Chesapeake Bay Program | Indicator Analysis and Methods Document
Brook Trout Habitat Occupancy | Updated August 01, 2025

Indicator Title: Brook Trout Habitat Occupancy

Relevant Outcome(s): Brook Trout

Relevant Goal(s): Vital Habitats

Location within Framework (i.e., Influencing Factor, Output or Performance): Output

A. Data Set and Source

(1) Describe the data set. What parameters are measured? What parameters are obtained by calculation? For what purpose(s) are the data used?

This dataset describes changes (gains and losses) in habitat occupied by brook trout between 2016 and 2024, as determined by the results of the Eastern Brook Trout Joint Venture (EBTJV) salmonid assessments conducted in those years. Gains and losses are measured in square kilometers and mapped at the catchment scale, which includes small watersheds with a 2-5 km reach. This dataset is used to track progress towards the 2014 Chesapeake Bay Watershed Agreement's Brook Trout outcome.

EBTJV assessments produce a habitat occupancy dataset that outlines the distribution of brook trout across the eastern United States. Occupancy is determined either by direct sampling, following fish survey data, or modeled using a spatial algorithm to infer occurrences upstream from sampled locations. Data are reported at the catchment scale and aggregated into "patches." Parameters informing occupancy include brook trout presence/absence, sampling dates, sampling locations, catchment ID and location data, and known barriers to stream connectivity. State biologists review the occupancy status of each catchment to verify presence-absence at each time point. The final determination of occupancy gains/losses excludes catchments unassessed in 2016 and catchments modeled from downstream sampling.

A complete summary of the data, parameters, and calculations is provided in the GIT-funded project report "Facilitating Brook Trout Outcome Attainability through Coordination with CBP Jurisdictions and Partners" (Rummel et al. 2024).

In addition to determining brook trout occupancy changes, a separate database was curated to document implementation projects completed throughout the watershed between 2016 and 2022. The major parameters of this dataset include project type (abandoned mine drainage restoration, aquatic organism

passage, brook trout reintroduction, dirt and gravel road improvement, instream habitat enhancement, riparian restoration, land protection, and others), location, year, number of projects, and project area.

The implementation project data were integrated with co-located habitat occupancy change results to help identify which project types may have contributed to brook trout occupancy changes or population enhancements throughout the watershed.

(2) List the source(s) of the data set, the custodian of the source data, and the relevant contact at the Chesapeake Bay Program.

- Source: GIT-funded Project: "*Facilitating Brook Trout Outcome Attainability through Coordination with CBP Jurisdictions and Partners*" (Rummel et al. 2024)
- Custodian: Dr. Shawn M. Rummel, Lead Science Advisor, Northeast Coldwater Habitat Program Trout Unlimited Shawn.rummel@tu.org

- Source: Chesapeake Bay Program Habitat Tracker
- Custodian: Dr. Emily Young, Habitat and Living Resources Data Manager, Interstate Commission on the Potomac River Basin, eyoung@chesapeakebay.net

- Chesapeake Bay Program Contact (name, email address, phone number): Chris Guy, Habitat Goal Implementation Team Coordinator, chris_guy@fws.gov

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included?

- Brook trout occupancy change is reported in "*Facilitating Brook Trout Outcome Attainability through Coordination with CBP Jurisdictions and Partners*" (Rummel et al. 2024).
- 2016 EBJTV Salmonid Assessment data is accessible at https://rpccr.ebtjv.de/
- Implementation Project Data are stored at the Chesapeake Bay Program Habitat Tracker.

B. Temporal Considerations

(4) Data collection date(s): 2016-2024

(5) Planned update frequency (e.g., annual, biannual, etc.): The outcome and indicators are currently being proposed for updates in 2026 as part of the Chesapeake Bay Program Beyond 2025 initiative. There will likely be new targets in the revised outcome.

(6) Date (month and year) next data set is expected to be available for reporting: The timeline for reporting the results of the new outcome targets has not yet been established. The best estimate for the next data set is December 2026.

C. Spatial Considerations

(7) What is the ideal level of spatial aggregation (e.g., watershed-wide, river basin, state, county, hydrologic unit code)? Sub-basin (HUC-8)

(8) Is there geographic (GIS) data associated with this data set? If so, indicate its format (e.g., point, line polygon)?

Yes, there is a GIS layer with HUC-8 catchments that illustrate habitat occupied by brook trout, as well as gains and losses in habitat occupied at the HUC-8 catchment level.

(9) Are there geographic areas that are missing data? If so, list the areas. No.

(10) Please submit any appropriate examples of how this information has been mapped or otherwise portrayed geographically in the past.

Brook trout occupancy changes are mapped in the Rummel et al. 2024 report. 2016 EBTJV brook trout catchments are mapped at https://rpccr.ebtjv.de/

D. Communicating the Data

(11) What is the target or threshold measured by this indicator? How was it established?

The goal of the Brook Trout outcome is to "Restore and sustain naturally reproducing brook trout populations in Chesapeake Bay headwater streams, with an eight percent increase in occupied habitat by 2025". The 2016 EBTJV assessment determined an occupancy baseline of 33,213 square kilometers of patch area. The annual restoration target is 266 square kilometers of habitat.

(12) What is the current status in relation to the target established in the outcome? Why? Would you define our outlook[1] toward achieving the outcome as on course, off course, uncertain, or completed? Upon what basis are you forecasting the outlook?

The outcome is off course. The Rummel et al. 2024 report *Facilitating Brook Trout Outcome Attainability through Coordination with CBP Jurisdictions and Partners*, demonstrated that the Bay program was able to make headway

towards the outcome and there was a net increase of 0.5% occupied brook trout habitat from 2016 to 2024. Habitat occupied by brook trout increased by 1,539 square kilometers from 2016 to 2024, not including loss in occupied habitat. However, this is well short of the 8% increase identified as the target by 2025.

(13) Has a new target, threshold or outcome been established since the last reporting period? Why?

Although new targets are not specified in the current agreement, proposed targets are under review with public feedback for outcomes beyond 2025 (see Planning for 2025 and Beyond).

(14) Has the methodology of data collection or analysis changed since the last reporting period? How? Why?

While the methodology for data collection and analysis has not changed, we now use the Chesapeake Bay Program Habitat Tracker, which consolidates reporting data on implemented projects.

(15) What is the long-term data trend (since the start of data collection)?

Partners have made a concerted effort to protect and enhance brook trout habitat across the landscape, resulting in an increase in occupied brook trout habitat within strongholds. These strongholds are defined by Trout Unlimited's 2017 Range-wide Conservation Portfolio as areas with at least 25 km of allopatric brook trout habitat based on catchment-scale data and at least one stream with a drainage area exceeding 50 km². However, in marginal brook trout habitats, populations continue to decline due to land use changes, water quality degradation, habitat loss, competition from non-native species, and changing environmental conditions. Although we have achieved a net gain of brook trout habitat across the watershed, considerable obstacles remain before we can fully succeed in achieving the outcome.

(16) What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Would you characterize that change in the recent progress[2] as an increase, decrease, no change, or completed for this outcome?

The last update was in 2016. Since then, brook trout occupancy has shown a net increase of 0.5%; therefore, there is an increase in recent progress. The most significant change is our ability to track projects annually using the Chesapeake Bay Program Habitat Tracker. Previously, data was only available every five years. This improvement in tracking enables the Brook Trout Action Team to provide more up-to-date progress toward the outcome goal.

(17) What is the key story told by this indicator?

Partners have made a concerted effort to protect and enhance brook trout habitat across the landscape, resulting in an increase in occupied brook trout habitat. However, in marginal habitats, populations continue to decline due to land use changes, habitat loss, competition from non-native species, and climate change. Although we have achieved a net gain of brook trout habitat across the watershed, significant obstacles remain before we can fully succeed in achieving the outcome.

E. Adaptive Management

(18) What factors influence progress toward the goal, target, threshold or expected outcome?

Three dominant factors influence progress toward this outcome: land use, warming temperatures, and non-native species. Historic land use practices, which removed tree canopy, blocked fish passage, increased sediment and nutrient loading, and altered stream chemistry, have diminished or extirpated brook trout from many streams across the watershed. Restoring stream conditions can take years or even decades. Additionally, increased water temperatures have diminished or extirpated brook trout from marginal habitats. Lastly, the introduction of non-native trout species has created competition for habitat, further diminishing or extirpating brook trout in streams they historically occupied.

(19) What are the current gaps in existing management efforts?

The primary gap is that the current target focuses solely on occupied habitat. The new outcome proposal suggests changing the target to also encompass the abundance and enhanced resilience of stronghold populations.

(20) What other workgroups or Goal Implementation Teams have overlapping management efforts? Is there existing cross-goal collaboration?

Water Quality, Forestry, Stream Health, Fish Passage, and Fish Habitat have overlapping management efforts in brook trout streams. Yes, there is some collaboration occurring, most notably with Fish Passage.

(21) According to the management strategy written for the outcome associated with this indicator, how will we (a) assess our performance in making progress toward the goal, target, threshold or expected outcome, and (b) ensure the adaptive management of our work?

The following priorities are outlined in the management strategy:

- Protect highly functional wild brook trout habitat from harmful changes in land and water use practices through permanent land conservation.
- Connect habitats with a high likelihood of supporting stable wild brook trout populations.
- Restore brook trout habitats that have been impacted by poor land and water use practices, such as livestock access to streams, denuded riparian areas, polluted runoff, and acid mine drainage.
- Enhance or restore natural hydrologic regimes through actions like road decommissioning, increasing forest cover, improving aquatic organism passage (AOP), and enhancing soil health.
- Prevent and mitigate the spread of non-native species into allopatric brook trout patches.
- Reintroduce wild brook trout into extirpated habitats or where an increase in genetic fitness of the population is needed and supported by science.

Performance will be assessed by 1) annual monitoring of brook trout populations and 2) tracking the implementation of priority practices mentioned in the document. Tracking outcome progress annually through the Habitat Tracker will enable the Brook Trout Action Team to adaptively adjust our collective implementation priorities.

F. Analysis and Interpretation

Please provide appropriate references and location(s) of documentation if hard to find.

(22) What method is used to transform raw data into the information presented in this indicator? Please cite methods and/or modeling programs.

The raw data for this analysis includes brook trout occupancy determined from EBTJV salmonid assessment fish surveys and implementation project data stored in the Chesapeake Bay Program Habitat Tracker. The methods used for the analyses are documented in the 2024 report by Rummel et al., titled "Facilitating Brook Trout Outcome Attainability through Coordination with CBP Jurisdictions and Partners."

(23) Is the method used to transform raw data into the information presented in this indicator accepted as scientifically sound? If not, what are its limitations?

Yes. The method was developed by multiple scientific experts.

(24) How well does the indicator represent the environmental condition being assessed?

The data provides a direct measurement of the information required to assess progress of the Brook Trout Outcome, specifically the presence or absence of brook trout in habitat catchments. However, it does not directly reflect the condition or quality of the habitat. Future changes beyond 2025, including assessments of abundance and resilience, should begin to address these aspects.

(25) Are there established reference points, thresholds, ranges or values for this indicator that unambiguously reflect the desired state of the environment?

The target threshold of 8% increased occupancy is unambiguous and reflects a desired state for the environment.

(26) How far can the data be extrapolated? Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

A conservative approach has been taken for the data presented on Chesapeake Progress. Brook trout occupancy gains in catchments are included only when based on sampled data and excluded when determined solely by biologist knowledge of unassessed waters or occupancy modeled upstream of sampled locations. Gains from these excluded scenarios are highlighted in the full report by Rummel et al.

G. Quality

Please provide appropriate references and location(s) of documentation if hard to find.

(27) Were the data collected and processed according to a U.S. Environmental Protection Agency-approved Quality Assurance Project Plan? If so, please provide a link to the QAPP and indicate when the plan was last reviewed and approved. **If not, please complete questions 29-31.** N/A

(28) *If applicable:* Are the sampling, analytical and data processing procedures accepted as scientifically and technically valid? Yes.

(29) *If applicable:* What documentation describes the sampling and analytical procedures used?

Data collection and analyses are detailed in Rummel et al. 2024. Each jurisdiction has their own protocol for fish sampling.

(30) *If applicable:* To what extent are procedures for quality assurance and quality control of the data documented and accessible?

Data is extracted from jurisdictional sampling, where each jurisdiction follows its independent protocol for fish sampling to determine presence or absence.

(31) Are descriptions of the study design clear, complete and sufficient to enable the study to be reproduced? Yes.

(32) Were the sampling, analytical and data processing procedures performed consistently throughout the data record? Yes.

(33) If data sets from two or more sources have been merged, are the sampling designs, methods and results comparable? If not, what are the limitations? Yes.

(34) Are levels of uncertainty available for the indicator and/or the underlying data set? If so, do the uncertainty and variability impact the conclusions drawn from the data or the utility of the indicator?

To minimize uncertainty, a conservative approach has been adopted. Brook trout occupancy gains in catchments are included only when supported by sampled data and excluded when based solely on biologist knowledge of unassessed waters or occupancy modeled upstream of sampled locations. Rummel et al. 2024

(35) For chemical data reporting: How are data below the MDL reported (i.e., reported as 0, censored, or as < MDL)? If parameter substitutions are made (e.g., using orthophosphate instead of total phosphorus), how are data normalized? How does this impact the indicator? N/A

(36) Are there noteworthy limitations or gaps in the data record?

Data limitations are addressed in detail in the Rummel et al. 2024 report.

H. Additional Information (*Optional)*

(37) Please provide any further information you believe is necessary to aid in communication and prevent any potential misrepresentation of this indicator. N/A

[1]*Outlook:* Outlook is the forecasted trajectory for whether the Chesapeake Bay Program is on course to achieving the outcome. An outcome's outlook may be on course, off course, uncertain, or completed. This information will be incorporated into the

outcome's progress page. An outcome's course outlook is reviewed and updated during the outcome's Strategy Review System (SRS) Quarterly Progress Meeting in addition to when recent progress is assessed.

[2]*Recent Progress:* Recent Progress describes the change in the indicator based on the most recent data collected since the last reporting period. The recent progress icon will reflect this change as an increase, decrease, no change, or completed, depending upon this progress. This information will be discussed at the outcome's Strategy Review System (SRS) Quarterly Progress Meeting.