Expert-based Model Guidance and Documentation (Version 1)

Project Information

- Species: green sea turtle (Chelonia mydas)
- Lead modeler: Adam Efird, NV5 (adam.efird@NV5.com), 919-836-4800
- Date started: April 2018
- Date completed: August 2022

Species Information

NCDOT NRTR Habitat Description

USFWS/NMFS Optimal Survey Window: April - August

The green sea turtle is found in temperate and tropical oceans and seas. Nesting in North America is limited to small communities on the east coast of Florida requiring beaches with minimal disturbances and a sloping platform for nesting (they do not nest in NC). The green sea turtle can be found in shallow waters. They are attracted to lagoons, reefs, bays, mangrove swamps, and inlets where an abundance of marine grasses can be found, as this is the principal food source for the green turtle.

Additional Species Information

NHP Tier 2 data from 2018 indicate 17 EOs for green sea turtle in North Carolina. Two of the 17 records are historic. NHP records used at the time of model were from January 2018.

County Information

- NHP listed counties: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender
- FWS current listed counties: Beaufort, Brunswick, Carteret, Craven, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pender
- Additions proposed by reviewers: Camden and Pasquotank – 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 green 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. Refined in 2022 V1 model to only include green turtle counties.

Layer 3

- Layer name: nheo_tier2
- Layer description:
    - July 2018 Tier 2 dataset acquired from the NC Natural Heritage Program.
- Layer selection justification:
    - Data layer was incorporated into the model with any green turtle records selected and merged into the final merged output file.
- "Habitat" versus "Nonhabitat" designations:
    - Potential habitat are polygon areas delineated in the July 2018 NC NHP Tier 2 dataset.

Layer 4

- Layer name: dcm_oceanfront_shorelines
- Layer description:
    - Division of Coastal Management shoreline data from 2009 and 2016. This range was selected to ensure complete coverage of the coastline across NC.
- 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.

Model Information

- Model domain
  - This model identifies 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 green 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, natural heritage data, buffered DCM shorelines (2009 and 2016) and selected counties and merged all layers to produce the model. Model was refined in 2022 to include green turtle counties only.
- 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 modeler.
  - AGOL review was completed in May 2019 on draft version of this model (See Appendix 2).
- Independent Data Review
  - Describe data sources – Natural Heritage Program element occurrences, Phase 1 and 2 open waters, DCM shorelines (2009 and 2016).
  - Describe methods – Current aerial imagery was used to determine likelihood of habitat. Open water layers were used to verify potential open water habitat.

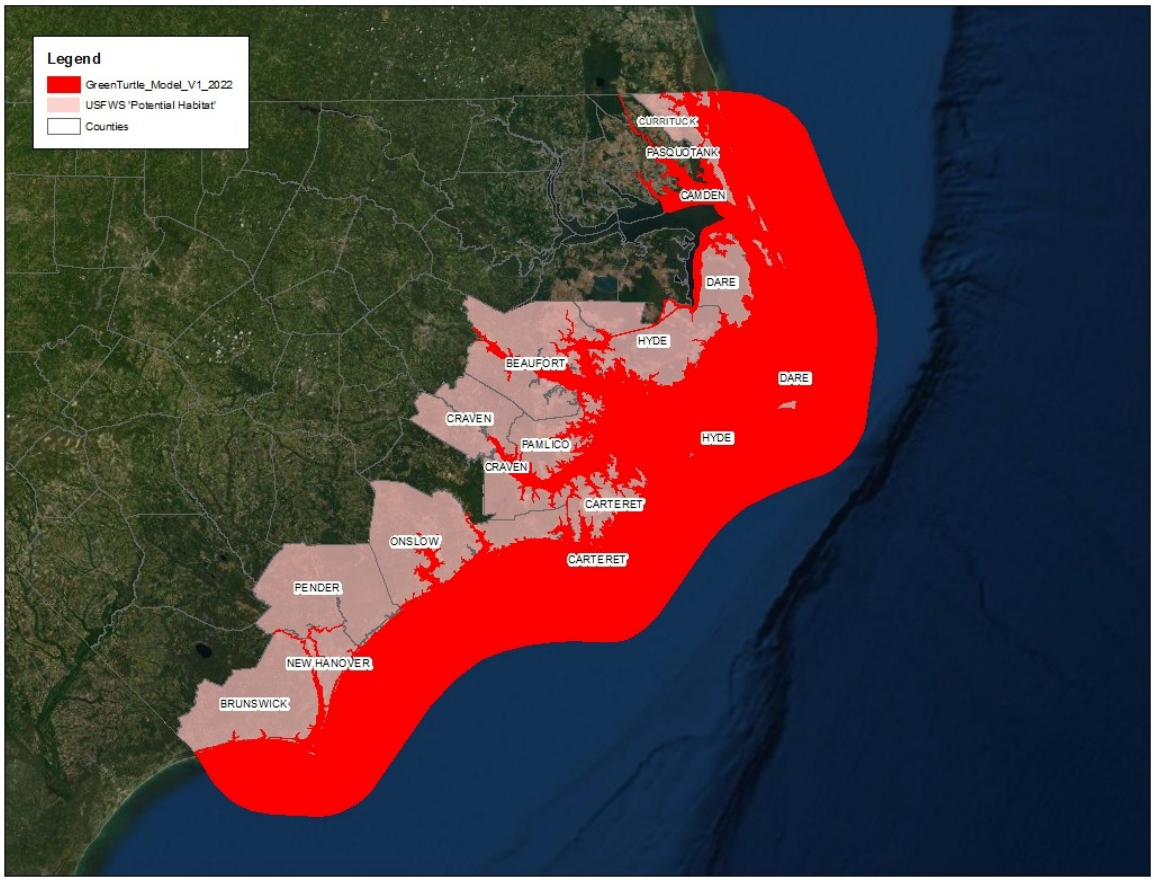


Figure 1. USFWS Range Map and High Potential Habitat (V1)

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 file (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).*

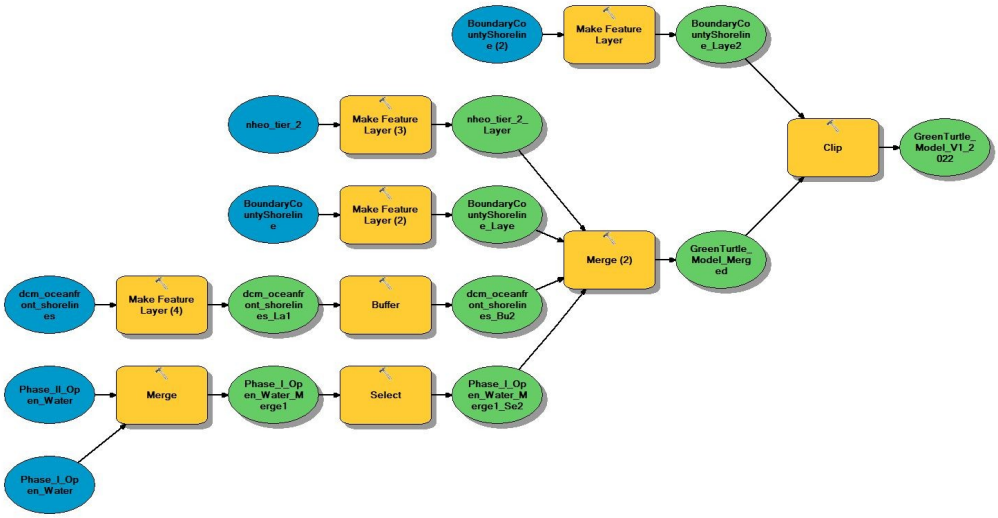
References

National Oceanic and Atmospheric Administration (NOAA). Fisheries Service. Green Turtle (*Chelonia mydas*). Species Directory. (Accessed 06/24/2018).

North Carolina Natural Heritage Program. 2018. Biotics Database. Division of Land and Water Stewardship. Department of Natural and Cultural Resources, Raleigh, North Carolina.

USFWS. Green sea turtle (*Chelonia mydas*). Species profile. https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=C00S (Accessed 06/24/2018).

Appendix 1: Green Sea Turtle Version 1 Expert Model



Appendix 2: Reviewer Documentation

Project Information

- Species: green sea turtle (*Chelonia mydas*)
- Lead modeler: Adam Efird, NV5 (adam.efird@NV5.com), 919-836-4800
- Desktop Reviewers:
  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 Draft Model

- USFWS Range 4,105,054 acres
- ATLAS Draft Range 6,474,971 acres (includes a large area of open water)

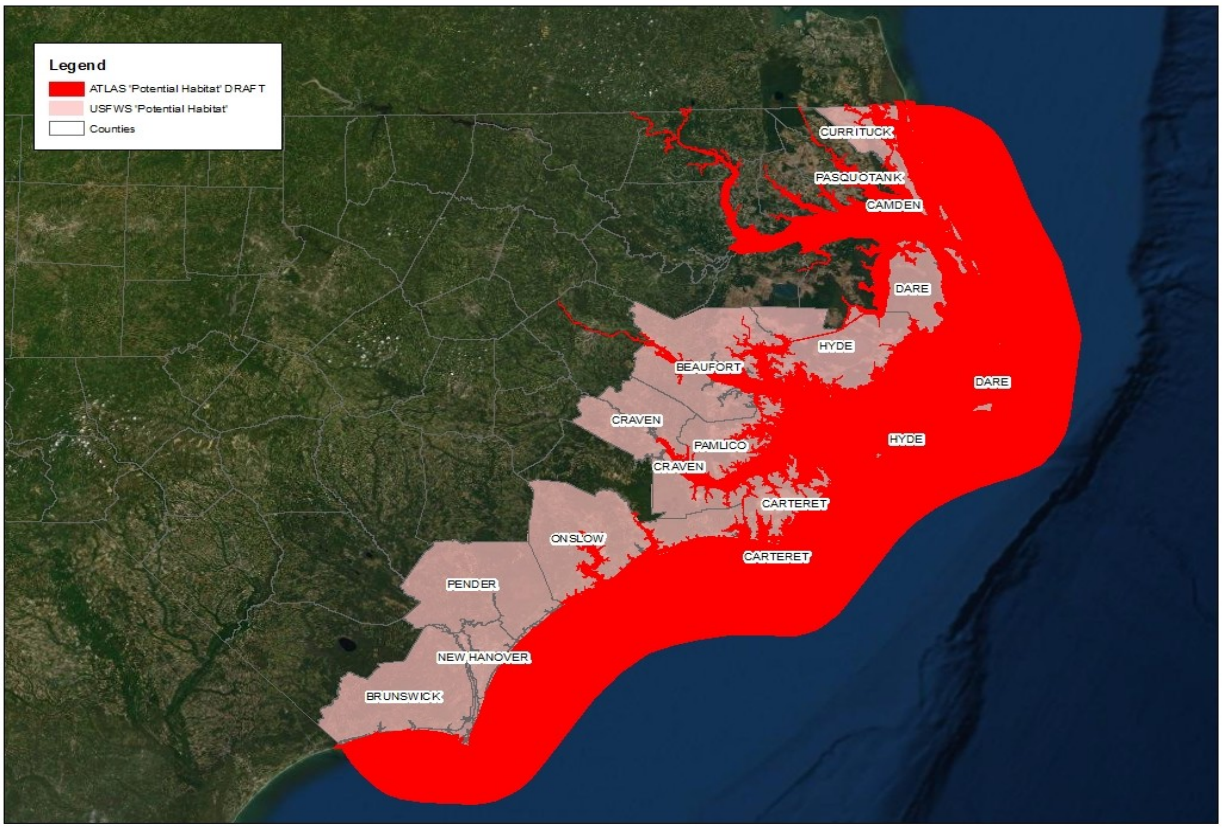


Figure 2. Range Map and High Potential Habitat (DRAFT)

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, natural heritage data, buffered DCM shorelines (2009 and 2016) and selected counties and merged all layers to produce the model.

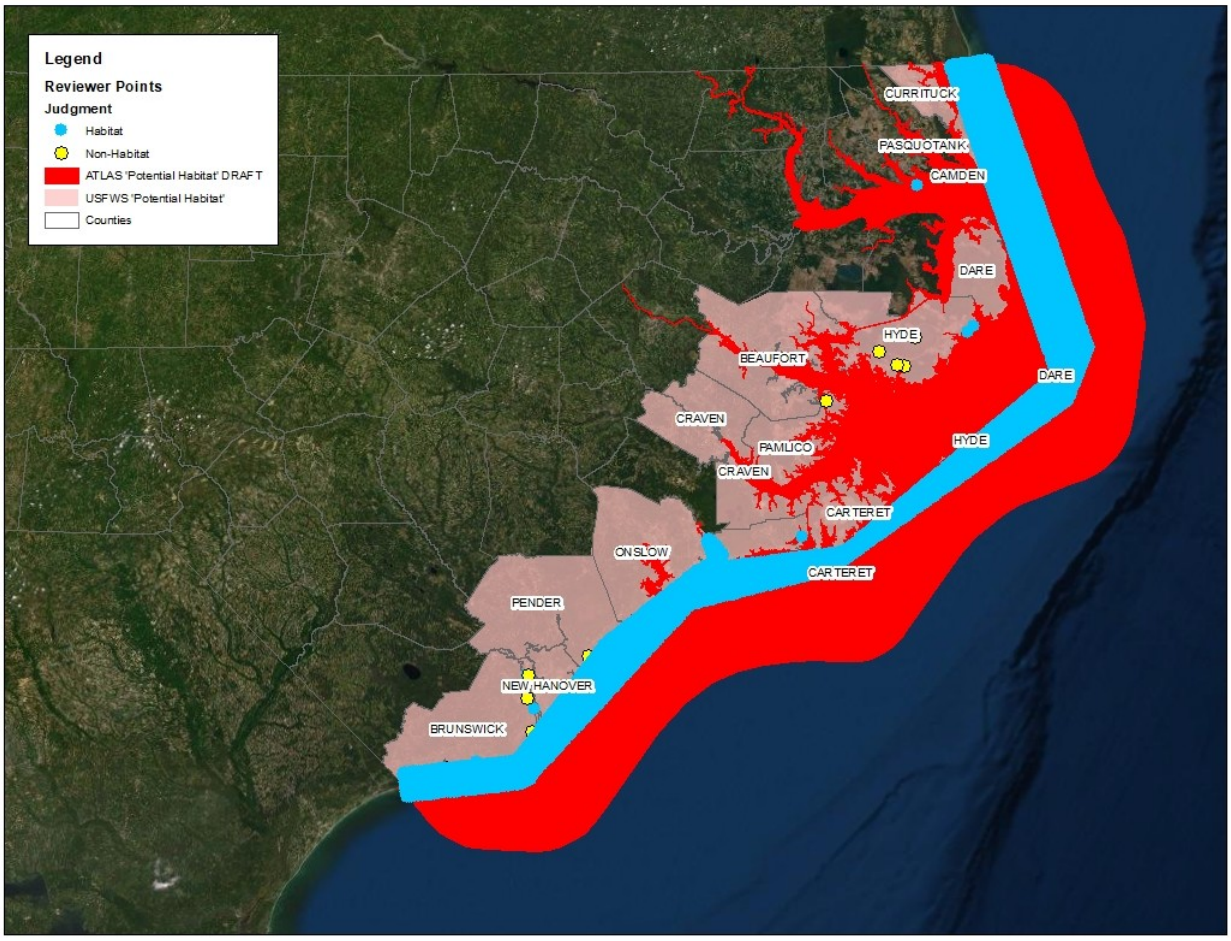


Figure 3. Desktop Reviewer Points

- Desktop Response Rate
  - AGOL Reviewer Response Rate: 100%
    - 8 reviewer points placed by modeler
  - # Additional comments (placed by reviewers): 12

<u>Desktop Reviewer Responses</u>

- 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 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.

Proposed Version 1 Model

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 (NCWRC) concerning species range.

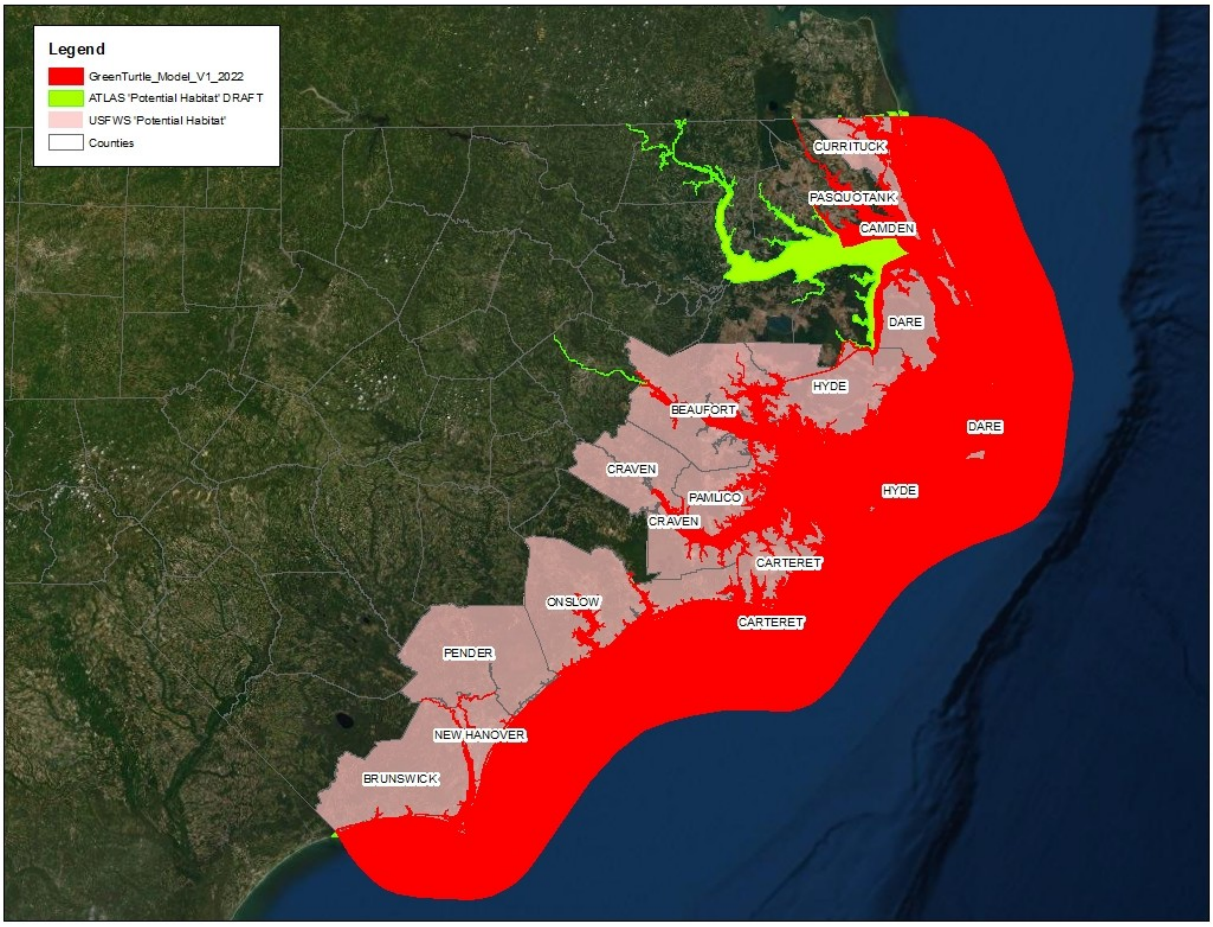


Figure 4. Range Map and Potential Habitat Version 1 (V1) (2022) vs DRAFT Model

Model Accuracy

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

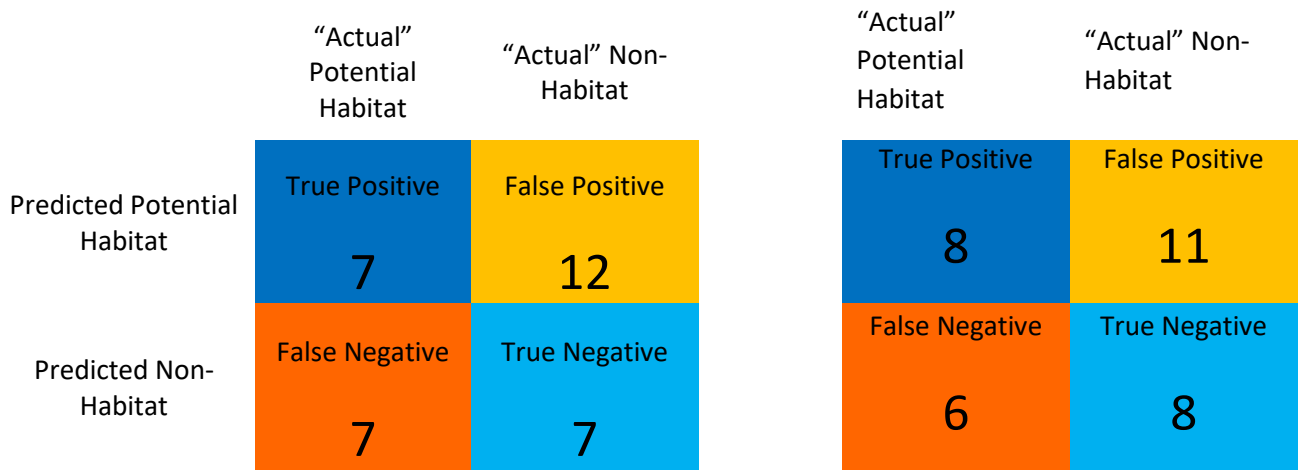


Figure 5. Accuracy summary of the desktop reviewer responses based on model assessment of Draft (left) Version and Version 1 (right) model output.

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

- Percent correctly classified was 43% (Draft), 48% (Version 1)
- Sensitivity was 0.50 (Draft), 0.57 (Version 1)
- Specificity was 0.37 (Draft), 0.42 (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 except for the county range of the model V1 being corrected. This however allowed for the percent correctly classified, sensitivity, and specificity value of the V1 model increasing slightly from the draft version.