

Indicators: Characteristics, Qualities and Options

Peter Tango

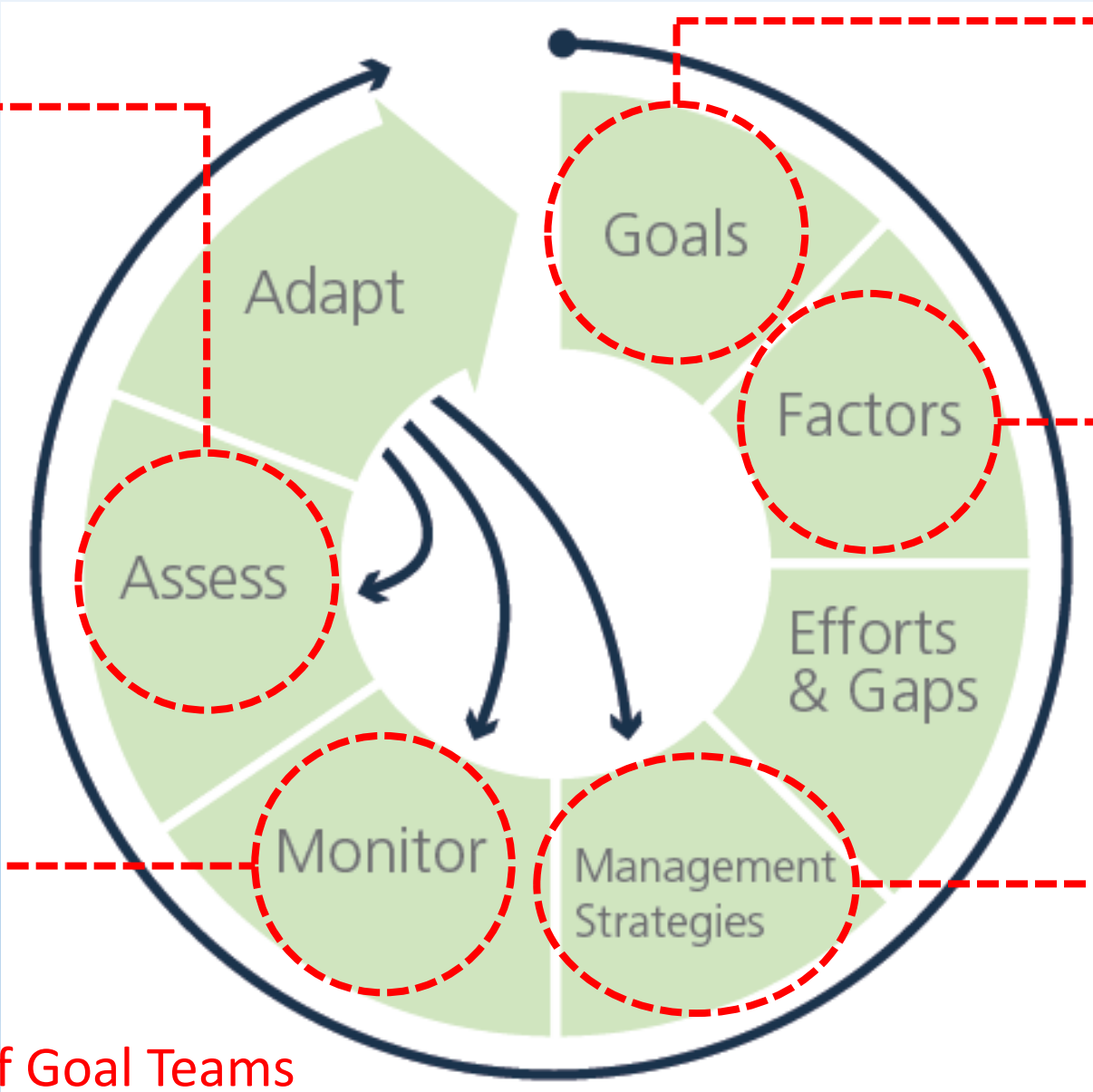
USGS@CBPO

STAR Coordinator

Indicators: *A summary measure that provides information on the state of, or change in, the system that is being measured.*

STAC ●
Performance
Assessment.
Effectiveness of
Management Actions.

STAR ●
Monitoring Network
Design to Support
Adaptive management.



● **STAC**
What are the Current
Conditions? Identify
need for progress.

● **STAC**
Identify the Impacts of
stressors.

● **STAR**
How do we fill
Monitoring, Research,
and Assessment Gaps?
Implementation.

Environmental Indicators

- are used to see if environmental objectives are being met,
- to communicate the state of the environment to the general public and decision makers, and
- as a diagnostic tool through detecting trends in the environment.

The Top 10 Characteristics of a Good Indicator



Important Indicator Qualities



Number 10. Policy relevant

Important Indicator Qualities



Number 9. Be useable by the community

Number 10. Policy relevant

Important Indicator Qualities

1. Simple and easy to understand
2. Be scientifically well-founded
3. Have a reference or threshold value of significance
4. Be responsive to changes in the environment
5. Show trends over time
6. Feasible to measure and report (reasonable cost/benefit ratio)
7. Updated regularly with reliable procedures (timely with support of a monitoring program)
8. Adequately documented, known quality
9. Be useable by the community
10. Policy relevant

Additional indicator qualities to potentially keep in mind

- **Clear in value:** no uncertainty about which direction is good and which is bad.
- **Clear in content:** easily understandable, with units that make sense.
- **Compelling:** interesting, exciting, suggestive of effective action.
- **Policy relevant:** for all stakeholders in the system.
- **Feasible:** measurable at reasonable cost.
- **Sufficient:** not too much or too little information.
- **Timely:** compliable without long delays.
- **Appropriate in scale:** neither over- nor under-aggregated.
- **Democratically** chosen and accessible.
- **Supplementary:** include what people cannot measure for themselves.
- **Participatory:** make use of what people can measure for themselves and compile it to provide geographic or time overviews.

Selected from a report to the Balaton Group by the Sustainability Institute:
“Indicators and information systems of sustainable development”

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Compelling!

- “Hypoxic Volume” ...

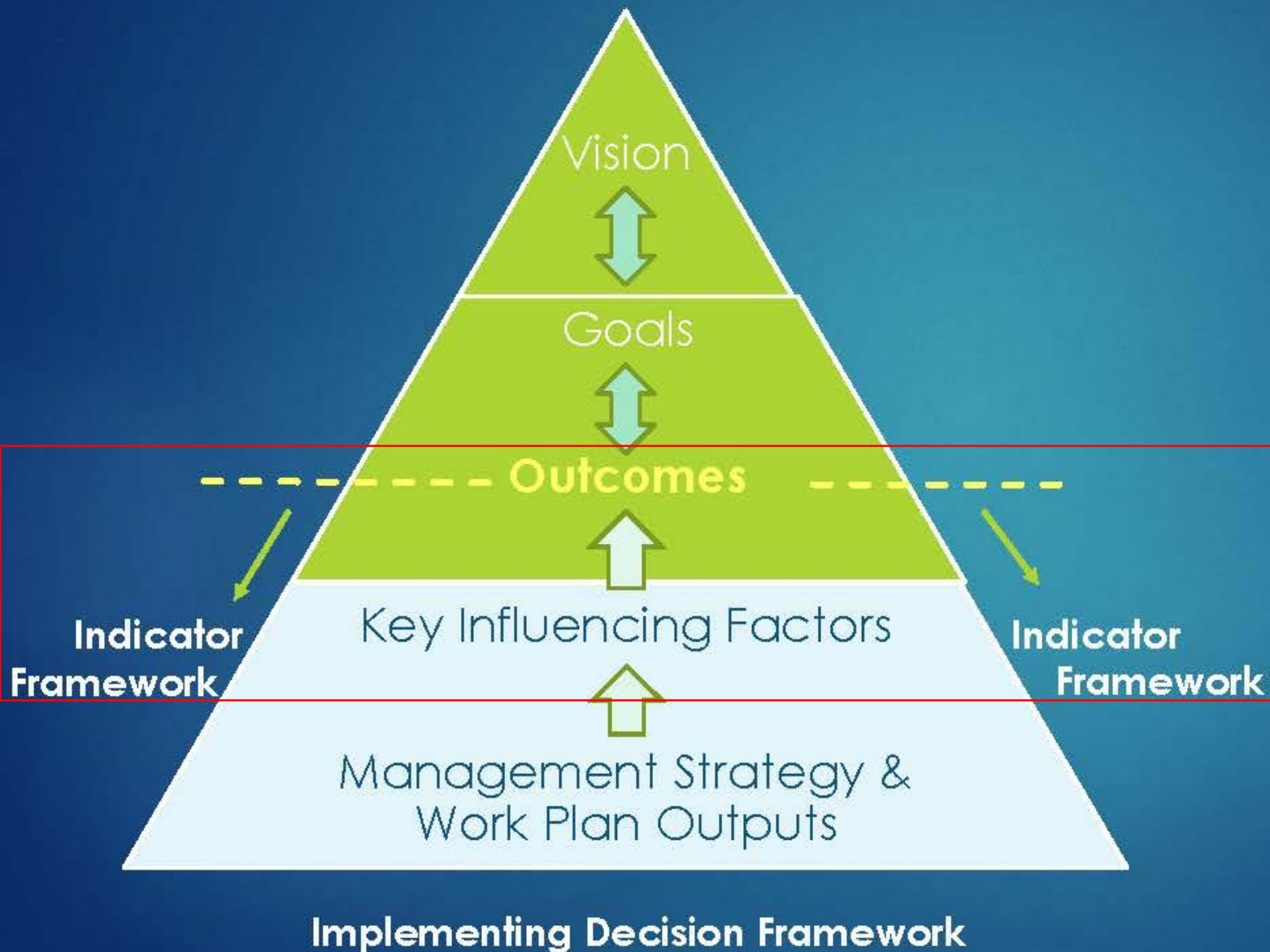


vs.

- “Dead Zones” ...



Aligning with the Agreement



FINDING: The NEW Indicators Framework is **ALIGNED** with the Agreement at the Outcome level.

Agreement GOALS that support achieving the **VISION** flow from the Vision and are aligned with the mission of the CBP.

Agreement OUTCOMES are those aligned with the CBP mission, programs and resources and support achieving the Goal.

Outcomes are achieved through implementing the Decision Framework.

Indicator Support at the CBP includes your A&M Documentation

Chesapeake Bay Program | Indicator Analysis and Methods Document

Water Quality Standards Achievement | Updated 8/2/2016

Note: This document is currently under review and should be considered draft at this time.

Indicator Title: Water Quality Standards Achievement

Relevant Outcome(s): Water Quality Standards Attainment and Monitoring

Relevant Goal(s): Water Quality

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

Analytical Methods Document outline reflects good indicator characteristics.

- **A. Data Set and Source**
- **B. Temporal Considerations**
- **C. Spatial Considerations**
- **D. Communicating the Data**
- **E. Adaptive Management**
- **F. Analysis and Interpretation**
- **G. Quality**
- **H. Additional Information**
(Optional)

A Good Indicator is:

- reflecting the current state of environmental problems
- scientifically grounded
- measurable with a simple measurement unit
- comparable to current and past measures;
- long term;
- policy-relevant;
- timely
- simple and easy to understand

Indicator Needs at CBP

(Laura Free: Status and Trends WG Coordinator)

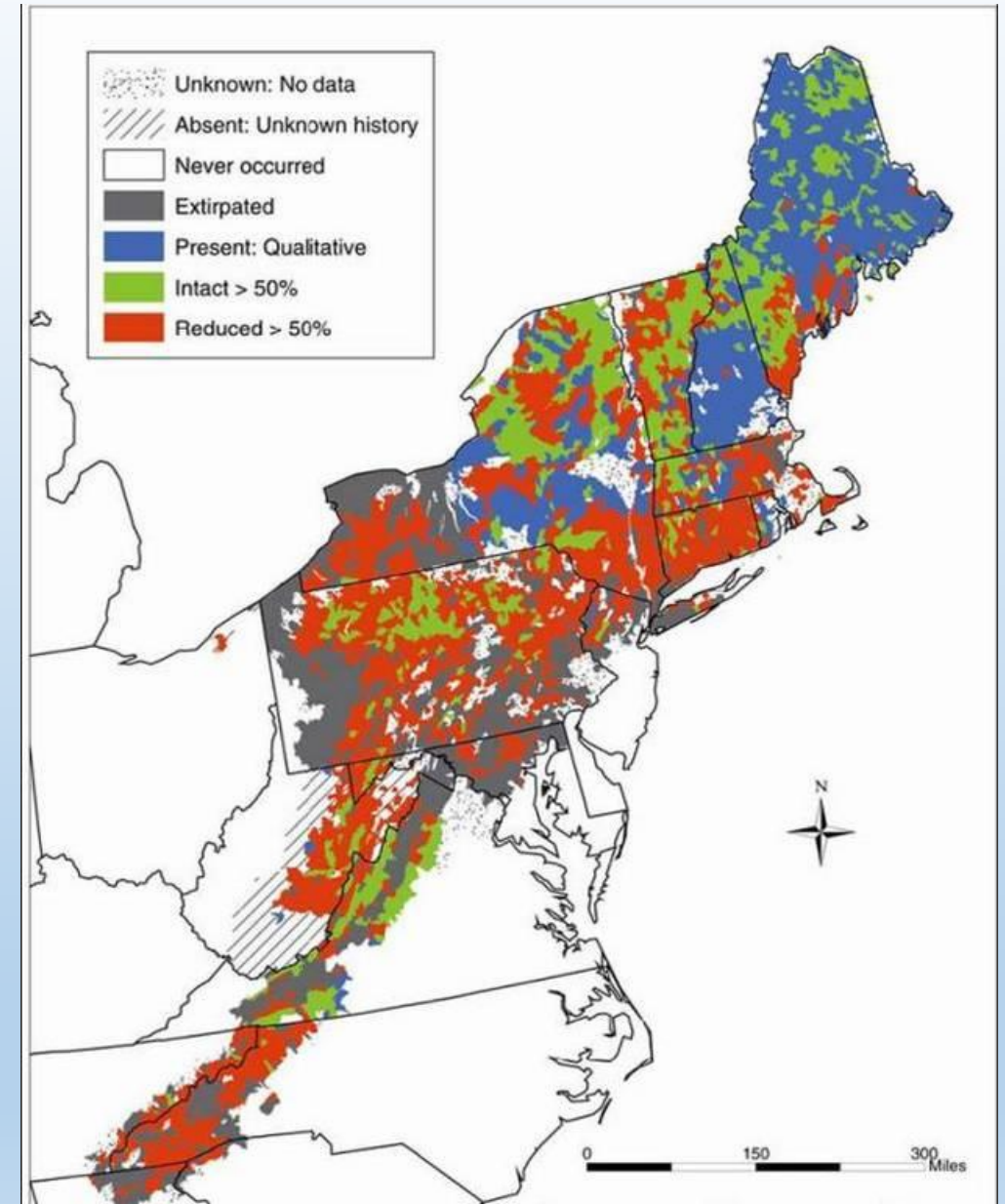
Indicator in Development	Research in Progress	Need to Align with Agreement	No Indicator
<ul style="list-style-type: none">• Environmental Literacy• Citizen Stewardship• Diversity• Oyster• Tree Canopy	<ul style="list-style-type: none">• Forage Fish• Stream Health• Toxic Contaminants Policy and Prevention• Healthy Watersheds• Local Leadership• Climate Resiliency	<ul style="list-style-type: none">• Black Duck• Brook Trout• Protected Lands	<ul style="list-style-type: none">• Fish Passage• Forest Buffer• Wetlands

Example: Options and Opportunities for a Brook Trout Indicator

- Direct measure
- Direct estimate
- Indirect estimate

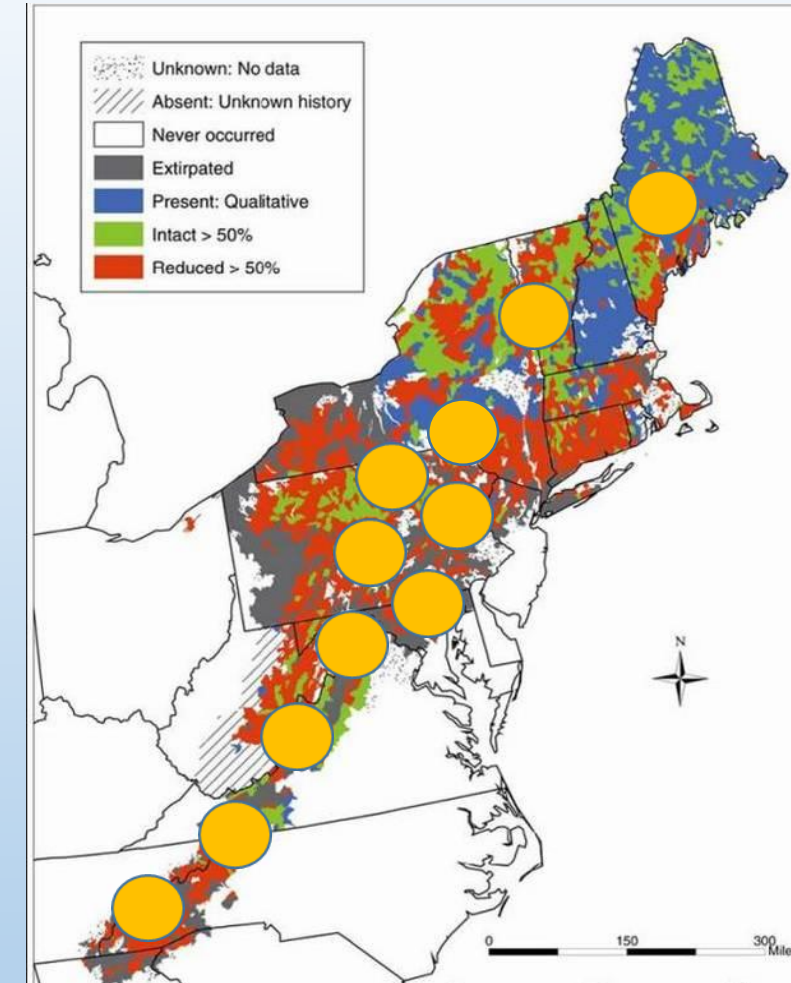
Brook Trout Indicators

- Direct measure:
 - Census the entire Chesapeake watershed and indicate if brook trout were present or absent.
 - Acres of occupied habitat/total acres available *100 = % occupied.
- This is the answer for % occupancy. We don't need to estimate the measure of interest because we are sampling every catchment each sampling period.



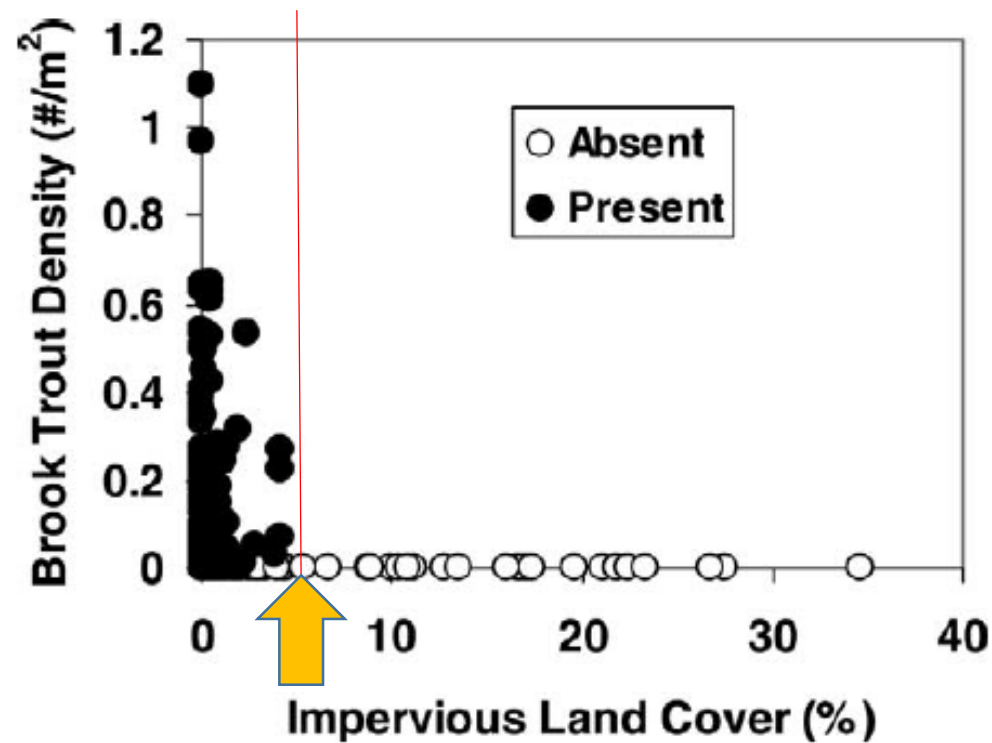
Brook Trout Indicators

- Direct *estimate*
- There were 952 occupied patches in the baseline data set.
- Use sampling theory methods to estimate area occupied (probability sampling).
- Randomly sample a subset of the patches –
 - Is the patch the same size as the original patch?
 - Estimate the proportion of patches that remained the same size
 - Estimate the proportion of patches that increased in size and by how much on average
 - Estimate the proportion of patches that decreased in size and by how much on average
 - Scale up to 952 patches to inform change in existing patch area
- Add in restoration project patch areas
 - The sum of net change in original patch area + restoration area = total patch area.
- Because you base the estimate on a subsample, you get an estimate with error bars of uncertainty and it could qualify as feasible and cost effective.



Brook Trout Indicators

- Indirect estimate – model the response of brook trout survival and extirpation to something else in the environment.



Threshold Response of Brook Trout to impervious cover.

FIGURE 3.—Relationship between brook trout density (fish/m²) and percentage of impervious land cover in Maryland stream catchments where the species was present and sites where the species was expected but absent.

Spatial assessment of brook trout presence absence with landcover.

Stranko et al. 2008. North Am. J. Fisheries Mgt.

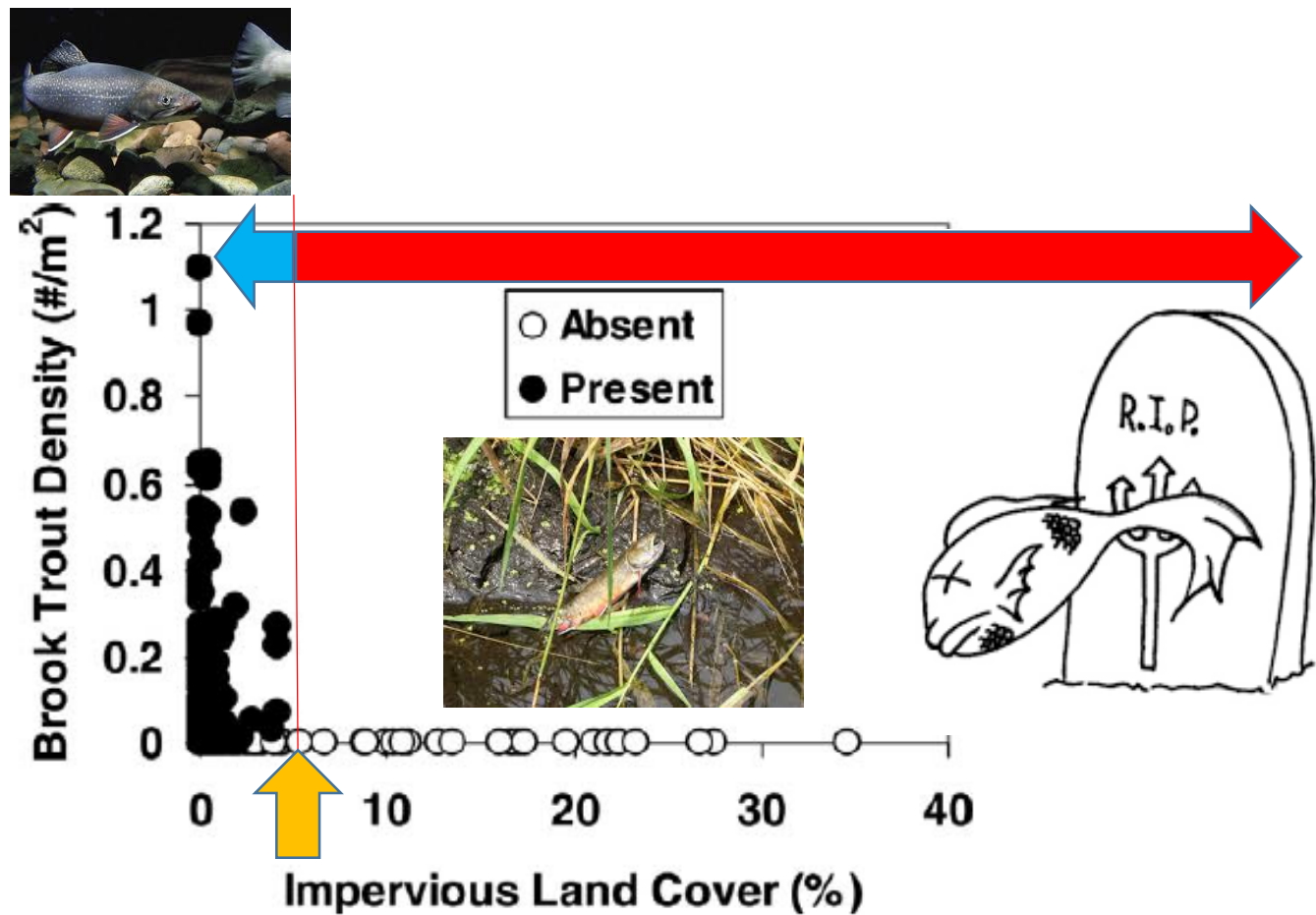


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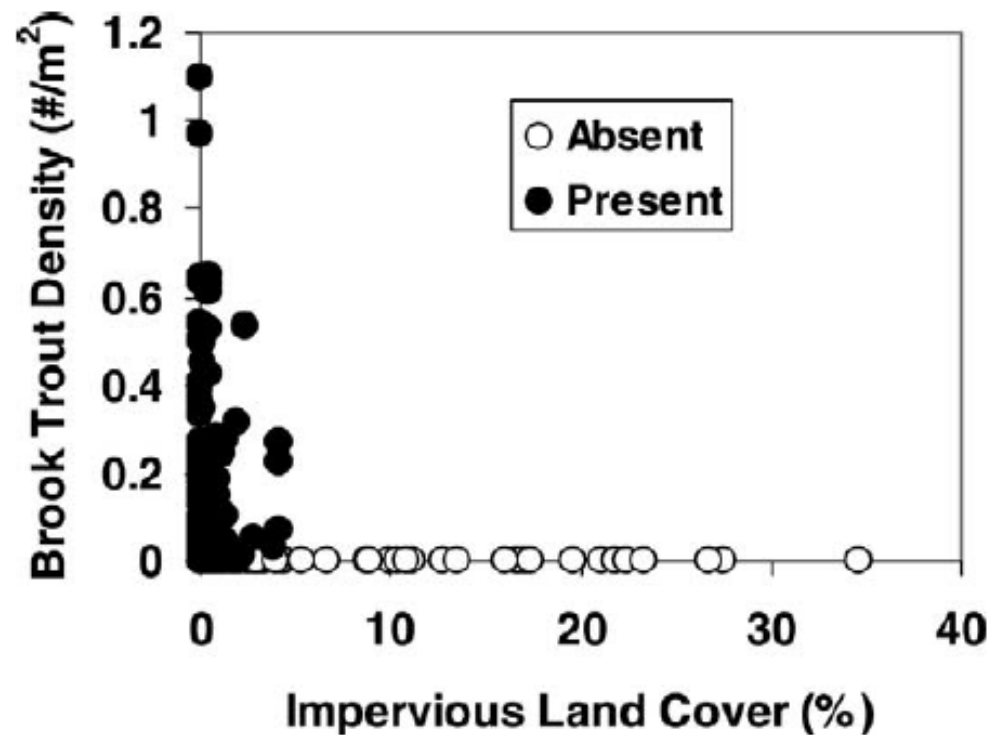
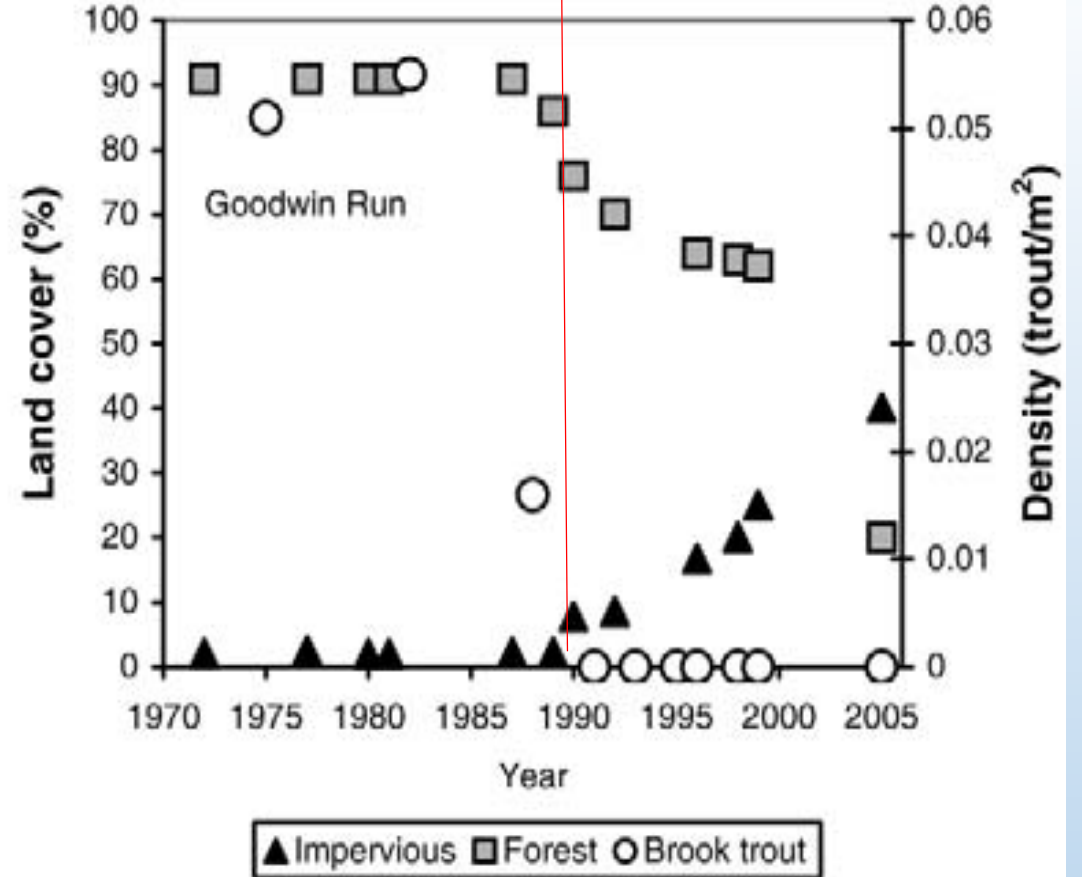


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Temporal response of presence absence with landcover.

Stranko et al. 2008. North Am. J. Fisheries Mgt.

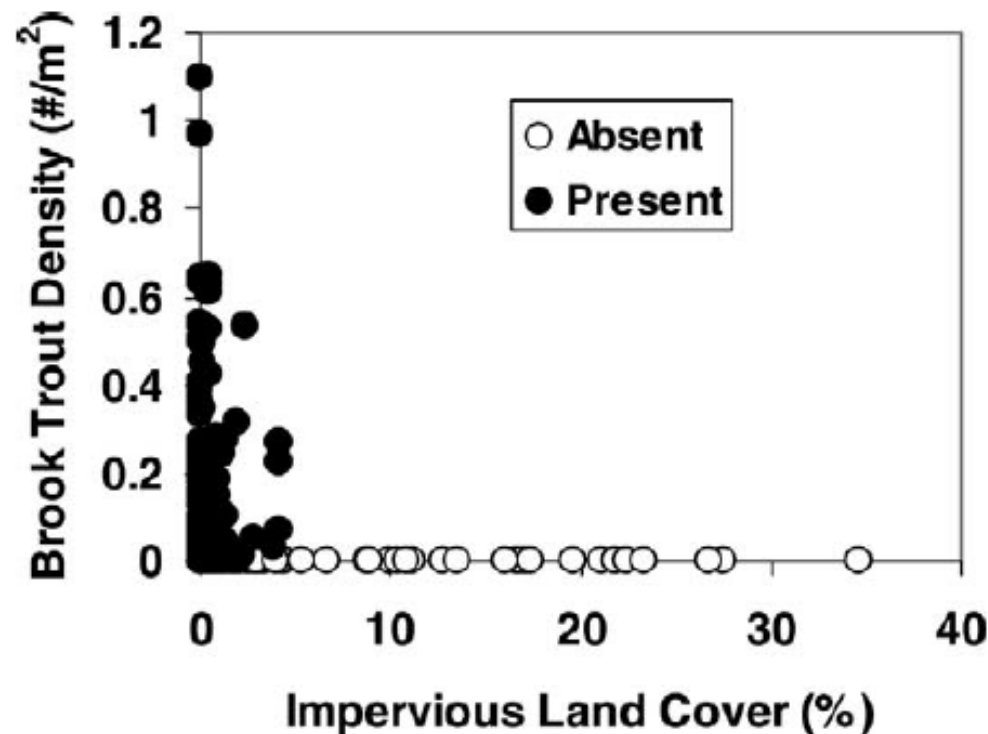


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Spatial assessment of brook trout presence absence with landcover.

Indicator: LANCOVER CHANGE TO >4% Imperviousness. = Patch loss.

If the impervious landcover
Changes from below 4% to above 4%
You can pretty much kiss that population
good bye!

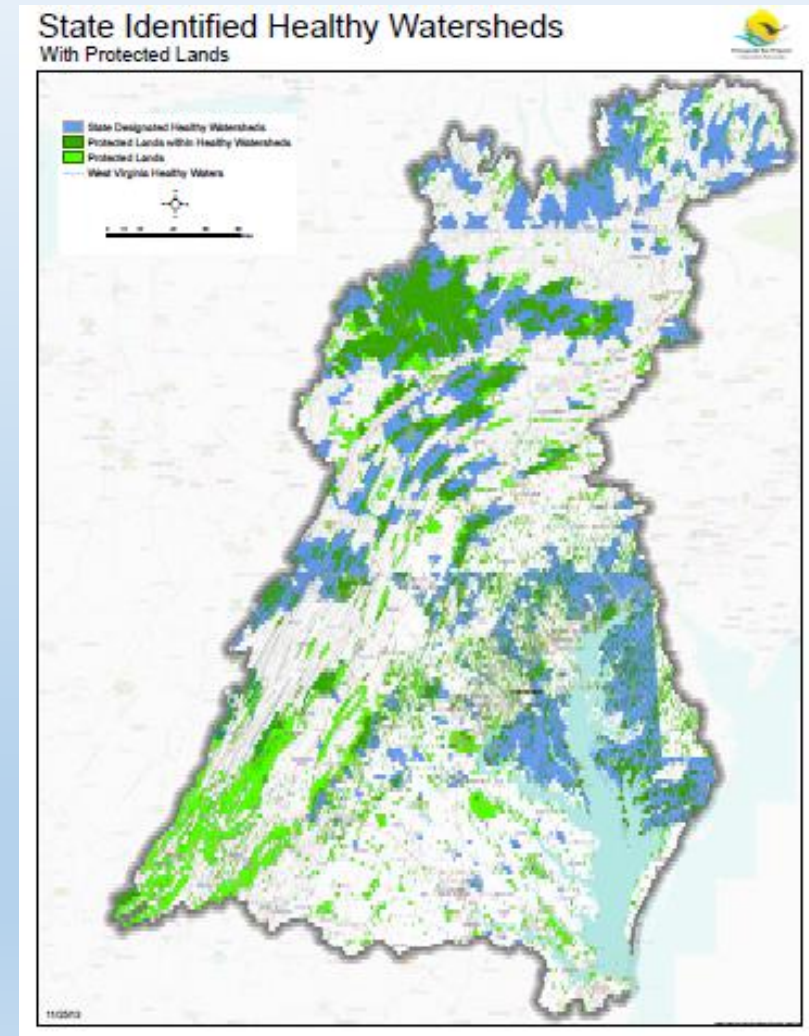
Sometimes you may not need to measure
The exact thing you are looking for to know
Get a major piece of info.

Example: Brook Trout Indicators

- Direct measure – a complete census is often resource intensive
 - Direct estimate – moderate to modest field work investment
 - Indirect estimate – GIS exercise, intensity depending on layer availability.
-
- With widely different levels of resources, with completely different information flows, we could effectively estimate brook trout patch area change over time.

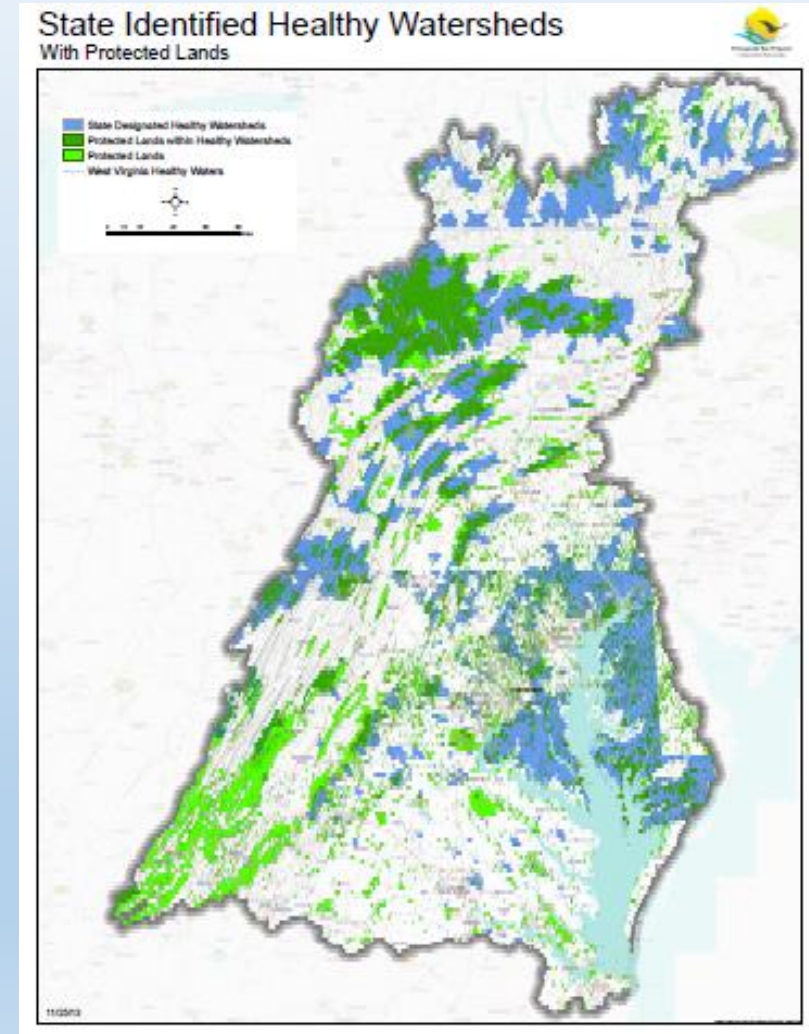
Example: Healthy Watersheds Indicator

- ***Healthy Watersheds Outcome*** 100 percent of state-identified currently healthy waters and watersheds remain healthy.



Healthy Watersheds Indicator

- ***Healthy Watersheds Outcome*** 100 percent of state-identified currently healthy waters and watersheds remain healthy.
- By default – the decision rule comes down to whether any single criterion that defined a healthy watershed fails, the watershed fails.

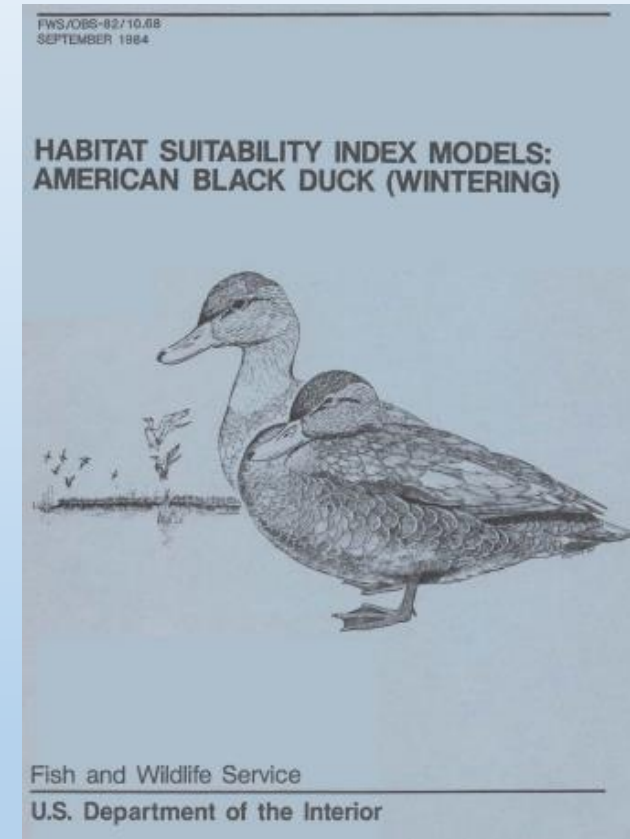


Black Duck Wintering Habitat

- Indicator under development

Black Duck – using existing science

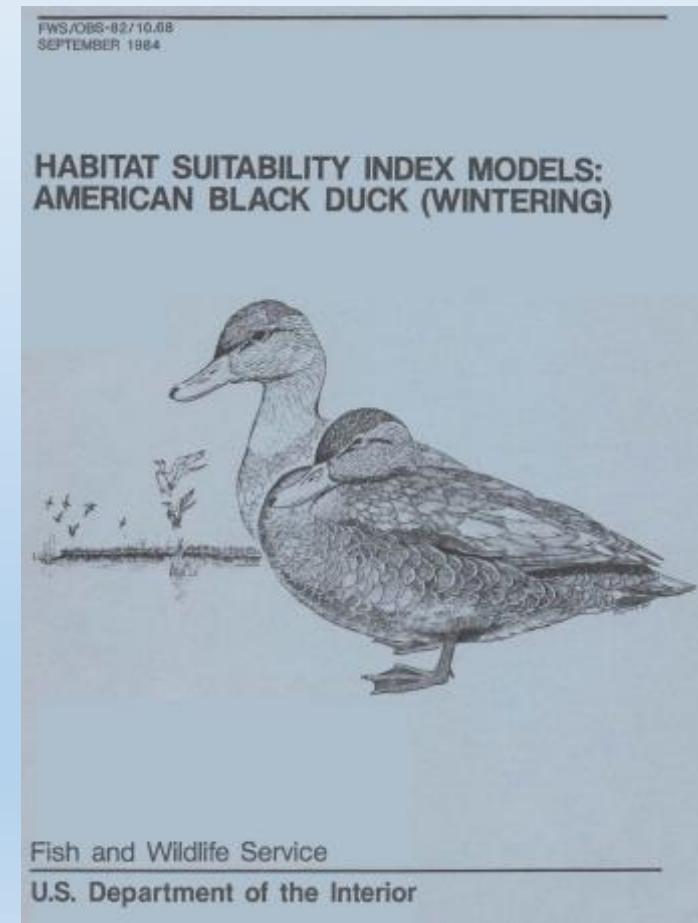
1984 USFWS published a wintering black duck
Habitat suitability index



Black Duck – using existing science

1984 USFWS published a wintering black duck
Habitat suitability index

Habitat	Equation
M and E open water north of Cape Cod, Massachusetts	$\left[\left(\frac{SI_{V_1} + SI_{V_2}}{2} \right)^2 \times SI_{V_4} \right]^{1/3}$
M and E open water south of Cape Cod, Massachusetts	$\left[\left(\frac{SI_{V_1} + SI_{V_2}}{2} \right)^2 \times \left(\frac{SI_{V_3} + SI_{V_4}}{2} \right) \right]^{1/3}$
E vegetated wetlands	$\frac{2 SI_{V_5} + SI_{V_6} + SI_{V_7}}{4}$



Umbrella Species concept in play here



The Panther is an Umbrella Species; when we protect the Panther, we protect all our neighbors! Credit: Steve Carbol

Umbrella Species concept in play here



Index of Community Waterbird Integrity (DeLuca et al.)

- The IWCI was used as a tool to gain insight into how human land use affects estuarine ecosystem integrity.
- 28 watershed study throughout Chesapeake Bay.
- The thresholds found by DeLuca et al. (2004) showed the marsh bird community is primarily vulnerable to disturbances at local scales.
- landscape stressors examined showed development near estuarine coastlines is the primary stressor to estuarine waterbird community integrity, and that estuarine ecosystem integrity may be impaired by even extremely low levels of coastal urbanization.

Index of Waterbird Community Integrity

- Pied-billed grebe (PBGR)
- Great blue heron (GBHE)
- Snowy egret (SNEG)
- Mute swan* (MUSW)
- Wood duck (WODU)
- Domestic duck* (DODU)
- Osprey (OSPR)
- Laughing gull (LAGU)
- Herring gull* (HEGU)
- Royal tern (ROTE)
- Forster's tern (FOTE)
- Belted kingfisher (BEKI)
- Double-crested Cormorant* (DCCO)
- Great egret (GREG)
- Green heron (GRHE)
- Canada goose* (CAGO)
- Mallard* (MALL)
- Bald eagle (BAEA)
- Spotted sandpiper
- Ring-billed gull* (RBGU)
- Great black-backed gull (GBGU)
- Common tern (COTE)
- Least tern (LETE)

*Site integrity scores reflect ecosystem integrity gradients for diagnostic assessments based on diverse criteria:

- Foraging niche breadth
- Nesting sensitivity
- Migratory status
- Breeding range
- State listing
- Native status

Index of Waterbird Communities

- Pied-billed grebe (PBGR) De
- Great blue heron (GBH) De
- Snowy egret (SE) De
- Mute swan (MS) De
- Wood duck (WD) De
- Domestic duck (DD) De
- Osprey (OSF) De
- Laughing gull (LG) De
- Herring gull* (HG) De
- Royal tern (ROTH) De
- Forster's tern (FOT) De
- Belted kingfisher (BK) De

A Current Baywide Monitoring Plan exists!

WATERBIRDS OF THE CHESAPEAKE BAY
A Monitoring Plan
Edition 1.0
December 2013

By Bryan D. Watts
Center for Conservation Biology
College of William & Mary and Virginia Commonwealth
University

- Breeding range
- State listing
- Native status

nents

Summary

- Checklist of good indicator qualities to keep in mind as we consider any indicator.
- Our CBP Analysis and Methods documentation focuses indicator development for needed support material to defend it.
- Diverse approaches across a wide range of resources are feasible to implement effective tracking indicators.
- Investigate existing tools and resources to support efficient and timely application of indicators and monitoring programs.