

HIGHEST RANKED WILDLIFE HABITAT BY ECOLOGICAL CONDITION
New Hampshire Fish and Game Department February 2007.

Information about habitat condition was analyzed to develop a statewide and regional ranking and identify the highest condition habitat relative to all polygons of a given habitat type in the state. The goal is to provide regional planners and conservation professionals a tool in identifying the most critical wildlife habitat locations. Results will be re-evaluated in the future to monitor the effectiveness of conservation actions and respond appropriately to new information or changing conditions. The overall condition of each polygon was assigned a relative rank based on all polygons of a habitat type that occur in NH.

Tier 1 Habitats of Highest Relative Rank by Ecological Condition in NH

Tier 2 Habitats of Highest Relative Rank by Ecological Condition in Biological Region

Tier 3 Supporting Landscapes

HABITAT	TIER	FACTOR	LEVEL
Matrix Forests	1	COND2	Top 15% in NH by area
	2	COND2	Top 15% in Subsection by area
	3	COND2	Top 30% in Subsection by area
Pine Barrens	1	COND1	Top 10% in NH by area
	2	COND1	Top 50% in Subsection by area
Rocky Ridges/Talus Slopes	1	COND1	Top 10% in NH by area
	2	COND1	Top 50% in Subsection by area
Cliffs	1	COND1	Top 10% in NH by quantity
	2	COND1	Top 50% in Subsection by quantity
Grassland 25+ acres	1	COND1	Top 10% in NH by area
	2	COND1	Top 50% in Subsection by area
Wet Meadow/Shrub Wetland	1	COND2	Top 10% in NH by area
	2	COND2	Top 50% in Watershed Group by area
Peatland	1	COND2	Top 10% in NH by area
	2	COND2	Top 50% in Watershed Group by area
Floodplain Forest	1	COND2	Top 10% in NH by area
	2	100%	Top 100% in Watershed Group by area
Watersheds (HUC12s)	1	COND2	Top 15% in Watershed Group by area (entire HUC12 watershed)
	2	COND2	Top 30% in Watershed Group by area (100m buffer of water bodies in these HUC12)
Lakes/Ponds	1		TNC's Top 10 most intact lakes, by lake class (including a 200m buffer of these lakes)
Saltmarsh	1	100%	100%
Coastal Islands	1	100%	100%
Dunes	1	100%	100%
Alpine	1	100%	100%
TNC top forest blocks	3		TNC forest blocks top-ranked in ELU Group and/or Ecoregion Subsection
Aquatic features	1-3		S1,S2,WAP level 1-4 Species, other occurrences (100m buffer of water bodies)
Animal occurrences	1-3		S1,S2,WAP level 1-4 Species, other occurrences
Ecological features (NHB)	1-3		Important ecological areas per NHB not overlapping a Tier 1 or 2 habitat polygon

The overall condition of each habitat polygon was assigned a relative rank based on all polygons of a given habitat type that occur in New Hampshire. Generally, CONDITION was based on the factors listed below: (Note: not all values are applicable to all habitat types). Factors by habitat are found starting on page 5.

BIOLOGICAL Value:

- Richness of rare wildlife within each habitat polygon (NH NHB)
- Richness of rare wildlife within their dispersal distances from each habitat polygon (NH NHB)
- Richness of all vertebrate wildlife within each habitat polygon (VT/NH GAP Analysis)
- Richness of rare plants within each habitat polygon (NH NHB)
- Richness of natural communities within each habitat polygon (NH NHB)

LANDSCAPE Value:

- Size of each habitat polygon
- Ecological Land Unit diversity within each habitat polygon (TNC)
- Proximity index or Distance to nearest neighbor of same habitat type
- Shape Index
- Proportion of polygon that is wetland (matrix forests and forest floodplain)

HUMAN IMPACT Value:

- Cation depletion index/risk from acid deposition (Miller, 2005)
- Mercury deposition (Miller et al. 2005)
- Wind power potential (Mass. Technology Coll., 2003)
- Fragmentation or Mean IFES score (TNC, 2005)
- Percent in Conservation (inverse)
- Number of dams and impounded area upstream of forest floodplain complexes (NHDES, 2005).
- Wetlands adjacent to a water body subject to drawdown (NHDES 2005)
- Wetlands impacted by alterations (NHDES Wetlands Bureau permit records, 1999-2004).
- Timber harvest, partial and clearcut (spruce-fir forest).
- Road density and/or distance to nearest road (NH DOT, 2005)
- Buildable area or risk to development based on statewide general buildout (NHFGD, 2005)
- Recreation use, e.g. cliffs listed in climbing guide books; density of hiking trails (AMC, 2005)
- 1990 and 2000 US Census data, population and housing unit density.
- Impervious surface and developed land use with upland buffer of wetlands, peatlands, forest floodplain, salt marsh.
- Relative area impacted by invasive plant species (salt marsh).

NOTES:

- 1.) Rare animal, rare plant and natural communities attributes assigned by NH Natural Heritage Bureau (2005).
- 2.) Digital data describing atmospheric deposition of mercury were provided by Ecosystems Research Group, Ltd using the methods described in Miller et al. (2005). Digital data describing the risk of calcium and other base cation depletion and limitation in forested ecosystems provided by Ecosystems Research Group, Ltd. using methods described in Miller (2005).
- 3.) Wind power spatial data were provided by Massachusetts Technology Collaborative (2003). Developed by TrueWind Solutions, LLC under contract to AWS Scientific, Inc. as part of a project jointly funded by the Connecticut Clean Energy Fund, Mass. Technology Collaborative, and Northeast Utilities System.
- 4.) Integrated Fragmentation Effects Surface spatial data provided by The Nature Conservancy, NH (2005).
- 5.) Draft vertebrate distributions in 1993 VT/NH Gap Analysis (report 2001). University of Vermont (2005).
- 6.) Dams and drawdown spatial data provided by NH Dept. of Environmental Services (2005).
- 7.) Wetland permits 2000-2004 spatial data provided by NHDES Wetlands Bureau (2005).
- 8.) Hiking trails spatial data provided by Appalachian Mountain Club, 2005.
- 9.) Timber harvest identified from 1992 and 1998 USGS orthophotos, data provided by Univ. of Vermont, 2005.
- 10.) NH DOT roads spatial data obtained from GRANIT (www.granit.sr.unh.edu) at Complex Systems Research Center, University of New Hampshire. Accessed in 2005.

Please refer to WAP spatial data notes (metadata folder) for complete source information.

Aquatic features and Animal occurrences:

Animal occurrence records were extracted from the NH Natural Heritage Inventory database and overlaid on the WAP habitat polygons.

Criteria used to select species:

- imperiled
- limited populations known or likely to occur
- isolated or restricted in NH
- point specific sensitive information
- provides critical habitat for state's population

Selected Element Occurrences (1985-to-current and excluding "general" precision) included:

- WAP Level 1-4 species identified in the preliminary risk groups
- S1 species State-ranked "critically imperiled"
- S2 species State-ranked "imperiled"
- Peregrine nest EOs
- Bald eagle nesting and wintering habitat - known and potential
- Known bat hibernacula, and small-footed bat EOs
- Supporting habitat of sensitive snake EOs
- Karner blue butterfly, persius duskywing skipper, pine barrens zanc., pine pinion moth, frosted elfin were used to elevate PINE BARREN habitat
- Cobblestone tiger beetle, American brook lamprey, and round whitefish EOs were used to elevate AQUATIC habitat
- Northern harrier, upland sandpiper, grasshopper sparrow EOs were used to elevate GRASSLAND habitat
- New England cottontail (with 1km buffer), Eastern hognose snake (with 1km buffer), marbled salamander (historic EOs), Blanding's turtle, spotted turtle, wood turtle, pied-billed grebe, common nighthawk (non-urban EOs), whip-poor-will, common loon, and northern leopard frog

The EO features listed above were used to elevate the underlying non-matrix forest habitat polygons to Tier 1. If the EO only overlapped a matrix forest habitat polygon, then a buffer was applied to the EO feature before scoring it and adding it to the WAPTIERs data layer.

NHB Additions to habitat polygons:

NH Natural Heritage Bureau provided spatial data identifying NHB-priority sites not covered by habitat polygons meeting "highest quality" tiers based on condition filters. Where NHB additions overlapped non-matrix habitat polygons, the entire polygon was elevated (if necessary) to Tier 1 or Tier 2 (according to NHB specification). Where NHB additions overlapped a matrix forest, the feature was buffered before scoring it and adding it to the WAPTIERs data layer.

Co-occurrence Scores:

This analysis identifies how habitats co-occur within a given area, a step in the process of identifying “focus areas”. The scoring used a simple point system:

- 3 points Habitats of Highest Relative Rank by Ecological Condition in NH
- 2 points Habitats of Highest Relative Rank by Ecological Condition in Biological Region
- 1 point Supporting Landscapes (top-ranked watersheds and TNC top-ranked forest blocks)
- 3 points Locations of one or more Element Occurrence records (of species listed on the preceding page) were used in two ways: either to elevate an underlying habitat polygon to highest relative rank and score it by 3 points, or where the EO only overlapped a matrix forest habitat, the buffered EO feature scored 3 points.
- 2-3 pts NH Natural Heritage Bureau provided locations of their top two tiers of significant ecological features. These features were applied the same technique as the animal element occurrences, where NHB’s top tier scored 3 pts (elevated underlying habitat, or where it only overlapped a matrix forest the NHB feature was scored); and in the same way NHB’s second tier features scored 2 points.

Co-occurrence scores greater than 3 (accumulative points) were further analyzed using the Getis-ord Gi statistic which in statistical terms measures the log-likelihood that high co-occurrence scores exist at each pixel based on the neighboring pixels. In other words it displays the probability that a given location is of higher relative condition. The higher the positive G-statistic result the higher that probability. This analysis is helpful because it helps smooth out uneven distribution of wildlife habitat across the landscape. It allows us to consider the density of information in a neighborhood instead of simple layering of information at a single point.

Attributes Used in Condition Filters for Each Habitat

MARSH AND SHRUB WETLANDS

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Number of marsh polygons in the complex

Area of largest marsh in the complex (hectares)

Number of dominant NWI vegetation classes in the complex

Road density within 250m of the complex

Distance to nearest road (meters)

Mean Integrated Fragmentation Effects score (Zankel 2005)

Wetlands Bureau permits (non-forestry)

Within 100m of a water body subject to fall draw down

Within 4000 ft of large water withdrawal

Wetlands Bureau forestry permits

Number of known contamination sites

Y or N, designated prime wetland area

Conservation land with 250 meter buffer around complex

PEATLANDS

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Area of buffer in hectares

Percent of 250m buffer of complex that is forest, water or wetland

Distance to nearest human impact

Wetlands Bureau permits (non-forestry)

Within 100m of a water body subject to fall draw down

Within 4000 ft of large water withdrawal

Wetlands Bureau forestry permits

Number of known contamination sites

Y or N, designated prime wetland area

conservation land with 250 meter buffer around complex

FLOODPLAIN FOREST

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Area of buffer in hectares

% of 1km buffer around complex that is wetland

Mean Int. Fragmentation Effects Surface score (Zankel, 2005)

Wetlands Bureau permits (non-forestry)

Wetlands Bureau forestry permits

% of 1km buffer around complex that is agriculture

Number of known contamination sites

Y or N, designated prime wetland area

conservation land with 250 meter buffer around complex

SALT MARSH

Ecoregional subsection

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Species richness of selected animal species occurrences in polygon

Species richness of selected animal species occurrences within 1km area (hectares)

Proximity index

Distance to nearest salt marsh area > 20 hectares in size (m)

Hectares of saltmarsh within one kilometer

Mean Int. Fragmentation Effects Surface score (Zankel, 2005)

Density of all DOT roads (km/km²)

Percent of polygon with invasive plants present

Percent impervious surface

Percent in conservation

Hectares of upland within 100m of polygon that are undeveloped

APPALACHIAN OAK PINE FOREST

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon
Percent of polygon in stand type consistent with matrix forest type (USFS)
Vertebrate richness based on GAP analysis
Area (hectares)
Shape index
Proximity index
Percent wetland
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Road density in the area/unit (km/km²)
Population density in 2000 (persons per square mile)
Housing units density in 2000 (houses per square mile)
Percent area that is buildable
Change in population density 1990 to 2000
Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Percent in conservation

HIGH ELEVATION SPRUCE FOREST

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Percent of polygon in stand type consistent with matrix forest type (USFS)
Vertebrate richness based on GAP analysis
Area (hectares)
Shape index
Proximity index
Percent wetland
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Population density in 2000 (persons per square mile)
Housing units density in 2000 (houses per square mile)
Density of hiking trails in the unit (km/km²)
Area of downhill ski operation (NHFGD 2005)
Percent area that is buildable
Change in population density 1990 to 2000
Percent of polygon with wind power potential
Distance to nearest power transmission line or pipeline (m)
Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Percent in conservation

HEMLOCK HARDWOOD PINE FOREST

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon

Percent of polygon in stand type consistent with matrix forest type (USFS)
Vertebrate richness based on GAP analysis
Area (hectares)
Shape index
Proximity index
Percent wetland
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Road density in the area/unit (km/km²)
Population density in 2000 (persons per square mile)
Housing units density in 2000 (houses per square mile)
Percent area that is buildable
Change in population density 1990 to 2000
Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Percent in conservation

LOWLAND SPRUCE FOREST

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Percent of polygon in in stand type consistent with matrix forest type (USFS)
Vertebrate richness based on GAP analysis
Area (hectares)
Shape index
Proximity index
Percent wetland
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Road density in the area/unit (km/km²)
Population density in 2000 (persons per square mile)
Housing units density in 2000 (houses per square mile)
Percent area that is buildable
Change in population density 1990 to 2000
Percent of polygon with wind power potential
Distance to nearest power transmission line or pipeline (m)
Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Percent in conservation

NORTHERN HARDWOOD CONIFER FOREST

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Percent of polygon in stand type consistent with matrix forest type (USFS)
Vertebrate richness based on GAP analysis

Area (hectares)
Shape index
Proximity index
Percent wetland
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Road density in the area/unit (km/km²)
Population density in 2000 (persons per square mile)
Housing units density in 2000 (houses per square mile)
Percent area that is buildable
Change in population density 1990 to 2000
Percent of polygon with wind power potential
Distance to nearest power transmission line or pipeline (m)
Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Percent in conservation

RIDGE/TALUS SLOPES

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Area (hectares)
Proximity index
Variety of ecological land units (ELU30 = elevation, substrate, landform)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Density of hiking trails in the unit (km/km²)
Distance to nearest hiking trail (meters)
Percent area that is buildable
Percent of polygon with wind power potential
Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)
Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)
Distance to nearest NREL class4 of 4+ acres in size (m)
Distance to nearest power transmission line or pipeline (m)
Percent in conservation

GRASSLANDS

Ecoregional subsection
Species richness of rare animals within their dispersal distances from the polygon
Species richness of rare animals within polygon
Species richness of rare plants in polygon
Richness of rare and exemplary natural communities in polygon
Area (hectares)
Proximity index
Percent wetland (National Wetlands Inventory)
Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)
Housing units density in 2000 (houses per square mile)
Percent area that is buildable
Change in population density 1990 to 2000
Percent in conservation

ALPINE

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Area (hectares)

Proximity index

Variety of ecological land units (ELU30 = elevation, substrate, landform)

Density of hiking trails in the unit (km/km²)

Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)

Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)

Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)

CLIFF

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Area (hectares)

Proximity index

recreational rock climbing (Y=yes, U=undetermined)

Distance to nearest highway (meters)

Distance to nearest road (meters)

Nat'l Renewable Energy Laboratory wind power class 4 percent (commercial turbine potential)

Distance (m) to nearest NREL class 4 polygon 4+ acres

Distance to nearest high power transmission line (meters)

Percent in conservation (%)

PINE BARRENS

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Percent of area classified by NHB as current pine barrens

Percent of area classified by NHB as current pine barrens

Area (hectares)

Proximity index

Variety of ecological land units (ELU30 = elevation, substrate, landform)

Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)

Population density in 2000 (persons per square mile)

Housing units density in 2000 (houses per square mile)

Percent area that is buildable

Change in population density 1990 to 2000

Ave. deposition of gaseous elemental mercury via assimilation into foliage by land cover type (Miller et al, 2005)

Average total deposition of mercury (wet + dry) by land cover type (Miller et al, 2005)

Average deposition index, rate of cation depletion per ha/per year (Miller et al, 2005)

Percent in conservation

COASTAL ISLANDS AND DUNES

Ecoregional subsection

Species richness of rare animals within their dispersal distances from the polygon

Species richness of rare animals within polygon

Species richness of rare plants in polygon

Richness of rare and exemplary natural communities in polygon

Average elevation (meters)

Vegetated (Y=yes or U=unknown)

Total size of island or unit (hectares)

Number of other islands within ½ kilometer

Average distance to mainland (meters)

Percent of island/unit that is wetland-NWI

Ecological land units variety (ELU30 = elevation, substrate, landform)

Mean IFES score (Integrated Fragmentation Effects Surface The Nature Conservancy; Zankel, 2005)

Percent already developed (2001 NH Land Cover from GRANIT)

Distance to nearest aquaculture operation (meters)

Percent buildable (NHFGD general statewide buildout)

Percent of polygon with wind power potential

Average GEN_SENS value from ESI shoreline data

Total percent in conservation

RIVERS AND STREAMS

Watershed Group

count of anadromous fish species

waterbodies managed for wild trout

waterbodies containing lake trout populations

Status of Eastern brook trout (EBT Joint Venture)

NHB tracked species count (mussels, eagle, osprey, wood turtle, Cobblestone tiger beetle)

Value based on rarity of fish species of concern present

Area of surface water in the unit (hectares)

Length of rivers in kilometers

Area of wetlands in hectares

Road density in the area/unit (km/km²)
Percent of land area that is agriculture
River kilometers not impounded / total river kilometers
Developed & developable land incl. constrained areas (percent of total land area)
Change in population density 1990 to 2000
Percent in conservation

LAKES AND PONDS

Watershed group
waterbodies managed for wild trout
waterbodies containing lake trout populations
Value based on rarity of fish species of concern present
NHB tracked species count (mussels, eagle, osprey, wood turtle, Cobblestone tiger beetle)
% watershed area in wetlands
% watershed area in open water
Road density in the area/unit (km/km²)
Developed & developable land incl. constrained areas (percent of total land area)
Percent of land area that is agriculture
Change in population density 1990 to 2000