EXECUTIVE SUMMARY

Identifying Representative Species for the North Atlantic Landscape Conservation Cooperative (LCC)

The U.S. Fish and Wildlife Service recently completed a year-long effort to identify representative species with support from the University of Massachusetts Amherst and U.S. Forest Service. The process included the development of species-habitat databases, cluster and indicator species analyses to group species based on habitat systems and use, and application of filtering criteria. Species experts provided extensive input throughout the process including selecting representative species during three workshops held in May and June, 2011. This document provides a summary of the key objectives, needs, methods and results of the process. It is important to note that the project was designed as a dynamic process that will allow the representative species list to be modified to adapt to future conditions, management needs, and partner input.

Goal

Identify a list of representative species for designing conservation and management strategies that will most effectively sustain fish and wildlife populations at desired levels in the face of land use change, climate change, and other stressors occurring within the North Atlantic LCC.

> A representative species is a species whose habitat needs, ecosystem function, or management responses are similar to a group of other species. It is assumed that conservation planning and actions for a representative species will also address the needs of other species.

Need

Consistent with the purpose and framework of Strategic Habitat Conservation (SHC), explicit management objectives and conservation planning for federal trust species are needed to guide delivery and evaluation of conservation actions. To facilitate achieving this objective, the SHC framework recommends that a subset of priority trust species, termed *representative species*, be identified and used to represent larger suites of priority species. Selection of representative species is considered a necessary planning and design shortcut to facilitate more detailed planning, conservation design and evaluation on fewer species.

Conservation planning and actions will also likely need to plan for stand-alone species that have unique habitat or ecosystem function; to prioritize management actions; or to help achieve a more comprehensive suite of species for biodiversity conservation. Using

representative species will help the Service, states and other partners make better decisions about managing trust resource responsibilities.

Approach & Methods:

The project was conducted in close collaboration with the Region 5 Strategic Habitat Conservation Steering Committee and consisted of five phases.

Phase I - Priority Species Lists

The terrestrial and aquatic priority species lists were compiled by the USFWS and included 341 terrestrial and 75 aquatic species of which 106 were federally listed as threatened or endangered and 32 were Species of Greatest Conservation Need from State Wildlife Action Plans. Based upon review by the USFWS, 121 species were dropped because either they were not known to occur in the North Atlantic LCC area, extirpated from the North Atlantic LCC area, exclusively marine, of concern only in Bird Conservation Region (BCR) 27 (southern boundary of NALCC), occurred only in BCR 27 and/or 28, too localized, no recognized threats, or insufficiently or not reviewed by experts. The final number of priority species considered as potential representative species was 290.

Phase II - Species Habitat Association Database Design and Development

Species-habitat association matrices (Table 1) were developed for the 290 potential representative species using the habitat systems defined in the Northeastern Terrestrial Wildlife Habitat Classification (Gawler 2008) and Northeastern Aquatic Habitat Classification (Olivero & Anderson, 2008), both developed by NatureServe and The Nature Conservancy for the Northeast Association of Fish & Wildlife Agencies (NEAFWA). The matrices were developed using online databases (i.e. NatureServe, Birds of North America) and current literature. Of the 141 habitat systems in the terrestrial classification, 28 habitat systems were dropped from the terrestrial database because they were either developed classes that provided only poor quality wildlife habitat, or habitats that did not occur in the NALCC. For the aquatic classification system, the simplified 92-habitat system classification was used. A suite of supplementary habitats was added to fill in habitat gaps in both the terrestrial and aquatic classification systems. For terrestrial species, seasonal use of habitats was identified as breeding and non-breeding, and habitats were classified as either preferred habitat (primary) or utilized habitats (secondary).

Table 1. Matrix format used for developing species-habitat database.

	Habitat System		
Species	A	B	C
X	0	.5	0
Y	.5	0	1
0 = not utilized, .5 = utilized, 1 = preferred			

For the terrestrial species, the occurrence of species and habitat systems was coded and analyzed by subregion (northern New England, southern New England, and the Mid-Atlantic). Additionally, all short-distance migrants were coded by seasonal occurrence in each subregion. There were too few aquatic species to split them into subregional analyses.

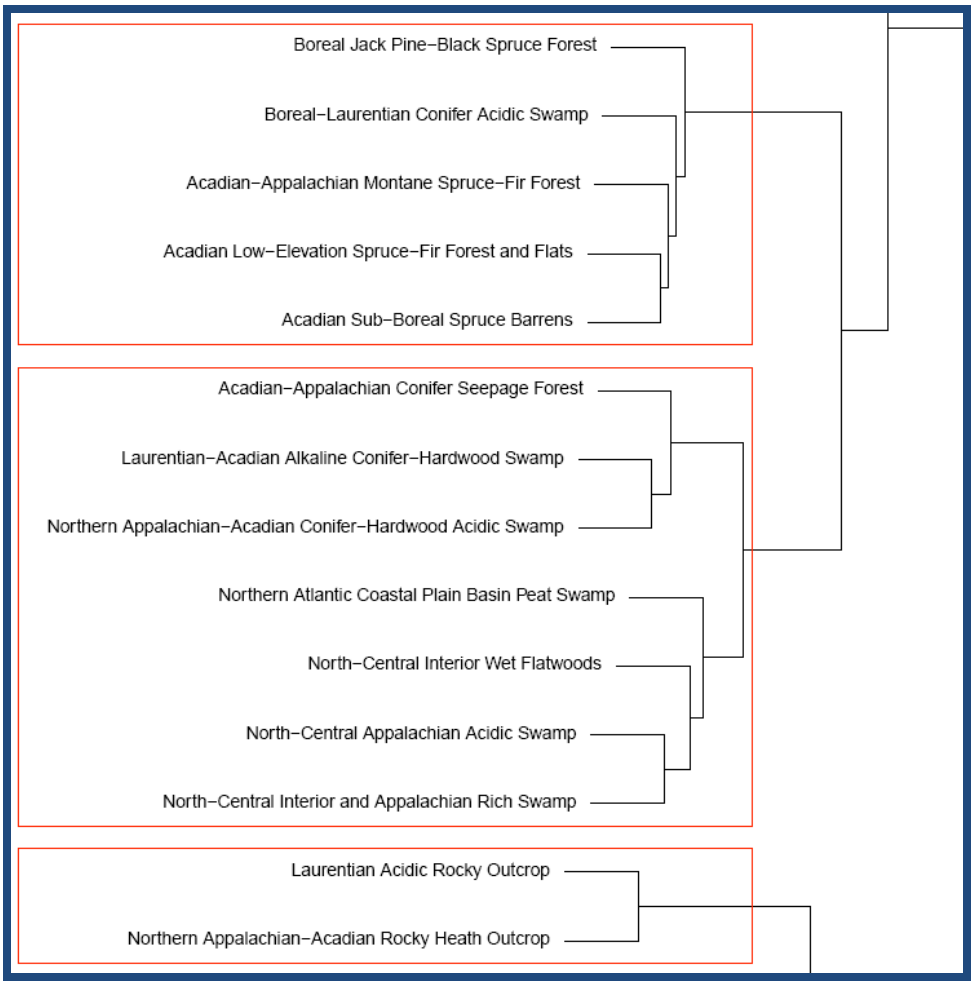
More than 50 species experts both inside and outside of the USFWS conducted an expert review of the databases. Lack of familiarity with the habitat classification systems, and lack of detailed knowledge of species associations with finest level of classification system hierarchy posed challenges for database development and review.

Phase III - Hierarchical Clustering and Indicator Species Analyses

Statistical analyses consisted of two components. First, we conducted a hierarchical agglomerative cluster analysis of the species and habitat systems that resulted in a dendrogram that grouped habitat systems based on similarity in priority species composition (Fig. 1). The clustering of habitats rather than species directly offered more transparency in the ecological characterization of clusters. With this clustering approach, each species was clustered with only one cluster group, representing the habitat systems that species is most closely associated. However, if the breeding and non-breeding habitats are distinctly different for a species, the species could cluster with two separate habitat system cluster groups.

Because the decision regarding how many clusters to accept for a final cluster solution is highly subjective, we compared several options based on scree plots. Selection of the primary cluster size was guided by the number of clusters where the scree plot leveled off, indicating that the dissimilarity among clusters was beginning to stabilize. A second, finer cluster solution was also selected to split the clusters further, providing supplementary information if workshop participants decided there wasn't sufficient commonality among habitat systems within the primary cluster group. Separate cluster analyses were conducted for terrestrial and aquatic species. For the terrestrial species, separate analyses were conducted for each of the three subregions, whereas a single analysis without regard to subregion was conducted for aquatic species.

Fig. 1. Example dendrogram from hierarchical agglomerative cluster analysis showing habitat system cluster groups based upon of similarity in terrestrial species composition.



Secondly, an indicator species analysis was conducted to identify those species most strongly associated with each habitat system cluster. All species received an indicator value and a *p*-value for its 'best' cluster that resulted in a ranked list of indicator species for each cluster group (Table 2). The indicator value was defined as the product of the relative frequency and relative average abundance in clusters and was calculated following Dufrene and Legendre (1997). The use value of the habitat associations (preferred = 1 or utilized = 0.5) was used as a surrogate for species abundance, and *p*-values were calculated non-parametrically using 1,000 randomizations.

Table 2. Example of output from indicator species analysis for terrestrial species associated with a particular cluster group (#3) showing indicator and *p*-values. Note that breeding (B) and non-breeding (NB) habitats of many species are ranked separately.

Species	Cluster	Indicator Value	P-value
Black-backed Woodpecker (NB)	3	0.8182	0.001
Bay-breasted Warbler (B)	3	0.8000	0.002
Boreal Owl (NB)	3	0.8000	0.001
Cape May Warbler (B)	3	0.8000	0.002
Pine Grosbeak (B)	3	0.8000	0.001
Black-backed Woodpecker (B)	3	0.6923	0.001
Boreal Owl (B)	3	0.6400	0.004
Blackpoll Warbler (B)	3	0.6000	0.001
Boreal Chickadee (B)	3	0.4500	0.01
Gray Jay (B, NB)	3	0.4500	0.014
Olive-sided Flycatcher (B)	3	0.4356	0.015
Northern Saw-whet owl (B, NB)	3	0.4170	0.015
White-throated Sparrow (B)	3	0.3584	0.029

Phase IV – Filtering Criteria for Selecting Representative Species

A suite of additional filtering criteria was developed to facilitate selection of the final set of representative species at workshops (Table 3). Development of the criteria was based on the recommendations of Lambeck (1997), Miller (unpublished), and Noon (2008). The expectation was that workshop participants would consider and apply these filtering criteria during the process of screening indicator species for each cluster group.

Table 3. Filtering criteria used at workshops to facilitate selection of potential representative species.

- The group of representative species collectively occur over a large geographic area in the region and represent a wide range of habitat types
- Level of sensitivity to landscape configuration (area, dispersal, or resource limited), disturbance (fire, hydrologic regime, forest management, invasive species, etc.), or management
- Feasibility of monitoring
- Life history and population dynamics are sufficiently "known" to allow direct or indirect estimates of relative abundance and spatial distribution
- The species' ecological relationships and responses to ecological processes are sufficiently "known" to allow development or refinement of species-habitat models of species distribution and their response to environmental change

Phase V – Regional Workshops

Three workshops were held, one in each subregion, with federal, state, and NGO partners to identify a list of representative species for the NALCC. Terrestrial species were selected at each of the three subregion workshops, whereas aquatic species were reviewed at the Mid-Atlantic and southern New England workshops. Fundamental objectives were established for the workshops (Table 4).

Table 4. Fundamental objectives used in workshops to guide selection of representative species for the NALCC.

- Represent as many priority species as possible with the fewest number of representative species (i.e. minimize number of rep species selected)
- Maximize geographic coverage across the LCC by selecting representative species with the widest geographic distributions (when possible, choose a species that occurs in all 3 subregions)
- Select representative species that occur across as many habitat systems as possible within the LCC (i.e. utilize primary cluster group if possible)

Workshop participants were provided dendrograms of the primary and secondary habitat system cluster solutions; hand-outs containing the species grouped with each cluster group for both the primary and secondary solutions; and documentation on the NEAFWA terrestrial and aquatic classification systems. Via a facilitator, workshop participants were guided through a structured decision making process to reach consensus on selection of representative species. Filtering criteria helped guide participants during the workshop, but there was no requirement that the criteria be consistently applied during the workshops. For clusters with no associated species, workshop participants suggested representative species when there was consensus that a representative species was needed for that habitat cluster.

Results

Terrestrial Species

Eighty-seven terrestrial species were selected as representative species for the three subregions of the NALCC, including: 66 birds, 9 reptiles, 4 mammals, 4 amphibians, 2 plants and 2 invertebrates (Table 5). However, breeding and non-breeding habitats were tabulated separately for American black ducks, Common loons, and Common mergansers whose selection as representative species varied across subregions. There were 35 species selected for the northern New England, 34 for southern New England and 54 for the Mid-Atlantic subregions. Of these 87 representative species, 60 were selected for a single subregion, 19 were identified in two subregions, and 8 were identified in three subregions.

Aquatic Species

Participants at the Mid-Atlantic workshop did not any select representative species for the aquatic habitat systems. Rather, they expressed concern about the limited number of species present on the list and that NALCC boundaries did not include complete watersheds. The group recommended expanding the list of priority species; starting with all species listed in the state wildlife action plans that occur in the Atlantic drainage. In addition, the group provided a number of data sources that could be used to supplement the list. The group also suggested including percentage of residency in a habitat system as an additional filtering criteria for aquatic species. Finally, the group suggested developing complete aquatic species lists for one or two pilot areas to assess how adding more species would impact the species-habitat clusters. The Potomac and James River basins or the Kennebec River basin in Maine were suggested as pilot areas, due to ongoing studies in those drainages. Subsequently, the James River basin was replaced as a pilot watershed for the Designing Sustainable Landscapes project with the Pocomoke and Nanticoke basins.

Participants at the southern New England workshop selected 13 representative species for 6 habitat system clusters (Table 6). Similar to the Mid-Atlantic workshop, the group expressed concern about the limited number of priority species, large number of habitat

classes, and lack of resident species. The group also recommended expanding the list to include all species that are listed in state wildlife action plans in NALCC.

The Way Forward

Terrestrial Species

With 87 terrestrial species selected as representative species, the next step in the SHC process for the NALCC is beginning development of habitat models for these representative species as part of the Designing Sustainable Landscapes project. In its first two phases, this project is designed to:

1. Assess the current capability of habitats in the NALCC to support sustainable populations of the representative species;

2. Predict the impacts of landscape-level changes (e.g., from urban growth, conservation programs, climate change, etc.) on the future capability of these habitats to support populations of representative species.

A variety of ecological and modeling feasibility criteria will be applied by the principal investigators and project steering committee in consultation with the Strategic Habitat Conservation Steering Committee to prioritize which suite of representative species will be modeled first.

Aquatic Species

Under the guidance of the Region 5 Strategic Habitat Conservation Steering Committee, an expanded aquatic priority species list will be compiled for a pilot area, including species listed in state wildlife action plans.

Table 5. Terrestrial representative species selected at workshops for the North Atlantic Landscape Conservation Cooperative by subregion.

Species & Season (B=breeding, NB=non-breeding)	NALCC Subregion		
	No. NE	*So. NE*	*Mid Atlantic*
American Bittern (B)		✔	
American Black Duck (B)			✔
American Black Duck (NB)	✔	✔	✔
American Oystercatcher (B)		✔	
American Woodcock (B, NB)	✔		
Bank Swallow (B)	✔		✔
Beetle, Puritan tiger (B, NB)			✔
Bicknell's Thrush (B)	✔		
Black Scoter (NB)			✔
Black Skimmer (B)			✔
Black-and-white Warbler (B)			✔
Blackburnian Warbler (B)	✔		
Blackpoll Warbler (B)	✔		
Blue-winged Warbler (B)		✔	
Bobolink (B)	✔	✔	
Brown Thrasher (B)			✔
Brown-headed Nuthatch (B, NB)			✔
Bufflehead (NB)			✔
Bur Oak			✔
Canvasback (NB)			✔
Chestnut-sided Warbler (B)	✔	✔	
Clapper Rail (B)			✔
Common Eider (B, NB)	✔	✔	

Common Loon (B)	✔	✔	
Common Loon (NB)		✔	
Common Merganser (B)	✔	✔	
Common Merganser (NB)		✔	✔
Common Nighthawk (B)			✔
Common Tern (B)	✔	✔	✔
Diamond-backed Terrapin (B) (NB)			✔
Eastern Box Turtle (B, NB)			✔
Eastern Hognose Snake (B)		✔	✔
Eastern Meadowlark (B, NB)		✔	✔
Eastern Red Bat (B)	✔	✔	✔
Eastern Towhee (B)	✔		✔
Eastern Whip-poor-will (B) (NB)			✔
Eastern Wood-Pewee (B)			✔
Field Sparrow (B)		✔	
Grasshopper Sparrow (B)			✔
Horseshoe Crab (B)		✔	✔
Kentucky Warbler (B)			✔
King Rail (B, NB)			✔
Least Bittern (B)			✔
Least Tern (B)			✔
Little Brown Bat	✔	✔	
Long-tailed Duck (NB)	✔		
Louisiana Waterthrush (B)		✔	✔
Marbled Salamander (B)			✔
Marsh Wren (B)		✔	✔
Mink Frog	✔		
Mountain Avens	✔		

Nelson's Sharp-tailed Sparrow (B)	✔		
Northern Pine Snake			✔
Northern Pintail (NB)			✔
Northern Waterthrush (B)	✔	✔	
Ovenbird (B)	✔	✔	✔
Painted Turtle (B) (NB)			✔
Palm Warbler (B)	✔		
Pine Marten	✔		
Piping Plover (B)	✔	✔	✔
Prairie Warbler (B)		✔	✔
Prothonotary Warbler (B)			✔
Purple Sandpiper (NB)	✔	✔	
Red Knot (NB)			✔
Red-breasted Merganser (NB)		✔	
Red-shouldered Hawk (B)			✔
Ring-necked Duck (NB)			✔
Ruffed Grouse (B, NB)	✔		
Saltmarsh Sharp-tailed Sparrow (B)		✔	✔
Sanderling (NB)			✔
Sea turtle, loggerhead (NB)			✔
Semipalmated Sandpiper (NB)	✔	✔	
Snowy Egret (B, NB)		✔	
Spotted Salamander (B)	✔	✔	✔
Spotted Turtle		✔	
Spruce Grouse	✔		
Tricolored Bat			✔
Turtle, bog (B, NB)			✔
Upland Sandpiper (B)		✔	

Virginia Rail (B)	✔		
Warbling Vireo	✔		
White-throated Sparrow (B)	✔		
White-winged Scoter (NB)		✔	✔
Willet (B)			✔
Willow Flycatcher (B)		✔	
Wood Duck (B)			✔
Wood frog (B)	✔	✔	✔
Wood Thrush (B)	✔	✔	✔
Wood Turtle (B)	✔		
Worm-eating Warbler (B)			✔
Subregion species totals	**35**	**34**	**54**

Table 6. Aquatic representative species selected for 6 habitat system cluster groups at southern New England workshop for the North Atlantic Landscape Conservation Cooperative.

Species (B=breeding, NB=non-breeding)	Cluster
Brook trout (B)	Primary 1
Slimy sculpin	Primary 1
Blacknose dace	Primary 1
Spring salamander	Primary 1
Brook trout (NB)	Primary 3
Altlantic salmon (B)	Primary 3
Rainbow smelt	Primary 3
American eel (NB)	Primary 5
American shad (B)	Primary 6
Shortnose sturgeon (B)	Primary 6
Dwarf wedge mussel	Primary 6
Alewife	Secondary 11
Lake trout	Secondary 12

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