**Chesapeake Bay Program | Indicator Analysis and Methods Document**

*Brook Trout Habitat Occupancy | Updated 10/12/18*

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): Performance

## 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?

In 2015, a range-wide assessment of wild Brook Trout at the catchment scale was completed by the Eastern Brook Trout Joint Venture (EBTJV) using 100+ years of historic data collected by state agencies (Hudy et al. 2008, 2013). These data are essentially stream surveys conducted to determine the presence/absence of trout species. Each catchment was then classified based on the presence/absence of wild trout as follows: Brook Trout only (code 1.1), Brook Trout and Brown Trout (code 1.2), Brook Trout and Rainbow Trout (code 1.3), and Brook Trout with both Brown Trout and Rainbow Trout (code 1.4). Catchments with only Brook Trout are knows as allopatric while those with Brown and/or Rainbow are sympatric. A GIS-based algorithm was created to extrapolate the point stream survey data to the catchment scale (Coombs and Nislow 2015). The output of the algorithm is a GIS shapefile containing polygons that are classified based on the allopatric/sympatric codes noted above. The parameters obtained by the EBTJV Catchment Assessment algorithm are:

1. EBTJV Code – The classification code of the catchment based on salmonid species present (Allopatric Brook Trout Habitat = 1.1 and 1.1P).
2. Catch Count – Sequential upstream catchment count from the catchment containing the sample point used for classification.
3. Cumulative Length – Cumulative stream length from the catchment containing the sample point used for classification.
4. Sample Year – The year in which the sample point used for classification was conducted.
5. Sample Distance – The Euclidian distance of the sample point location from the flowline (only calculated for catchments containing the sample point used for classification.
6. Dam – Whether the catchment contains a barrier.
7. Sample Location – Whether the sample point is above or below the barrier (only determined for catchments containing the sample point used for classification and a barrier).
8. Stream Order – The stream order of the flowline associated with the catchment.

9. Comment – Adds the classification code and sample year for additional sample points located in the catchment.

(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: Eastern Brook Trout Joint Venture
- Custodian: Dr. Ben Letcher (USGS)
- Chesapeake Bay Program Contact (name, email address, phone number): Dr. Stephen Faulkner (USGS), faulkners@usgs.gov, (304) 724-4471

(3) Please provide a link to the location of the data set. Are metadata, data-dictionaries and embedded definitions included?
http://ecosheds.org:8080/geoserver/www/Web_Map_Viewer.html

**B. Temporal Considerations**

(4) Data collection date(s): Varies by state, but a good range is 1980 to 2015.

(5) Planned update frequency (e.g., annual, biannual, etc.):

- Source Data: Every 5 years (beginning in 2015)
- Indicator: Every 5 years (beginning in 2015)

(6) Date (month and year) next data set is expected to be available for reporting: December 2020

**C. Spatial Considerations**

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

Watershed-wide, catchment (HUC14, defined by the NHD+ data utilized for this effort, is the land area draining directly to a single stream segment) level spatial aggregation is ideal for reporting brook trout occupancy.

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

Yes, the dataset is a shapefile that displays polygons of Brook Trout catchments.

(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.

See Hudy et al. (2008, 2013) and Eastern Brook Trout Joint Venture.

**D. Communicating the Data**

(11) What is the goal, target, threshold or expected outcome for this indicator? How was it established?

Brook Trout symbolize healthy waters because they rely on clean, cold stream habitat and are sensitive to rising stream temperatures. They are an essential part of the headwater stream ecosystem, an important part of the upper watershed's natural heritage and a valuable recreation resource. Wild Brook Trout populations in the Chesapeake Bay watershed have been significantly reduced over the last 150 years and continue to face ongoing and future threats (climate change, land use changes, etc.). The goal of this indicator is to display and sum the total of occupied allopatric (Brook Trout only) Brook Trout catchments in the Chesapeake Bay Watershed. We will be able to account for changes from census to census (every 5 years) to identify trends and overall progress toward the outcome goal of an 8% increase (1,080km$^2$) in allopatric Brook Trout habitat over the baseline (13,500km$^2$) by 2025.

(12) What is the current status in relation to the goal, target, threshold or expected outcome?

Per the 2015 EBTJV Occupancy Census, the current extent of allopatric Brook Trout habitat is 13,500 km$^2$ (EBTJV 2016).

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

No new goals have been established since the last reporting period.

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

2015 was the first year the EBTJV Occupancy Census data was collected and interpreted.

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

This data has only been collected and interpreted once (2015).

(16) What change(s) does the most recent data show compared to the last reporting period? To what do you attribute the change? Is this actual cause or educated speculation?

This data has only been collected and interpreted once (2015).

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

This indicator reflects the reduction and/or growth of allopatric Brook Trout habitat (catchment level) in the Chesapeake Bay Watershed on a 5-year basis. It shows where habitat was lost and/or gained and by how many kilometers squared. This information tells us how and where we are progressing toward and/or losing ground on our outcome goal of an 8% increase (1,080km$^2$) in allopatric Brook Trout habitat over the baseline (13,500km$^2$) by 2025.

**E. Adaptive Management**

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

Factors influencing progress toward the outcome goal include habitat stressors like acid mine drainage, land use (impervious surface, forest buffers), and climate change (leading to increases in water temperature), population genetics, habitat conservation and monitoring support, and the dissemination of important conservation and land use decision support tools to conservation managers and local decision makers.

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

Gaps include the need for better scientific understanding of population genetics and spatially explicit linkages between Brook Trout populations and stressors, funding for developing improved monitoring techniques, the need for data and analyses to correlate habitat restoration to improvements in Brook Trout populations, and Decision Support Tool coordination and knowledge for conservation managers.

(20) What are the current overlaps in existing management efforts?

The Brook Trout Outcome overlaps with the Fish Habitat Outcome, Fish Passage, and Maintain Healthy Watersheds GIT as habitat conservation efforts and land use decisions (forest buffers, impervious surface) are factors that influence outcome progress.

(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?

(a) The partnership uses this data to assess progress toward the Brook Trout occupancy goal by calculating what percentage of the goal has been reached and by identifying areas where allopatric Brook Trout habitat has increased and decreased.

(b) The Brook Trout Action Team meets at least annually to discuss progress, challenges, and opportunities. These meetings provide a forum to review performance and adjust management strategies if appropriate based on identified trends, priority areas, and research needs.

**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.

Please see Hudy et al. 2008, 2013 and Coombs and Nislow 2015 for information on occupancy model and algorithm development.

(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, it is a straightforward algorithm

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

It is the best estimate of current Brook Trout status.

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

No

(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)?

The point data can be extrapolated to the catchment or larger spatial extent with the recognition that those units are simply cataloguing units. There is no implication that Brook Trout are present in any other streams, but they have been observed in at least one stream reach within that spatial unit.

**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.**

No, there is no QAPP

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

Yes, each state has a standardized sampling designs and the approach has been peer reviewed in Hudy et al. 2008, 2013.

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

Hudy et al. (2008, 2013) and Coombs and Nislow (2015)

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

They are available from the state agencies that collect the data

(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?

No, there is some variability among states

(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, they are comparable.

(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?

Detection probabilities are unknown for the majority of the state efforts but ranged from 89 to 99 % in Pennsylvania streams (Wagner et al. 2013).

(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?

NA

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

No

**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.

References

Coombs and Nislow. (2015). EBTJV Salmonid Catchment Assessment and Habitat Patch Layers. Retrieved from https://easternbrooktrout.org/reports/ebtjv-salmonid-catchment-assessment-and-habitat-patch-layers/view. Prepared by University of Massachusetts Department of Environmental Conservation for The Eastern Brook Trout Joint Venture.

EBTJV. (2016). Range-wide Assessment of Brook Trout at the Catchment Scale: A Summary of Findings. *Eastern Brook Trout Joint Venture*. Retrieved from https://easternbrooktrout.org/resources/catchment-assessment-summary-report-appendix-tables/range-wide-assessment-of-brook-trout-at-the-catchment-scale-a-summary-of-findings-by-stephen-perry-2016-last-modified-aug-23-2016-11-49-am-2014-history/view.

Hudy, M. (2008). Distribution, Status, and Land Use Characteristics of Subwatersheds within the Native Range of Brook Trout in the Eastern United States. *North American Journal of Fisheries Management,* 1069-1085. doi:0.1577/M07-017.1

Hudy et al. (2013). The Importance of Scale: Assessing and Predicting Brook Trout Status in its Southern Native Range. Retrieved from https://easternbrooktrout.org/resources/science-publications/the-importance-of-scale-assessing-and-predicting-brook-trout-status-in-its-southern-native-range/view.

Wagner et al. (2013). Landscape-Scale Evaluation of Asymmetric Interactions between Brown Trout and Brook Trout using Two-species Occupancy Models. *Transactions of the American Fisheries Society*. doi:10.1080/00028487.2012.734892

Copies of references can be found on the Brook Trout Action Team webpage.