YUKON NORTH SLOPE BASELINE ECOLOGICAL AND CULTURAL CONSERVATION ASSESSMENT:

TRADITIONAL KNOWLEDGE-BASED GOOSE HABITAT MODEL

FINAL REPORT

PREPARED BY
ROUND RIVER CONSERVATION STUDIES

PREPARED FOR
WILDLIFE MANAGEMENT ADVISORY COUNCIL (NORTH SLOPE)

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Contents

Acknowledgements 3
Introduction 4
Methods and Results 4
Nesting Habitat 5
Staging 5
Foraging 6
Weighting 6
Habitat Suitability Index Model and Mapping 7
Validation 8
Supplement Information: Mapping Data Sources, Scales, and Buffering 9
Ecological Communities 9
Landscape Features 9
Hydrological Features 10
Buffering 10
Projection and Resolution of Habitat Model 10
Bibliography 11
Tables and Figures 12

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Introduction

The Inuvialuit Final Agreement (IFA) was legislated in 1984 and identifies that the management priority for the Yukon North Slope (YNS) is the conservation of the land, waters, wildlife and Inuvialuit traditional use. The IFA also formed the Wildlife Management Advisory Council (North Slope) or WMAC (NS) with the mandate to advise on all matters related to wildlife management on the YNS, including the preparation of a Wildlife Conservation and Management Plan. WMAC(NS) is currently in the process of updating the existing Wildlife Conservation and Management Plan ('Wildlife Plan') and is working closely with the Aklavik Hunters and Trappers Committee (Aklavik HTC) in developing the process, approach, and goals for the new plan. The revised Wildlife Plan will include climate-informed and spatially-explicit information and analyses of current and potential future conditions of the Yukon North Slope that affect the land, waters, wildlife and Inuvialuit traditional use. As part of these revisions, WMAC is working with Round River Conservation Studies in the development of a spatially-explicit Baseline Ecological and Cultural Conservation Assessment (BECCA) to support translating the conservation principles of the IFA to on-the-ground management guidance. This work includes developing habitat models and maps for focal fish and wildlife species identified by the Aklavik HTC.

The revisions to the Wildlife Plan will emphasize greater incorporation of Inuvialuit Traditional Knowledge (TK) and Traditional Use (WMAC(NS) and AHTC 2018b), including TK regarding important YNS fish and wildlife habitats (WMAC(NS) and AHTC 2018a). Inuvialuit TK of habitat for focal fish and wildlife species will provide the basis for developing habitat models and maps for selected focal species. The TK-based habitat modeling described here, predicts habitat for geese, specifically yellowlegs *(Anser albifrons)* and snow geese (*Chen caerulescens*) across the Yukon North Slope.

Multiple species of geese use the YNS seasonally and are culturally significant species for Inuvialuit land-users. For this project, interviews and associated habitat modeling focused specifically on yellowlegs and snow geese, which make large seasonal migrations that pass through the Inuvialuit Settlement Region, including locations on the YNS (Hines et al 2006, Bartzen 2014). Throughout the arctic, both species of geese return to nest each spring, rearing their brood through the summer before migrating south in the fall (Giroux et al. 1984, Carriere et al 1999). Inuvialuit knowledge has already contributed to identifying critical habitat for geese across the study area (Bartzen 2014, WMAC(NS) and AHTC 2018a), and this research builds on existing knowledge of goose ecology to develop a habitat suitability model and predictive maps for geese across the YNS.

Methods and Results

We based our modeling efforts on the descriptions of 15 Inuvialuit land-users who described goose habitat during wildlife habitat traditional knowledge interviews in October and November 2016 (WMAC(NS) and AHTC 2018a). During these interviews, land-users were asked to describe the habitat of both yellowlegs and snow geese. Interviewees had the option of verbally describing habitat, indicating specific locations on a map, or selecting photographs of habitat types identified through Predictive Ecosystem Mapping (PEM) of ecological communities throughout the study area. Whenever possible, interviewees were asked to link their habitat descriptions to a specific species (yellowlegs or snow geese), however most participants referred to goose habitat generally and suggested that the locations and ecosystem types selected were used by both species of geese, as well as other birds (Canada geese, brants, etc.). Therefore, we modeled goose habitat generally and did not differentiate between yellowlegs and snow geese.

Interviewees described goose habitat seasonally, differentiating between the location of geese in the spring, when they return to the study area to nest, through the summer and into the fall, when geese begin their southward migration. These descriptions were then tied to a specific habitat use. We focused our interviews on nesting, foraging, and staging habitat, asking interviewees to describe the specific habitat types used for each activity.

Habitat descriptions that could be mapped were identified from each interview transcript and combined to create a table with a relative weight for each feature, corresponding to the number of individuals describing that feature across all interviews. These descriptions were then mapped by using relevant spatial data that represented the vegetation, topographical, or hydrological features described by interviewees. No interview participants identified goose habitat outside of the coastal plain (as defined in Map 1 and inclusive of the Mackenzie Delta), and there is a lack of published data to suggest that geese use habitat on the North Slope outside of this area. Therefore, we limited these models to the coastal plain regardless of habitat type, hydrology, or terrain features that exist in other areas.

Below, we describe the three main habitat types described by interviewees and provide detailed technical descriptions of the underlying data used to predict the occurrence of these habitat types across the study area.

Nesting Habitat

Twelve participants described nesting habitat, referring to locations where they either have seen geese nesting or have seen newborn goslings. These habitat types were described as important in the spring and early summer and were often observed as interviewees were traveling to or from near-shore camps. All 12 participants described the importance of the Hydric Sedge PEM unit (Table 1). Seven participants described the importance of proximity to open water, focusing their descriptions on the region identified as the coastal plain (Map 1). We represented these descriptions by buffering lakes within this region by 30 meters and selecting the habitat that occurred within these zones. Two individuals described coastal beaches as nesting habitat (Table 1). We represented this habitat by selecting the PEM class “Alluvial non-vegetated coarse texture” within 150m of the shoreline.

One participant emphasized the importance of open areas with a mix of tundra and willows. To model willows generally, we referred to our October 2016 habitat cross-walk workshop (WMAC and AHTC 2018a), in which many participants made clear that they refer to “willows” as all woody shrubs above knee height that are not coniferous. Therefore, we included non-willow vegetation, such as alder, in our selection of “willow” habitat types. Additionally, participants referred to willow-shrub (“above knee height”) species in their interviews, not ground cover species such as *Salix reticulata*, so we removed these dwarf willow species from our habitat selections for “willow” to reflect the definition of willow generated in our workshop. Any additional PEM classes selected through photo identification were also incorporated in the nesting habitat model (Table 1).

Staging

Staging habitat was described as any habitat where geese collected in large groups either as they entered the study area or prepared to leave. Multiple participants identified the importance of non-vegetated land either in the form of mud bars or river beaches (Table 2). To model “river beach” habitat, we selected the PEM classes Alluvial non-vegetated coarse texture and Alluvial non-vegetated fine texture. We restricted this selection to area over 150m from the shoreline, to differentiate between "river beaches" and "coastal beaches." To model mud bar habitat, we selected the same PEM classes, 150m from the shoreline, supplemented by the polygonal watercourse features in the hydrology dataset, as these are the rivers large enough to have significant mud bars. Any additional PEM classes selected through photo identification were also incorporated in the staging model (Table 2). While some interviewees did suggest that geese were beginning to stage further inland, these observations were limited and did not include detailed habitat descriptions or identify specific locations. Therefore, we limited our description of staging habitat to include only known staging locations and habitat requirements.

Foraging

Interviewees also described any habitat where they observed geese foraging. Foraging occurs throughout the period geese are present on the YNS, including while geese are nesting or staging, however participants often described geese flying back and forth from staging or nesting grounds to areas with high quality forage. Table 3 reflects the habitat descriptions that represent high quality forage for geese across the YNS throughout the spring, summer, and fall, and is composed largely of the PEM classes that were selected through photo identification and landscape descriptions based on topography or proximity to water.

The presence of berries was an important determinant of foraging habitat quality, particularly in the fall. While some participants selected specific PEM photos to represent areas with good berry habitat, four participants were unable to refine their habitat description beyond "general berry habitat." To model these areas, we selected PEM Classes where vegetation associations included one or more of the following species: mountain bearberry *(Arctostaphylus alpina)*, red bearberry *(Arctostaphylus rubra)*, kinnikinnick *(Arctostaphylus uva-ursi)*, crowberry *(Empetrum nigrum)*, soapberry *(Sheperdia canadensis)*, bog blueberry *(Vaccinium uliginosum)*, or lingonberry *(Vaccinium vitis-idaea)*. We categorized PEM classes as low or high-quality berry habitat based on the abundance of berries. We described PEM classes where berries were sparse as low-quality and PEM classes where berries were common, abundant, or dominant as high-quality. We adjusted the weighting of low-quality berry habitats to reflect the lack of abundance in these PEM classes (weighting described below).

Weighting

Each habitat attribute was given a weight based on the number of interviewees selecting the attribute (Tables 1-3). In many cases, an individual may have indicated multiple habitat attributes, some of which overlapped. For example, some participants described habitat with proximity to water, and then went on to select photo specific to wetland habitats. In these instances, we gave a weight to each habitat descriptor; water and the PEM unit represented in the photo. While this may have double-counted the regions in the study area where two or more of these attributes overlap, we believe it is the most accurate way to portray the knowledge of participants in a quantitative sense. Classifying as many descriptions of goose habitat as possible ensures that unique areas that may only be described by one or two individuals are represented, while areas that are of high importance may be selected multiple times.

Habitat Suitability Index Model and Mapping

To develop the YNS goose habitat models, we created raster (grid) spatial layers for each of the specific habitats identified by the interviewees, with each layer attributed with the interview weight for that specific habitat (Tables 1-3) at a resolution of 6m (PEM resolution). The layers for each specific behavior (nesting, staging, or foraging) were then combined by summing their respective weights and the summed score was rescaled to range from 0 to 1 by dividing by the maximum value. This rescaled layer was classified into 10 quantile bins to produce final maps with values of 1 – 10, with 1 indicating the lowest quality habitat and 10 the highest (Maps 2-4). Quantile bins attempt to approximate equal area bins; however, with so few inputs into both the nesting and the staging model, the possible combination of values limits the equal area distribution of these bins. For example, 73% of the nesting model is comprised of only one value, classified as bin 1, leaving only 21% of the total area to fill the remaining 9 bins. However, given the spatial distribution of the data, quantile classification remains the best way to capture the variability in habitat on the landscape. The combined habitat model (Map 5) was generated by summing the standardized nesting, staging, and foraging models, then reclassifying the output into 10 quantile bins similar to the individual models.

Because the PEM is of such a fine resolution, and the habitat descriptions from the TK interviews were so specific, the habitat of all three behaviors is modelled at a finer scale than any previously developed maps or models. Due to the fine scale of interpretation, and the limited inputs into some of the models, high quality habitat is confined to small, specific areas that tend to be widely distributed across the landscape (with the exception of the nesting model), making interpretation of the results at a regional or even sub-regional scale difficult.

The nesting habitat model (Map 2) highlights areas with large amounts of water, including shorelines of rivers and lakes, as well as swampy ecotypes near the coastal plain. The staging model (Map 3) displays more general distribution of habitat along the entirety of the coastal plain, while avoiding higher elevations in the more inland parts of the modelled area. The foraging model (Map 4) also shows a more general distribution along the coastal plain, although it tends to highlight areas where berries are likely to be present– including pockets of high quality habitat on Herschel Island and near Kay Point. Because the foraging model had the highest number of inputs (Table 3), it tends to dominate the combined habitat model (Map 5). Overall, goose habitat on the coastal plain appears to be widely distributed, with pockets of higher quality habitat in the Mackenzie Delta, near Kay Point, on Herschel Island, and at the mouths of the Firth & Malcolm rivers.

The mosaic of habitats along the coastal area of the YNS can be further understood by examining areas that contain overlapping habitat types, primarily the coastal areas that include the northwest portion of the Mackenzie Delta (Map 7) and Kay Point (Map 8). Both areas were highlighted in the TK interviews as containing high ecological diversity that supports a combination of nesting, foraging, and staging habitat within a relatively small area. Nesting habitat in these areas is more concentrated and highly associated with water, whereas foraging and staging habitat are more dispersed and often overlap with one another.

Although our BECCA study area extent (Map 1) includes parts of Alaska and the Northwest Territories, the final extent of the goose habitat model was limited to the Yukon portion of the ISR based on the extent of the existing PEM.

Validation

With an absence of GPS location data for goose populations, we relied on areas identified by interview participants as known goose habitat (Maps 2-5) to validate our model. During the interview process, participants were asked to identify known nesting, staging, and foraging habitat on a 1:250,000 scale map of the study area (WMAC and AHTC 2018a). This resulted in 50 polygons that we overlaid on predicted goose habitat maps in a compositional analysis to assess the level of concurrence between known nesting, staging, and foraging locations and modeled habitat suitability. Given the difference in resolution of fine scale (6m) PEM-based habitat modeling and polygons drawn on a 1:250,000 scale map, a direct comparison is not possible between data sources, however overlaying both data types allow for a coarse comparison between known and predicted habitat maps.

Predicted nesting habitat overlaps significantly with areas identified by Inuvialuit land-users. In all TK-based polygons representing nesting areas, 5% of the pixels represent high-quality modeled habitat, compared to only 0.5% of pixels in the entire modelled extent. Given the specificity of nesting habitat requirements and the fine scale of mapping, the greater occurrence of high-quality pixels within nesting polygons represents a large difference in habitat suitability to surrounding areas. Specifically, land-user identified nesting areas in the Mackenzie Delta, Kay Point, and the mouth of the Firth River overlap significantly with predicted high-quality habitat based on vegetation, topography, and hydrography associations.

Both predicted and known foraging habitat are widespread throughout the study area. Modeled habitat shows high quality foraging areas distributed widely across the coastal plain. This agrees with land-user verbal descriptions of goose foraging behavior, in which interviewees described geese flying back and forth, across the study area, between foraging locations and their nesting or staging grounds. TK polygons of known foraging habitat are less expansive and tend to exist closer to the coast where land-users are frequently traveling. While these polygons do not have the same extent as predicted habitat, at least 17% of pixels contained within them are modeled as high-quality habitat, compared to only 6% of pixels across the modelled area.

Staging habitat is the most spatially restricted of land-user identified polygons, while modeled habitat remains expansive throughout the coastal plain. Though the polygons identified as staging sites do include high quality predicted habitat, they are limited to specific locations throughout the study area (Map 3). This may suggest that characteristics other than those modeled (terrain, vegetation, and hydrography), influence the locations of staging sites and that these locations are unique to the surrounding study area.

To validate goose habitat, generally, we combined all polygons identified by land-users as either goose nesting, foraging, or staging habitat, and overlaid them on a model that also combined all three habitat types. This map shows a high degree of concurrence between both predicted and TK polygons (Map 5), particularly in high value nesting areas.

We also considered the harvesting points and polygons collected as part of the Inuvialuit Traditional Knowledge (TK) and Traditional Use study (WMAC(NS) & AHTC 2018b) in validating the overall model. There were 16 points and 20 polygons, covering a total of 567km^2 (mostly overlapping in the delta area) within our modelled area (Map 6). All polygons contained habitat identified as the highest quality (bins

8-10). Thirteen out of sixteen points were located in the highest quality habitat, fifteen out of sixteen were within 30m of high-quality habitat, and all points were within 100m of high quality habitat.

Supplement Information: Mapping Data Sources, Scales, and Buffering

Ecological Communities

We based our mapping of ecological communities on the combined Predictive Ecosystem Maps for Ivvavik National Park and the Eastern North Slope. The Ivvavik PEM (Ponomarenko et al. 2011) was resampled from 5m to match the resolution of the Eastern North Slope PEM at 6m resolution. The combined PEM was passed through several filters to remove lone pixels and null value areas, which were replaced by majority filtering.

Some individual ecotype classes and TK subclasses were lost after the revisions to the Eastern North Slope PEM that occurred after our TK interviews were completed or when the Eastern North Slope PEM was cross-walked with the Ivvavik PEM. TK classes in which there was little change from the original classification (i.e., Timber, Rivers and Creeks) were retained; however, some TK classes were dropped entirely and as a result the TK Habitat Classification can no longer be mapped as wall-to-wall coverage. We used this final cross-walked PEM to map verbal descriptions of vegetation as well as map the remaining TK Habitat Classes that were selected through photo-identification.

Landcover products outside the ISR (Alaska to the west, Northwest Territory to the east, and a buffer to the south) were investigated with the goal of creating a wall-to-wall vegetation layer for the BECCA planning area which is larger than the YNS, as this would provide valuable information for connectivity models and additional landscape values. However, this would require six different landcover products to model the entire extent -- both PEMs, the North Slope Science Initiative (NSSI) PEM [Alaska], the National Landcover Dataset [Alaska], the Canadian Northern Landcover circa 2000, and the more general Canadian Landcover circa 2000. These six products all varied drastically in both spatial and ecotype resolution, and cross-walking them would degrade the PEM data we have within the Yukon ISR. Therefore, we decided to model the most relevant areas in which the best data exists, limiting modelling to the Yukon North Slope.

Landscape Features

We based our terrain mapping on 1:50,000 Canadian Digital Elevation Data (CDED) tiled Digital Elevation Models (DEMs). The CDED dataset was chosen over other potential elevation sources because it was continuous into the Northwest Territories and presented fewer anomalies along seamlines after mosaicking. Because many participants referenced the "mountains" (higher elevation, steeper terrain) and the "coast" (rolling hills and flat plains) in their habitat descriptions, we used this elevation data to spatially differentiate these landscapes in our analysis. Potential existing definitions (bioclimate zones, ecoregions, etc.) were too coarse in scale to apply to our data but were used as general guidelines. After testing different input variable combinations, we were able to define the mountainous region using elevation (Elevation > 250m) and terrain complexity (Terrain Ruggedness Index (TRI; Riley et al 2007; @ 1,000m > 300). These two variables were merged, and the resulting layer was simplified to removed holes, islands, and other anomalies to create a smooth, wall-to-wall classification. The small area of the Mackenzie Delta that passes through the northeastern corner of the YNS was digitized to identify it, so that descriptions specific to the delta system could be queried in the future (Map 1). As mentioned in previous sections of this report, we limited the extent for the goose habitat models to the coastal plain inclusive of the Mackenzie Delta.

To identify landforms described in TK interviews (i.e., “steep banks”, “rolling hills”, etc.) we mapped the Topographic Position Index (TPI; Weiss 2001), which identifies a pixel’s location on a landscape relative to neighboring pixels (i.e., ridge top, valley, etc.), at a variety of scales between 50 – 3,000 m. We then combined TPI’s from smaller and larger scales to produce a map of 10 landform classes that provide a richer interpretation of the landscape (Figure 1). Landforms were mapped at four different scales (50 – 300m, 200 – 1,000m, 500 – 2,000m, and 700 – 3,000m) utilizing eight scales of TPI. When selecting terrain features that occur within the mountainous region of the study area, we used larger-scale landforms (700 – 3,000m). When selecting terrain features that occur in the flatter region of the study area, we often supplemented the larger-scale landform definitions with higher resolution (50 – 300m) ones when necessary to capture the small-scale topographic differences that influence habitat on the coastal plain.

Hydrological Features

For base hydrologic inputs (rivers, watercourses, waterbodies, hydro junctions), we used Natural Resource Canada’s National Hydro Network (NHN) at a scale of 1:50,000. First order streams were identified based on initial junction-to-junction relationships, but higher stream orders could not be further delineated.

Buffering

We buffered the large river polygons and coastlines at 100m. The available polygonal dataset that represents these rivers, and the linear representation of coast lines, does not account for their greater zone of influence. Because these rivers are frequently changing size and path, based on environmental conditions such as precipitation or temperature, and because of the dynamic nature of coastline habitats, we treated them with a larger buffer to better capture their presence in the study area.

Projection and Resolution of Habitat Model

The modeling relied on three main inputs: vegetation (cross-walked PEM), hydrology (rivers, lakes, and watercourses from the NHN), and derived terrain variables (calculated from the CDED). The NHN and the CDED are both produced in the NAD 1983 geographic coordinate system. The final TK moose model was produced in NAD83 UTM Zone 7N projection. We chose this projection because it is the same projection in which the original PEM was produced, making it consistent with most of the inputs into the model. All analyses of the rivers and terrain features were done in the native NAD 1983 coordinate system to minimize distortion and projected into UTM as the last step of processing before input into the model.

The final resolution of this model is 6 m, which matches the spatial resolution of the cross-walked PEM. All vector layers were rasterized using this resolution and snapped to the PEM. Terrain data was mostly used for queries, and therefore kept in its native resolution (~16m) but any terrain features that went directly into the model were resampled to a resolution of 6m. This was done so as not to degrade the accuracy of the PEM.

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Tables and Figures

Table 1. TK descriptions of goose nesting habitat, number of participants identifying each habitat feature, and the GIS query used to represent the description spatially

Habitat Feature Description	Weight	GIS Query
PEM Class Hydric Sedge	12	PEM Class
Close to Water	7	30m buffer around lakes on coastal plain
Coastal Beaches	2	PEM Class Alluvial non-vegetated coarse texture within 150m of coastline
Coast of Herschel Island	2	Coast of Herschel Island buffered 100m
Lowlands with Mudbars	1	Polygonal watercourse features supplemented by PEM Classes Alluvial non-vegetated coarse texture and Alluvial non-vegetate fine texture
PEM Class (Shrub) Sedge Fen	1	PEM Class
Flat areas with Willows and Water	1	Mackenzie Delta portion of the YNS
Flat Open Country with Sparse Willows, Open tundra, and Water	1	Intersection of willows (buffered 30m) and lakes (buffered 30m) on coastal plain

Table 2. TK descriptions of goose staging habitat, number of participants identifying each habitat feature, and the GIS query used to represent the description spatially

Habitat Feature Description	Weight	GIS Query
Tundra/low flatlands	6	TK Class (PEM Classes (Shrub) Sedge Fen and Tussock
Close to Water	4	Polygonal rivers and lakes on the coastal plain, buffered 100m
Swamps	2	TK Class (PEM Classes Hydric Sedge and Non-vegetated peat)
Mudbars	2	Polygonal watercourse features, supplemented by PEM Classes Alluvial non-vegetated coarse texture and Alluvial non-vegetated fine texture
PEM Class Herb-willow Riparian	2	PEM Class
PEM Class Mesic Sparse Low Shrub Tundra	1	PEM Class
PEM Class (Shrub) Sedge Fen	1	PEM Class
PEM Class Hydric Sedge	1	PEM Class
River Beaches	1	PEM Class Alluvial non-vegeated coarse texture and PEM Class Alluvial non-vegetated fine texture more than 150m from ocean shoreline
Rivers Along the Coast	1	Buffered (150m) watercourse polygons within 2km of the ocean shoreline

*Table 3. TK descriptions of goose foraging habitat, number of participants identifying each habitat feature, and the GIS query used to represent the description spatially. *Four participants described goose foraging in "good berry habitat," we represented this description by selecting PEM classes where berries were common or dominant. To acknowledge that berries are present in other PEM classes, we created a "low quality berry habitat" feature, weighted by half, and included PEM classes where berries abundance was sparse.*

Habitat Feature Description	Weight	GIS Query
Close to Water	6	Polygonal rivers and lakes on coastal plain, buffered 100m
Tundra/Low Flatlands	6	TK Class (PEM Classes (Shrub) Sedge Fen and Tussock
PEM Class Hydric Sedge	5	PEM Class
High Quality Berry habitat*	4*	PEM classes Subxeric sSparse Dwarf Shrub Tundra, Heather Nivation Slope, Mesic Sparse Low Shrub Tundra, Shrub-Sedge Tussock, Dense Med-Tall Shrub, Sub-mesic Spruce, Mesic Spruce, Spruce-Alder (Willow)
Low Quality Berry Habitat*	2*	PEM classes Hydric Sedge, Tussock, Alder-Cottongrass Tussock, Subhygric Spruce Tussock
PEM Class Mesic Sparse Low Shrub Tundra	4	PEM class
PEM Class Shrub-Sedge Tussock	2	PEM class
TK Class Rivers and Streams	2	TK Class (PEM Classes Dense Low-Med Shrub, Herb-Willow Riparian and Dense Med-Tall Shrub)
Flat Areas Between Rivers Along Coast	1	"Flat slopes" in topographic position index (TPI) at a scale of 50m between polygonal watercourse features on coastal plain
Flat Wet Grassy Lowlands	1	PEM Classes Hydric Sedge and Tussock in flat areas, represented by "plains" in TPI at a scale of 50-300m
Rolling Hills Behind Coast	1	Open slopes in smallest scale (50-300m) landform analysis
PEM Class Slumps	1	PEM class
PEM Class Dense Low-medium Shrubs	1	PEM class
PEM Class Alder Cottongrass Tussock	1	PEM class
PEM Class Tussock	1	PEM class
PEM Class (shrub) Sedge Fen	1	PEM class
TK Class Swamps	1	TK Class (PEM Classes Hydric Sedge and Non-vegetated peat)

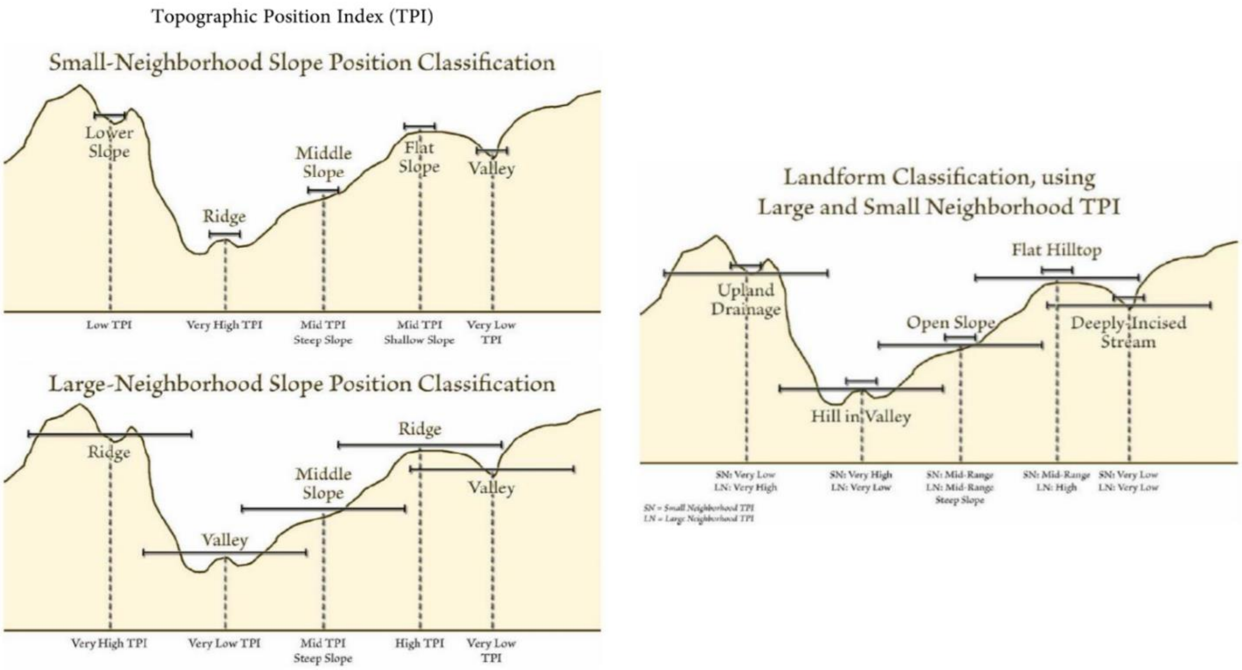
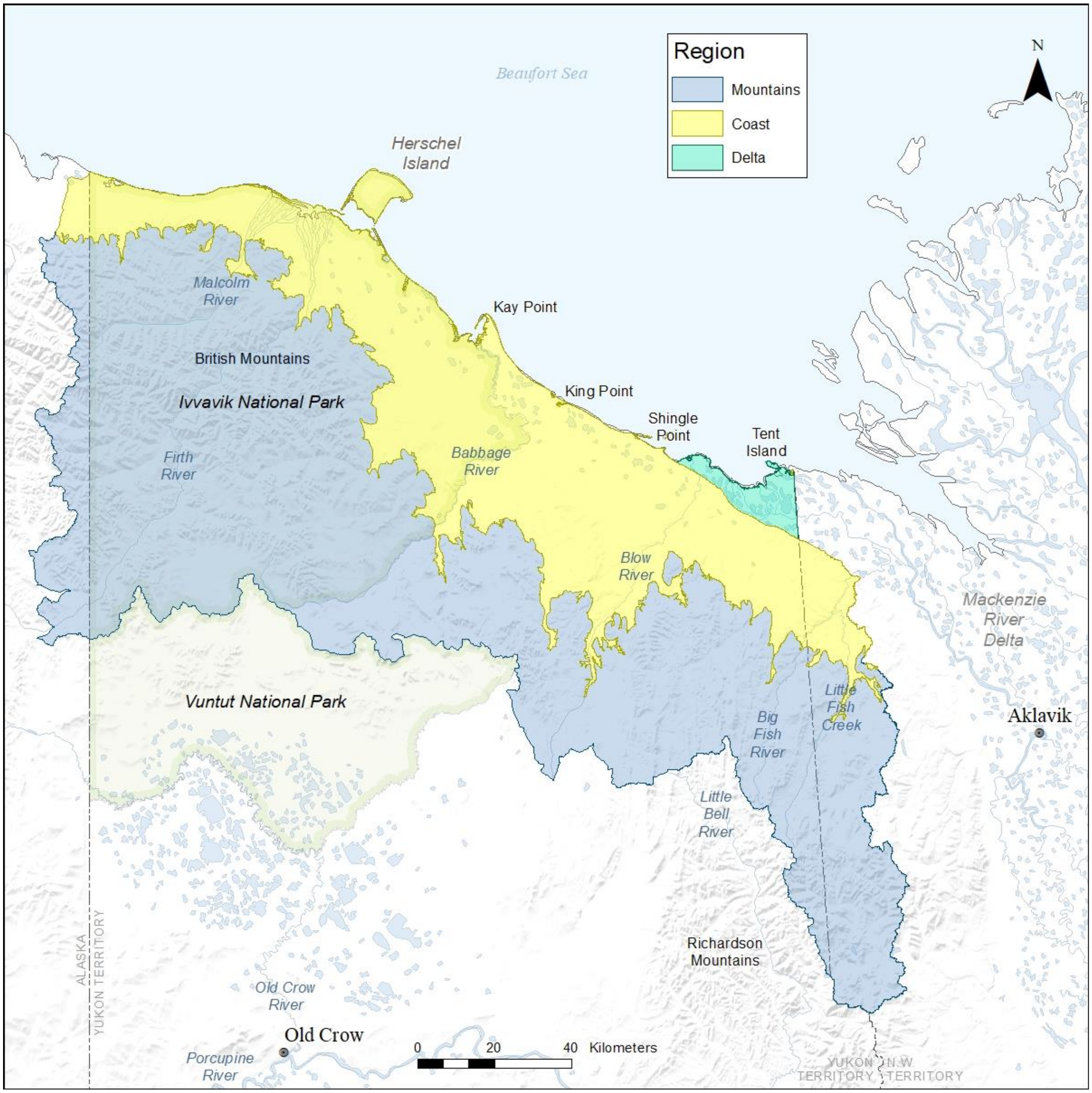
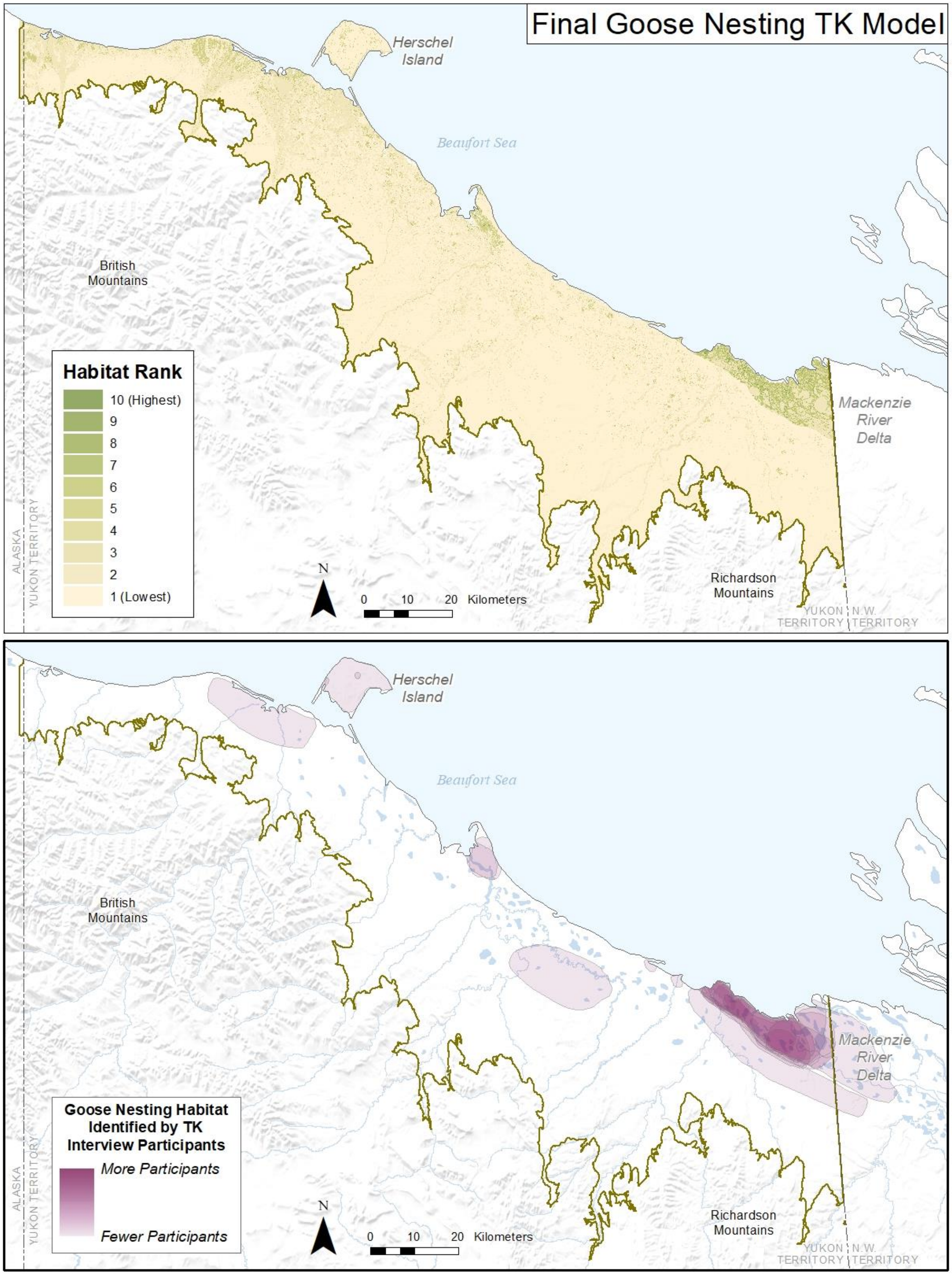


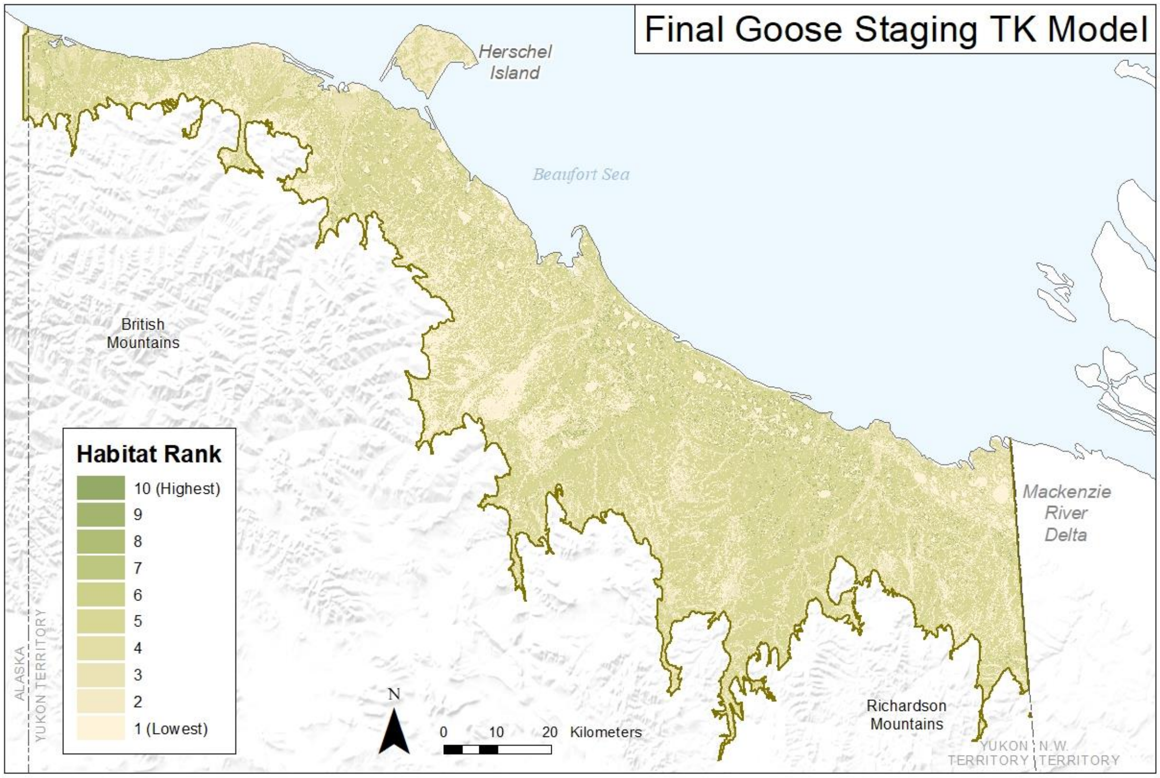
Figure 1: Interpretation of Topographic Position Index (TPI) at small and large scales, and subsequent landform classification (from Jenness 2006) used in identifying different types of willow and riverine habitats for the TK-based moose habitat model.

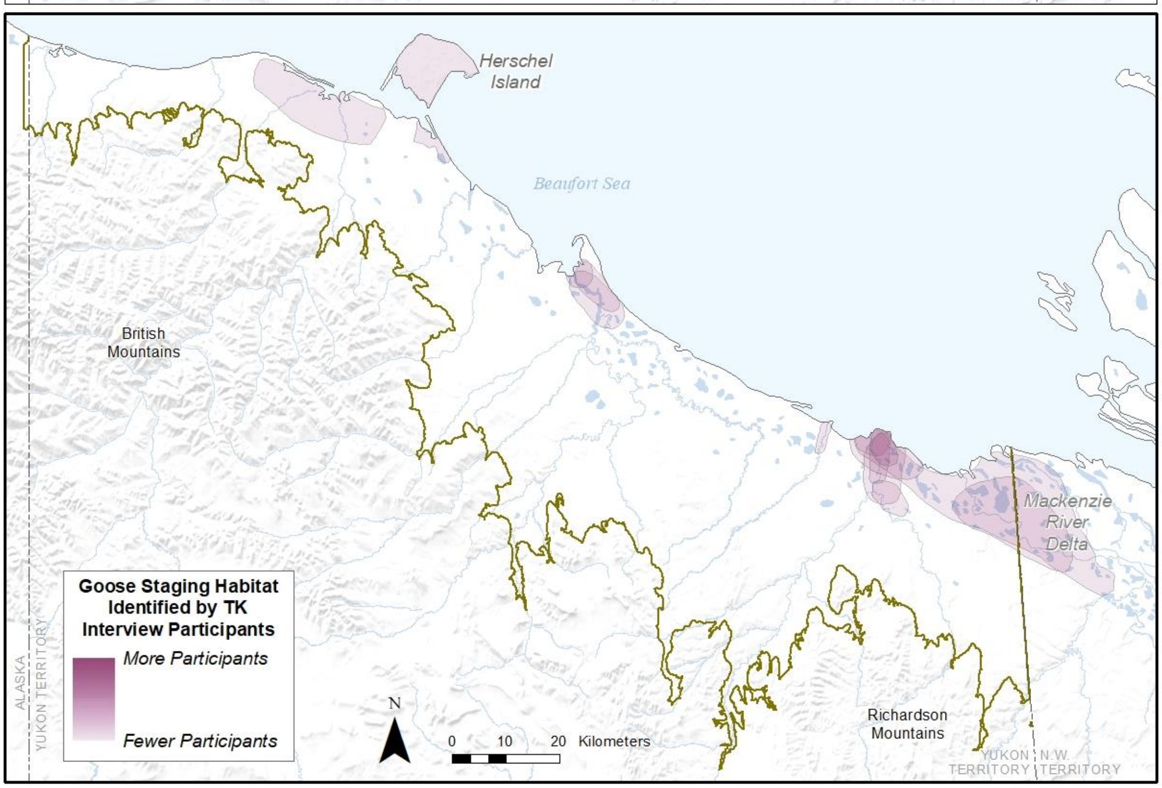


Map 1. The study area divided into mountainous, coastal and delta regions to support moose habitat modeling.

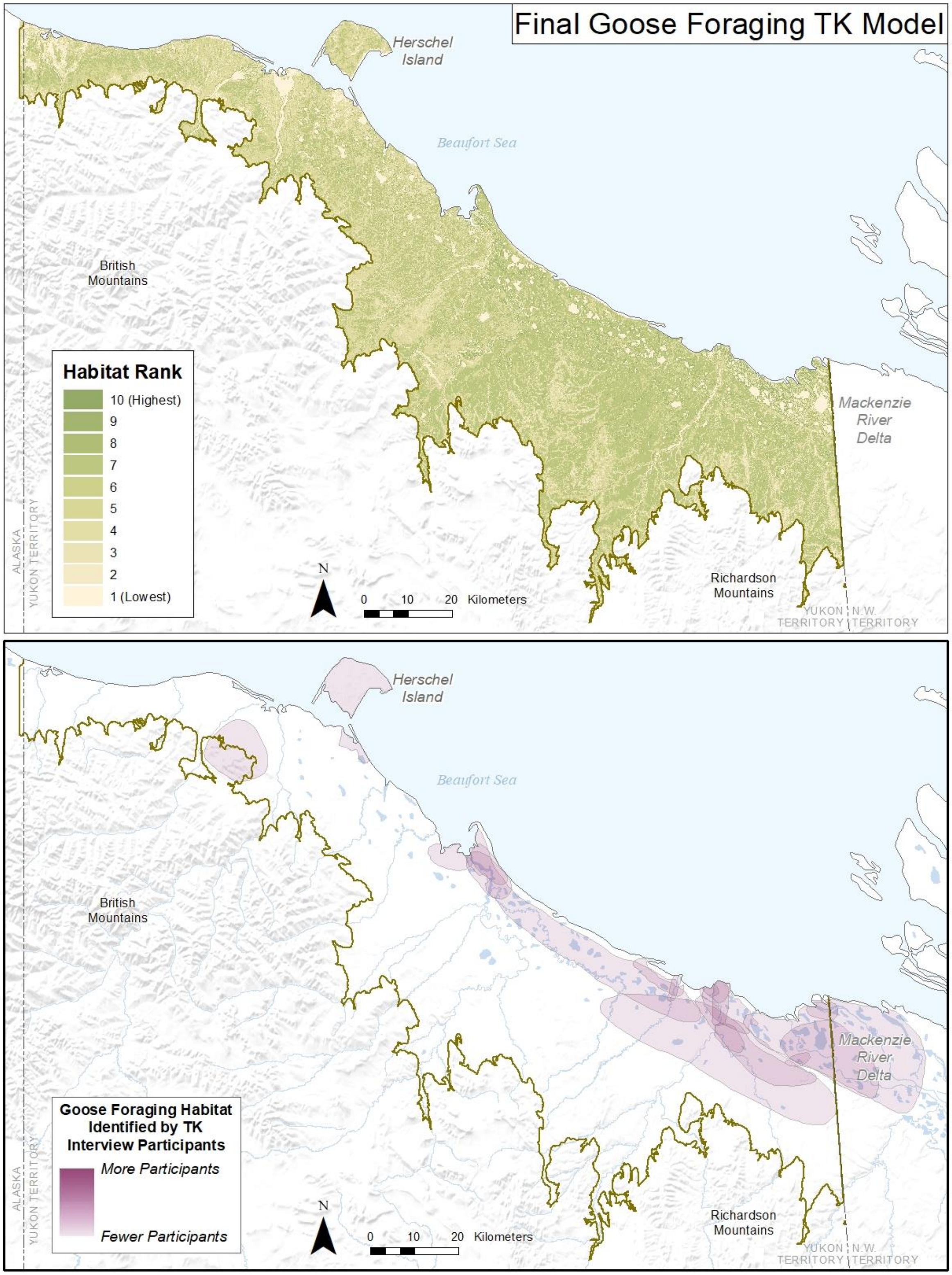


Map 2. Nesting model (top) compared to the important nesting areas identified in the TK interviews (bottom)

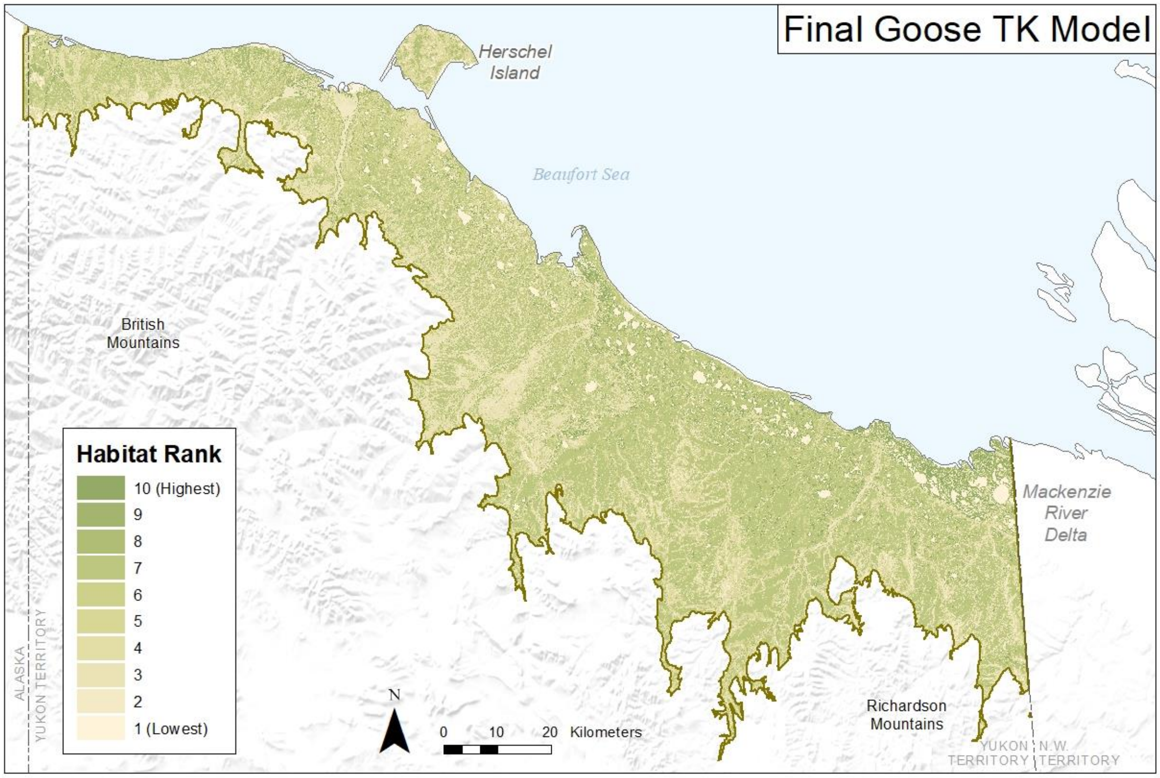


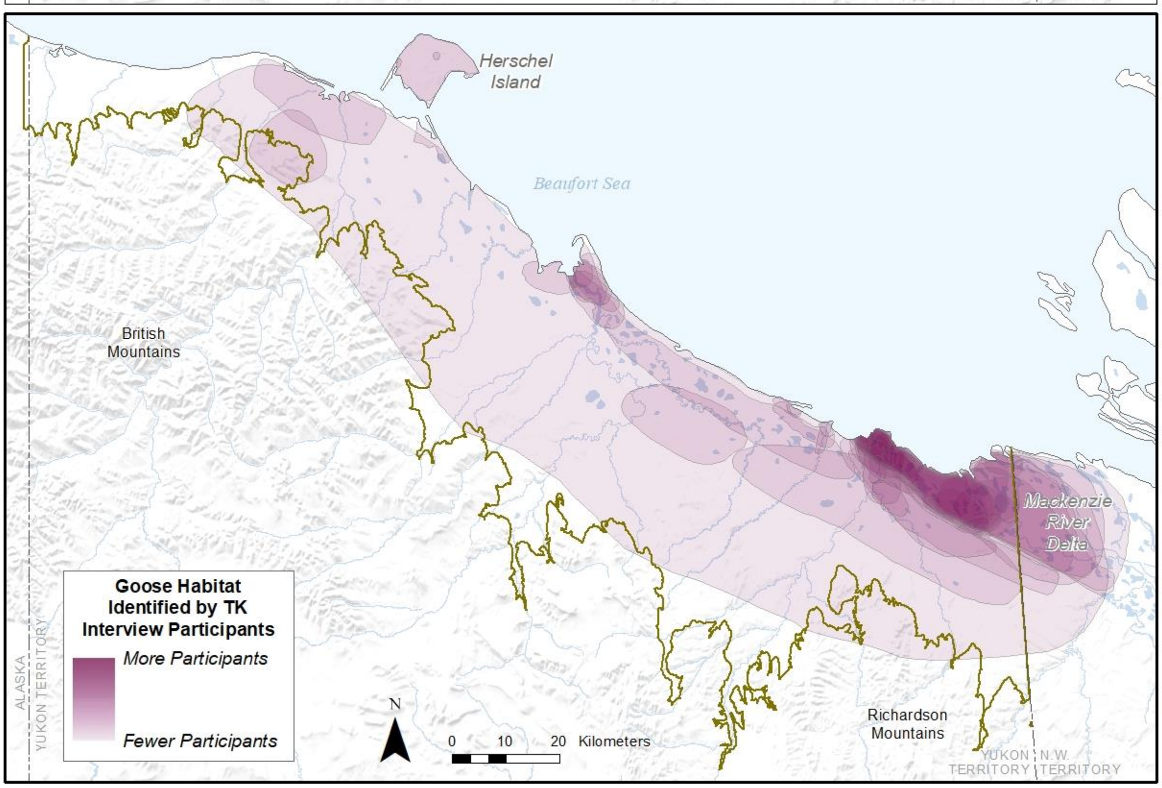


Map 3. Staging model (top) compared to the important staging areas identified in the TK interviews (bottom).

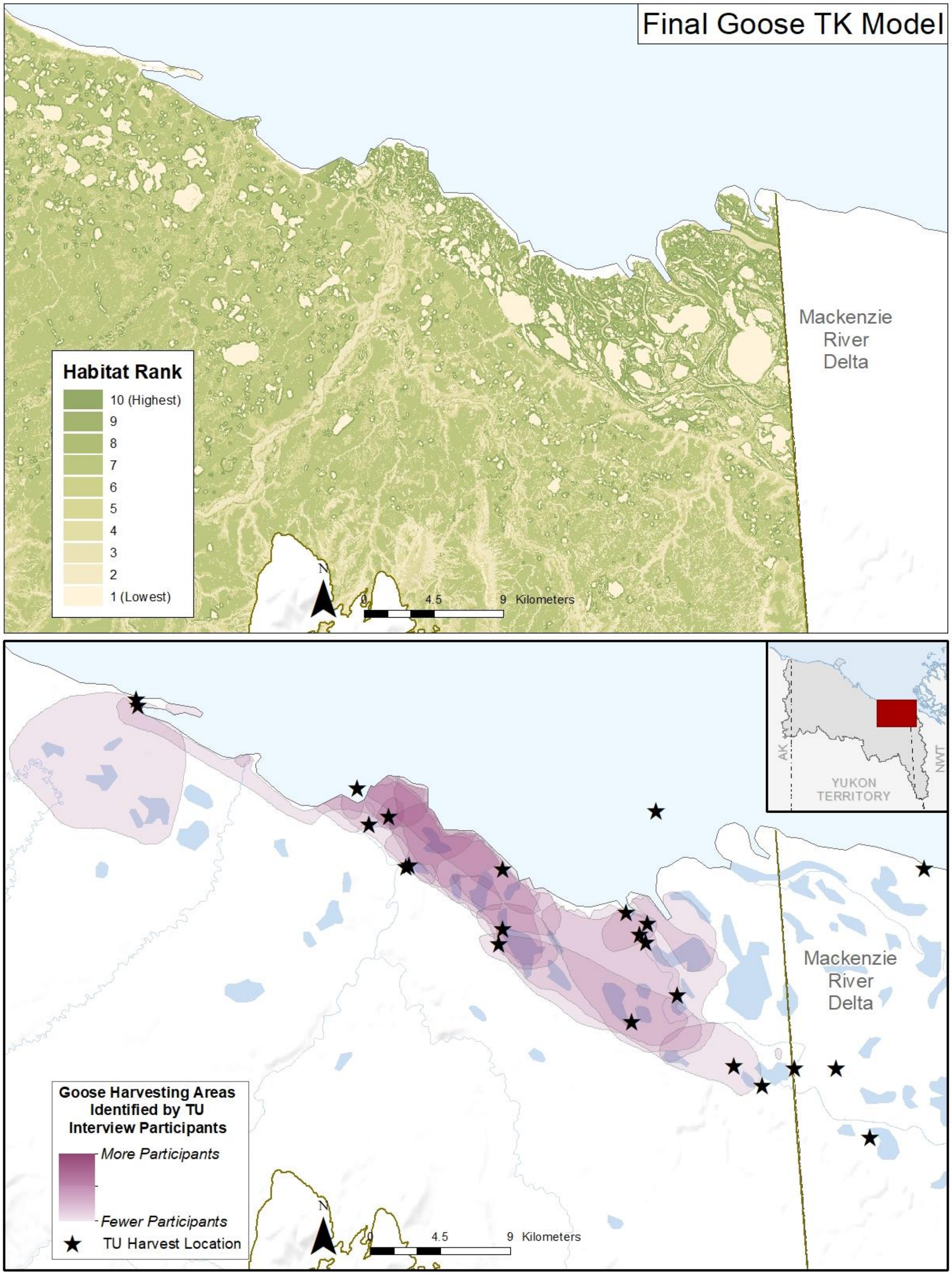


Map 4. Foraging model (top) compared to the important foraging areas identified in the TK interviews (bottom).

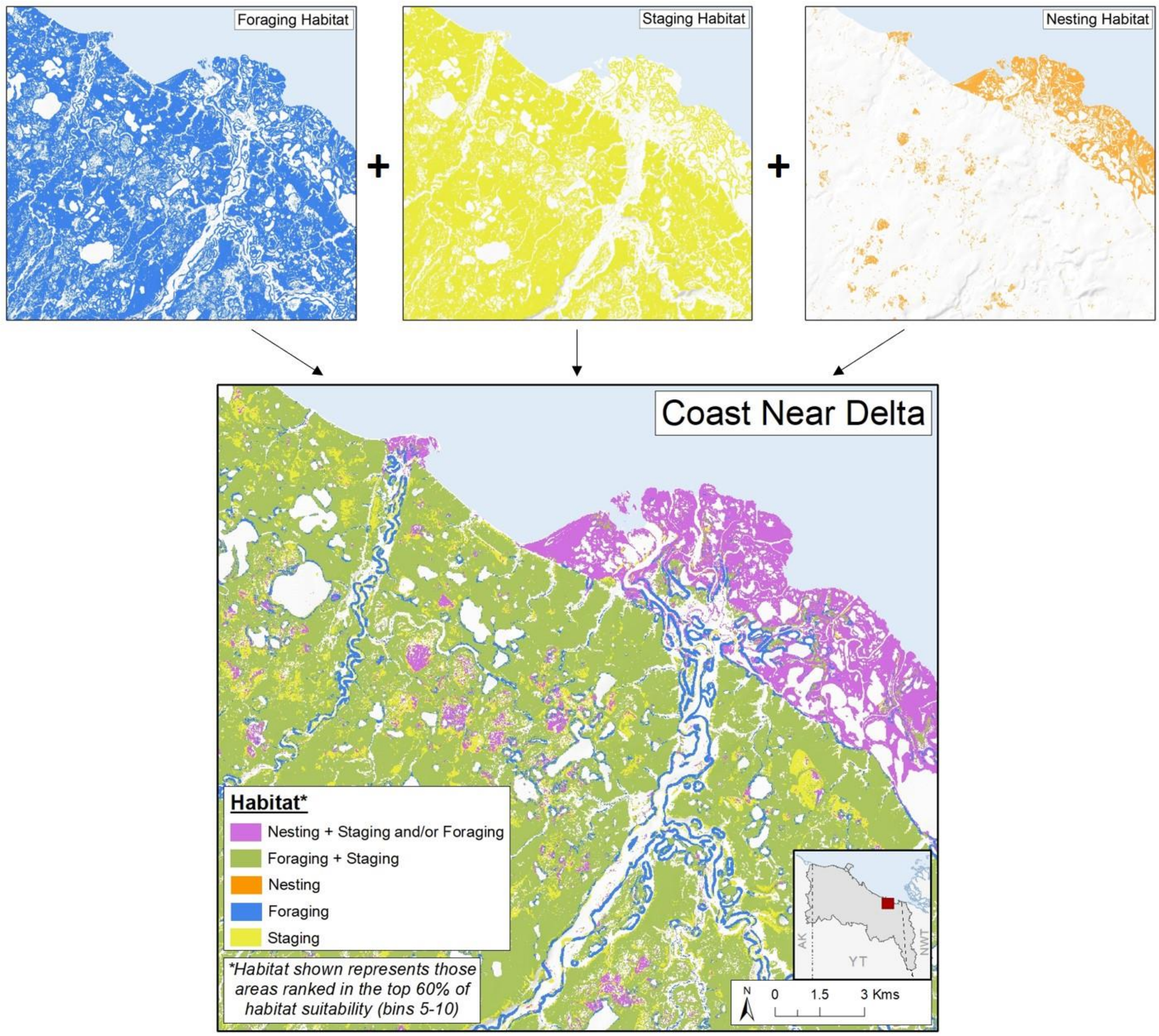




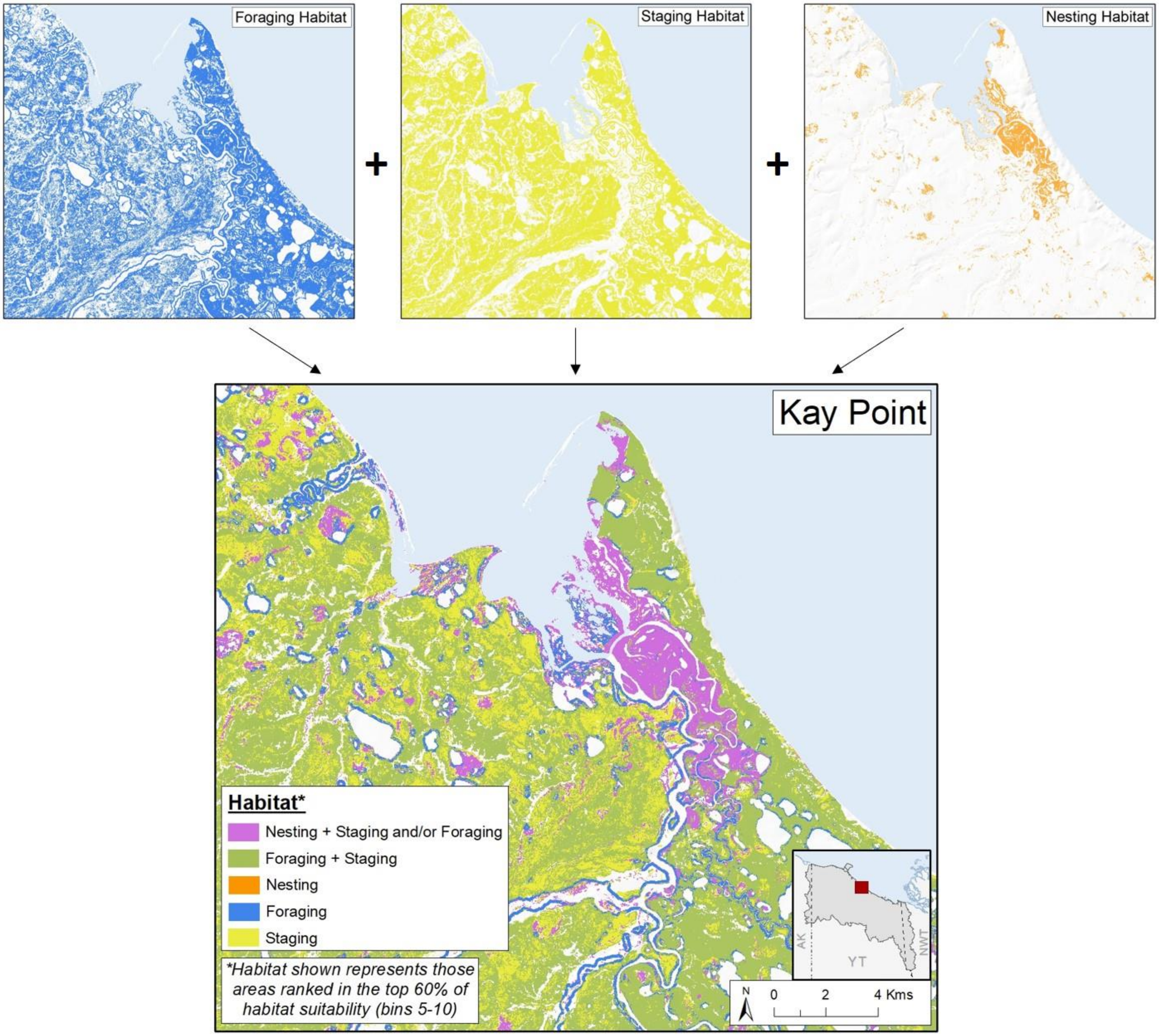
Map 5. Final goose habitat model (top) – nesting, foraging, and staging combined – compared to all areas identified as goose habitat (even generally) in the TK interviews (bottom).



Map 6. Final goose habitat model (top) – nesting, foraging, and staging combined – compared to goose harvesting areas (even generally) identified in the TU interviews (bottom).



Map 7. Goose habitat (all uses) along the coast near the Mackenzie Delta.



Map 8. Goose habitat (all uses) at Kay Point.