in top 5cm of soil (percent)
5 (2, 8)
Sub-basin average terrain slope (slope)
4 (1, 5)
Sub-basin wetland extent (percent cover)
3 (2, 5)
Human footprint in sub-basin (index value)
3 (1, 5)
Average annual natural discharge (m3/sec)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Potamopyrgus antipodarum**

Common **New Zealand Mud Snail**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **1627**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Very High**[4]

Potential Vectors:

Stowaway & Contaminants

Species Group:

Mollusk

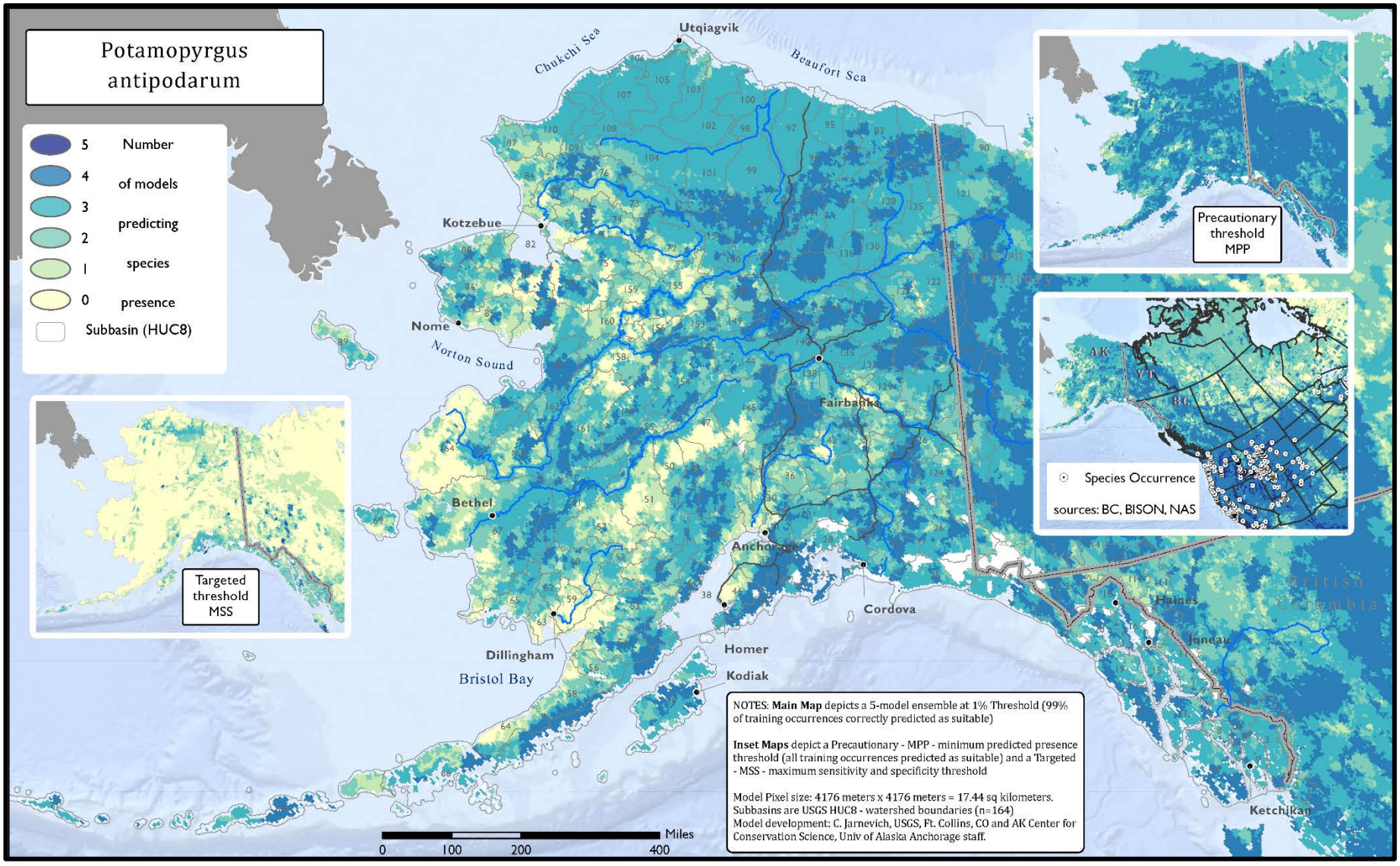
Data Sources:

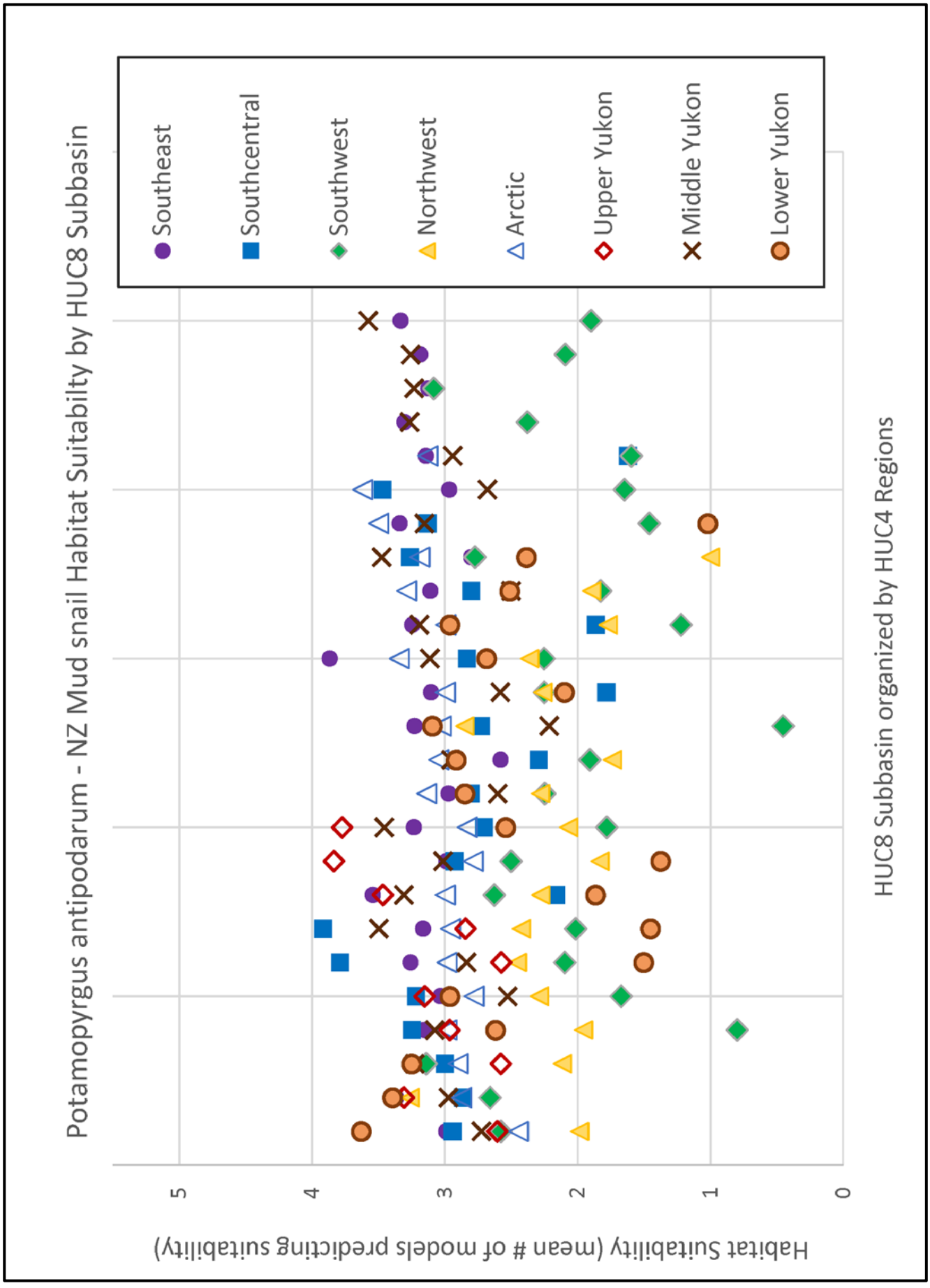
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

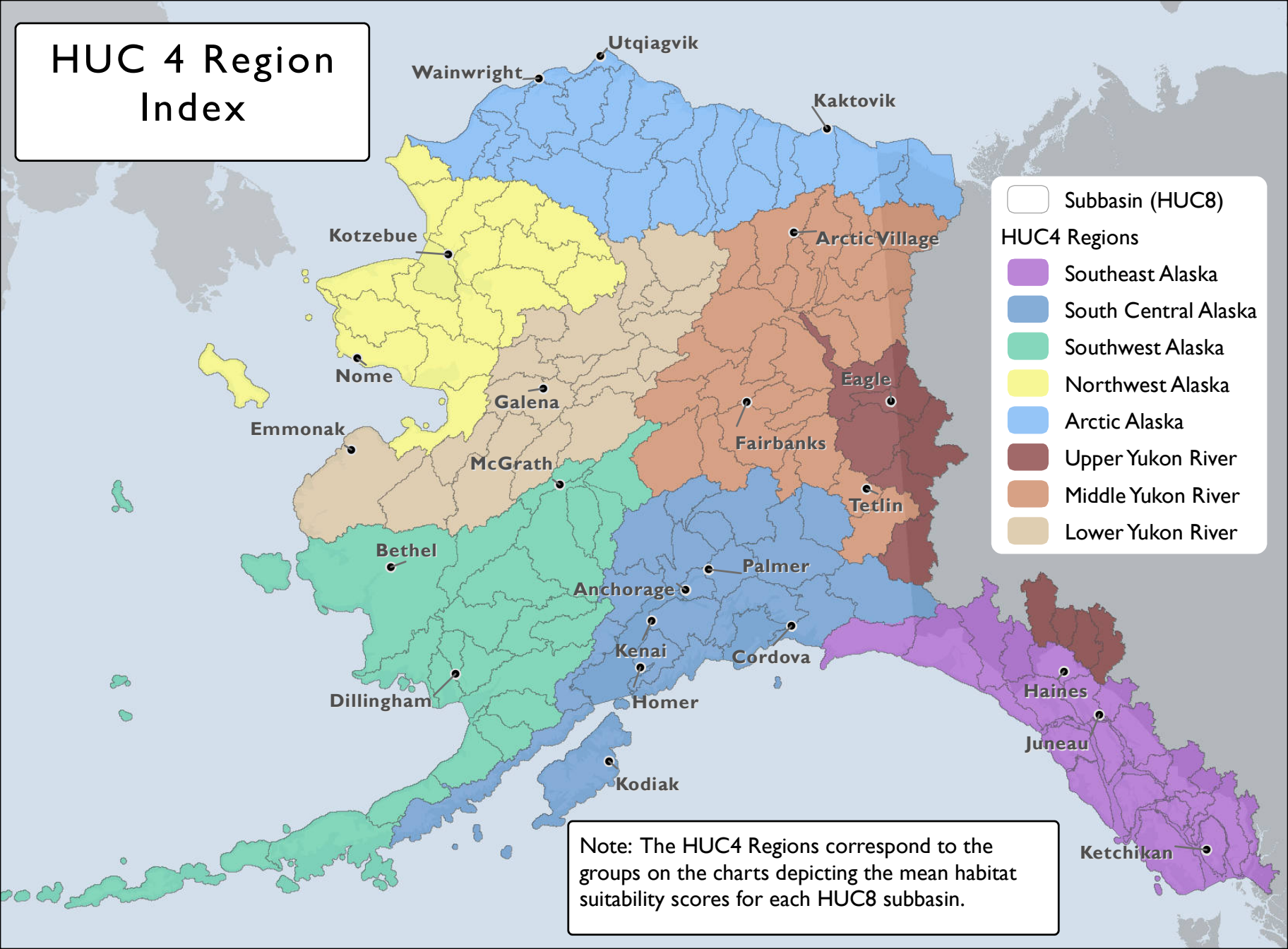
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Potamopyrgus antipodarum
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
Yukon Territory
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Potamopyrgus antipodarum - NZ Mud snail Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

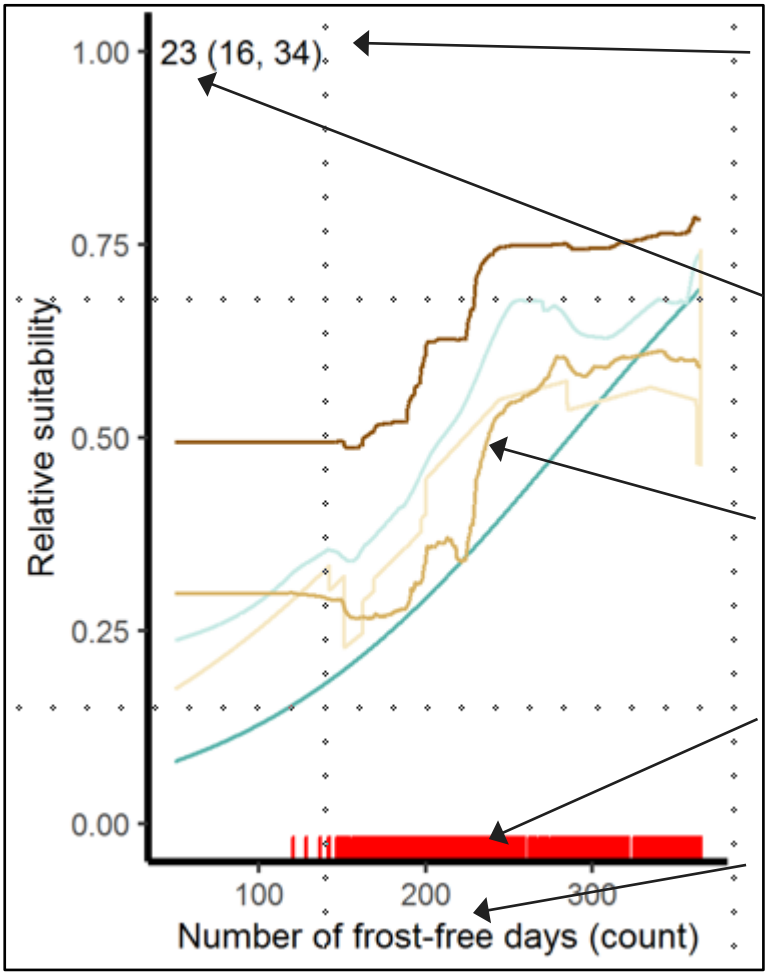
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

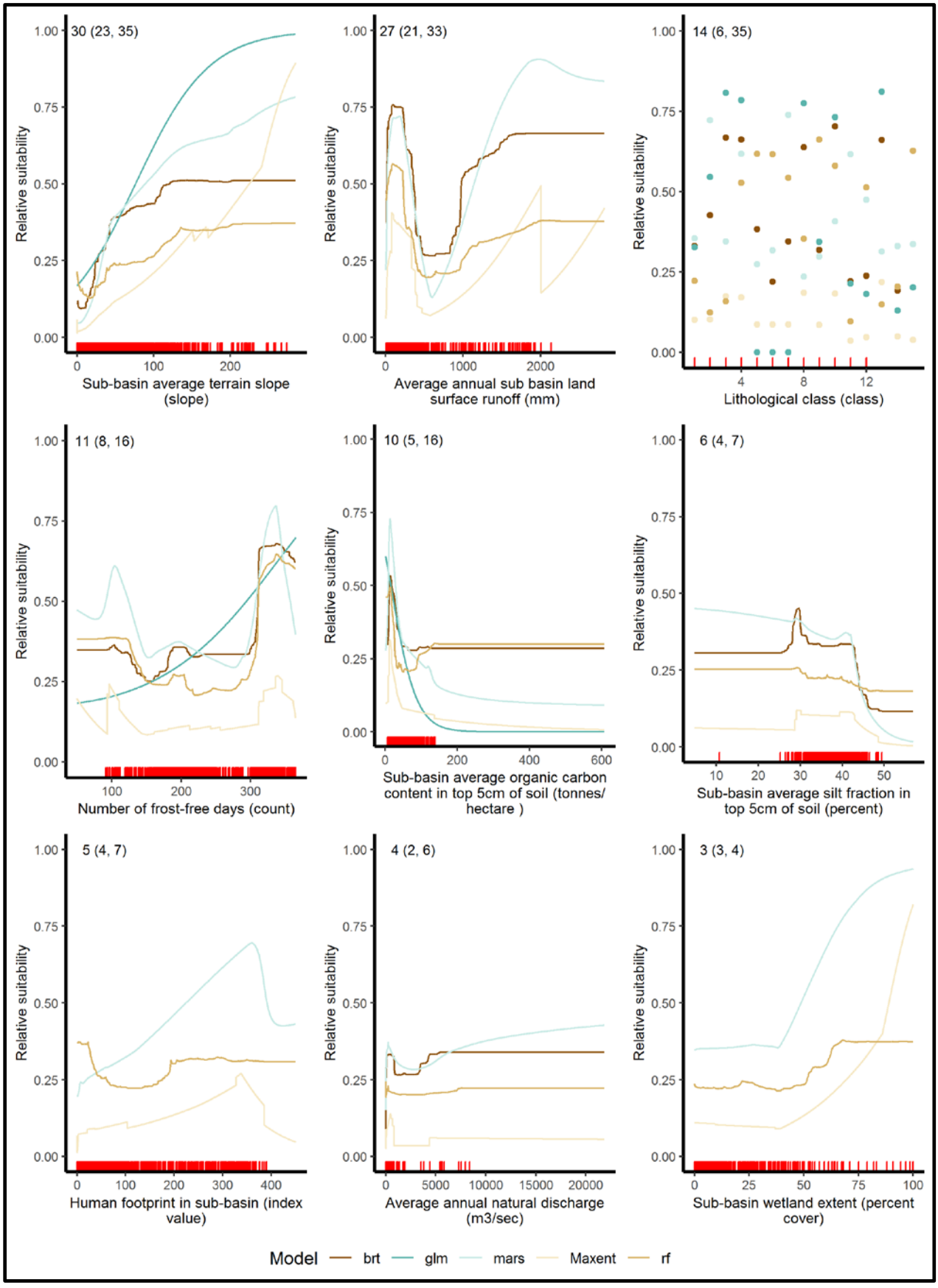
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


30 (23, 35)
27 (21, 33)
14 (6, 35)
11 (8, 16)
10 (5, 16)
6 (4, 7)
5 (4, 7)
4 (2, 6)
3 (3, 4)
Relative suitability
Sub-basin average terrain slope (slope)
Average annual sub basin land surface runoff (mm)
Lithological class (class)
Number of frost-free days (count)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
Sub-basin average silt fraction in top 5cm of soil (percent)
Human footprint in sub-basin (index value)
Average annual natural discharge (m3/sec)
Sub-basin wetland extent (percent cover)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Richardsonius balteatus** *Common Name* **Redside Shiner**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **71**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

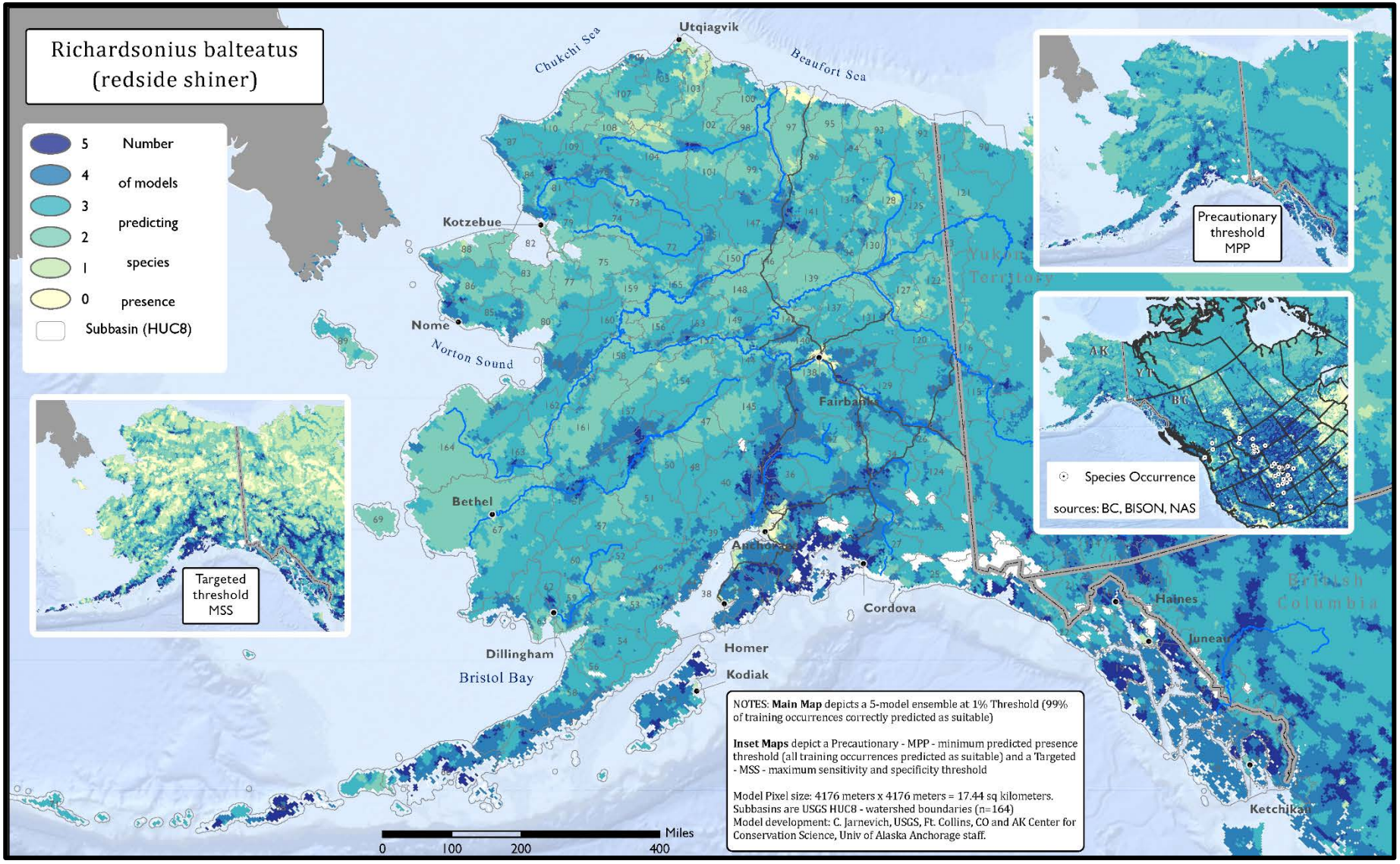
Data Sources:

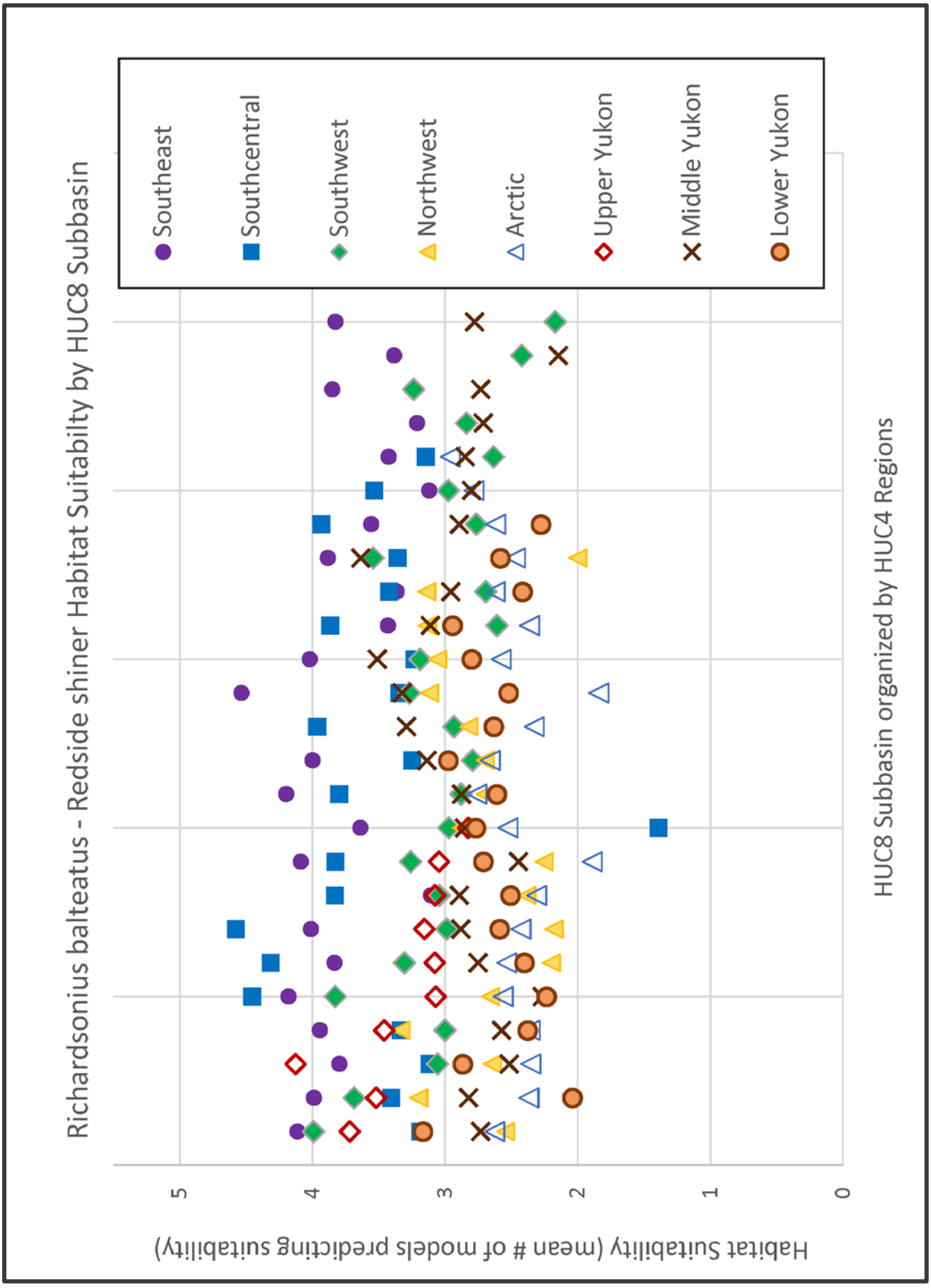
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

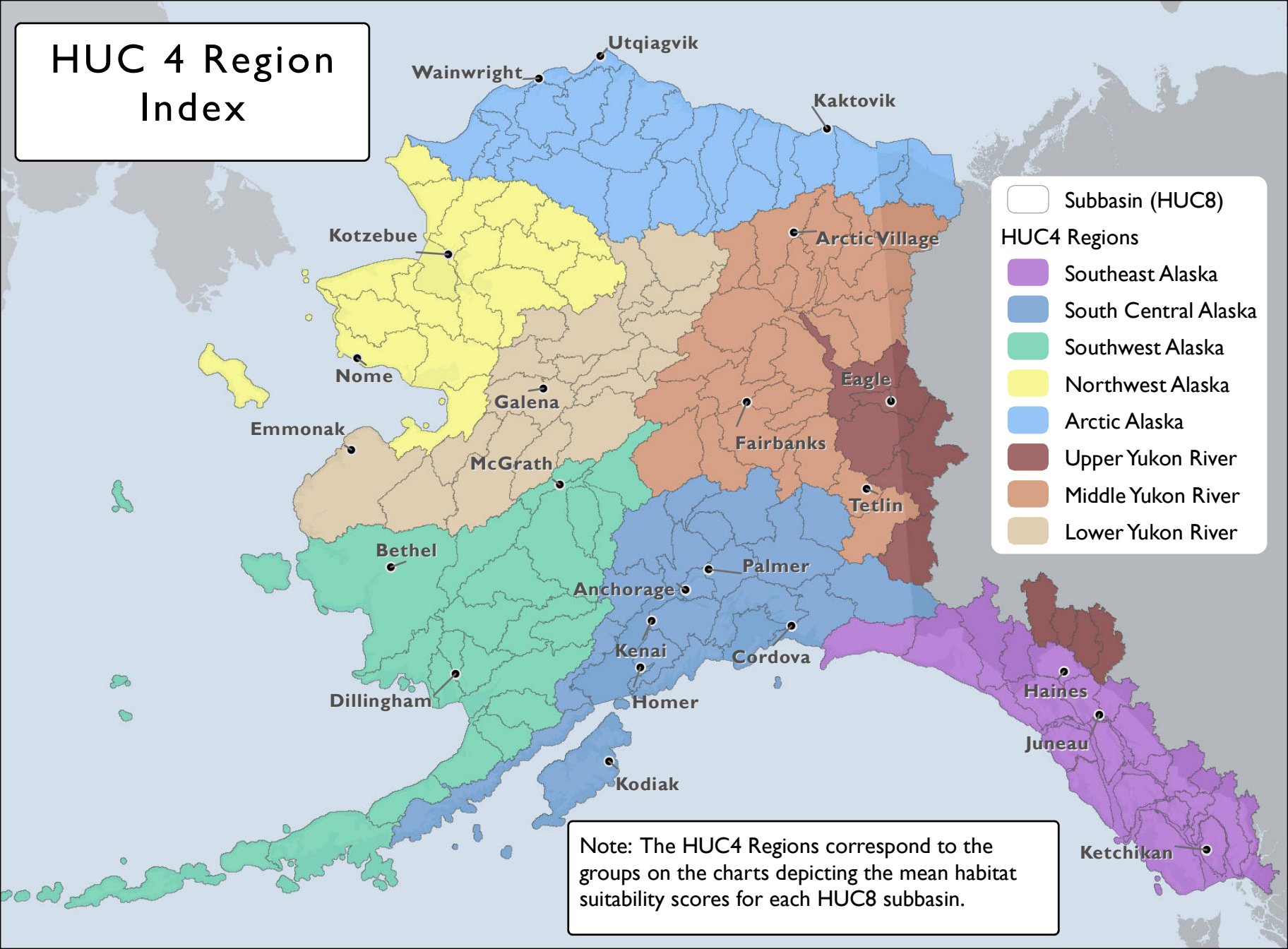
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Richardsonius balteatus
(redside shiner)
5
4
3
2
1
0
Number of models predicting species presence
Subbasin (HUC8)
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Fairbanks
Bethel
Anchorage
Cordova
Haines
Juneau
Dillingham
Bristol Bay
Homer
Kodiak
Ketchikan
Yukon Territory
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.
Miles
0
100
200
400


Richardsonius balteatus - Redside shiner Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

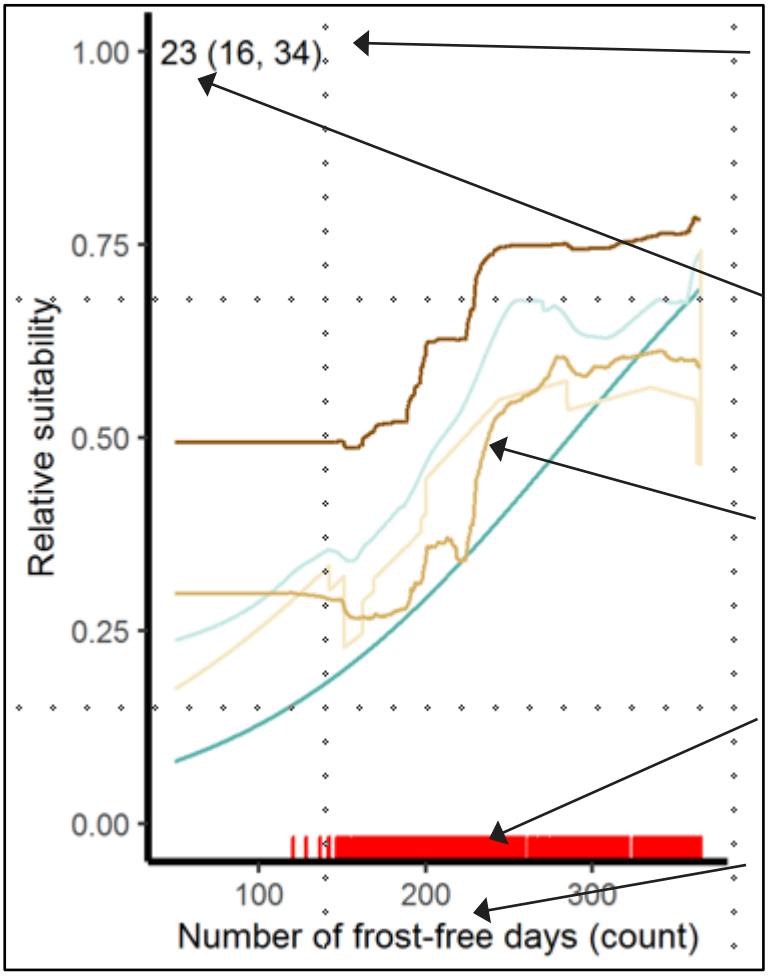
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

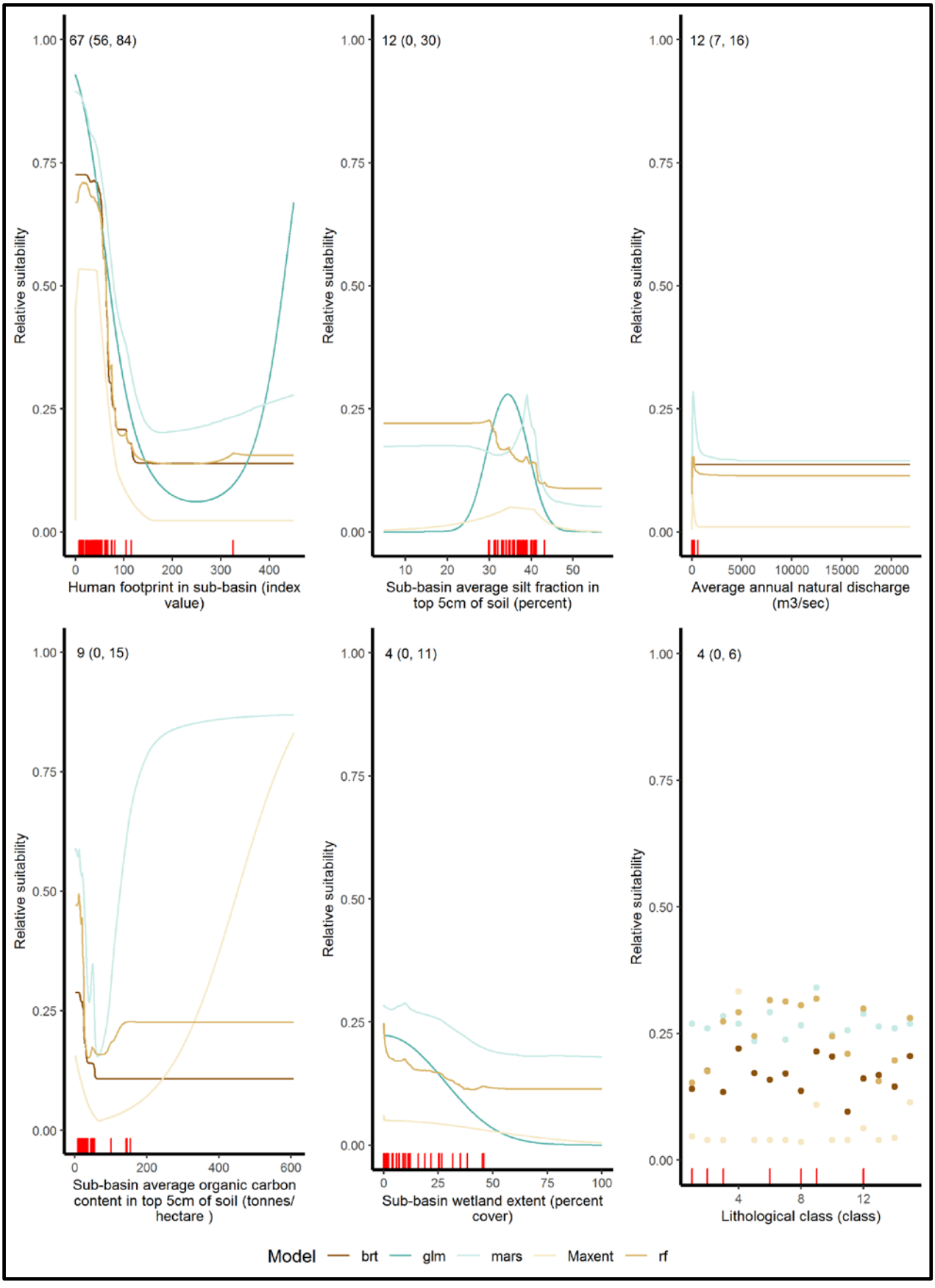
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


67 (56, 84)
Relative suitability
Human footprint in sub-basin (index value)
12 (0, 30)
Sub-basin average silt fraction in top 5cm of soil (percent)
12 (7, 16)
Average annual natural discharge (m3/sec)
9 (0, 15)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
4 (0, 11)
Sub-basin wetland extent (percent cover)
4 (0, 6)
Lithological class (class)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Salmo trutta** *Common Name* **Brown Trout**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **70505**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

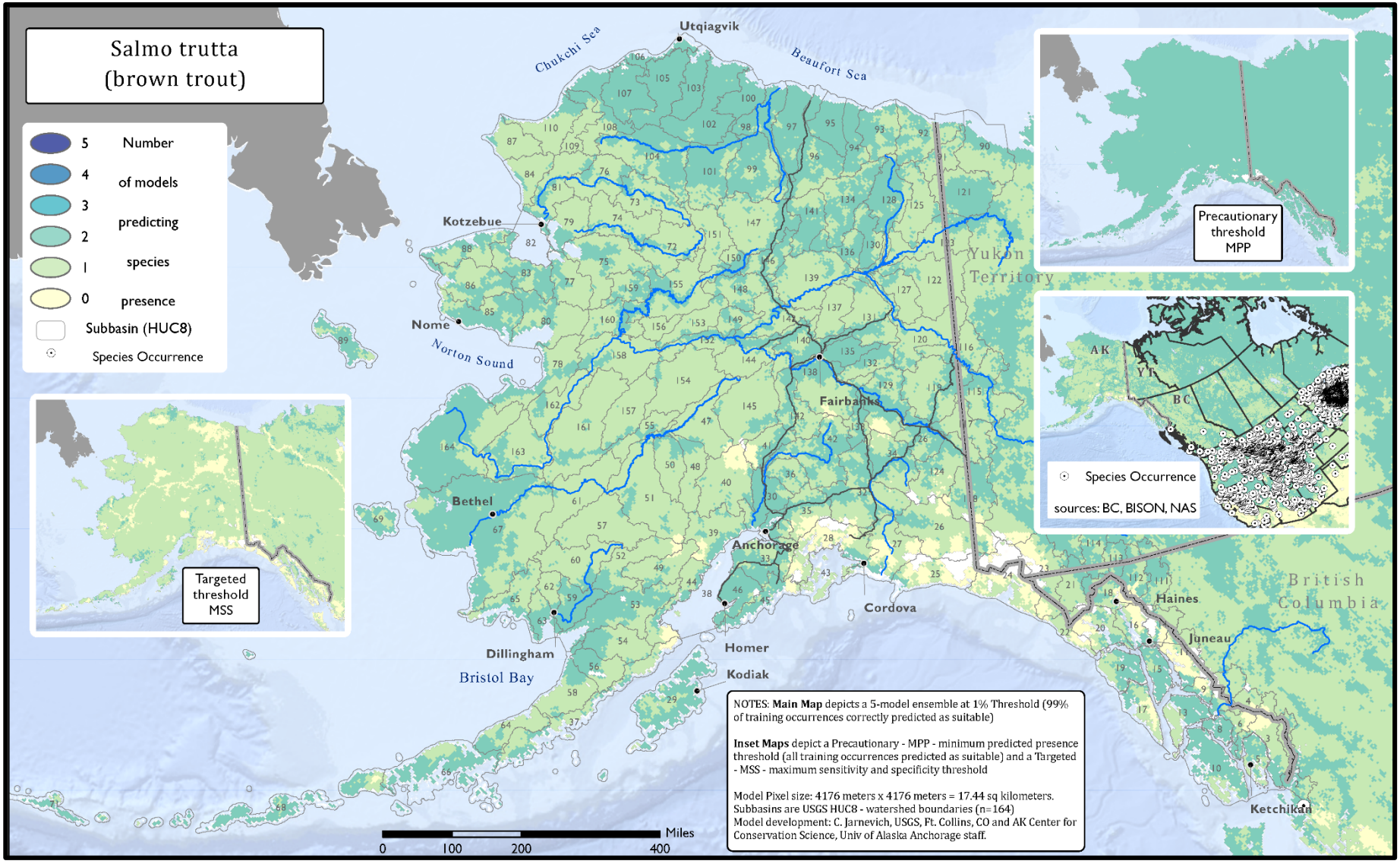
Data Sources:

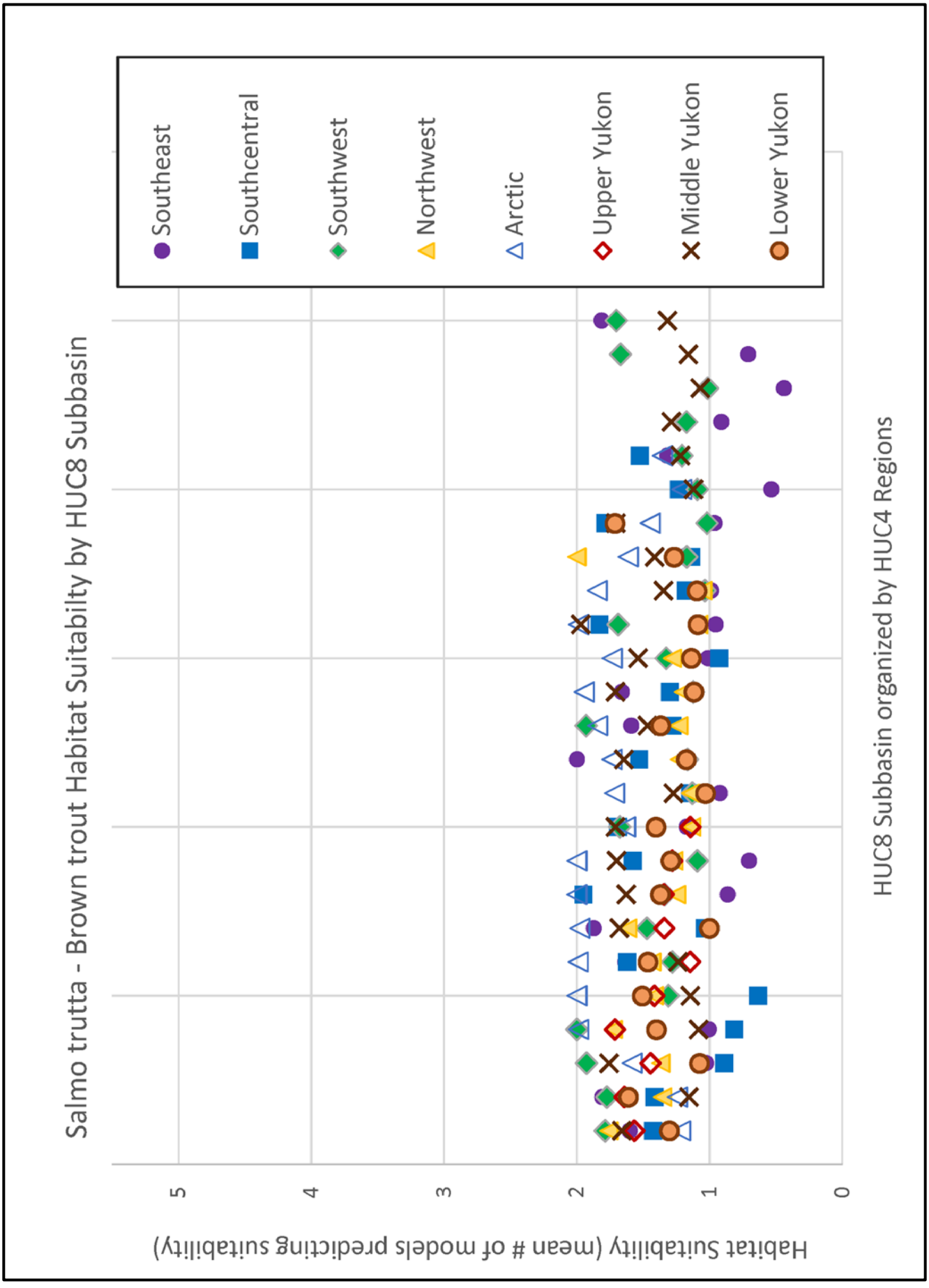
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

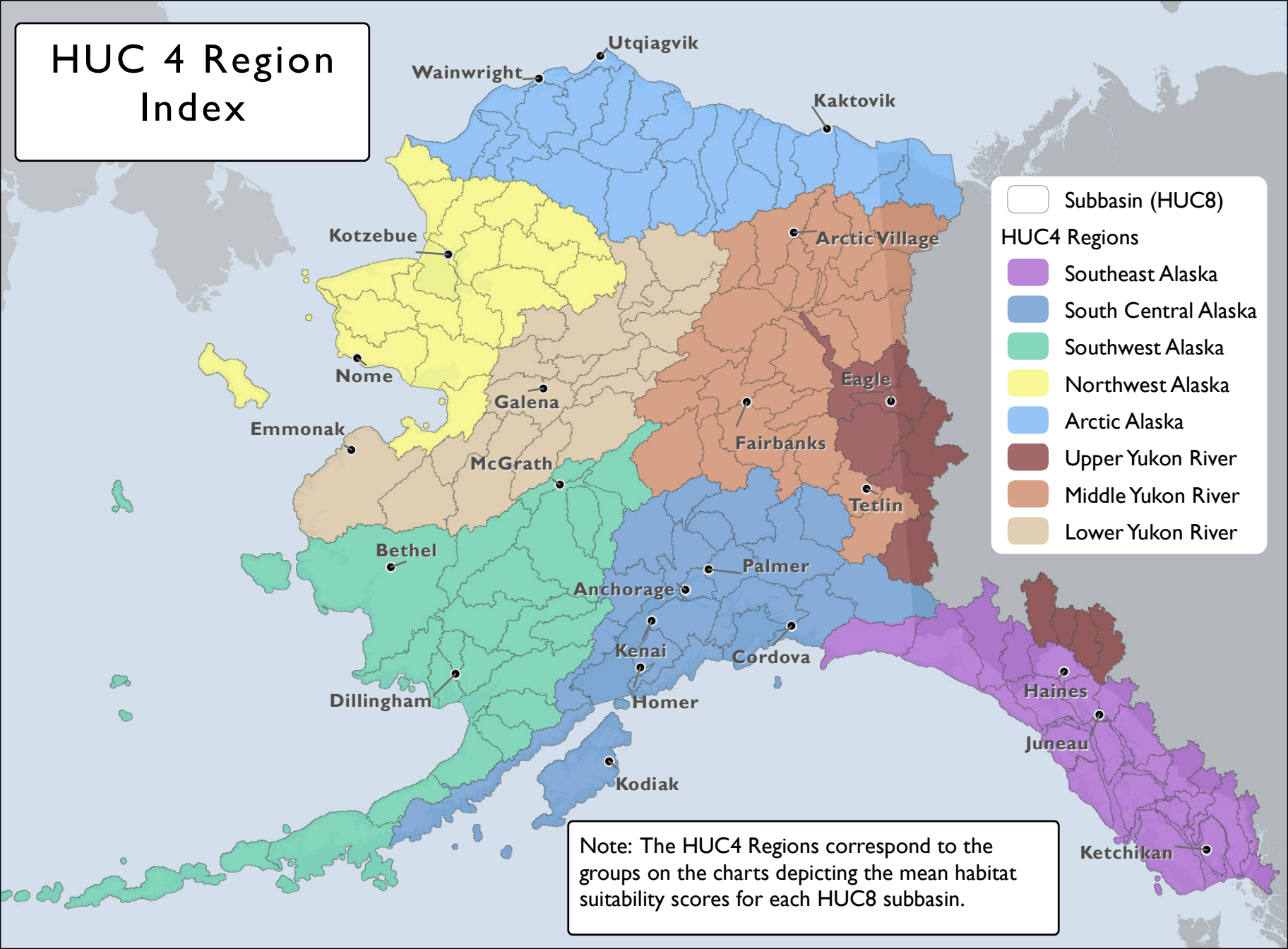
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Salmo trutta
(brown trout)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Species Occurrence
Utqiagvik
Chukchi Sea
Beaufort Sea
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
Ketchikan
British Columbia
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Salmo trutta - Brown trout Habitat Suitabilty by HUC8 Subbasin
Habitat Suitability (mean # of models predicting suitability)
HUC8 Subbasin organized by HUC4 Regions
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
0
1
2
3
4
5

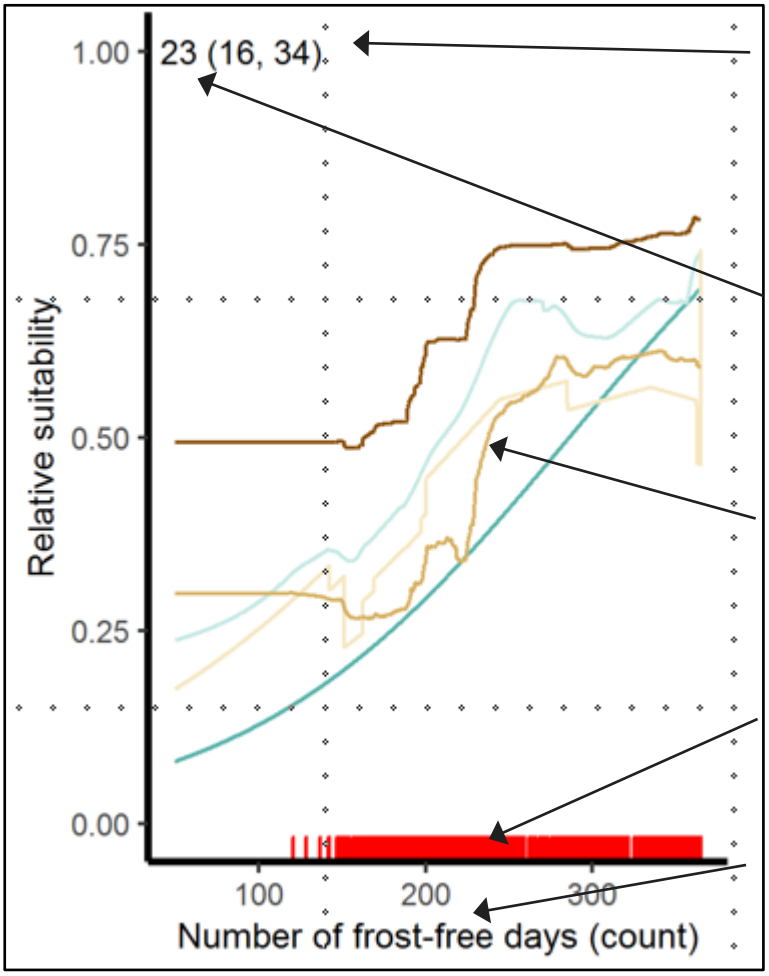
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

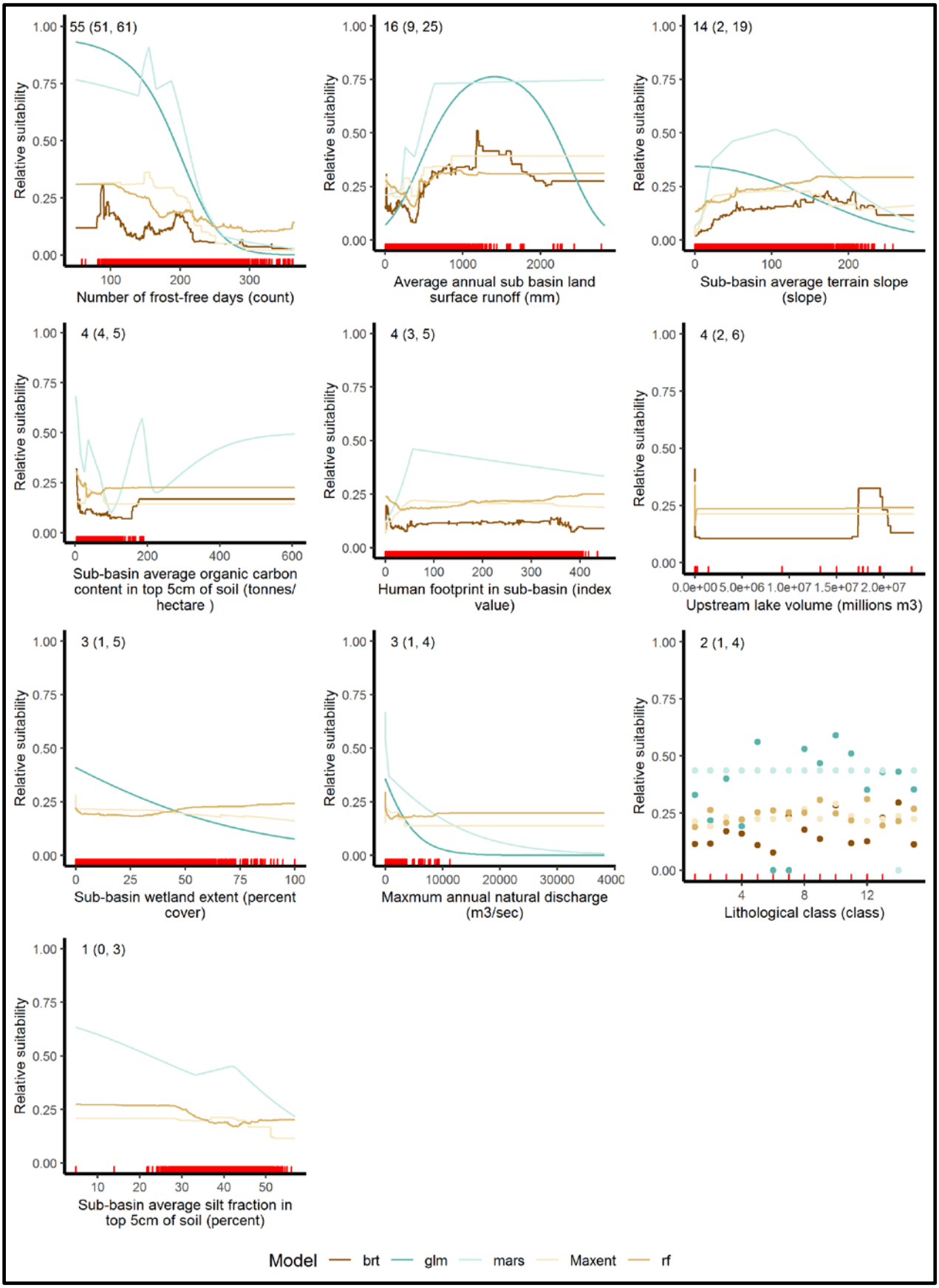
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


55 (51, 61)
Number of frost-free days (count)
16 (9, 25)
Average annual sub basin land surface runoff (mm)
14 (2, 19)
Sub-basin average terrain slope (slope)
4 (4, 5)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
4 (3, 5)
Human footprint in sub-basin (index value)
4 (2, 6)
Upstream lake volume (millions m3)
3 (1, 5)
Sub-basin wetland extent (percent cover)
3 (1, 4)
Maxmum annual natural discharge (m3/sec)
2 (1, 4)
Lithological class (class)
1 (0, 3)
Sub-basin average silt fraction in top 5cm of soil (percent)
Relative suitability
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Salvelinus fontinalis** *Common Name* **Brook Trout**

Alaska Occurrence Records: species occurrences found in Alaska - 7**0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **6411**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Natural Migration

Importation and Release

Species Group:

Fish

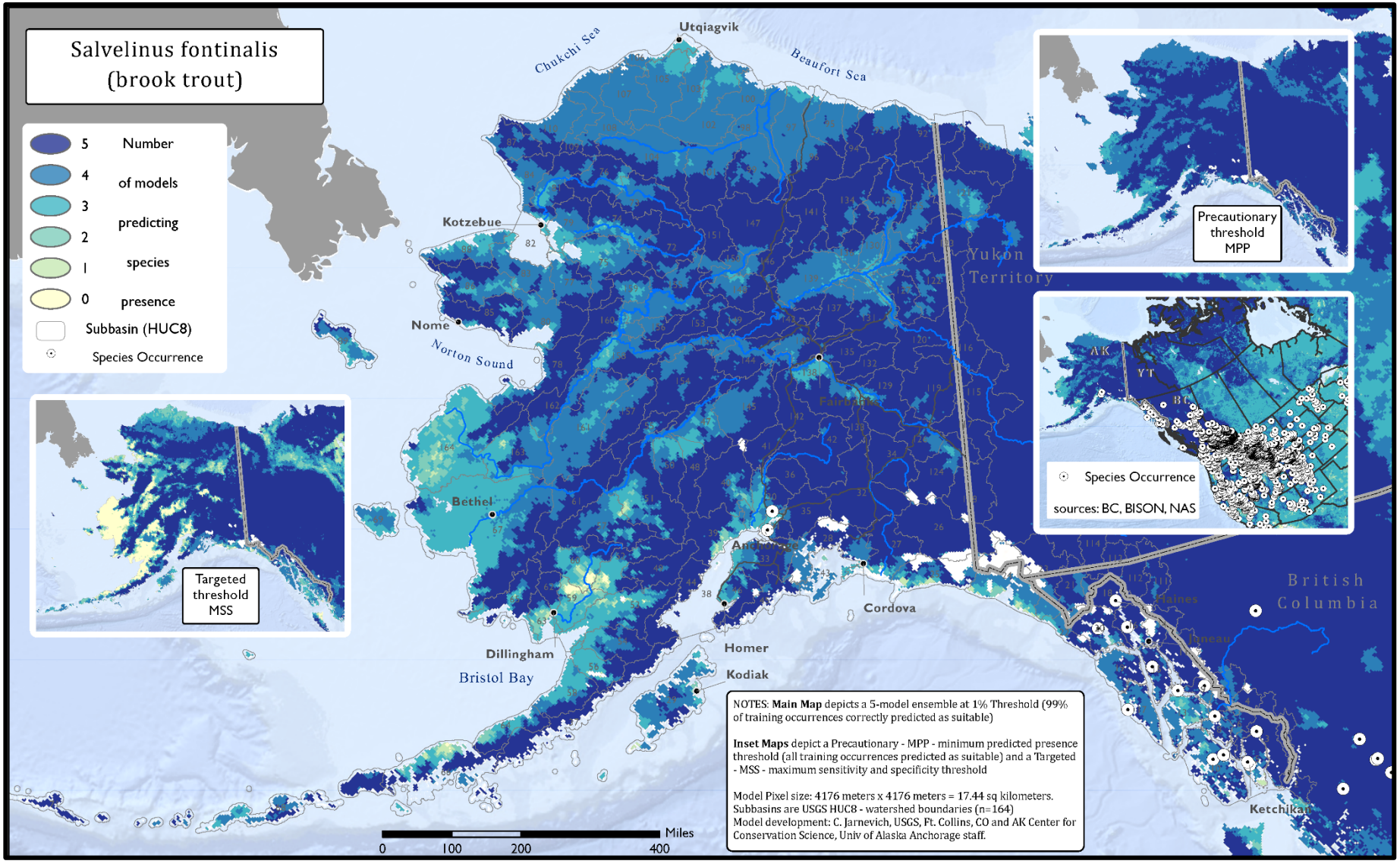
Data Sources:

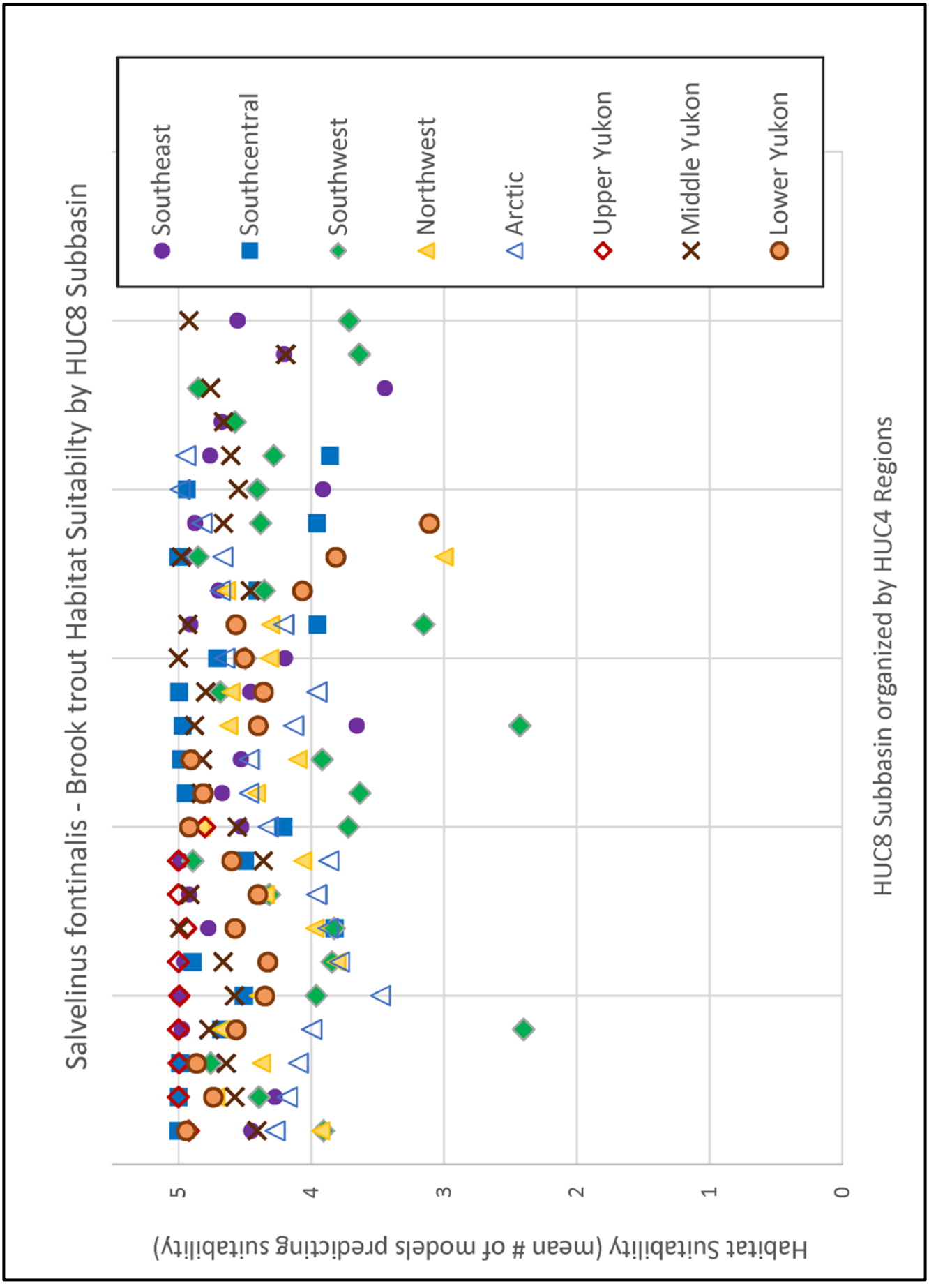
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

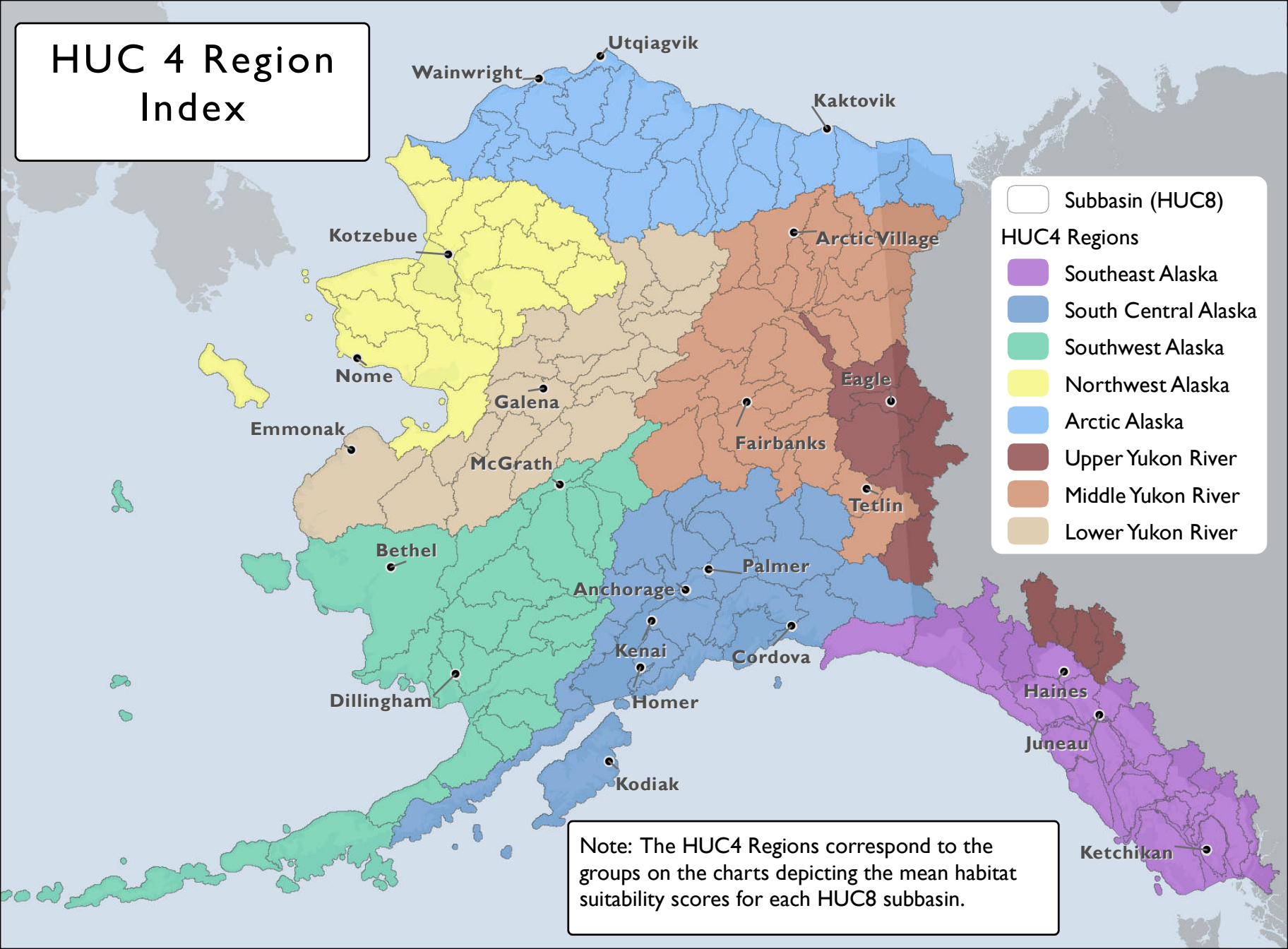
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Salvelinus fontinalis
(brook trout)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Species Occurrence
Targeted threshold MSS
Precautionary threshold MPP
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Yukon Territory
Fairbanks
Bethel
Anchorage
Cordova
Dillingham
Bristol Bay
Homer
Kodiak
Haines
Juneau
British Columbia
Ketchikan
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Salvelinus fontinalis - Brook trout Habitat Suitability by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

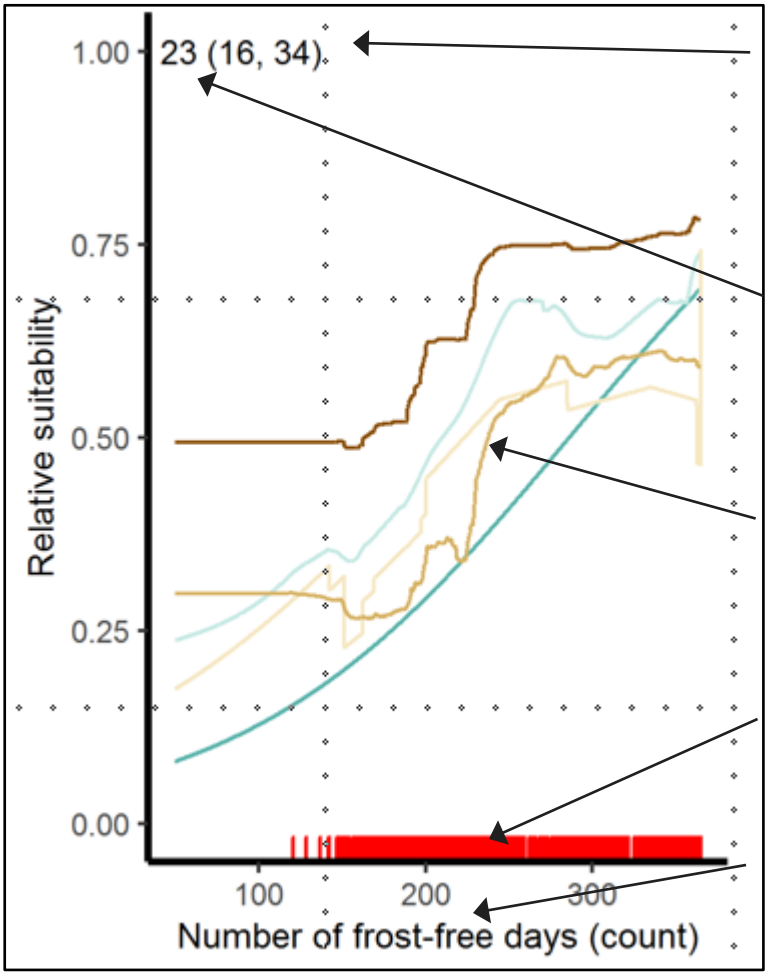
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

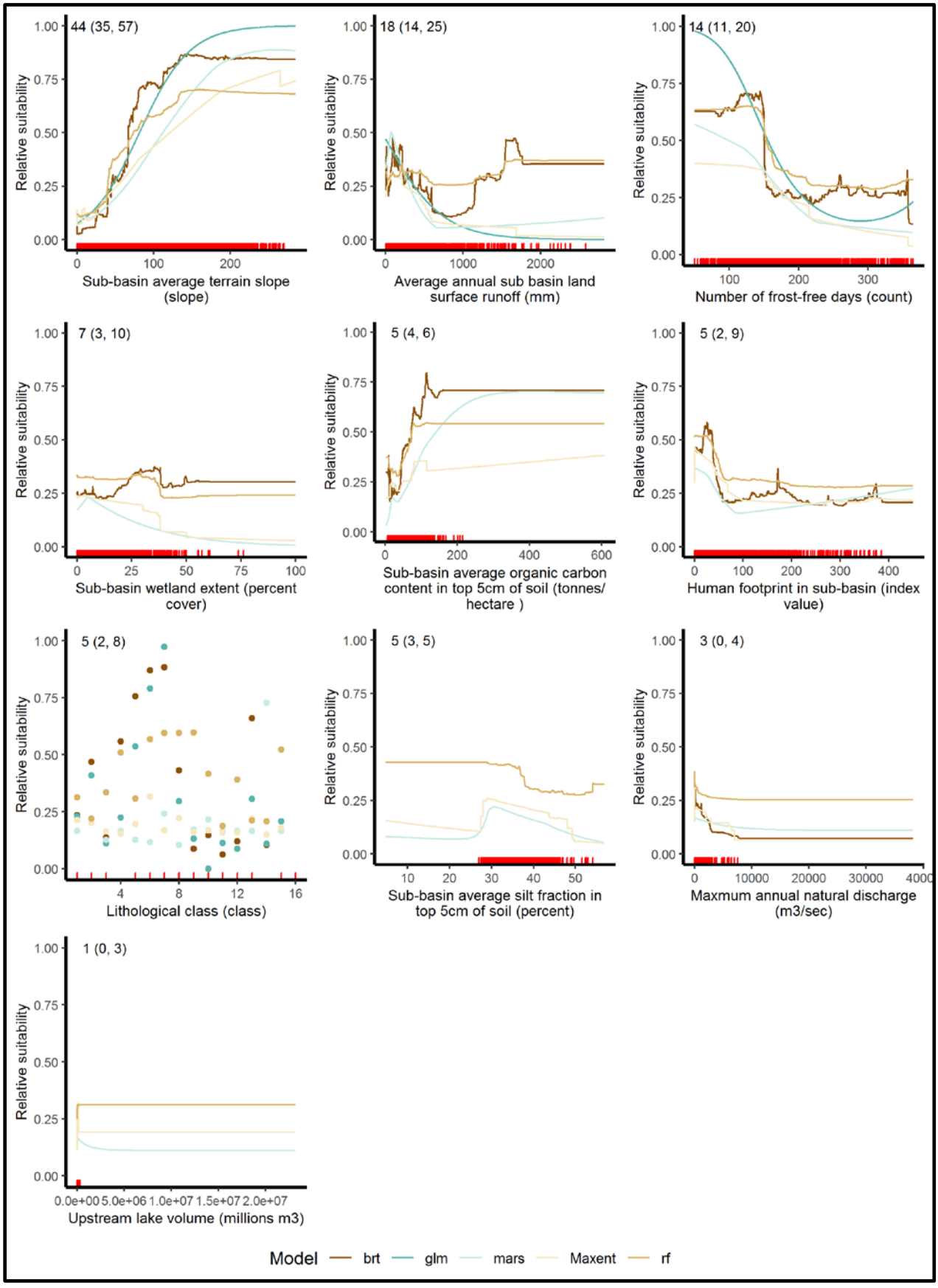
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


44 (35, 57)
Relative suitability
Sub-basin average terrain slope (slope)
18 (14, 25)
Average annual sub basin land surface runoff (mm)
14 (11, 20)
Number of frost-free days (count)
7 (3, 10)
Sub-basin wetland extent (percent cover)
5 (4, 6)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
5 (2, 9)
Human footprint in sub-basin (index value)
5 (2, 8)
Lithological class (class)
5 (3, 5)
Sub-basin average silt fraction in top 5cm of soil (percent)
3 (0, 4)
Maxmum annual natural discharge (m3/sec)
1 (0, 3)
Upstream lake volume (millions m3)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Sander vitreus** *Common Name* **Walleye**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **2568**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Importation and Release

Species Group:

Fish

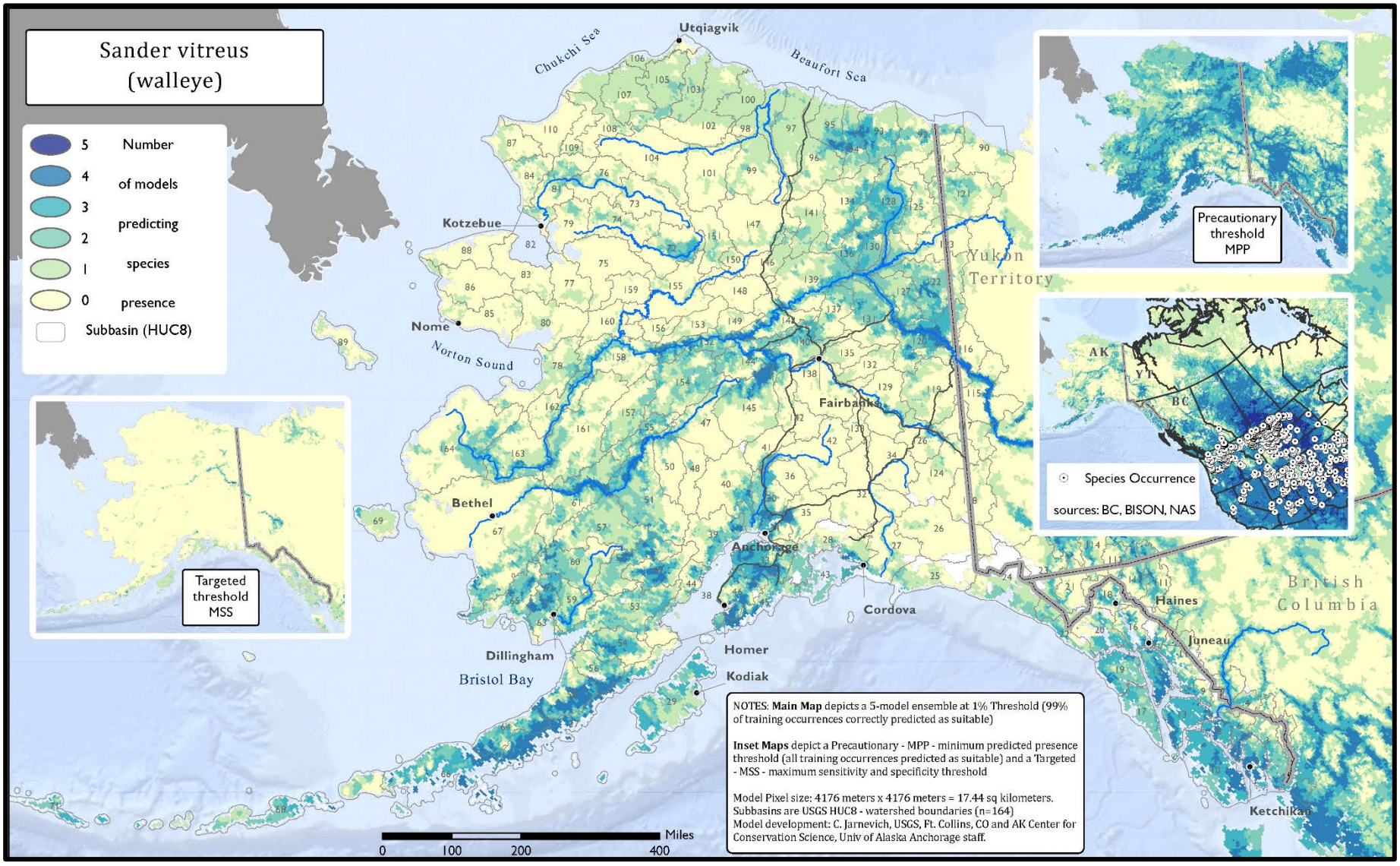
Data Sources:

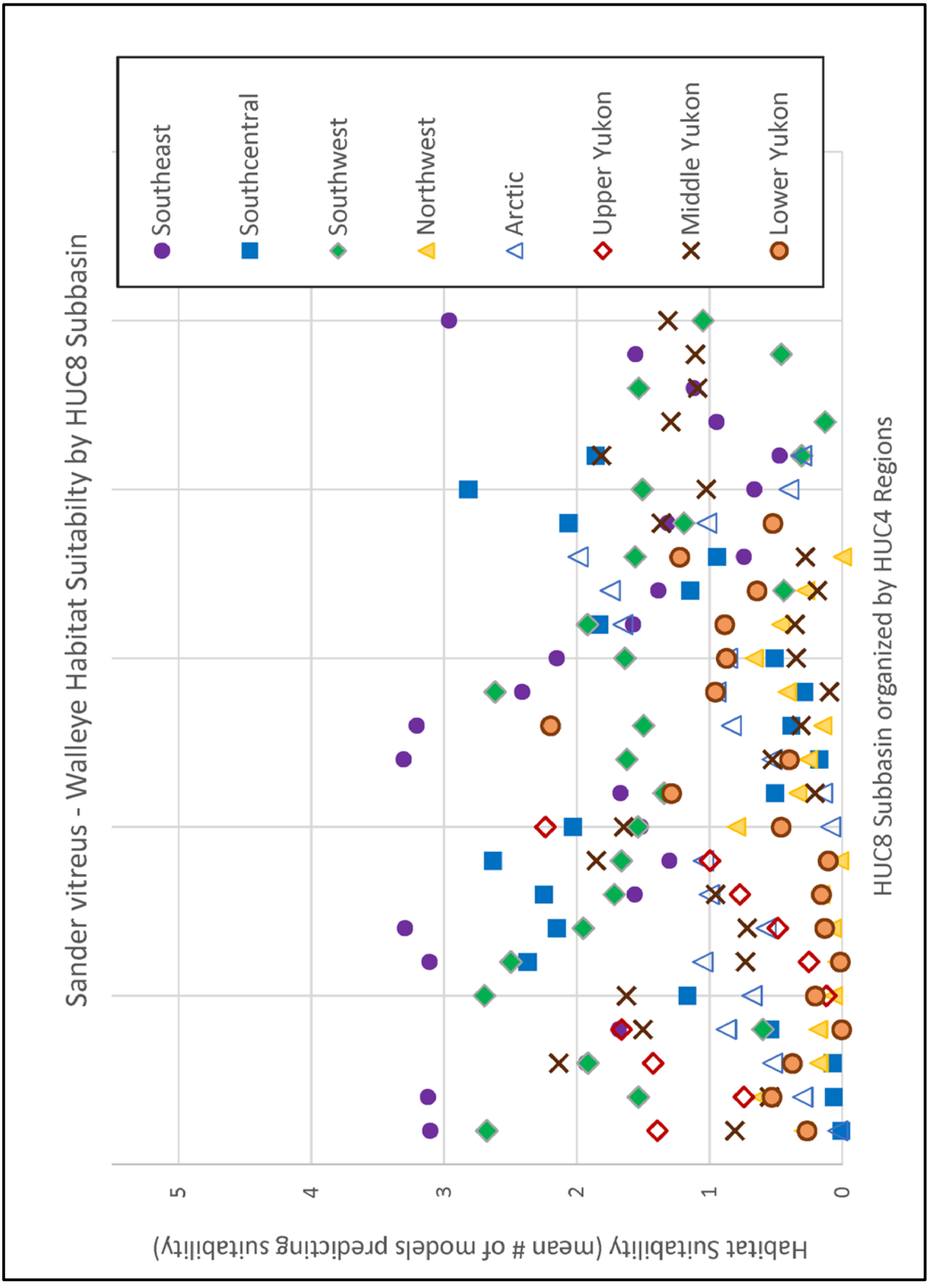
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

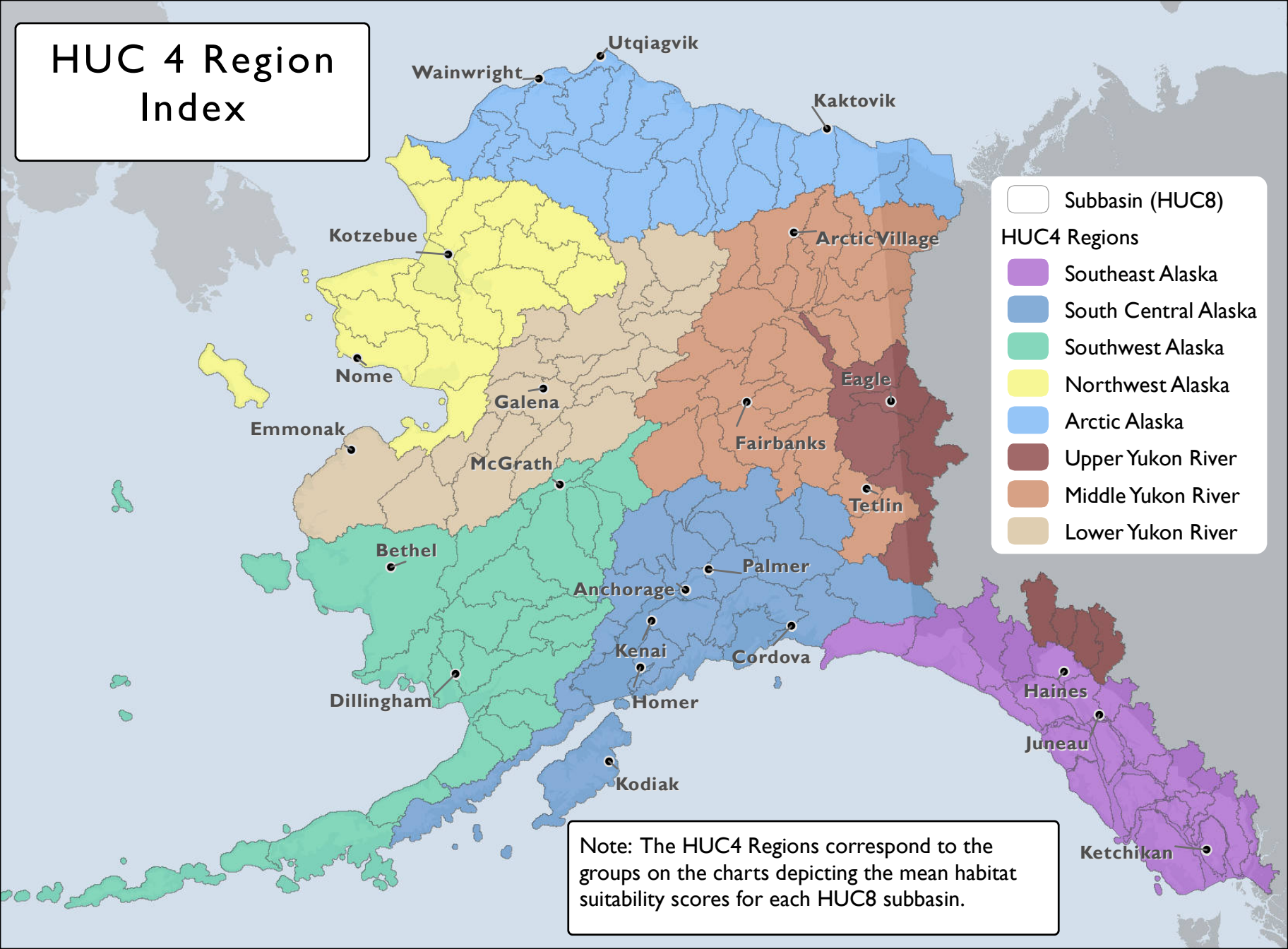
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Sander vitreus
(walleye)
5 Number
4 of models
3 predicting
2 species
1 presence
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Bethel
Dillingham
Bristol Bay
Fairbanks
Anchorage
Cordova
Homer
Kodiak
Yukon Territory
British Columbia
Haines
Juneau
Ketchikan
Precautionary threshold MPP
Targeted threshold MSS
AK
YT
BC
Species Occurrence
sources: BC, BISON, NAS
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Sander vitreus - Walleye Habitat Suitabilty by HUC8 Subbasin
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
Habitat Suitability (mean # of models predicting suitability)
0
1
2
3
4
5
HUC8 Subbasin organized by HUC4 Regions

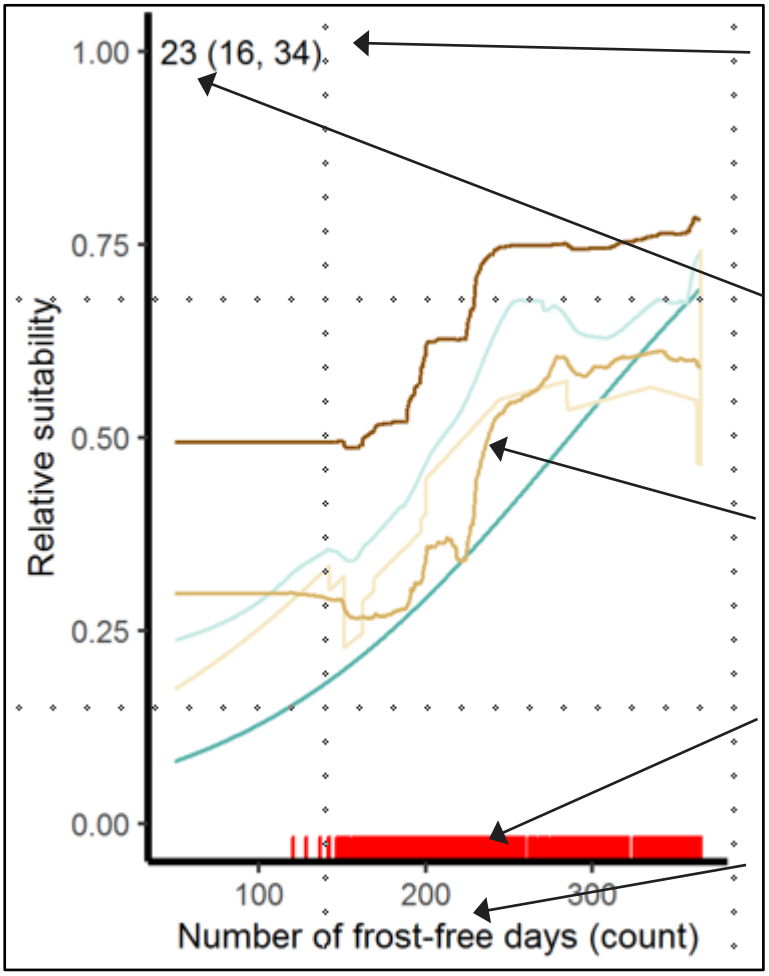
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

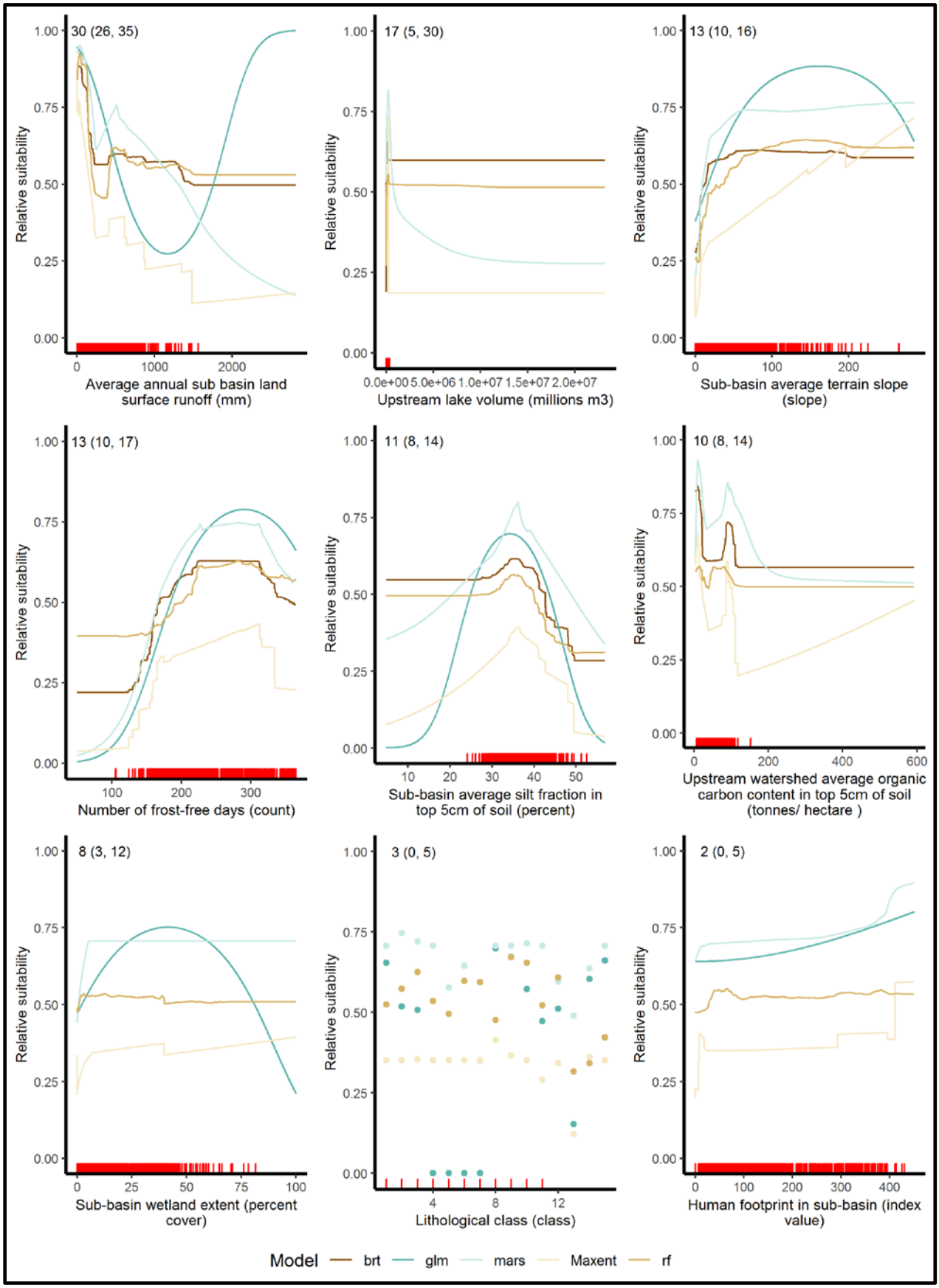
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


30 (26, 35)
Relative suitability
Average annual sub basin land surface runoff (mm)
17 (5, 30)
Upstream lake volume (millions m3)
13 (10, 16)
Sub-basin average terrain slope (slope)
13 (10, 17)
Number of frost-free days (count)
11 (8, 14)
Sub-basin average silt fraction in top 5cm of soil (percent)
10 (8, 14)
Upstream watershed average organic carbon content in top 5cm of soil (tonnes/ hectare)
8 (3, 12)
Sub-basin wetland extent (percent cover)
3 (0, 5)
Lithological class (class)
2 (0, 5)
Human footprint in sub-basin (index value)
Model
brt
glm
mars
Maxent
rf

Freshwater Non-native Species Invasiveness Assessment

Species: *Scientific Name* **Tinca tinca** *Common Name* **Tench**

Alaska Occurrence Records: species occurrences found in Alaska - **0**[1,2]

Outside Occurrence Records: species occurrences found outside Alaska, United States (other 49 United States and British Columbia, Canada) – **286**[3]

Invasiveness Risk Ranking: based upon ASK-IK ranking tool - **Moderate**[4]

Potential Vectors:

Uncertain

Species Group:

Fish

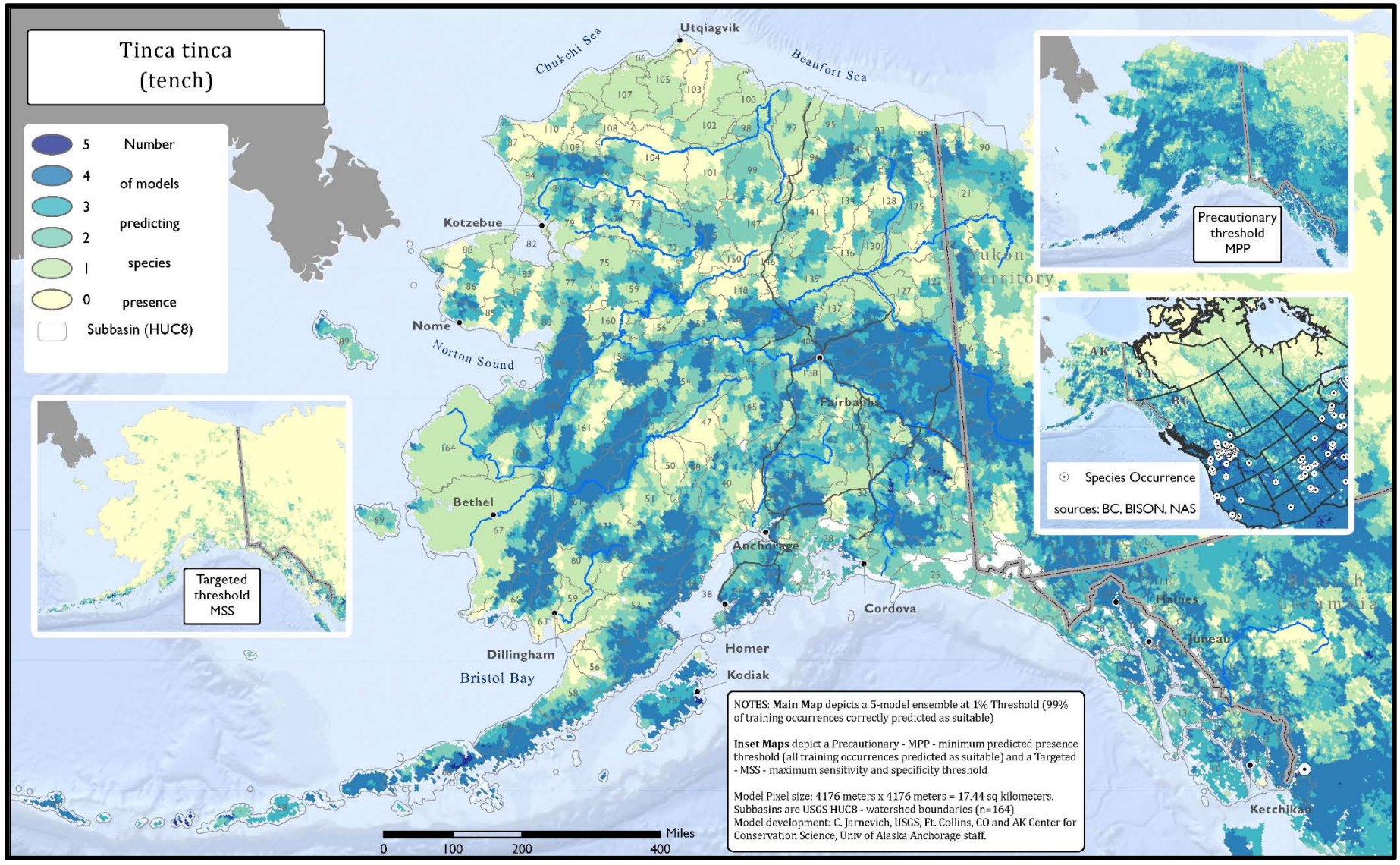
Data Sources:

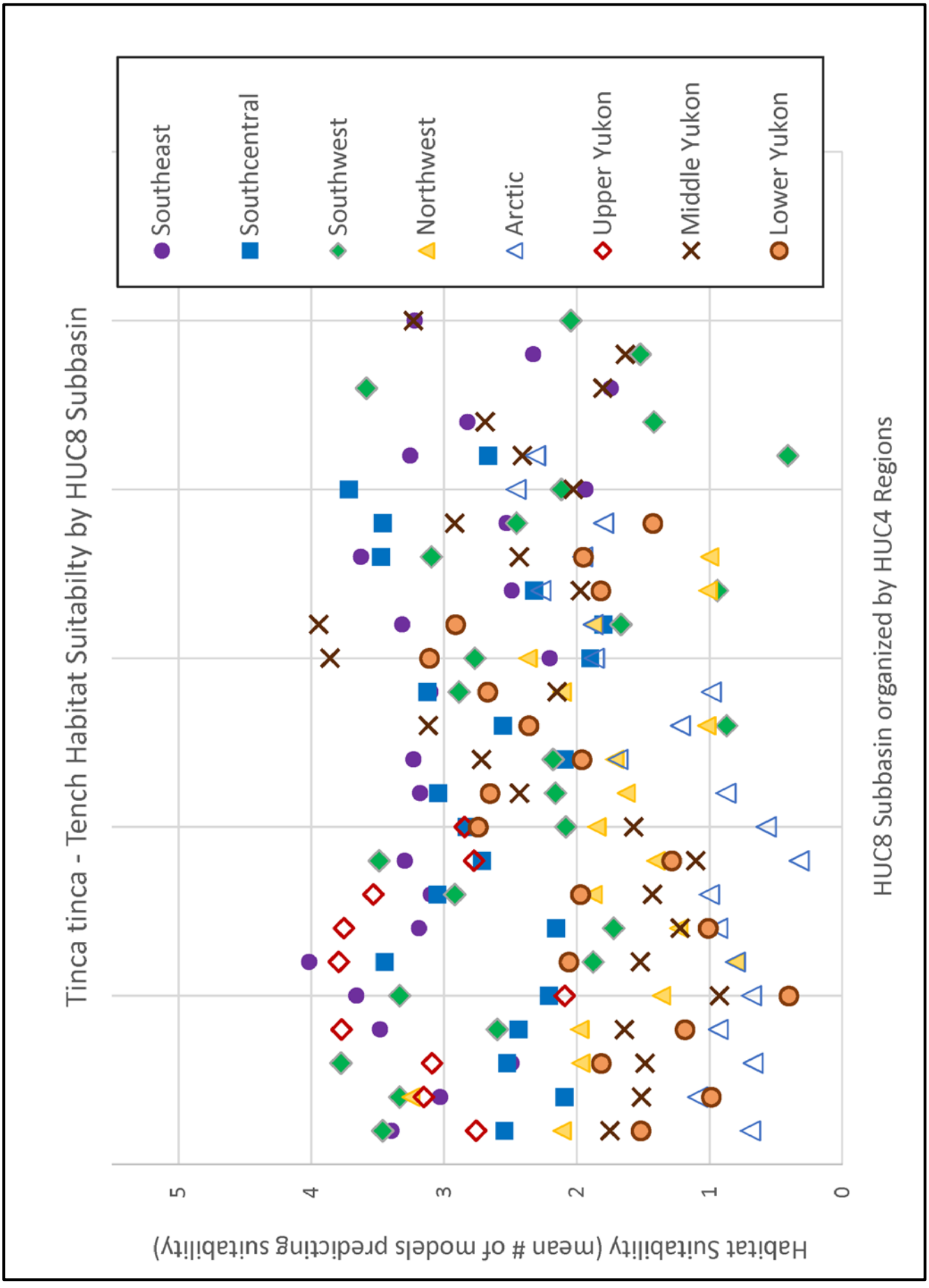
[1]GBIF, 2022. Global Biodiversity Information Facility North America Region. (www.gbif-north-america.org). Formerly, BISON (Biodiversity Information Serving Our Nation) https://bison.usgs.gov/#home

[2]U.S. Geological Survey (USGS). 2020. Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov.

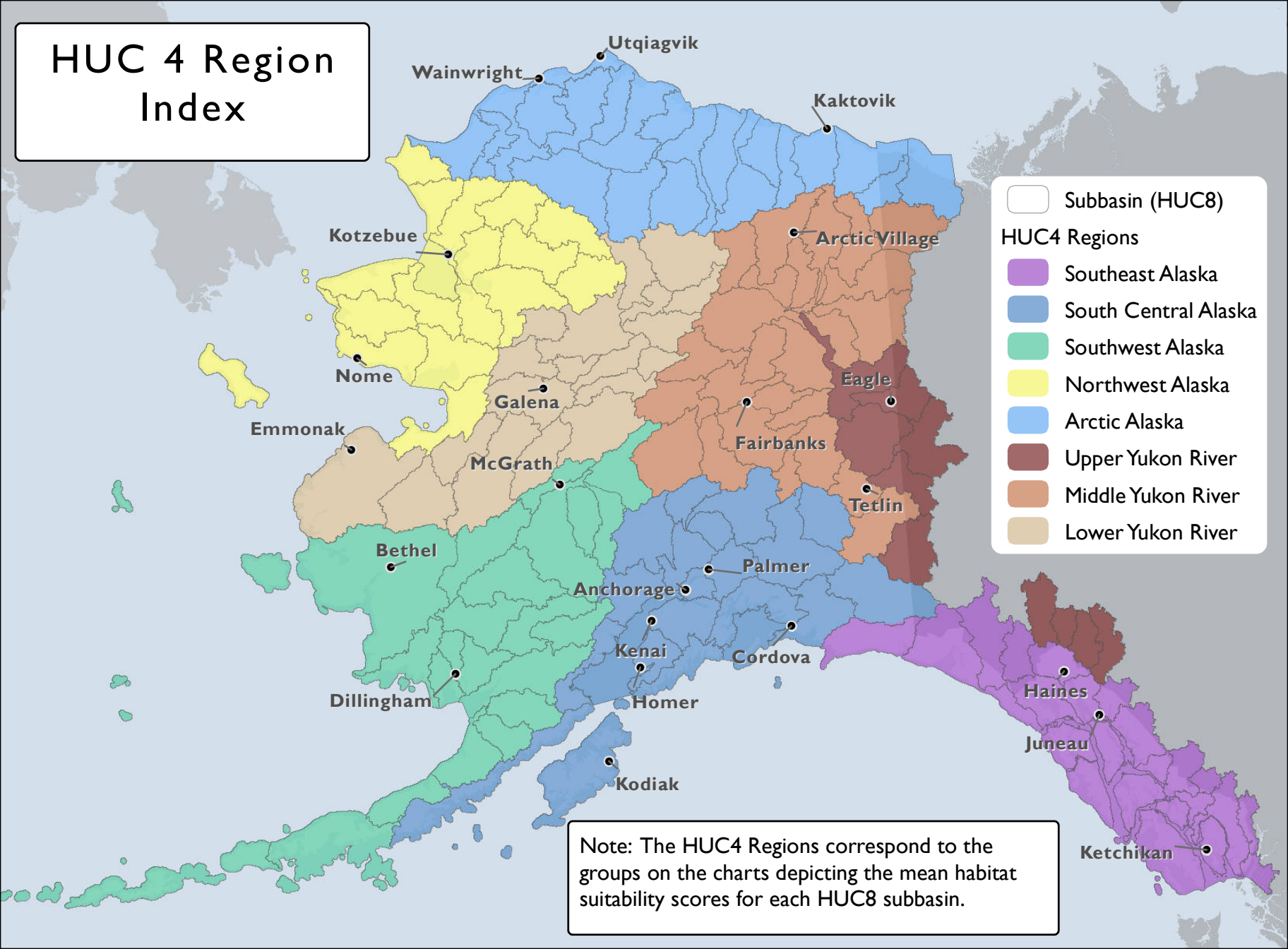
[3]BC (Province of British Columbia, Canada). 2020. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species

[4]Copp, GH, L Vilizzi, H Tidbury, PD Stebbing, AS Tarkan, L Miossec, & PH Goulletquer. 2016b. Development of a generic decision-support tool for identifying potentially invasive aquatic taxa: as-ISK. Management of Biological Invasions 7: 343–350. https://doi.org/10.3391/mbi.2016.7.4.04. (https://www.cefas.co.uk/services/research-advice-and-consultancy/non-native-species/decision-support-tools-for-the-identification-and-management-of-invasive-non-native-aquatic-species/)


Tinca tinca
(tench)
5 Number
4 of models
3 predicting
2 species
1
0 presence
Subbasin (HUC8)
Chukchi Sea
Beaufort Sea
Utqiagvik
Kotzebue
Nome
Norton Sound
Bethel
Fairbanks
Anchorage
Cordova
Haines
Juneau
Ketchikan
Dillingham
Bristol Bay
Homer
Kodiak
Yukon Territory
Precautionary threshold MPP
Targeted threshold MSS
Species Occurrence
sources: BC, BISON, NAS
AK
YT
BC
Miles
0 100 200 400
NOTES: Main Map depicts a 5-model ensemble at 1% Threshold (99% of training occurrences correctly predicted as suitable)
Inset Maps depict a Precautionary - MPP - minimum predicted presence threshold (all training occurrences predicted as suitable) and a Targeted - MSS - maximum sensitivity and specificity threshold
Model Pixel size: 4176 meters x 4176 meters = 17.44 sq kilometers.
Subbasins are USGS HUC8 - watershed boundaries (n=164)
Model development: C. Jarnevich, USGS, Ft. Collins, CO and AK Center for Conservation Science, Univ of Alaska Anchorage staff.


Tinca tinca - Tench Habitat Suitabilty by HUC8 Subbasin
Habitat Suitability (mean # of models predicting suitability)
HUC8 Subbasin organized by HUC4 Regions
Southeast
Southcentral
Southwest
Northwest
Arctic
Upper Yukon
Middle Yukon
Lower Yukon
0
1
2
3
4
5

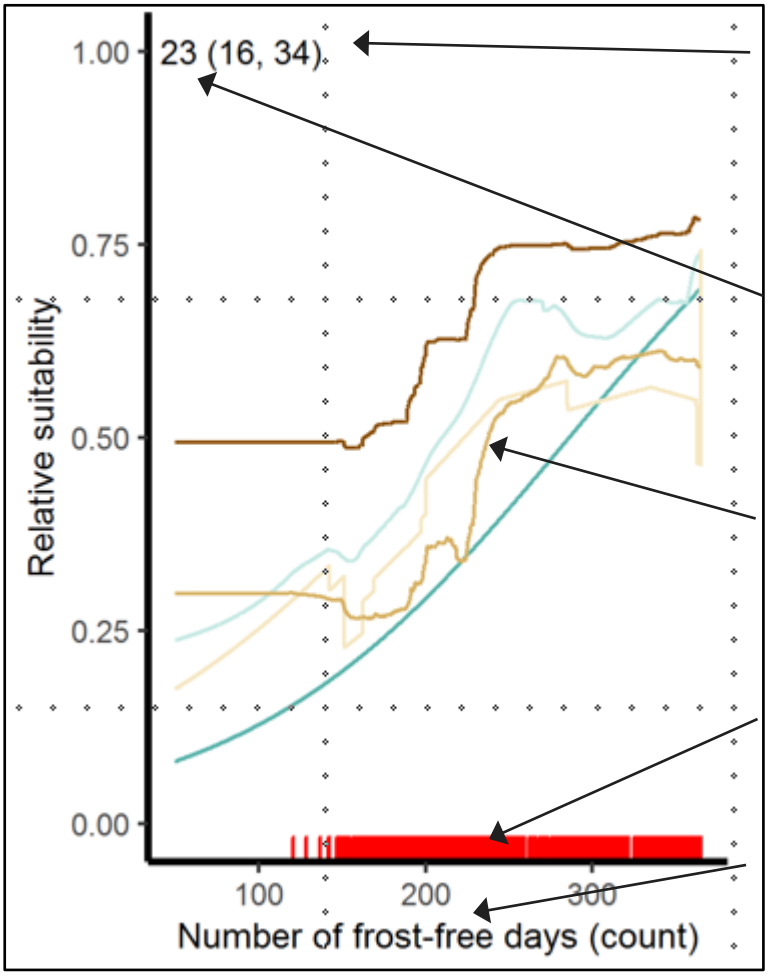
HUC 4 Region Index



Note: The HUC4 Regions correspond to the groups on the charts depicting the mean habitat suitability scores for each HUC8 subbasin.

Model Criteria Response Curve Matrix

The maps and chart presented on the previous two pages are composite outputs of the five separate habitat suitability models. The matrix of graphs on the next page represents the criteria datasets[1] which are the models' inputs. The criteria graphs are arrayed in descending order of relative importance for each focal species from upper left across top row and then across second and third rows from left to right. The example graph is annotated to explain the details of the matrix



(Low, High) – Range of this predictor variable's importance across 5 habitat suitability models (lowest value is 16%, highest is 34%)

Average relative importance of the predictor across 5 models (e.g. this variable represents 23% of the overall suitability)

Each colored line represents one of five models in the ensemble.

Red tick marks represent the species occurrence data

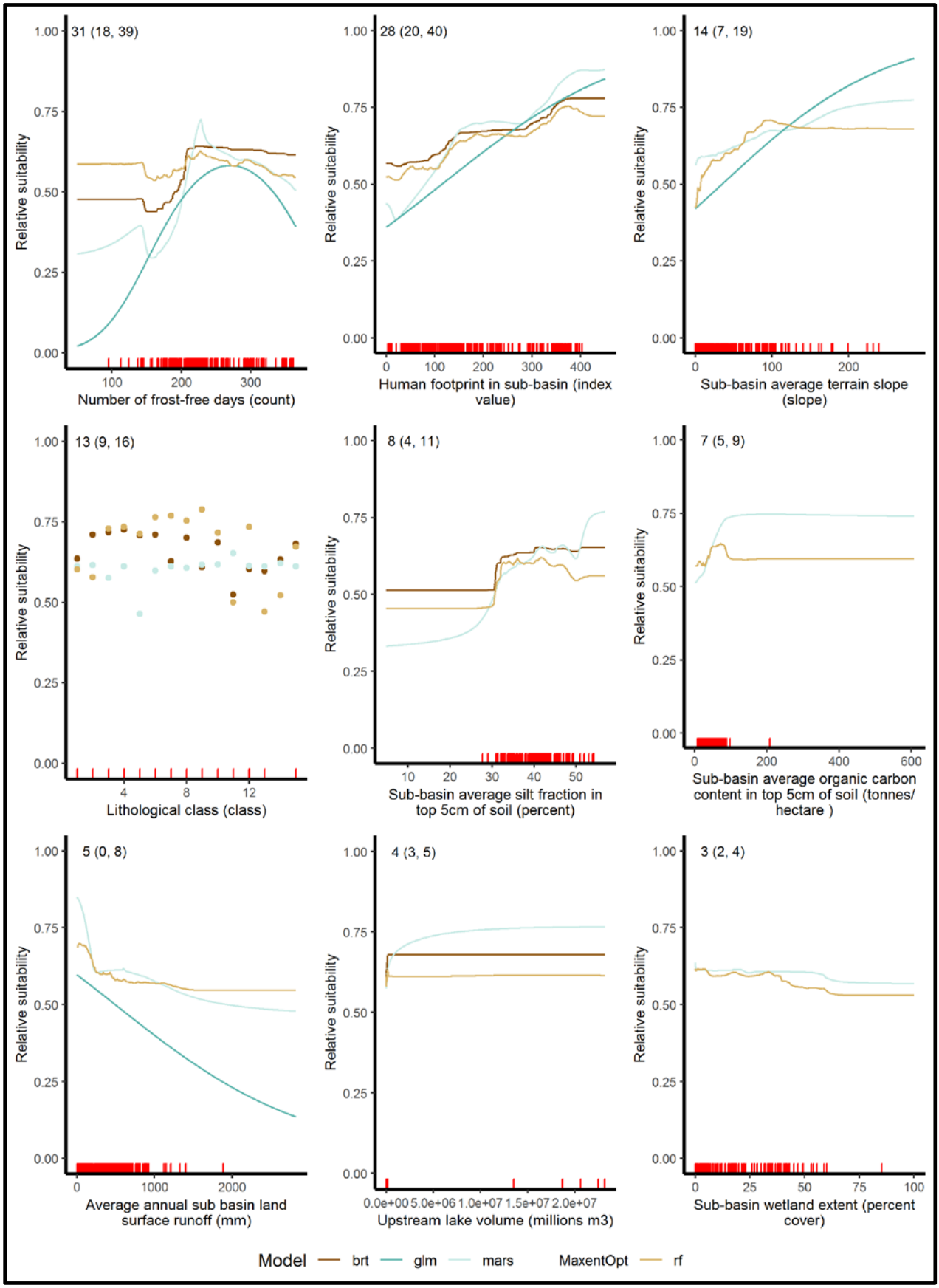
Variable Name

Data Sources: Model Criteria - HydroSheds Hydro Atlas https://www.hydrosheds.org/page/hydroatlas

Natural Discharge, Subbasin Surface Runoff, Upstream Lake Volume, Terrain Slope, Wetland Extent

Lithological (Geology), Soil Organic Carbon, Soil Silt Fraction, Snow Cover Extent, Human Footprint

Climate – Frost free days


31 (18, 39)
Number of frost-free days (count)
28 (20, 40)
Human footprint in sub-basin (index value)
14 (7, 19)
Sub-basin average terrain slope (slope)
13 (9, 16)
Lithological class (class)
8 (4, 11)
Sub-basin average silt fraction in top 5cm of soil (percent)
7 (5, 9)
Sub-basin average organic carbon content in top 5cm of soil (tonnes/ hectare)
5 (0, 8)
Average annual sub basin land surface runoff (mm)
4 (3, 5)
Upstream lake volume (millions m3)
3 (2, 4)
Sub-basin wetland extent (percent cover)
Relative suitability
Model
brt
glm
mars
MaxentOpt
rf

Invasive Vector Summary

Species			Vectors				
Taxon Name	**Common Name**	**Category**	**In State Transfer**	**Natural Migration**	**Stowaway & Contaminant**	**Importation and Release**	**Aquarium Release**
Lithobates catesbeianus	American bullfrog	Amphibian					1
Mysis diluviana	mysid crustacean	Crustacean			1		
Pacifastacus leniusculus	signal crayfish	Crustacean			1		
Alosa sapidissima	American Shad	Fish				1	
Carassius auratus	Goldfish	Fish				1	1
Channa argus	Northern Snakehead	Fish					
Cyprinus carpio	Common Carp	Fish	1				
Esox masquinongy	Muskellunge	Fish	1			1	
Gambusia holbrooki	Eastern Mosquitofish	Fish					
Ictalurus punctatus	Channel catfish	Fish				1	
Lepomis gibbosus	pumpkinseed	Fish					
Micropterus dolomieu	smallmouth bass	Fish	1			1	
Micropterus salmoides	Largemouth bass	Fish	1			1	
Morone americana	white perch	Fish	1				
Notemigonus crysoleucas	golden shiner	Fish					
Perca flavescens	yellow perch	Fish					
Pimephales promelas	fathead minnow	Fish					
Pomoxis nigromaculatus	black crappie	Fish					
Richardsonius balteatus	redside shiner	Fish					

Invasive Vector Summary

Species			Vectors				
Taxon Name	**Common Name**	**Category**	**In State Transfer**	**Natural Migration**	**Stowaway & Contaminant**	**Importation and Release**	**Aquarium Release**
Salmo trutta	brown trout	Fish		1		1	
Salvelinus fontinalis	brook trout	Fish		1		1	
Sander vitreus	walleye	Fish				1	
Tinca tinca	tench	Fish					
Pectinatella magnifica	magnificent bryozoan	Invertebrate					
Corbicula fluminea	Asiatic clam; Asian clam	Mollusk			1		
Dreissena bugensis	quagga mussel	Mollusk			1		
Dreissena polymorpha	zebra mussel	Mollusk			1		
Potamopyrgus antipodarum	New Zealand mud snail	Mollusk			1		

Appendix 3. Cumulative Vulnerability within a HUC8 subbasin.

For each species, habitat suitability is evaluated by 5 different models in binary fashion either a 1 for suitable habitat or a 0 for unsuitable habitat. These scores are generated for each model mapping unit, a square with 4167-meter sides (17.44 square kilometers) and then summed across all five maps. Each mapping unit has a value ranging from 0 (no models predict suitability) to 5 (all models predict suitable habitat).

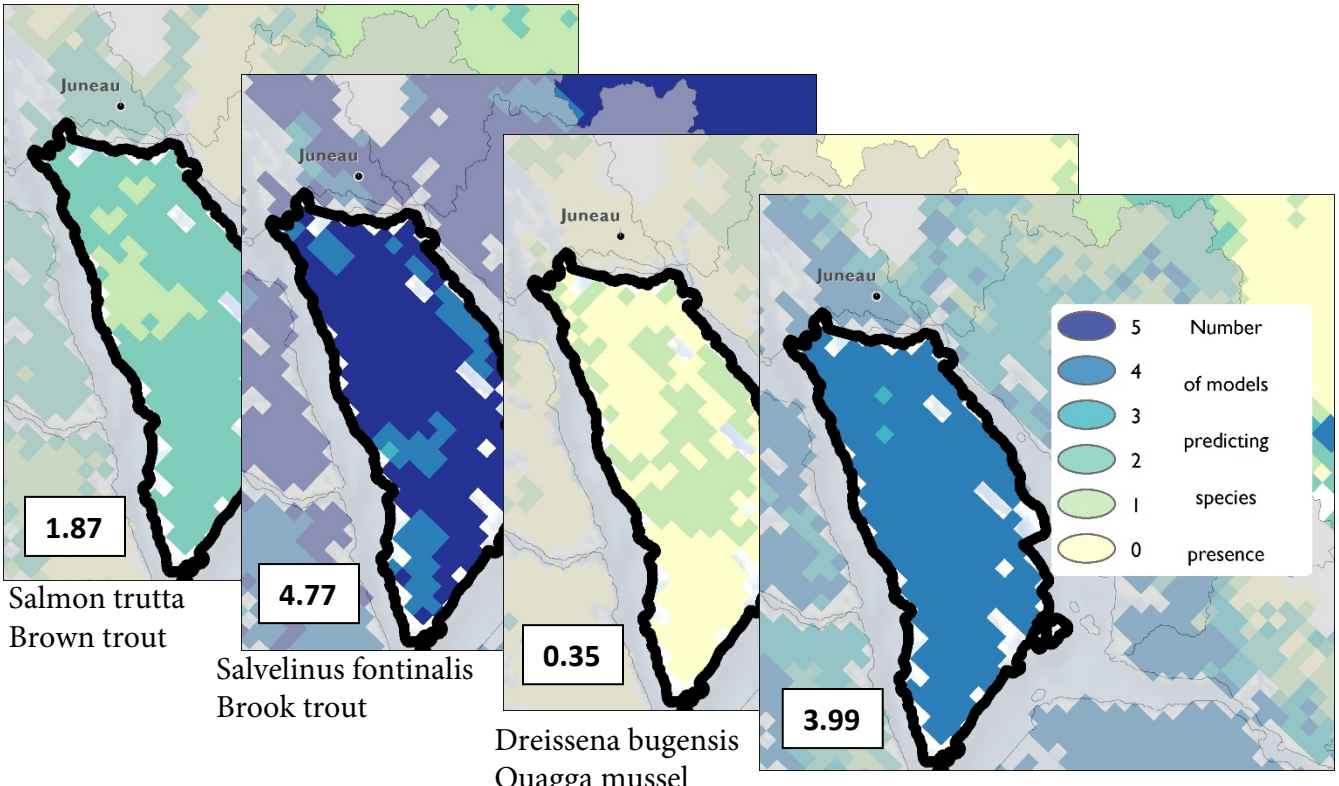
The cumulative vulnerability is calculated by deriving a mean habitat suitability score for each species by summing all of the mapping unit values within a subbasin and then dividing by the number of map units. Then we added the mean species scores to create a cumulative vulnerability. The maximum cumulative vulnerability score for a subbasin would be 5 (all models predict suitability) x 28 (total # of species) = 140. The mean cumulative vulnerability across all 164 Alaska subbasins was 50.68. Scores ranged from a high of 75.09 (Prince of Wales HUC8 19010103) to a low of 35.52 (Middle Fork Kuskokwim River HUC8 19030407). We plot cumulative invasive vulnerability for all subbasins and for the top 10% of subbasins.

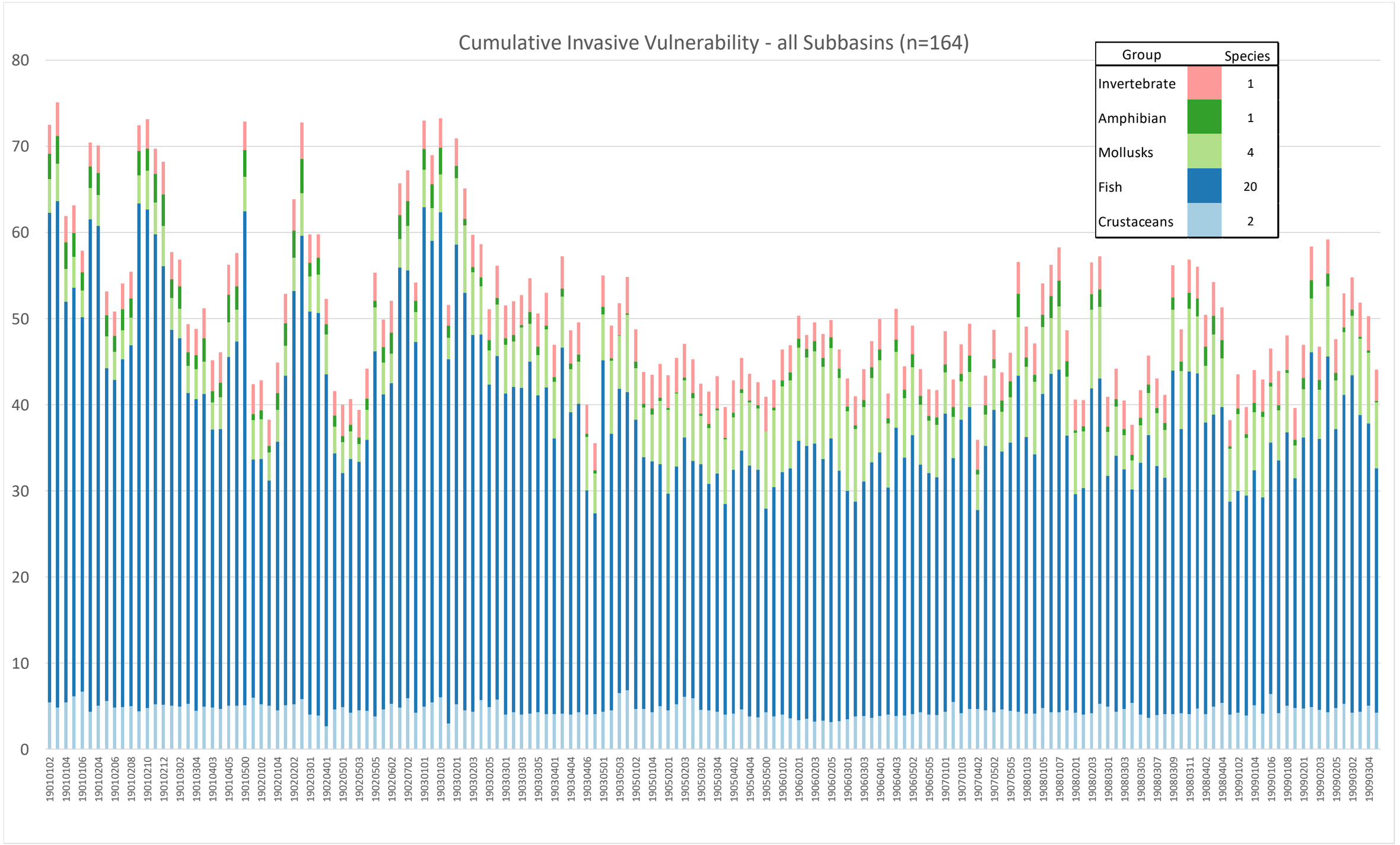
We used the VisTrails Software for Assisted Habitat Modeling (SAHM) software (version 2.2.1; Morisette et al. 2013)

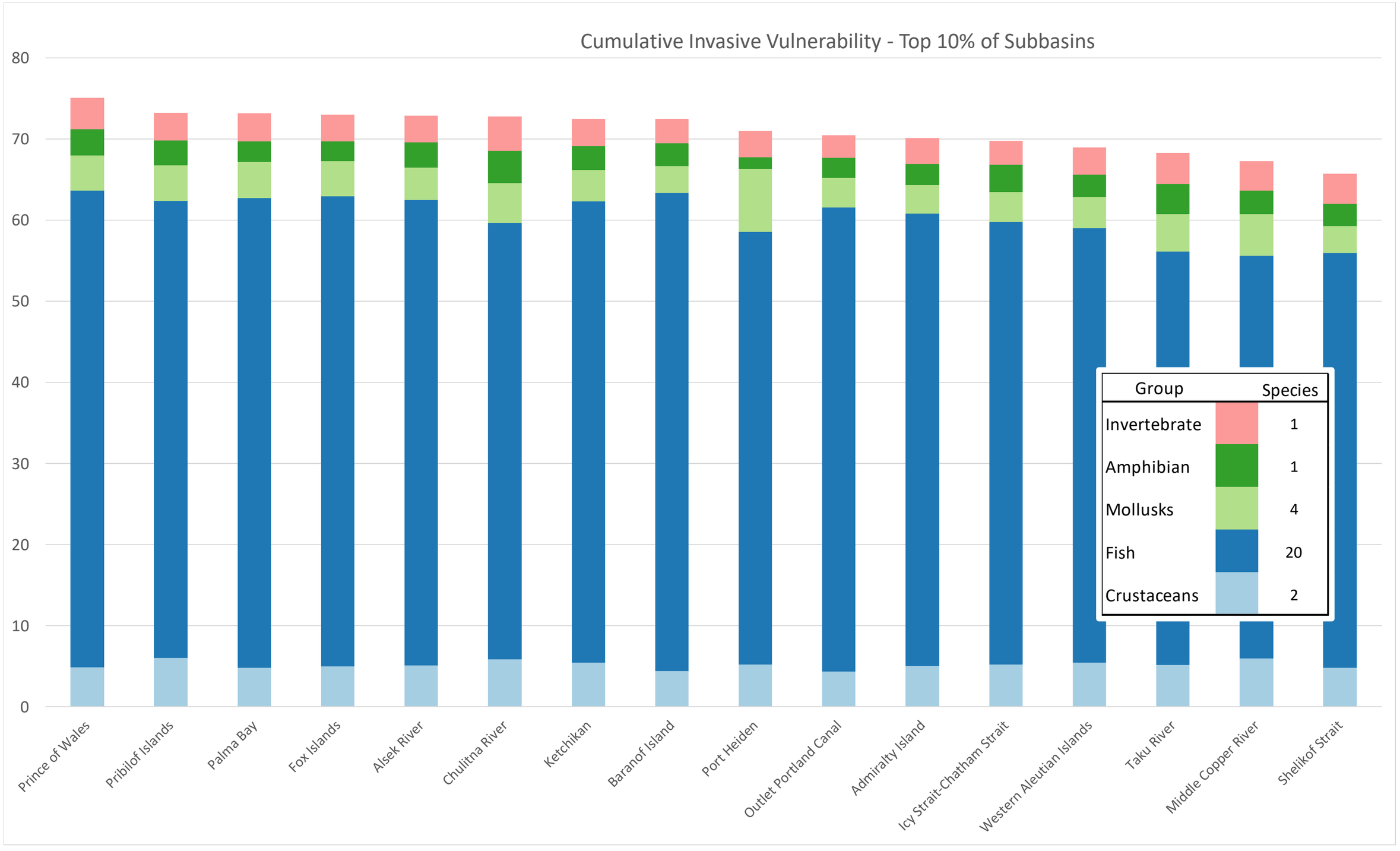
Morisette, JT, CS Jarnevich, TR Holcombe, CB Talbert, D Ignizio, MK Talbert, C Silva, D Koop, A Swanson, & NE Young. 2013. VisTrails SAHM: visualization and workflow management for species habitat modeling. Ecography 36:129–135.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Example: Admiralty Island subbasin (HUC8 19010204) displaying four of twenty-eight total species-specific habitat suitability model mean ensemble scores.




Cumulative Invasive Vulnerability - all Subbasins (n=164)
Group
Species
Invertebrate
1
Amphibian
1
Mollusks
4
Fish
20
Crustaceans
2
80
70
60
50
40
30
20
10
0
19010102
19010104
19010106
19010204
19010206
19010208
19010210
19010212
19010302
19010304
19010403
19010405
19010500
19020102
19020104
19020202
19020301
19020401
19020501
19020503
19020505
19020602
19020702
19030101
19030103
19030201
19030203
19030205
19030301
19030303
19030305
19030401
19030404
19030406
19030501
19030503
19050102
19050104
19050201
19050203
19050302
19050304
19050402
19050404
19050500
19060102
19060201
19060203
19060205
19060301
19060303
19060401
19060403
19060502
19060505
19070101
19070103
19070402
19070502
19070505
19080103
19080105
19080107
19080201
19080203
19080301
19080303
19080305
19080307
19080309
19080311
19080402
19080404
19090102
19090104
19090106
19090108
19090201
19090203
19090205
19090302
19090304


Cumulative Invasive Vulnerability - Top 10% of Subbasins
80
70
60
50
40
30
20
10
0
Prince of Wales
Pribilof Islands
Palma Bay
Fox Islands
Alsek River
Chulitna River
Ketchikan
Baranof Island
Port Heiden
Outlet Portland Canal
Admiralty Island
Icy Strait-Chatham Strait
Western Aleutian Islands
Taku River
Middle Copper River
Shelikof Strait
Group
Species
Invertebrate 1
Amphibian 1
Mollusks 4
Fish 20
Crustaceans 2