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Maritimes Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/050

IDENTIFICATION OF IMPORTANT HABITAT FOR WHITE SHARK (ATLANTIC POPULATION)



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Figure 1. Underwater photo of a White Shark (Carcharodon carcharias).

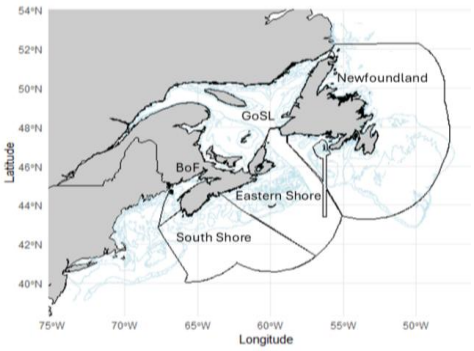


Figure 2. Atlantic Canadian waters as bounded by the Exclusive Economic Zone (EEZ), partitioned into general geographic regions: Bay of Fundy (BoF), South Shore, Eastern Shore, Gulf of St. Lawrence (GoSL) and Newfoundland.

CONTEXT

The Species at Risk Program of Fisheries and Oceans Canada (DFO) requested Science advice on important habitat for White Sharks *(Carcharodon carcharias)* to inform future delineation of critical habitat in an amended Recovery Strategy under the *Species at Risk Act*. DFO Science, in collaboration with the Massachusetts Division of Marine Fisheries and Atlantic White Shark Conservancy, has been studying the movement ecology and habitat use of White Sharks in Atlantic Canadian waters (ACW) to address this need.

This Science Advisory Report is from the multi-regional peer review of February 24 - 25, 2026, on the Identification of Important Habitat for White Shark (*Carcharodon carcharias*) in Atlantic Canadian Waters. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- White Shark presence data (mainly 2010–2024) were generated from acoustic telemetry and pop-up satellite archival tags (PSATs) in collaboration with Fisheries and Oceans White Shark research program, and verified sightings throughout Atlantic Canadian waters (ACW). Most of the data were from juvenile and sub-adult sharks.
- Variables used as proxies for foraging environments (chlorophyll-a [CHL] concentration and gradient, sea-surface temperature [SST], surface salinity, and distance to large seal colonies) were integrated in an Ecological Niche Model (ENM) to predict the distribution and suitability of important habitats in ACW.

- Average habitat suitability was scored on the scale of 0–100%, where 30% was considered the minimum value representing important White Shark foraging habitat.
- Important habitat is widely distributed seasonally throughout ACW, including the Bay of Fundy, south shore and eastern shore of Nova Scotia, Gulf of St. Lawrence and parts of Newfoundland and Labrador.
- The distribution and amount of important habitat show strong seasonal variability peaking in late summer (August–October), with minimal occurrence documented from January through April.
- While in ACW, White Sharks are highly mobile. Differences in habitat use among life stages or sexes were not apparent in the data. Environmental conditions throughout ACW have changed in recent years, which is reflected by shifts in the distribution and amount of suitable habitat.
- The identified important habitat supports the function of foraging behaviour, including predation, food intake, hunting and movement/exploration. The biophysical features that support foraging behaviour are the food supply (prey), water quality, water column (continental shelf waters) and physical space. These features are associated with measurable attributes including chlorophyll-a concentration and gradient, contaminant levels, sea surface temperature, surface salinity and density and distribution of obstructions.
- There are multiple anthropogenic activities with the potential to destroy functions, features and attributes (FFAs) of important habitat but the magnitude of and ecological processes leading to those impacts are not well understood.
- The ENM describes important habitat. Optimal use of the ENM to delineate critical habitat for White Sharks would generate annual habitat predictions, consider seasonal patterns, and use a moderate (e.g., 50%) threshold value for habitat suitability. A moderate threshold encompasses the broader coastal environments where White Shark are frequently observed, rather than being highly restricted to near-shore environments.

BACKGROUND

The Atlantic population of White Shark (*Carcharodon carcharias*) is listed as Endangered under the *Species at Risk Act* (SARA) (Fisheries and Oceans Canada 2025). The recovery strategy required by Section 73 of SARA must include an identification of the species' critical habitat, to the extent possible, based on the best available information. Under SARA, habitat is defined as:

- *"(a) in respect of aquatic species, spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced; and*
- *(b) in respect of other wildlife species, the area or type of site where an individual or wildlife species naturally occurs or depends on directly or indirectly in order to carry out its life processes or formerly occurred and has the potential to be reintroduced."*

and critical habitat is defined as:

- *"critical habitat means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species."*

The purpose of this Canadian Science Advisory Secretariat (CSAS) process is to provide science advice on important habitat for White Shark, which will inform future work by the Species at Risk Program to delineate critical habitat in an amended White Shark Recovery Strategy (Fisheries and Oceans Canada 2025). Important habitat has no formal definition, but represents habitat considered important for the survival or recovery of the species and will be used to inform the identification of critical habitat. However, not all important habitat will necessarily be identified as critical habitat under SARA. The Species at Risk Program may also choose to consider other available sources of information in addition to these analyses when delineating critical habitat.

ASSESSMENT

White Shark presence data throughout the Canadian Exclusive Economic Zone (EEZ) were compiled for these analyses, representing acoustic monitoring information (179,200 unique detections of 214 tags; 199 individual White Sharks; 2010–2024), light-based position estimates generated from pop-up satellite archival tags [PSAT] (N = 29; median monitoring duration = 46 days, range 1–116 days; 2011–2024), and verified, georeferenced sightings records (N = 118; 1873–2022). We refer readers back to associated publications for comprehensive descriptions of each data source (Skomal et al. 2017, Bowlby et al. 2022, Winton et al. 2023, Allegue et al. 2025, Davis et al. 2025, Bowlby et al. In press). An additional seven PSAT tracks from 2025 were used for validation.

For all types of presence data (Figure 3), animals were categorized as juvenile (< 3 m), sub-adult (male: 3.0 to < 3.5 m; female 3.0 to < 4.8 m) or adult (male: ≥ 3.5; female: ≥ 4.8 m) based on sex-specific estimates of size at maturity (Skomal et al. 2017, Bowlby et al. 2022, Allegue et al. 2025) to assess ontogenetic patterns.

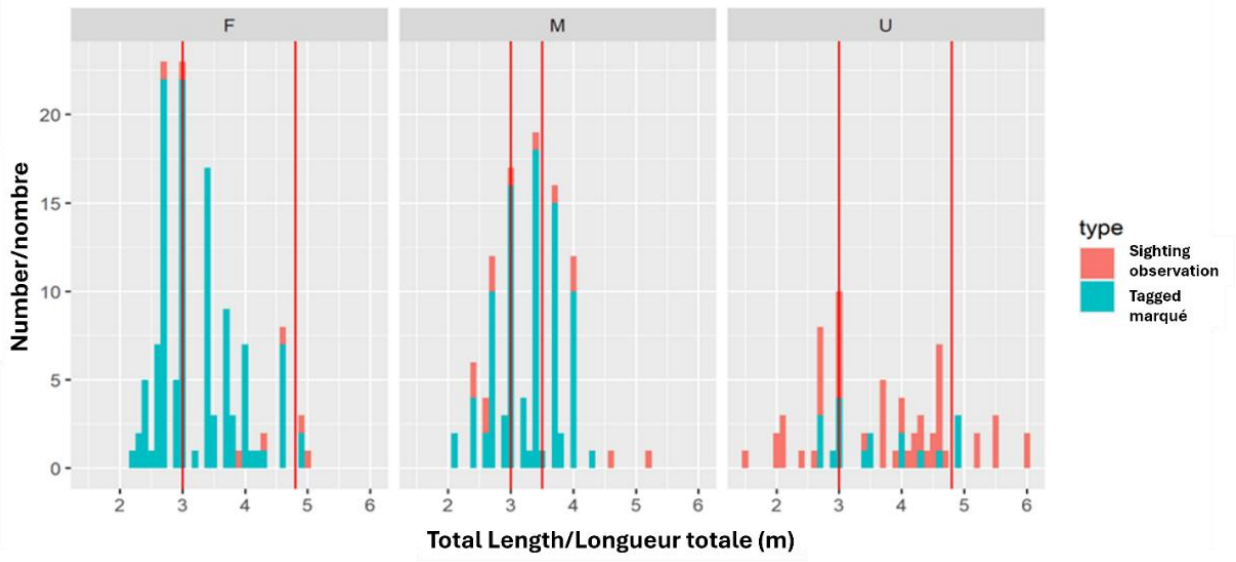


Figure 3. Length distributions of the White Sharks, separated by sex (Female, N = 124; Male, N = 102; and Unknown, N = 68) and data source (sighting, tagged), based on information from 2010–2024. Break-points used to identify life stage categories (juvenile, sub-adult and adult) are shown as solid vertical lines.

Ecological Niche Model

An Ecological Niche Model was developed to describe important habitat for White Sharks in ACW. This approach was deterministic and used the relationship between daily presence

observations and matched environmental characteristics to predict how often suitable foraging habitat occurred at a given place and time. It used ecological knowledge to define habitat suitability thresholds (steps 1–3, Figure 4), and incorporated few analytical assumptions other than the expectation that the available presence data were representative of the population's expected foraging behaviour. This simple model (steps 4–5, Figure 4) was preferred over statistical analytical options because of the limited and biased nature of the available presence data. However, when predicting habitat suitability, the choice of thresholds becomes subjective and model validation does not intrinsically guard against overfitting. Habitat that was predicted to have a suitability score of 30% or greater was considered important habitat for White Shark. Full methodological details (ecological basis, derivation of predictor variables, model structure, sensitivity analyses, and validation techniques) are provided in Bowlby et al. (In press).

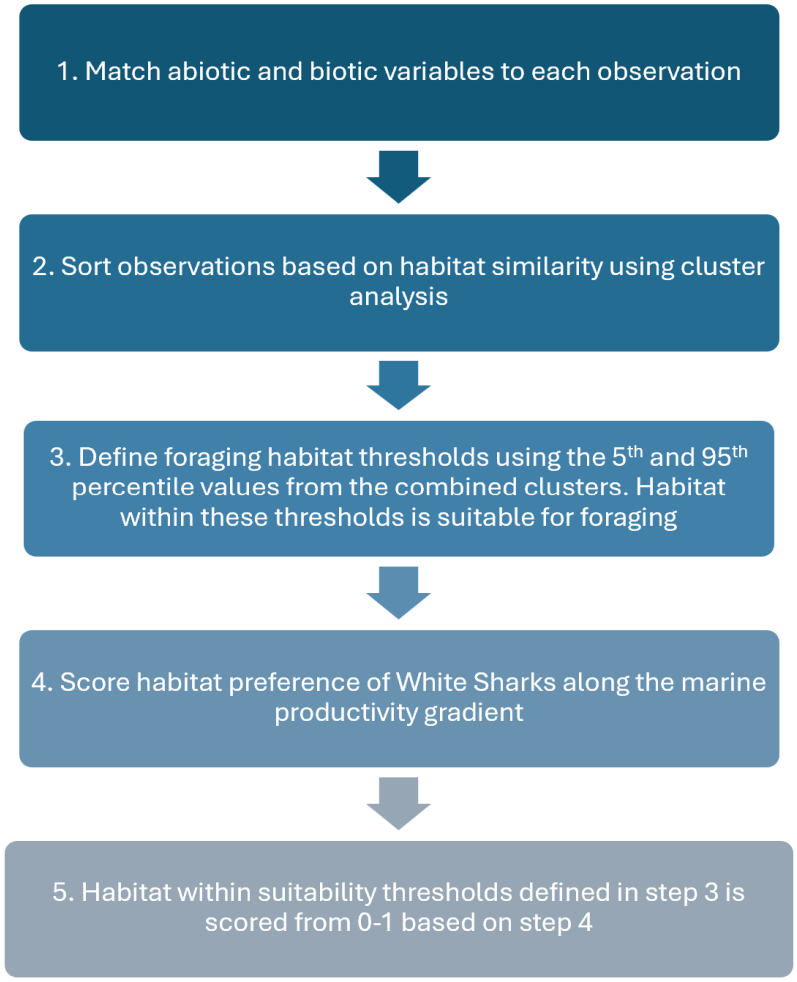


Figure 4. Schematic of the workflow and analytical elements that go into the Ecological Niche Model used to predict suitable foraging habitat for White Shark (methodological details provided in Bowlby et al. In press).

Multiple candidate structures for the ENM were evaluated (Bowlby et al. In press), representing different hypotheses on what drives foraging habitat selection for White Sharks in ACW. An appropriate model would be expected to be able to predict when and where White Sharks were observed, while also identifying areas and times of year when White Shark presence is unlikely. The chosen model described the foraging niche of White Sharks using variability in chlorophyll-a

(CHL) concentration and gradient, sea surface temperature (SST), surface salinity, and distance to large seal colonies (Grey Seal, *Halichoerus grypus*, and Harbour Seal, *Phoca vitulina*). This ENM was used to address the terms of references (TORs).

Sources of Uncertainty

Each data source documenting the presence of White Sharks has different limitations when attempting to infer important habitat in Canada. Acoustic detections are conditional on receiver placement and the timing of deployments, which leads to biases in effort as well as variability in detection efficiency. Efficiency would be anticipated to be lowest in locations that are sparsely monitored; a bias that would augment the impression that White Shark presence is low. PSAT information was sparse, concentrated in the late summer and autumn, and over-represented the component of the population using the Gulf of St. Lawrence. Positional errors were substantial and necessitated averaging environmental conditions over a 25 km radius in the analyses. Autocorrelation could not be accounted for, and it remains possible that the tagged individuals did not reflect the entire foraging niche of White Sharks in ACW.

The ENM uses the spatial preference of White Sharks along the CHL gradient of marine productivity fronts to assign habitat suitability for foraging. Given all the trophic linkages between a generalist apex predator and primary productivity, sources of uncertainty include any mismatch between White Shark prey availability and CHL productivity signals.

Information was insufficient to consider ontogenetic patterns in habitat use in ACW, so the ENM primarily describes the foraging habitats of juveniles and sub-adults. The temperature and salinity values used as physiological thresholds in the ENM do not fully capture seasonality of movements nor habitat use in the St. Lawrence River estuary due to high variability in these parameters. The environmental predictors also do not account for stratification of conditions throughout the water column. The ENM could not account for potential interannual variability in summer seal colony size, nor temporal variability in the precision of light-based geolocation estimates. Finally, behaviours other than foraging may motivate habitat selection at any given time.

The ENM was deterministic, did not explore the impact of variability in parameter inputs, and habitat suitability predictions were conditional on user-supplied thresholds. While the sensitivity analysis undertaken before and during the CSAS meeting demonstrated the ENM gave consistent predictions from numerous formulations, future simulation analyses are recommended to determine the robustness of the approach.

TOR 1: The locations and likely spatial extent of White Shark presence in Atlantic Canada

All data sources document widespread presence of White Sharks in ACW, with a slightly greater spatial extent suggested by the sightings records and the acoustic monitoring data as compared to the more limited satellite tracks. Predictions of suitable foraging habitat are similar in the years prior to increases in White Shark presence in ACW (2011–2019; Allegue et al. 2025) and following abundance increase (2020–2024) in that they were concentrated in the Bay of Fundy, along the Atlantic coast of Nova Scotia, around the Magdalen Islands and the Southern coast of Newfoundland (*c.f.* left panel and right panel of Figure 5). Average habitat suitability was highest directly adjacent to the coast; however, suitable habitat commonly occurred throughout the Gulf of St. Lawrence, offshore to the areas around Sable Island, and towards Georges Bank in Southwestern Nova Scotia (both panels; Figure 5), and extended farther from the coast and further into the St. Lawrence estuary in recent years (right panel; Figure 5). A much greater amount of monitoring data exist in recent years, but presence observations were distributed

throughout the majority of areas that were predicted to be highly suitable, with the exception of coastal Newfoundland where comparatively little acoustic monitoring takes place (both panels; Figure 5).

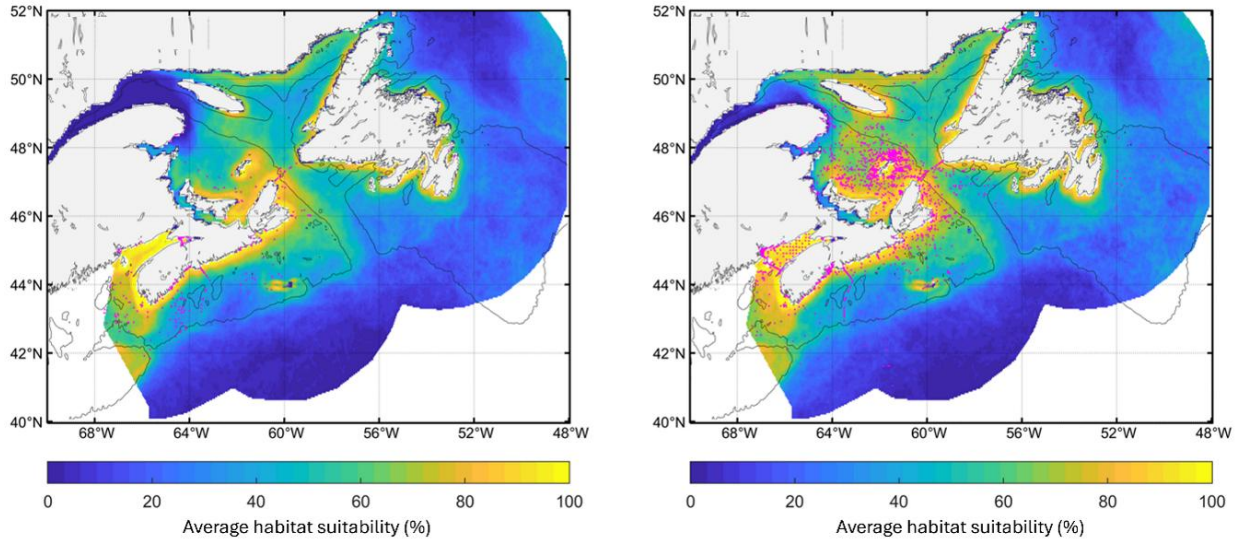


Figure 5. A composite map showing the suitability and distribution of available foraging habitat for White Sharks in ACW from August–October 2011–2019 (left panel) and 2020–2025 (right panel). Habitat with an average suitability of 30% or greater is considered important habitat. The colour ramp represents the mean foraging habitat over the entire time period for each grid cell. Observations of all White Sharks recorded during each timeframe are shown as pink dots (N = 1,774 left panel; N = 15,163 right panel).

TOR 2: Seasonal patterns in White Shark presence

Over 90% of daily acoustic detections occurred between June and October, corresponding to the months when coastal acoustic equipment is typically deployed. From 2010–2024, no White Sharks were detected in ACW in January and detection events from February–March were extremely rare (Figure 6). The earliest northward migrants seemed to be recorded around the Bay of Fundy in May. Presence expanded along coastal Nova Scotia, into the Gulf of St. Lawrence and further northward from June–August, and then contracted from October–December as animals presumably left ACW (Figure 6). The number of unique individuals, as well as the total number of detections each month followed the same pattern, indicating that the seasonality in detections did not result from a few individuals remaining in specific areas over extended timeframes.

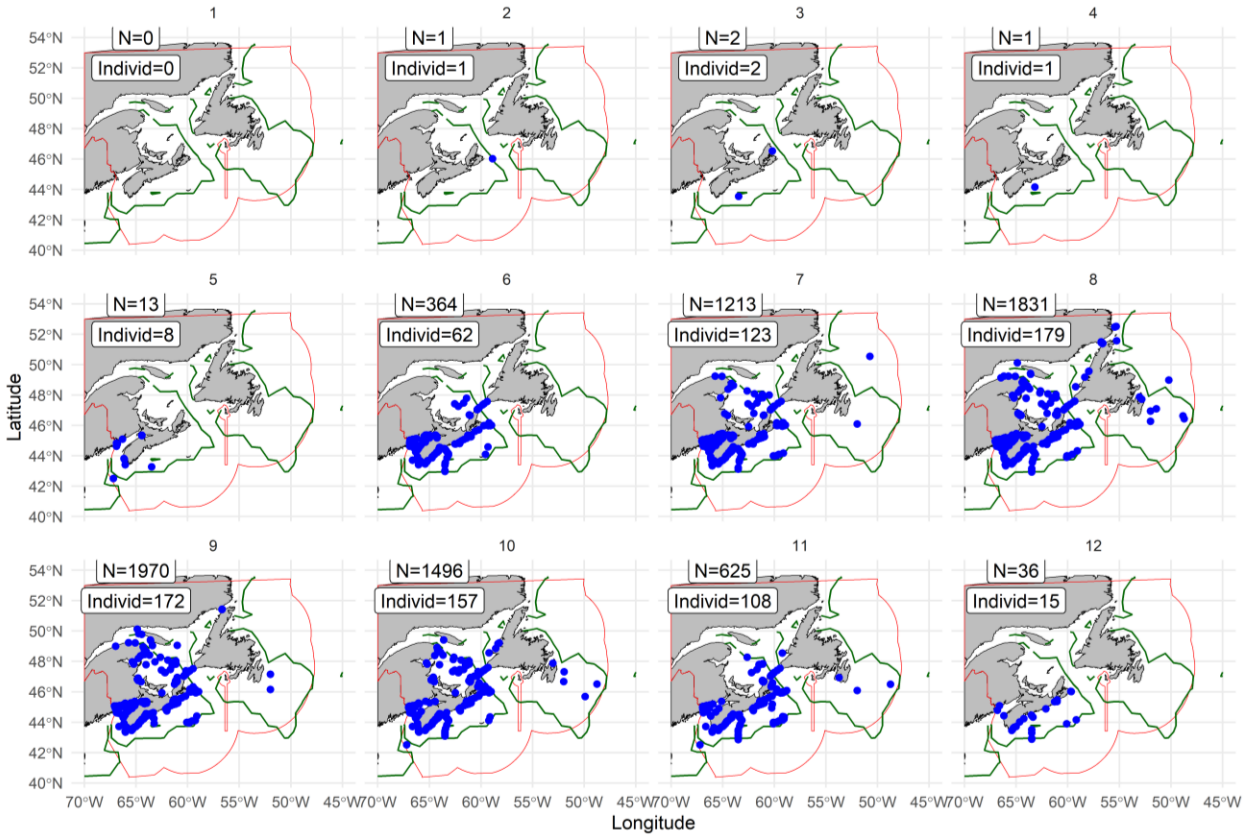


Figure 6. Acoustic detections in Atlantic Canadian waters from 2010–2024 aggregated by month (1–12). The inset numbers represent the sum of the daily detections in each month across individuals and years (N) and the number of unique individuals in each month across years (Individ).

The amount of sea surface area within the Canadian EEZ predicted to contain important habitat for White Shark was exceptionally low from January–April, marginally higher in May and December, increased markedly between June and November, and peaked in September (Figure 7), coincident with seasonal temperature changes. Habitat suitability starts in the Bay of Fundy and Gulf of Maine in early spring, moves progressively up the Scotian Shelf, encompasses the Gulf of St. Lawrence, and extends to coastal Newfoundland and Labrador at the height of summer (Figure 7), implying that the Atlantic coast of Nova Scotia could be used as a migratory pathway twice each year.

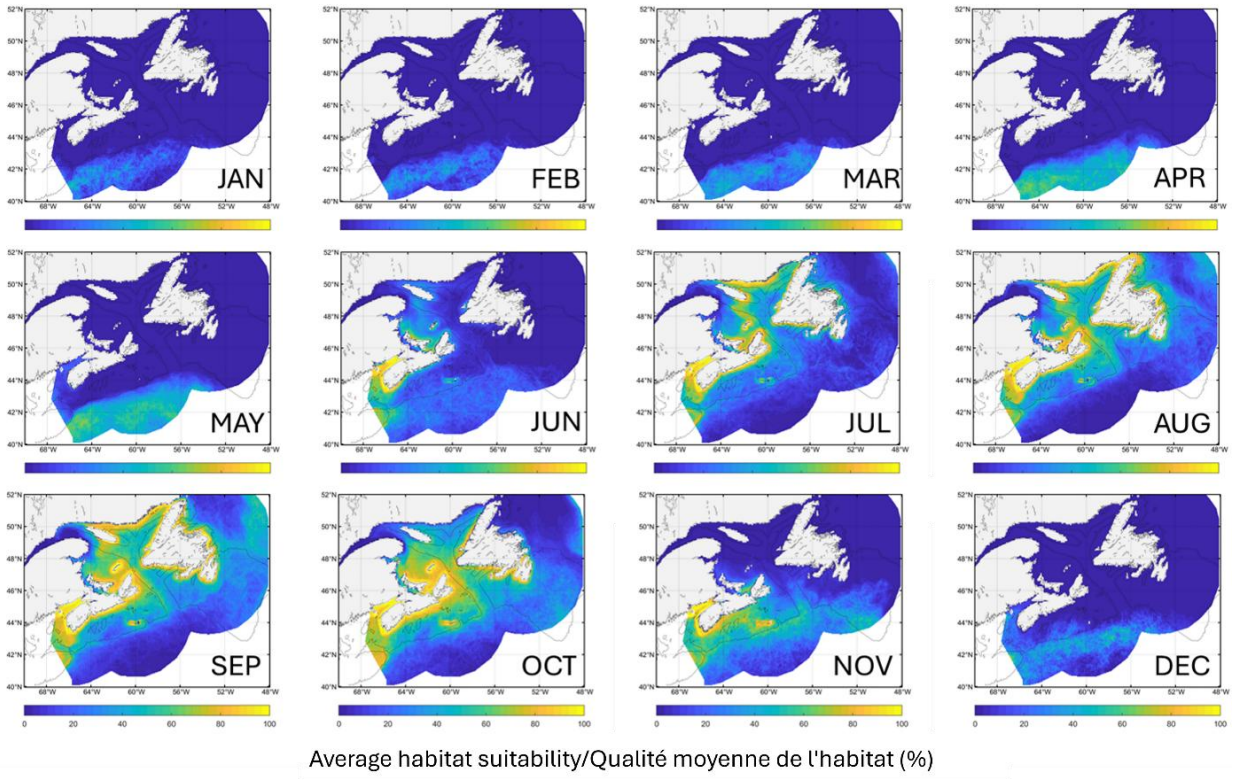


Figure 7. Composite maps showing the suitability and distribution of available foraging habitat for White Sharks in ACW for each month (2011–2024). Habitat with an average suitability of 30% or greater is considered important habitat. The colour ramp represents the frequency of occurrence of foraging habitat over the time period for each grid cell.

The percentage of sea surface that contains important habitat within the Canadian EEZ changes from approximately 1% in January–April to a peak of approximately 36% in September (top left panel, Figure 8). Waters in the Bay of Fundy warm up quickly and contain a relatively consistent amount of important habitat from June–November (top middle panel, Figure 8), while all other regions warm and cool more gradually. The Gulf of St. Lawrence is similar to the Bay of Fundy but cools slightly earlier in the year, in October (lower middle panel, Figure 8). August tends to be the month associated with the maximum percentage of important habitat. The Bay of Fundy had the highest percentage of sea surface (approximately 80% in summer) containing important habitat, yet was also the region with the smallest area (km^2). In all regions, the number of unique individuals detected in each month followed a similar pattern, with low numbers in the months with little important habitat, and higher numbers in months with higher percentages of important habitat.

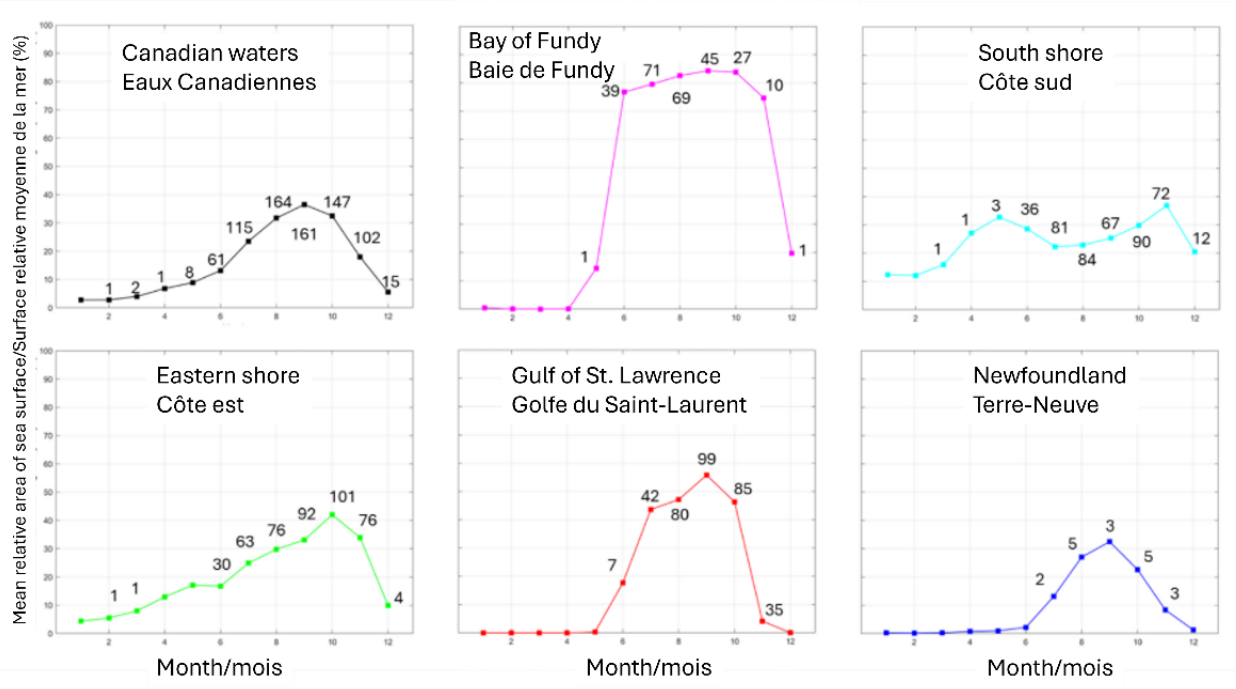


Figure 8. The monthly relative area of available suitable foraging habitat for White Shark expressed as a percentage, based on the averaged data from 2011–2024. Cells are weighted by the daily habitat value when calculating the percentage. Moving from the top left to bottom right, panels represent the entire Canadian EEZ, Bay of Fundy, South Shore Nova Scotia, Eastern Nova Scotia, Gulf of St. Lawrence, and Western Newfoundland (refer to Figure 2). Numbers next to points represent the total number of individual White Sharks detected by acoustic receivers in each region by month.

TOR 3: Environmental or biological factors related to presence

The spatial extent of habitat use seemed consistent for all life stages and both sexes. There remains the possibility that spatial separation among the sexes or among life stages could occur over shorter time periods (e.g., days, weeks, or months) or over smaller spatial scales in ACW, patterns that are not yet evident from the available presence data. White Sharks range widely while in ACW, with acoustic detection events having a median duration of 5.7 minutes, and 92% of events being less than one hour. However, there was evidence of substantial variability in movement behaviour among individuals (Allegue et al 2025, Bowlby et al. 2022, Franks et al. 2021, Skomal et al. 2017, Winton et al. 2023), and individual animals had a tendency to return to the same general region in numerous years (Bowlby et al. 2022).

PSAT-tagged White Sharks spent > 95% of time in the top 50 m of the water column, where they tended to experience water temperatures between 12°C and 19°C. This range was nearly identical to the 5th and 95th percentiles of SST identified from the PSAT observations in the cluster analyses. Daily dives below 100 m were relatively infrequent, although there were instances of animals diving in excess of 600 m. While diving, individual White Sharks could experience substantial differences in water temperature, with surface waters tending to be substantially warmer than conditions at depth.

From 2011–2020, the annual fraction of sea surface that represented important habitat varied from approximately 13% to approximately 16% of the EEZ, with no systematic pattern through time (left panel, Figure 9). This value increased to approximately 17.5% in 2021, remained relatively high in 2022 and 2023, before decreasing in 2024 to approximately 16.4%. This pattern aligns directly with the changes in relative abundance documented by Allegue et al.

(2025) from 2019–2023, suggesting differences are biologically relevant. Important habitat becomes more prominent in May, peaks in the summer, and then declines until December (right panel, Figure 9). The height of the peak has been consistently higher since 2021. Important habitat availability peaked in August in 2024, rather than in September as in previous years (right panel, Figure 9), showcasing the interannual variability in the distribution and amount of important habitat.

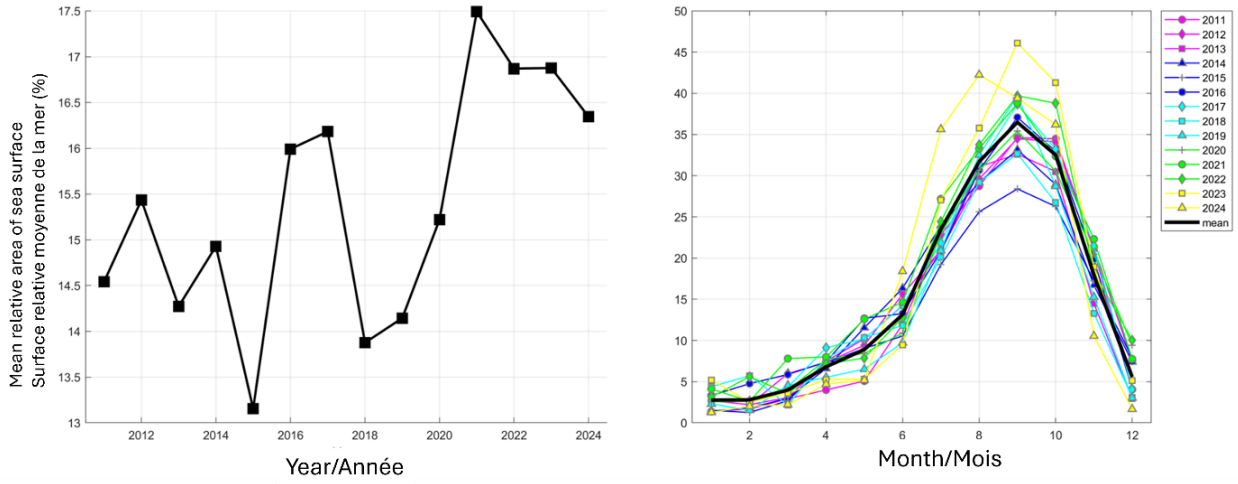


Figure 9. The percentage of sea surface area classified as important habitat for White Shark in each year during the White Shark monitoring period (2011–2024; left panel) and each month during each year (right panel).

Within the overall annual pattern, different regions are associated with greater or lesser amounts of important habitat each year. Particularly in 2022 and 2023 (and somewhat in 2021), areas adjacent to the Gulf of Maine and along coastal Nova Scotia had higher habitat suitability scores than the long-term average. Given that White Sharks enter ACW from the south (Skomal et al. 2017, Franks et al. 2021, Bowlby et al. 2022), it is possible that favorable habitat conditions were encountered more frequently by dispersing animals in those years, which may have provided the behavioural motivation to move northward. In 2024, these same areas had less favorable habitat than the long-term average, corresponding to the intrusion of the cold Labrador current into the Gulf of Maine (Record et al. 2024), which may have reduced movements into ACW.

TOR 4: Functions, features and attributes (FFAs) of important habitat

A *function* is a lifecycle process that takes place in critical habitat. Each lifecycle function is directly or indirectly supported by essential biophysical *features* of the habitat. Features are composed of *attributes*, which are the measurable characteristics of the habitat feature (Fisheries and Oceans Canada 2015).

The ENM was built from biologically-relevant attributes to describe the habitats associated with foraging and movement behaviour in ACW (Table 1). The main attribute linked to the feature *food supply* was a proxy for marine productivity, chosen to reflect overall abundance, density, diversity and distribution of the suite of prey available to White Shark (Table 1). Global analyses suggest that a considerable amount of variation in local fish abundance can be explained by the planktonic food web (Stock et al. 2017). In the North Atlantic, species such as Atlantic Bluefin Tuna (*Thunnus thynnus*) are associated with gradients in primary productivity while feeding (Druon et al. 2016). Thus, it seemed reasonable to expect that productivity fronts were

associated with higher fish biomass and represented a realistic proxy for areas of higher prey density for White Sharks in ocean environments. Surface salinity, SST, and CHL were indicative of characteristics of the water column and water quality associated with different foraging environments used by White Sharks (Table 1). While physical space is also recognized as important, there is currently no threshold for the density or distribution of obstructions.

It is probable that White Sharks display numerous behaviours when they are in close proximity to one another, but it is unknown if other critical life history functions (e.g., reproductive behaviour) are supported by important foraging habitats in ACW.

Table 1. Biophysical functions, features and attributes (FFAs) of habitat considered important for survival and recovery of White Sharks in Atlantic Canadian waters, based on the Ecological Niche Model. Units are $mg.m^{-3}$ and $mg.m^{-3}.km^{-1}$ for absolute CHL and CHL gradient, respectively, and Practical Salinity Unit (PSU) for surface salinity.

Function	Feature	Attribute	Thresholds
Foraging behaviour ● Predation ● Food intake ● Hunting ● Movement/exploration	Food supply ● Prey	Potential prey density, abundance, diversity and distribution indicated using a proxy for marine productivity fronts ● CHL gradient	Minimum CHL gradient = 0.00361
Foraging behaviour ● Predation ● Food intake ● Hunting ● Movement/exploration	Water quality	SST CHL Surface salinity Contaminant levels	Minimum SST = 7.8 CHL ranging from 0.225–12.719 Minimum surface salinity = 27.3 Contaminant threshold not available
Foraging behaviour ● Predation ● Food intake ● Hunting ● Movement/exploration	Water column ● Continental shelf waters	SST CHL Surface salinity	Minimum SST = 7.8 CHL ranging from 0.225–12.719 Minimum surface salinity = 27.3
Foraging behaviour ● Predation ● Food intake ● Hunting ● Movement/exploration	Physical space	Density and distribution of obstructions	Not Available

TOR 5: Activities likely to destroy FFAs of important habitat

An activity is considered to be destructive to critical habitat when it causes a temporary or permanent loss of one or more features and/or attributes that maintain a habitat function needed by the species (Fisheries and Oceans Canada 2015). To permanently destroy a function, feature or attribute (FFA) of White Shark important habitat, the human activity would have to be widespread and cause systemic and catastrophic changes to marine environments. These occurrences would be rare, impacting not only White Sharks, but entire marine communities.

Temporary loss of a habitat function is a more likely outcome of human activities in the marine environment. Although White Sharks are not considered to be habitat-limited, they are anticipated to avoid suboptimal habitats and areas impacted by localized threats (COSEWIC

2021). This avoidance could be interpreted as temporary destruction, where increases in the amount of area or duration of the human activity would be associated with greater impact on White Sharks. Impacts are likely cumulative, but the point at which localized destruction becomes impactful on overall population dynamics (e.g., survival and reproductive rates, abundance; thus impacting the ability of the habitat to support White Shark recovery) is unknown.

Examples of activities likely to destroy important habitat, that are consistent with the threat assessment in the recovery strategy (Fisheries and Oceans Canada 2025), include global greenhouse gas emissions from human activities, commercial fishing pressure on prey species, oil and gas development, ocean dumping and accidental discharge, industrial or telecommunications infrastructure development, agricultural operations, introduction of underwater noise, offshore renewable energy development, and/or ocean climate mitigation (details provided in Bowlby et al. In press).

CONCLUSIONS

All presence data on White Sharks indicate that the species seasonally inhabits ACW, being most commonly observed in July–November. Individuals are highly mobile with little indication of long-term residency in specific areas. Suitable foraging habitat was concentrated in the Bay of Fundy, along the Scotian Shelf and around the Magdalen Islands. The seasonal variability at specific locations over the course of a year (i.e., winter–summer) was substantially greater than the spatial variability among regions in the same season (i.e., important habitat was widely distributed and occurred in all regions). Temporal and spatial variability in important habitat were consistent with the ecological conclusions from other analyses, giving consistent inference on the years and months that would be associated with higher presence and longer durations spent in ACW.

ADDITIONAL CONSIDERATIONS

What represents important habitat for a species in an ecological sense might be different from what is considered critical habitat under SARA. The composite maps produced from the ENM scored average habitat suitability on the scale of 0–100%, where suitability scores of 30% or greater were considered important habitat. The distribution of White Shark presence observations across the CHL gradient indicated preference for specific conditions, which was used to define the 30% threshold (Bowlby et al. In press). However, SARP may decide to use a higher threshold value to delineate critical habitat. Doing so would encompass less ocean surface area and be restricted to those habitats associated with higher productivity and more concentrated marine productivity fronts.

Here, we present thresholds of 30%, 50%, 70% and 90% (representing 53%, 31%, 13% and 2% of sea surface within the Canadian EEZ, respectively) that could be chosen to delineate critical habitat. In each case, the underlying ENM is the same and aggregates information in August–October from 2020–2025 (Figure 10). For comparison, the number of White Shark presence records contained in each polygon over the same timeframe was calculated, representing 97%, 94%, 87%, and 40% of observations, respectively (Figure 10). There is no purely objective way to choose a threshold, but it could be defined by considering the trade-off between the amount of area protected relative to the potential impact on the population (by encompassing the locations where White Sharks are regularly observed). In this specific example, using a threshold of 70% encompasses 13% of the habitat area and 87% of observations; while using a threshold of 50% encompasses nearly 3 times the area (31%) yet only slightly more of the presence observations (94%). Another consideration may be the spatial

distribution of habitats, as higher thresholds exclude specific regions associated with known presence of White Sharks (e.g., large portions of the GoSL and offshore habitat on the eastern Scotian shelf; Figure 10).

Irrespective of the chosen threshold value, if critical habitat is delineated from the ENM, habitat suitability should be predicted from the most recent year of available environmental data (i.e., use the ENM to generate annual habitat predictions), to ensure output reflects recent conditions. Also, seasonal predictions from the ENM should be used (i.e., similar to the monthly patterns in Figure 7), to capture temporal changes in the amount of area considered critical in each month. From these predictions, a moderate threshold value for habitat suitability (e.g., 50%) is recommended to define critical habitat to ensure that it encompasses the broad range of coastal environments where White Sharks are frequently observed.

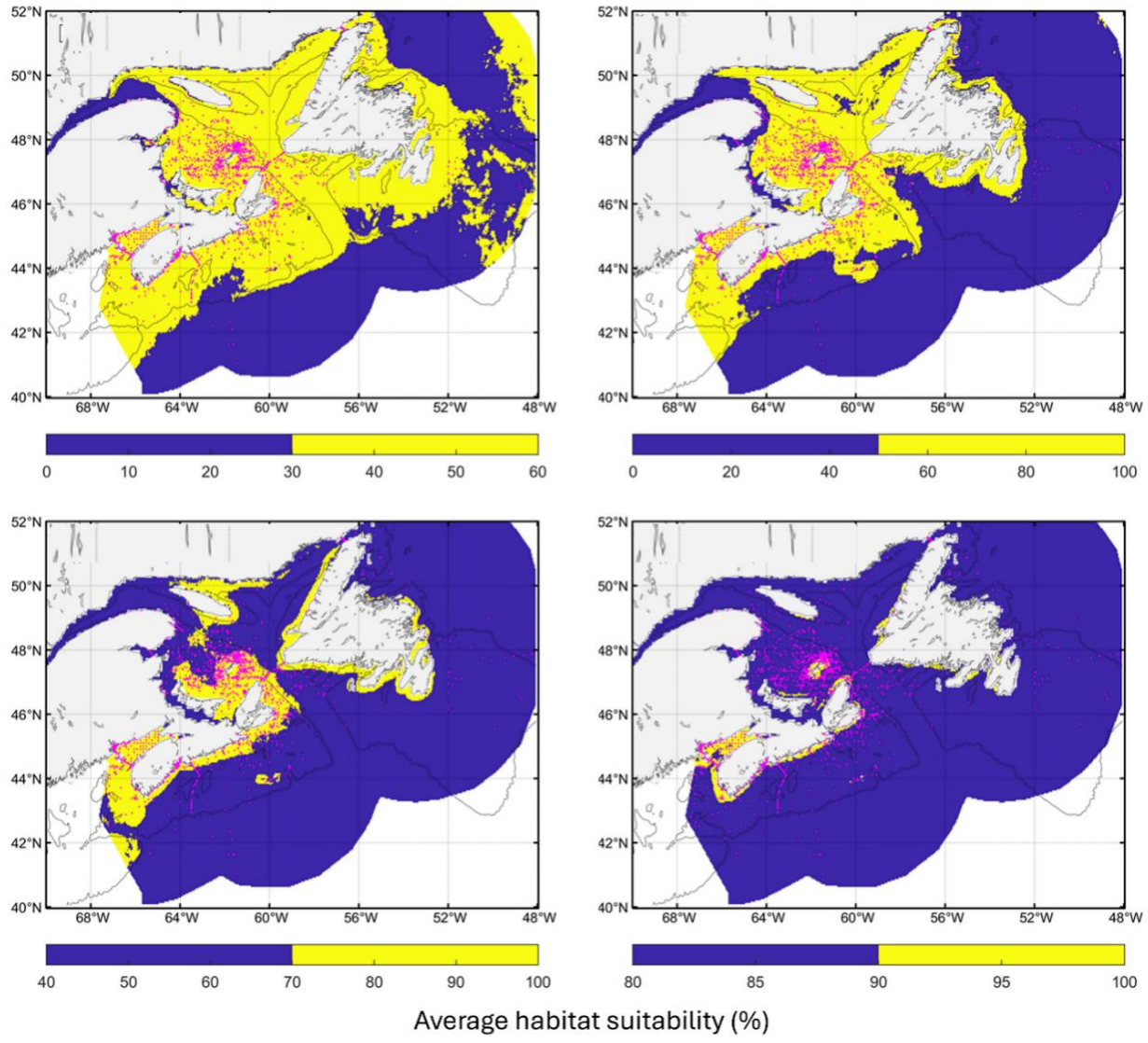


Figure 10. Visual comparison of different thresholds for delineating critical habitat from the ENM where areas in yellow in each panel would be considered critical: 30% (top left), 50% (top right), 70% (bottom left) and 90% (bottom right) based on percent frequency of occurrence of available foraging habitat for White Sharks in ACW (August–October 2020–2025). The spatial distribution of all White Shark observations that occurred over this time period are shown as pink dots (N = 15,613).

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SOURCES OF INFORMATION

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