

## Expert-based Model Guidance and Documentation (Version 1)

### Project Information

- Species: loggerhead turtle (*Caretta caretta*)
- Lead modeler: Adam Efird, NV5 ([adam.efird@NV5.com](mailto:adam.efird@NV5.com)), 919-836-4800
- Date started: April 2018
- Date completed: January 2022

### Species Information

#### **NCDOT NRTR Habitat Description**

USFWS/NMFS Optimal Survey Window: April to August

The loggerhead is widely distributed within its range and is found in three distinct habitats during their lives. These turtles may be found hundreds of miles out in the open ocean, in neritic areas, or on coastal beaches. In North Carolina, this species has been observed in every coastal county. Loggerheads occasionally nest on North Carolina beaches and are the most common of all the sea turtles that visit the North Carolina coast. They nest nocturnally, at two to three-year intervals, between May and September, on isolated beaches that are characterized by fine-grained sediments. In near shore areas, loggerheads have been observed in bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and shipwrecks are often used as foraging areas.

#### **Additional Species Information**

NHP Tier 2 data from 2018 indicate 24 NHP EOs for loggerhead turtle. All records are current. NHP records used at the time of the model were from January 2018.

### County Information

- NHP listed counties: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender.
- FWS current listed counties: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pender
- Additions proposed by reviewers: Add Craven, Pamlico, Pasquotank, Perquimans, Washington – comments provided by Matthew Godfrey (NCWRC)

### Environmental Data Information

All spatial data are in NAD 1983 StatePlane North Carolina FIPS 3200 (US feet).

### Layer 1

- Layer name: Phase\_I\_Open\_Water and Phase\_II\_Open\_Water
- Layer description:
  - Layer obtained from Sweeping Environmental ATLAS team.
  - Vector layer for all open water areas throughout the state. Two parts but combined in model.
- Layer selection justification:
  - This data contains open waters for the state that have been merged from two files into one and then selected for any polygons large enough to consist of bays (Pamlico Sound, Core Sound, etc.) and ocean waters.
- “Habitat” versus “Nonhabitat” designations:
  - Areas of open coastal water are potential habitat for the loggerhead turtle.

### Layer 2

- Layer name: CountyBoundaryShoreline
- Layer description:
  - Select Water from County Boundary shapefile
- Layer selection justification:
  - Species possible within areas designated “Water” in CountyBoundaryShoreline layer.
- “Habitat” versus “Nonhabitat” designations:
  - Species possible within areas designated “Water” in CountyBoundaryShoreline layer.

### Layer 3

- Layer name: dcm\_oceanfront\_shorelines
- Layer description:
  - Division of Coastal Management shoreline data from 2009 and 2016.
- Layer selection justification:
  - Data layer was incorporated into the model with 2009 and 2016 shorelines (to ensure complete coverage of coast) buffered 1400 feet. DCM shorelines were variable in their actual distance from shorelines on aerial photography. 1400 feet was selected to ensure all coastal beaches, including the primary dune line were included in the model.
- “Habitat” versus “Nonhabitat” designations:
  - Area within buffer is potential habitat.

### Layer 4

- Layer name: nheo\_tier2
- Layer description:
  - Tier 2 data acquired from NC Natural Heritage Program
- Layer selection justification:

- Data layer was incorporated into model with any loggerhead turtle records selected and included in final merged output file.

## Layer 5

- Layer name: USFWS and NOAA Critical Habitat Layers
- Layer description:
  - Data Layers for NOAA and USFWS Critical Habitat for loggerhead turtle included in final step of model to be merged into final output file.

## Model Information

- Model domain
  - This model identifies all year-round potential suitable habitat for the species.
- Model output
  - Figure 1 – Model prediction.
  - Model range output is for “high” potential habitat areas only. Areas not within the “high” range are not considered suitable habitat for loggerhead turtle.
  - Shapefile covering listed counties.
- ArcGIS Model Builder
  - version ArcMap 10.4.1.
  - Model builder toolbox attached as deliverable.
  - Selected all coastal open water areas, NHP element occurrence data, buffered DCM shorelines (2009 and 2016), critical habitat, and selected counties and merged all layers to produce the model.
- ArcGIS Online (AGOL) Review
  - A model prediction file was shared with select reviewers on ArcGIS Online. Points were placed within the USFWS potential habitat as well as the model potential habitat in order to solicit feedback. Reviewers could place additional comments for consideration by the modeler.
  - AGOL review was completed in May 2019 on draft version of this model (See Appendix 2).
- Independent Data Review
  - Describe data sources –Phase 1 and 2 open waters, natural heritage element occurrence data, critical habitat data, DCM shorelines (2009 and 2016).
  - Describe methods – Current aerial imagery was used to determine likelihood of habitat. Open water layer used to determine potential habitat.

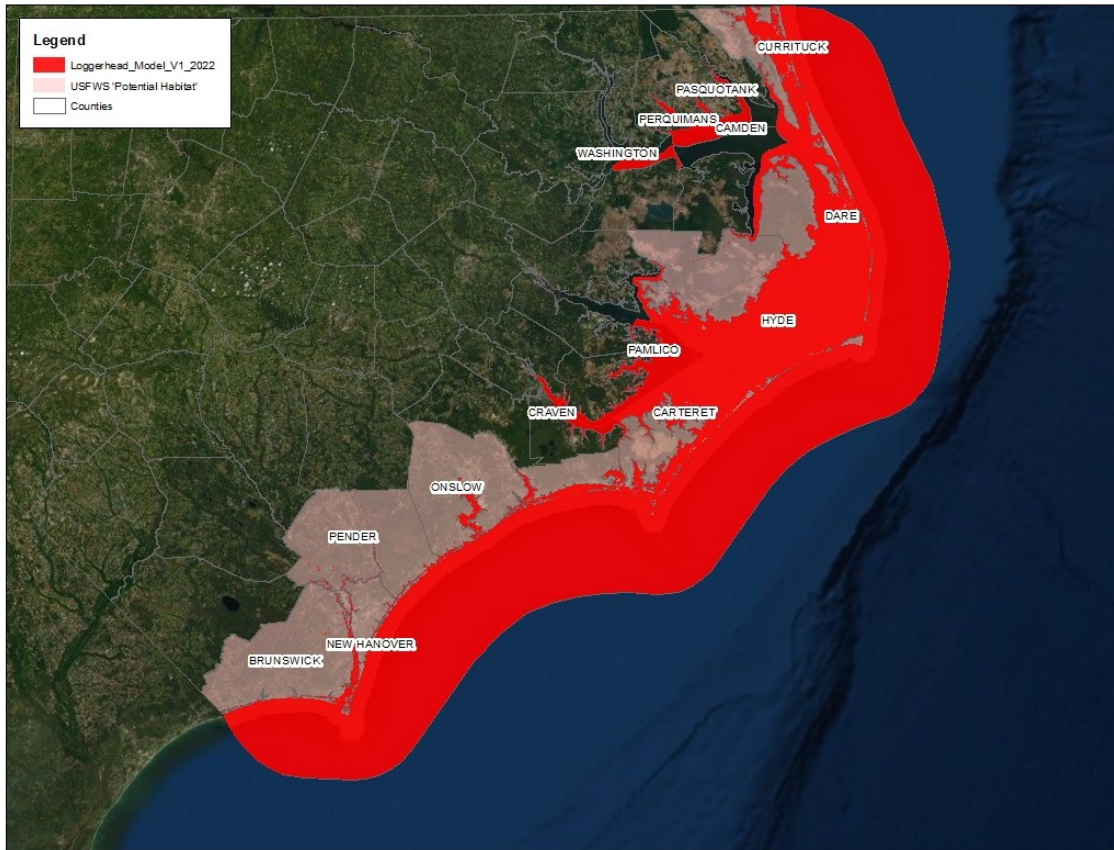


Figure 1. USFWS Range Map and High Potential Habitat (V1)

### Previous Model Versions (Draft)

The previous version of this model was developed in July 2018. The layer for waters was substituted between versions. The January 2022 version was updated with correct county distribution.

### List of Delivered Model Products

- *This summary document.*
- *Version 1 Model builder toolbox and model screenshot (Appendix 1).*
- *Reviewer documentation (Appendix 2) – summary of comments and general model recommendations.*
- *Version 1 Model prediction file(s) (shapefile).*
- *Desktop AGOL reviewer comments (shapefile).*

## References

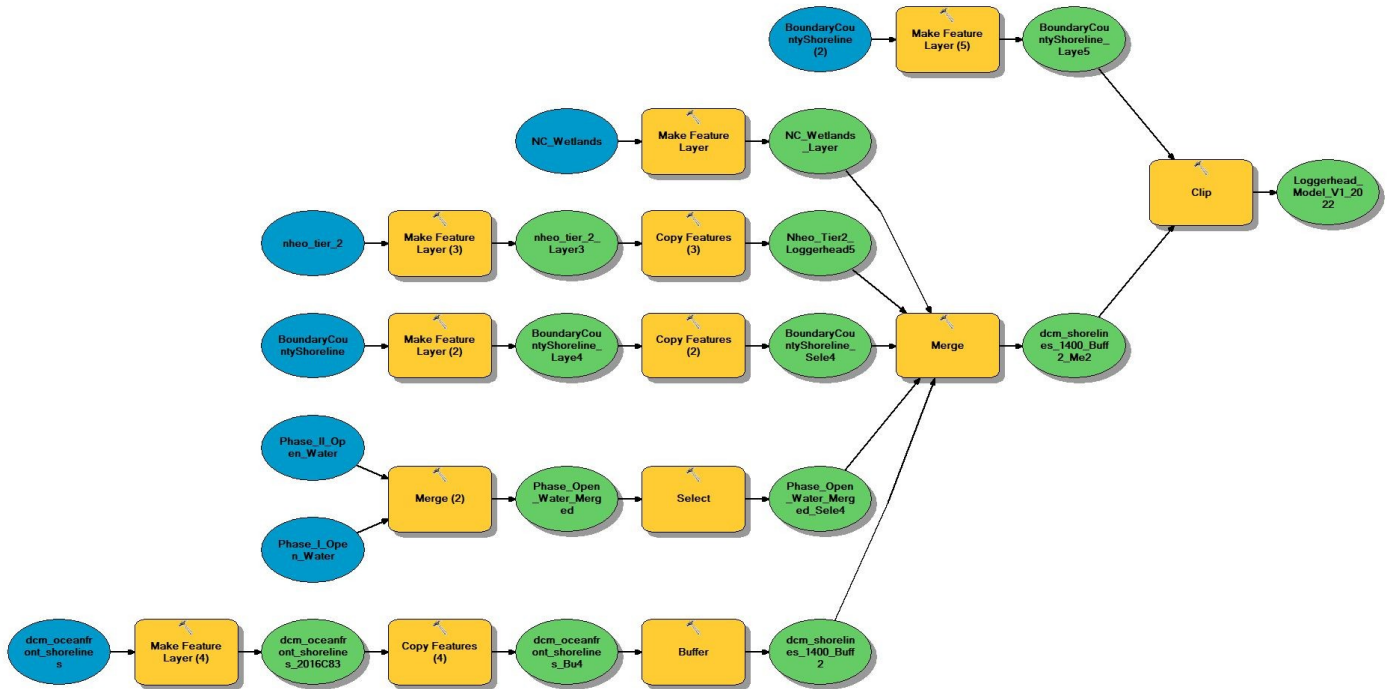
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NatureServe. 2018. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>.

National Oceanic and Atmospheric Administration (NOAA). Fisheries, Office of Protected Resources. Loggerhead Turtle (*Caretta caretta*). <https://www.fisheries.noaa.gov/species/loggerhead-turtle>. (Accessed: May 2, 2018).

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# Appendix 1: Loggerhead Turtle Version 1 Expert Model



## Appendix 2: Reviewer Documentation

### Project Information

- Species: loggerhead turtle (*Caretta caretta*)
- Lead modeler: Adam Efird ([adam.efird@NV5.com](mailto:adam.efird@NV5.com)), 919-836-4800
- Reviewer names:
  1. Bob Hoffman (NOAA)
  2. Kathryn Matthews (USFWS)
  3. Matthew Godfrey (NCWRC)
  - Robert Hoffman is the branch chief at the NOAA Southeast regional office for turtles and fisheries coordination.
  - Kathy Matthews is a biologist with the U.S. Fish and Wildlife Service, and previously worked for EPA as a wetland biologist. She reviews proposed projects for impacts to federally listed species. She has degrees in marine biology and marine ecology from Florida Institute of Technology.
  - Matthew Godfrey is sea turtle biologist who as has worked for the N.C. Wildlife Resources Commission for 18 years. He has coordinated a volunteer network across coastal NC to monitor and protect nesting sea turtles and their eggs. He is a liaison with federal, state, local and private entities on coastal issues as they related to sea turtles in North Carolina.

### Range Map to Potential Habitat Version 1

- USFWS Range            2,893,157 acres
- ATLAS Draft Range    6,473,680 acres (includes open water and critical habitat)



Figure 2. Range Map and High Potential Habitat (DRAFT)

Summary of Draft Model

- Environmental data layers remained the same between versions, except for the open water layer used for the model.
- Selected all coastal open water areas, NHP element occurrence data, buffered DCM shorelines (2009 and 2016), critical habitat, and selected counties and merged all layers to produce the model.

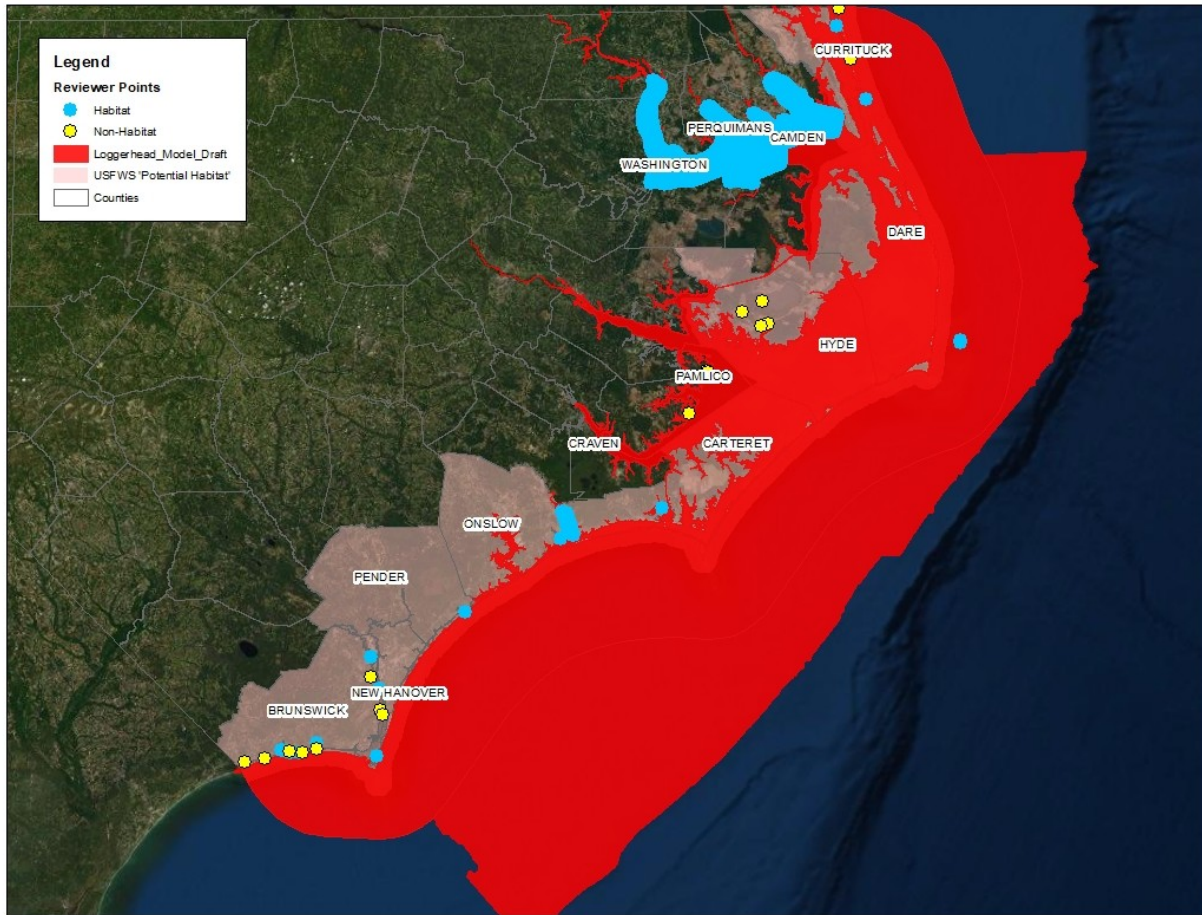


Figure 3. Desktop Reviewer Points

- Desktop Response Rate
  - AGOL Reviewer Response Rate: 100%
    - 10 reviewer points placed by modeler
  - # Additional comments (placed by reviewers): 13

Desktop Reviewer Responses

- Reviewers provided a complete and balanced review. Flags of non-habitat areas were primarily focused on areas where the landcover data or the open water data did not match what was viewable on the aerial photography. Most comments were about non-beach shorelines and upland areas showing up as habitat and needed the value to be reversed to non-habitat.
- Most reviewers generally agreed with the potential habitat model. Modelers commented that areas of non-habitat occasionally were included in the model and should be removed. Examples of non-habitat observed by reviewers: maritime forest, forested uplands, non-sandy shorelines or beaches, marshes, canals, ditches, developed land, and inland waterbodies not connected to the estuary. There was one large area of

open water not picked up by the model initially. Version 1 of the model addresses this and the waters are included.

### Proposed Version 1 Model

In order to address comments by reviewers, the following changes were made to the model:

- A new open water layer (Phase I and II open waters) was used in place of the previous one (AXE\_TIZ), which included areas of tidal influence that would often stretch too far inland and not provide an accurate picture of potential habitat.
- Model was refined in January 2022 to include only counties that are included in the species range, as well as incorporating comments from Matthew Godfrey (NC WRC) concerning species range.
- Critical habitat area had coverage along the coastline from the county open water layer, so the open ocean critical habitat area was removed.



Figure 4. Range Map and Potential Habitat Version 1 (2022) vs DRAFT model

## Model Accuracy

Figure 5 illustrates the accuracy statistics for the model assessment sites. The loggerhead turtle potential habitat model clearly illustrates the general geographic areas along barrier islands beaches, sounds, and sandy natural areas that GIS-based layers are able to best predict for at a particular time period.

	“Actual” Potential Habitat	“Actual” Non-Habitat	“Actual” Potential Habitat	“Actual” Non-Habitat
Predicted Potential Habitat	True Positive 33	False Positive 12	True Positive 37	False Positive 7
Predicted Non-Habitat	False Negative 4	True Negative 6	False Negative 2	True Negative 9

Figure 5. Accuracy summary of the desktop reviewer responses based on model assessment of Draft (left) Version and Version 1 (right) model output.

Desktop accuracy statistics of the Draft and Version 1 binary classification model are as follows:

- Percent correctly classified was 71% (Draft), 84% (Version 1)
- Sensitivity was 0.89 (Draft), 0.95 (Version 1)
- Specificity was 0.33 (Draft), 0.56 (Version 1)

Desktop comments are summarized as follows:

- The model generally overpredicts for potential habitat and predicted false positives for developed neighborhoods, maritime forests, forested uplands, non-sandy shorelines or beaches, marshes, canals, ditches, and inland waterbodies not connected to the estuary. It was unable to distinguish between eroding shorelines from accreting shorelines. Due to the dynamic nature of coastal beaches this model will capture a snapshot in time of the current shoreline.

The model remained largely the same between draft and V1 versions except for the county range of the model V1 version being corrected as well as improvements in determining non-habitat landcover types. This allowed for the percent correctly classified, specificity value, and sensitivity of the V1 model slightly increasing from the draft version.