Appendix 1: Indicators for Forest Target

Description of Forest Target

Forests are the dominant ecosystem of the northeast landscape, covering over 65% of its total area. Trees structure the forest, but forests include the diversity of shrubs, herbs, and wildlife, and the soils, natural and human disturbances that shape them. Wetland forests are included with the Wetland Target.

Subtargets:

Southern Broadleaf Evergreen Forest – beech-magnolia-oak forests and live oak forests in the Atlantic coastal plain region.

Coastal Plain Pine Forest – includes longleaf pine and other pine forests of the Atlantic coastal plain region.

Central Oak Hardwood & Pine Forest – the common central hardwood type.

Northern & Central Mesophytic Hardwood & Conifer Forest – the common northern hardwoods type (including red spruce-fir-hardwoods).

Eastern North America Ruderal and Plantation Forest – both planted (plantation) forest and forests established on abandoned agricultural or other heavily disturbed sites.

Indicators of Forest Status

Indicators are listed in order of priority.

Forests Indicator 1a: Forest Area - by Forest Type

This indicator reports the areal extent of forested lands in the northeastern United States.

Knowing how much land is forested is vital to making informed decisions about forests. Gains and losses in forest area directly affect the public's continued enjoyment of the goods and services that forests provide—recreation, lumber, watershed protection, and many other things. Gain and losses in forest size affect the type of species and processes that occur in the patches, and affect the resistance and resilience of forests to natural and anthropogenic disturbances (adapted from Heinz Center 2002).

Information on forest area by forest type is combined with information on forest area by reserve status in the section on Forest Area Indicators below.

Forests Indicator 1b: Forest Area - by Reserve Status

This indicator reports how much forest land there is in particular land use categories based on conservation reserve status.

Gains and losses in forest area directly affect the public's continued enjoyment of the goods and services that forests provide—recreation, lumber, watershed protection, and many other things. Knowing how much land is forested and how much is in reserve is vital to making informed decisions about forests. Forest in reserve versus non-reserve often have very different goals, differences that are reflected in management priorities and practices (adapted from Heinz Center 2002).

A. Description of Existing Data for Forest Area Indicators

- **Why is this indicator being monitored by this program**
  FIA conducts an inventory of forest resources across all lands and ownerships in the US.

- **Who is collecting the data**
  FIA field crews collect the data. In some States, such as Maine, the State forest agency collects the data for FIA through a cooperative agreement.

- **When is the data being collected (monitoring frequency)**
  In the northeast, each plot is currently measured on a 5-year cycle. But the plots are divided into interpenetrating annual panels in order to be able to provide a statistical sample each year or across any group of up to 5 years.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

FIA has three Phases. Phase 1 uses satellite imagery to stratify an entire State. The focus is on forest vs. nonforest. The FIA unit at the Northern Research Station (NRS) is currently evaluation the use of the NLCD percent cover layer for this purpose. Phase 2 is the traditional tree resource sample focusing on tree regeneration and on overstory tree status and changes. There is one plot for every 6,000 ac. Phase 3 has its roots in Forest Health Monitoring and samples crown condition, down woody material, vascular plants, soils, and lichens (the latter two on a 10-year cycle). There is one plot for every 96,000 ac. Ozone damage is sampled on a separate grid. Some forest ownership information is collected along with the plot data, but a separate National Woodland Owner Survey is also conducted to learn more about the owners.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  With the shift in 1999 from a periodic inventory to an annual one, a systematic hexagonal grid was placed across the US. Each cell is roughly 6,000 ac. If any periodic plots fell in the cell, one of them was randomly chosen as the permanent plot. If the cell was empty, a random point was chosen. The result is a spatially balanced simple random sample. The Phase 1 stratification is then used to post-stratify the data to improve the precision of the results. The design is described in detail in Reams et al. (2005).

- **Data management/storage**
  Internally, FIA uses portable data recorders in the field with software that error checks the data as they are entered. These data are then uploaded into the National Information Management System (NIMS). Further edit checks are performed. Computed variables, such as basal area, biomass and volume, are added. These data are then stored online in the FIADB. They can be downloaded by State: http://fia.fs.fed.us/tools-data/data/.

- **Data analysis/assessment**
  Data analysis tools are also provided so that the user can make tables of estimates online: http://fia.fs.fed.us/tools-data/tools/. The FIDO tool also provides sampling errors for each estimate.

- **Quality Assurance**
  FIA has an active Quality Assurance/Quality Control program. Each crew is checked for the quality of their work (Quality Control). A Hot Check is performed by watching the crew as they work. A Cold Check is performed by revisiting the plot after the crew is done. The crew's work is then scored and feedback is provided. For Quality Assurance purposes, 3% of all plots are revisited but without the original data in hand in order to provide users with information on how repeatable the results are. Pollard et al. (2006) provide Quality Assurance results for Phase 2.

B. Potential Issues in Applying Forest Area Data Sets for NEAFWA Framework

FIA surveys provide forest area data with a reliability of ±3–10% per 1 million acres (67% confidence limit). This standard applies to all data reported for 1953 and later. Regional totals

generally have errors of less than ±2%. No error estimate is provided for data from before 1953. Note also that data collected before 1953 come from a wide variety of sources (see above).

Methods for Measuring Forest Area are in place, using both a plot-based approach and a map based approach.

Methods for determining Reserve status are in place, but the FIA categories for Reserve status need to be migrated to the Conservation Lands categories.

C. Data Gaps for Forest Area

Monitoring of forest area based on the FIA sample grid provides one important source of information. Mapped information of forest area may also be helpful for comparison purposes. Measurements of forest area by patch size needs much further development before monitoring can be implemented.

D. Next Steps for Data Compilation and Analysis for Forest Area

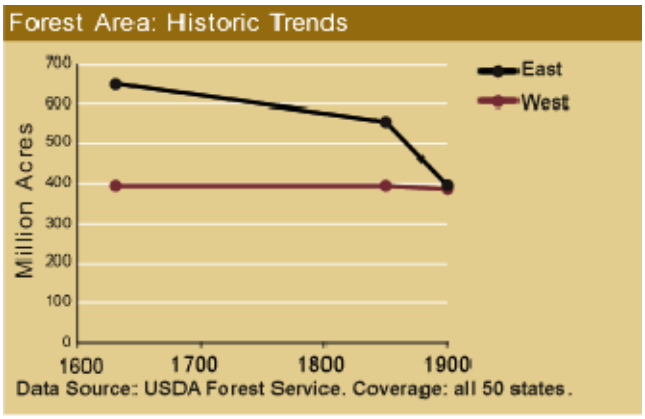
For total forest area, see standard FIA compilations and summary.

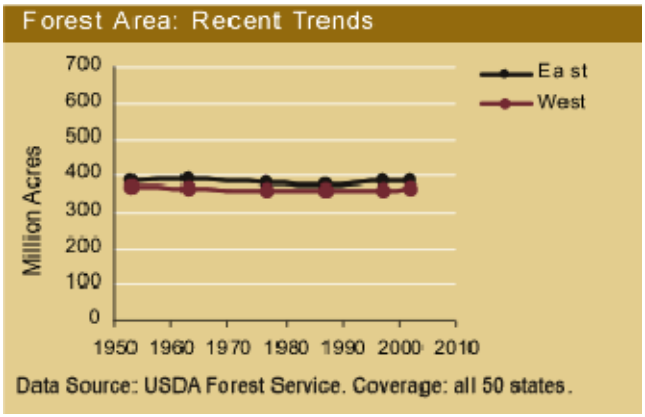
The data for this reserve were collected by the Forest Service's Forest Inventory and Analysis (FIA) program. These data do not include information on private lands that are legally reserved from harvest, such as lands held by private groups like The Nature Conservancy. In addition, many "natural" and "semi-natural" lands are at times reserved from harvest because of administrative or other restrictions.

We hope that, in future reports, it will be possible to report on the existence of protected or reserved areas on a broader range of land ownerships. One dataset being developed for this purpose will report the acreage of lands according to a system of categorizing management intensity developed by the U.S. Geological Survey Gap Analysis Program (see http://www.gap.uidaho.edu/handbook/Stewardship/default.htm). This database is currently under development by the Conservation Biology Institute in conjunction with the USDA Forest Service; see http://www.consbio.org/cbi/what/pad.htm.

E. Baseline Condition and/or Past Trends of Forest Area

Currently, only total area trends can be reported. See figure below for an example of baseline condition assessments for total forest area (based on FIA data, from Heinz Center 2002).





F. Additional Comments for Forest Area

None offered.

G. Citations for Forest Area

Heinz Center. 2002. The State of the Nation's Ecosystems. Measuring the Lands, Waters, and Living Resources of the United States. The H. John Heinz III Center for Science, Economics, ad the Environment. Cambridge University Press, New York, NY 270 pp.

Northern Forest Center. 2000. Northern Forest Wealth Index: Exploring a Deeper Meaning of Wealth. Concord, New Hampshire and Bethel Maine. 56 pp.

Smith, W.B., J. Vissage,D. Darr, and R. Sheffield. 2001. Forest statistics of the United States, 1997. Gen. Tech. Rep. NC-219. St. Paul, MN: U.S. Department of Agriculture, Forest Service. 191p.

H. Mock-up of Report to Decision Makers (for Forest Area)

None offered.

Forests Indicator 4: Forest Composition and Structure -by Seral Stage

This indicator reports the percentage of forest lands with stands in several development stages. Forests of different developmental stages often provide different goods, services, and values. For example, woodpeckers and species that need trunk cavities for nesting find older forests, with their dead trees, a suitable habitat. Younger forests, with their rapid growth and smaller trees, provide habitat for species such as the Kirtland's warbler, which can only live in forests recently regrown after fire (adapted from Heinz 2002).

Seral stage is currently available from FIA data based on saw-timber seral stages: (1) Non-stocked, (2) Small diameter, (3) Medium diameter, and (4) Large diameter.

An altenative ecologically-based measure of seral stage has five stages: (1) Sapling, (2) Pole, (3) Mature, (4) Old-growth and (5) Mature-sapling mosaic (see Goodell and Faber-Langendoen 2007 for details).

A. Description of Existing Data for Forest Composition and Structure Indicator

- **Why is this indicator being monitored by this program**
  FIA conducts an inventory of forest resources across all lands and ownerships in the US.

- **Who is collecting the data**
  FIA field crews collect the data. In some States, such as Maine, the State forest agency collects the data for FIA through a cooperative agreement.

- **When is the data being collected (monitoring frequency)**
  In the northeast, each plot is currently measured on a 5-year cycle. But the plots are divided into interpenetrating annual panels in order to be able to provide a statistical sample each year or across any group of up to 5 years.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  FIA has three Phases. Phase 1 uses satellite imagery to stratify an entire State. The focus is on forest vs. nonforest. The FIA unit at the Northern Research Station (NRS) is currently evaluation the use of the NLCD percent cover layer for this purpose. Phase 2 is the traditional tree resource sample focusing on tree regeneration and on overstory tree status and changes. There is one plot for every 6,000 ac. Phase 3 has its roots in Forest Health Monitoring and samples crown condition, down woody material, vascular plants, soils, and lichens (the latter two on a 10-year cycle). There is one plot for every 96,000 ac. Ozone damage is sampled on a separate grid. Some forest ownership information is collected along with the plot data, but a separate National Woodland Owner Survey is also conducted to learn more about the owners.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  With the shift in 1999 from a periodic inventory to an annual one, a systematic hexagonal grid was placed across the US. Each cell is roughly 6,000 ac. If any periodic plots fell in the

cell, one of them was randomly chosen as the permanent plot. If the cell was empty, a random point was chosen. The result is a spatially balanced simple random sample. The Phase 1 stratification is then used to post-stratify the data to improve the precision of the results. The design is described in detail in Reams et al. (2005).

- **Data management/storage**
  Internally, FIA uses portable data recorders in the field with software that error checks the data as they are entered. These data are then uploaded into the National Information Management System (NIMS). Further edit checks are performed. Computed variables, such as basal area, biomass and volume, are added. These data are then stored online in the FIADB. They can be downloaded by State: http://fia.fs.fed.us/tools-data/data/.

- **Data analysis/assessment**
  Data analysis tools are also provided so that the user can make tables of estimates online: http://fia.fs.fed.us/tools-data/tools/. The FIDO tool also provides sampling errors for each estimate.

- **Quality Assurance**
  FIA has an active Quality Assurance/Quality Control program. Each crew is checked for the quality of their work (Quality Control). A Hot Check is performed by watching the crew as they work. A Cold Check is performed by revisiting the plot after the crew is done. The crew's work is then scored and feedback is provided. For Quality Assurance purposes, 3% of all plots are revisited but without the original data in hand in order to provide users with information on how repeatable the results are. Pollard et al. (2006) provide Quality Assurance results for Phase 2.

B. Potential Issues in Applying Forest Composition and Structure Data Sets for NEAFWA Framework

FIA data are currently available only for timberlands. Data on the age class of forest trees are not available for national parks and wilderness areas and other forest land not classified as timberlands. These data will be available for future reports.

FIA data provide seral stage information based on saw-timber stages. It would be preferable to report this indicator using ecologically-based seral stage index. Goodell and Faber-Langendoen (2007) have developed such an index, which can be applied to FIA data. The index has been primarily tested in the Northern & Central Mesophytic Hardwood & Conifer Forest sub-target, and needs further testing in other sub-targets.

C. Data Gaps for Forest Composition and Structure

Data are currently available only for timberlands. Data on the age class of forest trees are not available for national parks and wilderness areas and other forest land not classified as timberlands. These data will be available for future reports.

D. Next Steps for Data Compilation and Analysis for Forest Composition and Structure

Work with FIA to add an ecologically-based seral stage index to their reports.

E. Baseline Condition and/or Past Trends of Forest Composition and Structure

The following summary, based on a summary from the Heinz Center (2002), for the entire country, is provided as an illustration. The summary uses forest age rather than the two seral stage methods above (note that FIA does not recommend using stand age to assess seral stage, because the age estimate is often based on a single core from a representative large tree in the stand).

Based on Forest Age, sixty-four percent of eastern timberlands, where most of the nation's timber products are produced are less than 60 years old, and about 90% are less than 100 years old. Most of the nation's older timberland stands are in the West—about 35% of western timberlands are more than 100 years old, with the remainder split between stands that are between 60 and 100 years old and less than 60 years old. Although not included in this indicator, most of the nation's forests in wilderness areas and national parks, which contain many old stands, are also in the West.

F. Additional Comments for Forest Composition and Structure

Forest stand structure reflects historic and current management as well as natural factors. For example, the high percentage of younger forests in the eastern United States reflects such factors as the reforestation of former agricultural land, the management of many private landholdings for commercial harvesting, and the fact that very old stands are much less common in the East

G. Citations for Forest Composition and Structure

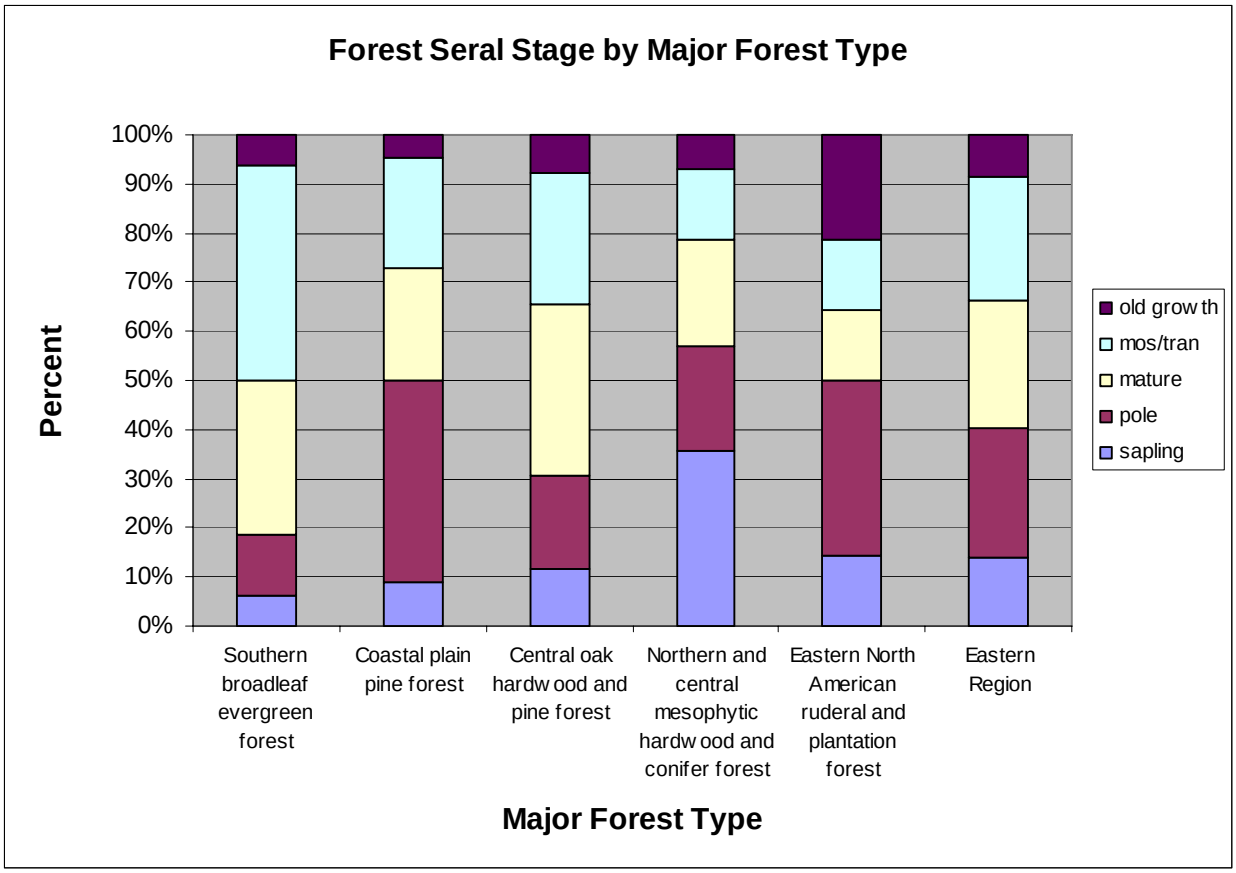
Goodell, L, and D. Faber-Langendoen. 2007. Development of stand structural stage indices to characterize forest condition in Upstate New York. Forest Ecology and Management 249:158-170.

Heinz Center. 2002. The State of the Nation's Ecosystems. Measuring the Lands, Waters, and Living Resources of the United States. The H. John Heinz III Center for Science, Economics, ad the Environment. Cambridge University Press, New York, NY 270 pp.

Smith, W.B., J. Vissage,D. Darr, and R. Sheffield. 2001. Forest statistics of the United States, 1997. Gen. Tech. Rep. NC-219. St. Paul, MN: U.S. Department of Agriculture, Forest Service. 191p.

H. Mock-up of Report to Decision Makers (for Forest Structure and Composition)

The figure below is an example of a graph that could be included in the report to decision makers (mock data).


Forest Seral Stage by Major Forest Type
Percent
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
old growth
mos/tran
mature
pole
sapling
Southern broadleaf evergreen forest
Coastal plain pine forest
Central oak hardwood and pine forest
Northern and central mesophytic hardwood and conifer forest
Eastern North American ruderal and plantation forest
Eastern Region
Major Forest Type

Forests Indicator 3: Forest Fragmentation Index

Habitat fragmentation is the process of subdividing continuous habitat into smaller patches, resulting in a variety of deleterious effects on wildlife populations. This indicator reports on the relative level and causes of forest fragmentation in northeastern forests based on a GIS data and methods developed by Wade (2004) for the National Atlas Project (http://www.nationalatlas.gov/). Wade (2004) reports on three fragmentation indices: forest connectivity (pff), human caused fragmentation (pfa) and natural fragmentation (pfn). Each parameter is scaled to a 0-100 rating, based on analysis of landcover patterns within a 9 x 9 pixel window (e.g., pff + pfa + pfn = 100). For this indicator, the mean value of each index will be calculated for the region as a whole and for all subtargets.

A. Description of Existing Data for Forest Fragmentation Index Indicator

- **Why is this indicator being monitored by this program**
  Forest fragmentation has been studied extensively and can be quantified in several ways. This map layer was the first to identify sources of forest fragmentation, separating fragmentation into human and natural components.

- **Who is collecting the data**
  Data for this indicator was collected analyzed by the United States EPA for the National Atlas Project. See, Wade, Tim, 200402, Causes of Forest Fragmentation in the United States – 270 Meter Resolution: National Atlas of the United States, Reston, VA.

- **When is the data being collected (monitoring frequency)**
  This data set is not part of a regular monitoring program and represents a one-time snap shot of forest fragmentation based on analysis of 1992 National Land Cover Data. Future updates will be reliant on the availability of high quality land cover data.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  The data was compiled for the conterminous United States.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  From the National Atlas Project website:

  First, the land-cover map was condensed to four classes - forest (NLCD codes 41, 42, 43, 91), other natural (NLCD codes 51, 52, 53, 71, 92), human (NLCD codes 21, 22, 23, 32, 33, 61, 81, 82, 83, 84, 85), and nodata (NLCD codes 11, 12, 31).

  Next, a connectivity of forest value (Pff) was determined for each forested pixel by calculating the proportion of adjacent pixel pairs that were both forest, given that at least one of a pair was forest, for pixel pairs within a 9 x 9-pixel window centered on the subject pixel.

Also, a fragmentation by natural causes value (Pfn) was determined for each forested pixel by calculating proportion of adjacent pixel pairs where one was forest and the second was natural, given that at least one of a pair was forest, for pixel pairs within a 9 x 9-pixel window centered on the subject pixel.

Also, a fragmentation by human causes value (Pfa) was determined for each forested pixel by calculating proportion of adjacent pixel pairs where one was forest and the second was human, given that at least one of a pair was forest, for pixel pairs within a 9 x 9-pixel window centered on the subject pixel.

"Adjacent pixels" were defined as being in cardinal directions only, and pixel pairs involving nodata pixels were excluded from the calculation.

Pff (roughly) estimates the probability that, given a pixel of forest, its neighbor is also forest. Forest connectivity is higher for larger values of Pff. Pfa and Pfn partition into components the non- connectivity of forest, based on human and natural land-cover types. Values for Pff, Pfa and Pfn were rescaled to 0 to 100 so that fragmentation and connectivity can be thought of in percentage terms (Pff + Pfa + Pfn = 100).

- **Data management/storage**
  Data is stored on the National Atlas Project website for free download by the public.

- **Data analysis/assessment**
  Unknown

- **Quality Assurance**
  The quality of this dataset is directly related to the accuracy of the 1992 NLCD data from which it is derived. For details on the methods and quality of NLCD, see:

  Vogelmann, J.E., T. Sohl, and S.M. Howard, 1998. Regional characterization of land cover using multiple sources of data. Photogrammetric Engineering and Remote Sensing, 64: 45-57.

B. Potential Issues in Applying Forest Fragmentation Index Data Sets for NEAFWA Framework

The fragmentation index is based on analysis of 1992 Landsat TM imagery and is already out of date considering the rate of land cover change in the northeastern United States over the last 15 years. For this to be a useful indicator, the analysis needs to be run again with the newly available 2005 NLCD.

C. Data Gaps for Forest Fragmentation Index

There are no significant spatial gaps in this dataset.

D. Next Steps for Data Compilation and Analysis for Forest Fragmentation Index

The next step in compilation of this information will be to re-run the analysis based on more recent land cover data.

E. Baseline Condition and/or Past Trends of Forest Fragmentation Index

Past trend information is not available.

F. Additional Comments for Forest Fragmentation Index

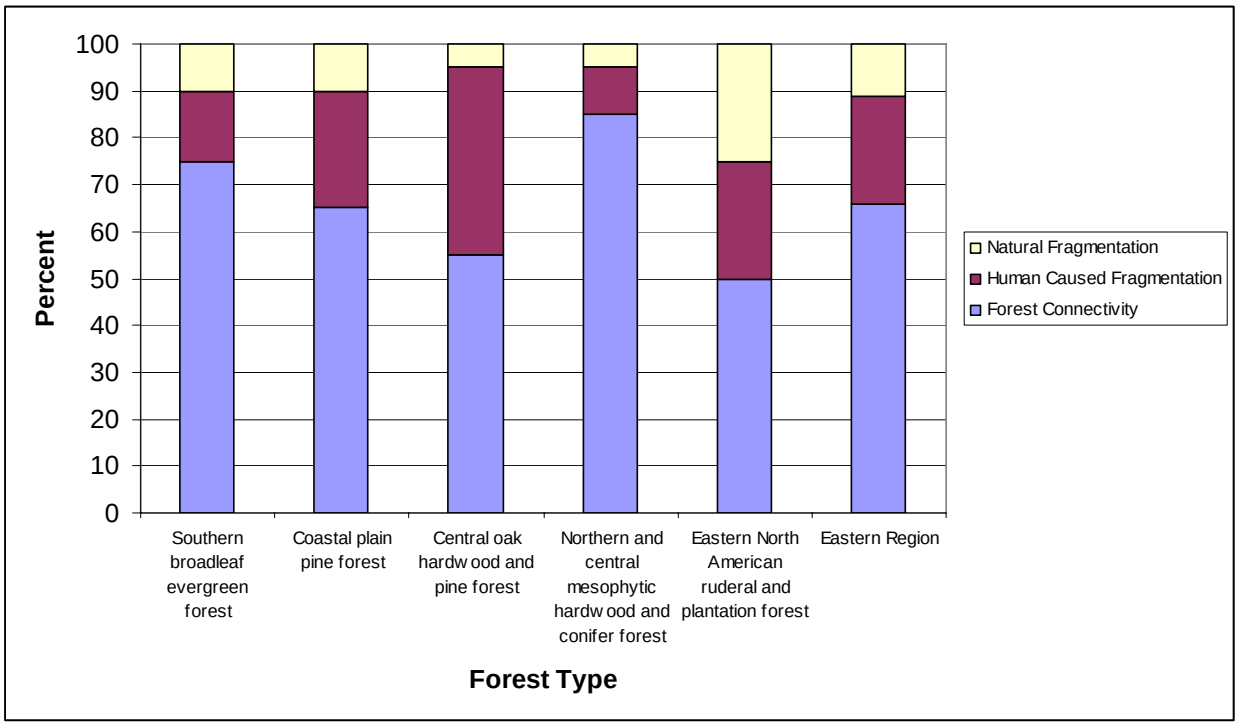
None offered.

G. Citations for Forest Fragmentation Index

None offered.

H. Mock-up of Report to Decision Makers (for Forest Fragmentation Index)

A chart of the mean values for each index, summarized by forest type, is likely to be the most effective way to convey this information.



Forests Indicator 4: Forest Bird Population Trends (1996-2006)

***Indicator groupings*:** Woodland Breeding Birds, Successional or Scrub Breeding Birds, Cavity Nesting Birds, Mid-story or Canopy Nesting Birds

***Trend information to be reported for each grouping*:** # of species in grouping that qualify for analysis, proportion with significant negative trend, proportion with significant positive trend, proportion with no significant trend detected, mean trend for grouping

***Key characteristics*:** Birds stand out among other wildlife taxa as excellent indicators of forest condition. They occur in all forest types and respond quickly to environmental change. Their mobility allows them to leave locations that do not meet their basic requirements and colonize areas where suitable habitat arises. Many bird species are sensitive to hidden factors, as well, such as chemical toxins, climate change, or various forms of avian disease. Most birds can be easily detected, either through passive methods or the use of audio recordings to evoke detectable responses. Recent advances in field ornithology and biometrics have produced effective techniques for collecting and analyzing bird population data. Finally, birds have a popular appeal that can be used to engage volunteers in data collection at spatial and temporal scales that would otherwise be impossible.

Because birds are biologically meaningful and practical indicators, they have been the subject of countless studies in the Northeast. The North American Breeding Bird Survey (BBS) presents the opportunity to describe changes in forest bird populations since 1966. However, BBS data are limited to roadside habitat, are subject to multiple sources of bias and error, and do not include environmental or management covariates. Efforts to strengthen BBS are deserving of support, as are rigorously designed monitoring programs that target off-road habitat, address causes of population change, measure effectiveness of conservation action, and/or produce quantitative tools to guide stewardship.

A. Description of Existing Data for Forest Bird Population Trends Indicator

Over 140 forest bird monitoring initiatives are active in the Northeast region, operating at local to international scales with varying levels of scientific rigor and coordination. Although its design features several limitations, the North American Breeding Bird Survey is the most credible source of information on regional trends for forest birds.

- **Why is this indicator being monitored by this program**
  The mission of the BBS is to provide "measures of the status and trends of North American bird populations at continental and regional scales to inform biologically sound conservation and management actions." Primary functions of the BBS are to: measure avian population change to help identify species' priorities for conservation; provide avian count data for model-based conservation planning; and provide avian count data for estimating species' population sizes.

- **Who is collecting the data**

In the United States, BBS is administered by the US Geological Survey from offices at the Patuxent Wildlife Research Center, in Laurel, MD. The BBS staff is assisted by state coordinators affiliated with various governmental and non-governmental institutions. The data are collected by volunteer observers who are skilled in avian identification.

- **When is the data being collected (monitoring frequency)**
  Data are collected once each year during June, the height of the avian breeding season.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Data are collected on hundreds of roadside survey routes throughout the Northeast region. Gaps in coverage currently exist in Rhode Island, northern Maine, and New York.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  Survey routes were established on secondary roadways that were identified randomly within certain geographic strata. The starting point and direction of each route were also randomly determined. Each survey route is 24.5 miles long with stops at 0.5-mile intervals. At each stop, a 3-minute point count is conducted. During the count, every bird seen within a 0.25-mile radius or heard is recorded. Surveys start one-half hour before local sunrise and take about 5 hours to complete.

- **Data management/storage**
  Data are centrally located and available for download, visualization, and analysis at http://www.mbr-pwrc.usgs.gov/bbs/.

- **Data analysis/assessment**
  BBS data, which reside in the public domain, have been published in hundreds of scientific articles. Analyses have focused on: identifying priorities for conservation, management, and additional research: assessing response of bird populations to collective conservation and management activities; providing context for local abundance and trend estimates; describing basic patterns of distribution, abundance, and species richness.

- **Quality Assurance**
  Quality assurance is a challenge for the BBS because of its continental scope, limited resources, and reliance on volunteers with varying skill and observational acuity. It is not feasible to train and evaluate thousands of observers monitoring hundreds of species, each with regional dialects. Statisticians have developed models to address observer bias. Even still, there is considerable debate about the value of auditory point count surveys, like the BBS, that do not quantify detection rates and therefore can not be used to estimate abundance. In addition, many trends measured by online BBS analysis are scored low to moderate for reliability.

B. Potential Issues in Applying Forest Bird Population Trends Data Sets for NEAFWA Framework

Compilation and analysis of data is relatively simple, thanks to the online summary and analysis tools at http://www.mbr-pwrc.usgs.gov/bbs/. The main limitation is that few forest birds are

restricted to just one of the identified sub-targets or structural stages. And while many species are area-sensitive, regionally applicable patch-size thresholds are not available. As a result, there is little correspondence between this indicator's groupings and other indicators within this target.

C. Data Gaps for Forest Bird Population Trends

Data are needed: to describe the distribution and abundance of forest birds away from roads; to measure changes in these parameters; and to identify underlying factors. The most significant need is for a regionally coordinated monitoring program for high-elevation forest birds, since montane spruce-fir forests are not sampled by BBS even though they significantly enrich the region's avifauna.

The Mountain Bird Working Group of the Northeast Coordinated Bird Monitoring Partnership has made significant progress toward the design of high-elevation bird monitoring in the region.

D. Next Steps for Data Compilation and Analysis for Forest Bird Population Trends

Once indicator groupings have been finalized, queries should be submitted online to determine regional trends from 1966 to 2006 (preliminary results are attached). Framework can report number of species that qualified for analysis, the proportion of species exhibiting significant negative trends, significant positive trends, and no significant trends, respectively. Other options for displaying the results include species-specific trend results in the form of tables or maps (both available online), trend lines (would require significant data processing), or photographs with detailed caption.

E. Baseline Condition and/or Past Trends of Forest Bird Population Trends

***DRAFT* North American Breeding Bird Survey Species Group Summary Results**

Species Group is Woodland Breeding
Period: 1966 - 2006
Region is RE5

Summary Data for Species Group	Estimate
Number of species encountered on more than 14 routes	78.
Proportion of species with positive trend estimates	0.54
Proportion of species with significant negative trend estimates	0.26
Proportion of species with significant positive trend estimates	0.37
Prior mean trend	0.54
Prior variance	7.534

Declining Species:

Species	Adjusted Trend	N routes	(Unadjusted Trend	P value)

Significant trends (P less than 0.1):

Olive-sided Flycatcher	-3.6930	86	(-5.2420	0.0023)
Evening Grosbeak	-3.4605	111	(-8.2790	0.0071)
Kentucky Warbler	-3.1734	216	(-3.3610	0.0000)
Whip-poor-will	-2.7908	148	(-2.9860	0.0000)
Cerulean Warbler	-2.7580	124	(-3.1690	0.0015)
Tennessee Warbler	-2.6269	46	(-8.1030	0.0303)
Canada Warbler	-2.4384	232	(-2.6830	0.0008)
Eastern Wood-Pewee	-2.4375	620	(-2.4560	0.0000)
Black-and-white Warbler	-2.3633	481	(-2.4200	0.0000)
Black-billed Cuckoo	-2.2622	438	(-2.5700	0.0049)
Wood Thrush	-2.1767	624	(-2.1870	0.0000)
Least Flycatcher	-1.9754	398	(-2.0070	0.0000)
Veery	-1.2605	404	(-1.2750	0.0000)
American Redstart	-1.0527	514	(-1.0950	0.0147)
Rose-breasted Grosbeak	-0.7692	438	(-0.7890	0.0198)
Yellow-billed Cuckoo	-0.7424	448	(-0.7750	0.0767)
Carolina Chickadee	-0.6119	217	(-0.6280	0.0539)
Scarlet Tanager	-0.4084	606	(-0.4160	0.0899)
Grt. Crested Flycatcher	-0.3870	611	(-0.3930	0.0737)
Downy Woodpecker	-0.3816	620	(-0.3880	0.0905)

Nonsignificant trends (P greater than 0.1):

Ruby-crowned Kinglet	-1.9206	78	(-3.6160	0.1167)
Blackpoll Warbler	-1.2059	21	(-4.0280	0.2705)
Northern Waterthrush	-1.1067	198	(-1.3610	0.2083)
Brown-headed Nuthatch	-0.9572	16	(-1.8170	0.4004)
Ruffed Grouse	-0.7785	162	(-2.6600	0.4181)
Purple Finch	-0.6894	327	(-0.7290	0.1390)
Pine Siskin	-0.6055	68	(-2.2160	0.4981)
Worm-eating Warbler	-0.5916	211	(-0.6640	0.3391)
Brown Creeper	-0.4753	210	(-0.7670	0.6024)
Acadian Flycatcher	-0.2621	280	(-0.2700	0.3220)
Bay-breasted Warbler	-0.1672	57	(-0.5120	0.7901)
Dark-eyed Junco	-0.1669	246	(-0.1860	0.6804)
Louisiana Waterthrush	-0.1486	287	(-0.1720	0.7336)
Blue-gray Gnatcatcher	-0.0879	358	(-0.1250	0.8508)
Eastern Screech-Owl	0.1794	37	(-2.4670	0.7426)
Cape May Warbler	0.3953	44	(-0.3120	0.9588)

Increasing Species:

Species Adjusted Trend N routes (Unadjusted Trend P value)

Significant trends (P less than 0.1):

Black-th. Green Warbler	1.0946	330	(1.1130 0.0274)
Black-capped Chickadee	1.1918	438	(1.1940 0.0000)
Red-eyed Vireo	1.2891	629	(1.2930 0.0000)
Northern Parula	1.3584	314	(1.4060 0.0350)
Ovenbird	1.3867	605	(1.3940 0.0000)
Hairy Woodpecker	1.5350	542	(1.5890 0.0135)
Pine Warbler	1.7614	274	(1.7990 0.0002)
Red-breasted Nuthatch	1.7681	218	(1.8000 0.0001)
Warbling Vireo	1.7916	400	(1.8180 0.0000)
Tufted Titmouse	1.8869	516	(1.8950 0.0000)
Hooded Warbler	2.1577	233	(2.3170 0.0078)
Ruby-thr. Hummingbird	2.1807	484	(2.2470 0.0001)
Yellow-rumped Warbler	2.2000	225	(2.2230 0.0000)
Red-bellied Woodpecker	2.2477	390	(2.2890 0.0000)
White-breasted Nuthatch	2.2713	556	(2.3240 0.0000)
Philadelphia Vireo	2.6403	37	(11.4480 0.0502)
Hermit Thrush	2.6455	286	(2.7550 0.0000)
Sharp-shinned Hawk	2.8488	118	(7.2880 0.0591)
Red Crossbill	2.9600	15	(7.0580 0.0765)
Pileated Woodpecker	3.0161	488	(3.0610 0.0000)
Magnolia Warbler	3.0932	226	(3.1870 0.0000)
Yellow-throated Warbler	3.3514	83	(3.9260 0.0024)
Yellow-bell. Flycatcher	3.4979	55	(5.1670 0.0160)
Blue-headed Vireo	3.5589	327	(3.6600 0.0000)
Barred Owl	3.7033	135	(5.1510 0.0066)
Yellow-bell. Sapsucker	5.0246	239	(5.2850 0.0000)
Sapsucker (3 species)	5.0388	239	(5.2940 0.0000)
Cooper's Hawk	5.7163	124	(8.0370 0.0000)
Wild Turkey	6.8019	290	(8.8260 0.0000)

Nonsignificant trends (P greater than 0.1):

Yellow-throated Vireo	0.0273	403	(0.0120 0.9801)
Swainson's Thrush	0.3404	94	(0.3120 0.7617)
Summer Tanager	0.3564	111	(0.3440 0.6270)
Red-shouldered Hawk	0.3663	202	(0.3310 0.7878)
Blackburnian Warbler	0.4939	241	(0.4920 0.3655)
Black-thr. Blue Warbler	0.5227	230	(0.5210 0.5104)
Winter Wren	0.6437	206	(0.6550 0.4790)
Broad-winged Hawk	0.7510	303	(0.8070 0.5718)
Gray Jay	0.7866	19	(1.5480 0.7541)
Chuck-will's-widow	0.8638	31	(0.9070 0.3763)
Prothonotary Warbler	0.9726	53	(1.0730 0.4234)
Golden-crowned Kinglet	1.2823	116	(1.3840 0.1771)
Boreal Chickadee	1.3231	25	(1.5320 0.2933)

Species Group is Successional or Scrub Breeding
Period: 1966 - 2006
Region is RE5

Summary Data for Species Group	Estimate
Number of species encountered on more than 14 routes	27.
Proportion of species with positive trend estimates	0.26
Proportion of species with significant negative trend estimates	0.56
Proportion of species with significant positive trend estimates	0.11
Prior mean trend	-1.19
Prior variance	2.715

Declining Species:

Species Adjusted Trend N routes (Unadjusted Trend P value)

Significant trends (P less than 0.1):

Golden-winged Warbler	-6.4925	128	(-8.5540 0.0000)
Northern Bobwhite	-4.5745	280	(-4.7760 0.0000)
Field Sparrow	-3.7125	567	(-3.7520 0.0000)
Eastern Towhee	-2.6790	568	(-2.7360 0.0000)
Brown Thrasher	-2.4810	575	(-2.5260 0.0000)
Yellow-breasted Chat	-2.3297	274	(-2.4560 0.0000)
Prairie Warbler	-1.8391	337	(-1.9690 0.0078)
White-throated Sparrow	-1.8079	215	(-1.8880 0.0016)
Song Sparrow	-1.0827	629	(-1.0820 0.0000)
Blue-winged Warbler	-1.0722	258	(-1.0620 0.0320)
House Wren	-0.7914	566	(-0.7880 0.0000)
Indigo Bunting	-0.7808	591	(-0.7780 0.0000)
American Goldfinch	-0.6189	628	(-0.6060 0.0149)
Chestnut-sided Warbler	-0.5931	403	(-0.5720 0.0663)
Common Yellowthroat	-0.4144	629	(-0.4060 0.0183)

Nonsignificant trends (P greater than 0.1):

American Woodcock	-2.0881	71	(-4.4850 0.1020)
Wilson's Warbler	-1.1373	30	(-0.3730 0.9548)
Nashville Warbler	-0.8558	191	(-0.8060 0.2092)
White-eyed Vireo	-0.2972	251	(-0.2180 0.6574)
Yellow Warbler	-0.2564	581	(-0.2400 0.2732)

Increasing Species:

Species Adjusted Trend N routes (Unadjusted Trend P value)

Significant trends (P less than 0.1):

Northern Cardinal	0.3480	556	(0.3660 0.0407)
Willow/Alder Flycatcher	0.8331	456	(0.9340 0.0116)
Carolina Wren	1.9755	388	(2.0750 0.0000)

Nonsignificant trends (P greater than 0.1):

Lincoln's Sparrow	-0.3596	31	(0.9130 0.6588)
Gray Catbird	0.0228	623	(0.0380 0.8371)
Blue Grosbeak	0.3169	147	(0.3960 0.2971)
Mourning Warbler	0.7421	142	(1.1610 0.1330)

Species Group is Cavity Nesting
Period: 1966 - 2006
Region is RE5

Summary Data for Species Group	Estimate
Number of species encountered on more than 14 routes	28.
Proportion of species with positive trend estimates	0.64
Proportion of species with significant negative trend estimates	0.25
Proportion of species with significant positive trend estimates	0.57
Prior mean trend	1.60
Prior variance	12.736

Declining Species:

Species	Adjusted Trend	N routes	(Unadjusted Trend	P value)

Significant trends (P less than 0.1):

Northern Flicker	-2.9042	630	(-2.9510	0.0000)
American Kestrel	-1.9086	443	(-2.0120	0.0011)
European Starling	-1.7149	622	(-1.7250	0.0000)
House Wren	-0.7836	566	(-0.7880	0.0000)
Carolina Chickadee	-0.6098	217	(-0.6280	0.0539)
Grt. Crested Flycatcher	-0.3855	611	(-0.3930	0.0737)
Downy Woodpecker	-0.3799	620	(-0.3880	0.0905)

Nonsignificant trends (P greater than 0.1):

Brown-headed Nuthatch	-0.9527	16	(-1.8170	0.4004)
Red-headed Woodpecker	-0.9392	99	(-1.4670	0.3702)
Eastern Screech-Owl	0.8306	37	(-2.4670	0.7426)

Increasing Species:

Species	Adjusted Trend	N routes	(Unadjusted Trend	P value)

Significant trends (P less than 0.1):

Tree Swallow	0.7928	554	(0.7800	0.0842)
Black-capped Chickadee	1.1948	438	(1.1940	0.0000)
Hairy Woodpecker	1.5893	542	(1.5890	0.0135)
Eastern Bluebird	1.6809	534	(1.6820	0.0000)
Red-breasted Nuthatch	1.7969	218	(1.8000	0.0001)
Tufted Titmouse	1.8939	516	(1.8950	0.0000)
Purple Martin	2.1341	287	(2.1810	0.0396)
Red-bellied Woodpecker	2.2792	390	(2.2890	0.0000)
White-breasted Nuthatch	2.3111	556	(2.3240	0.0000)
Pileated Woodpecker	3.0454	488	(3.0610	0.0000)
Barred Owl	4.3933	135	(5.1510	0.0066)
Wood Duck	4.5603	279	(5.6780	0.0102)
Yellow-bell. Sapsucker	5.1624	239	(5.2850	0.0000)
Sapsucker (3 species)	5.1739	239	(5.2940	0.0000)
Hooded Merganser	6.8491	29	(17.2210	0.0030)
Common Merganser	6.9391	75	(8.1350	0.0000)

Nonsignificant trends (P greater than 0.1):

Prothonotary Warbler	1.1367	53	(1.0730	0.4234)
Boreal Chickadee	1.5409	25	(1.5320	0.2933)

Species Group is Mid-story or Canopy Nesting
Period: 1966 - 2006
Region is RE5

Summary Data for Species Group	Estimate

Number of species encountered on more than 14 routes	72.
Proportion of species with positive trend estimates	0.50
Proportion of species with significant negative trend estimates	0.33
Proportion of species with significant positive trend estimates	0.32
Prior mean trend	0.12
Prior variance	5.687

Declining Species:

Species Adjusted Trend N routes (Unadjusted Trend P value)

Significant trends (P less than 0.1):

Olive-sided Flycatcher	-3.4907	86	(-5.2420 0.0023)
Evening Grosbeak	-3.1146	111	(-8.2790 0.0071)
Loggerhead Shrike	-2.9461	23	(-9.2450 0.0156)
House Sparrow	-2.8029	592	(-2.8360 0.0000)
Cerulean Warbler	-2.7027	124	(-3.1690 0.0015)
Eastern Wood-Pewee	-2.4349	620	(-2.4560 0.0000)
Bank Swallow	-2.2433	261	(-3.6260 0.0479)
Wood Thrush	-2.1755	624	(-2.1870 0.0000)
Common Grackle	-2.0644	629	(-2.0830 0.0000)
Least Flycatcher	-1.9722	398	(-2.0070 0.0000)
Eastern Kingbird	-1.7618	603	(-1.7770 0.0000)
European Starling	-1.7124	622	(-1.7250 0.0000)
Barn Swallow	-1.3697	624	(-1.3810 0.0000)
American Redstart	-1.0536	514	(-1.0950 0.0147)
Baltimore Oriole	-0.8616	574	(-0.8690 0.0000)
House Wren	-0.7842	566	(-0.7880 0.0000)
Chipping Sparrow	-0.7781	625	(-0.7820 0.0000)
Rose-breasted Grosbeak	-0.7711	438	(-0.7890 0.0198)
Blue Jay	-0.6537	631	(-0.6580 0.0002)
Carolina Chickadee	-0.6144	217	(-0.6280 0.0539)
American Goldfinch	-0.5982	628	(-0.6060 0.0149)
Scarlet Tanager	-0.4104	606	(-0.4160 0.0899)
Grt. Crested Flycatcher	-0.3887	611	(-0.3930 0.0737)
American Robin	-0.2899	632	(-0.2910 0.0201)

Nonsignificant trends (P greater than 0.1):

Ruby-crowned Kinglet	-1.8322	78	(-3.6160 0.1167)
Blackpoll Warbler	-1.1990	21	(-4.0280 0.2705)
Brown-headed Nuthatch	-0.9792	16	(-1.8170 0.4004)
Pine Siskin	-0.6947	68	(-2.2160 0.4981)
Purple Finch	-0.6942	327	(-0.7290 0.1390)
Brown Creeper	-0.5218	210	(-0.7670 0.6024)
Acadian Flycatcher	-0.2649	280	(-0.2700 0.3220)
Bay-breasted Warbler	-0.2629	57	(-0.5120 0.7901)
Yellow Warbler	-0.2370	581	(-0.2400 0.2732)
Eastern Phoebe	-0.1516	603	(-0.1530 0.3638)
Blue-gray Gnatcatcher	-0.1070	358	(-0.1250 0.8508)
Cape May Warbler	0.0650	44	(-0.3120 0.9588)

Increasing Species:

Species	Adjusted Trend	N routes	(Unadjusted Trend P value)

Significant trends (P less than 0.1):

Tree Swallow	0.7574	554	(0.7800 0.0842)
American Crow	0.7765	630	(0.7780 0.0000)
Black-th. Green Warbler	1.0711	330	(1.1130 0.0274)
Black-capped Chickadee	1.1893	438	(1.1940 0.0000)
Red-eyed Vireo	1.2850	629	(1.2930 0.0000)
Northern Parula	1.3139	314	(1.4060 0.0350)
Eastern Bluebird	1.6381	534	(1.6820 0.0000)
Pine Warbler	1.7332	274	(1.7990 0.0002)
Red-breasted Nuthatch	1.7441	218	(1.8000 0.0001)
Warbling Vireo	1.7719	400	(1.8180 0.0000)
Purple Martin	1.8446	287	(2.1810 0.0396)
Philadelphia Vireo	1.8494	37	(11.4480 0.0502)
Tufted Titmouse	1.8809	516	(1.8950 0.0000)
Orchard Oriole	2.0104	288	(2.0510 0.0000)
Yellow-rumped Warbler	2.1851	225	(2.2230 0.0000)
Boat-tailed Grackle	2.2228	15	(2.8200 0.0539)
White-breasted Nuthatch	2.2386	556	(2.3240 0.0000)
Red Crossbill	2.2601	15	(7.0580 0.0765)
Fish Crow	2.4808	182	(2.6830 0.0002)
Magnolia Warbler	3.0446	226	(3.1870 0.0000)
Yellow-throated Warbler	3.1152	83	(3.9260 0.0024)
Blue-headed Vireo	3.5097	327	(3.6600 0.0000)
House Finch	4.3083	532	(4.5260 0.0000)

Nonsignificant trends (P greater than 0.1):

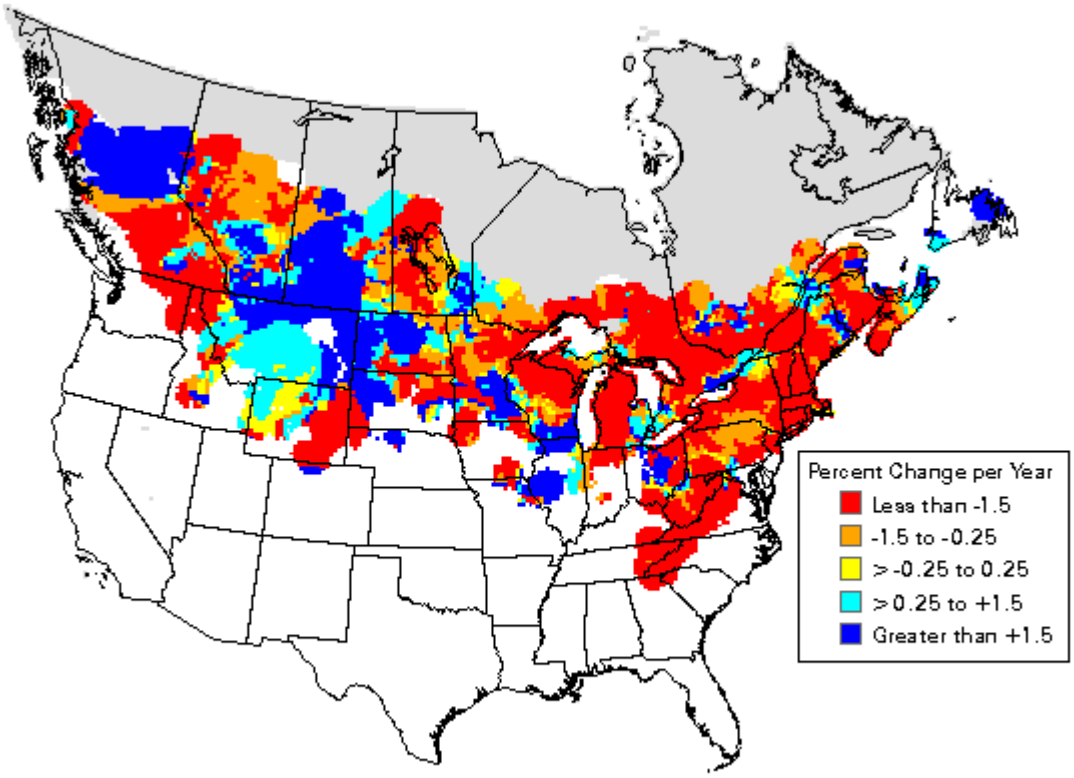
Yellow-throated Vireo	0.0163	403	(0.0120 0.9801)
Cedar Waxwing	0.2884	593	(0.2910 0.3277)
Summer Tanager	0.3263	111	(0.3440 0.6270)
N. Rough-winged Swallow	0.3480	393	(24.6350 0.3224)
Gray Jay	0.4010	19	(1.5480 0.7541)
Cliff Swallow	0.4228	249	(0.5280 0.7097)
Blackburnian Warbler	0.4739	241	(0.4920 0.3655)
Black-thr. Blue Warbler	0.4818	230	(0.5210 0.5104)
Rusty Blackbird	0.7342	23	(10.8210 0.2785)
Prothonotary Warbler	0.8486	53	(1.0730 0.4234)
Common Raven	0.9182	254	(1.4840 0.4618)
Boreal Chickadee	1.1632	25	(1.5320 0.2933)
Golden-crowned Kinglet	1.1898	116	(1.3840 0.1771

Estimated trends:

Note: Estimated trends are presented , along with the precision-adjusted estimates. The adjusted estimates take into account the relative precision of the estimated trends, and provide a better ranking of change for the species relative to other species in the group. Results are ranked by the precision-adjusted estimates.

Least Flycatcher *Empidonax minimus*

BBS Trend Map, 1966 - 2003



	1966-2006 trends						1966-1979			1980-2006		
Species	Trend	P	N	(95% CI)		R.A.	Trend	P	N	Trend	P	N
Least Flycatcher	-2.0	0.00	398	-2.6	-1.4	2.85	-1.6	0.02	285	-2.4	0.00	357

Trend: this refers to the average annual change in the abundance index for the designated time period, derived from a linear route-regression approach based on estimating equations. It is the precision-weighted mean trend (called a prior mean).

Any negative trend could put a population at risk if the population is small enough and the time period is long enough. Whether this is good, bad, or neutral depends on one's conservation objectives, which often hang on rarity. No one is too excited about 2% annual declines in Red-winged Blackbird since it is a common and widespread species. Because Marsh Wrens are uncommon in the Northeast, annual declines of 5-7% are more troubling. Is it good that Great Blue Herons are increasing? Not if you're a trout farmer.

P: P value or the probability, if the test statistic really were distributed as it would be under the null hypothesis (no change in population), of observing a test statistic as extreme as, or more extreme than the one actually observed.

N: Number of survey routes factored into the trend analysis

R.A.: Regional abundance, which is the average number of individuals per route. Yellow reliability codes assigned to all but Red-winged Blackbirds, largely because it's difficult to fit a trend line with decent precision when your data set is full of 0's and 1's.

Regional credibility measures

Regional credibility measures are available online for each species reported in this template.

Although the BBS provides a huge amount of information about regional population change for many species, there are a variety of possible problems with estimates of population change from BBS data. Small sample sizes, low relative abundances on survey routes, imprecise trends, and missing data all can compromise BBS results. Often, users do not take these problems into account when viewing BBS results, and use the results inappropriately.

To provide some guidance to interpretation of BBS data, we have implemented a series of checks for some attributes that we view as cause for caution in interpretation of BBS results. We categorize BBS data in 3 credibility categories:

 This category reflects data with an important deficiency. In particular:

1. The regional abundance is less than 0.1 birds/route (very low abundance),

2. The sample is based on less than 5 routes for the long term, or is based on less than 3 routes for either subinterval (very small samples), or

3. The results are so imprecise that a 5%/year change would not be detected over the long-term (very imprecise).

This category reflects data with a deficiency. In particular:

1. The regional abundance is less than 1.0 birds/route (low abundance),

2. The sample is based on less than 14 routes for the long term (small sample size),

3. The results are so imprecise that a 3%/year change would not be detected over the long-term (quite imprecise), or

4. The sub-interval trends are significantly different from each other (P less than 0.05, based on a z-test). This suggests inconsistency in trend over time).

● This category reflects data with at least 14 samples in the long term, of moderate precision, and of moderate abundance on routes.

Note:

1. Even data falling in the ● category may not provide valid results. There are many factors that can influence the validity and use of the information, and any analysis of BBS data should carefully consider the possible problems with the data.

2. We are occasionally asked to identify which deficiency is causing the flag. However, the point of the codes is to provide a quick and simple set of cautions to users, and we are resisting the notion of setting up a complicated series of codes. To determine why the code exists, look at the results. All of these deficiencies (abundances, precisions, etc) will be evident from the results we present.

Ranking of condition *(ad hoc)*

By grouping

Excellent	ratio of increasing to declining species ≥ 2:1
Good	ratio of increasing to declining species between 1:1 and 2:1
Fair	ratio of increasing to declining species between 1:1 and 1:1.5
Poor	ratio of increasing to declining species less than 1:1.5

By individual species

Excellent	Trend > 1.5%
Good	Trend 0 to 1.5%
Fair	Trend –1.5% to -0.1%
Poor	Trend < -1.5%

F. Additional Comments for Forest Bird Population Trends

None given

G. Citations for Forest Bird Population Trends

No additional citations (only within text)

H. Mock-up of Report to Decision Makers (for Forest Bird Population Trends)

None given but see baseline condition section (Section E) for maps and other figures that could be used.

Forests Indicator 5: Acid Deposition Index

This indicator reports on the relative sensitivity of northeastern forests to acid rain as estimated by spatially explicit models of sulfur and nitrogen deposition (Miller et al. 2005). Excess S and N can have a profound effect on forest ecosystems by reducing the supply of nutrients available for plant growth. This increases the vulnerability of forests to climate, pest and pathogen stressors. Over time, acid deposition can lead to reduced overall forest health, smaller timber yields and eventual changes to forest species composition.

The metric for this indictor will be the percentage of forest area considered to be "impaired" by acid deposition (Miller 2005), summarized for the region as a whole and for each subtarget. Impaired forests are defined as those areas where the current level of acid deposition exceeds the critical load. These parameters will be estimated by modeling pollution loading in forested landscapes, the interaction of pollutants with forest canopies, plant nutrient requirements and the ability of soils to buffer acid inputs (Miller 2005). Therefore, this indicator requires spatially explicit information on current forest cover, soil characteristics and relative levels of sulfur and nitrogen deposition. Data on land cover and soils can be obtained from a variety of sources and generally provide a "snap shot" of current conditions. On the other hand, data on sulfur and nitrogen is monitored on a continuous basis and is likely to have the largest impact on measuring changes to this indicator over time. Thus, this report summarizes acid rain monitoring programs and ignores data needs for the other input parameters.

A. Description of Existing Data for Acid Deposition Index Indicator

- **Why is this indicator being monitored by this program**
  The purpose of the various deposition monitoring networks is to collect data on the chemistry of precipitation for monitoring long-term geographical and temporal trends.

- **Who is collecting the data**
  The spatial models required to calculate pollutant loading rely on a series of atmospheric chemistry monitoring stations throughout the northeast, including US NADP (http://nadp.sws.uiuc.edu/), CASTNet (http://www.epa.gov/castnet/) and NOAA's AirMon deposition monitoring network (http://www.arl.noaa.gov/research/programs/airmon.html).

- **When is the data being collected (monitoring frequency)**
  Sampling frequency differs among the monitoring networks in the northeast. In most cases, data is collected at least once per week and during rain events.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Deposition monitoring sites are sparsely and unevenly distributed throughout the region.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Sampling design and analytical techniques vary across programs but are generally compatible with each other.

- **Data management/storage**
  Data is stored and managed by each of the individual programs. All of the information is publicly available and easily accessible for analysis, manipulation and modeling.

- **Data analysis/assessment**
  Data analysis and assessment will require compilation of relevant information (S and N deposition, forest cover, soils) and complex spatial modeling.

- **Quality Assurance**
  Each monitoring program has differing, yet rigorous quality assurance standards.

B. Potential Issues in Applying Acid Deposition Index Data Sets for NEAFWA Framework

Sampling design, frequency and analysis methods differ widely across monitoring programs. However, the data sets appear to be compatible for easy compilation. However, analysis of this data requires complex spatial modeling and skilled GIS technicians that may prove to be beyond the means of most state agencies.

C. Data Gaps for Acid Deposition Index

Although there aren't necessarily any major gaps in coverage, sulfur and nitrogen monitoring locations are sparsely distributed throughout the northeast and factors affecting deposition rates are highly variable, especially in mountainous regions. Thus, deposition estimates may have large and unquantifiable spatial uncertainty.

D. Next Steps for Data Compilation and Analysis for Acid Deposition Index

Because data compilation and analysis will require complex GIS modeling and a relatively large time commitment, it is unlikely that any of the state agencies in the region will have the capacity to complete the work in-house. Thus, monitoring of this indicator will require outside contracts (private or academic) and significant partnerships.

E. Baseline Condition and/or Past Trends of Acid Deposition Index

Baseline information on the spatial distribution of acid deposition has been compiled for New England as summarized below (from The Forest Mapping Group 2007):

Jurisdiction	Critical Load		Exceedance		
	Median	5th percentile	Median	95th percentile exceedance	Area mapped as exceeded
	(eq ha^{-1} y^{-1})				(%)
Maine	1280	340	-420	660	35.8
New Hampshire	1350	440	-520	600	17.6
Vermont	1600	390	-390	930	29.9
Rhode Island	1130	230	70	1260	51.6
Massachusetts	1770	540	-420	1250	29.1
Connecticut	2290	1330	-790	-10	4.4
Total New England states	1590	360	-470	730	29.3
Newfoundland	519	227	16	343	52.3
Nova Scotia	692	353	81	538	61.2
Prince-Edward-Island	2212	876	-1549	-190	3.3
New Brunswick	960	488	-215	298	28.2
Quebec	934	420	-175	532	31.6
Total Eastern Canadian provinces	946	423	-220	444	37.6

Individual state summaries, including the percent of impaired forests by cover type, are provided by Miller 2005, Miller 2006a and Miller 2006b. Information for states south of New England has not been compiled.

F. Additional Comments for Acid Deposition Index

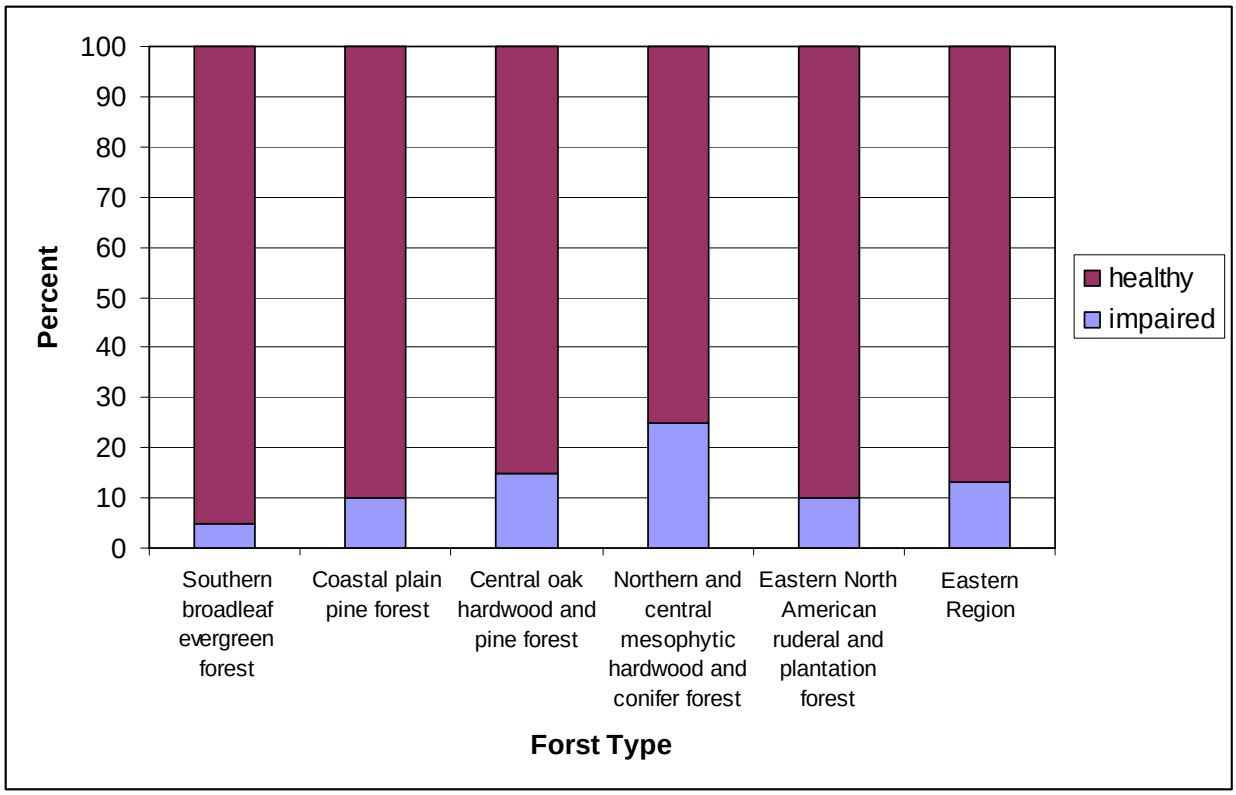
None offered.

G. Citations for Acid Deposition Index

None offered.

H. Mock-up of Report to Decision Makers (for Acid Deposition Index)

The most direct way to convey the status of this indicator is a simple graph depicting the proportion of each forest type that is considered to be impaired.


100
90
80
70
60
50
40
30
20
10
0
Percent
Southern broadleaf evergreen forest
Coastal plain pine forest
Central oak hardwood and pine forest
Northern and central mesophytic hardwood and conifer forest
Eastern North American ruderal and plantation forest
Eastern Region
Forst Type
healthy
impaired

Appendix 2: Indicators for Freshwater Streams and River Systems Target

Description of Freshwater Streams and River Systems Target

Freshwater Stream and River Systems are defined as all non-tidal flowing surface waters. The physical, chemical, and biological properties of streams vary considerably throughout the Northeast. Most (although not all) of this variability is due to differences in stream size, latitude and geology, which influence temperature, gradient, substrate (the material that makes up the stream bottom), how much acidity can (or cannot) be neutralized, and the primary sources of food for stream invertebrates. Although some states have described the different types of streams found within their borders, a thorough investigation to characterize the different types of streams found throughout the Northeast is warranted.

Indicators of Freshwater Streams and River Systems Status

Indicators are listed in order of priority.

Freshwater Streams and River Systems Indicator 1: % Impervious Surface

The proportion of land area covered with impervious features (e.g. roads, parking lots, driveways, and roof-tops) has often been shown to be associated with degradation of streams and rivers. Due to reduced infiltration of rainwater, flooding tends to be more frequent and erosive. As a result, increasing amounts of impervious land cover in a watershed contributes to increases in stream temperature, more sediment, and less structural habitat. Chemical pollution also tends to be higher in areas with an abundance of roads, parking lots, and houses. Although many pollutants wash into streams from these impervious features, many are associated with urban areas, where imperviousness is at its highest proportion.

Biological responses to the chemical and physical changes associated with imperviousness are typically severe. Ten to fifteen percent imperviousness in a watershed has most often been reported as a threshold to maintain biological integrity. However, certain sensitive biota are eradicated from streams when total impervious land cover exceeds five percent, or less.

A. Description of Existing Data for % Impervious Surface Indicator

- **Why is this indicator being monitored by this program?**
  Impervious surface can directly influence the biological and physical status of streams and thus is an important indicator.

- **Who is collecting the data?**
  The USGS is the source for the National Land Cover Data (NLCD).

- **When are the data being collected (monitoring frequency)?**
  The NLCD are anticipated to be updated approximately every 10 years (perhaps more frequently).

- **Where are the data collected (monitoring scope – remote, screening, intensive)?**
  Data are remotely collected.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)?**
  Actual data collection methodology is developed by USGS.

- **How are data managed/stored?**
  Data are stored in GIS-compatible data layers.

- **How are data analyzed/assessed?**
  Data Analysis tools currently available include the Impervious Surface Analysis Tool (ISAT) http://www.csc.noaa.gov/crs/cwq/isat.html. The National Land Cover Data (http://landcover.usgs.gov/uslandcover.php) may serve as the dataset on which to apply the ISAT tool.

- **What Quality Assurance/Quality Controls (QA/QC) are applied to the data?**
  USGS would have QA/QC protocols for the NLCD.

B. Potential Issues in Applying % Impervious Surface Data Sets for NEAFWA Framework

Impervious surface has long been recognized as a factor influencing waterways. There is considerable information on these effects and current land cover data should provide a good source for assessing this factor. Additionally, there is a general recognition of the scale of effects which can occur with different levels of imperviousness. The most significant obstacle to for applying the scale of watersheds in which to assess the extent of imperviousness. Studies are underway to evaluate the effects of increasing impervious surface: Collaborative Research: *Streamflow, Urban Riparian Zones, BMPs, and Impervious Surfaces* S. Taylor Jarnagin (http://www.epa.gov/nerlesd1/land-sci/epic/clarksburg01-05.htm).

C. Data Gaps for % Impervious Surface

No significant data gaps are apparent with assessing impervious surface, however additional monitoring may be required to evaluate site or regional responses to impervious surface or to remediation measures.

D. Next Steps for Data Compilation and Analysis for % Impervious Surface

A regional habitat classification project (National Fish and Wildlife Foundation-Doris Duke Charitable Foundations funded project) will be developing a common land use classification scheme. It is expected that this system will serve a valuable role in ensuring a consistent regional interpretation of impervious surfaces.

E. Baseline Condition and/or Past Trends of % Impervious Surface

The National Land Cover Datasets (NLCD) http://landcover.usgs.gov/uslandcover.php could serve as baseline for this indicator. The value of historic data would need to be evaluated for resolution and comparability with more recent data and with the regional habitat classification system.

F. Additional Comments on % Impervious Surface

None offered.

G. Citations for % Impervious Surface

The following reference provides information on rationale and supporting literature:

Impervious Surface Standards (Wisconsin):
http://www.dnr.state.wi.us/org/water/wm/dsfm/shore/documents/Wt54200/Chapter5.pdf.

Chandler C. Morse, Alexander D. Huryn, and Christopher Cronan. 2003. Impervious Surface Area as a Predictor of the Effects of Urbanization on Stream Insect Communities in Maine, U.S.A. Journal of Environment and Monitoring 89:95-127
http://www.springerlink.com/content/kr38v315287gxh44/

Tilburg, Christine and Merryl Alber. Impervious Surfaces: Review of Recent Literature, Georgia Coastal Research Council.

http://crd.dnr.state.ga.us/assets/documents/jrgcrddnr/ImperviousLitReview_Final.pdf

Moffett, Donna and John Hasse 2006. Looking for the Relationship between Sprawl and Water Quality: A Case Study of Gloucester County, NJ. Middle States Geographer 39: 26-33. http://geographyplanning.buffalostate.edu/MSG2006/4%20Moffett%20and%20Hasse.pdf

Multi-Resolution Land Characteristics Consortium (see this web site http://gisdata.usgs.net/website/MRLC/viewer.php) are available from (a group of federal agencies working together).

H. Mock-up of Report to Decision Makers (for Impervious Surface)

See Mock-up of Report at the end of Freshwater Streams and River Systems 5: NAS.

Freshwater Streams and River Systems Indicator 2: Distribution and Population Status of Native Eastern Brook Trout

Many species of fishes, amphibians, crayfishes, freshwater mussels, and insects have been severely affected by human activities, and few northeastern species (with the exception of the Atlantic salmon) have gained as much attention as the native eastern brook trout. The eastern brook trout provides a useful indicator because it is:

- Important to people who enjoy fishing (it is a popular game fish) and thus there is already has received strong public recognition of the value of this species.
- Indicative of the highest quality streams, requiring both good water quality and physical habitat.
- An important and imperiled component of northeastern stream biodiversity and has been recognized by resource managers and the scientific community as an important species for northeast aquatic systems. Loss of eastern brook trout from streams and watersheds represents a severe loss of ecosystem integrity and biodiversity. According to the Eastern Brook Trout Joint Venture (www.easternbrooktrout.org):
  - Brook trout are extirpated from over 20% of the subwatersheds across their eastern range. Intact stream populations of brook trout (where wild brook trout occupy 90-100% of their historical habitat) exist in only 5% of subwatersheds. The majority of these are in Maine, New Hampshire, New York, Vermont and Virginia. Pennsylvania, Maryland, West Virginia and the other New England states each possess only a handful of these intact subwatersheds. Wild/native populations of eastern brook trout have vanished or are greatly reduced in nearly half of subwatersheds.
  - The vast majority of historically occupied large rivers no longer support self-reproducing populations of native brook trout. Native eastern brook trout survive almost exclusively as fragmented populations relegated to the extreme headwaters of streams.
  - Poor land management associated with agriculture ranks as the most widely distributed impact to brook trout across the eastern range.
  - Non-native fish rank as the largest biological threat to native eastern brook trout.
  - Intact subwatersheds of wild brook trout in lakes and ponds are almost exclusively located in Maine, but self-reproducing populations remain in some lakes and ponds in New York, New Hampshire and Vermont.

More data collection is needed to determine the status of brook trout in various parts of the eastern range, particularly in Maine, New Hampshire, New York, Massachusetts and Pennsylvania.

A. Description of Existing Data for Native Eastern Brook Trout Indicator

- **Why is this indicator being monitored by this program?**
  The native eastern brook trout integrates water quality and habitat conditions and is typically found where both of these factors are of high quality. It is also a popular fish species and thus has strong public appeal.

- **Who is collecting the data?**
  It is expected that many state fisheries agencies are collecting data on native eastern brook trout as part of monitoring or directed sampling.

- **When are the data being collected (monitoring frequency)?**
  A survey or review of these states/agencies would be able to identify extent of sampling, frequency, etc.

- **Where is the data collected (monitoring scope – remote, screening, intensive)?**
  A survey or review of these states/agencies would be able to identify geographic distribution and purpose for sampling.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)?**
  A survey or review of these states/agencies would be able identify collection methodology and purpose for sampling.

- **How are data managed/stored?**
  Unknown.

- **How are data analyzed/assessed?**
  See the Eastern Brook Trout Joint Venture web-site (http://www.easternbrooktrout.org/).

- **What Quality Assurance/Quality Controls (QA/QC) are applied to the data?**
  Unknown.

B. Potential Issues in Applying Native Eastern Brook Trout Data Sets for NEAFWA Framework

- The distribution, resolution and consistency of the data across the region may require concessions on applicability for specific analyses.
- Compiling and maintaining any database containing information from the states and agencies will require resources (e.g., financial, personnel).

C. Data Gaps for Native Eastern Brook Trout

- More intensive field data collection efforts are required to assess local populations of native eastern brook trout. These efforts are often time-consuming and expensive. Thus, watershed prioritization will be needed to focus resources where they can be used most efficiently.
- These data will also be necessary to understand effectiveness of management and restoration initiatives.

D. Next Steps for Data Compilation and Analysis for Native Eastern Brook Trout

- Work closely with the National Fish Habitat Initiative and the Eastern Brook Trout Joint Venture to identify state contacts, priority watersheds and streams, and data sources and data gaps.

- After identifying these data sources, the data will need to be gathered and assessed for comparability in methodologies. It will be especially important to understand the analytical limits of the data.

E. Baseline Condition and/or Past Trends of Native Eastern Brook Trout

Data gathered thus far through the Eastern Brook Trout Joint Venture will provide an invaluable resource for a baseline on this species. After data compilation and initial analysis, the actual performance measures will need to be developed and evaluated.

F. Additional Comments for Native Eastern Brook Trout

None offered

G. Citations for Native Eastern Brook Trout

None offered.

H. Mock-up of Report to Decision Makers (for Native Eastern Brook Trout)

See Mock-up of Report at the end of Freshwater Streams and River Systems 5: NAS.

Freshwater Streams and River Systems Indicator 3: Stream Connectivity (Length of Open River) and Blockages

Stream blockages such as dams, weirs, and culverts can prevent migratory fishes access to spawning and nursery habitats and have been responsible for population extirpations, reductions in river basin distribution, and general population depletions of migratory species throughout the world, including the north eastern United States. Population depletions or extirpations of diadromous species (e.g. Atlantic salmon, American shad, hickory shad, alewife herring, blueback herring, white perch, yellow perch, striped bass, and American eel) from many Atlantic coastal streams and rivers, as a result of stream blockages, have warranted efforts to restore fish passages and re-establish populations of these recreationally and commercially important species.

Like migratory species, many resident fishes are known to move to preferred local seasonal habitats for spawning and feeding, and also to refugia during times of stress. The influence of blockages on resident fishes can be profound. The most pervasive influence that blockages have on resident fishes may be as barriers to upstream re-colonization. Blockages can interrupt interactions between individuals in different streams. Fragmented and isolated populations upstream of a blockage can result in local extinctions following catastrophic events. These events may displace or eliminate all or part of a stream fish community, after which re-colonization is impossible. Stream blockages may have more pronounced effects on rare resident species because fragmentation of populations of rare species often increases the likelihood of local extinction.

Although barriers to fish migration have gained the most attention, deleterious effects of stream blockages are not limited to stream fish communities. Barriers have also been implicated in the decline of freshwater mussels in parts of the north eastern United States. The parasitic larval stage of most freshwater mussels requires a fish as a host. Stream barriers can indirectly result in declines of freshwater mussels by directly excluding host species from upstream, and by altering upstream habitats such that unfavorable conditions reduce survival of host fishes. Therefore, stream blockages that serve as barriers to host fishes may cause isolation and fragmentation of freshwater mussel populations, leading to local extinctions. The distribution of the eastern elliptio (*Elliptio complanata*) and the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*) in certain streams is confined to stream reaches below blockages, suggesting that blockages may impede the upstream movement of migratory and resident host fishes, thereby restricting mussels to downstream habitats.

A. Description of Existing Data for Stream Connectivity and Blockages Indicators

- **Why is this indicator being monitored?**
  To assess the occurrence and distribution of known man-made barriers to fish movement and evaluate the amount of habitat upstream of these barriers that may be made available through removal or fishway construction

To measure progress on providing fish access to historic spawning and nursery habitat and the reconnection of fragmented or altered riverine habitat

To assess fish passage upstream of barriers with monitored fishways, with a focus on anadromous species

- **Who is collecting the data?**
  U. S. Fish and Wildlife Service National Fish Passage Program (http://fpdss.fws.gov/)

  Federal Fish Passage Action Plan (November 2006) see: http://www.nmfs.noaa.gov/habitat/habitatconservation/publications/Fish%20Passage%20Action%20Plan.pdf

  Fishway construction, planning, and assistance information funded through Sport Fish Restoration (SFR), State Wildlife Grant (SWG), or Anadromous Fish Conservation Act (AFC) programs have required annual reports and are administered by USFWS and NOAA Fisheries

  Other primary Federal Agencies involved with fish passage include the Army Corps of Engineers, US Forest Service and the Natural Resource Conservation Service

  Other NGO funding organizations involved with fish passage or stream connectivity include the National Fish and Wildlife Foundation, American Rivers, The Nature Conservancy, Trout Unlimited, and the Fish America Foundation

  U. S. Fish and Wildlife Service Fishery Resources Offices and State Agencies fish passage count data are found at:
  http://www.fws.gov/r5crc/Fish/daily.html (CT River basin)
  http://www.fws.gov/r5cneafp/returns.htm (Merrimack River basin)
  http://www.fish.state.pa.us/shad_susq.htm (Susquehanna River basin)
  http://www.ctriversalmon.org/runs.html (State of CT fishways)
  http://www.maine.gov/asc/research/trap_count_stats.shtml (Maine rivers)

  Fish count data are also prepared for Sport Fish Restoration (SFR) and State Wildlife Grants (SWG) projects on an annual basis for many state monitored fishways by agency staff.

- **When are the data being collected (monitoring frequency)?**
  The USFWS Fish Passage Program data relies on many other data sources (e.g., state dam bureaus and federal sources) , resulting in a variety of monitoring frequencies.

  Annual updates or reports for grant funded projects from a variety of sources are typically available.

  Fish count data for listed web sites are updated daily to weekly.

  Fish count data provided in State agency Sport Fish Restoration (SFR), State Wildlife Grant (SWG), Anadromous Fish Conservation (AFC) grant reports are produced annually and include daily to final run counts (or estimates).

- **Where are the data collected (monitoring scope – remote, screening, intensive)?**
  Barrier data for the USFWS Fish Passage Program are obtained from many outside sources internal and external (federal, state, other).

Fish count data may be obtained by direct visual counts, electronic counts, estimated partial visual counts, or hydroacoustic estimates (e.g., Delaware River).

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc).**
  Barrier data come from many sources and sampling (survey) design varies accordingly.

  Fish count data are often obtained at viewing windows by human counters, passage may be restricted to times of counter presence (gates or lifts closed affecting some species passage).

  Fish count data may occur at random time periods with data expansion based upon a multiplier at smaller coastal fishways.

- **How are the data managed/stored?**
  Barrier data are managed under the supervision of the USFWS National Fish Passage Coordinator, refer to web site for details and documentation

  Count data for fishways are maintained by State agencies and some regional USFWS Fisheries Program Offices (web sites listed earlier). Annual reports are also available from USFWS Federal Assistance (SFR and SWG funded projects) or NOAA Fisheries (AFC).

- **How are the data analyzed/assessed?**
  Barrier data may be examined by geographic area and at various scales on the USFWS Fish Passage Program site.

  For example, barrier data by county will list the number known (over 6ft), construction types (%), purpose (%), and ownership (%).

  A mapped barrier can be selected for relevant data. The quantity of upstream habitat opened up after its removal is calculated using a defined algorithm, limitations are described. Data may be imported to a GIS.

  Fish count data from web sites show count data and may include previous years data

  Grant performance reports received by USFWS Federal Assistance or NOAA Fisheries may include analysis and assessment details of fish passage counts in addition to fishway construction, modification, or barrier removal.

- **What Quality Assurance/Quality Controls (QA/QC) are applied to the data?**
  Barrier data comes primarily from state agency sources with varied QA/QC procedures (need to refer to the listed sources).

  Fish passage count data are collected at specific sites with varying degrees of QA that is generally highest with state-staffed count data compared to volunteers or power company counts.

  Lower main stem dams on the larger rivers along the Northeast are typically well-staffed due to their placement in the basin and the numbers of returning anadromous fishes that are passed.

B. Potential Issues in Applying Stream Connectivity and Blockages Data Sets for NEAFWA Framework

- The frequency with which barrier data are updated should be more clearly stated and understood.
- Obtaining regular, timely updates on barrier removals, fishway construction, or fishway improvement. Some agencies have this information readily accessible via their web site. Partnering agencies, NGOs, and other sources may provide some types of information that may vary within states or across the region.
- Obtaining fish count data in a timely, accessible manner from sources that do not update existing web sites. Fish count data availability and count data monitoring occurrence and sampling intensity is variable among states. Posted information may not include additional important information for data interpretation (e.g., high flow, equipment failures, and others that impact effectiveness) and put count data in some context given the complexities of many fishways.

C. Data Gaps for Stream Connectivity and Blockages

- Information evaluating barrier removal effects on habitat and target species.
- Evaluations of new fishway or fishway modification would be helpful in assessing the actual passage efficiency versus perceived efficiency – under a range of conditions for all targeted species.
- Follow-up evaluation is often limited in scale and design for fish passage or barrier removal if even attempted.
- Modifications to existing fishways or their operation may be required to achieve desired goals and will require subsequent evaluation.

D. Next Steps for Data Compilation and Analysis for Stream Connectivity and Blockages

- In most state fishery agencies there is an individual(s) involved with proposed fish barrier removals, fishway construction, or fishway improvement. This person(s) could be charged with filling out a standardized form of a general nature that would reflect the types of metrics or information that would adequately meet the intended need of this exercise.
- A centralized data base may be developed that would be accessible to key agency personnel and potentially other identified individuals (volunteer coordinators, NGOs, power companies) for populating key data prior to report due dates. This would be kept very basic by design and may include categories (excellent, good, fair, poor) to improve an understanding of values that may not otherwise be directly comparable. These data could be examined for progress towards achieving desired measures or trends at the regional scale.
- Fish passage count data for species and fishways identified as desired indicators throughout the region could be developed and maintained.
- The Northeast Rivers and Streams Technical Committee would be a good starting place to develop mechanisms to address these information compilation and data sharing needs. The Committee was recently formed by the State Fish Chiefs and the American Fisheries Society's Northeastern Division.

E. Baseline Condition and/or Past Trends of Stream Connectivity and Blockages

It is not possible to complete an initial compilation and analysis for this indicator across the region at this time. Attached below is some information that reflects individual agency efforts that could be summarized in a more useful and simple way to reflect measures and information of interest. Information may be developed in tables, graphically with figures, or with some limited descriptive text. This will

need to be developed as the information is gathered and the appropriate measures and some appropriate context are identified.

An example for fish passage information may be:

Draft table 1

State	Watershed and stream name	Location (County and Town)	Site name	Fish passage type (new, modified)(specs? 6ft dam?)	Miles/acres of new habitat	Species benefited (*SGCN)	Phase (design, construction, evaluation) - dates	Partners	Others?? Funding sources?
CT	Long Island Sound Coastal watershed, Jordan Brook	New London County, Waterford	Jordan Millpond Dam	Steeppass fishway, new	One mile	Alewife* Sea-run brook trout* Sea-run brown trout,	Constructed in 2006, operational in 2007	Town of Waterford	
MA									

* SGCN

Table 1 could be summarized in another table which would just add up new fishways, fishways modified/improved, dams/barriers removed and other summary information of interest. Qualitative information may be included (e.g., excellent, good, fair, poor). The listed information came from a SFR performance report written by the Diadromous Fish Project Leader.

An example for fish passage may be:

Draft table 2

State	Watershed and stream name	Site name	Operational dates	American shad	Some previous measures for context and trend for each species	Atlantic Salmon	Blueback herring	American eel	Sea lamprey	Other species that are of interest>>>
MA	Connecticut River	Holyoke Fish Lift	April 15, 2007 through July 9, 2007	163,444	70% of 5 year mean or 2006 count 128,000, etc	134	74	172	42434	Also a comments column that would address high flows, equip failure, other insights into observed numbers
MA										

With considerable effort, more information may be compiled to complete these tables. Most of these data came from the USFWS Connecticut River Coordinator's website; other parts would come from an annual SWG report submitted by the Anadromous Fish Project Leader for MassWildlife. Table 2 may be developed to either include a lot of numeric information or to incorporate more general measures that would place count data in more comparable formats (% increase or decrease from previous year's numbers or from some multi-year averaged period). Figures could also be developed here to illustrate trends more effectively.

F. Additional Comments for Stream Connectivity and Blockages

Fish blockage information is available from the USFWS (see: http://www.fws.gov/fisheries/fwma/fishpassage/ regarding fish passage in the northeast. Contact Leslie Hartsell at Leslie_Hartsell@fws.gov , the National Fish Passage Coordinator for USFWS.

G. Citations for Stream Connectivity and Blockages

None offered

H. Mock-up of Report to Decision Makers (for Stream Connectivity and Blockages)

See Mock-up of Report at the end of Freshwater Streams and River Systems 5: NAS section.

Freshwater Streams and River Systems Indicator 4: Index of Biotic Integrity (IBI)

A multi-metric index can help to summarize complex physical, chemical and biological information for streams and other aquatic habitats. These metrics are based upon *expected* conditions for minimally disturbed streams of similar type. For fish, these multi-metric measures, based upon the structure and functional components of the assemblage, are often referred to as an ***Index of Biotic Integrity*** (IBI). Similar indices (e.g., Hilsenhoff Index) have also been developed for macroinvertebrates assemblages. This approach builds upon individual aspects of stream health such as the presence or absence of rare, threatened, or endangered fish species, the number of pollution-sensitive benthic macroinvertebrates, trophic status, etc. to provide a comprehensive assessment of the ecological health of a system. Each metric provides a measure of a structural or functional component of the assemblage. Metrics should be developed which provide minimal redundancy for the ecological factor being measured.

The benthic macroinvertebrate IBI is widely used by state and federal agencies to assess the ecological integrity of streams and has been incorporated into the water quality criteria regulations of some state agencies. This has been valuable for prioritizing streams for restoration and protection.

A. Description of Existing Data for IBI Indicator

- **Why is this indicator being monitored by this program?**
  This indicator can provide a useful measure of the current biological condition of a stream relative to an expected condition. The multi-metric approach helps ensure that several biotic signals of the assemblage are evaluated.

- **Who is collecting the data?**
  The data to be applied to an IBI are usually collected by a state fisheries/natural resources agency or the state affiliate of the Environmental Protection Agency.

- **When are the data being collected (monitoring frequency)?**
  The frequency of collection is anticipated to vary among states and agencies. This would need to be determined through a regional survey.

- **Where are the data collected (monitoring scope – remote, screening, intensive)?**
  These data may be collected as part of a monitoring or intensive basin survey.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc).**
  Unknown. This information would need to be collected as part of a more intensive regional survey.

- **How are the data managed/stored?**

Each state would have its own data management system and details of these systems are unknown.

- **How are the data analyzed/assessed?**
  Data analysis and assessment would need to be evaluated for all states/agencies collecting data. Data collection methodology will need to be considered in any analysis to ensure data are used appropriately.

- **What Quality Assurance/Quality Controls (QA/QC) are applied to the data?**
  QA/QC would need to be evaluated for all states/agencies collecting data.

Many states across the region are collecting biological data (e.g., fish, macroinvertebrates), but specific information about these data sets will need to compiled as part of the next steps in developing this indicator. Additionally, some states have developed their own IBI's (e.g., New Jersey http://www.state.nj.us/dep/wms//bfbm/fishibi.html; Maryland http://www.montgomerycountymd.gov/content/dep/publications/pdf/benthicindex.pdf) and it would thus be important to understand the metrics in these IBI's and how a regionally adjusted IBI score would relate to these state-specific indices.

B. Potential Issues in Applying IBI Data Sets for NEAFWA Framework

- An Index of Biotic Integrity requires development of expectations for each metric (e.g., species richness, number of insectivorous cyprinids) based upon collections of representative fish or macroinvertebrate assemblages. Ensuring completeness and consistency of samples, geographic distribution of IBI development, data management and analysis will present challenges for development of this indicator. Identifying the metrics which may provide a good measure of human disturbance across the region will require considerable analysis. This analysis may want to consider a hierarchical approach which would allow IBI determinations within states or small among states which share drainages or ecoregions.
- More than one IBI may need to be developed due to significant differences in stream types (i.e., coldwater, warmwater, large-rivers) across the region. The application of habitat-specific IBI's has been implemented in specific states (e.g., Wisconsin) and will likely be required in the Northeast.
- Ensuring that IBI scores are comparable across the region will be a significant challenge (i.e., a specific score in ME is comparable to a similar score in VA.

C. Data Gaps for IBI

An assessment of data gaps will need to be made following compilation of data throughout the region.

D. Next Steps for Data Compilation and Analysis for IBI

To accomplish this task (for the region), at least one coordinator (and an assistant) familiar with IBI development should be hired. This coordinator would build upon previous data compilation efforts and work with states and federal agencies to acquire, organize, summarize and analyze data collected by each entity. An outcome of this process would be a summary on data

collection methodologies, quality assurance, and related topics. The USGS National Biological Information Inventory (NBII) should be incorporated into this regional data coordination effort. The overall process would require an estimated 3 years and approximately $140,000 per year. At the conclusion of the project an analytical tool will be available which would account for regional variability. This would allow comparable assessments of riverine biological communities across the region (i.e., an IBI score of 50 in Maryland would be comparable to an IBI score of 50 in Maine).

The Multistate Aquatic Resources Information System (MARIS) may serve as another model for this data compilation effort (see: http://www.gis.uiuc.edu/maris/).

E. Baseline Condition and/or Past Trends of IBI

The EPA Wadeable Streams Assessment (United States Environmental Protection Agency Office of Water Washington, DC 20460 EPA 841-B-06-002 May 2006) (http://www.cpcb.ku.edu/datalibrary/assets/library/projectreports/WSAEPAreport.pdf) and Fact Sheet (see: http://www.epa.gov/owow/monitoring/wsa/WSAfactsheet_0506.pdf) provide data from throughout the Northeast using consistent sampling methods. However, this information has been collected at a coarse scale. It is expected that each state has much more detailed information. However, differences in sampling design and field methods must be considered if these data are used to report on findings throughout the region.

F. Additional Comments on IBI

- A northeast regional IBI will serve as a useful tool for evaluating trends and conditions of streams. In addition to overall scores, specific metric values may provide valuable insight into causative factors influencing biotic communities.
- Numerous references are available in journals of the *American Fisheries Society*.
- The approach of a multi-metric IBI has received considerable application. See: Miller *et al.* 1988. *Fisheries* 13 (5): 12-20. http://afs.allenpress.com/perlserv/?request=get-abstract&doi=10.1577%2F1548-8446%281988%29013%3C0012%3ARAOAIO%3E2.0.CO%3B2

G. Citations for IBI

No additional citations (only within text)

H. Mock-up of Report to Decision Makers (for IBI)

See Mock-up of Report at the end of Freshwater Streams and River Systems 5: NAS section.

Freshwater Streams and River Systems Indicator 5: Distribution and Population Status of Non-indigenous Aquatic Species (NAS)

Non-indigenous aquatic species (NAS) are member(s) (i.e. individual, group, or population) of a species that enters a body of water or aquatic ecosystem outside of its historic or native range. They may be vertebrates, invertebrates, plants or diseases. Invasive NAS are a major cause of biodiversity loss. They alter ecosystems by preying on or out-competing native species, hybridizing with native species, or introducing and spreading diseases to native species. NAS may be more likely to become established when stream and watershed conditions are degraded, such as when waters warmed as a result of watershed damage support non-indigenous fish species that would not be able to survive under colder conditions.

There are many individual databases of the occurrence of NAS for particular species, ecosystems, or geographic areas. The National Biological Information Infrastructure (NBII) Invasive Species Information Node provides links to databases of aquatic and terrestrial invasive species (http://invasivespecies.nbii.gov/dbases.html). The data are collected primarily by state and federal agencies, research programs, and non-profit organizations. The most comprehensive way to access information on the geographic distribution of NAS is through the USGS Nonindigenous Aquatic Species (NAS) website (http://nas.er.usgs.gov/queries/). This site has been established as a central repository for accurate and spatially referenced biogeographic accounts of NAS. In addition, NatureServe maintains a database of the current and historical presence of native species, which can be used to estimate the reduction in native fauna from historical levels.

In 2003, the USEPA released its first national draft Report on the Environment (http://www.epa.gov/roe/publications.htm) see Technical Document, Chapter 5 page 47), which it planned to update every 3 years. It includes an analysis of the number of non-native freshwater fish species by HUC6, based on the USGS-NAS data. The second draft Report on the Environment was released for peer review in August 2007 (www.epa.gov/roe/ see Science Report, Chapter 6 page 34). The 2007 report includes an analysis of the percent reduction in native fish fauna by HUC6, based on the NatureServe data. The two analyses are quite different. The 2007 analysis indicates that most of the Northeast has undergone less than 10% reduction in native fish fauna, except the Great Lakes basins. The Southwest had the greatest reduction in native fish fauna, over 50% for Arizona. The 2003 analysis shows some Northeast states have numbers of non-native fish species that are as high as the highest western states. This difference is very likely because the number of total species is variable, with the West being generally low and the Northeast variable.

A. Description of Existing Data for NAS Indicator

- **Why is this indicator being monitored?**
  Non-indigenous aquatic species provide a means of inferring the status of native biodiversity and watershed health.

- **Who is collecting the data?**
  The USGS-NAS program obtains data from many sources including literature, museums, databases, monitoring programs, state and federal agencies, professional communications, online reporting forms, and Aquatic Nuisance Species (ANS) hotline reports. The data are not from a site-based monitoring program, and new discoveries are not always reported. Data collection is piecemeal—in some locations a state agency collects data, in others a non-profit collects data or there is no data collection at all.

  The *NatureServe* data are derived from a number of sources, including species occurrence data from state natural heritage programs, relevant scientific literature, and expert review.

- **When are the data being collected (monitoring frequency)?**
  Variable. The USGS-NAS database receives data when it is reported to them. The *NatureServe* database is updated regularly, but the collection of data is variable.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Variable.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)?**
  Variable. The USGS-NAS data includes reported occurrences, which may not necessarily indicate established breeding populations. It also may not identify all established breeding populations.

- **How are data managed/stored?**
  USGS and *NatureServe* serve as data repositories.

- **How are data analyzed/assessed?**
  Both USGS-NAS and *NatureServe* datasets are available and can be analyzed geospatially. The *NatureServe* data is available by HUC8. The USGS-NAS fish data is available nationwide but is only be available by HUC6 [this needs to be confirmed]. USGS-NAS also has data on aquatic invertebrates and plants.

- **What Quality Assurance/Quality Controls (QA/QC) are applied to the data?**
  This would be variable, depending on the source of the data.

B. Potential Issues in Applying NAS Data Sets for NEAFWA Framework

The two approaches identified have been used in the past and previous benchmarks are available. Whether to use either or both would depend on their ability to track changes over time and their value in indicating what is intended. Before making a decision, it would be helpful to learn why EPA used one approach in 2003 and a different one in 2007, and what the peer reviewers say for both reports. In addition, the nature of NAS is that they will only become more widespread over time, so it is not clear how to gauge success. The two approaches described will likely not be able to identify improvements due to improved environmental conditions, because once a NAS population is established, it will still be present, just at lower densities.

C. Data Gaps for NAS

Consistent monitoring across states for NAS presence.

D. Next Steps for Data Compilation and Analysis for NAS

- Talk to Pam Fuller at USGS-NAS to learn more.

  Contact: Pam Fuller
  USGS/BRD - Nonindigenous Aquatic Species Program
  Florida Integrated Science Center
  7920 NW 71st Street
  Gainesville, FL 32653
  Pam_Fuller@usgs.gov

- States conducting SWG/WAP projects could measure NAS themselves as an indicator to provide watershed-specific data to measure success.
- Federal funds may be available through the Aquatic Nuisance Species Taskforce. When states complete Aquatic Nuisance Species plans they become eligible for federal funding. Plans completed: Maine, Massachusetts, Connecticut, New York, Lake Champlain interstate ANS Management Plan. Plans in progress: Pennsylvania, Rhode Island, New Hampshire.

E. Baseline Condition and/or Past Trends of NAS

Please see the two EPA reports.

F. Additional Comments on NAS

Data from federal agencies and other region wide groups for these indicators should be used for this Indicator. This would provide consistent representation of conditions across the region and data are fairly accessible. We should invite a representative from each of these groups to take part in this reporting for the Northeast region.

Another option would be to compile data available from the states and other groups for each indicator, compile the information, understand the inconsistencies, build a database etc. This is a large task, however the information could prove very useful.

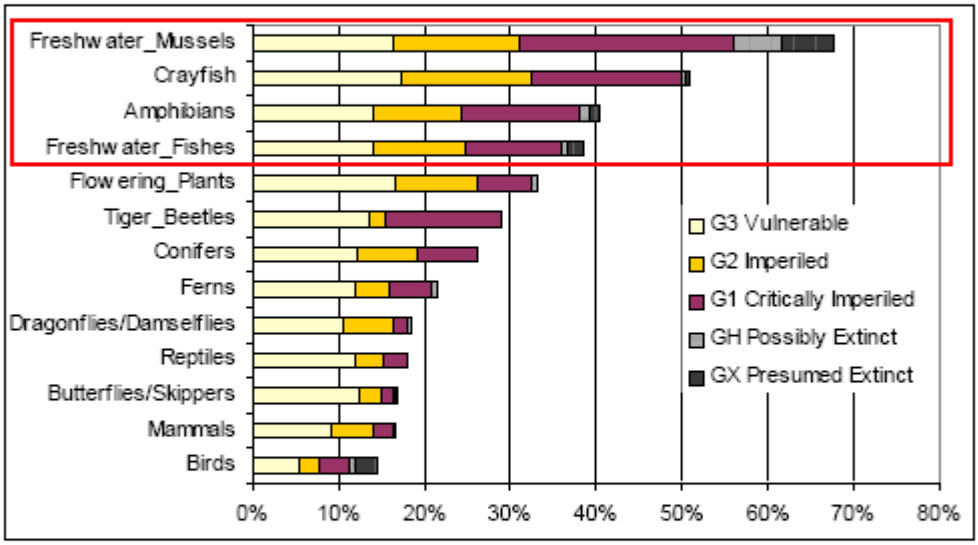
G. Citations for NAS

None offered.

H. Mock-up of Report to Decision Makers (<u>for Freshwater Streams and River Systems' Indicators 1-5)</u>

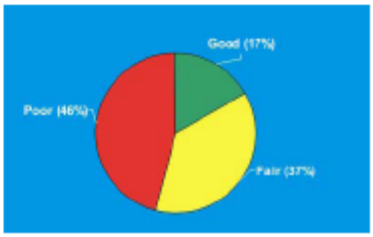
Initial mock-up by Scott Stranko with minor revisions by Dave Day.

Provided below is copy of a graph from the TNC 1997 document *Species report card: the status of US plants and animals* where I put a red box around the freshwater stream taxa. I have done the same type of graph for Maryland's listed stream species. I show these to a lot of people because it emphasizes the imperiled nature of stream ecosystems and the biota that live in streams.



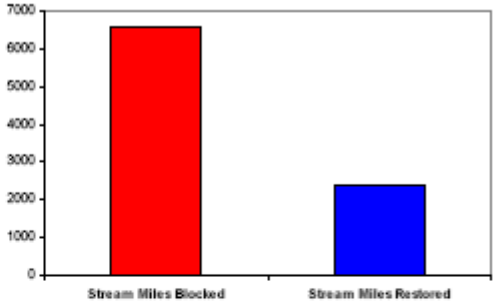
<u>Index of Biotic Integrity and Species Conditions</u>

A pie chart showing IBI results from Maryland showing the percent of stream miles good, fair and poor. We should be able to get something like this for the NE from the EPA, wadeable streams assessment:

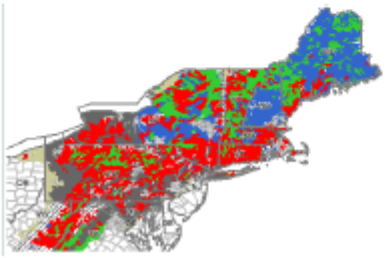


Stream Connectivity and Blockages

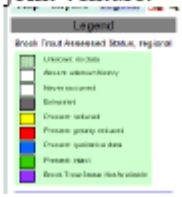
A graph showing the number of stream miles blocked to access for migratory fishes and then the number of miles restored over the last 30 or so years would be nice. It would show that we are trying to restore habitat, but we still have lots to do. It might look something like this, or may be broken down by state or watershed with a title something like stream miles available to migratory fishes. This is a hypothetical (and not very aesthetically pleasing) graph……



Native Eastern Brook Trout



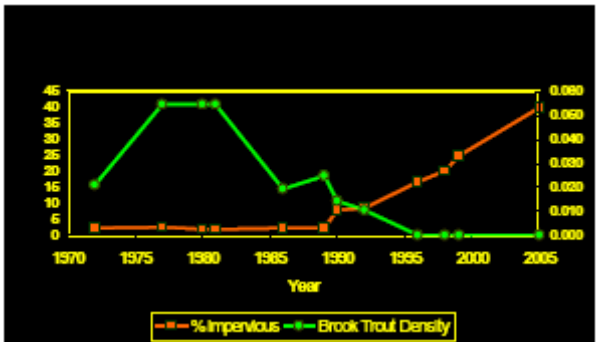
A map showing the condition of watersheds in the NE for brook trout from the Eastern Brook trout joint venture:



Here are some examples we have used in Maryland. Maybe we can do something similar (we would need to decide on the best variables to show correlated with impervious) for the NE. The first is brook trout loss over time as impervious increased for six MD watersheds.

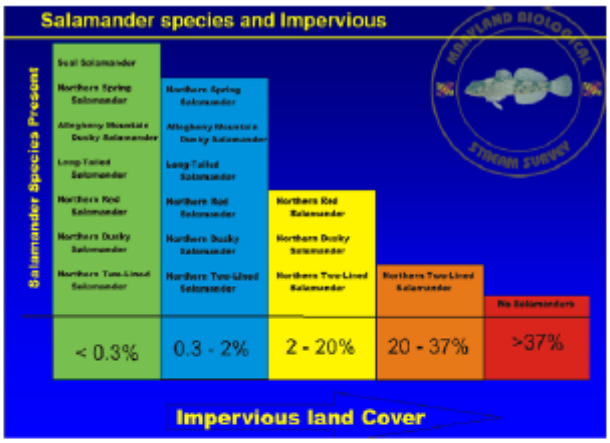
The second is stream salamander species found at different levels of impervious.

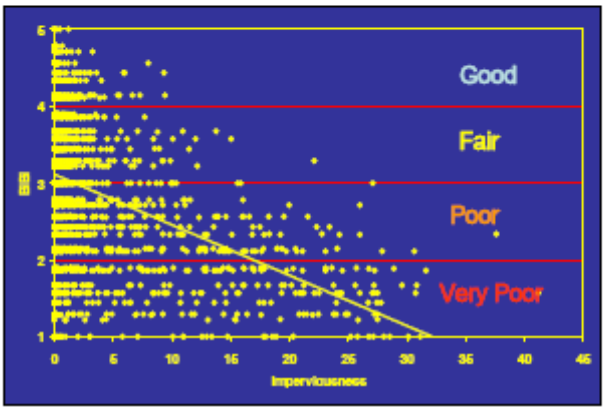
The third is the relationship between impervious and IBI score



Impervious Surface Relationships:

Perhaps show a map of impervious surfaces in NE states.

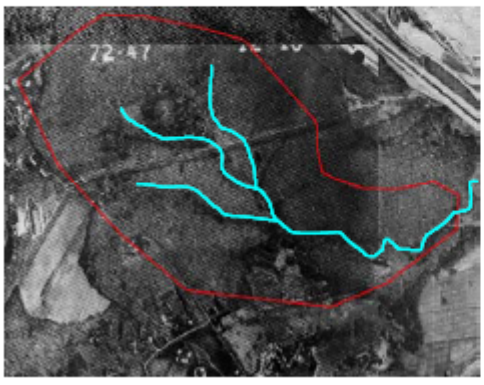




I think we should fit in pictures of the most imperiled stream fauna of the NE with captions describing them and their plight (at least ones sp.). It might even be nice to have a box that talks about restoration efforts for a particular species (maybe Atlantic salmon?). We should have some other photos of critters and streams if we can fit them too.

Here are a couple possible example photos:

First a pair of photos showing LU in a watershed (watershed outline in red) in 1972 then in 2002. Then various stream and critter photos…….



Appendix 3: Indicators for Freshwater Wetlands Target

Description of Freshwater Wetlands Target

Wetlands are ecological communities that occur at the transition of terrestrial and aquatic systems, and are defined by hydrology (depth and duration of flooding), soils, and vegetative cover type.

Sub-Targets:

1. **Bog/Fen-Wetlands formed by peat**.
    a. Bog-Contains acidic waters and the substrate is covered by sphagnum moss. As bogs are closed systems (water received via precipitation, not streams or groundwater), they are low in nutrients.
    b. Fen- Contains either acidic or alkaline waters that are developed in open or closed, relatively shallow basins. They are high in nutrients, usually with grass or shrub dominance.

2. **Freshwater marsh-** Contains emergent, submergent, and scrub-shrub vegetation. They are often associated with lakes, ponds, and streams. Sizes range from small pockets to large acreages.

3. **Floodplain or swamp forest.**

    a. Floodplain forest systems develop along medium to large rivers, on mostly flat topography. Most areas are under water each spring.
    b. Swamp forests are found in basins or slopes, on mineral soils that are acidic and nutrient-poor, and remain saturated for all/nearly all of the growing season.

4. **Vernal Pools -** Small, intermittently filled, generally isolated, wetlands particularly important for amphibians. The unique environment of vernal pools provides habitat for numerous rare plants and animals that are able to survive and thrive in these harsh conditions.

The following table summarizes the indicators and provides criteria for rating their condition. The remainder of the appendix provides detailed information for each indicator

Table 1. Summary Table for Freshwater Wetlands Indicators

Key Ecological Attribute	Indicator	Condition Rating					Data Sources
		Excellent	**Good**	**Fair**	**Poor**	**Very Poor**	
Size	Total Area	No net loss? Or gain.	Minor Loss?	Modest Loss?	Major Loss?	—	USFWS Status and Trends http://wetlandsfws.er.usgs.gov/status_trends/index.html
	Patch Size						
Landscape Context	Connectivity						
	Buffer – Avg buffer Width (m)	>200	100-200	50-100	10-50	<10	Collins et al (2006), adapted for remote sensing, and for small buffers.
	Buffer- % of wetland with buffer	75-100	50-74	25-49	<25	—	
Condition	% Impervious Surface	0-4	5-10	11-20	>21	—	NWI maps; NLCD 2001 Impervious Surface layer; future use of NHD High Resolution maps; NHD+, NLCD non-natural layers
	Road Density (km/km2 for each HUC 11)	Very Low Density	Low Density	Moderate Density	High Density	—	US Census Bur. Website: www.census.gov Tiger web: www.census.gov/geo/www/tiger/index.html
(biotic)	Birds						
(abiotic)	Hydrology- Upstream Surface Water Retention (% of catchment that drains to surface water storage facilities)	<5	5-20	21-50	>50	—	Smith (2000).

Note: Where cells are blank, the team did not have enough information to propose categories.

Indicators of Freshwater Wetlands Status

Indicators are listed in order of priority. The table at the end of this document provides a summary of the Freshwater Wetlands indicators, their condition ratings, and data sources where applicable.

Freshwater Wetlands Indicator 1: Size/Area of Freshwater Wetlands

This indicator shows trends in the total extent of wetlands, as well as the extent of several types of freshwater and intertidal wetlands. In the analyses available from the Fish and Wildlife Service (see below), freshwater wetlands include forested, shrub, emergent, and non-vegetated wetlands (e.g., shallow ponds). Shrub and herb wetlands contain both Freshwater Marsh and Bog & Fen.

A. Description of Existing Data for Size/Area Indicator

- **Why is this indicator being monitored by this program**

U.S. Fish and Wildlife Service's Wetlands Status and Trends survey monitors wetlands because they support a variety of fish and wildlife species and contribute to the aesthetic and environmental quality of the U.S. Millions of Americans use freshwater wetlands annually for hunting, fishing, bird watching and other outdoor activities. Estuarine wetlands provide valuable nursery, feeding, breeding, staging, and resting areas for an array of fish, shellfish, mammals, and birds (Dahl, 2000). In addition, wetlands serve as ground water recharge areas and filter contaminants from surface runoff and contain a high proportion of the biodiversity in a region (Mitsch and Gosselink, 1986). Destruction or alteration of wetlands, therefore, can have wide-ranging biological and hydrological impacts.

- **Who is collecting the data**

This indicator presents data from the U.S. Fish and Wildlife Service's Wetlands Status and Trends survey.

- **When is the data being collected (monitoring frequency)**

This survey is conducted approximately every 10 years.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

This survey provides an estimate of the extent of all wetlands in the contiguous U.S., regardless of land ownership.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

The Status and Trends survey uses a probabilistic design, based initially on stratification of the 48 contiguous states by state boundaries and 35 physiographic subdivisions. Within these subdivisions are located 4,375 randomly selected, four square mile (2,560 acre) sample plots. These plots are examined with the use of aerial imagery. Although the imagery ranges in scale and type, most are 1:40,000 scale, color infrared from the National Aerial Photography Program.

➢ **Data management/storage**

Data on wetland area are managed and stored by the Fish and Wildlife Service, and can be viewed at http://wetlandsfws.er.usgs.gov/status_trends/index.html

➢ **Data analysis/assessment**

Data analysis and assessment of wetland area, including trends analysis, have been regularly conducted by the Fish and Wildlife Service. See http://wetlandsfws.er.usgs.gov/status_trends/index.html for a list of publications. Data on wetland extent are described from several Status and Trends analyses: 1950s-1970s, 1970s-1980s, 1980s-1990s, and 1998-2004 (Frayer et al., 1983; Dahl and Johnson, 1991; Dahl, 2000, 2006). For the most recent period, the indicator also describes sources of wetland loss or gain, which the survey divided into five distinct categories along with an "other" category (Dahl, 2006).

➢ **Quality Assurance**

Field verification is conducted to address questions of image interpretation, land use coding, and attribution of wetland gains or losses; plot delineations are also completed. In the 1980s to 1990s analysis, 21 percent of the sample plots were field-verified; in the most recent analysis, 32 percent were field-verified (Dahl, 2000, 2006). The Fish and Wildlife Service used the Cowardin et al. (1979) definition of wetlands, which is part of the draft national standard for wetland mapping, monitoring, and data reporting as determined by the Federal Geographic Data Committee.

B. Potential Issues in Applying Size/Area Data Sets for NEAFWA Framework

- Different methods were used in some of the early schemes to classify wetland types. As methods and spatial resolution have improved over time, acreage data have been adjusted, resulting in changes in the overall wetland base over time, thus reducing the accuracy of the trend.
- Ephemeral waters and effectively drained palustrine wetlands observed in farm production are not recognized as wetland types by the Status and Trends survey and are therefore not included in the indicator.
- Forested wetlands are difficult to photointerpret and are generally underestimated by the survey.
- The aerial imagery used for this survey generally does not allow detection of small, isolated patches of wetland less than about an acre.

C. Data Gaps for Size/Area

By relying on aerial imagery and statistical surveying techniques, the Wetlands indicator provides a national estimate without an impractical number of samples. However, a limitation to this survey is that it may omit or undercount certain types of wetlands, including forested wetlands—which are difficult to photo-interpret—and ephemeral or well-drained agricultural wetlands, which are not necessarily obvious to the surveyor but are particularly threatened by development. This indicator also does not include wetland parcels less than about 1 acre, which become more critical as larger wetlands are fragmented into smaller pieces.

Wetland condition poses a larger challenge for assessment. While the Wetlands indicator provides information that can be used to infer potential wetland condition, it does not explicitly measure condition—in part because condition is difficult to quantify. Condition is made up of many different attributes, and each wetland has its own unique baseline condition, with a unique hydrologic setting and combination of plant and animal species. Some studies have quantified regional changes in specific stressors; however, national indicators would have to bring together many regional datasets and cover many different aspects of condition in order to be truly comprehensive. The lack of such national-scale information is currently a gap in addressing the question of wetland condition. Potential human health effects associated with wetland extent and condition are also difficult to quantify, and there are no indicators on this topic.

Another information gap concerns the spatial patterns of wetland change, which are not documented in the existing national data. Are most large wetlands being left intact? Are human activities threatening to fragment larger wetlands into smaller pieces that are less connected and more isolated, and therefore less able to perform the desired ecological functions? Data on patterns of wetland loss—e.g., fragmentation and edge effects—would be a useful complement to the existing data on overall losses and gains. Thus we recommend that a separate metric could be developed, based on mapped polygons of all wetlands, whereby the range of wetland sizes currently present for sub-targets be evaluated against the historic range of wetland sizes. This would permit an evaluation of the condition of wetlands based on wetland size (Faber-Langendoen 2007).

D. Next Steps for Data Compilation and Analysis for Size/Area

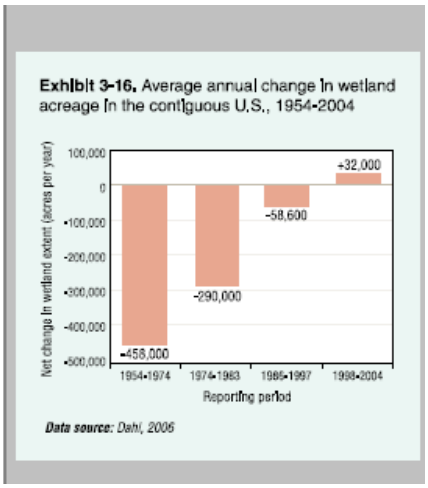
Work with Fish and Wildlife Service and state wetland experts to generate a northeast states evaluation, similar to section F below. Once a baseline area is complete for the Northeast, % change of total wetland area can be calculated and tracked.

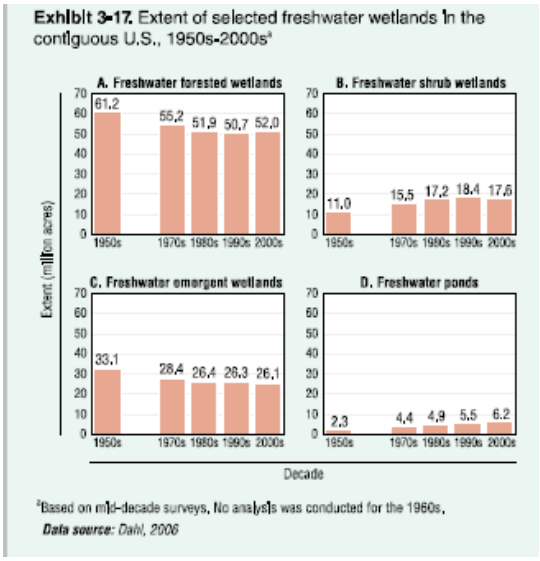
E. Baseline Condition and/or Past Trends of Size/Area

Total wetland acreage declined over the last 50 years, but the rate of loss appears to have slowed over time. From the 1950s to 1970s, an average of 458,000 acres was lost per year (Exhibit 3-16). By the 1986-1997 period, the loss rate had declined to 58,600 acres per year; and in the most recent study period, 1998-2004, wetland area *increased* at a rate of 32,000 acres per year (Exhibit 3-16).

Gains and losses have varied by wetland type. Freshwater forested wetlands, which make up more than half of all freshwater wetlands, lost acreage from the 1950s to the 1990s but have shown gains since 1998 (Exhibit 3-17, panel A). Freshwater emergent wetlands have continued to lose acreage, although the rate of loss has slowed recently (panel C). Among freshwater categories, forested wetlands have sustained the greatest absolute losses since the 1950s, about 9 million acres, while emergent wetlands have shown the largest percentage loss (about 21 percent). Conversely, the extent of freshwater shrub wetlands increased until 1998 but declined thereafter, suggesting that some of the gains and losses in specific categories may reflect conversion rather than outright wetland loss or gain (Dahl, 2006; Exhibit 3-17, panel B). Shallow freshwater ponds, meanwhile, have increased steadily throughout the last 50 years, with current

acreage more than twice what it was in the 1950s (panel D). These wetlands account for a large percentage of the recent gains illustrated in Exhibit 3-17 (Dahl, 2006).





F. Additional Comments for Size/Area

Wetland extent in the contiguous 48 states is substantially lower than it was prior to widespread European settlement and it generally continued to decline over the last 50 years. The rate of loss of wetlands overall and for most types of wetlands has slowed over time, however, and since 1998 the overall extent of wetlands has actually increased. Not all types of wetlands have experienced the same rate of losses or overall percent losses. For example, freshwater shrub wetlands actually increased over the last 50 years—providing evidence of wetland conversion, most likely from forested wetlands to shrub. The nation has also seen a steady increase in acreage of freshwater ponds, which account for a substantial portion of the recent gains in overall wetland acreage.

This indicator also confirms the role of many stressors. Over the last decade, development, forestry, and conversion to deepwater (e.g., marsh to open water) have led to losses in wetland extent, while agricultural areas have experienced overall gains in wetland acreage. The other source of new wetland acreage is from the "other" land use category, which reflects the growing importance of constructed and restored wetlands, including ponds associated with golf courses and residential development.

While this indicator does not directly quantify the condition of the nation's wetlands, it suggests that the condition of many wetlands may be impacted. As discussed above in Section D, extent is only a partial surrogate for condition because wetland loss can increase the stress on those wetlands that remain, while decreasing their connectivity. Thus, the overall decline in extent over the last 50 years suggests the potential for substantial ecological impacts such as habitat loss and increased flood impacts. Changes in the extent of different *types* of wetlands also suggest changes in condition. Shallow ponds, which constitute a large fraction of the recent gains in wetland acreage, will not perform the same range and type of environmental functions as the vegetated wetlands that disappeared between the 1950s and the 1990s. Similarly, evidence of

wetland conversion indicates that even if extent is no longer declining rapidly, changes in wetland structure and function are still occurring. In the past, studies have shown that wetlands that have been created to mitigate for wetland losses have not yet provided the same functions and values of the wetlands that were lost.[1]

G. Citations for Size/Area

Much of the information for this indicator was compiled from recent draft U.S. EPA reports, including:

U.S. EPA 2003. Draft Report on the Environment. Washington, DC:U.S. Environmental Protection Agency. Available: http://www.epa.gov/indicators/roe/ [accessed 13 July 2004].

Data for this indicator are largely based on Dahl (2006). Historical trends are based on data originally presented in earlier Fish and Wildlife Service reports (Dahl, 2000; Dahl and Johnson, 1991; Frayer et al., 1983).

Other References:

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS–79/31. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. http://library.fws.gov/FWS-OBS/79_31.pdf

Dahl, T.E. 1990. Wetlands losses in the United States 1780s to 1980s. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. http://wetlandsfws.er.usgs.gov/status_trends/

Dahl, T.E. 2000. Status and trends of wetlands in the conterminous United States 1986 to 1997. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service. http://wetlandsfws.er.usgs.gov/status_trends/

Dahl, T.E. 2006. Status and trends of wetlands in the conterminous United States 1998 to 2004. Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service. http://wetlandsfws.er.usgs.gov/status_trends

Dahl, T.E., and C.E. Johnson. 1991. Status and trends of wetlands in the conterminous United States, mid-1970s to mid-1980s. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service. http://wetlandsfws.er.usgs.gov/status_trends/

Frayer, W.E., T.J. Monahan, D.C. Bowden, and F.A. Graybill. 1983. Status and trends of wetlands and deepwater habitats in the conterminous United States, 1950s to 1970s. Ft. Collins, CO: Colorado State University. http://wetlandsfws.er.usgs.gov/status_trends/

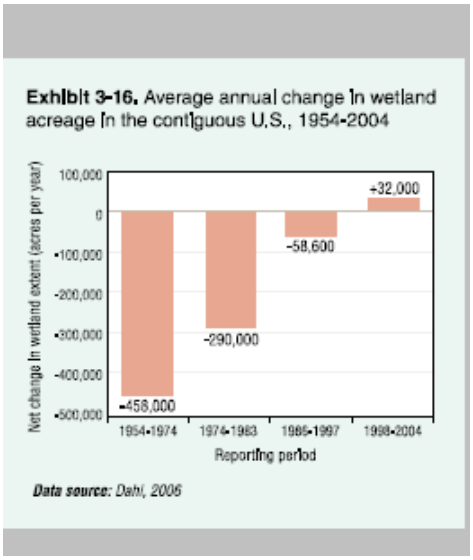
Mack, J.J., and M. Micacchion. 2006. An ecological assessment of Ohio mitigation banks: vegetation, amphibians, hydrology, and soils. Ohio EPA Technical Report WET/2006-1. Columbus, OH: Ohio Environmental Protection Agency. http://www.epa.state.oh.us/dsw/wetlands/WetlandBankReport.html

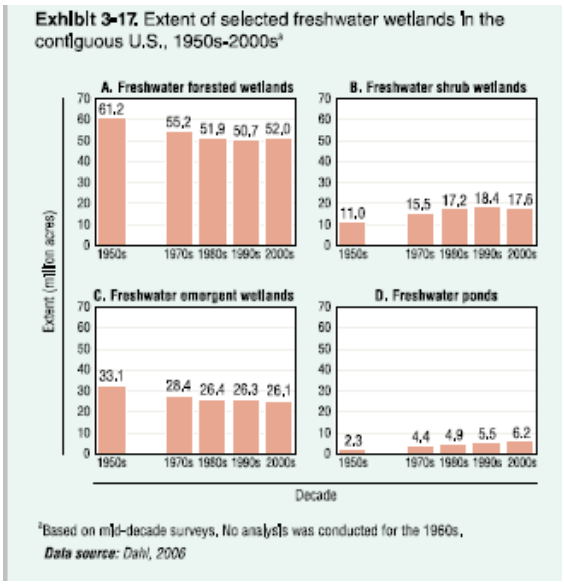
[1] National Research Council. 2001 and Mack & Micacchion. 2006.

Mitsch, W.J., and J.G. Gosselink. 1986. Wetlands. New York, NY: Van Nostrand Reinhold Company Inc.

National Research Council. 2001. Compensating for wetland losses under the Clean Water Act. Washington, DC: National Academy Press. http://www.nap.edu/books/0309074320/html/

H. Mock-up of Report to Decision Makers (Size/Area)





Freshwater Wetlands Indicator 2: % Impervious Surface

Stressor indicators can be a rapid and cost-effective way of predicting wetland condition. Percent (%) impervious surface in watershed (Hydrologic Unit Code- 11): Indicates relative impact of nearby land use. Impervious surfaces are a major anthropogenic stressor to wetlands. When native vegetation is reduced, nutrient loads, sediment, water temperature, and contaminants increase.

A. Description of Existing Data for % Impervious Surface Indicator

There are currently no known monitoring programs/existing data sources specifically for this indicator. The following are recommendations for gathering such information.

- **Why does this indicator need to be monitored**

Impervious surfaces are a major anthropogenic stressor to wetlands.

- **Who will collect the data**

Unknown at this time

- **When will the data be collected (monitoring frequency)**

Each update to the NLCD (MRLC) or NWI maps

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Tier 1 assessment - remote

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc.**

Using GIS MRLC data layer of Impervious surface in MRLC/NLCD (2001) http://www.mrlc.gov/mrlc2k_nlcd.asp, overlaid on HUC units (though catchments units, as defined by the National Hydrography Dataset (NHD),may be more ecologically relevant).

Use NWI map data, where available, as an overlay (wetland acreage) of NLCD % impervious surface layer where available. Use National Hydrography Dataset (NHD) High Resolution 1:24,000 maps to help model location of additional wetlands missed by NWI. (J. McKenna pers comm.. 2007)

When NWI information is not available, the NLCD wetland layer (acreage) can be used, pending a reliability assessment of its wetland map units. A hydric soils layer could also be used in difficult landscapes.

- **Data management/storage**

Unknown at this time

- **Data analysis/assessment**

None offered.

➢ **Quality Assurance**

Unknown at this time.

B. Potential Issues in Applying % Impervious Surface Data Sets for NEAFWA Framework

- Lack of fully digitized wetlands maps.
- Need to use the same wetland classification system across all states.
- Need to use the same automated computer analysis for percent impervious surface across all states.

C. Data Gaps for % Impervious Surface

Comprehensive wetland maps for the northeast are not readily available (but see below "Next steps" for some workable solutions).

D. Next Steps for Data Compilation and Analysis for % Impervious Surface

1. Need to determine impervious surface for each HUC-11 containing wetlands in the Region. See histogram below as an example.

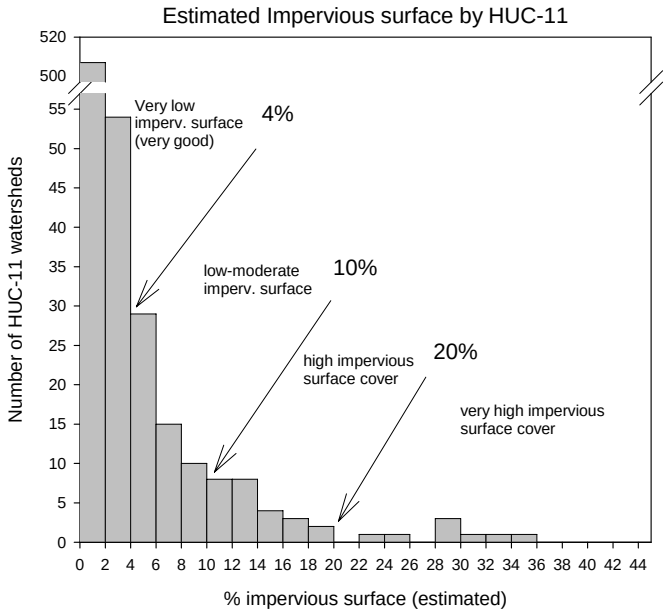


Figure 1. The number of HUC-11 units (New York) in each category of percent impervious surface.

This only provides an estimate of HUC condition, not wetlands. This process could be used in the short term.

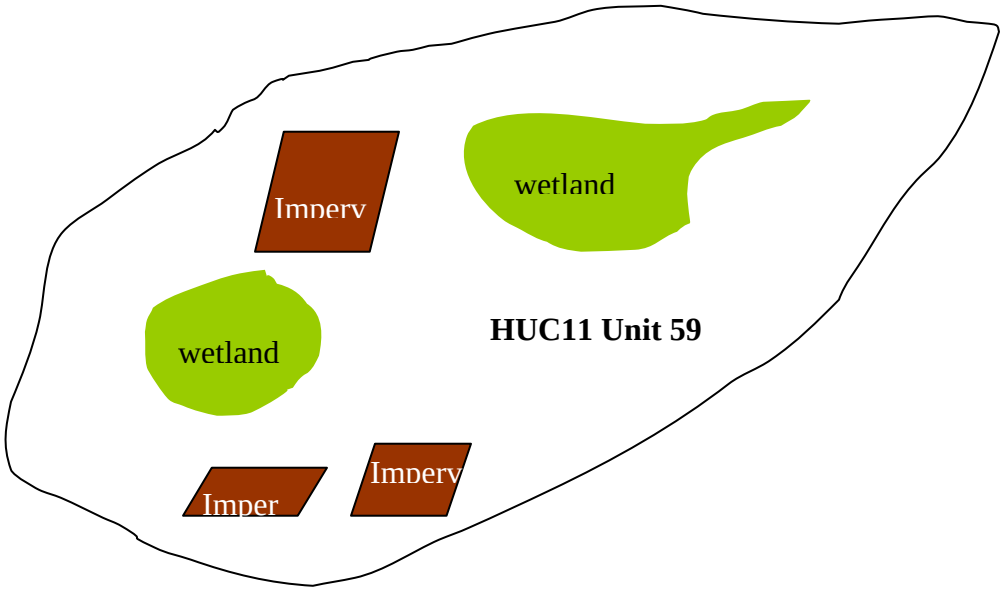
2. Long Term: Determine the acreage of wetlands within each HUC 11 (Wetland acreage)and subtract that from the total HUC acreage to get a Catchment Area acreage. Use Impervious Layer data to determine the % of the HUC that is impervious, then convert the percent to total acres of Impervious Surface Area. To determine the percent of the Catchment Area that is

impervious divide the Catchment Area by Impervious Surface Area. This will provide a range of wetland conditions that can be rated using the same scale for #1. See example below.

3. Future Need:

- Consider using NHD+ datalayer to calculate catchment area, and HUCs as a reporting unit.
- Consider using all non-natural land cover or land use categories (not just impervious surface) within a catchment area. A land-use index could be used. However, impervious surface has the advantage of being a straightforward metric to interpret.

	1	2	3 (1 minus2)	4	5 (1 X 4)	6 (5 / 3)
HUC	HUC area (acres)	Wetland area (acres)	Catchment area (acres)	Impervious Area (%)	Impervious area (acres)	Impervious Area / Catchment Area. (%)
Unit 59	1000	100	900	3	30	30



E. Baseline Condition and/or Past Trends of % Impervious Surface

None offered.

F. Additional Comments on % Impervious Surface

Percent (%) impervious surface in HUC 11 with wetlands: To estimate surface water quality, wetland condition/impact of urbanization, and wetland water level fluctuations (higher

fluctuation, less plant richness; less amphibian species richness; less macroinvertebrate taxa richness):

Excellent: 0-4 %
Good: 5-10 %
Fair: 11-20 %
Poor: >21 %

Percent (%) impervious surface of the Catchment area in HUC 11 with wetlands. Thus this metric is a refinement of the above metric. The rating scale is the same as above.

G. Citations for % Impervious Surface

Bartoldus, C.C. 1999. A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practioners. Environmental Concern, Inc., St. Michaels, MD. 196 pp..Pages 80-83: New England Freshwater Wetlands Invertebrate Biomonitoring Protocol – Assesses the impact of urbanization on permanently flooded freshwater wetlands.

Brabec,E., S. Schulte, and P.L. Richards. 2002. Impervious Surfaces and Water Quality: A Review of Current Literature and Its Implications for Watershed Planning. Journal of Planning Literature.

Gergel, S.E.a, M.G. Turner, J.R. Miller, J.M. Melack, and E.H. Stanley. 2002. Landscape Indicators of human impacts to riverine systems. Aquatic –Sciences. [Print] 2002; 64:118-128

Larson, J.S., B. Nevel, A.L. Whitlock, T.H. Stevens, A.L. Hicks, and N.M. Jarman. 1998. A Two-Tiered Approach to Regional Freshwater Wetland Assessment in New England. Publication No. 98-1, The Environmental Institute, University of Massachusetts, Amherst., page 49.

Massachusetts Coastal Zone Management Rapid Habitat Assessment Method

Washington State Wetland Rating System, Western Version

H. Mock-up of Report to Decision Makers (Impervious Surface)

None offered.

Freshwater Wetlands Indicator 3: Buffer Area and Condition (Buffer Index)

Buffer can be characterized by their extent (length), width (depth), and condition. The ability of buffers to protect a wetland increases with the extent of buffers along the wetland perimeter. A wider buffer has a greater capacity to serve as habitat for wetland edge dependent species, to reduce the inputs of non-point source contaminants, to control erosion, and to generally protect the wetland from human activities. The condition or composition of the buffer, in addition to its width and extent around a wetland, determines the overall capacity of the buffer to perform its critical functions.

A. Description of Existing Data for Buffer Area/Condition Indicator

No program is currently monitoring this indicator comprehensively. Some of the following sections provide recommendations for gathering such information.

B. Potential Issues in Applying Buffer Area/Condition Data Sets for NEAFWA Framework

Lack of digitized maps of wetlands. Need to use the same automated computer analysis of buffer across all states.

C. Data Gaps for Buffer Area/Condition

A summary of the data that are needed to collect this indicator is described below (from Faber-Langendoen 2007, based on information from Collins et al. (2006)).

Buffer Index

Definition: A measure of the overall area and condition of the buffer immediately surrounding the wetland, using 2 measures: Percent of Wetland with Buffer and Average Buffer Width. Wetland buffers are vegetated, natural (non-anthropogenic) areas that surround a wetland.

Background: Metric is adapted from Collins et al. (2006) for use in remote sensing

Metric Type: Condition

Tier: 1 (remote sensing based measure)

Rationale for Selection of the Variable: Semlitsch (1998) monitored terrestrial migrations for six Ambystomid salamander species and concluded buffer areas 164 m from wetland edges were needed to encompass 95% of population forays.

Measurement Protocol: Metric is taken from Collins et al. (2006). An equation is provided to integrate the two measures into an overall index. First, points are assigned to each rating, from A = 4 to D = 1 for Percent of Wetland with Buffer, and A = 4, B = 3, C = 2, D= 1, E=0 for Buffer Width. The points are summed, then divided by 8. Final rating is A = 7-8, B = 5-6, C = 3-4 and

D <3. The table below provides additional guidance on buffer definitions (from Table 4.3, Collins et al. 2006).

Metric Rating: Specify the narrative and numerical ratings for a metric, from Excellent to Poor.

	A	B	C	D	E
Percent of wetland with Buffer	Buffer is > 75 – 100% of wetland perimeter.	Buffer is > 50 – 74% of wetland perimeter.	Buffer is 25 – 49% of wetland perimeter.	Buffer is < 25% of wetland perimeter.	
Average Buffer Width	Average buffer width of wetland is > 200 m.	Average buffer width of wetland is 100 – 200 m.	Average buffer width of wetland is 50 – 100 m.	Average buffer width of wetland is 10- 50 m.	Average buffer width of wetland is <10 m

Data:

Scaling Rationale: See Collins et al. (2006) for Percent of Wetland with Buffer, and Average Buffer width. Average Buffer width is slightly modified to have a longer scale, since even buffers of 3 m have been shown to have some value in preventing sedimentation into wetlands.

Confidence that reasonable logic and/or data support the index: Medium/High

D. Next Steps for Data Compilation and Analysis for Buffer Area/Condition

Follow guidelines for the metric in Collins et al. (2006), but adapted for use in remote sensing analysis.

E. Baseline Condition and/or Past Trends of Buffer Area/Condition

Information not available.

F. Additional Comments for Buffer Area/Condition

None offered.

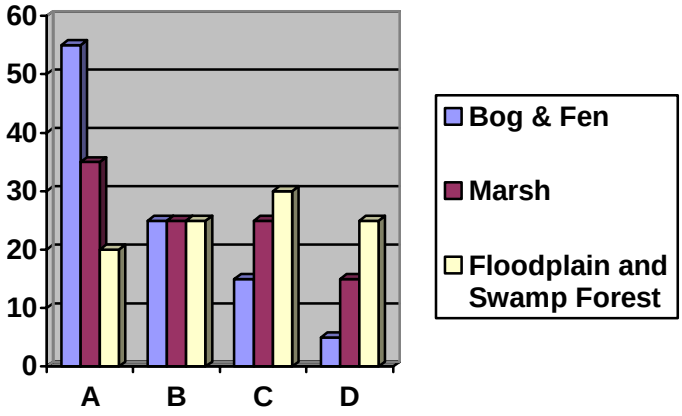
G. Citations for Buffer Area/Condition

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, A.E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2006. California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas. Version 4.2.3. 136 pp.

Faber-Langendoen, D. 2007. A Freshwater Wetlands Assessment and Scorecard for the Northeast Temperate Network, National Park Service. NatureServe, Arlington, VA.

H. Mock-up of Report to Decision Makers (Buffer Area/Condition)

Mockup should include a graph showing a histogram of the percentage of wetland polygons with the various buffer ratings (A- D) by wetland subtargets. Data below are hypothetical and used for illustration only.


60
50
40
30
20
10
0
A
B
C
D
Bog & Fen
Marsh
Floodplain and Swamp Forest

Freshwater Wetlands Indicator 4: Hydrology

Indicator A. Upstream Surface Water Retention (primary metric)

A measure of the percentage of the contributing watershed (e.g., HUC 11) which drains into water storage facilities (e.g., reservoirs, sediment basins, retention ponds, etc.), which are capable of storing surface water from several days to months. Ecological processes of riparian areas are driven to a large degree by the magnitude and frequency of peak flows and the duration and volume of base flows. The biotic and physical integrity of riparian areas are dependent on the natural variation associated with these flow characteristics. The amount of water retained in upstream facilities has a direct effect on these flows and subsequent effects on the continued biotic and physical integrity of the riparian area. For example, retention of surface water can decrease or eliminate episodic, high intensity flooding, decrease seasonal high flows (e.g., spring snowmelt) and increase base flows during seasonal dry periods causing a shift in channel morphology and altering the dispersal capabilities, germination, and survival of many plant species dependent on those flows.

Indicator B. Hydrology – High and Low Stream Flow (secondary metric)

Flow is a critical aspect of the physical structure of stream ecosystems, and the associated floodplain wetlands. High flows shape the stream channel and clear silt and debris from the stream, and some fish species depend on high flows for spawning. Low flows define the smallest area available to stream biota during the year. In some cases, the lowest flow is no flow at all—particularly in arid and semi-arid regions where intermittent streams are common. Riparian vegetation and aquatic life in intermittent streams have evolved to complete their life histories during periods when water is available; however, extended periods of no flow can still impact their survival. The timing of high and low flows also influences many ecological processes. Changes in flow can be caused by dams, water withdrawals, ground water pumping (which can alter base flow), changes in land cover (e.g., deforestation or urbanization), and weather and climate. Note: the streams and river group will probably address this indicator.

A. Description of Existing Data for Hydrology Indicator

- **Why is this indicator being monitored by this program**

Indicator A. No existing sources.

Indicator B. The USGS mission is to provide water information that benefits the Nation's citizens: Publications, data, maps, and applications software. USGS Water-Resources offices are located in every State.

- **Who is collecting the data**

Indicator A. No one.

Indicator B. This indicator is collected by USGS, on stream gauging sites.

- **When is the data being collected (monitoring frequency)**

Indicator A. No regular monitoring.

Indicator B. This indicator reports the percentage of streams or rivers that experienced major changes in the magnitude or the timing of average annual 1-day high flows or 7-day low

flows in the 1970s, 1980s, or 1990s, compared to a 20-year baseline period between 1930 and 1949.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Indicator A. Available throughout the region, provided data layers can be readily compiled to assess water diversions. A GIS layer of surface water retention facilities is needed to calculate this metric. For example, for Colorado wetlands, see the Colorado Division of Water Resource's Decision Support Systems website: http://cdss.state.co.us/

Indicator B. This indicator reports on 867 streams or rivers with USGS stream gauges, which are found throughout the contiguous 48 states. The basis for the "867" should be explained.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Indicator A. This metric is measured as the percent of the contributing watershed to the riparian area that occurs upstream of a surface water retention facility. First the total area of the contributing watershed needs to be determined. Next, the area of the contributing watershed which is upstream of the surface water retention facility furthest downstream is calculated for each stream reach (e.g., main channel and/or tributaries) then summed, divided by the total area of the contributing watershed, then multiplied by 100 to arrive at the metric value. For example, if a dam occurs on the main channel, then the entire watershed upstream of that dam is calculated. whereas if only small dams occur on tributaries then the contributing watershed upstream of each dam on each of the tributaries would be calculated then summed (Poff et al. 1997, Patten 1998, Raff et al. 2001, Gregory et al. 1991).

These calculations can be conducted using GIS themes of surface water retention facilities, USGS 7.5 minute topographic maps, and/or Digital Elevation Models. The contributing watershed can be calculated or digitized using Digital Elevation Models in a GIS. The percentage of the contributing watershed upstream of surface water retention facilities is simply "cut" from the original contributing watershed layer and its area is then calculated then compared to the total area.

Indicator B. This indicator is based on 867 USGS stream gauging sites with 20 years of continuous discharge records during the baseline period and continuous records for the three decades between 1970 and 1999. Although the sites analyzed here are spread widely throughout the U.S., gauge placement by the USGS is not a random process. Gauges are generally placed on larger, perennial streams and rivers, and changes seen in these larger systems may differ from those seen in smaller streams and rivers.

- **Data management/storage**

Indicator A. Unknown.
Indicator B. Data are managed by USGS. See http://waterdata.usgs.gov/nwis

- **Data analysis/assessment**

Indicator A. Unknown.

Indicator B. The data presented in this indicator have been published in Heinz Center (2005). The Heinz Center's analysis was conducted by David Raff and N. LeRoy Poff, Colorado State University (Raff and Poff, 2001; Raff et al., 2001; Raff, 2001), using stream flow data from the USGS National Water Information System database (USGS, 2005) (http://waterdata.usgs.gov/nwis). All data, including the 1930-1949 reference data, can be downloaded from this database. Ecoregions are based on Bailey (1995).

- **Quality Assurance**

Indicator A. Unknown.

Indicator B. Periodic manual field measurements of streamflow and gage height are conducted. These measurements are often used to supplement and (or) verify the accuracy of the time-series measurements. See http://waterdata.usgs.gov/nwis

B. Potential Issues in Applying Hydrology Data Sets for NEAFWA Framework

Indicator A. Variability across the states in terms of comprehensive water diversion information.

Indicator B. The following limitations should be noted:

- The "magnitude and timing" component of this indicator compares stream flows in the decades from 1970 to 1999 with a baseline period, 1930-1949. Many dams and other waterworks had already been constructed by 1930, and this baseline period was characterized by low rainfall in some parts of the country. However, a similar analysis based on data from 506 watersheds (USDA Forest Service, 2004) showed a tendency toward higher high- and low-flow rates in the decades of the 1940s, 1950s, and 1960s compared to the earlier period 1879-1929.
- Although the sites analyzed here are spread widely throughout the U.S., gauge placement by the USGS is not a random process. Gauges are generally placed on larger, perennial streams and rivers, and changes seen in these larger systems may differ from those seen in smaller streams and rivers.

C. Data Gaps for Hydrology

Indicator A. Lack of information on water diversion information across the regions.

Indicator B. In order to provide a comprehensive view of all watershed alterations, not just the USGS streams and rivers with gauges, it may be helpful to look at an alternative metric based on "Upstream Surface Water Diversions (Faber-Langendoen 2007). This is a measure of the percentage of the contributing watershed which drains into water storage facilities (e.g., reservoirs, sediment basins, retention ponds, etc.) that are capable of storing surface water from several days to months. A full description of the metric is provided below (from Faber-Langendoen 2007):

D. Next Steps for Data Compilation and Analysis for Hydrology

Indicator A. A GIS layer of surface water retention facilities is needed to calculate this metric. Application of this metric would require a comprehensive set of water diversions across all watersheds of the northeastern states. E.g., for Colorado wetlands, see the Colorado Division of Water Resource's Decision Support Systems website: http://cdss.state.co.us/

The "Impervious Surface metric" calculated by watershed could also serve as a proxy for assessment of both floodplain and swamp forest hydrology. Mapped locations of floodplains and swamp forests would be needed. The amount of impervious surface within the HUC11 watershed that the wetlands were found in would serve as a proxy for altered hydrology.

Indicator B. USGS should be contacted to determine how to compile the data for the northeastern states. The data presented in this indicator have been published in Heinz Center (2005). The Heinz Center's analysis was conducted by David Raff and N. LeRoy Poff, Colorado State University (Raff and Poff, 2001; Raff et al., 2001; Raff, 2001), using stream flow data from the USGS National Water Information System database (USGS, 2005) (http://waterdata.usgs.gov/nwis). All data, including the 1930-1949 reference data, can be downloaded from this database. Ecoregions are based on Bailey (1995).

Future use: consider comparing frequency/duration of flooding to what it naturally should be (on the ground work); TNC's floodplain conversion maps/modeling.

E. Baseline Condition and/or Past Trends of Hydrology

Indicator A. Baseline condition would be the Excellent rating shown in the summary table for Freshwater Wetlands indicators at the beginning of this document. Trend data not yet available.

Indicator B. The following summary is an example from the lower 48 states. It could be redone for the Northeast states.

More than half of the streams and rivers showed changes of 75 percent or more in their high or low flows or a shift of 60 days or more in the timing of their high or low flows, compared to the period 1930-1949 (Exhibit 3-1, see Mock-Up below). This percentage increased from 55 percent in the 1970s to 61 percent in the 1990s. About one-third of the streams showed moderate changes in flow (25-75 percent) or timing (30-60 days). Only 10 percent of the streams and rivers had minimal alterations of flow of less than 25 percent or timing of fewer than 30 days, compared to the historical baseline period.

Additional detail about the nature of "major changes" in stream flow between the historical reference period (1930-1949) and the 1970s-1990s period of record include:

- Approximately two-thirds of streams had major changes in the volume of low flow, with about one-third of streams showing substantially larger low flows throughout the period of record and another one-third showing substantially smaller low flows.
- In terms of high flow volume, more streams showed major decreases than major increases. In the 1970s and 1980s, only 12 percent of streams had substantially larger high-flow volumes than they had from 1930 to 1949, although this figure jumped to 31 percent in the 1990s. In contrast, throughout the 1970s, 1980s, and 1990s, nearly 40 percent of streams exhibited smaller high flows than they had during the reference period.

F. Additional Comments on Hydrology

Data from federal agencies and other region wide groups for these indicators should be used for this Indicator. This would provide consistent representation of conditions across the region and data are fairly accessible. We should invite a representative from each of these groups to take part in this reporting for the Northeast region.

Another option would be to compile data available from the states and other groups for each indicator, compile the information, understand the inconsistencies, build a database etc. This is a large task, however the information could prove very useful.

G. Citations for Hydrology

Much of the information for this indicator was compiled from recent draft U.S. EPA reports, including:

U.S. EPA 2003. Draft Report on the Environment. Washington, DC:U.S. Environmental Protection Agency. Available: ***http://www.epa.gov/indicators/roe/*** [accessed 13 July 2004].

Other References:

Bailey, R.G. 1995. Description of the ecoregions of the United States. Second ed. Misc. Publ. No. 1391 (rev). Washington, DC: USDA Forest Service. http://www.fs.fed.us/land/ecosysmgmt/ecoreg1_home.html

Calow, P., and G.E. Petts, eds. 1992. The rivers handbook: hydrological and ecological principles. Volume 1. Oxford, United Kingdom: Blackwell Scientific.

Faber-Langendoen, D. 2007. A Freshwater Wetlands Assessment and Scorecard for the Northeast Temperate Network, National Park Service. NatureServe, Arlington, VA.

Fisher, S.G. 1995. Stream ecosystems of the western United States. In: Cushing, C.E., K.W. Cummings, and G.W. Minshall, eds. River and stream ecosystems, ecosystems of the world 22. New York, NY: Elsevier Press.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones. BioScience 41(8): 540-551.

The H. John Heinz III Center for Science, Economics, and the Environment. 2005. The state of the nation's ecosystems: measuring the lands, waters, and living resources of the United States. New York, NY: Cambridge University Press, September 2002. Web update 2005: http://www.heinzctr.org/ecosystems/report.html

Patten, D.T. Riparian Ecosystems of Semi-Arid North America: Diversity and Human Impacts. Wetlands 18(4): 498-512

Raff, D., S. Howard, and N. Poff. 2001. Report on hydrologic alteration of rivers and streams in predominantly grassland and shrubland ecosystems in support of the State of the Nation's Ecosystems project for The H. John Heinz III Center. Colorado State University.

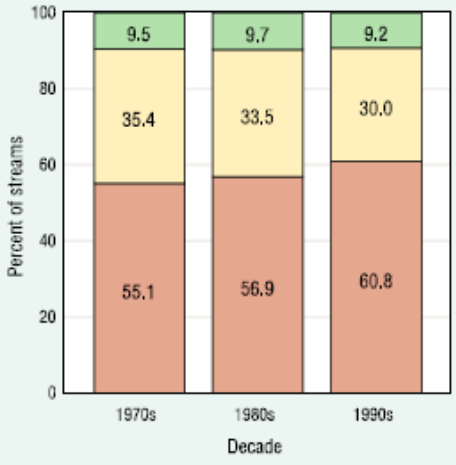
Robinson, C.T., K. Tockner, and J.V. Ward. 2002. The fauna of dynamic riverine landscapes. Freshwater Biol. 47:661-677.

Smith, R.D. 2000. Assessment of Riparian Ecosystem Integrity in the San Diego Creek Watershed, Orange County, California. Unpublished report prepared for the U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA. Engineering Research and Development Center, Waterways Experiment Station, Vicksburg, MS.

USDA Forest Service

H. Mock-up of Report to Decision Makers (Hydrology)

Exhibit 3-1. Alteration of high and low flow in rivers and streams in the contiguous U.S., 1970s-1990s, compared with 1930-1949 baseline[a]



[a] **Coverage:** 867 stream gauging sites in the contiguous U.S. with continuous discharge measurements from 1930 to 1949 and from 1970 to 1999.

Degree of alteration:
- Minimal[b]
- Moderate[c]
- Major[d]

[b] **Minimal:** Less than 25% increase or decrease in flow, or less than a 30-day change in timing of low or high flow.

[c] **Moderate:** Between 25% and 75% increase or decrease in flow, or a 30- to 60-day change in timing of low or high flow.

[d] **Major:** More than 75% increase or decrease in flow, or more than a 60-day change in timing of low or high flow.

Data source: *Heinz Center, 2005. Data collected by USGS, with analysis by Raff and Poff, 2001.*

Freshwater Wetlands Indicator 5: Wetland Bird Population Trends

Birds stand out among other wildlife taxa as excellent indicators of wetland condition. They occur in all wetland types and respond quickly to environmental change. Their mobility allows them to leave locations that do not meet their basic requirements and colonize areas where suitable habitat arises. Many bird species are sensitive to hidden factors, as well, such as chemical toxins, climate change, or various forms of avian disease. Most birds can be easily detected, either through passive methods or the use of audio recordings to evoke detectable responses. Recent advances in field ornithology and biometrics have produced effective techniques for collecting and analyzing bird population data. Finally, birds have a popular appeal that can be used to engage volunteers in data collection at spatial and temporal scales that would otherwise be impossible.

Because birds are biologically meaningful and practical indicators, they have been the subject of countless studies in the Northeast. The North American Breeding Bird Survey (BBS) presents the opportunity to describe changes in wetland bird populations since 1966. However, BBS data are limited to roadside habitat, are subject to multiple sources of bias and error, and do not include environmental or management covariates. The BBS is not considered adequate for monitoring waterfowl or secretive marsh birds. Efforts to strengthen BBS are deserving of support, as are rigorously designed monitoring programs that: a) target breeding waterfowl (e.g., the Atlantic Flyway Breeding Waterfowl Survey), secretive marsh birds, and off-road habitat; b) address causes of population change; c) measure effectiveness of conservation action; and/or d) produce quantitative tools to guide stewardship.

A. Description of Existing Data for Wetland Bird Population Trends Indicator

There are scores of wetland bird monitoring programs in the Northeast region, operating at local to international scales with varying levels of scientific rigor and coordination. Although its design features several limitations, the North American Breeding Bird Survey is the most credible source of information on regional trends for wetland songbirds, with records dating back to 1966. The Atlantic Flyway Breeding Waterfowl Survey (BWS) has been active in an area stretching from Virginia to New Hampshire since 1989. It targets American Black Duck, Mallard, Wood Duck, and Canada Goose.

We report BBS wetland bird results in this template because of the program's extraordinary duration, geographic scope, and availability of online trend results. BWS data could be downloaded and analyzed to provide trend information for wetland-breeding, northeastern waterfowl.

- **Why is this indicator being monitored by this program**

The mission of the BBS is to provide "measures of the status and trends of North American bird populations at continental and regional scales to inform biologically sound conservation and management actions." Primary functions of the BBS are to: measure avian population change to

help identify species' priorities for conservation; provide avian count data for model-based conservation planning; and provide avian count data for estimating species' population sizes.

The purpose of the BWS is to collect breeding population abundance data that would support effective management of eastern waterfowl breeding populations.

- **Who is collecting the data**

In the United States, the BBS is administered by the US Geological Survey from offices at the Patuxent Wildlife Research Center, in Laurel, MD. The BBS staff is assisted by state coordinators affiliated with various governmental and non-governmental institutions. The data are collected by volunteer observers who are skilled in avian identification.

The BWS is administered by US Fish and Wildlife Service in partnership with state wildlife agencies.

- **When is the data being collected (monitoring frequency)**

BBS and BWS data are collected once each year during, the height of the avian breeding season.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

BBS data are collected on hundreds of roadside survey routes throughout the Northeast region. Gaps in observer effort currently exist in Rhode Island, northern Maine, and New York.

BWS sampling is carried out at designated waters and wetlands in 11 states, from Virginia to New Hampshire.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

BBS routes were established on secondary roadways that were identified randomly within certain geographic strata. The starting point and direction of each route were also randomly determined. Each survey route is 24.5 miles long with stops at 0.5-mile intervals. At each stop, a 3-minute point count is conducted. During the count, every bird seen within a 0.25-mile radius or heard is recorded. Surveys start one-half hour before local sunrise and take about 5 hours to complete.

During the BWS, approximately 1,500 1-km2 plots are surveyed each spring by biologists from participating states. The survey plots are randomly allocated among nearly 20 physiographic strata. Prior to 1993 certain plots were checked annually, while others were reselected each year. In 1993, all plot locations were fixed and plots were surveyed every year. In addition to recording waterfowl observations on each plot, the time of day (twilight or daylight) that each plot is surveyed is recorded. Analyses of survey data indicate that the time of day that a plot is surveyed can significantly affect detection probability. Since 1993, survey participants have been instructed to survey plots consistently during the twilight or daylight periods from year to year. Sample plots are surveyed in most cases from the ground by either automobile, boat, or on foot.

- **Data management/storage**

BBS data are centrally located and available for download, visualization, and analysis at http://www.mbr-pwrc.usgs.gov/bbs/.

BWS count data and population estimates are centrally located and available for download by individual species, state, and year at http://mbdcapps.fws.gov/mbdc/databases/afbws/afpoptions.asp.

- **Data analysis/assessment**

BBS data, which reside in the public domain, have been published in hundreds of scientific articles. Analyses have focused on: identifying priorities for conservation, management, and additional research: assessing response of bird populations to collective conservation and management activities; providing context for local abundance and trend estimates; describing basic patterns of distribution, abundance, and species richness.

BWS data are used to establish harvest regulations and monitor waterfowl levels as they relate to population targets.

- **Quality Assurance**

Quality assurance is a challenge for the BBS because of its continental scope, limited resources, and reliance on volunteers with varying skill and acuity. It is not feasible to train and evaluate thousands of observers monitoring hundreds of species, each with regional dialects. Statisticians have developed models to address observer bias. Even still, there is considerable debate about the value of auditory point count surveys, like the BBS, that do not quantify detection rates and therefore can not be used to estimate abundance.

The limited number of target species and the use of professional observers increases the reliability of information gathered during the BWS. Correction factors have been suggested for population estimates derived from this survey. These include a time-of-day correction, especially useful in wood duck and mallard estimates. A correction for aggregations at feeding sites is applicable for mallard estimates. Estimates presented online are uncorrected for time-of-day and feeding-site effects. Although estimates provided are useful in examining population trends or relative changes in populations, they should not be considered absolute measures of abundance, especially for mallards and wood ducks.

B. Potential Issues in Applying Wetland Bird Population Trends Data Sets for NEAFWA Framework

Because BBS routes are situated along roadways, they do not sample wetland habitats in a representative manner. Therefore, results should be interpreted cautiously.

Compilation and analysis of BBS data is relatively simple, thanks to the online summary and analysis tools at http://www.mbr-pwrc.usgs.gov/bbs/. The main challenge is to identify species that occur through all or most of the region, are wetland obligates, and are encountered frequently enough on BBS routes to provide reliable trend estimates for the sample area.

Indicator groupings are not useful in this case, as most wetland species exhibit considerable habitat breadth.

There are no automated analytical tools for the BWS. Preparation of these data for presentation could be expensive.

C. Data Gaps for Wetland Bird Population Trends

Data are needed: to describe the distribution and abundance of secretive marsh birds and wetland birds with populations concentrated away from roads; to measure changes in distribution and abundance; and to identify underlying factors. The most significant need is for a regionally coordinated monitoring program for freshwater and tidal marsh birds. These habitats significantly enrich the region's avifauna, however they are under-represented on BBS routes.

The Marsh Bird Working Group of the Northeast Coordinated Bird Monitoring Partnership has made significant progress toward the design of regionally coordinated freshwater and tidal marsh bird monitoring.

D. Next Steps for Data Compilation and Analysis for Wetland Bird Population Trends

The current system of BBS data compilation and analysis is adequate to meet the current needs of the Northeast Monitoring and Performance Reporting Framework. However, future reports should gradually shift the emphasis to results from the emerging Northeast marsh bird monitoring program. The cost of administering the Northeast marsh bird monitoring program has not been estimated.

The cost of presenting regional BBS or BWS trendlines would be significantly higher since these must be generated manually.

E. Baseline Condition and/or Past Trends of Wetland Bird Population Trends

These seven birds were selected because they: a) are native birds; b) breed primarily or exclusively in wetland habitat, c) occur in at least half of the states in FWS Region 5, d) are readily detected in suitable habitat by the BBS point count, and e) were not among those species whose trend results were identified as having an "important deficiency" by BBS.

Great Blue Heron
Habitat: Rivers, lake edges, marshes, saltwater seacoasts, and swamps; primarily inland

Marsh Wren
Habitat: Freshwater and saltwater marshes, roadside ditches, and small agricultural runoff sites

Prothonotary Warbler
Habitat: In woods near water: slow running river or creek, large wooded lake, flooded bottomland forests, or low spot in forest that maintains temporary standing water.

Northern Waterthrush

Habitat: cool, dark, wooded swamps, thickets of bogs, margins of northern lakes, and willow and alder bordered rivers

Louisiana Waterthrush
wet woodlands near running water

Red-winged Blackbird
Habitat: Primarily fresh and saltwater marshes, but also open fields (often in agricultural areas)

Swamp Sparrow
Breeds in: freshwater marshes, bogs, and margins of streams and ponds; also in salt marshes

North American Breeding Bird Survey Trend Results for FWS Region 5

		---------1966-2006 trends--------			--1966-1979---			--1980-2006---		
Species	Trend	P	N	(95% CI)	R.A.	Trend	P	N	Trend	P	N
Great Blue Heron	2.6	0.00	426	1.5 3.7	0.64	6.6	0.01	157	1.2	0.10	410
Marsh Wren	-5.5	0.00	51	-8.8 -2.2	0.22	-7.5	0.11	30	-5.0	0.00	36
Prothonotary Warbler	1.1	0.42	53	-1.5 3.7	0.35	-9.1	0.01	29	1.2	0.18	45
Northern Waterthrush	-1.4	0.21	198	-3.5 0.8	0.53	-2.4	0.33	99	-1.1	0.24	164
Louisiana Waterthrush	-0.2	0.73	287	-1.2 0.8	0.45	0.0	0.99	122	-0.6	0.38	260
Red-winged Blackbird	-2.1	0.00	625	-2.5 -1.8	46.48	-2.0	0.00	483	-1.2	0.00	588
Swamp Sparrow	1.4	0.01	295	0.4 2.3	0.88	-2.0	0.13	181	1.6	0.01	258

Trends in blue = positive and significant
Trends in red = negative and significant
Trends in black = no significant change detected

Trend: this refers to the average annual change in the abundance index for the designated time period, derived from a linear route-regression approach based on estimating equations. It is the precision-weighted mean trend (called a prior mean).

Any negative trend could put a population at risk if the population is small enough and the time period is long enough. Whether this is good, bad, or neutral depends on one's conservation objectives, which often hang on rarity. No one is too excited about 2% annual declines in Red-winged Blackbird since it is a common and widespread species. Because Marsh Wrens are uncommon in the Northeast, annual declines of 5-7% are more troubling. Is it good that Great Blue Herons are increasing? Not if you're a trout farmer.

P: P value or the probability, if the test statistic really were distributed as it would be under the null hypothesis (no change in population), of observing a test statistic as extreme as, or more extreme than the one actually observed.

N: Number of survey routes factored into the trend analysis

R.A.: Regional abundance, which is the average number of individuals per route. Yellow reliability codes assigned to all but Red-winged Blackbirds, largely because it's difficult to fit a trend line with decent precision when your data set is full of 0's and 1's.

Regional credibility measures

Although the BBS provides a huge amount of information about regional population change for many species, there are a variety of possible problems with estimates of population change from BBS data. Small sample sizes, low relative abundances on survey routes, imprecise trends, and missing data all can compromise BBS results. Often, users do not take these problems into account when viewing BBS results, and use the results inappropriately.

To provide some guidance to interpretation of BBS data, we have implemented a series of checks for some attributes that we view as cause for caution in interpretation of BBS results. We categorize BBS data in 3 credibility categories:

This category reflects data with an important deficiency. In particular:

- 1. The regional abundance is less than 0.1 birds/route (very low abundance),
- 2. The sample is based on less than 5 routes for the long term, or is based on less than 3 routes for either subinterval (very small samples), or
- 3. The results are so imprecise that a 5%/year change would not be detected over the long-term (very imprecise).

None of these species received this low regional credibility measure.

This category reflects data with a deficiency. In particular:

- 1. The regional abundance is less than 1.0 birds/route (low abundance),
- 2. The sample is based on less than 14 routes for the long term (small sample size),
- 3. The results are so imprecise that a 3%/year change would not be detected over the long-term (quite imprecise), or
- 4. The sub-interval trends are significantly different from each other (P less than 0.05, based on a z-test). This suggests inconsistency in trend over time).

This category reflects data with at least 14 samples in the long term, of moderate precision, and of moderate abundance on routes.

Note:

- 1. Even data falling in the category may not provide valid results. There are many factors that can influence the validity and use of the information, and any analysis of BBS data should carefully consider the possible problems with the data.
- 2. We are occasionally asked to identify which deficiency is causing the flag. However, the point of the codes is to provide a quick and simple set of cautions to users, and we are resisting the notion of setting up a complicated series of codes. To determine why the code exists, look at the results. All of these deficiencies (abundances, precisions, etc) will be evident from the results we present.

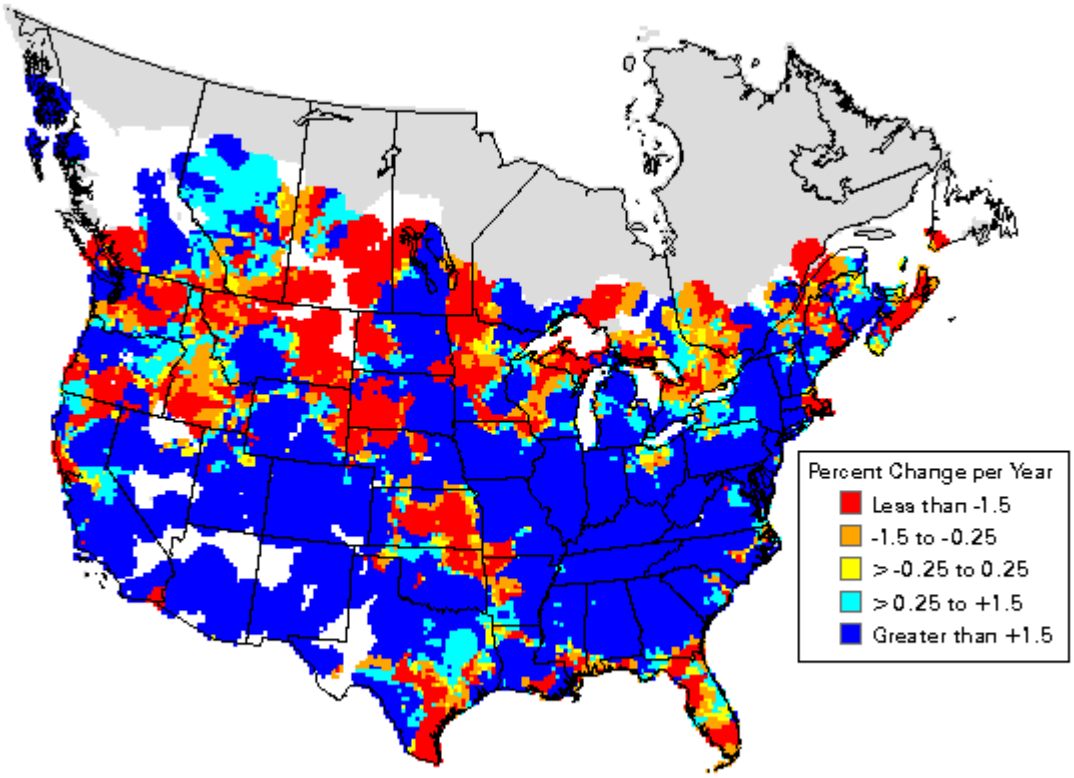
Ranking of condition (*ad hoc*)

Excellent	Trend > 1.5%
Good	Trend 0 to 1.5%
Fair	Trend –1.5% to -0.1%

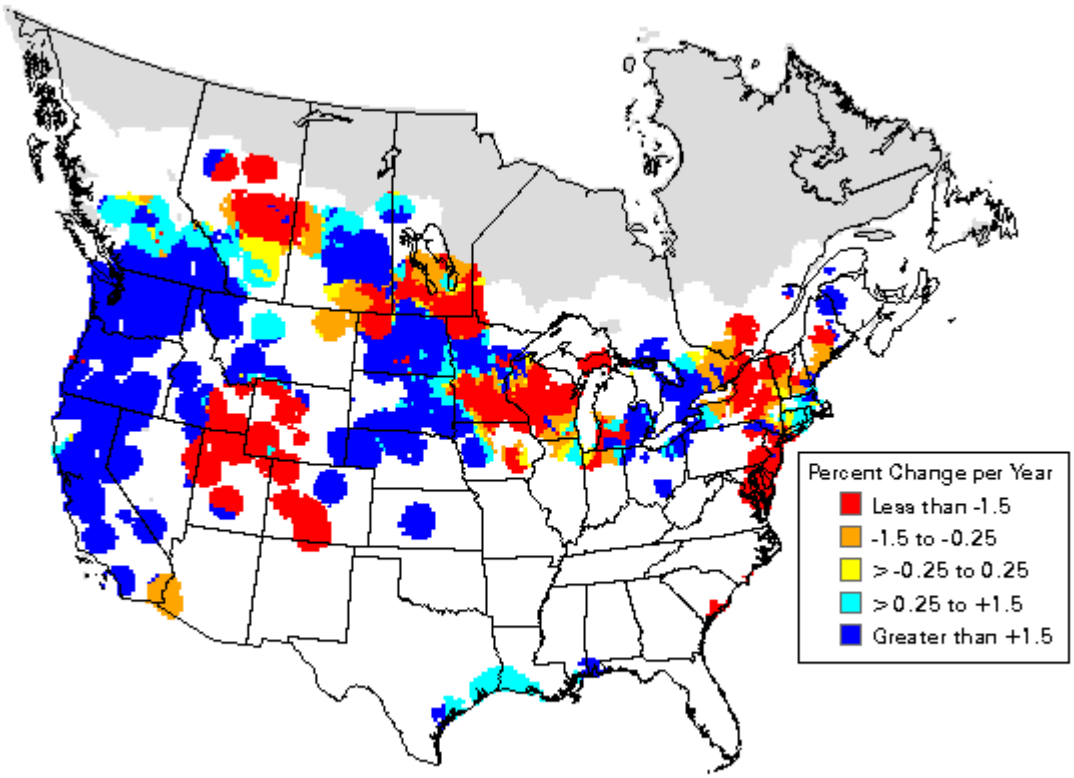
Poor Trend < -1.5%

Great Blue Heron *Ardea herodias*

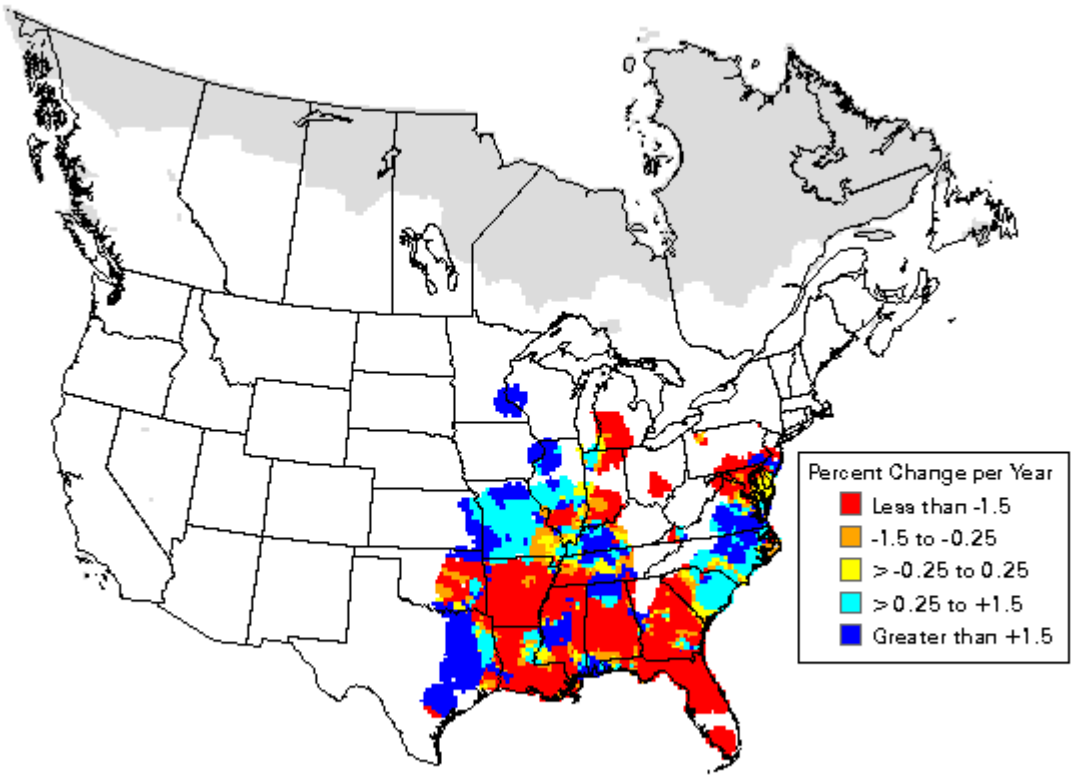
BBS Trend Map, 1966 - 2003



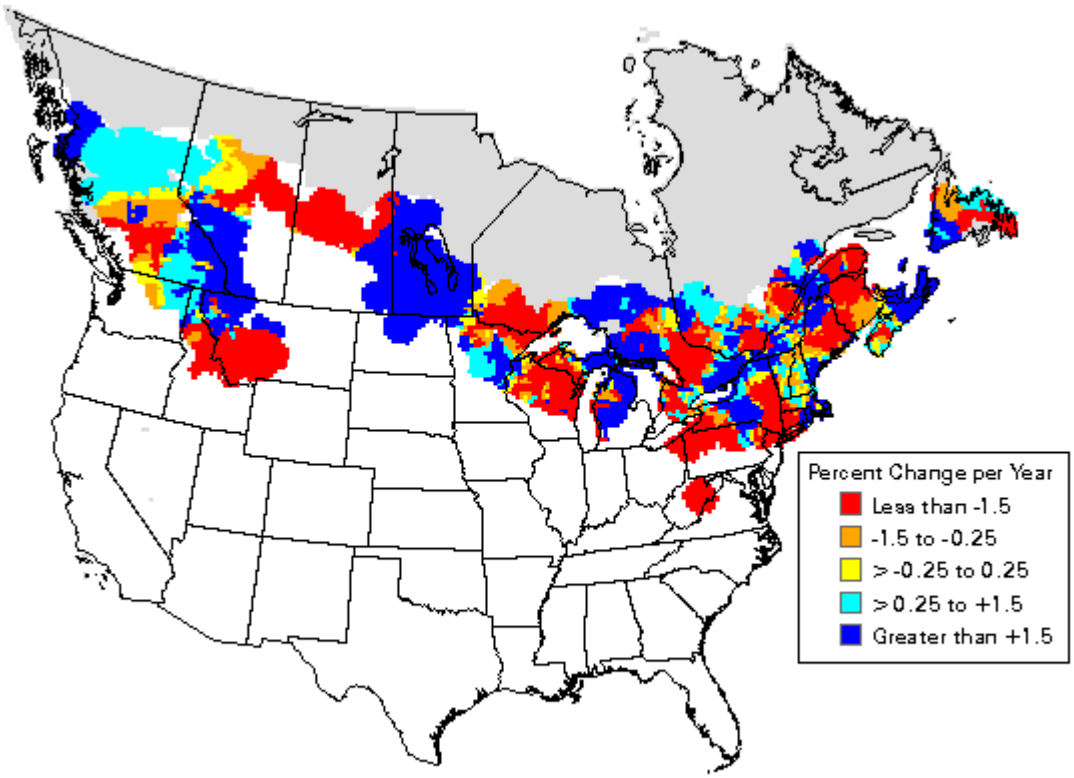
Marsh Wren *Cistothorus palustris*
BBS Trend Map, 1966 - 2003



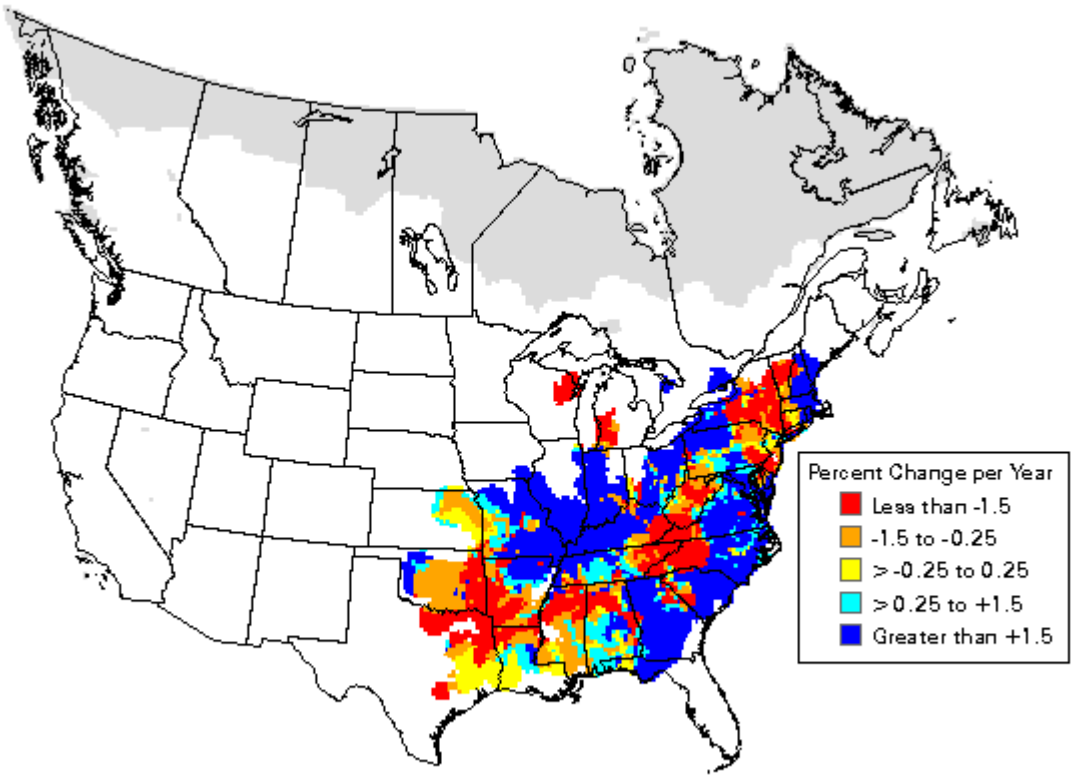
Prothonotary Warbler *Protonotaria citrea*
BBS Trend Map, 1966 - 2003



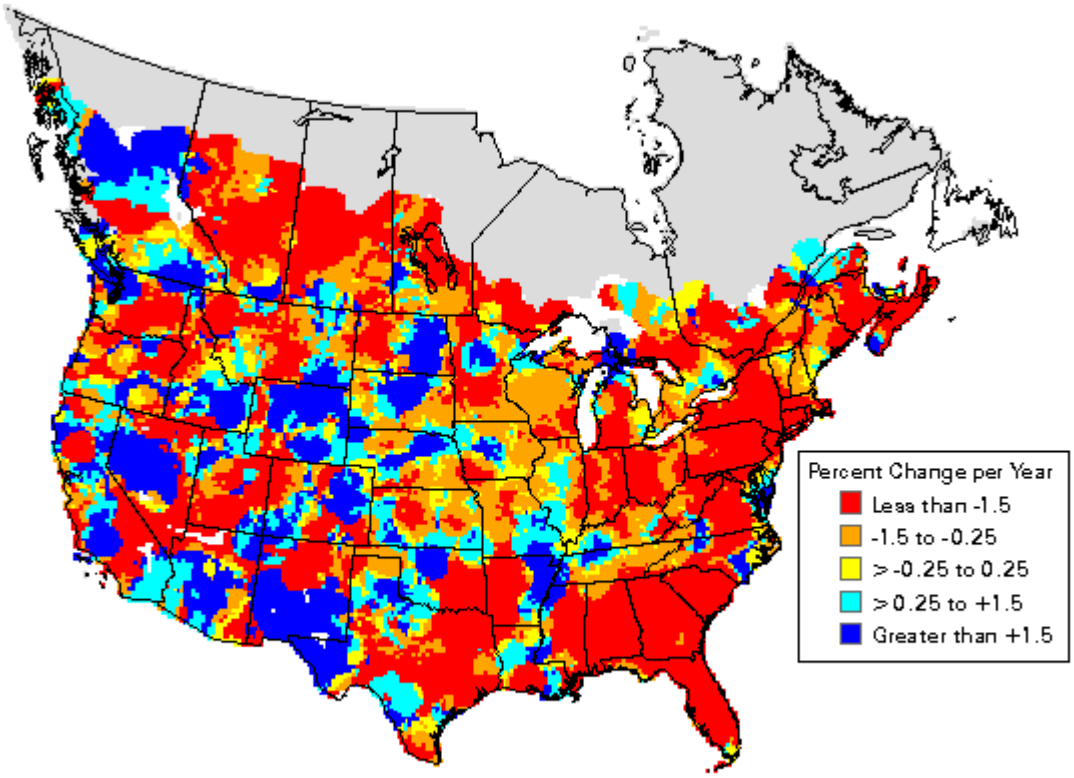
Northern Waterthrush *Seiurus noveboracensis*
BBS Trend Map, 1966 - 2003



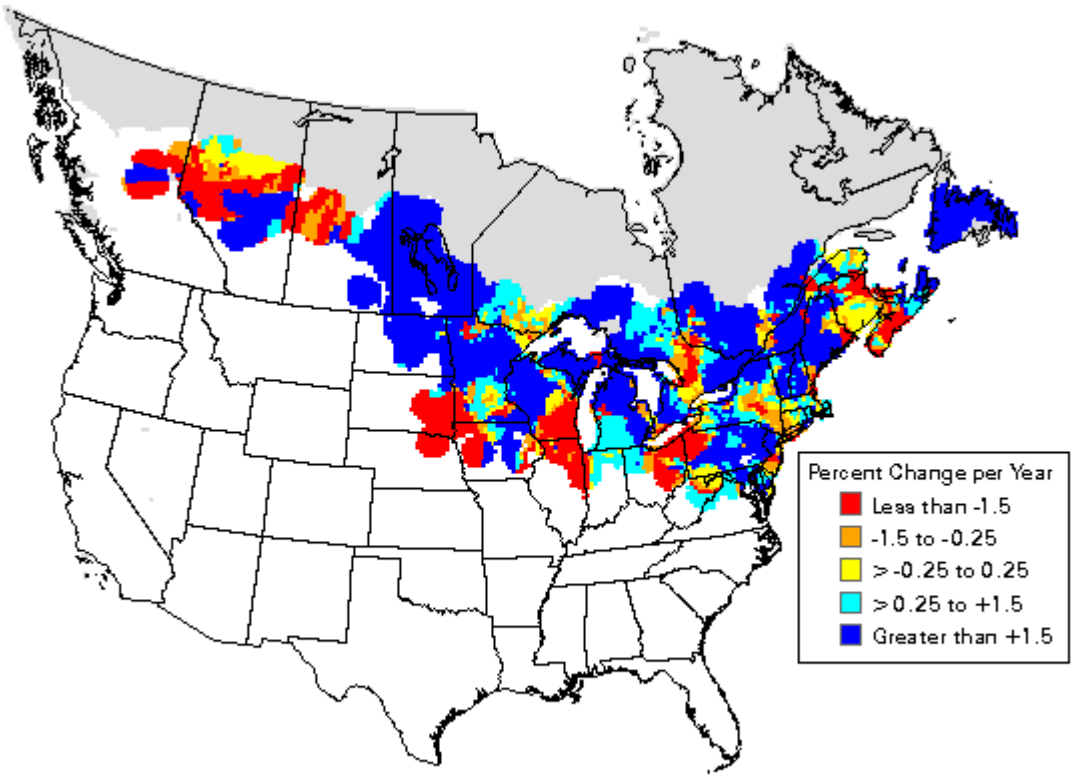
Louisiana Waterthrush *Seiurus motacilla*
BBS Trend Map, 1966 - 2003



Red-winged Blackbird *Agelaius phoeniceus* (emergent wetland)
BBS Trend Map, 1966 - 2003



Swamp Sparrow *Melospiza georgiana*
BBS Trend Map, 1966 - 2003



F. Additional Comments on Wetland Bird Population Trends

None offered

G. Citations for Wetland Bird Population Trends

None offered

H. Mock-up of Report to Decision Makers (for Wetland Bird Population Trends)

None offered
Caveat for mockup:
The Breeding Bird Survey provides an abundance index of birds in roadside habitat, including wetlands. Trends may or may not reflect changes in overall wetland bird populations. Results should be interpreted with caution.

Freshwater Wetlands Indicator 6: Road Density

Road Density of Paved and First Dirt Class Roads: Indicates road impacts to wetlands. Roads are a primary form of habitat modification, and can have negative effects on wetlands: loss of wetland biodiversity; habitat fragmentation; barriers to amphibian movement; etc.

A. Description of Existing Data for Road Density Indicator

There are currently no known monitoring programs/existing data sources specifically for this indicator. Some of the following points provide recommendations for gathering such information.

- **Why does this indicator need to be monitored**

Roads are an important landscape component to monitor when estimating wetland condition

- **Who will collect the data**

Unknown at this time

- **When will the data be collected (monitoring frequency)**

Each update to TIGER (Topologically Integrated Geographic Encoding and Referencing System), NWI, or NLCD

- **Where will the data be collected (monitoring scope – remote, screening, intensive)**

Tier 1 assessment (remote)

US Census Bureau website: www.census.gov

TIGER website: www.census.gov/geo/www/tiger/index.html

2006 2nd edition: www.census.gov/geo/www/tiger/tiger2006se/tgr/2006se.html

- **How will the data be collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Using GIS, calculate the length of road per unit area for each HUC 11 using the TIGER datalayer

- **Data management/storage**

Unknown at this time

- **Data analysis/assessment**

Use TIGER layers: Class A, road – primary highway; primary road; secondary and connecting roads; vehicular trail. Class B, railroads – unknown category; main line

- **Quality Assurance**

Unknown at this time

B. Potential Issues in Applying Road Density Data Sets for NEAFWA Framework

- Lack of fully digitized wetlands maps.
- Need to use the same wetland classification system across all states.
- Need to use the same automated computer analysis for road density across all states.

C. Data Gaps for Road Density

An assessment of data gaps will need to be made following compilation of data throughout the region.

D. Next Steps for Data Compilation and Analysis for Road Density

- Calculate the length of road (km) per unit area (km2) for each HUC 11.
- A ranking of wetland condition (Excellent; Good; Fair; Poor) needs to be identified. Until then, relative condition can be ascertained: the smaller the road density, the better the wetland condition

E. Baseline Condition and/or Past Trends of Road Density

None offered. Please see summary table at beginning of appendix for condition categories.

F. Additional Comments on Road Density

None offered

G. Citations for Road Density

None offered. Please see summary table below.

H. Mock-up of Report to Decision Makers (for Road Density)

None offered

Appendix 4: Indicators for Highly Migratory Species Target

Description of Highly Migratory Species Target

This target is comprised of migratory species or populations of resident species that are migratory through the northeastern states at some point in their life cycle. At least four sub-target groups make up this target: birds, mammals, diadromous fish, migratory invertebrates (notably the monarch butterfly). Some regional functions, such as migratory corridors and linkages may also be incorporated.

One particular challenge with this group as a target is that, by definition, much of the life history, threats, and ecological processes affecting these species occur outside the region, beyond the direct influence of management decisions within our control. This creates distinctive challenges for managers to identify actions that positively affect these species. However, critical issues face species in migration, and some even have suggested that the threats during migration are the most significant for migratory birds. While each species faces distinct threats, the group shares several key ecological attributes that make them important as a broad-based indicator of conservation effectiveness in the northeastern region.

At least 200 species found in the northeastern region are highly migratory, including such diverse groups as birds (e.g., raptors and shorebirds), mammals (the *Lasiurus* bats), and insects (Monarch butterfly). Some of these species occur in this region only as migrants (e.g., Red Knot), while other are resident in this region during part of their life cycle (breeding or wintering), but migrate long distances (e.g. many of the raptors). This Target focuses on the migratory life cycle of the species involved and develops indicators based on monitoring during migration.

Two broad ecological features of this target that are most closely linked to this region include: stopover habitats necessary for the survival of the species and critical to successful migration, and ecological threats and processes directing affecting species in migration, such as wind power development.

Sub-targets:
Birds

- Raptors, via Raptor Population Index. Well-established raptor migration concentration sites across the northeastern region provides an ideal indicator of a suite of high-order predators that have in the past and may again be used as a bell-weather for environmental responses to broad-scale factors.
- Shorebirds, via International Shorebird Survey. Indicative of changes at hemispheric scales, migratory shorebirds concentrate at well-known points during migration.

Mammals

- Migratory bats. Bats, particularly migratory tree bats in the genus *Lasiurus*, have been found dead at wind energy sites at higher rates than would be predicted at random. Studies

are being conducted to assess this poorly known species to determine the significance (population impact) and causes of this mortality.

Diadromous Fish

- Several species important to this region are highly migratory, including the American shad and the Atlantic Eel. However, these are also represented in other Targets and will not be developed here.

Insects

- Monarch butterfly. This is the best known of several insect species that are migratory in the northeastern states. Some monitoring is in place to track this species during migration.

Indicators of Highly Migratory Species Status

Indicators are listed in order of priority.

Indicators developed to track migratory wildlife have been drawn from three of the sub-targets of this diverse group: birds, mammals, and insects.

1) Sub-target **Birds**
   a. Indicator: **Migratory Raptor Population Index (RPI)**.
      This Indicator is a sophisticated analysis of existing, ongoing hawk migration counts that tract the direction in annual population trend for the most commonly observed birds of prey at the best-monitored sites. Raw data are in the form of counts per hour. RPI has been developed for at least 5 northeastern hawk count sites, and provides an indicator of the health of highly migratory birds of prey, which themselves are good indicators of higher-order functions in the environment.

      Monitoring is conducted annually throughout the region at established hawk-watch locations such as Hawk Mountain (PA), Cape May (NJ). Volunteers and paid personnel participate and the data is compiled through the organization Hawk Migration of North America (HMANA). In order to compensate for annual variation and observer effects on data quality, the Raptor Population Index (RPI) has been developed.

   b. Indicator: **Shorebird Abundances**
      The second avian indicator to address this sub-target includes migratory shorebirds monitored through the Program for Regional and International Shorebird Monitoring (PRISM) and its International Shorebird Surveys (ISS) coordinated by Manomet Center for Conservation Science. An international network of shorebird stopover sites is currently monitored, predominately by volunteers, and information is collated from many sites in the northeastern states into a national database. Raw data are in the form of counted or estimated totals at a site.

2) Sub-target **Mammals**:
   a. Indicator: **Bat mortality at wind energy installations**

This Indicator is derived from observations of mortality of poorly known populations of migratory bats, the *Lasiurus* (migratory tree bats) at recently developed wind energy installations. The species include the red bat, hoary bat, and silver-haired bat. Monitoring for these species has been established at wind power sites in the Allegheny Mountains since installation in about 2004. Protocols have been developed and are being employed at sites statewide in Pennsylvania, and other states have developed guidelines. Consistent use of standard methods across the region is needed for this Indicator to be most effective. Raw data are in the form of dead animals per turbine per day.

3) Sub-target **Insects**
   a. Indicator: **Monarch Butterfly Presence/Absence**
   This Indicator will track the population of one specific migratory insect, the Monarch Butterfly, which is well known as a long-distant migrant through the northeastern states. This is an early-succession species, completing one breeding cycle within the northeast prior to its migration to Mexico. A volunteer network has been established to report monarch migration, and national tag recoveries are collated into a web-based database.

A. Description of Existing Data for Highly Migratory Species Indicators

Sub-Targets				
Issues	**Raptors**	**Shorebirds**	**Bats**	**Monarchs**
Why is indicator being monitored?	Population Monitoring	Population Monitoring	Wind Power Risk Assessment	General Interest
Who is collecting data?	NGOs and volunteers, guided by Hawk Migration of North America (HMANA.org)	Manomet Center for Conservation coordinates Manomet.org	USFWS, State Agencies, and wind developers in collaboration	Several efforts, including Cape May Bird Observatory
When is data being collected?	Fall and spring seasonal daily counts, 3 since 1930s, most since 1970s.	Fall and some spring seasonal counts, since 1974	Fall and some spring seasonal daily counts	Fall migration
Where is data collected?	55 mid-Atlantic concentration sites have 10+years data;. 400 sites nationally	Over 50 concentration points throughout mid-Atlantic states	Mountains from Vermont to Kentucky	Various points, mostly coastal, Cape May NJ

Sub-Targets				
Issues	**Raptors**	**Shorebirds**	**Bats**	**Monarchs**
How is data collected?	Established counting protocols; daily survey of counts per hour	Established protocol: (3 counts per month – or every 10 days), using 'high count' of day as metric	Mist-netting, acoustic, and mortality counts, sampling at cooperating installations	Hourly counts, tagging and recoveries are collected.
Data management & storage	HMANA at Hawk Mountain Sanctuary	Manomet	State agencies Pgc.state.pa.us	http://rkwalton.com/ and others
Data analysis	Raptor Population Index http://rpi-project.org/	"Highest" daily count is recommended metric	Methods being field-tested.	Needed
Quality assurance	High	High	High	Good

B. Potential Issues in Applying Highly Migratory Species Data Sets for NEAFWA Framework

Raptors: As many as 55 sites have been completing near-daily counts (either spring or fall or both) for at least 10 years. In the 2006 RPI report, nine (9) raptor species were assessed at five (5) sites (Farmer 2006). To adequately represent the region, robust indices need to be developed for more sites with longer-term data sets. Automated analysis tools are being developed to produce indexes at more sites. This analysis requires long-term funding.

Shorebirds: The PRISM manual states that "counts during the non-breeding period in the foreseeable future will not provide sufficient reliability to be the only basis for trend estimation" (Bart et al. 2002), but further analysis is needed to evaluate survey intensity and sampling issues necessary to produce reliable index.

Bats: Methodology is just now being developed and standardized for mortality monitoring to compensate for carcass removal and searching efficiency. Mortality counts (corrected for scavenging and searcher efficiency) are measured as "bats killed per turbine." Protocols for monitoring bat and bird mortality at wind power installations in Pennsylvania may be found at: http://www.pgc.state.pa.us/pgc/lib/pgc/programs/exhibit_c.pdf

Monarch: Standardized monitoring methods and data management standards are needed.

C. Data Gaps for Highly Migratory Species

Raptors: A number of important monitoring sites do not yet have the sufficient scope of data (10 years) to generate an adequate trend. This data set is growing, however, and more sites will be suitable for statistical analysis each year.

Shorebirds: Sampling biases identified as: sample frame bias, survey area selection bias, and measurement bias are being evaluated to determine effectiveness of migratory counts as a population index. Proposals have been developed to address this at a regional level, but considerable analytical work needs to be done to provide statistically valid sampling regime.

Bats: This is a newly developing methodology, dependent on cooperation of the wind industry. Many gaps exist to understand the mechanisms that result in the observed mortality, but the basic monitoring techniques are well developed and could be implemented at any site.

Monarch: A sampling scheme is needed that could generate annual trends representative of the large regional population.

D. Next steps for data compilation and analysis for Highly Migratory Species

Raptors: Development of a regional index for suitable species is needed. To date the index has been applied only at a site-by-site basis for species with sufficient data.

Shorebirds: A sampling strategy is needed and analytical procedures similar to the RPI should be developed to produce reliable trend analysis. Methods to combine data across sites also are needed.

Bats: Research and analysis needs include: 1) Better understanding of exposure rates (observed mortality with respect to bat populations), 2) Evaluate if observed mortality is having population-level effects, 3) Mitigation methods to reduce mortality, and many other topics.

Monarch: Monitoring and tagging measures are needed.

E. Baseline condition and/or past trends of the target for Highly Migratory Species

Raptors: 103 sites are submitting data on regular basis in eastern region from Carolinas north to Maine. Of those about 55 have counts going back at least 10 years or longer; many go back to 1970s. One could say that most of the 55 sites have daily counts in either spring or fall covering 95% of the migration period for most species.

Shorebirds: The ISS data files contain results from more than 35,000 surveys of approximately 1,700 sites widely distributed across the Western Hemisphere. About 1,300 surveys are added each year.

Bats: Studies conducted since 2004 have attempted to assess risk of bat mortality to wind energy facilities. Much of this work has been supported by industry, although independent studies are underway to examine causes for the unexpected mortality. This effort is being spearheaded by Bat Conservation International (http://www.batcon.org/home/default.asp), although many diverse partners have collected data.

Monarch: Several diverse monitoring programs have been established to count monarchs in migration (at Cape May, New Jersey, http://rkwalton.com/), larva development (nationwide, http://www.mlmp.org/results.asp), and a coordinated monarch-marking program (http://www.monarchwatch.org/). Considerable baseline data (10 years at Cape May) exists, and a web-based tag recovery database reports on all >11,000 Monarch Watch tag recoveries from 1994 to date – hundreds of which are from northeastern states.

F. Comments for Highly Migratory Species

None given

G. Citations for Highly Migratory Species

Ecological Risk Assessment, draft 2007, A Framework for Wildlife Assessments at Wind Energy Facilities. March 2007. http://www.nationalwind.org/workgroups/wildlife/era.pdf

Farmer, Christopher J. 2006. Trends in Autumn Counts of Migratory Raptors in U.S. Fish and Wildlife Service Region Five. Raptor Population Index Technical Report. Acopian Center for Conservation Learning, Hawk Mountain Sanctuary, Orwigsburg, PA 17961. 64 pp.

Farmer, C.J., D.J.T. Hussell, and D. Mizrahi. 2007. Methods for detecting population trends in migratory birds of prey. The Auk 123. In press.

Hawk Migration Association of North America (HMANA). 2007. Http://hmana.org.

International Shorebird Surveys, Program for Regional and International Shorebird Monitoring (PRISM), Manomet Center for Conservation Sciences, PO Box 1770, Manomet, MA USA 02345. www.shorebirdworld.org.

Monarch Watch: Migration and Tagging. 2007. http://www.monarchwatch.org/tagmig/tag.htm

National Wild Coordinating Collaborative 2007.

Pennsylvania Game Commission. 2007. Wind Energy Voluntary Cooperative Agreement. http://www.pgc.state.pa.us/pgc/lib/pgc/programs/voluntary_agreement.pdf

Raptor Population Index (RPI). 2007. Contact: Ernesto Ruelas Inzunza, Hawk Migration Association of North America, Cornell Lab of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY 14850. http://RPI-Project.org

Wildlife Workgroup Blueprint. 2007. http://www.nationalwind.org/workgroups/wildlife/2007_NWCC_Wildlife_Workgroup_Blueprint.pdf

H. Mock-up of Report to Decision Makers (for Highly Migratory Species)

None offered.

Appendix 5: Indicators for Lakes and Ponds Target

Description of Lakes and Ponds Target

Lakes and ponds are defined as all naturally occurring permanent standing bodies of freshwater, including those that may be altered, modified, or dammed. Delaware and Maryland have no naturally occurring lakes, and Virginia has very few. Lakes and ponds are highly diverse in terms of size, configuration, water chemistry, and biota. Differences between lakes and ponds are also less than clear, but in general, ponds are considered those standing water bodies sufficiently shallow to allow sunlight to reach the pond bottom. Potential threats to lakes and ponds in the northeast include direct habitat modification, flow alteration, pollution, invasive species, and climate change. The desired conditions for all lake and pond communities include:

- Naturally reproducing populations of Species of Greatest Conservation Need (SGCN)
- Intact shorelines.
- Minimally disturbed littoral zones
- Evolutionary processes not accelerated by disturbance
- Pollutant levels below concentrations that would adversely affect SGCN
- Absence of exotic species that adversely affect SGCN
- Unimpeded access of SGCN to habitats required for the maintenance of life cycle functions
- Unaltered hydrological and temperature regimes

Indicators of Lakes and Ponds Status

Indicators are listed in order of priority.

Lakes and Ponds Indicator 1: % Impervious Surface/Landscape Integrity

The proportion of land area covered with nonporous features (e.g. roads, parking lots, driveways, and roof-tops) has been shown to be associated with degradation of lakes and ponds. Due to reduced infiltration of rainwater, flooding tends to be more frequent and erosive. As a result, increasing amounts of impervious land cover in a watershed contributes to increases in water temperature and sediments washed into water bodies. Chemical pollution also tends to be higher in areas with an abundance of roads, parking lots, and houses. Generally, the degree of imperviousness increases with increasing urbanization within a watershed. The USGS is the source of National Land Cover Data (NLCD), which includes GIS-compatible data layers on impervious surfaces and is anticipated to be updated approximately every 10 years. Although most research on the effects of watershed impervious cover on aquatic ecosystems has focused on riverine systems, lakes are expected to experience negative impacts similar to riverine waters (Center for Watershed Protection 2003).

A. Description of Existing Data for % Impervious Surface Indicator

- **Why is this indicator being monitored by this program**
  Impervious surface can directly influence the biological and physical status of lakes and ponds and thus is an important indicator.

- **Who is collecting the data**
  The USGS is the source for the National Land Cover Data (NLCD).

- **When is the data being collected (monitoring frequency)**
  The NLCD are anticipated to be updated approximately every 10 years. It was previously completed in 1992 and 2001.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Data are remotely collected.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  Data collection methodology is developed by USGS.

- **Data management/storage**
  Data are stored in GIS-compatible data layers.

- **Data analysis/assessment**
  Data Analysis tools currently available include the Impervious Surface Analysis Tool (ISAT) http://www.csc.noaa.gov/crs/cwq/isat.html. The National Land Cover Data

(http://landcover.usgs.gov/uslandcover.php) may serve as the dataset on which to apply the ISAT tool.

- **Quality Assurance**
  USGS has QA/QC protocols for the NLCD.

B. Potential Issues in Applying % Impervious Surface Data Sets for NEAFWA Framework

Impervious surface has long been recognized as a factor influencing waterways. There is considerable information on these effects and current land cover data should provide a good source for assessing this factor. Additionally, there is a general recognition of the scale of effects which can occur with different levels of imperviousness. The most significant obstacle to for applying this is the scale of watersheds in which to assess the extent of imperviousness. Studies are underway to evaluate the effects of increasing impervious surface: Collaborative Research: Streamflow, Urban Riparian Zones, BMPs, and Impervious Surfaces S. Taylor Jarnagin (http://www.epa.gov/nerlesd1/land-sci/epic/clarksburg01-05.htm). Although most research on the effects of watershed impervious cover on aquatic ecosystems has focused on riverine systems, lakes are expected to experience negative impacts similar to riverine waters (Center for Watershed Protection 2003).

C. Data Gaps for % Impervious Surface

No significant data gaps are apparent with assessing impervious surface, however additional monitoring may be required to evaluate site or regional responses to impervious surface or to remediation measures.

D. Next Steps for Data Compilation and Analysis for % Impervious Surface

NEAFWA's Regional Habitat Classification project is developing a common land use classification system. It is expected that this system will serve a valuable role in ensuring a consistent regional interpretation of impervious surfaces.

E. Baseline Condition and/or Past Trends of % Impervious Surface

The National Land Cover Datasets (NLCD) http://landcover.usgs.gov/uslandcover.php could serve as baseline for this indicator. The value of historic data would need to be evaluated for resolution and comparability with more recent data and with the regional habitat classification system.

F. Additional Comments for % Impervious Surface

None offered

G. Citations for % Impervious Surface

Arnold, C., J. Gibbons. 1996. Impervious Surface Coverage: The Emergence of a Key Environmental Indicator. Jour. of the Am. Planning Asso. 62(2):243-258

Brabec, E., S. Schulte and P.L. Richards. 2002. Impervious Surfaces and Water Quality: A Review of Current Literature and Its Implications for Watershed Planning. Journal of Planning Literature 16(4):499-514.

Schueler, T. 2003. Impacts of Impervious Cover on Aquatic Systems. Center for Watershed Protection. Ellicott City, MD

Center for Watershed Protection (CWP). 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research monograph No. 1.

Chandler C. Morse, Alexander D. Huryn, and Christopher Cronan. 2003. Impervious Surface Area as a Predictor of the Effects of Urbanization on Stream Insect Communities in Maine, U.S.A. Journal of Environment and Monitoring 89:95-127 http://www.springerlink.com/content/kr38v315287gxh44/

Tilburg, Christine and Merryl Alber. Impervious Surfaces: Review of Recent Literature, Georgia Coastal Research Council. http://crd.dnr.state.ga.us/assets/documents/jrgcrddnr/ImperviousLitReview_Final.pdf

Moffett, Donna and John Hasse 2006. Looking for the Relationship between Sprawl and Water Quality: A Case Study of Gloucester County, NJ. Middle States Geographer 39: 26-33. http://geographyplanning.buffalostate.edu/MSG2006/4%20Moffett%20and%20Hasse.pdf

Multi-Resolution Land Characteristics Consortium (see this web site http://gisdata.usgs.net/website/MRLC/viewer.php) are available from (a group of federal agencies working together).

H. Mock-up of Report to Decision Makers (for % Impervious Surface)

Lakes and Ponds Indicator 2: % Shoreline Developed (shoreline integrity)

This indicator would report on the degree of development within 200 meters of the shoreline of lakes and ponds in the Northeast US. The degree of shoreline integrity, or the percentage of shoreline developed can be calculated using National Land Cover Data (NLCD) and data classification developed as part of NEAFWA's Regional Habitat Classification Project.

Development along the shores of lakes and ponds in the Northeast can be detrimental to Species of Greatest Conservation Need populations that utilize these habitats. As reported in Olivero and Bechtel (2005), shoreline development contributes to eutrophication through both impervious cover runoff and septic system leeching. Most lakefront developments are serviced by septic systems because of their seasonal use or distance from wastewater treatment plants. Because of their proximity to lakes, septic systems can become a source of subsurface phosphorus seepage to the lake. Poorly functioning waterfront septic systems have been shown to be an important source of phosphorus and nitrogen in a wide range of lake systems (Harper 1995, Robertson and Harman 1999, Arnade 1999). Although the relative impact of shoreline and shoreline buffer development vs. watershed development to overall lake biotic integrity has not been well studied (Whittier et al. 2002), shoreline development has been associated with many other negative impacts on lake ecosystems. For example, a number of studies have noted declining fish abundance or diversity with increasing shoreline development (Hinch and Collins 1993, Hinch et al 1994, Bryan and Scranecchia 1992). Fish foraging and spawning have also been shown to decline as a direct function of cottage or home density around the lakeshore (Engel and Pederson 1998). Alteration of the littoral habitat is particularly noted as a critical concern because many fish species spend at least part of the lifecycle in the littoral zone of the shoreline. Maintaining shade, leaf litter, woody debris, complexity of emergent and submergent plants, and water quality components of the littoral habitat becomes increasingly difficult with shoreline development. Bird species, such as eagles, loons, and songbirds, have also been found to avoid developed lakes. Whether due to loss of nesting sites, changes in prey base, or lack of tolerance for noise or other disturbances, their avoidance has been noted at a relatively low rate of cottage development (Johnson and Brown 1990, Heimberger et al 1983). Similar relationships have been discovered for amphibians and reptiles which utilize the lakeshore to bask, feed, nest, and overwinter (Engel and Pederson 1998). Since lakefront property is so desirable, it is quite common to have intense lakefront development in otherwise lightly developed watersheds (Capiella and Schueler 2004). These shorelines are often increasingly developed as additional owners build summer homes or cottages and seek both good access to the water and an unobstructed view of the lake. The greatest density of homes is usually found within 500 ft (150m) of the lake and less density further away (Capiella and Schueler 2004).

A. Description of Existing Data for <u>% Shoreline Developed</u> Indicator

- **Why is this indicator being monitored by this program**

Shoreline development can directly influence the biological and physical status of lakes and ponds, and have significant impacts on Species of Greatest Conservation Need utilizing this habitat, and thus is an important indicator.

- **Who is collecting the data**
  The USGS is the source for the National Land Cover Data (NLCD).

- **When is the data being collected (monitoring frequency)**
  The NLCD dataset are anticipated to be updated approximately every 10 years. It was previously completed in 1992 and 2001.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Data are remotely collected.

- **How are the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  Data collection methodology is developed by USGS.

- **Data management/storage**
  Data are stored in GIS-compatible data layers.

- **Data analysis/assessment**
  NLCD datasets and imagery would be paired with the classifications created for lakes and ponds as part of NEAFWA's Regional Habitat Classification Project and a buffer analysis would be conducted to determine the percent of shoreline developed using a method described in Olivero and Bechtel (2005).

- **Quality Assurance**
  USGS has QA/QC protocols for the NLCD.

B. Potential Issues in Applying % Shoreline Developed Data Sets for NEAFWA Framework

This report recommends assessing the percentage of shoreline developed within 200 meter of shoreline for lakes and ponds of all sizes. After running the assessment it may become apparent that buffer size should be tiered to lake size.

C. Data Gaps for % Shoreline Developed

No significant data gaps are apparent with assessing the degree of shoreline development.

D. Next Steps for Data Compilation and Analysis for % Shoreline Developed

NLCD datasets and imagery would be paired with the classifications created for lakes and ponds as part of NEAFWA's Regional Habitat Classification Project and a buffer analysis

would be conducted to determine the percent of shoreline developed using a method described in Olivero and Bechtel (2005).

E. Baseline Condition and/or Past Trends of % Shoreline Developed

The 1992 and 2001 National Land Cover Datasets (NLCD) http://landcover.usgs.gov/uslandcover.php could be used to develop a baseline for this indicator. The value of historic data would need to be evaluated for resolution and comparability with more recent data and with the regional habitat classification system.

F. Additional Comments for % Shoreline Developed

None offered

G. Citations for % Shoreline Developed

Arnade, L.J. 1999. Seasonal Correlations of Well Contamination and Septic Tank Distance. Ground Water 36(6):920-923.

Bryan, M.D. and D.L. Scranecchia. 1992. Species Richngess, Composition, and Abundance of Fish Larvae and Juveniles Inhabiting Natural and Developed Shorelines of a Glacial Iowa Lake. Environmental Biology of Fishes 35.

Capiella, K. and T. Schueler, 2004 Crafting a Lake Protection Ordinance. Technical Article in Urban Lake Management. p751-768.

Center for Watershed Protection (CWP). 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research monograph No. 1.

Engel, S. and J.L. Pederson. 1998. The Construction, Aesthetics, and Effects of Lakeshore Development: A Review. Wisconsin Department of Natural Resources.

Harper, H.H. 1995. Effects of Groundwater Seepage from Septic Tank Areas on Nutrient Loadins and Bacteriological Inputs to Clear Lake.

Heimberger, M., Euler, D, and J. Barr. 1983. The Impact of Cottage Development on Common Loon Reproductive Success in Centeral Ontario. Wilson Bulletin 95:431-439.

Hinch, S.G. and Collins, N.C. 1993. Relationships of Littoral Fish Abundance to Water chemistry and Macrophyte Variables in Central Ontario Lakes. Canadian Journal of Fisheries and Aquatic Sciences 50.

Hinch, S.G., Somers, K.M., and N.C. Collins. 1994. Spatial Autocorrelation and Assessment of Habitat-Abundance Relationships in Littoral Zone Fish. Canadian Journal of Fisheries and Aquatic Sciences 51:701-712.

Johnson, W.N. Jr., and P.W. Brown. 1990. Avian Use of a Shoreline buffer Strip and an Undisturbed Lakeshore in Maine. Northern Journla of Applied Forestry 7: 114-17.

Olivero, A and D Bechtel, 2005. Chapter 2. Classification and Condition Assessment for New Hampshire's Lakes. A report to the New Hampshire Fish and Game Department. The Nature Conservancy.

Robertson, W.D. and J. Harman. 1999. Phosphate Pluem Persistence at Two Decomissioned Septic System Sites. Gound Water 37 (2): 228-236.

Whittier, T.R., Paulsen, S.G., Larsen, D.P., Peterson, S.A., Herlihy, A.T., Kaufmann, P.R. 2002. Indicators of Ecological Stress and Their Extent in the Population of Northeastern Lakes: A Regional-Scale Assessment. BioScience 52(3):235-247.

H. Mock-up of Report to Decision Makers (for % Shoreline Developed)

Lakes and Ponds Indicator 3: # Overall Productivity of Common Loons

Loons (Gavia spp) are generally considered to be good indicators of high quality lacustrine habitats (Strong 1990). With increasing human presence and activity in formerly high quality areas, however, the status of Common loon (Gavia immer) now also serves as indicator of aquatic health and landscape-level alterations in aquatic environments (Evers 2004). As a top predator in the aquatic food chain of many lakes, the Common loon can also serve as a good measure of mercury in lacustrine systems. Monitoring the status of the Common loon can also provide fisheries and wildlife managers with insight into the status of other Species of Greatest Conservation Need that utilize lakes and ponds in the Northern-most northeast states (MA, ME, NH, NY, VT).

Estimating Overall Productivity of Common Loons: Estimated overall productivity is best determined by counting the number of territorial pairs and the number of fledged young within a target area (or number of chicks fledged per number of territorial pairs). Because the number of young that actually fledge is difficult to substantiate, most monitoring programs use a surrogate of "chicks greater than 6 weeks of age" (or nearly in full basic plumage). Chick mortality after six weeks is minimal and serves as a suitable predictor of fledging rate (Evers 2004).

A. Description of Existing Data for Overall Productivity of Common Loons Indicator

- **Why is this indicator being monitored by this program**
  As a highly charismatic resident of the waters of the Northern-most northeast states (MA, ME, NH, NY, VT), the Common loon has captured the attention of the public and wildlife managers and is the forefront of many aquatic-based conservation efforts. Monitoring data are collected to assess the status of the Common loon and the effectiveness of conservation actions.

- **Who is collecting the data**
  Loon monitoring programs exist in the states of Maine, Massachusetts, New Hampshire, New York and Vermont monitor. The programs are generally managed collaboratively by state Fish & Wildlife agencies and non-governmental organizations.

  Maine: FPL Energy Maine Hydro (www.fplenergy.com), The Maine Audubon Society (www.maineaudubon.org), Maine Inland Fisheries and Wildlife (www.state.me.us/ifw) BioDiversity Research Institute www.BRILoon.org,

  Massachusetts: Massachusetts Division of Fisheries and Wildlife Service www.state.ma.us/mdc, BioDiversity Research Institute www.BRILoon.org,

  New Hampshire: the Loon Preservation Committee LPC; www.loon.org, Lake Umbagog National Wildlife Refuge,

  New York: the Adirondack Cooperative Loon Program ACLP; www.adkscience.org/loons

Vermont: the Vermont Loon Recovery Project www.vtecostudies.org/loons/ a joint venture of the Vermont Center for EcoStudies and the Nongame and Natural Heritage Program of the Vermont Fish & Wildlife Department www.vtfishandwildlife.com/
The specific nature of these programs is described in Evers (2004).

- **When is the data being collected (monitoring frequency)**
  Data are collected yearly during the breeding season with July being the key time to assess is chicks survived to six-weeks.

- **Where is the data collected (monitoring scope – remote, screening, intensive)**
  Data are collected at targeted lakes throughout MA, ME, NH, NY and VT.

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
  The data are collected by direct observation. These data have been collected annually for 20-30 years in ME, NH, and VT.

  The protocols for measuring overall loon productivity are well-established for the Northeast, based on the Northeast Loon Study Working Group (which has met annually since 1994). Those protocols are described in Evers (2004).

- **Data management/storage**
  Data are managed and stored by the individual monitoring programs in each state

- **Data analysis/assessment**
  Data analysis and assessment of loon status, including analyses of overall productivity have been regularly conducted by the monitoring programs in each state. Loon chick productivity is very well documented in all of VT and NH, the Adirondacks, and several regions of Maine.

- **Quality Assurance**
  Quality assurance is conducted by the organizations and agencies that manage the loon monitoring programs in each state.

B. Potential Issues in Applying <u>Overall Productivity of Common Loons</u> Data Sets for NEAFWA Framework

- Lakes with loons that are not breeding probably should not use loons as an indicator species, since loons regularly wander and use lakes for non-breeding purposes.
- Changes in loon chick productivity should be assessed over several years in order to reduce impact of single year dips (e.g., caused by flooding) or peaks.

C. Data Gaps for Overall Productivity of Common Loons

Common loons currently nest only in MA, ME, NH, NY and VT. There is some potential for their nesting in Connecticut.

D. Next Steps for Data Compilation and Analysis for Overall Productivity of Common Loons

Determine how to best report overall productivity (the number of territorial pairs and the number of chicks surviving to 6 weeks of age) as a single number or trend per state.

E. Baseline Condition and/or Past Trends of Overall Productivity of Common Loons

Overall loon productivity data have been collected annually for 20-30 years in ME, NH, and VT.

F. Additional Comments for Overall Productivity of Common Loons

non submitted

G. Citations for Overall Productivity of Common Loons

Evers, D. C. 2004. Status assessment and conservation plan for the Common Loon (Gavia immer) in North America. U.S. Fish and Wildlife Service, Hadley, MA.

Strong, P.V. 1990. The Suitability of the Common Loon as an Indicator Species. Wildlife Society Bulletin, Vol. 18, No. 3 (Autumn, 1990), pp. 257-261

H. Mock-up of Report to Decision Makers (for Overall Productivity of Common Loons)

Appendix 7: Indicators for Regionally Significant Species of Greatest Conservation Need Target

Note: Appendix is incomplete. Text is forthcoming.

Description of Species of Greatest Conservation Need (SGCN) Target

This target describes Regional Conservation and Monitoring for Priority Northeast Species in Greatest Need of Conservation. The relatively small geographic area of individual Northeast states necessitates interstate cooperation for conserving species in greatest need of conservation. Most often, coordinated efforts to collect data, develop management strategies, and track progress toward species recovery do not take place until after species have undergone extensive scientific and political review and are listed under the federal ESA. State Wildlife Grants and the completion of State Wildlife Plans provides new opportunities for coordinating species monitoring and management efforts. For most species, habitat-based or multi-species conservation approaches are most practical. Nevertheless, some species that have already undergone significant population declines or range reductions in the Region need more targeted single species or guild-based approaches to maintain viability. Because state wildlife agencies play a key role in federally listed wildlife recovery, consolidating, prioritizing and coordinating endangered species recovery indicators would demonstrate how Regional actions benefit these species.

Sub targets:

- Federally listed and candidate wildlife in the region
- Highly Imperiled Species without federal status (eg. Blanding's turtle, Eastern small-footed bat, Allegheny woodrat)
- Species endemic to the region, or with a high proportion of their distribution and abundance in the Region (eg. Bicknell's thrush, E. ribbon snake)

Indicators of SGCN Status

Indicators are listed in order of priority.

SGCN Indicator 1: Population Trends and Productivity of Federally Listed Species

The status of federally listed wildlife would rely on population recovery goals, productivity measures to determine management effectiveness and progress toward recovery. A variety of academic, public and private conservation organizations collect data annually for most federally listed species. These data are accessible through USFWS's ECOS Database.

A. Description of Existing Data for SGCN Population Trends & Productivity Indicator

- **Why is this indicator being monitored by this program**
- **Who is collecting the data**
- **When is the data being collected (monitoring frequency)**
- **Where is the data collected (monitoring scope – remote, screening, intensive)**
- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
- **Data management/storage**
- **Data analysis/assessment**
- **Quality Assurance**

B. Potential Issues in Applying SGCN Population Trends & Productivity Data Sets for NEAFWA Framework

C. Data Gaps for SGCN Population Trends & Productivity

D. Next Steps for Data Compilation and Analysis for SGCN Population Trends & Productivity

E. Baseline Condition and/or Past Trends of SGCN Population Trends & Productivity

F. Additional Comments for SGCN Population Trends & Productivity

G. Citations for SGCN Population Trends & Productivity

H. Mock-up of Report to Decision Makers (for SGCN Population Trends & Productivity)

SGCN Indicator 2: State-Listing Status and Heritage Rank of Highly Imperiled Wildlife

This indicator includes the proportion of NatureServe/Natural Heritage A and B ranked populations of highly imperiled species with no federal listing status on Conservation Land Changes in state-listing status and heritage rank. Summaries of state-listing and heritage status changes could demonstrate changes in population condition of these species. Consensus among biologists that species long-term viability is uncertain due to factors such as low reproductive rates and loss of populations from large portions of historic range. (See Wildlife Species of Regional Conservation Concern in the Northeastern United States, published in Northeast Wildlife, Volume 54, 1999, pages 93-100). Data for this indicator is highly variable and periodic. Existing data ranges from intensive radio-tracking and population studies to distribution surveys based on accumulated and verified sightings (i.e. Heritage element occurrences) through NatureServe/State Natural Heritage Programs.

A. Description of Existing Data for SGCN State-Listing Status & Heritage Rank Indicator

- **Why is this indicator being monitored by this program**
- **Who is collecting the data**
- **When is the data being collected (monitoring frequency)**
- **Where is the data collected (monitoring scope – remote, screening, intensive)**
- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
- **Data management/storage**
- **Data analysis/assessment**
- **Quality Assurance**

B. Potential Issues in Applying SGCN State-Listing Status & Heritage Rank Data Sets for NEAFWA Framework

C. Data Gaps for SGCN State-Listing Status & Heritage Rank

D. Next Steps for Data Compilation and Analysis for SGCN State-Listing Status & Heritage Rank

E. Baseline Condition and/or Past Trends of SGCN State-Listing Status & Heritage Rank

F. Additional Comments for SGCN State-Listing Status & Heritage Rank

G. Citations for SGCN State-Listing Status & Heritage Rank

H. Mock-up of Report to Decision Makers (for SGCN State-Listing Status & Heritage Rank)

SGCN Indicator 3: Population Trends of Endemic Species

Species endemic to the region, or with a high proportion of their distribution and abundance in the Region (High Regional Responsibility) are included in this indicator. Birds are the only taxa in this category that have population trend data, with the annual survey for birds covered by BBS. State Natural Heritage Programs/ NatureServe can provide distribution data

A. Description of Existing Data for SGCN Population Trends of Endemics Indicator

- **Why is this indicator being monitored by this program**
- **Who is collecting the data**
- **When is the data being collected (monitoring frequency)**
- **Where is the data collected (monitoring scope – remote, screening, intensive)**
- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
- **Data management/storage**
- **Data analysis/assessment**
- **Quality Assurance**

B. Potential Issues in Applying SGCN Population Trends of Endemics Data Sets for NEAFWA Framework

C. Data Gaps for SGCN Population Trends of Endemics

D. Next Steps for Data Compilation and Analysis for SGCN Population Trends of Endemics

E. Baseline Condition and/or Past Trends of SGCN Population Trends of Endemics

F. Additional Comments for SGCN Population Trends of Endemics

G. Citations for SGCN Population Trends of Endemics

H. Mock-up of Report to Decision Makers (for SGCN Population Trends of Endemics)

SGCN Indicator 4: AA

Add indicator description

A. Description of Existing Data for SGCN AA Indicator

- **Why is this indicator being monitored by this program**
- **Who is collecting the data**
- **When is the data being collected (monitoring frequency)**
- **Where is the data collected (monitoring scope – remote, screening, intensive)**
- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
- **Data management/storage**
- **Data analysis/assessment**
- **Quality Assurance**

B. Potential Issues in Applying SGCN AA Data Sets for NEAFWA Framework

C. Data Gaps for SGCN AA

D. Next Steps for Data Compilation and Analysis for SGCN AA

E. Baseline Condition and/or Past Trends of SGCN AA

F. Additional Comments for SGCN AA

G. Citations for SGCN AA

H. Mock-up of Report to Decision Makers (for SGCN AA)

SGCN Indicator 5: BB

Add indicator description

A. Description of Existing Data for SGCN BB Indicator

- **Why is this indicator being monitored by this program**
- **Who is collecting the data**
- **When is the data being collected (monitoring frequency)**
- **Where is the data collected (monitoring scope – remote, screening, intensive)**
- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**
- **Data management/storage**
- **Data analysis/assessment**
- **Quality Assurance**

B. Potential Issues in Applying SGCN BB Data Sets for NEAFWA Framework

C. Data Gaps for SGCN BB

D. Next Steps for Data Compilation and Analysis for SGCN BB

E. Baseline Condition and/or Past Trends of SGCN BB

F. Additional Comments for SGCN BB

G. Citations for SGCN BB

H. Mock-up of Report to Decision Makers (for SGCN BB)

Appendix 8: Indicators for Unique Habitats of the Northeast Target

Description of Unique Habitats Target

- Habitats considered unique as they are geomorphic in nature and are not captured within any habitat classification system
- Habitats that are rare, but are not captured within the other five target habitat groups identified within this exercise

Unique habitats include those wildlife habitats with characteristics and features not associated with the major habitat types of the region that have been identified for future monitoring and evaluation through the *Northeast Monitoring and Performance Reporting Framework,* and therefore include both unique and rare habitats. They are often geomorphic in nature and include such habitats as rock outcrops, talus and scree, cliffs, caves, karsts, and mines. They also include natural grasslands and barrens (habitats within the transitional state between grasslands and forests; may include savannah habitats), and beaches and dunes. They provide a unique system/ function for wildlife species such as snake denning, gestating and basking sites, bat hibernacula, and avian nest sites to name a few. These habitats are difficult, if not impossible, to mimic or recreate and achieve the same micro- and macro-habitat features that specific wildlife species require.

Subtargets:

1. Caves, karsts, mines

- Caves are naturally occurring and geomorphic in nature, underground chamber(s) that is (are) accessible from the surface.
- Karsts (naturally occurring) include underground limestone caverns formed by the erosive process of underground streams.
- Mines include underground manmade excavation sites.

2. Rocky habitats (outcrops, talus, scree, ridgeline, cliffs)

- Rocky habitats are geomorphic in nature and are not captured within any formal habitat classification system.
    - Talus consisting of broken rocks including boulders, shelter and other large rocks with sparse, if any, vegetation, with many crevices reaching below the surface.
    - Scree consists of smaller pieces of broken rock than talus and is extremely unstable.
    - Cliffs include steep, vertical rock surfaces.
    - Ridgeline may be found along the top of a cliff or may run the linear length of a mountain top; geomorphic features are exposed.
    - Outcrops include isolated, rocky accumulations throughout forested habitats providing shelter and basking areas for smaller wildlife species.

3. Barren lands

- Barren lands include those areas in transition between open grassland and forest, may include savanna habitats.

4. Natural grasslands

- Natural grasslands include those lands naturally consisting of native grasses (warm or cool season; have not been converted from agricultural lands) and may require minimal management (e.g., prescribed burns, alternate mowing) to minimize succession.

5. Alpine/higher elevations

- Alpine zones pertain to areas, typically sloping, on or part of any lofty mountain above the timber line where low, shrubby vegetation and ground cover (lichens, grasses, sedges) persist.

6. Waterfalls

- A waterfall is agreed to consist of a river or stream flowing over a cliff face or slope for a long enough distance that it creates a certain amount of agitation in the water below. An additional criterion is that a "true" waterfall has free-falling water. We exclude from waterfalls the water that flows downhill fast over bedrock or boulders - a phenomenon that many would define as a cascade.

Indicators of Unique Habitats Status

Indicators are listed in order of priority.

Unique Habitats Indicator 1: Proximity to Human Activity/Roads

Human activity has been reported to cause nest failures and abandonment, population declines due to indirect and direct mortality, and stress to breeding wildlife. Understanding the proximity of human activity and roads to and the effects on critical nesting/ breeding, foraging, and wintering sites will provide insight to the potential impacts on wildlife species and for future planning and management efforts.

A. Description of Existing Data for Proximity to Human Activity/Roads Indicator

There are currently no known monitoring programs/existing data sources for this indicator.

- NOTE: Spatial data layers exist for some of the northeastern states that provide updated road coverage (e.g., NJ has road coverage; update frequency uncertain).
- NOTE: Some active recreational activity may be mapped through geographic information systems (e.g., ball fields, race tracks).
- NOTE: Sub-target habitats may be difficult to discern through spatial data layers due to inaccuracies or lack of detail (e.g., rock outcrops embedded among forest habitats labeled "forest", barren/ savanna habitats identified as "forest").

➢ **Why is this indicator being monitored by this program**

Human activity/ presence is known to negatively impact sensitive species; many SGCN are sensitive to disturbances and habitat alterations.

➢ **Who is collecting the data**

State agencies were asked if they collect spatial data for road coverage and the unique sub-target habitats and if so, who collects this data/ manages the database:

CT	No master spatial dataset; they have point data for species sightings, mines, den locations, etc. // They have grassland and forest spatial data layers.// Road data collected by CT DEP.
DE	DE NHP and ESP- some habitat data; spatial data for LULC & roads & some habitat data,
ME	ME Dept. Inland Fisheries and Wildlife, ME Office of GIS, [LULC available combination of satellite/orthophoto data (5 and 30 m resolution), road data available, Natural areas program maintains some habitat data]
MA	NHESP; LU codes coarse (rocky habitats together with mining, sand, gravel, road data available)
MD	MD State GIS Comm and Townson Univ: LULC and roads available
NH	NH Natural Heritage Bureau, Univ. of NH-GRANIT, state wide LULC available for multiple years, roads available
NJ	DEP (although rocky habitats, caves/karsts/mines, and barren habitats will be limited data as they become embedded under "forest" land cover due to canopy closure and interpretation of aerial photographs) (1 sq. ft increments)

NY	NYS DEC - LULC, NYDOT - Roads, point data for mines/caves, rocky habitats mapped
VT	Dep. of Fish and Wildlife, Nongame and Natural Heritage Program (data mapped, no natural grasslands/shrublands)
PA	PSU, PADOT, Natural Lands Trust (roads data, LULC data available, specific grasslands, shrub lands data available)
RI	Univ. of RI (spatial data for LULC & roads & some habitat data), RI NHP ESP (some habitat data)
VA	VA Geographic Information network
WV	WVU-GIS Tech. Center, LULC, Roads, Caves, Karsts data available

- **When is the data being collected (monitoring frequency)**

States were asked (if they collect data on road coverage and unique sub-target habitats), from what imagery is the data interpreted, at what grid size, and how often is it updated.

State	Aerial/Satellite?	Grid Size?	Update Frequency?
CT	Pending		
DE	Aerial (2002)	????	variable
ME	combination of satellite/orthophoto data	Combination of 5 and 30 m resolution data	variable
MA	Satellite & orthophoto interpreted	.5 m	Periodic
MD	????	????	????
NH	Aerial & satellite	30 m	????
NJ	Aerial	1 sq. ft.	Periodic (previously 1986, 1995 & 2002, but no set timeline and it takes 3-4 years to interpret the data; e.g., "2002 LU/LC" wasn't available for use until 2006)
NY	Satellite/aerial	30 m	variable
VT	Satellite	30 m	10 years
PA	Satellite	30 m	Roads 2 years, LULC variable
RI	Aerial	30 m	variable
VA	????	????	????
WV	Satellite	30	variable

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

For those states collecting data, tier 1 - remote

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Interpretation of aerial and/or satellite imagery (see table above)

- **Data management/storage**

Unknown

➢ **Data analysis/assessment**
Unknown

➢ **Quality Assurance**
Unknown

B. Potential Issues in Applying Proximity to Human Activity/Roads Data Sets for NEAFWA Framework

- Lack of information/standardization across states.
  - Spatial mapping capability and interpretation of those maps
- [Possible] variation in the states' interpretation of "active" human activity.
- Sub-target habitats may be difficult or impossible to discern through spatial data layers due to inaccuracies or lack of detail, making analysis inaccurate:
  - Rock outcrops, caves, karsts, and mines may be embedded among forest habitats and therefore, mislabeled "forest"
  - Savanna habitats (under barren lands) may be valued according to their canopy density and misidentified as "forest" (e.g., NJ's land use/land cover data can identify "mixed forest with 10-50% canopy" but there is no way to determine if there is a dense understory making this "forest" or open understory, "savanna").

C. Data Gaps for Proximity to Human Activity/Roads

- Coordinated interpretation and/or evaluation of "human activity" must be established.
- Standardized interpretation of mapping must be established for consistency (e.g., NJ is interpreting aerial photos at 1 sq. foot, other states are using 1 sq. meter, others may still be at 30 sq. meters).
- States need to establish method to address the sub-target habitats not captured through aerial or satellite imagery (e.g., outcrops, caves, karsts, mines, savanna).
  - As a starting point, use the equivalent of NJ's canopy coverage to identify barren lands (scrub-shrub habitats and potential savanna habitats).
    http://www.state.nj.us/dep/gis/lulc02cshp.html

D. Next Steps for Data Compilation and Analysis for Proximity to Human Activity/Roads

➢ **Why does this indicator need to be monitored**
Activity and noise pollution from roads and humans are major stressors (directly and indirectly) to species of greatest conservation need at and around critical sites (hibernacula, nests, breeding/ gestating areas, and bisecting foraging grounds).

➢ **Who will collect the data**
Unknown at this time; given the difficulty in identifying some of the sub-target habitats through GIS, this may require partnerships?

➢ **When will the data be collected (monitoring frequency)**
With updates to the states' Land Use/ Land Cover (LU/LC) data. This timeline will be dependent upon each states' resources to update their spatial data layers and time required to

interpret the data. For example, in NJ, there is no set schedule for updating and reinterpreting aerial photographs. LU/LC was updated with 1995 aerials and then with 2002 aerials, but interpretation of aerials takes 3-4 years therefore, the "NJ 2002 LU/LC" was not available until 2006.)

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Tier 1 assessment - remote

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc.**

Using GIS, calculate the average and median linear distances between sub-target habitats and the nearest road(s)/ human activity. Also, provide minimum and maximum distances.
NOTE: This may also require additional information especially when assessing ridges and cliffs spanning long distances. For example, if 50% of the span is within 100m of a road and 50% within 300m of a road, we may want to share that information as the portion at the greater distance from human activity/ roads will be more suitable/ optimal habitat for that area/ species.

- **Data management/storage**

Unknown at this time

- **Quality Assurance**

Unknown at this time.

E. Baseline Condition and/or Past Trends of Proximity to Human Activity/Roads

Requires literature searches.

Sub-target	Indicator species	Habitat qualifiers based on distance to roads and/or human activity			
		Excellent	**Good**	**Fair**	**Poor**
Rocky habitats	Peregrine falcon	???????	???????	???????	???????
	Timber rattlesnake	ROADS: Hibernacula/ gestation sites: 4km Foraging areas: ???? HUMAN ACTIVITY: Hibernacula/gestation sites: (season dependent) ??? Foraging areas: ????	ROADS: Hibernacula/ gestation sites: 2.4 km (????) Foraging areas: ???? HUMAN ACTIVITY: Hibernacula/gestation sites: (season dependent) ??? Foraging areas: ????	ROADS: Hibernacula/ gestation sites: 1.6 km (????) Foraging areas: ???? HUMAN ACTIVITY: Hibernacula/gestation sites: (season dependent) ??? Foraging areas: ????	ROADS: Hibernacula/ gestation sites: .8 km Foraging areas: ???? HUMAN ACTIVITY: Hibernacula/gestation sites: (season dependent) ??? Foraging areas: ????
	Allegheny woodrat	ROADS: Minimum 150 meters from edge of occupied talus to activity	???????	???????	???????
	Long-tailed (rock) shrew	???????	???????	???????	???????
Barren lands	Red-headed woodpecker	Nest area: >250m	Nest area: ????	Nest area: ????	Nest area: <50m
	Common nighthawk	NA	NA	NA	NA
	Golden-winged warbler	Nest area: >1000m	500m <Nest area<1000m	300m <Nest area<500m	Nest area: <300m
Natural grasslands	Upland sandpiper	Nest area: >1000m	NA	300m <Nest area < 1000m	Nest area: <300m
	Grasshopper Sparrow	Nest area: >200m	150m <Nest area < 200m	100m < Nest area < 150m	Nest area: <100m
	Vesper Sparrow	Nest area: >300m	200m <Nest area <300m	100m <Nest area < 200m	Nest area: <100m
	Northern harrier	Nest area: >1000m	NA	300m <Nest area < 1000m	Nest area: <300m
	Frosted Elfin	???????	???????	???????	???????

Appendix 8: Indicators for Unique Habitats of the Northeast Target – NEAFWA Performance Monitoring Framework

Sub-target	Indicator species	Habitat qualifiers based on distance to roads and/or human activity			
		Excellent	**Good**	**Fair**	**Poor**
Caves, mines	Indiana bat Eastern small footed myotis	Hibernacula: ???? Foraging: ???? Maternity roosts: ???	Hibernacula: ???? Foraging: ???? Maternity roosts: ???	Hibernacula: ???? Foraging: ???? Maternity roosts: ???	Hibernacula: ???? Foraging: ???? Maternity roosts: ???
Karsts	???????	???????	???????	???????	???????

F. Additional Comments for Proximity to Human Activity/Roads

None offered

G. Citations for Proximity to Human Activity/Roads

Brown, William S. 1993. Timber Rattlesnake: Ecology, Land Protection. *In* Biology, Status, and Management of the Timber Rattlesnake (*Crotalus Horridus)*: A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 15-24, 39-40.

DeGraaf, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. 1989. Terrestrial, Wetland, and Other Nonforested Habitat Types. Pp. 143-144; *In: New England Wildlife: Management of Forested Habitats*. U.S. Government Printing Office, Washington, D.C. Pp. 271.

Martin, W.H. 1993. Reproduction of the Timber Rattlesnake (*Crotalus Horridus)* in the Appalachian Mountains. Journal of Herpetology 27(2):133-143.

Random House Unabridged Dictionary. 2006. Website visited 10/26/07 (http://dictionary.reference.com/browse/).

Schantz, Kris. 2006. Personal communication. Endangered and Nongame Species Program Timber Rattlesnake Telemetry Research 1999-2000, 2003-2005.

US Department of Agriculture-Forest Service. 1979. Cliffs, Talus, and Caves. Pp. 90-103; *In*: J. Louise Parker and Robert A. Mowrey, Eds., *Wildlife Habitats in Managed Forests, the Blue Mountains of Oregon and Washington*. Pp. 510.

H. Mock-up of Report to Decision Makers (for all Unique Habitat Indicators 1-4)

Each report would focus on 1 "poster child" species and their associated habitat. Reports would rotate so that a "new" sub-target habitat is being addressed with each report.

UNIQUE HABITATS OF THE NORTHEAST

FAILURES AND SUCCESSES OF UNIQUE HABITATS:

Description of restoration/enhancement success(es) or loss of a unique habitat.

DISTRIBUTION MAP OF NESTED TARGETS:

Each targeted "unique habitat" would be shown in different colors for quick review and overall understanding.

PERHAPS, we could even provide different shades of each color to illustrate managed/protected areas vs. not, areas where habitats have been altered due to natural processes, etc. For example, caves/mines that are known to exist may be dark blue, while caves/mines that are gated due to known bat populations are in a lighter blue. Basically, by using shades of each color, we would provide visual insight into what's available, what's being monitored for change and/or improvements, even some measure of wildlife diversity and/or population trends…but keep it simple – only 2-3 shades per habitat type.

ENDEMISM VULNERABILITY GRAPHIC:

Provide graphic representation of population trends of species we identify as "key" endemic species under the wildlife indicator (e.g., peregrine falcon, timber rattlesnake, Indiana bat, grasshopper sparrow, vesper sparrow, red-headed woodpecker) –or some other grassland bird, frosted elfin).

FEATURE SPECIES:

Poster child species…details of species' habitat & resource needs, regional status, etc.

PHOTO OF FEATURE SPECIES…
changes with each report

FEATURE BOX (associated with "feature species"):

Recreation value vs. threats to wildlife species. This should focus on the unique habitat that is associated with the "feature species" above but of course also include threats to other wildlife associated with that habitat.

Unique Habitats Indicator 2: Wildlife Presence/Absence

Condition: Monitor wildlife populations in sub-target habitats to evaluate presence/absence and if present, to confirm productivity (focusing on those species dependent upon the sub-target habitat for their survival and/or reproduction).

The presence of a species alone does not indicate a population is stable or recovering but will provide a target location for continued monitoring. Proof of productivity and increasing numbers of individuals is necessary in understanding the dynamics of the population and/or metapopulation. Absence in an area does not indicate a population decline. However, documenting the short- and long-term presence of species followed by a decline in the number of individuals at or disappearance from a site is cause for concern. It is unlikely for species using/ inhabiting sub-targets that are geomorphic in nature to move to another location given the uniqueness of these sites (e.g., temperature regulation, aspect to sun, elevation, underground depth accessibility). However, birds and mammals using barren lands and natural grasslands may change locations due to limited resources or other variables, and therefore, a decline in their presence would require additional surveys to determine if the decline is a population decline or a location shift.

A. Description of Existing Data for Wildlife Presence/Absence Indicator

- **Why is this indicator being monitored by this program**

The presence of species of greatest conservation need at the sub-target habitats can be used as an indicator to help evaluate the suitability of the site. More importantly, proof of productivity and/or recruitment to a location would imply the site is suitable and providing the micro- or macro-habitat climate and resources the species needs to persist.

- **Who is collecting the data**

Presence: State Natural Heritage Programs or Biotics databases; variable data
Productivity: Highly variable data; some states, some species, some sites

Data collection varies among states (*see table below*):
1. For both the sub-target habitats and the species surveyed that occupy those habitats.
2. Regarding survey methods and frequency.

Table: Survey data - wildlife presence

State	Who Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	DEP, FW	Peregrine falcons; 5-lined skink		Grassland birds (BOBO, EAME, GRSP, UPSA HOLA)	Misc.; Indiana, e. small footed bat
DE	DE-NHP-ESP	NA	NA		

State	Who Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
ME	ME Dept of Inland Fisheries and Wildlife; National Park Service	Peregrine falcons			
MA	NHESP	Peregrine falcons; some rattlesnake		Grassland birds	Misc.; Indiana, e. small footed bat
MD	????????				
NH	DFW, NEWP	Peregrine falcons		Grassland birds UPSA	Indiana, e. small footed bat
NJ	DEP's DFW, ENSP	Peregrine falcons; some rattlesnake	Nightjars (whip-poor-wills, common nighthawk, Chuck-wills-widow)	Not really, there's 1 area of natural grasslands that contains a couple of survey points as part of our statewide grassland surveys.	Indiana bats
NY	NYS DEC, ENSP	Peregrine falcons, some rattlesnake	Golden winged warbler?	Grassland birds	Misc. bats, Indiana, e. small footed bat
VT	DFW	Peregrine falcons; 5-lined skink	NA	NA	Indiana bats, eastern small footed bat, other spp. Avail.
PA	PA Dept. of Cons. And natural Resources	Peregrine falcons	????????	????????	Indiana bats, E. Small footed bat
RI	RI-Dept. of Envl. Management	????????	????????	????????	????????
VA	????????				
WV	????????				

- **When is the data being collected (monitoring frequency) (*see table below*):**

Data collection timeframes and frequency varies among states for both the sub-target habitats and the species surveyed that occupy those habitats.

Table: Survey data - wildlife presence

State	When Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	Wildlife: see columns	Peregrine falcons- annual	NA	Grassland birds	Bats - Every 2 years, survey of

State	When Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
		Timber rattlesnakes-periodic			known sites "sites"… Hibernacula? Roosts?
DE	????????				
ME	LULC-no regular update, some specific habitats/locations regularly updated	Peregrine falcons-annual			
MA	Wildlife: see columns	Peregrine falcons (annual); timber rattlesnakes (periodic)		Grassland birds (variable)	Bats (periodic) Hibernacula? Roosts?
MD	????????				
NH	Wildlife: see columns	Peregrine falcons (annual)	NA	Grassland birds (???)	Bats (periodic)
NJ	Wildlife: see columns	Peregrine falcons (annually); some rattlesnake (3-4 year intervals at select dens/gestation sites)	Common nighthawk: (annually if funded, but only selected locations with the NE Coordinated Bird Monitoring); Golden-winged warbler (survey possibly on 5-7 year cycle, funding dependent)	NA	Indiana bats (every 2 years @ 1 known hibernacula)
NY	Wildlife: see columns	Peregrine falcons (variable); rattlesnake (variable)	Golden winged warbler –project (???)	Grassland birds (variable)	Bats [all sites, (hibernacula) surveyed approx. 1 time out of 3years…3-yr cycle]
VT	Wildlife: see columns	Peregrine falcons (annually)	NA	NA	Bats (survey of known sites, varying schedule) "sites"… Hibernacula? Roosts?
PA	Wildlife: see columns	Peregrine falcons (annually)			Bats (survey of known sites, varying schedule, surveys

State	When Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
					conducted to locate new sites)
RI	????????				
VA	????????				
WV	????????				

Table: Public reporting/ observations - wildlife presence

CT	CT-accepts and reviews public sightings, limited spatial input, a) bats surveyed every two years at known sites, b) peregrines surveyed annually c) grassland birds, habitat surveyed on a varying schedule, ongoing d) rattlesnakes no ongoing monitoring, periodic survey of known sites
DE	DE: accepts and reviews public sightings data
ME	Natural Areas Program conducts some surveys and reviews(habitat oriented) and data(rare wildlife) is maintained by Dept. of Inland Fisheries and Wildlife
MA	Mass: accepts and reviews public sightings data
MD	MD accepts and reviews public sightings via the NHP
NH	NH. accepts sightings from the public regarding SGCN at the sub-target habitats throughout the year which populates NH's Biotics database; conducts surveys for a) peregrine falcons annually at cliffs, b) bats at suitable caves/mines c) Audubon Soc. Conducts grassland bird surveys
NJ	NJ accepts sightings from the public regarding SGCN at the sub-target habitats throughout the year which populates NJ's Biotics database; conducts surveys for a) bats at suitable caves/mines every 2 years for known hibernaculum, every year for potential locations, b) peregrine falcons annually at cliffs, c) timber rattlesnakes at a subset of potential den locations annually and a subset of gestation sites every 3-5 years, d) songbird surveys at select sites of grasslands and barren lands varies with funding resources.
NY	NY accepts sightings from the public regarding SGCN at the sub-target habitats throughout the year which populates NY's Natural heritage database; conducts surveys for a) peregrine falcons annually at cliffs, b) bats at suitable caves/mines every 3 years c) grassland bird surveys, c) golden winged warbler surveys -Shrub??? e) rattlesnake surveys as part of larger Herptile project
VT	VT accepts sightings from the public regarding SGCN at the sub-target habitats throughout the year which populates VT's Biotics database; conducts surveys for a) peregrine falcons annually at cliffs, b) bats at suitable caves/mines c) planned monitoring for black racers, rock voles, 5 lined skinks in rocky habitats
PA	????????
RI	????????
VA	????????
WV	????????

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Tier 3 assessment

Table: Survey data - wildlife presence

State	Where Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	Wildlife: see columns	Peregrine falcons		Grassland birds (screening)	Misc. bats & Indiana bats

State	Where Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
		(intensive);			(screening/ intensive)
DE	????????				
ME	Wildlife- see columns	Peregrine falcons (intensive)			
MA	Wildlife- see columns	Peregrine falcons (intensive)		Grassland birds (screening)	Misc. bats & Indiana bats (screening/ intensive)
MD	????????				
NH	Wildlife: see columns	Peregrine falcons (intensive)		Grassland birds (screening)	Misc. bats & Indiana bats (screening/ intensive)
NJ	Wildlife: see columns	Peregrine falcons (intensive); some rattlesnake (screening and intensive)	Common nighthawk: (screening and intensive, but only selected locations); Golden-winged warbler (screening and intensive – if conducted)	NA	Misc. bats & Indiana bats (screening/ intensive)
NY	Wildlife: see columns	Peregrine falcons (screening); some rattlesnake (screening)	GWWA (screening)	Grassland birds (screening)	Misc. bats (screening/ intensive) – use telemetry
VT	Wildlife: see columns	Peregrine falcons (intensive)	NA	NA	Misc. bats & Indiana bats (screening/ intensive)
PA	Wildlife: see columns	Peregrine falcons (intensive)			Misc. bats & Indiana bats (screening/ intensive)
RI	????????				
VA	????????				
WV	????????				

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Depends on habitat (sub-target) and target species

Table: Survey data - wildlife presence

State	Rocky habitats	Barren lands	Natural grasslands	Caves, karsts, mines
CT	Peregrine falcons (fixed); rattlesnakes (fixed)		Grassland birds (fixed)	Indiana bats (fixed)
DE	????????			
ME	Peregrine falcons (fixed)			Indiana bats (fixed)
MA	Peregrine falcons (fixed); rattlesnakes (fixed)		Grassland birds (fixed)	Indiana bats (fixed)
MD	????????			
NH	Peregrine falcons (fixed);		Grassland birds (fixed)	Indiana bats (fixed)
NJ	Peregrine falcons (fixed); some rattlesnake (fixed for trend/ productivity and probabilistic for new dens)	Common nighthawk: (fixed-point counts)	NA	Indiana bats (fixed)
NY	Peregrine falcons (fixed); rattlesnake (fixed)	GWWA (fixed)	Grassland birds (fixed)	Indiana bats, other bats (fixed, radio tracking)
VT	Peregrine falcons (fixed)	NA	NA	Indiana bats (fixed)
PA	Peregrine falcons (fixed)			Indiana bats (fixed)
RI	????????			
VA	????????			
WV	????????			

- **Data management/storage**

CT	DEP - FW - natural heritage database, no spatial database
DE	????????
ME	????????
MA	????????
MD	????????
NH	DFW - nongame program, NHP - Biotics
NJ	DEP, DFW, ENSP – Biotics database and Landscape Map
NY	Natural Heritage Program's database
VT	DFW - Biotics database, mapped spatially
PA	????????
RI	????????
VA	????????
WV	????????

- **Data analysis/assessment**

Unknown at this time

➢ **Quality Assurance**

CT	Public observations are reviewed by DFW staff
DE	????????
ME	????????
MA	Public observations are reviewed by NHESP staff
MD	Public observations are reviewed by NHP staff
NH	Public observations are reviewed by DFW staff before processing by NHP
NJ	Public observations are submitted through an intense screening process that includes the state's expert biologist for the observed species reviewing, scrutinizing, and when necessary gathering additional information or conducting a field site visit to confirm or reject the observation of rare wildlife.
NY	Public observations are reviewed by program staff before entry
VT	Public observations are reviewed by Biotics staff before entry
PA	????????
RI	????????
VA	????????
WV	????????

B. Potential Issues in Applying Wildlife Presence/Absence Data Sets for NEAFWA Framework

- Lack of information/standardization across states.
    - Spatial mapping capability and interpretation of those maps
- Lack of standards across states for survey methods and species tracked; may lead to erroneous results in regional trend data.
- Sub-target habitats may be difficult or impossible to discern through spatial data layers due to inaccuracies or lack of detail, making locating potential sites for wildlife surveys impossible:
    - Rock outcrops, caves, karsts, and mines may be embedded among forest habitats and therefore, mislabeled "forest"
    - Savanna habitats (under barren lands) may be valued according to their canopy density and misidentified as "forest" (e.g., NJ's land use/land cover data can identify "mixed forest with 10-50% canopy" but there is no way to determine if there is a dense understory making this "forest" or open understory, "savanna").

C. Data Gaps for Wildlife Presence/Absence

- Coordinated survey methods and time periods must be established and conducted for each appropriate taxonomic group and sub-target habitat among the states.
- States need to establish method to locate sub-target habitats not captured through aerial or satellite imagery.

D. Next Steps for Data Compilation and Analysis for Wildlife Presence/Absence

➢ **Why does this indicator need to be monitored**

Proof of continued productivity and increasing numbers (or recruitment) of individuals is necessary in understanding the dynamics of the population and/or metapopulation and the suitability of the sub-target habitat (and surrounding habitat).

- **Who will collect the data**

Partnerships between state wildlife agencies and non-government organizations; can rely on trained and/or experienced volunteers to help complete surveys.

- **When will the data be collected (monitoring frequency)**

Sub-target	Indicator species	Monitoring frequency?
Rocky habitats	Peregrine falcon	Annually
	Timber rattlesnake	Known dens and gestation sites should be NOT be surveyed annually due to disturbance; sites should not be visited at less than 3 - 4 year intervals; dens=spring, gestation sites=July – early September
	Allegheny woodrat	Minimum: Annually – early fall (e.g, NJ=October) Preferred: Bi-annually (spring and early fall)
	Long-tailed (rock) shrew	????????
Barren lands	Red-headed woodpecker	Every 3-5 years
	Common nighthawk	Current project is annually to develop baseline data, once baseline developed then every 3-5 years
	Golden-winged warbler	Every 3-5 years
Natural grasslands	Upland sandpiper	Annually
	Grasshopper Sparrow	Annually
	Vesper Sparrow	Annually
	Northern harrier	Annually
	Frosted Elfin	Annually
Caves, mines	Indiana bat	Known hibernacula should not be surveyed more than every other year due to disturbance; winter survey
	Eastern small footed myotis	
Karsts	????????	????????

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Tier 3 assessment - intensive

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc.**

Survey methods will vary with state depending on available resources and GIS capabilities

Sub-target	Indicator species	Data collection?
Rocky habitats	Peregrine falcon	Fixed
	Timber rattlesnake	Known dens: fixed Potential dens: some states – random; NJ – probability map (GIS model) Known gestation sites: fixed Potential gestation sites: random/ opportunistic

Sub-target	Indicator species	Data collection?
	Allegheny woodrat	Fixed or random/opportunisitic
	Long-tailed (rock) shrew	????????
Barren lands	Red-headed woodpecker	Stratified by habitat
	Common nighthawk	Stratified by habitat
	Golden-winged warbler	Stratified by habitat
Natural grasslands	Upland sandpiper	Stratified by habitat
	Grasshopper Sparrow	Stratified by habitat
	Vesper Sparrow	Stratified by habitat
	Northern harrier	Stratified by habitat
	Frosted Elfin	Known sites: fixed Potential sites: opportunistic OR probabilistic ????
Caves, mines	Indiana bat	Known hibernacula: fixed
	Eastern small footed myotis	
Karsts	????????	????????

- **Data management/storage**

Unknown at this time. Method should be coordinated among states…although the national biotics database seems the most likely method given the data that can be queried from it.

- **Quality Assurance**

Unknown at this time. Method should be coordinated among states.

E. Baseline Condition and/or Past Trends of Wildlife Presence/Absence

Information not available.

F. Additional Comments on Wildlife Presence/Absence

None offered

G. Citations for Wildlife Presence/Absence

DeGraaf, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. 1989. Terrestrial, Wetland, and Other Nonforested Habitat Types. Pp. 143-144; *In: New England Wildlife: Management of Forested Habitats*. U.S. Government Printing Office, Washington, D.C. Pp. 271.

Random House Unabridged Dictionary. 2006. Website visited 10/26/07 (http://dictionary.reference.com/browse/).

US Department of Agriculture-Forest Service. 1979. Cliffs, Talus, and Caves. Pp. 90-103; *In*: J. Louise Parker and Robert A. Mowrey, Eds., *Wildlife Habitats in Managed Forests, the Blue Mountains of Oregon and Washington*. Pp. 510.

H. Mock-up of Report to Decision Makers (for Wildlife Presence/Absence)

See Mock-up for all Unique Habitat Indicators under Unique Habitats Indicator 1: Proximity to Human Activity/Roads.

Unique Habitats Indicator 3: Wildlife Population Trends

Condition: Monitor wildlife populations in sub-target habitats to determine population trends in relation to changing land use at or around unique habitats.

Understanding the effects of a changing landscape on a population is critical to the development and implementation of management strategies. SGCN populations' baseline database must be developed in order to evaluate the long-term effects of the ever-changing landscape (through natural or manmade processes). SGCN are often wildlife species sensitive to disturbance and that require specific micro- and macro-habitats (e.g., nests in trees of a particular diameter within a particular vegetated structure, hibernacula reaching below the frost line and maintaining stable temperatures). When those characteristics are altered, the impacts could be detrimental to the species that depend upon them.

A. Description of Existing Data for Wildlife Population Trends Indicator

- **Why is this indicator being monitored by this program**

Understanding populations trends as they relate to a changing landscape provides insight to the needs and requirements (thresholds) of SGCN and can be used in planning, prioritizing land acquisition, and developing habitat and/or wildlife management strategies.

- **Who is collecting the data**

Wildlife Trends: Highly variable data; some states, some species, some sites (*see table below)*
LU/LC: *see table below*

Table: Wildlife populations

State	Who Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	DEP, FW	Peregrine falcons; 5-lined skink		Grassland birds (BOBO, EAME, GRSP, UPSA HOLA)	Misc.; Indiana, e. small footed bat
DE	DE-NHP-ESP	NA	NA		
ME	ME Dept of Inland Fisheries and Wildlife; National Park Service	Peregrine falcons			
MA	NHESP	Peregrine falcons; some rattlesnake		Grassland birds	Misc.; Indiana, e. small footed bat
MD	????????				
NH	DFW, NEWP	Peregrine falcons		Grassland birds UPSA	Indiana, e. small footed bat
NJ	DEP's DFW, ENSP	Peregrine falcons; some	Nightjars (whip-poor-wills,	Not really, there's 1 area of	Misc. bats, Indiana bats

State	Who Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
		rattlesnake	common nighthawk, Chuck-wills-widow)	natural grasslands that contains a couple of survey points as part of our statewide grassland surveys.	
NY	NYS DEC, ENSP	Peregrine falcons, some rattlesnake	Golden winged warbler?	Grassland birds	Misc.; Indiana, e. small footed bat
VT	DFW	Peregrine falcons; 5-lined skink	NA	NA	Indiana bats, eastern small footed bat, other spp. Avail.
PA	PA Dept. of Cons. And natural Resources	Peregrine falcons	????????	????????	Indiana bats, E. Small footed bat
RI	RI-Dept. of Envl. Management	????????	????????	????????	????????
VA	????????				
WV	????????				

Table: Landscape changes (land use/ land cover) - WHO is collecting?

CT	DEP, UCONN - (limited data, spp. Or habitat specific, problem with classification of aquaducts (bats) as being manmade, cave, or mine. Generally considered a mine but not quite the same)
DE	DE-LULC available 1997, 2002 for comparison, other specific habitat data available
ME	Maine office of GIS, LULC data available for several years/possible use for LULC change
MA	Natl. Heritage Endangered Species Program
MD	MD State Geographic Information Comm: LULC avail, not regularly updated, roads available
NH	NHP
NJ	NJ DEP (data can be used to evaluate changing landscapes, but rocky habitats, caves/karsts/mines, and barren lands will be limited data as they become embedded under "forest" land cover due to canopy closure and therefore, changes in their immediate area may not be identified)
NY	NYS DEC
VT	DFW
PA	PSU-Dept. of Cons. & Natl. Resources, LULC is available for two different years but later version is update of older version not really good for a comparison?
RI	WHO???; LULC 1995 is available, roads available no update schecule
VA	???????
WV	WVU-GIS Tech. Center, LULC, roads, Karsts, mines data available

- **When is the data being collected (monitoring frequency)**

Table: Wildlife populations

State	When Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	Wildlife: see columns	Peregrine falcons- annual Timber rattlesnakes- periodic	NA	Grassland birds	Bats - Every 2 years, survey of known sites "sites"… Hibernacula? Roosts?
DE	????????				
ME	LULC-no regular update, some specific habitats/locations regularly updated	Peregrine falcons-annual			
MA	Wildlife: see columns	Peregrine falcons (annual); timber rattlesnakes (periodic)		Grassland birds (variable)	Bats (periodic) Hibernacula? Roosts?
MD	????????				
NH	Wildlife: see columns	Peregrine falcons (annual)	NA	Grassland birds (???)	Bats (periodic)
NJ	Wildlife: see columns	Peregrine falcons (annually); some rattlesnake (3-4 year intervals at select dens/gestation sites)	Golden-winged warbler (survey possibly on 5-7 year cycle, funding dependent); Common nighthawk: (annually if funded, but only selected locations with the NE Coordinated Bird Monitoring)	NA	Indiana bats (every 2 years @ 1 known hibernacula)
NY	Wildlife: see columns	Peregrine falcons (variable); rattlesnake (variable)	Golden winged warbler –project (???)	Grassland birds (variable)	Bats [all sites, (hibernacula) surveyed approx. 1 time out of 3years…3-yr cycle]
VT	Wildlife: see columns	Peregrine falcons (annually)	NA	NA	Bats (survey of known sites, varying schedule) "sites"… Hibernacula? Roosts?

State	When Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
PA	Wildlife: see columns	Peregrine falcons (annually)			Bats (survey of known sites, varying schedule, surveys conducted to locate new sites)
RI	????????				
VA	????????				
WV	????????				

Table: Landscape changes (land use/ land cover) – WHEN are they collecting data?

CT	????????
DE	????????
ME	????????
MA	Monitoring for LU/LC change done for 1971-1985 and 1985-1999, rocky habitats embedded with mining, sand, gravel, etc.; LU/LC data collection - timeline variable
MD	
NH	Data available for LU/LC, not regularly updated; LU/LC data collection - timeline variable
NJ	No set schedule for updating LU/LC; version done in 1986, 1995, and 2002 (although it takes 3-4 years to interpret the data; e.g., "2002 LU/LC" wasn't available for use until 2006); LU/LC data collection - timeline variable
NY	LU/LC - timeline variable, use USGS data
VT	LU/LC data collection - timeline variable
PA	LULC data all available, specific data available for grasslands, shrub lands; LULC is available for two different years but later version is update of older version not really good for a comparison? - timeline variable
RI	????????
VA	????????
WV	????????

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

Table: Wildlife populations – tier assessment?

State	Where Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	Wildlife: see columns	Peregrine falcons (intensive);		Grassland birds (screening)	Misc. bats & Indiana bats (screening/ intensive)
DE	????????				
ME	Wildlife- see columns	Peregrine falcons (intensive)			
MA	Wildlife- see columns	Peregrine falcons (intensive)		Grassland birds (screening)	Misc. bats & Indiana bats (screening/ intensive)

State	Where Collecting?	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
MD	????????				
NH	Wildlife: see columns	Peregrine falcons (intensive)		Grassland birds (screening)	Misc. bats & Indiana bats (screening/ intensive)
NJ	Wildlife: see columns	Peregrine falcons (intensive); some rattlesnake (screening and intensive)	Common nighthawk: (screening and intensive, but only selected locations)	NA	Misc. bats & Indiana bats (screening/ intensive)
NY	Wildlife: see columns	Peregrine falcons (screening); some rattlesnake (screening)	GWWA (screening)	Grassland birds (screening)	Misc. bats (screening/ intensive) – use telemetry
VT	Wildlife: see columns	Peregrine falcons (intensive)	NA	NA	Misc. bats & Indiana bats (screening/ intensive)
PA	Wildlife: see columns	Peregrine falcons (intensive)			Misc. bats & Indiana bats (screening/ intensive)
RI	????????				
VA	????????				
WV	????????				

Table: Landscape changes (land use/ land cover) – tier assessment?

CT	????????
DE	????????
ME	????????
MA	Tier 1 - remote but then ground truthed (Tier 2?)
MD	????????
NH	Tier 1 - remote
NJ	Tier 1 - remote
NY	Tier 1 - remote
VT	Tier 1 - remote
PA	Tier 1 - remote
RI	????????
VA	????????
WV	????????

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

State	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
CT	Peregrine falcons (fixed);		Grassland birds (fixed)	Indiana bats (fixed)

State	Rocky Habitats	Barren Lands	Natural Grasslands	Caves, Karsts, Mines
	rattlesnakes (fixed)			
DE	????????			
ME	Peregrine falcons (fixed)			Indiana bats (fixed)
MA	Peregrine falcons (fixed); rattlesnakes (fixed)		Grassland birds (fixed)	Indiana bats (fixed)
MD	????????			
NH	Peregrine falcons (fixed);		Grassland birds (fixed)	Indiana bats (fixed)
NJ	Peregrine falcons (fixed); some rattlesnake (fixed for trend/ productivity and probabilistic for new dens)	Common nighthawk: (fixed-point counts)	NA	Misc. bats (hibernacula population trend only); Indiana bats (fixed)
NY	Peregrine falcons (fixed); rattlesnake (fixed)	GWWA (fixed)	Grassland birds (fixed)	Indiana bats, other bats (fixed, radio tracking)
VT	Peregrine falcons (fixed)	NA	NA	Indiana bats (fixed)
PA	Peregrine falcons (fixed)			Indiana bats (fixed)
RI	????????			
VA	????????			
WV	????????			

- **Data management/storage**

CT	DEP, FW - natural heritage database, no spatial database
DE	????????
ME	Maine –Natural Areas Program, Dept. Inland Fisheries and Wildlife
MA	NHESP- natural heritage database
MD	????????
NH	DFW - nongame program, NHP - Biotics
NJ	DEP, DFW, ENSP – Biotics database and Landscape Map
NY	NYS DEC, NHP database
VT	DFW - Biotics database, mapped spatially
PA	PA Natural heritage program, Dept. of Cons. And Natl. Resources
RI	RI Dept. of Envl. Management-Natural heritage Program
VA	VA Dept. of Conservation and Recreation-NHP
WV	WV Wildlife Diversity Program and Natural heritage Program

- **Data analysis/assessment**

Unknown at this time.

CT	????????
DE	????????
ME	????????
MA	????????
MD	????????
NH	????????
NJ	????????
NY	????????
VT	????????
PA	????????
RI	????????
VA	????????
WV	????????

- **Quality Assurance**

CT	Surveys done by experienced or trained volunteers, wildlife professionals or staff, observations/data reviewed by staff
DE	????????
ME	????????
MA	Surveys done by experienced or trained volunteers, wildlife professionals or staff, observations/data reviewed by staff
MD	????????
NH	Surveys done by experienced or trained volunteers, wildlife professionals or staff, observations/data reviewed by nongame program staff
NJ	Surveys done by experienced or trained volunteers, wildlife professionals; ENSP's biologists review all rare species observations, scrutinize reports and determine validity
NY	Surveys done by experienced or trained volunteers, wildlife professionals; ENSP's biologists review all rare species observations, scrutinize reports and determine validity
VT	Surveys conducted by DFW staff, observations/ data reviewed by staff
PA	????????
RI	????????
VA	????????
WV	????????

B. Potential Issues in Applying <u>Wildlife Population Trends</u> Data Sets for NEAFWA Framework

- Lack of information/standardization across states.
  - Spatial mapping capability and interpretation of those maps
  - Survey methods and species tracked; may lead to erroneous results in regional trend data.
- Sub-target habitats may be difficult or impossible to discern through spatial data layers due to inaccuracies or lack of detail, making analysis inaccurate:
  - Rock outcrops, caves, karsts, and mines may be embedded among forest habitats and therefore, mislabeled "forest"
  - Savanna habitats (under barren lands) may be valued according to their canopy density and misidentified as "forest" (e.g., NJ's land use/land cover data can identify "mixed forest with 10-50% canopy" but there is no way to determine if there is a dense understory making this "forest" or open understory, "savanna").

C. Data Gaps for Wildlife Population Trends

- Coordinated survey methods and time periods must be established and conducted for each appropriate taxonomic group and sub-target habitat among the states.
- Coordinated interpretation and/or evaluation of changing landscape must be established and implemented among the states.
- States need to establish method to address sub-target habitats not captured through aerial or satellite imagery.

D. Next Steps for Data Compilation and Analysis for Wildlife Population Trends

➢ **Why does this indicator need to be monitored**

Alteration in micro- and/or macro-habitat structure has been shown to cause nest failure and abandonment, alteration in behavior (from optimal to less optimal), and population declines (whether through site abandonment by birds, mammals, and invertebrates or through mortality or failure to reproduce by reptiles, amphibians, and invertebrates). Understanding species' thresholds will provide critical insight to planning processes.

➢ **Who will collect the data**

Wildlife: Partnerships between state wildlife agencies and non-government organizations; can rely on trained and/or experienced volunteers to help complete surveys.
LU/LC: Same agencies currently working on this data, but states will need to coordinate information collection.

➢ **When will the data be collected (monitoring frequency)**

Wildlife: This should be coordinated between the states.
LU/LC: *See same question under "B" above.* Due to the expense of this task, states will need to coordinate efforts or develop a method to account for partial updated information (if some states update and others don't).

➢ **Where is the data collected (monitoring scope – remote, screening, intensive)**

Wildlife: Tier 2 and 3 assessment – screening and intensive
LU/LC: Tier 1 - remote

➢ **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc.**

This should be coordinated between the states.

➢ **Data management/storage**

Incomplete data compilation for this exercise at this time

➢ **Quality Assurance**

Incomplete data compilation for this exercise at this time

E. Baseline Condition and/or Past Trends of Wildlife Population Trends

Information not available.

F. Additional Comments for Wildlife Population Trends

None offered.

G. Citations for Wildlife Population Trends

DeGraaf, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. 1989. Terrestrial, Wetland, and Other Nonforested Habitat Types. Pp. 143-144; *In: New England Wildlife: Management of Forested Habitats*. U.S. Government Printing Office, Washington, D.C. Pp. 271.

Random House Unabridged Dictionary. 2006. Website visited 10/26/07 (http://dictionary.reference.com/browse/).

US Department of Agriculture-Forest Service. 1979. Cliffs, Talus, and Caves. Pp. 90-103; *In*: J. Louise Parker and Robert A. Mowrey, Eds., *Wildlife Habitats in Managed Forests, the Blue Mountains of Oregon and Washington*. Pp. 510.

H. Mock-up of Report to Decision Makers (for Wildlife Population Trends)

See Mock-up for all Unique Habitat Indicators under Unique Habitats Indicator 1: Proximity to Human Activity/Roads.

Unique Habitats Indicator 4: Land Use/Connectivity

Connectivity: Monitor land use/ land cover changes at or surrounding unique sub-target habitats.

Species using these unique habitats (sub-targets) often rely upon these areas for critical life stages (e.g., hibernacula, gestation/birthing/nesting areas) or for their survival, conducting all their activities within the designated habitat. As these areas are naturally (e.g., succession, rock slides, cave-ins, drought) or human- (e.g., development, filling/ blocking) altered, these species must adapt or find suitable habitat elsewhere forcing them to use valuable fat resources in search of new sites. By monitoring these areas, management plans to maintain optimal habitats can be developed, implemented, and evaluated at priority locations and adapted as necessary.

A. Description of Existing Data for Land Use/Land Cover Changes Indicator

Currently, states collecting land use data encompasses all habitat types, but detail is limited by GIS capability and satellite imagery/ aerial photography and therefore, some habitats (e.g., rocky areas under canopy, barren lands such as scrub-shrub or savanna) may not be identified properly.

- **Why is this indicator being monitored by this program**

SGCN are often sensitive to habitat disturbance and alteration, leading to nest failure, site abandonment, and population declines.

- **Who is collecting the data**

CT	DEP, UCONN (limited data, spp. or habitat specific, problem with classification of aquaducts (bats) as being manmade, cave, or mine. Generally considered a mine but not quite the same).// They have grassland and forest spatial data layers.// Road data collected by CT DEP.
DE	DE-LULC available 1997, 2002 for comparison, other specific habitat data available
ME	Maine office of GIS, LULC data available for several years/possible use for LULC change
MA	Natl. Heritage Endangered Species Program
MD	MD State Geographic Information Comm: LULC avail, not regularly updated, roads available
NH	NHP
NJ	DEP (data can be used to evaluate changing landscapes, but rocky habitats, caves/karsts/mines, and barren lands will be limited data as they become embedded under "forest" land cover due to canopy closure and therefore, changes in their immediate area may not be identified)
NY	NHP-data available for LULC, DOT-roads, not regularly updated, more specific data available to certain locations or habitat types
VT	DFW
PA	PSU-Dept. of Cons. & Natl. Resources, LULC is available for two different years but later version is update of older version not really good for a comparison?
RI	WHO???; LULC 1995 is available, roads available no update schedule
VA	???????
WV	WVU-GIS Tech. Center, LULC, roads, Karsts, mines data available

- **When is the data being collected (monitoring frequency)**

States were asked (if they collect data on road coverage and unique sub-target habitats), from what imagery is the data interpreted, at what grid size, and how often is it updated.

State	Aerial/Satellite?	Grid Size?	Update Frequency?
CT	Pending	???????	???????
DE	Aerial (2002)	????	variable
ME	combination of satellite/orthophoto data	Combination of 5 and 30 m resolution data	variable
MA	Satellite & orthophoto interpreted	.5 m	Periodic
MD	???????	???????	???????
NH	Aerial & satellite	30 m	???????
NJ	Aerial	1 sq. ft.	Periodic (previously 1986, 1995 & 2002, but no set timeline and it takes 3-4 years to interpret the data; e.g., "2002 LU/LC" wasn't available for use until 2006)
NY	Satellite/aerial	30 m	variable
VT	Satellite	30 m	10 years
PA	Satellite	30 m	Roads 2 years, LULC variable
RI	Aerial	30 m	variable
VA	???????	???????	???????
WV	Satellite	30	variable

- **Where is the data collected (monitoring scope – remote, screening, intensive)**

For those states collecting data, tier 1 - remote

- **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc)**

Interpretation of aerial and/or satellite imagery (see table above)

- **Data management/storage**

Unknown

- **Data analysis/assessment**

Unknown

- **Quality Assurance**

Unknown

B. Potential Issues in Applying Land Use/Land Cover Changes Data Sets for NEAFWA Framework

- Lack of information/standardization across states.
  - Spatial mapping capability and interpretation of those maps
- Requires long-term monitoring to see severe change at a regional level; may appear stable for some time during reporting.
- Sub-target habitats may be difficult or impossible to discern through spatial data layers due to inaccuracies or lack of detail, making analysis inaccurate:

- Rock outcrops, caves, karsts, and mines may be embedded among forest habitats and therefore, mislabeled "forest"
- Savanna habitats (under barren lands) may be valued according to their canopy density and misidentified as "forest" (e.g., NJ's land use/land cover data can identify "mixed forest with 10-50% canopy" but there is no way to determine if there is a dense understory making this "forest" or open understory, "savanna").

C. Data Gaps for Land Use/Land Cover Changes

- Coordinated mapping techniques (and metrics) and interpretation of aerial photos must be established (e.g., NJ is interpreting aerial photos at 1 sq. foot, other states are using 1 sq. meter, others may still be at 30 sq. meters).
- States need to establish method to address sub-target habitats not captured through aerial or satellite imagery.
- Establish on-the-ground monitoring/ evaluation techniques at set number of each sub-target to develop potential changes occurring regionally at more frequent intervals. (NOTE: This one requires intensive surveying…may be too much for this exercise.)

D. Next Steps for Data Compilation and Analysis for Land Use/Land Cover Changes

➢ **Why does this indicator need to be monitored**

Species of greatest conservation need are often those species most sensitive to disturbance (human and habitat alteration). These species often have specific requirements for their persistence (e.g., hibernacula, nest trees of particular size and within a particular vegetative structure). As such, changes to their micro- and macro-habitat could lead to unsuccessful productivity and/or foraging causing population declines.

➢ **Who will collect the data**

Unknown at this time; given the difficulty in identifying some of the sub-target habitats through GIS, this may require partnerships?

➢ **When will the data be collected (monitoring frequency)**

With updates to the states' Land Use/ Land Cover (LU/LC) data. This timeline will be dependent upon each states' resources to update their spatial data layers and time required to interpret the data. For example, in NJ, there is no set schedule for updating and reinterpreting aerial photographs. LU/LC was updated with 1995 aerials and then with 2002 aerials, but interpretation of aerials takes 3-4 years therefore, the "NJ 2002 LU/LC" was not available until 2006.)

➢ **Where is the data collected (monitoring scope – remote, screening, intensive)**

Tier 1 assessment - remote

➢ **How is the data collected (sampling design; random; stratified random; fixed; before/after; probabilistic; etc.**

Using GIS, calculate changes to the landscape at or surrounding sub-target habitats within a given buffer (maximum requirement for SGCN persistence).

Sub-target	Indicator species	Buffer surrounding sub-target habitat for analysis
Rocky habitats	Peregrine falcon	???????
	Timber rattlesnake	4 km buffer around known den locations
	Allegheny woodrat	Minimum 150 meters from edge of occupied talus
	Long-tailed (rock) shrew	???????
Barren lands	Red-headed woodpecker	250 m buffer around nesting areas
	Common nighthawk	300 m buffer around nesting areas
	Golden-winged warbler	800 m buffer around nesting areas
Natural grasslands	Upland sandpiper	1 km buffer around nesting areas
	Grasshopper Sparrow	150 m buffer around nesting areas
	Vesper Sparrow	250 m buffer around nesting areas
	Northern harrier	500 m buffer around nesting areas
	Frosted Elfin	???????
Caves, mines	Indiana bat	5 mile buffer around known hibernacula (????)
	Eastern small footed myotis	
Karsts	???????	???????

- **Data management/storage**

Unknown at this time

- **Quality Assurance**

Unknown at this time.

E. Baseline Condition and/or Past Trends of Land Use/Land Cover Changes

Information not available. This would require an understanding of what percentage of "remaining" suitable sub-target habitat would still permit SGCN to survive/ persist…some threshold for persistence whereby any less, a population would decline.

F. Additional Comments on Land Use/Land Cover Changes

Data from federal agencies and other region wide groups for these indicators should be used for this Indicator. This would provide consistent representation of conditions across the region and data are fairly accessible. We should invite a representative from each of these groups to take part in this reporting for the Northeast region.

Another option would be to compile data available from the states and other groups for each indicator, compile the information, understand the inconsistencies, build a database etc. This is a large task, however the information could prove very useful.

G. Citations for Land Use/Land Cover Changes

DeGraaf, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. 1989. Terrestrial, Wetland, and Other Nonforested Habitat Types. Pp. 143-144; *In: New England Wildlife: Management of Forested Habitats*. U.S. Government Printing Office, Washington, D.C. Pp. 271.

Random House Unabridged Dictionary. 2006. Website visited 10/26/07 (http://dictionary.reference.com/browse/).

US Department of Agriculture-Forest Service. 1979. Cliffs, Talus, and Caves. Pp. 90-103; *In*: J. Louise Parker and Robert A. Mowrey, Eds., *Wildlife Habitats in Managed Forests, the Blue Mountains of Oregon and Washington*. Pp. 510.

H. Mock-up of Report to Decision Makers (for Land Use/Land Cover Changes)

See Mock-up for all Unique Habitat Indicators under Unique Habitats Indicator 1: Proximity to Human Activity/Roads.

Appendix 9: Examples of Results Chains

The Effectiveness Measures Working Group compiled results chains and potential effectiveness indicators for some strategies it felt were either important or commonly supported through State Wildlife Grants. In addition, the first stakeholders' workshop in Albany included an exercise to develop results chains for commonly-used strategies. This appendix serves as a record of those results chains and should be consulted as a reference as States begin to develop results chains for their own strategies. These are organized according to the categories listed in Table 9 of the main Framework report and repeated below:

Table 1. Key Actions for Which Generic Results Chains Could be Developed

1.1 Site/Area Protection
- 1.1.1 Land acquisition

1.2 Resource and Habitat Protection
- 1.2.1 Land protection

2.1 Site/Area Management
- 2.1.1 Site protection
- 2.1.2 Environmental review
- 2.1.3 Habitat surveys and assessment

2.2 Invasive/Problematic Species Control
- 2.2.1 Invasive plant control
- 2.2.2 Invasive animal control

2.3 Habitat and Natural Process Restoration
- 2.3.1 Land clearing/prescribed burns
- 2.3.2 Plantings for SGCN management
- 2.3.3 Dam removal/fish passage
- 2.3.4 Lake/impoundment restoration

3.1 Species Management
- 3.1.1 Baseline Survey/Research
- 3.1.2 Database/GIS/Map development
- 3.1.3 SGCN conservation planning

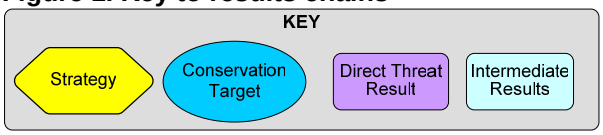
3.2 Species Recovery
- 3.2.1 Spawning/nesting sites

3.3 Species Re-Introduction
- 3.3.1 Species translocation
- 3.3.2 Artificial propagation/stocking

4.2 Training
- 4.2.1 Information exchange with stakeholders

4.3 Awareness and Communications
- 4.3.1 Outreach on program benefits

Figure 1. Key to results chains



2.1 Site/Area Management

2.1.1 Site Protection

Figure 2. Generic Predator Exclosure

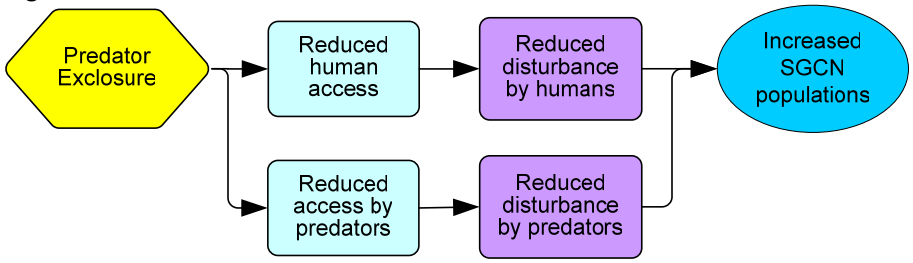


Figure 3. Bat Gates

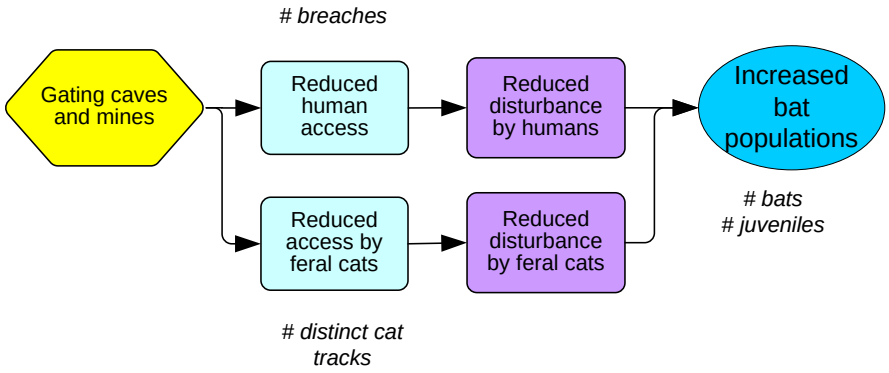


Figure 4. Piping Plover Nest Site Protection Results Chain

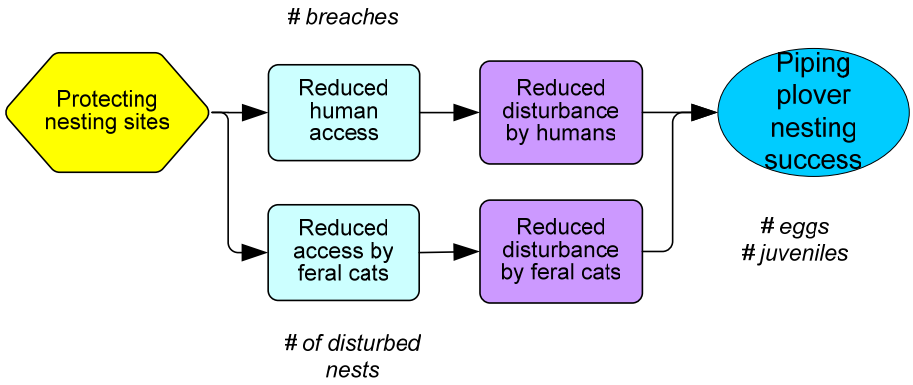


Figure 5. Technical Assistance for Conservation/Wetland Planning

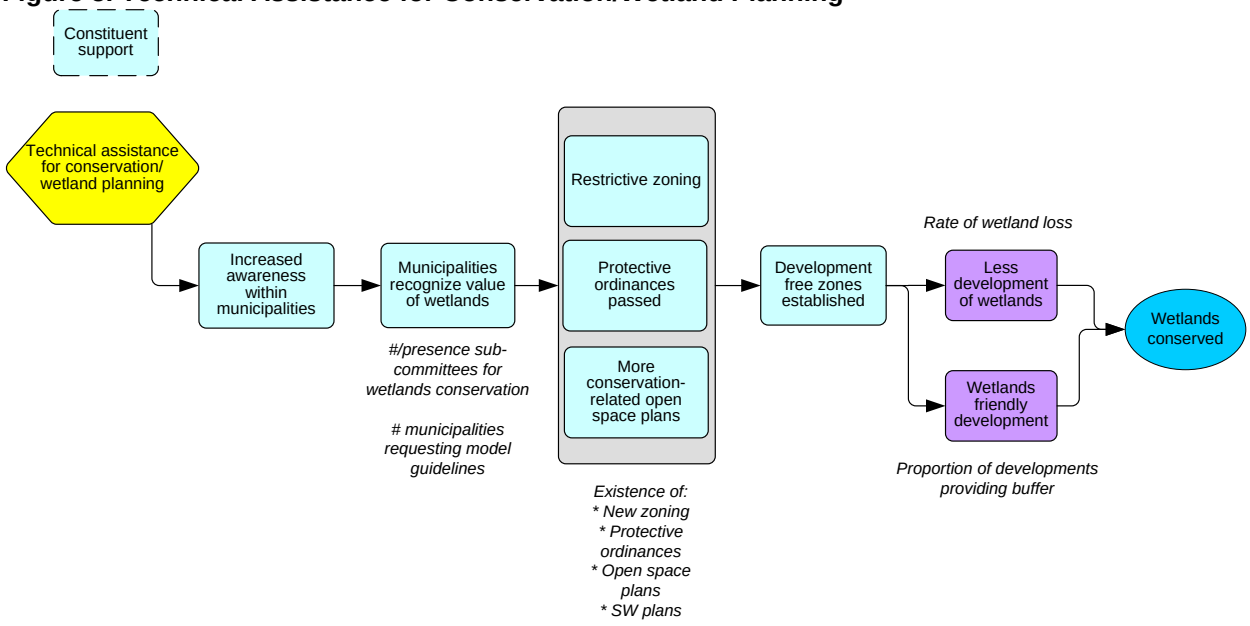
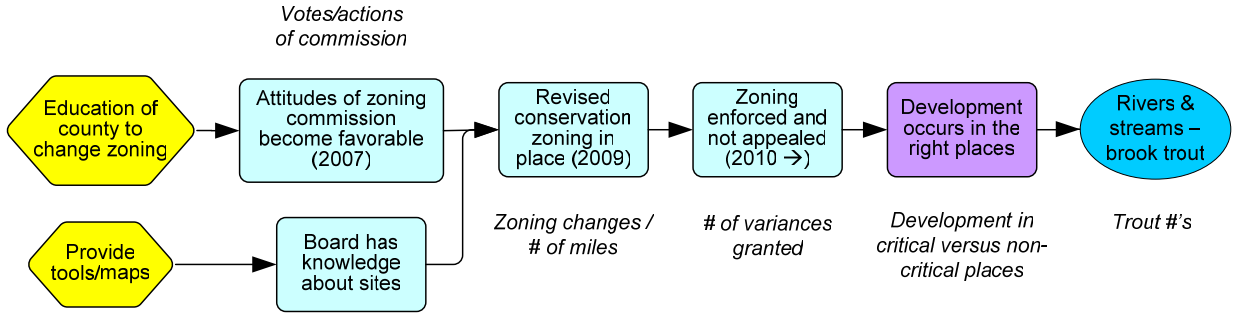


Figure 6. Education on Zoning



2.1.3 Habitat surveys and assessment

Figure 7. Generic Research Example

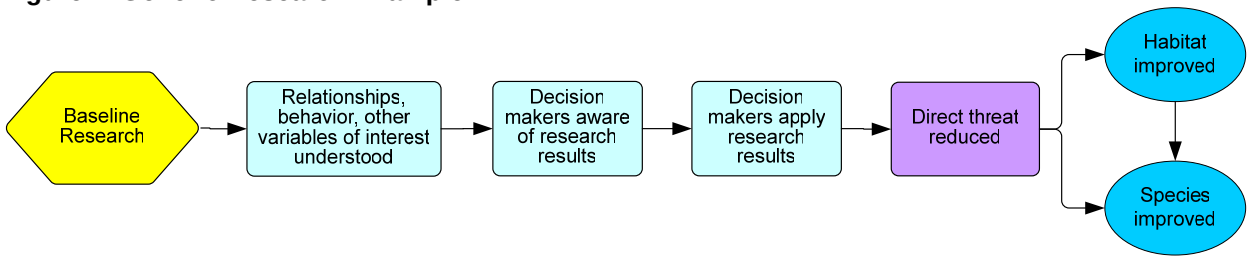


Figure 8. Vermont Lakes Research

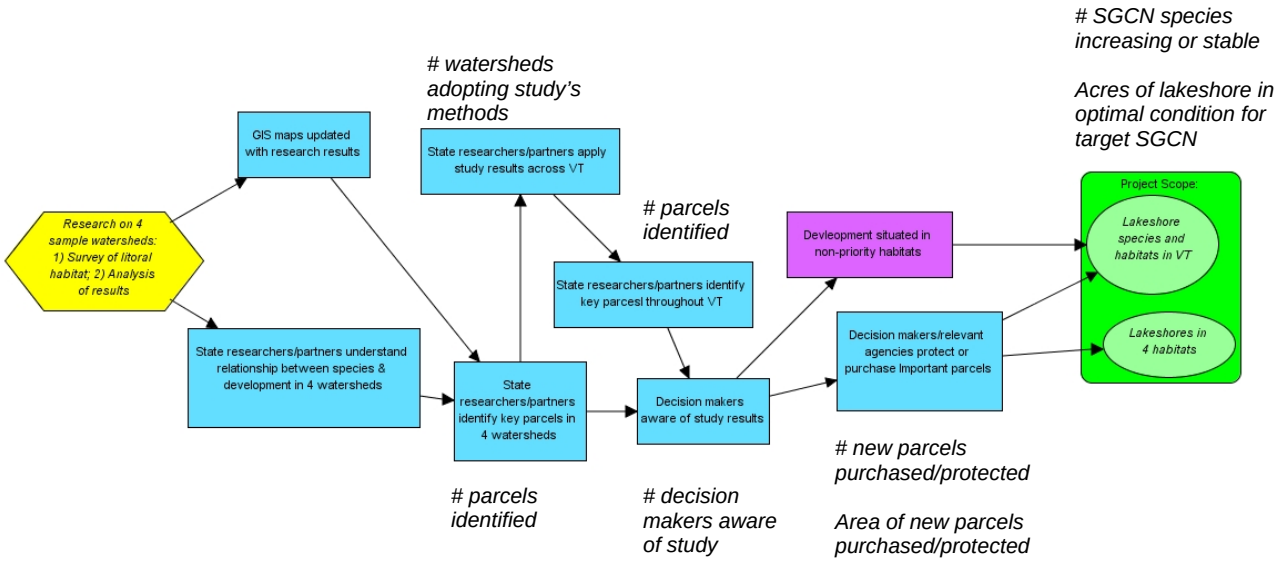


Figure 9. Research on Shortnosed Sturgeon in Delaware River

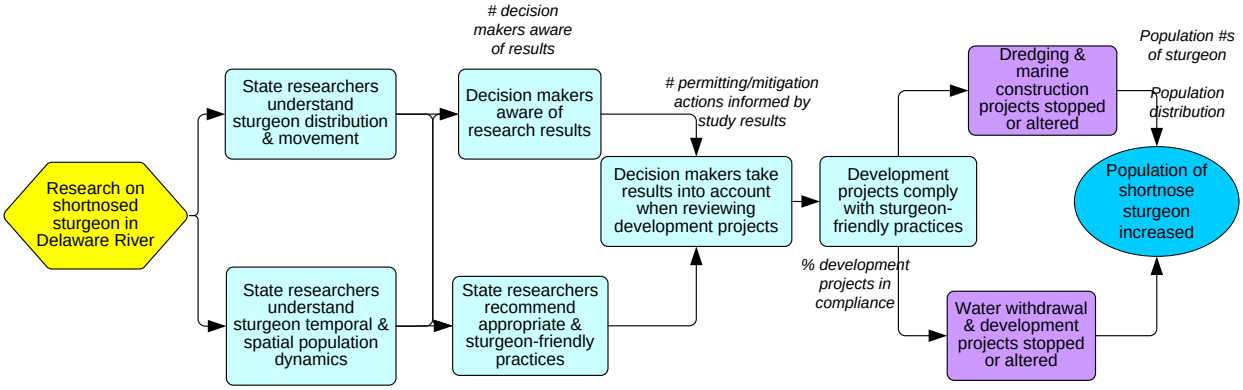
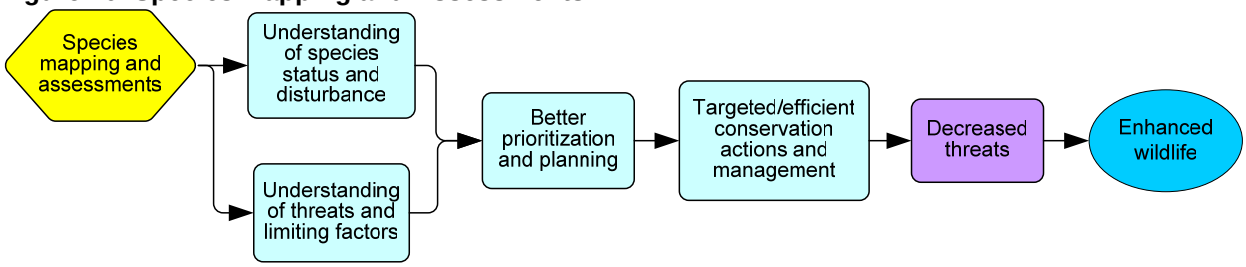


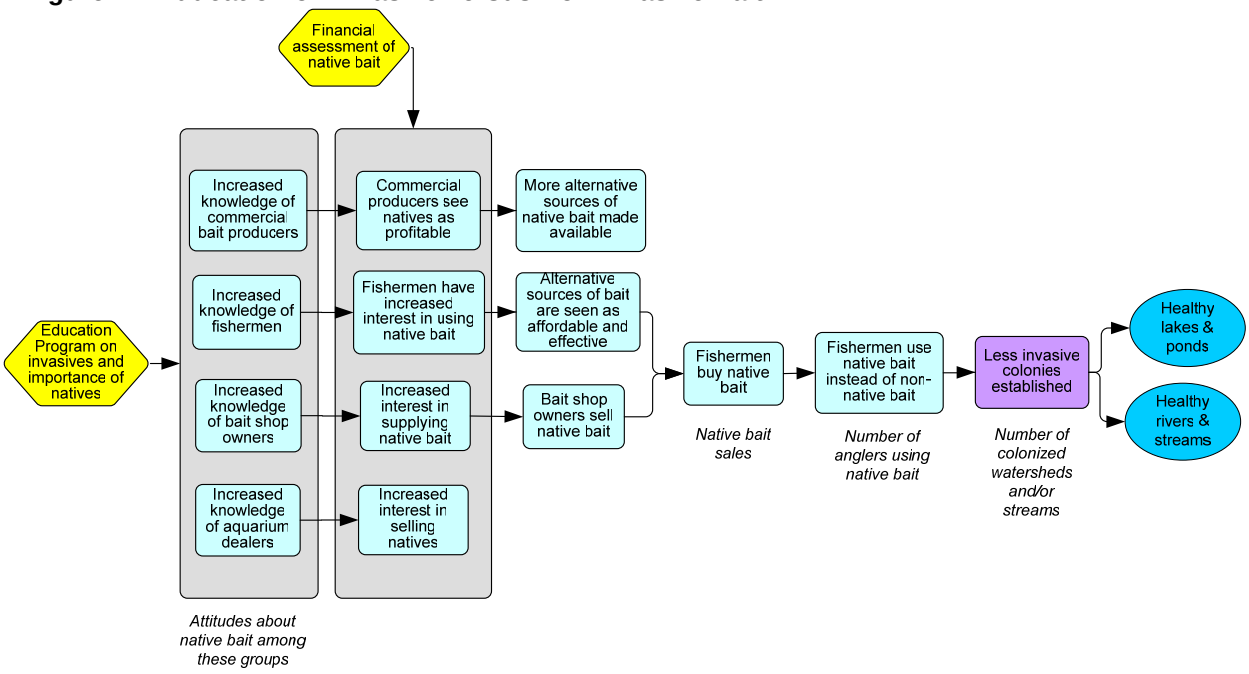
Figure 10. Species Mapping and Assessments



2.2 Invasive/Problematic Species Control

2.2.2 Invasive animal control

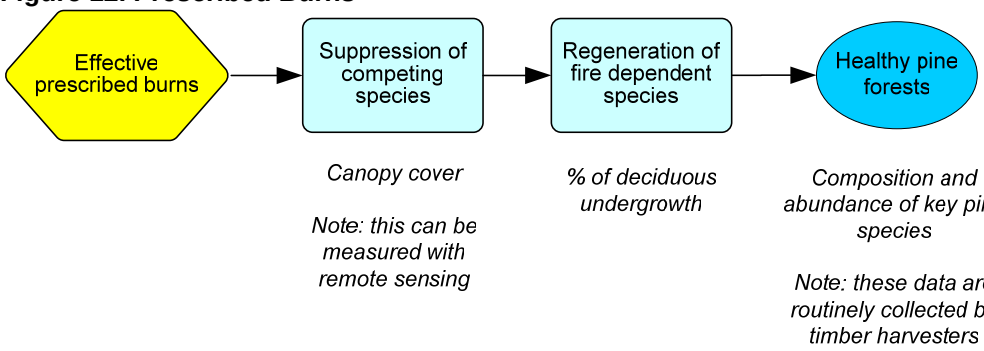
Figure 11. Education on Invasive versus Non-invasive Bait



2.3 Habitat and Natural Process Restoration

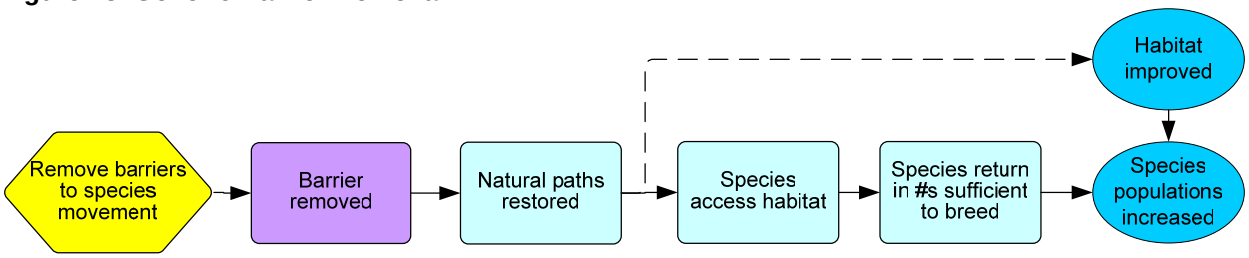
2.3.1 Land clearing/prescribed burns

Figure 12. Prescribed Burns



2.3.3 Dam removal/fish passage

Figure 13. Generic Barrier Removal



Note: Dotted line indicates that not all chains will have this relationship

Figure 14. Dam Removal Example

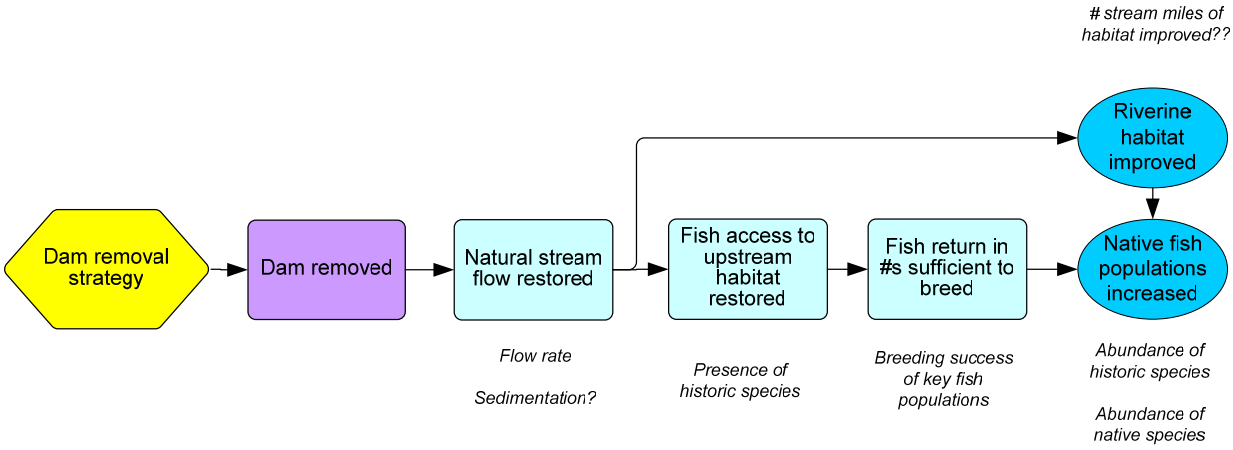
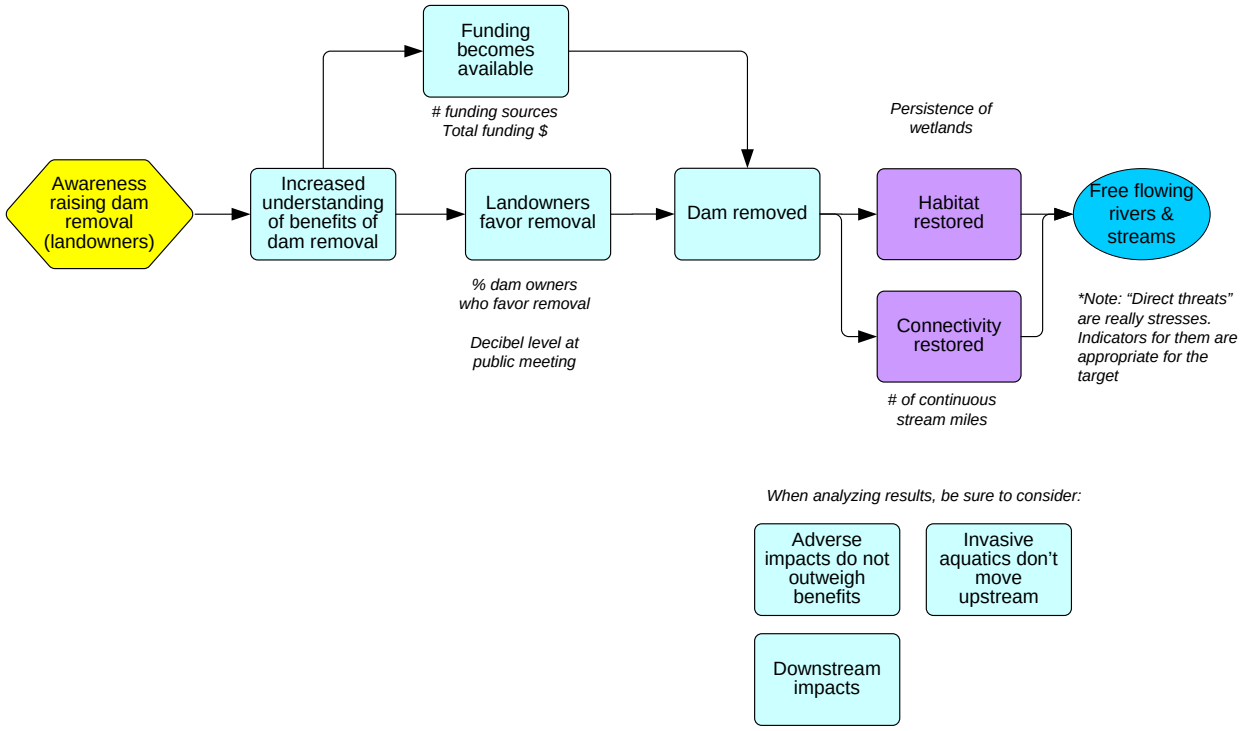


Figure 15. Education about Dam Removal



Appendix 10: Proposed Data Fields for Strategy Effectiveness Database

This appendix includes a draft proposal for linking databases of conservation actions and projects. This proposal was drafted by a coalition of key conservation practitioners and researchers that include:

- **Conservation Evidence** – Key representatives of a movement towards evidence based conservation including ConservationEvidence.com and the Center for Evidence Based Conservation.
- **Conservation Measures Partnership** – A consortium of conservation organizations including WWF, The Nature Conservancy, Wildlife Conservation Society, Africa Wildlife Foundation, Conservation International, Foundations of Success, IUCN, National Fish and Wildlife Foundation, and RARE Conservation. This consortium developed the CMP *Open Standards for the Practice of Conservation* and are currently developing Miradi Software.
- **The Nature Conservancy** – Currently manages ConserveOnline as well as the ConPro Database.
- **Society for Conservation Biology** – The leading global academic society in conservation.

The Effectiveness Working Group for the NEAFWA Monitoring and Performance Reporting Framework felt NEAFWA would benefit from promoting data exchange standards that followed those proposed by this coalition of conservation practitioners and researchers. NEAFWA proposed a few additional fields that would be particularly relevant to Fish and Wildlife work. These fields are highlighted in the following proposal.

Conservation Effectiveness Data Exchange Standards[1]

A Proposal for Linking Databases of Conservation Actions and Projects

Draft Version: 20 September 2007

With Additions for the NEAFWA Effectiveness Working Group

*** DRAFT – FOR REVIEW ONLY ***

Contents

About this Document

This document is currently being developed by the CEDEx Consortium which includes members of the Conservation Measures Partnership, the Centre for Evidence Based Conservation, ConservationEvidence.com, and the Society for Conservation Biology.

Please contact CEDEx@conservationmeasures.org for more info about this document.

1. Introduction

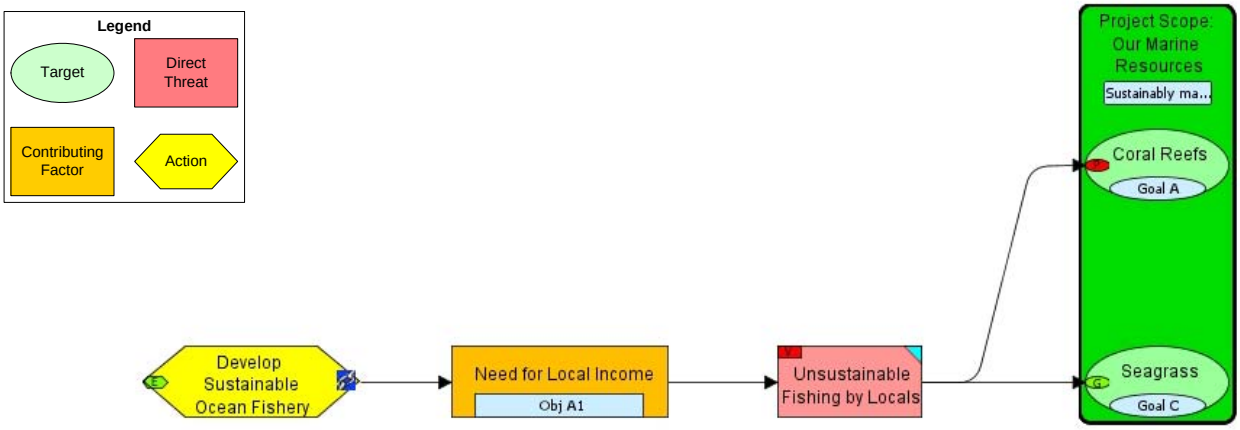
1.1 Problem Statement

- Conservation is an action-oriented discipline. Conservation practitioners are using and gaining experience about their strategies and actions every day.
- Much of what they learn is either never written down, or is not shared beyond the project team or (at best) their organization.
- Practitioners need tools to support collaboration & learning:
  - identify people with relevant experience
  - facilitate sharing information and expertise within and across organizations
  - link project needs with donor interests
- There are a number of efforts to develop online databases of conservation practice. But a hodge-podge of incompatible databases would be of limited utility beyond one organization.
- The time is ripe to catalyze formation of a coalition of leading groups to create if not one global database of conservation projects & practice, then at least a set of common data standards to link these efforts.

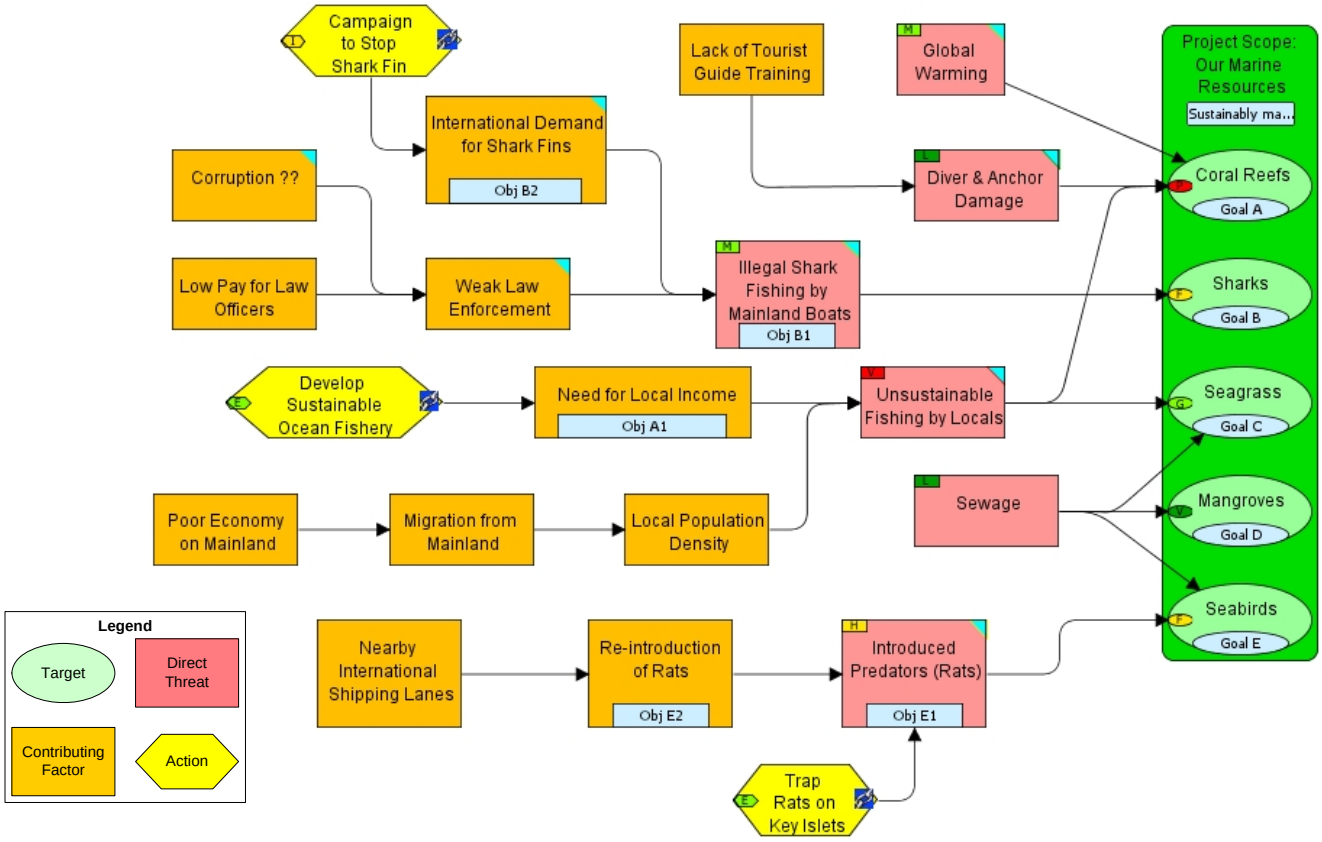
1.2 Some Key Definitions

Some key terms that we use in this document include:

- **Conservation Practitioner** – Any individual involved in designing, managing, monitoring, and/or learning about conservation actions and projects. Examples of conservation practitioners include protected area managers, local community members, NGO or land trust staff, applied researchers, donors, and interested citizens.
- **Conservation Action** – An intervention designed to reach a project's objectives and ultimate conservation goals. For example using herbicide to treat an invasive species, establishing a ecotourism business to provide alternative income to fishermen, or setting up a protected area to protect the breeding area of a bird species. "Actions" are roughly synonymous with *strategies*, *interventions*, *activities*, *responses*, and *measures* (in the action sense, not the monitoring sense). An example of one broad action – developing a sustainable ocean fishery to provide income for fishermen – is shown in the following diagram:



- **Conservation Project –** For the purposes of this exercise, a project is "any set of actions undertaken by a group of people and/or organizations to achieve defined goals and objectives." Projects can range in scale from efforts by local people to protect a small sacred grove to management of a provincial or national park to a global funding program to protect the world's oceans. Projects thus consist of one or more sets of actions as shown in the following diagram:



1.3 Who We Are

We are a coalition of key conservation practitioners and researchers:

- **Conservation Evidence** – Key representatives of a movement towards evidence based conservation including ConservationEvidence.com and the Center for Evidence Based Conservation.
- **Conservation Measures Partnership** – A consortium of conservation organizations including WWF, The Nature Conservancy, Wildlife Conservation Society, Africa Wildlife Foundation, Conservation International, Foundations of Success, IUCN, National Fish and Wildlife Foundation, and RARE Conservation. This consortium developed the CMP *Open Standards for the Practice of Conservation* and are currently developing Miradi Software.
- **The Nature Conservancy** – Currently manages ConserveOnline as well as the ConPro Database.
- **Society for Conservation Biology** – The leading global academic society in conservation.

1.4 Our Vision

A few years from now, a conservation practitioner anywhere in the world will be able to go online and immediately access information about the specific experiences of fellow practitioners from around the world as well as contribute his or her own experiences. In particular, the practitioner will be able to search for specific conservation actions and will be able to learn the conditions under which the action was applied, the results of the action (both successes and failures), and any lessons that emerged. Practitioners will also be able to select any given location and learn about the specific conservation projects taking place there.

For example, suppose a team of protected area managers has tried two conservation actions. In one case, they applied an herbicide at varying intervals to control an invasive weed and in another, they have tried to set up an ecotourism business to provide alternative income for local residents involved in destructive logging operations. They found that the weed action was highly effective (once they figured out that they needed to apply the herbicide in fall when the plant was pulling nutrients down into its roots), but the tourism action didn't work at all.

If this team can post their results online in a format that can be easily scanned and reviewed by others, then other practitioners around the world that are facing this weed at their site, or are contemplating using ecotourism can search the databases and find these results and learn from them. Furthermore, if there is a group that is interested in conducting a systematic review of the conditions under which the herbicide is effective or whether tourism works to reduce logging, then this group will have access to the original study that they can then add to their analyses.

Throughout this process, the protected area managers retain full control over the data that they contribute to the online records. Furthermore, the system is set up in such a way that it only requires minimal effort for them to contribute and update their results. Finally, the system also enables the project to post their conservation needs, and as a result, to "market" these needs to donors who might potentially be interested in providing support.

1.5 Conservation Data Exchange Standards

To achieve the above vision, we do <u>not</u> have to develop one standard database to which all practitioners have to contribute their information. Instead, we merely need to develop and implement a set of standards that govern the exchange of data among databases around the world. In particular, these standards have three parts:

- **Common Data Fields** – The fields that needs to be collected for each action and/or project.
- **Database Access Rights** – The terms that participating databases must agree regarding the mutual exchange of information.
- **Search Portal** – The requirements for a portal that users can employ to search all participating databases.

In the remainder of this document, we provide a bit more detail about each of these three parts.

2. Proposed Common Data Fields

The following lists the proposed data fields that could potentially be collected in common across all databases of conservation actions. It is subdivided into the data that would be collected for each "project" and the data that would be collected for each specific "action." In each table, the columns are defined as:

Field – The specific data field name
Priority – The importance of collecting this data on a 1-4 scale where:

4	**Mandatory** – Must be filled out for all records
3	**Highly Recommended** – Should be filled out for all records
2	**Useful** – Desirable for all records
1	**Exploratory** – Under development

Type – The type of data in the field (text, drop-down list, date, numerical, URL, image)
Comment – Additional info

Note that for this effort to be effective, participating organizations would have to agree on the list values to use (for fields restricted to a predefined set of values) as well as the fields themselves. Fields marked with an (*) have been added or given a different rating by NEAFWA Working Group members.

2.1 Basic Information

This section describes the basic information required about each entry. It will often be replicated across multiple actions being implemented by a given project and as such, we need to develop a way to avoid having to re-enter this info each time.

Location

Description: The political unit(s) where the action is taking place.

Field	Priority	Type	Comments
Country(s)	4	list	Allow multiple selection; based on standard UN lists
State or Province	4 *	text	Allow multiple selection; ideally should be standardized lists, perhaps with "other" option
Congressional District *	4	list	Allow multiple selection
County / Township *	3	text	Would be nice to standardize
Watershed and/or Ecoregion *	3	list or text	Ecological management unit (not geopolitical). If ecoregion, would have to clarify which system we are using.
Latitude / Longitude	3	num	Centroid location of the action
State Legislative Districts *	2	text	Lower priority because probably corresponds with other jurisdictions
Location Detail	2	text	Additional description of location

Additional Comments: The latitude / longitude can be used to locate the action on a global map.

Contact Person

Description: The individual who is the key source for more information about the action.

Field	Priority	Type	Comments
Contact First Name(s)	4	text	
Contact Surname	4	text	
Contact Position	3	text	
Contact Organization	3	text	
Contact E-Mail	4	text*	see discussion below
Contact Current as of Date	4	date	

Additional Comments: People may be reluctant to post e-mail on open website because of spam potential. May have to create private registry for folks to get e-mail. Or click to send e-mail to this person. Needs to have option to rapidly copy or clone information about person entering data to save time.

Data Entry

Description: Information about the person entering data about the action. Often will be same as the contact person.

Field	Priority	Type	Comments
Entry First Name(s)	3	text	
Entry Surname	3	text	
Entry E-Mail	3	text*	see discussion below
Date of Data Entry	4	date	

Additional Comments: People may be reluctant to post e-mail on open website because of spam potential. May have to create private registry for folks to get e-mail. Or click to send e-mail to this person. Needs to have option to clone info from contact person fields to save time.

Reference

Description: Where to go for additional detail about the action and the results.

Field	Priority	Type	Comments
Reference Type	4	list	Single selection; list includes peer reviewed paper, book or chapter, report, website, other
Reference Citation	4	text	Probably need to break into author, year, title, publisher, journal, etc. subfields
Reference URL	4	URL	Location of reference on web
Additional Data URL	2	URL	Location of data sets on web
Reference Detail	2	text	Additional info about reference

Additional Comments: Need to figure out how to handle multiple references. We also need to decide whether we need separate fields for citation info.

Project Information

Description: Information about the "project" that is implementing the action. For the purposes of this exercise, a project is "any set of actions undertaken by a group of people and/or organizations to achieve defined goals and objectives." Projects can range in scale from efforts by local people to protect a small sacred grove to management of a provincial or national park to a global funding program to protect the world's oceans.

Field	Priority	Type	Comments
Project Name	2	text	
Implementing Organizations	2	text	Can we standardize?? Do we need to distinguish the lead org??
Project Description	2	text	A 1-2 paragraph description
Project Needs	1	text	A description of project financial/other resource needs for potential donors

Additional Comments: This information will be valuable to expand the database of actions to be a database of conservation projects around the world.

2.2 Standard Information About Each Action

This section describes the basic information required about each action. Actions take place in the context of a "chain" as shown in the following figure:

Action

Description: Interventions designed to reach a project's objectives and ultimate conservation goals. For example using herbicide to treat an invasive species, establishing an ecotourism business, or setting up a protected area. As indicated by the box in Figure 1, actions can be applied to contributing factors, direct threats, or directly to the targets themselves. "Actions" are roughly synonymous with *strategies, interventions, activities, responses,* and *measures* (in the action sense, not the monitoring sense).

Field	Priority	Type	Comments
Action Type	4	list	Single selection; Based on IUCN-CMP Actions Classification, Level 2
Action Name	4	text	Equivalent of IUCN-CMP Level 3
Objective(s)	4 *	text	The specific objectives that project wants to achieve with the action
Action Detail	4 *	text	Additional description of action
Wildlife Action Plan (WAP) Objectives *	4 *	text	The broader WAP objectives to which the action contributes
Results/Outcomes	4	text	The results of the action
Action Scale	3	text	Scope of the action
Action Cost	3	text	Cost per action (per year if needed, or perhaps for initial & subsequent years); Standard currency ($ or € or other)

Additional Comments: Unlike other factors, this will be single selection. We will need to figure out how to handle the issue of other confounding actions. We will also have to provide guidance to screen out basic adaptive management actions (e.g., fundraising, strategic planning) that every project needs to undertake. At the moment, Level 3 of the IUCN-CMP classification (see Annex 3) is not standardized so this will have to be a text field, but this might be an impetus to try to develop a more standard list.

Conservation Target(s): Habitats and Species

Description: The biological entities (species/communities or habitats/ecosystems) that a project is trying to conserve with a given action. For example, a population of a specific fish species or a forest ecosystem. Synonymous with *conservation targets, biodiversity features,* and *focal targets.* Note that not all actions will be targeted at specific species, but the habitat should be recorded even for species targets.

Field	Priority	Type	Comments
Habitat Type	4	list	Multiple selection; Based on IUCN Habitat Classification List
Species	4 *	text	The scientific and common names of the species
Listing Status of Species	4 *	list	Degree to which species is endangered (using IUCN Red List)
Habitat Detail	2	text	Additional description of habitat

Additional Comments: We need to decide how fine-grained we want to make this list. See Annex 1 for a list of the IUCN Habitats. We also need to figure out how we will handle species guilds and communities.

Direct Threat(s)

Description: The proximate human activities or processes that have caused, are causing or may cause the destruction, degradation and/or impairment of biodiversity and natural processes. In other words, the problem that the conservation action is ultimately designed to address. For example, unsustainable fishing or logging. Threats can be past (historical), ongoing, and/or likely to occur in the future. Synonymous with *sources of stress* and *proximate pressures*.

In addition to recording the name of the direct threat, we may also eventually give people the option to record the *magnitude* of the threat following the IUCN-CMP system currently being developed.

Field	Priority	Type	Comments
Threat Type	4	list	Multiple selection; Based on IUCN-CMP Threats Classification, Level 2
Threat Name	4	text	Equivalent of IUCN-CMP Level 3
Threat Magnitude	1	text	Scope of the action
Action Detail	2	text	Additional description of action

Comments: At the moment, Level 3 of the IUCN-CMP classification (see Annex 2) is not standardized so this will have to be a text field, but this might be an impetus to try to develop a more standard list.

Contributing Factor(s)

Description: Factors, usually social, economic, political, institutional, or cultural, that enable or otherwise add to the occurrence and/or persistence of direct threats. There is typically a chain of contributing factors behind any given direct threat. In a situation analysis, these factors are often subdivided into *indirect threats* (factors with a negative effect) and *opportunities* (factors with a potential positive effect). For example, market demand for fish (an indirect threat) or a country's land use planning system (an opportunity). Synonymous with *drivers* or *root causes.*

Field	Priority	Type	Comments
Contributing Factors	2	text	Eventually, we may have standard list
Conceptual Model or Results Chain	2	image or mpz	A graphical representation of the chain linking the action to the conservation situation

Comments: These are very difficult to record in any standard fashion. As such, it is probably best if people just capture the results chain in a picture or in Miradi format.

Monitoring Design

Description: The type of monitoring design used to collect information about the results of the intervention. This field enables users to stratify their query to allow for differing degrees of rigor. Monitoring designs can include:

- anecdote
- pre-test/post-test observation
- time series observations
- comparison groups
- replicated experiment
- randomized replicated controls

Field	Priority	Type	Comments
Monitoring Design Type	4	list	Single selection
Monitoring Design Detail	2	text	A more detailed description
Monitoring Design Indicators	2	text	A description of the indicators collected
Monitoring Design Spatial Data	2	list	Single selection; degree to which data is georeferenced (all data, some data, none)
Monitoring Design Spatial Data	2	url	A link to where spatial data can be obtained

Additional Comments: There are two dimensions here: cross-sectional and time series – we may have to allow folks to record both.

3. Database Access Rights

This section will contain a description of the proposed database access rights. Key aspects might include:

- To be in compliance with standards, a database would have to make all project related data available to all interested folks.
- Data on any given site would be treated as "published." This means that other folks could then use the data in analyses, but would have to give credit to the sources.
- We might want to explore appropriate creative commons licenses.
- Donors could potentially require grantees to post their results on a certified database.
- Publishers could potentially require authors to post their results on a certified database as well.

4. Search Portal Specifications

This section will contain a description of the search portal specifications.

5. Conclusion

We believe that the Common Data Fields, Database Access Rights, and Search Portal as outlined above will help us to achieve our vision. Ultimately, this effort will enable:

- Practitioners in field to plan and implement more effective projects,
- Managers and donors to get better information to improve their work,
- All stakeholders learning from each other,
- Increased public support for conservation,
- Ultimately, better conservation outcomes.

Annex 1. IUCN Habitat Classification

The following is a draft version that has not yet been finalized.

#	Description
1	**Forest**
1.1	Forest - Boreal
1.2	Forest - Subarctic
1.3	Forest - Subantarctic
1.4	Forest - Temperate
1.5	Forest - Subtropical/Tropical Dry
1.6	Forest - Subtropical/Tropical Moist Lowland
1.7	Forest - Subtropical/Tropical Mangrove
1.8	Forest - Subtropical/Tropical Swamp
1.9	Forest - Subtropical/Tropical Moist Montane
2	**Savanna**
2.1	Savanna - Dry
2.2	Savanna - Moist
3	**Shrubland**
3.1	Shrubland - Subarctic
3.2	Shrubland - Subantarctic
3.3	Shrubland - Boreal
3.4	Shrubland - Temperate
3.5	Shrubland - Subtropical/Tropical Dry
3.6	Shrubland - Subtropical/Tropical Moist
3.7	Shrubland - Subtropical/Tropical High Altitude
3.8	Shrubland - Mediterranean-type Shrubby Vegetation
4	**Grassland**
4.1	Grassland - Tundra
4.2	Grassland - Subarctic
4.3	Grassland - Subantarctic
4.4	Grassland - Temperate
4.5	Grassland - Subtropical/Tropical Dry
4.6	Grassland - Subtropical/Tropical Seasonally Wet/Flooded
4.7	Grassland - Subtropical/Tropical High Altitude
5	**Wetlands (inland)**
5.1	Wetlands (inland) - Permanent Rivers/Streams/Creeks (includes waterfalls)
5.2	Wetlands (inland) - Seasonal/Intermittent/Irregular Rivers/Streams/Creeks
5.3	Wetlands (inland) - Shrub Dominated Wetlands
5.4	Wetlands (inland) - Bogs, Marshes, Swamps, Fens, Peatlands
5.5	Wetlands (inland) - Permanent Freshwater Lakes (over 8ha)
5.6	Wetlands (inland) - Seasonal/Intermittent Freshwater Lakes (over 8ha)
5.7	Wetlands (inland) - Permanent Freshwater Marshes/Pools (under 8ha)
5.8	Wetlands (inland) - Seasonal/Intermittent Freshwater Marshes/Pools (under 8ha)
5.9	Wetlands (inland) - Freshwater Springs and Oases
5.10	Wetlands (inland) - Tundra Wetlands (incl. pools and temporary waters from snowmelt)
5.11	Wetlands (inland) - Alpine Wetlands (includes temporary waters from snowmelt)
5.12	Wetlands (inland) - Geothermal Wetlands
5.13	Wetlands (inland) - Permanent Inland Deltas

#	Description
5.14	Wetlands (inland) - Permanent Saline, Brackish or Alkaline Lakes
5.15	Wetlands (inland) - Seasonal/Intermittent Saline, Brackish or Alkaline Lakes and Flats
5.16	Wetlands (inland) - Permanent Saline, Brackish or Alkaline Marshes/Pools
5.17	Wetlands (inland) - Seasonal/Intermittent Saline, Brackish or Alkaline Marshes/Pools
5.18	Wetlands (inland) - Karst and Other Subterranean Hydrological Systems (inland)
6	**Rocky areas (eg. inland cliffs, mountain peaks)**
7	**Caves and Subterranean Habitats (non-aquatic)**
7.1	Caves and Subterranean Habitats (non-aquatic) - Caves
7.2	Caves and Subterranean Habitats (non-aquatic) - Other Subterranean Habitats
8	**Desert**
8.1	Desert - Hot
8.2	Desert - Temperate
8.3	Desert - Cold
8.4	Desert - Semi-Desert (no trees present)
9	**Marine Neritic**
9.1	Marine Neritic - Pelagic
9.2	Marine Neritic - Subtidal Rock and Rocky Reefs
9.3	Marine Neritic - Subtidal Loose Rock/pebble/gravel
9.4	Marine Neritic - Subtidal Sandy
9.5	Marine Neritic - Subtidal Sandy-Mud
9.6	Marine Neritic - Subtidal Muddy
9.7	Marine Neritic - Macroalgal/Kelp
9.8	Marine Neritic - Coral Reef
9.8.1	Outer Reef Channel
9.8.2	Back Slope
9.8.3	Foreslope (Outer Reef Slope)
9.8.4	Lagoon
9.8.5	Inter-Reef Soft Substrate
9.8.6	Inter-Reef Rubble Substrate
9.9	Marine Neritic - Seagrass (Submerged)
9.10	Marine Neritic - Estuaries
10	**Marine Oceanic**
10.1	Marine Oceanic - Epipelagic (0-200m)
10.2	Marine Oceanic - Mesopelagic (200-1000m)
10.3	Marine Oceanic - Bathypelagic (1000-4000m)
10.4	Marine Oceanic - Abyssopelagic (4000-6000m)
11	**Marine Deep Benthic**
11.1	Marine Deep Benthic - Continental Slope/Bathyl Zone (200-4,000m)
11.1.1	Hard Substrate
11.1.2	Soft Substrate
11.2	Marine Deep Benthic - Abyssal Plain (4,000-6,000m)
11.3	Marine Deep Benthic - Abyssal Mountain/Hills (4,000-6,000m)
11.4	Marine Deep Benthic - Hadal/Deep Sea Trench (>6,000m)
11.5	Marine Deep Benthic - Seamount
11.6	Marine Deep Benthic - Deep Sea Vents (Rifts/Seeps)
12	**Marine Intertidal**
12.1	Marine Intertidal - Rocky Shoreline
12.2	Marine Intertidal - Sandy Shoreline and/or Beaches, Sand Bars, Spits, Etc
12.3	Marine Intertidal - Shingle and/or Pebble Shoreline and/or Beaches

*** DRAFT – FOR REVIEW ONLY ***

#	Description
12.4	Marine Intertidal - Mud Flats and Salt Flats
12.5	Marine Intertidal - Salt Marshes (Emergent Grasses)
12.6	Marine Intertidal - Tidepools
12.7	Marine Intertidal - Mangrove Submerged Roots
13	**Marine Coastal/Supratidal**
13.1	Marine Coastal/Supratidal - Sea Cliffs and Rocky Offshore Islands
13.2	Marine Coastal/supratidal - Coastal Caves/Karst
13.3	Marine Coastal/Supratidal - Coastal Sand Dunes
13.4	Marine Coastal/Supratidal - Coastal Brackish/Saline Lagoons/Marine Lakes
13.5	Marine Coastal/Supratidal - Coastal Freshwater Lakes
14	**Artificial/Terrestrial**
14.1	Artificial/Terrestrial - Arable Land
14.2	Artificial/Terrestrial - Pastureland
14.3	Artificial/Terrestrial - Plantations
14.4	Artificial/Terrestrial - Rural Gardens
14.5	Artificial/Terrestrial - Urban Areas
14.6	Artificial/Terrestrial - Subtropical/Tropical Heavily Degraded Former Forest
15	**Artificial/Aquatic & Marine**
15.1	Artificial/Aquatic & Marine - Water Storage Areas (over 8ha)
15.2	Artificial/Aquatic & Marine - Ponds (below 8ha)
15.3	Artificial/Aquatic & Marine - Aquaculture Ponds
15.4	Artificial/Aquatic & Marine - Salt Exploitation Sites
15.5	Artificial/Aquatic & Marine - Excavations (open)
15.6	Artificial/Aquatic & Marine - Wastewater Treatment Areas
15.7	Artificial/Aquatic & Marine - Irrigated Land (includes irrigation channels)
15.8	Artificial/Aquatic & Marine - Seasonally Flooded Agricultural Land
15.9	Artificial/Aquatic & Marine - Canals and Drainage Channels, Ditches
15.10	Artificial/Aquatic & Marine - Karst and Other Subterranean Hydrological Systems (human-made)
15.11	Artificial/Aquatic & Marine - Marine Anthropogenic Structures
15.12	Artificial/Aquatic & Marine - Mariculture Cages
15.13	Artificial/Aquatic & Marine - Mari / Brackishculture Ponds
16	**Introduced vegetation**
17	**Other**
18	**Unknown**

Annex 2. IUCN-CMP Unified Classification of Direct Threats, v 1.1

Level of Classification 1 2 3 (examples only)	Definition
1. Residential & Commercial Development	**Threats from human settlements or other non-agricultural land uses with a substantial footprint**
1.1 Housing & Urban Areas *urban areas, suburbs, villages, vacation homes, shopping areas, offices, schools, hospitals*	Human cities, towns, and settlements including non-housing development typically integrated with housing
1.2 Commercial & Industrial Areas *military bases, factories, shopping centers, office parks, power plants, train & ship yards, airports*	Factories and other commercial centers
1.3 Tourism & Recreation Areas *ski areas, golf courses, resorts, cricket fields, county parks, afghan goat polo fields, campgrounds*	Tourism and recreation sites with a substantial footprint
2. Agriculture & Aquaculture	**Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture**
2.1 Annual & Perennial Non-Timber Crops *farms, household swidden plots, plantations, orchards, vineyards, mixed agroforestry systems*	Crops planted for food, fodder, fiber, fuel, or other uses
2.2 Wood & Pulp Plantations *teak or eucalyptus plantations, loblolly pine silviculture, Christmas tree farms*	Stands of trees planted for timber or fiber outside of natural forests, often with non-native species
2.3 Livestock Farming & Ranching *cattle feed lots, chicken farms, dairy farms, cattle ranching, goat, camel, or yak herding*	Domestic terrestrial animals raised in one location on farmed or non-local resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching)
2.4 Marine & Freshwater Aquaculture *shrimp or fin fish aquaculture, fish ponds on farms, hatchery salmon, seeded shellfish beds, artificial algal beds*	Aquatic animals raised in one location on farmed or non-local resources; also hatchery fish allowed to roam in the wild
3. Energy Production & Mining	**Threats from production of non-biological resources**
3.1 Oil & Gas Drilling *oil wells, deep sea natural gas drilling*	Exploring for, developing, and producing petroleum and other liquid hydrocarbons
3.2 Mining & Quarrying *coal mines, alluvial gold panning, gold mines, rock quarries, coral mining, deep sea nodules, guano harvesting, dredging outside of shipping lanes*	Exploring for, developing, and producing minerals and rocks
3.3 Renewable Energy *geothermal power production, solar farms, wind farms (including birds and bats flying into windmills), tidal farms*	Exploring, developing, and producing renewable energy
4. Transportation & Service Corridors	**Threats from long narrow transport corridors and the vehicles that use them including associated wildlife mortality**
4.1 Roads & Railroads *highways, secondary roads, logging roads, bridges & causeways, road kill, fencing associated with roads, freight/passenger/mining railroads*	Surface transport on roadways and dedicated tracks
4.2 Utility & Service Lines *electrical & phone wires, aqueducts, oil & gas pipelines, electrocution of wildlife*	Transport of energy & resources
4.3 Shipping Lanes *dredging, canals, shipping lanes, ships running into whales, wakes from cargo ships*	Transport on and in freshwater and ocean waterways
4.4 Flight Paths *flight paths, jets impacting birds*	Air and space transport
5. Biological Resource Use	**Threats from consumptive use of "wild" biological resources including both deliberate and unintentional harvesting effects; also persecution or control of specific species**
5.1 Hunting & Collecting Terrestrial Animals *bushmeat hunting, trophy hunting, fur trapping, insect collecting, honey or bird nest hunting, predator control, pest control, persecution of snakes*	Killing or trapping terrestrial wild animals or animal products for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch
5.2 Gathering Terrestrial Plants *wild mushroom collection, forage for stall fed animals, orchid collection, rattan harvesting, control of host plants to combat timber diseases*	Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons
5.3 Logging & Wood Harvesting *clear cutting of hardwoods, selective commercial logging of ironwood, pulp or woodchip operations, fuel wood collection, charcoal production*	Harvesting trees and other woody vegetation for timber, fiber, or fuel
5.4 Fishing & Harvesting Aquatic Resources *trawling, blast fishing, spear fishing, shellfish harvesting, whaling, seal hunting, turtle egg collection, live coral collection, seaweed collection*	Harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch
6. Human Intrusions & Disturbance	**Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources**
6.1 Recreational Activities *off-road vehicles, motorboats, jet-skis, snowmobiles, ultralight planes, dive boats, whale watching, mountain bikers, hikers, skiers, birdwatchers, scuba divers, pets in rec areas, campsites, caving, rock-climbing*	People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons
6.2 War, Civil Unrest & Military Exercises *armed conflict, mine fields, tanks & other military vehicles, training exercises & ranges, defoliation, munitions testing*	Actions by formal or paramilitary forces without a permanent footprint
6.3 Work & Other Activities *law enforcement, drug smugglers, illegal immigrants, species research, vandalism*	People spending time in or traveling in natural environments for reasons other than recreation or military activities

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Level of Classification 1 2 3 (examples only)	Definition
7. Natural System Modifications	**Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare**
7.1 Fire & Fire Suppression *fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires, fires for hunting*	Suppression or increase in fire frequency and/or intensity outside of its natural range of variation
7.2 Dams & Water Management/Use *dam construction, dam operations, sediment control, change in salt regime, wetland filling for mosquito control, levees/dikes, surface water diversion, groundwater pumping, channelization, artificial lakes*	Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities
7.3 Other Ecosystem Modifications *land reclamation projects, abandonment of managed lands, rip-rap along shoreline, mowing grass, tree thinning, beach construction, removal of snags from streams, physical pest & weed control efforts*	Other actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare
8. Invasive & Other Problematic Species & Genes	**Threats from non-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance**
8.1 Invasive Non-Native/Alien Species *feral cattle, household pets, zebra mussels, Dutch elm disease or chestnut blight, Miconia tree, introduction of species for biocontrol, chytrid fungus affecting amphibians outside of Africa*	Harmful plants, animals, pathogens and other microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities
8.2 Problematic Native Species *overabundant native deer, overabundant algae due to loss of native grazing fish, native plants that hybridize with other plants, plague affecting rodents*	Harmful plants, animals, or pathogens and other microbes that are originally found within the ecosystem(s) in question, but have become "out-of-balance" or "released" directly or indirectly due to human activities
8.3 Introduced Genetic Material *pesticide resistant crops, hatchery salmon, restoration projects using non-local seed stock, genetically modified insects for biocontrol, genetically modified trees, genetically modified salmon*	Human altered or transported organisms or genes
9. Pollution	**Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources**
9.1 Household Sewage & Urban Waste Water *Discharge from municipal waste treatment plants, leaking septic systems, untreated sewage, outhouses, oil or sediment from roads, fertilizers and pesticides from lawns and golf-courses, road salt*	Water-borne sewage and non-point runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments
9.2 Industrial & Military Effluents *toxic chemicals from factories, illegal dumping of chemicals, mine tailings, arsenic from gold mining, leakage from fuel tanks, PCBs in river sediments*	Water-borne pollutants from industrial and military sources including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments
9.3 Agricultural & Forestry Effluents *nutrients from fertilizer run-off, herbicide & chemical pest-control, manure from feedlots, nutrients from aquaculture, soil erosion*	Water-borne pollutants from agricultural, silivicultural, and aquaculture systems that include nutrients, toxic chemicals and/or sediments including the effects of these pollutants on the site where they are applied
9.4 Garbage & Solid Waste *municipal waste, litter from cars, flotsam & jetsam from recreational boats, waste that entangles wildlife, construction debris*	Rubbish and other solid materials including those that entangle wildlife
9.5 Air-Borne Pollutants *acid rain, smog from vehicle emissions, excess nitrogen deposition, airborne mercury, radioactive fallout, wind dispersion of pollutants or sediments, smoke from forest fires or wood stoves*	Atmospheric pollutants from point and nonpoint sources
9.6 Excess Energy *noise from highways or airplanes, sonar from submarines that disturbs whales, heated water from power plants, lamps attracting insects, beach lights disorienting turtles, atmospheric radiation from ozone holes*	Inputs of heat, sound, or light that disturb wildlife or ecosystems
10. Geological Events	**Threats from catastrophic geological events**
10.1 Volcanoes *eruptions, emissions of volcanic gasses*	Volcanic events
10.2 Earthquakes/Tsunamis *earthquakes, tsunamis*	Earthquakes and associated events
10.3 Avalanches/Landslides *avalanches, landslides, mudslides*	Avalanches or landslides
11. Climate Change & Severe Weather	**Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events that are outside of the natural range of variation, or potentially can wipe out a vulnerable species or habitat**
11.1 Habitat Shifting & Alteration *sea-level rise, desertification, tundra thawing, coral bleaching, changes in elevetational gradients*	Major changes in habitat composition and location
11.2 Droughts *severe lack of rain, loss of surface water sources*	Periods in which rainfall falls below the normal range of variation
11.3 Temperature Extremes *heat waves, cold spells, oceanic temperature changes, disappearance of glaciers/sea ice*	Periods in which temperatures exceed or go below the normal range of variation
11.4 Storms & Flooding *thunderstorms, tropical storms, hurricanes, cyclones, tornados, hailstorms, ice storms or blizzards, dust storms, erosion of beaches during storms*	Extreme precipitation and/or wind events

Annex 3. IUCN-CMP Unified Classification of Conservation Actions, v 1.1

Level of Classification 1 2 3 (examples only)	Definition
1. Land/Water Protection	**Actions to identify, establish or expand parks and other legally protected areas**
1.1 Site/Area Protection *national parks, town wildlife sanctuaries, private reserves, tribally owned hunting grounds*	Establishing or expanding public or private parks, reserves, and other protected areas roughly equivalent to IUCN Categories I-VI
1.2 Resource & Habitat Protection *easements, development rights, water rights, instream flow rights, wild & scenic river designation*	Establishing protection or easements of some specific aspect of the resource on public or private lands outside of IUCN Categories I-VI
2. Land/Water Management	**Actions directed at conserving or restoring sites, habitats and the wider environment**
2.1 Site/Area Management *site design, demarcating borders, putting up fences, training park staff, control of poachers*	Management of protected areas and other resource lands for conservation
2.2 Invasive/Problematic Species Control *cutting vines off trees, preventing ballast water discharge*	Controlling and/or preventing invasive and/or other problematic plants, animals, and pathogens
2.3 Habitat & Natural Process Restoration *creating forest corridors, prairie re-creation, riparian tree plantings, coral reef restoration, proscribed burns, breaching levees, dam removal, fish ladders, liming acid lakes, cleaning up oil spills*	Enhancing degraded or restoring missing habitats and ecosystem functions; dealing with pollution
3. Species Management	**Actions directed at managing or restoring species, focused on the species of concern itself**
3.1 Species Management *harvest management of wild mushrooms, culling buffalo to keep population size within park carrying capacity, controlling fishing effort*	Managing specific plant and animal populations of concern
3.2 Species Recovery *manual pollination of trees, artificial nesting boxes, clutch manipulation, supplementary feeding, disease/pathogen/parasite management*	Manipulating, enhancing or restoring specific plant and animal populations, vaccination programs
3.3 Species Re-Introduction *re-introduction of wolves*	Re-introducing species to places where they formally occurred or benign introductions
3.4 *Ex-situ* Conservation *captive breeding of gorillas, artificial propagation of orchids, gene-banking*	Protecting biodiversity out of its native habitats
4. Education & Awareness	**Actions directed at people to improve understanding and skills, and influence behavior**
4.1 Formal Education *public schools, colleges & universities, continuing education*	Enhancing knowledge and skills of students in a formal degree program
4.2 Training *monitoring workshops or training courses in reserve design for park managers, learning networks or writing how-to manuals for project managers, stakeholder education on specific issues*	Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programs
4.3 Awareness & Communications *radio soap operas, environmental publishing, web blogs, puppet shows, door-to-door canvassing, tree sitting, protest marches*	Raising environmental awareness and providing information through various media or through civil disobedience
5. Law & Policy	**Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards**
5.1 Legislation ***Global:*** *promoting conventions on biodiversity, wildlife trade laws like CITES* ***National:*** *work for or against government laws such as the US Endangered Species Act, influencing legislative appropriations* ***State/Provincial:*** *state ballot initiatives, provi*	Making, implementing, changing, influencing, or providing input into formal government sector legislation or polices at all levels: international, national, state/provincial, local, tribal
5.2 Policies & Regulations *Input into agency plans regulating certain species or resources, working with local governments or communities to implement zoning regulations; promoting sustainable harvest of timber on state forest lands*	Making, implementing, changing, influencing, or providing input into policies and regulations affecting the implementation of laws at all levels: international, national, state/provincial, local/community, tribal
5.3 Private Sector Standards & Codes *Marine & Forest Stewardship Councils, Conservation Measures Partnership (CMP) Open Standards, corporate adoption of forestry best management practices, sustainable grazing by a rancher*	Setting, implementing, changing, influencing, or providing input into voluntary standards & professional codes that govern private sector practice
5.4 Compliance & Enforcement *Water quality standard monitoring, initiating criminal and civil litigation*	Monitoring and enforcing compliance with laws, policies & regulations, and standards & codes at all levels

Level of Classification 1 2 3 (examples only)	Definition
6. Livelihood, Economic & Other Incentives	**Actions to use economic and other incentives to influence behavior**
6.1 Linked Enterprises & Livelihood Alternatives	Developing enterprises that directly depend on the maintenance of natural resources or provide substitute livelihoods as a means of changing behaviors and attitudes
ecotourism, non-timber forest product harvesting, harvesting wild salmon to create value for wild population	
6.2 Substitution	Promoting alternative products and services that substitute for environmentally damaging ones
Viagra for rhino horn, farmed fish as a replacement for pressure on wild populations, promoting recycling and use of recycled materials	
6.3 Market Forces	Using market mechanisms to change behaviors and attitudes
certification, positive incentives, boycotts, negative incentives, grass & forest banking, valuation of ecosystem services such as flood control	
6.4 Conservation Payments	Using direct or indirect payments to change behaviors and attitudes
quid-pro-quo performance payments, resource tenure incentives	
6.5 Non-Monetary Values	Using intangible values to change behaviors and attitudes
spiritual, cultural, links to human health	
7. External Capacity Building	**Actions to build the infrastructure to do better conservation**
7.1 Institutional & Civil Society Development	Creating or providing non-financial support & capacity building for non-profits, government agencies, communities, and for-profits
creating new local land trusts, providing circuit riders to help develop organizational capacity	
7.2 Alliance & Partnership Development	Forming and facilitating partnerships, alliances, and networks of organizations
country networks, Conservation Measures Partnership (CMP)	
7.3 Conservation Finance	Raising and providing funds for conservation work
private foundations, debt-for-nature swaps	