

Maryland Coastal Zone Management Program

Grant No. NA170Z0497-01

Final Report

TASK B

Protection of Nontidal Wetlands
and Critical Habitat Areas



William Donald Schaefer
Governor

Maryland Department of Natural Resources
Tawes State Office Building
Fish, Heritage and Wildlife Administration
580 Taylor Avenue
Annapolis, Maryland 21401
April 8, 1993

Torrey C. Brown, M.D.
Secretary

MEMORANDUM

TO: Suzanne Aucella
Coastal and Watershed Resources Division

VIA: Janet McKegg
Natural Heritage Program

FROM: Katharine McCarthy *Katharine*
Natural Heritage Program

SUBJ: Final Report of Progress in Protection of Nontidal
Wetlands and Critical Habitat Areas (Contract C299-92-
005)

Educational Projects

Mobile Educational Display: Attached are copies of the final text and final layout for the display. We have had delays in obtaining the photo enlargements due to new restrictions in DNR's procurement process that required us to formally bid the work. All titles/headings have been produced and other graphics are in preparation. We have obtained the display hardware and expect to receive the maps, graphics, and photos by the first week of May. The display will be assembled immediately upon receipt of these components and will be ready for exhibition.

Educational Unit: Attached is the final text and draft layout. Five additional drawings are being prepared for the final product. We have met with and received very favorable responses from environmental education program staff both within DNR and at the U.S. Fish and Wildlife Service (Chesapeake Bay Estuary Program). We have also discussed the unit with the Coordinator of math and science curricula for the state Department of Education. The unit is being sent through the Coordinator for review by a group of school supervisors prior to printing. The Coordinator will also facilitate distribution of the unit to school supervisors and teachers in Coastal Plain counties. The unit will also be distributed at annual state teachers meetings, DNR regional workshops on environmental

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education, and other relevant forums.

Fact Sheets: The fact sheet on nontidal wetlands of special state concern was completed in 1992 and submitted previously; another copy is attached. The fact sheet on habitat fragmentation is in final draft. The text and draft layout are attached. We are incorporating final comments and will complete the text and layout this month. The Natural Heritage Program will pay for the cost of printing the final fact sheet on habitat fragmentation.

Bog Study

We made numerous contacts with landowners at the two sites selected for study. Contacts with owners at North Grays Bog yielded more information about land use history than contacts at Gumbottom Wetland. A summary of our findings is attached.

A summary of progress in our bog vegetation monitoring is also attached.

Nontidal Wetlands of Special State Concern

Landowner Contact: The final report of progress on this task was submitted in January.

Remapping Boundaries: We consulted with staff of the Water Resources Administration on their effort to map these wetlands on the new, more detailed scale of 1"=6000'. We determined that only general guidelines were practical as guidance for the initial mapping. We then consulted on several individual site boundaries that mappers had problems or questions on. The following list includes general guidelines that we agreed upon.

- 1) If the more detailed mapping results in the division of what was formerly a single wetland area (identified as of special state concern) into two or more disjunct wetlands separated by a very narrow upland, all smaller (now disjunct) polygons should be highlighted as of special state concern.
- 2) If the area of a special state concern wetland is shown to be larger, all newly identified wetland areas that are contiguous with the previously identified wetland should be highlighted as of special state concern.
- 3) If the area of a special state concern wetland is shown to be smaller, the larger original area will be specially annotated on the new map. This annotation will give notice to permit reviewers and landowners that, if a regulated activity is proposed, the larger original area needs to be field-checked to determine if

wetlands are present.

We have been reviewing each boundary for the wetlands of special state concern within the geographic region that is being remapped in order to identify errors in the boundaries. We have been providing corrected boundaries to the mapping staff.

KMAC/dab

LAND USE HISTORY AT NORTH GRAY'S BOG AND GUMBOTTOM WETLAND

North Gray's Bog

North Gray's Bog is located in Lake Shore peninsula area of Anne Arundel County, at the headwaters of North Gray's Creek, a tidal tributary of the Magothy River. The bog occurs on the fringes of and just upstream from a small pond and is bordered by marsh, shrub swamp, and forested upland.

Most of the residents of the immediate vicinity of North Gray's Bog have lived in the area fewer than 10 years (Sillery Bay Forest community, upstream) or 25-30 years (Sylvan View community, downstream from the bog). I found only a few area residents who had any knowledge of the area prior to 1960. Most helpful were Mr. and Mrs. Henry Stegall, Mr. and Mrs. Richard Devoe, Dale Roberts, and especially Doug King, Glen Lowman, and Marie Angell Durner.

Mrs. Durner, whose parents owned the nearby Angell's Store from 1921-1960, grew up in the immediate vicinity of North Gray's Bog (from 1923 to 1960). She still owns a 9-acre parcel that includes part of the pond. Mr. Lowman has researched the history of the Lake Shore peninsula with his son for a Boy Scout project. Mr. King's knowledge did not go back extensively, but he provided pertinent information on the road and dam that maintain the pond and thus the bog.

Before the North Gray's area was developed with suburban residences, beginning in the mid- to late- 1950's, year-round residents consisted primarily of farmers and watermen. A few small stores such as Angell's Store on Old Mountain Road served community needs. In addition, several summer homes had been built along Gray's Creek and nearby tributaries of the Magothy river, on waterfront properties where wealthy Baltimoreans came for summer recreation.

The earth road that serves as a dam to maintain the water in the pond at North Gray's bog was built to provide access from Mountain Road to several summer homes on the East side of North Gray's Creek. I have not been able to determine exactly how long ago the road was built. Although it has been reported in the scientific literature that the pond did not show up on USGS quadrangle maps until 1975, both the road and pond do appear in the earliest aerial photos I could locate, dated 1948. Furthermore, Mrs. Durner reports that both the road and pond were there when she moved to the area in 1923.

Mr. King, a civil engineer and resident of the Sylvan View community just south of North Gray's Bog for 25 years, recalled shoring up the pond dam about 20 years ago. The pipe that drained the pond was only about 4" in diameter and the earth was eroding badly around it. The community replaced the pipe with a 15" pipe, covered the pond end with screening, and built a concrete end-

section at the pond end to control erosion.

The forested uplands around North Gray's Bog are second growth, although none of my contacts know exactly when the woods were cut. None had explored the marsh or pond vegetation in the immediate vicinity of the bog.

Gumbottom Wetland

I have not been able to locate many contacts with any knowledge of the vegetational history of this site. There are only a few property owners in the vicinity of the wetland, each owning large parcels. They were either relatively recent landowners (e.g. Mr. and Mrs. Gardner) or relatively unavailable for consultation (the Mallonees, Jr. and Sr.)

One owner, however, did provide some significant historical information that confirms existence of bog vegetation at the site at least 50 years ago. Mr. Alvin Stinchcomb (now in his 60's) has lived on his property upstream from the bog all his life. He recalls walking down to the wetland with his mother as a boy, going down a steep bank to pick cranberries. The wetland was more open then - it is closing in now - and it was also wetter. The stream at the bottom of their property, now narrow and shallow, was wide and deep enough to require a bridge or logs to cross it. Mr. Stinchcomb reports that the tributary of Gumbottom Branch between his property and the next property upstream was filled in when mining was done in about 1986. Thereafter, some sort of sludge was applied for several years, until several neighbors signed a petition complaining of the odor.

J.R. Modlin
March 31, 1993

VEGETATION MONITORING IN COASTAL BOGS

Methodology was developed to monitor vegetation succession in two coastal bogs in Anne Arundel County, Gumbottom Wetland in the Severn River watershed and North Grays Bog in the Magothy River watershed. Within coastal bogs, numerous state rare orchids, sedges, and insectivorous plants inhabit canopy gaps which are early successional habitats. Historically, natural disturbances such as fire and flooding created canopy openings and limited the establishment of trees within these wetlands. Modern practices of fire suppression and flood control as well as the decimation of beaver populations have reduced the frequency and intensity of these natural disturbances. In addition, most of the bogs historically documented on the Western Shore (McAtee, 1918) have been destroyed by residential and commercial development. The opportunities for formation of new bogs are extremely limited, both by the suppression of natural disturbances and by extensive habitat conversion to residential, commercial, and agricultural use. Monitoring the encroachment of trees in the remaining bogs is essential in order to assess the potential threat to rare herbaceous species and to determine if management of woody vegetation is necessary.

METHODOLOGY

The two bogs were selected for monitoring based upon the following criteria: number and status of rare species present, condition of rare species' populations (i.e. size, reproduction), habitat quality (such as size of herbaceous opening), and habitat defensibility (for example, presence of undisturbed buffer), and landowners' interest in protecting the bog. We reviewed the Natural Heritage Program's database for all documented bogs on both the Eastern and Western Shores.

Gumbottom Wetland is publicly-owned and harbors 12 rare or uncommon plant species. The bog mat is well-developed and the herbaceous opening is one of the largest documented in coastal Maryland. Adequate buffer exists along much of the perimeter; however, much of the watershed of the large stream that borders the bog is developed, so sedimentation and pollutants may reduce water quality in the bog. The Western Shore region that supports bogs (Prince Georges and Anne Arundel Counties) is densely inhabited, and there are no bogs in this region that are more defensible than this site.

North Grays Bog harbors six rare plant species. This site is privately-owned by a homeowners' association that has agreed to voluntarily protect the bog through our Natural Areas Registry. The bog occurs at the perimeter of a marsh and pond that were created by damming a stream. Most of the bog is bordered by a wide forested buffer. There is still a large area of open water into which the bog mat may expand, so there is good

potential for long-term viability of the bog community. The current herbaceous opening in the bog is one of the largest documented in coastal Maryland.

We conducted a literature search on bogs as well as on vegetation monitoring in early successional habitats. The studies found to be the most similar in purpose to this study examined the effects of prescribed burning in managing and restoring prairies and savannas. The bog habitat is substantially different however, and the methods were not directly applicable. We chose to modify those methods dramatically, but followed the same intent to design sampling so that the current monitoring design will also provide the data necessary if we pursue experimental active management in the future.

We developed a stratified-random sampling design. Transects follow the gradient from forest edge through the bog to the opposite edge of the bog perpendicular to the direction of water flow. At each end of each transect, a 5m x 5m plot is located on a randomly selected side of the transect. We determined that monitoring encroachment within the center of the bog is necessary because the current pattern of woody plant distribution is not entirely sequential from edge to center. While many trees and shrubs are growing near the perimeter, others also grow on hummocks that occur within the bog. Shrub cover is to be measured on two randomly selected sides of each plot using the line intercept method.

Within each 5m x 5m plot the densities of tree saplings and seedlings will be reported by species in seven size classes:

- 1) $25\text{cm} \leq \text{height} < 50\text{cm}$;
- 2) $50\text{cm} \leq \text{height} < 1\text{m}$;
- 3) $1.0 \leq \text{height} < 1.5$;
- 4) $\text{height} > 1.5\text{m}$, $\text{dbh} < 1\text{cm}$;
- 5) $1\text{cm} \leq \text{dbh} < 3.5\text{cm}$,
- 6) $3.5 \leq \text{dbh} < 6\text{cm}$,
- 7) $6\text{cm} \leq \text{dbh} < 10\text{cm}$.

At the four corners of each 5m x 5m plot, a 1m x 1m plot is to be established. Herbaceous cover will be recorded for all species present for each plot. Density will also be determined for herbaceous species listed as endangered or threatened in Maryland.

In the future, if experimental management of woody vegetation is pursued, three of the four 1m x 1m plots could be treated experimentally while the fourth could serve as a control. Rates of new encroachment could be compared between central and perimeter plots. Some of the 5m x 5m plots could remain undisturbed for continue monitoring or for experimental manipulation at a later date.

In 1992, four transects were established following these methods at Gumbottom Wetland, with three (5m x 5m) plots located on each transect. We did not complete the establishment of plots at North Grays Bog.



M · A · R · Y · L · A · N · D · 'S NATURAL HERITAGE

WHAT IS RARITY?

(An educational unit on causes of rarity and extinction in plant & animal communities, with particular reference to Maryland's Coastal Plain)

OBJECTIVES

- 1) To give students an understanding of why plants and animals become **rare** or are threatened with **extinction** as a result of human activities.
- 2) To teach students the concept of **commonness** and **rarity** in nature.
- 3) To increase students' awareness of, and appreciation for, local and regional flora (plants) & fauna (animals), and the diversity of common and rare habitats in their region and neighborhood.
- 4) To introduce students to some of the rare, threatened and endangered species of **Maryland's Coastal Plain**.
- 5) To expose students to some of the source materials and references used by botanists, zoologists and ecologists.

BACKGROUND

Many scientists believe that the Earth is experiencing a period of mass extinction of species - a tremendous loss of biological diversity - as a result of human activities. Hundreds of species of plants and animals have gone extinct at the hands of humans in the last 500 years and thousands or tens of thousands are threatened with extinction in the next 10-50 years. Over geologic time, species naturally go extinct at an average rate of perhaps one per 1000 years. But today, many biologists agree that as many as **four species per day** are going extinct worldwide. Most of the loss is occurring in the tropics, where more than half of all species on Earth are found. Tropical rain forests are being destroyed so rapidly that many of the species being lost (especially plants and insects) have never been studied or given a scientific name.

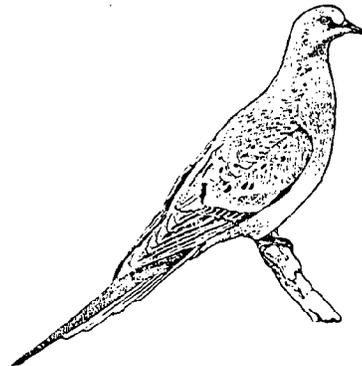
Species are also going extinct in industrialized countries in the temperate zone, and many more have become rare and are threatened with extinction. In the U.S. and Canada, over 100 species and subspecies of vertebrates (mammals, birds, reptiles, amphibians, fish) have gone extinct since Columbus arrived in the New World in 1492. Dozens, if not hundreds of plants and insects have probably disappeared during the same time, but historical records for these groups are limited. In Maryland, over 200 species of plants and animals are **extirpated** (no longer occur - local

extinction) from the state. Today, almost 750 species of plants and animals are federally listed as **Threatened** or **Endangered** in the U.S., and 3000 more have been nominated to be added to the list. Many of these are species that have been extirpated from entire states or large portions of their former ranges. Thousands of others across the country have been designated by state governments as rare, threatened or endangered within individual states.

Human-Related Causes of Rarity

- | | |
|---------------------------------------|-----------------------|
| 1) Habitat loss | 4) Pollution |
| 2) Habitat fragmentation | 5) Introduced species |
| 3) Habitat alteration and degradation | 6) Hunting |

Species are driven to extinction, or become so rare that they are threatened with extinction, usually as a result of one or more human activities. **Hunting**, although responsible for the demise of some well-known species - passenger pigeons, wolves in the lower 48 states, bison in the Great Plains, blue whales - is not the most common cause of rarity or extinction. **Habitat loss** and **habitat fragmentation** are the leading causes of the loss of species from the land. Every animal needs a certain amount of space for food, shelter, and breeding. When large areas of habitat are destroyed by development, some animals are killed directly, and all of the remaining animals cannot be squeezed into nearby habitat, so many perish.



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Passenger Pigeons once occurred in the millions in the U.S. The last one died in the Cincinnati Zoo in 1914.



Even where natural habitat persists, it is often fragmented (broken into small sections) by roads, housing developments, and shopping centers. Many species cannot or will not cross such human-dominated "barriers", so their populations are reduced to a few, small, isolated groups. Numerous birds on Maryland's Coastal Plain (and in the Northeastern U.S.) are "FID's" - Forest Interior Dwelling birds. These species are adapted to live deep inside mature forests. They do very poorly where the forest is small and heavily disturbed at the edges by surrounding farms, roads, and developed areas. Similarly, black bear were once common throughout Maryland, including the Coastal Plain. But these large omnivores require great expanses of natural habitat, a situation that no longer exists in most of the state. With their numbers also reduced by hunting, only a few black bears are now found in extreme western Maryland.

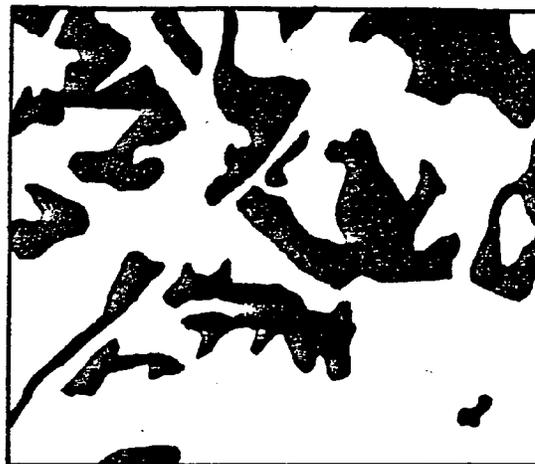
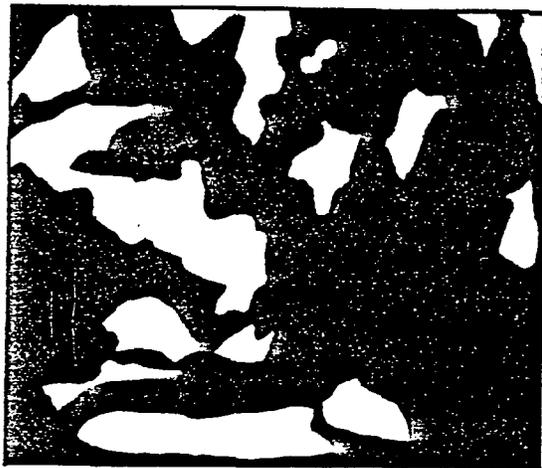


Figure 1. An aerial view of forest cover (black) in Maryland in (a) the early 1950's and (b) the early 1980's. Total tree cover has been greatly reduced, and the small fragments of forest remaining are increasingly isolated.

Plants may be less affected than animals by habitat fragmentation, but they are still vulnerable. For example, **dwarf trillium**, a wildflower that grows in mature forests on Maryland's Eastern Shore, is endangered in part because so little of this habitat remains, and what does remain is fragmented into small "islands" of natural habitat surrounded by a "sea" of human-dominated land.

When the number of individuals of any species becomes low (i.e., the species becomes rare), the chance of extinction increases dramatically. Disease, natural "disasters" (e.g., forest fires, floods, a sudden freeze) or further development could easily wipe out an entire population - perhaps the last population found anywhere.

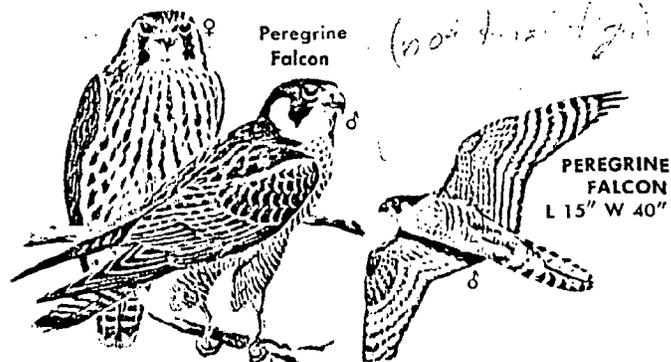


Dwarf Trillium
(State Endangered, Federal Candidate)

Two significant but less important human-related causes of rarity and extinction are **pollution** and **habitat alteration** or **degradation**. Many birds of prey (hawks, falcons, eagles) became very rare in the U.S. during the 1960's and '70's when they ingested large amounts of DDT insecticide in their food. DDT, which was widely sprayed around the country from the 1940's to the 1960's to control mosquitos and other insect pests, causes abnormal thinning of egg shells, so many birds could no longer produce young. With a ban on the use of DDT in 1972, **bald eagles** and **peregrine falcons** have slowly made a comeback (in Maryland and the U.S.) after falling to very low levels in the early 1970's.

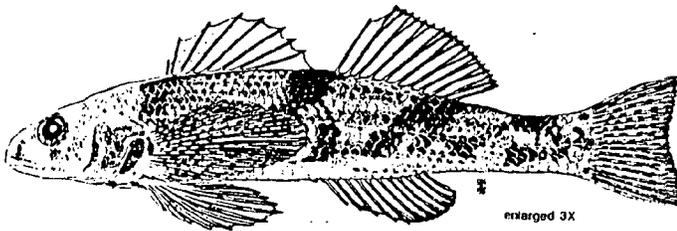
Unfortunately, we may be repeating this tragedy of unintended side effects of chemical use today. In the Northeastern U.S., the chemical diflubenzuron (trademark name - **Dimilin**) is being widely used to control **gypsy**

moth, a pest species that feeds on the leaves of many native and ornamental trees. Gypsy moths caterpillars were first brought to Massachusetts from Europe in 1868 for scientific study. But some escaped from captivity, and this small insect now denudes hundreds of thousands of acres a year from Maine to Virginia and west to Michigan. Dimilin effectively inhibits larval growth in gypsy moths, but the spray also kills larvae of all other moths and butterflies in the vicinity. Butterflies are important pollinators of many plant species, so where butterflies are wiped out, plant populations may also be reduced. Dimilin is also highly toxic to many aquatic invertebrates, so animal communities of streams, rivers and lakes are at risk.



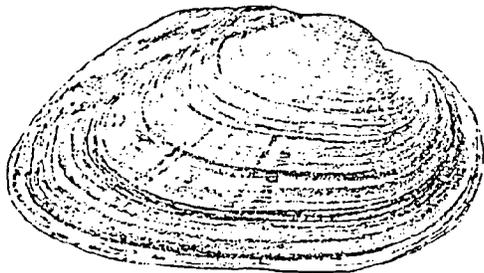
Peregrine Falcon (height = 15 in, wingspan = 40 in)
(Federal & State Endangered)

Habitat alteration and degradation certainly affect terrestrial habitats like forests, but there is also serious impact on fish populations and other organisms in aquatic habitats. Dams, canals, marinas, dredged channels and similar management activities all directly alter aquatic habitats, usually to the detriment of native species. Further, waste-water pumped out of factories and, ironically, effluent from sewage-treatment plants, plus overland runoff of chemicals and sediment from farms and developed areas, alters the quantity and degrades the quality of water flowing into streams and rivers. In the late 1960's a small fish called the **Maryland darter** was found in only one place in the world - a small portion of Deer Creek in Harford County. But a manure containment tank on a farm upstream of the darter's habitat collapsed and flooded the stream in the early 1980's, producing a massive fish kill near the spill. Since then, no Maryland darters have been seen in Deer Creek.



Maryland Darter This tiny fish occurred nowhere else in the world but Maryland. It may now be extinct. (Federally & State Endangered)

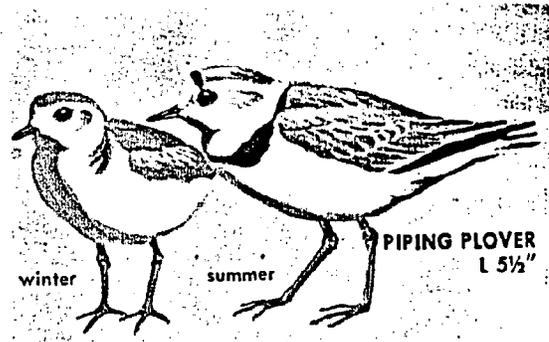
Several species of freshwater mussels (e.g., the federally listed **dwarf wedge mussel**) have almost disappeared from Maryland waters. Because these invertebrates are filter-feeders, they are vulnerable to high levels of sediment and chemical pollutants in the water. Furthermore, the poor health of the Chesapeake Bay and its tributaries, and the decline of many important aquatic species (e.g., rockfish, oysters, submerged aquatic vegetation) in the Bay, reflect the impact of human activities over many years.



Dwarf Wedge Mussel
(Federally & State Endangered)

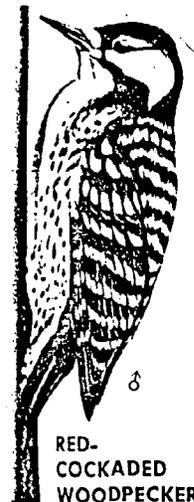
Habitat alteration and degradation can come in many forms and can be quite subtle. On Maryland's Atlantic beaches, birds like **least terns** and **piping plovers** are threatened by several related factors: loss of beach habitat

due to construction of jetties that alter the pattern of sand accumulation; off-road vehicles that crush nests, eggs and young; frequent disturbance of nesting birds by sunbathers and beachcombers, so that the eggs cannot be properly incubated. These activities have also virtually eliminated several species of dune plants - **seabeach amaranth** and **seaside knotweed** for example - from Maryland's beaches.



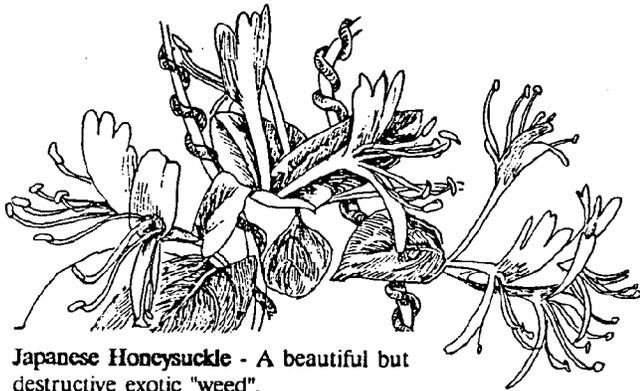
Piping Plover (Federally Threatened & State Endangered)
Seabeach Amaranth (State Endangered, Federal Candidate)

Inland from the shore, **red-cockaded woodpeckers** have disappeared from Maryland's abundant pine forests. There are still plenty of trees in these forests, but management practices have eliminated the large, old (60-100 yrs.) dead trees that these birds need for carving out nest cavities. Red-cockaded woodpeckers, which live in small colonies of related individuals, are federally listed as endangered because most old-growth pine forests in the East have been transformed into even-aged pine plantations that are harvested when the trees are only 25-30 years old.



Finally, humans have inadvertently contributed to the rarity or extinction of native species by importing thousands of "exotic" species of plants and animals from other countries and continents. These **introduced species** often dominate habitats and out-compete native species for space, food and other resources. For example, many of the

native birds of Hawaii are rare or extinct because of competition from introduced birds, predation from introduced predators (e.g., cats and rats), or habitat alteration due to introduced plants. Much of the natural vegetation of South Florida is being overtaken by several species of fast-growing trees (e.g., casuarina, Brazilian pepper) introduced from Australia and South America. Here in Maryland, Japanese honeysuckle, multiflora rose, kudzu and English ivy spread rapidly and cover large areas formerly vegetated by native trees and shrubs. Dozens of exotic grasses and weeds out-compete native wildflowers both in forests and fields. Introduced birds like starlings and house sparrows aggressively take over nesting sites and food resources that normally support native bird species.



Japanese Honeysuckle - A beautiful but destructive exotic "weed".

It's important to remember that several human-related causes usually act in combination to bring about rarity, extirpation or extinction of a species. For example, as forests are fragmented and disturbed, introduced species invade and become established much more quickly and in greater numbers. Thus, rare species not only have less

habitat, but suffer greater competition for what little remains. Populations of native birds are reduced by habitat loss and fragmentation, but in the last few years it has become clear that they also suffer heavy predation from house cats. Fish and other aquatic animals are often over-harvested at the same time that their habitat is being degraded and polluted by human activities. Protecting rare species - slowing the march toward extinction - requires addressing all of the factors contributing to the decline of their populations.

Natural patterns of rarity

- 1) Naturally low population density
- 2) Adapted to unusual/unique habitats (which are rare)
- 3) Adapted for specialized diets

Not all species that are rare got that way because of human activities. In fact, when looked at from a regional or continent-wide perspective, most species are uncommon. Every species is adapted to a particular set of environmental conditions (temperature, precipitation, elevation, etc.), soil, and vegetation types. So, rather than being distributed across the whole landscape (Fig. 2a), most species are found in only one geographic region, or in only one habitat type within a large region (see Fig. 2b). A good example here would be plants and animals adapted to sandy beaches or salt marshes of the Atlantic coast. Although gulls and terns and beach grass would be common if you drove along the coast from New York City to Florida, you wouldn't encounter these species if you drove from, say, Washington, D.C. to Chicago (or if you lived anywhere in-between). Even geographically widespread species might only occur in isolated communities across their range, making them "rare" over

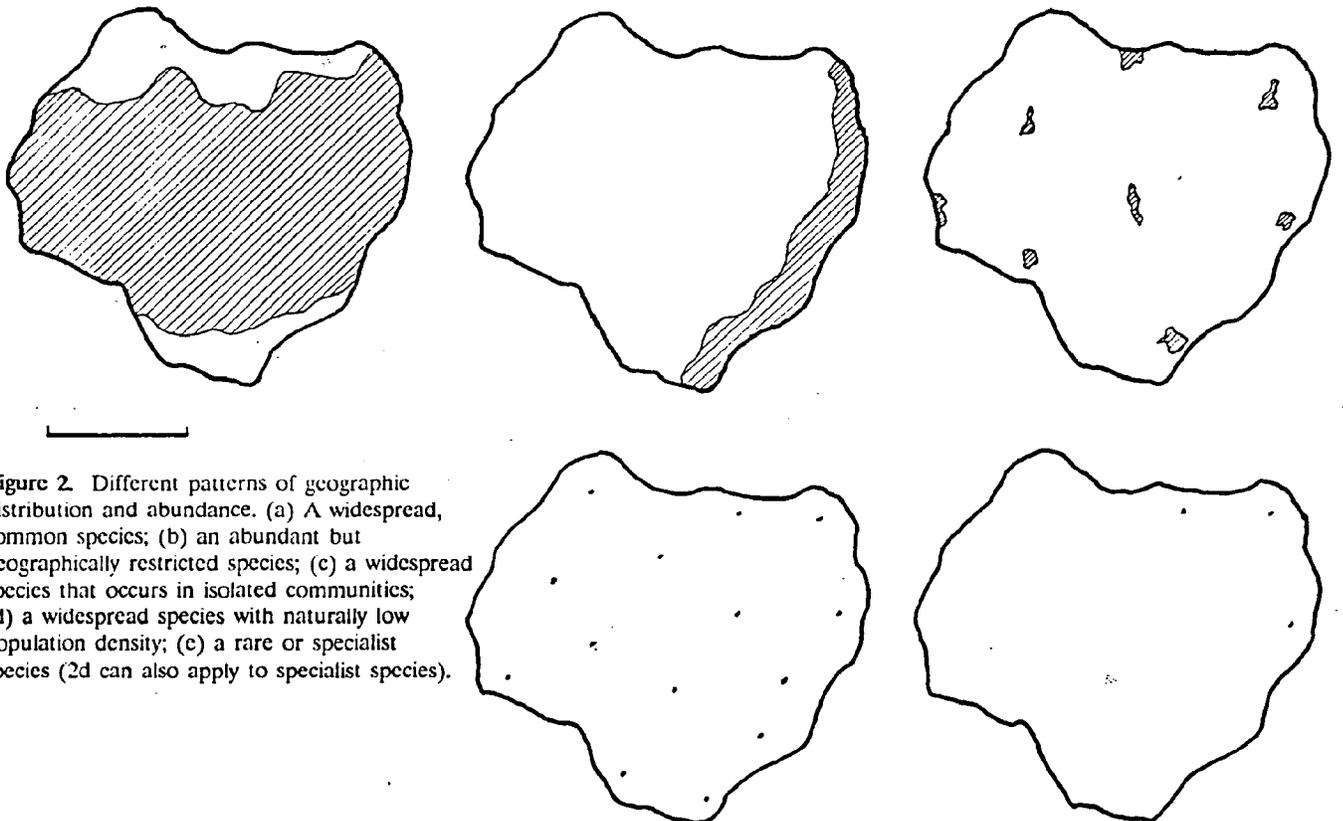
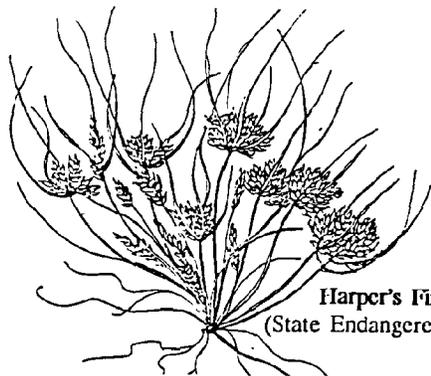


Figure 2. Different patterns of geographic distribution and abundance. (a) A widespread, common species; (b) an abundant but geographically restricted species; (c) a widespread species that occurs in isolated communities; (d) a widespread species with naturally low population density; (e) a rare or specialist species (2d can also apply to specialist species).

most of the land surface (see Fig. 2c). This means that many of the species in the area where you live are "special", in the sense that you would not see them in too many other places around the country.

Some species are rare because they naturally occur at low population densities. Large predatory mammals (bears, wolves, cougars, etc.), for example, require large territories and produce few young each year, so only a few animals might be found in an area the size of a county (see Fig. 2d), even when natural habitat is abundant.

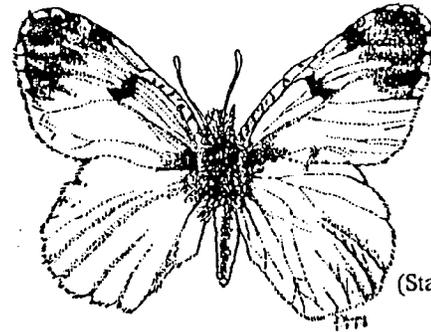
Species that are naturally very rare are often those we call specialists, because they are adapted to unique or unusual (i.e., rare) habitats, or they have specialized diets (Fig. 2e). A number of plant species on Maryland's Coastal Plain, for example, grow only in bogs, and others are found only in seasonal ponds known as Delmarva bays. Compared to, say, forest tree species, these plants were uncommon even before Europeans arrived. But because so many bogs and Delmarva bays have been converted to farmland, commercial developments or housing areas, these plants are extremely rare today. A fascinating rare species found in Maryland bogs is the carnivorous northern pitcher plant. This plant digests insects that become trapped in unusual pitcher-shaped leaves filled with water. Bogs are characterized by soil that is acidic and low in the nutrients plants need to grow. With their ability to get nutrients from the insects they trap, northern pitcher plants have developed a remarkable adaptation to the bog environment. Another rare species, so inconspicuous as to be nearly invisible, is Harper's fimbriatylis, a tiny, grass-like plant that germinates in the deepest parts of Delmarva bays after the ponds dry out in late summer. This plant appears only in some years, and grows for only three or four months before setting seed and dying.



Harper's Fimbriatylis
(State Endangered, Federal Candidate)

Good examples of specialists with restricted diets are certain butterflies that feed on a single type of host plant (either as leaf-eating caterpillars or nectar-feeding adults). Where the host plant is rare or limited in distribution, the butterflies will also be uncommon. One of a number of rare butterflies in Maryland is the frosted elfin, whose caterpillars feed on the leaves of wild lupine. A perennial wildflower with showy blue flowers, wild lupine grows primarily on dry sandy soils associated with ancient sand dunes on the Eastern Shore. This species is threatened in Maryland because most of these sandy areas were cleared for farm fields long ago. Another rare butterfly, the regal fritillary, feeds on the nectar of several species of native

violets. Although these plants are not rare per se, the open meadow habitat in which they are commonly found is much rarer than before. Several other unknown factors may also play a role in making the regal fritillary rare.



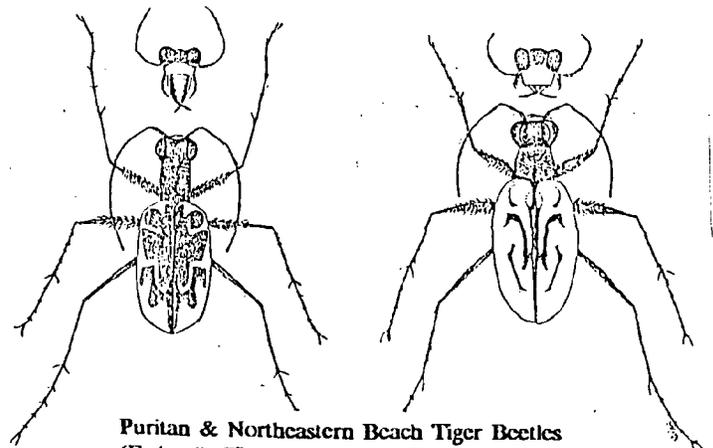
Frosted Elf
(State Endangered)

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Fig)

MARYLAND'S COASTAL PLAIN

Of the three physiographic provinces found in Maryland - Coastal Plain, Piedmont and Appalachian - the Coastal Plain is the largest, encompassing all of 12 counties, parts of four others and most of Baltimore City. The Coastal Plain extends from the Atlantic coast through the Eastern and Western Shores to the Fall Line, which marks the zone of transition to the Piedmont province. The Fall Line runs in a curving arc from Virginia to Delaware through western Washington, D.C., along the western border of Prince George's County, through eastern Howard County, western Baltimore City, and eastern Baltimore, Harford, and Cecil counties.

The topography (landform) of the Coastal Plain is generally low with little relief (change in elevation), especially on the Eastern Shore. Most of the land is less than 33 meters (about 100 ft) above sea level, though elevations reach 100 m in a few places. Probably the most dramatic relief can be seen on the Western Shore peninsula between the Bay and the Potomac. Here, estuaries rise rapidly to uplands at more than 30 m elevation. Along the Bay in Calvert County, sheer sandy cliffs rise 20-30 m above the beach below. These cliffs provide ideal habitat for the puritan tiger beetle and the northeastern beach tiger beetle. Both of these colorful, predatory insects are federally listed as threatened. The largest populations of each left in the world are in Calvert County.



Puritan & Northeastern Beach Tiger Beetles
(Federally Threatened, State Endangered)

Ecologists, botanists and zoologists classify the Earth's surface into **biomes** - large regions of similar climate and vegetation, **plant associations** - smaller geographic areas dominated by one or a few species, and **habitat types** - local areas of similar soil and vegetation that are distinctive from surrounding types. Thus, all of Maryland falls into the **Eastern Deciduous Forest** biome. Within that biome, most of the Lower Eastern Shore is classified as an **oak-loblolly pine association**, while the Upper Eastern Shore (Kent and Cecil Counties) and the Western Shore belong to either the **willow oak-loblolly pine**, the **tulip poplar**, or the **chestnut oak-post oak-blackjack oak** associations. **Tidal marshes** are extensive along the Bay in Dorchester and Somerset counties (in large part because the land is so low), but they are also found along the Bay shore in Harford County and along stretches of all of the major rivers (e.g., Potomac, Patuxent, Choptank, Pocomoke). An association dominated by **loblolly pine** occurs in the southern parts of Dorchester, Somerset and St. Mary's counties, and the **bald cypress association** borders the Pocomoke River and its' tributaries in Wicomico and Worcester counties.

Within the larger plant associations, habitats are often classified as **estuarine** (associated with salt or brackish water), **riverine** (occurring along streams and rivers), **lacustrine** (open water ponds and lakes), **palustrine** (forested wetlands) or **terrestrial** (forested uplands). More familiar terms like **intertidal beach**, **dunes**, **salt marsh**, **fresh marsh**, (wetlands without trees), **swamp** (wetlands with trees), **broadleaf** (or "hardwood") **forest**, **pine forest**, **scrub-shrub woodland**, **grassland**, **meadow**, **shale barren**, **bog** and **Delmarva Bay**, are commonly used by field biologists to describe local areas. Human-created or modified habitats include **pine plantations**, **farm fields** and **ponds**, **roadside grasslands** and **ditches**, **urban/suburban lawns** and **gardens**, and **vacant weedy lots**.

Among the rarest, most unusual and most threatened natural habitats on Maryland's Coastal Plain are **bogs** and **Delmarva Bays**. Bogs are pond- or lake-sized areas of slow-flowing water filled with extensive mats of **sphagnum**

moss and raised tussocks where rare and uncommon herbs, grasses and shrubs grow. At least 30 of these unique habitats once occurred in Prince George's and Anne Arundel counties, but residential and commercial development have eliminated all but one. **Delmarva bays** are seasonal ponds with an **open canopy** (few or no trees) that fill with water in the winter and dry out in late summer. This cycle allows a diverse mix of both common and rare plants to grow, flower and set seed in sequence from the outer, shallow zone to the deeper, center zone. Probably 95% of the bays that once stretched from Kent to Worcester County have been destroyed by clearing and draining for farmland and timber plantations.

These same **anthropogenic** (human-caused) modifications of the landscape - clearing and draining for farmland, timber plantations, and residential and commercial development - have also significantly impacted other wetland habitats - emergent fresh marshes, shrub swamps, swamp forest, flood plain forests, salt and tidal marshes - that were once so extensive on the Eastern Shore. On the Western Shore, farming and massive urbanization around Washington, Baltimore, and Annapolis have eliminated most of the upland deciduous forest, and transformed or degraded many **riparian** (streamside) and wetland habitats.

Today, more than 300 species of plants and over 100 species of animals are officially listed by the state as **Threatened** or **Endangered** on Maryland's Coastal Plain. The vast majority of the remaining populations of these species occur on private land. Without concerted efforts by Maryland citizens, many of these species will be lost from the state in the near future, and some will disappear from Earth. Protecting our native biological diversity requires that citizens act as voluntary "stewards" of the natural habitats on their land, and that development be carefully planned so as to minimize adverse impacts to rare species and significant habitats. We should all recognize that preservation of our unique natural resources is a important common goal, and that by working together we can ensure that this rich natural heritage is passed on to future generations.



A Coastal Plain Bog with a well-developed vegetation mat. 1 - Northern Pitcher Plant (State Threatened), 2 - Sphagnum moss, 3 - Leatherleaf (State Threatened), 4 - Large cranberry.

ACTIVITIES FOR STUDENTS

1) Identify all of the different types of habitats within a given distance (e.g., 1/4, 1/2, 1, or 2 miles) of the school (or a student's home). One way to do this is to obtain a U.S. Geological Survey 7.5 minute topographic map of the area (or a county highway map) and draw concentric circles around the school. Have different students survey different portions of each area.

a) Classify the habitats as **natural, developed, managed** (e.g., farmland, timber land), **mixed**, etc.

b) Mark the different habitats on the map (colored pencils would work for this).

c) Rank the different habitats, with 5 = most common and 1 = most rare.

d) Calculate (estimate) what proportion of the total area is covered by each of the major habitat types.

e) Rank the habitats as to their ability to support native plants & animals (1 = highest, 10 = lowest).

f) Write or call your local planning office and ask them what proportion of your city or county is protected as open space (parks, preserves, etc.). Try mapping the locations of open space and parks in your area. Do they protect all of the different kinds of natural habitats? Are they all over the county or do some areas lack open space?

g) Discuss which habitats were probably common and rare in your area prior to development.

2) Identify common and rare species in the neighborhood (city, county, etc.).

a) Have students collect 2-5 types (species) of common & uncommon plants from the neighborhood (**Note:** plants cannot be collected in State, County or local parks, and students should be advised to ask permission before entering private property).

b) Combine all the specimens from different students to get a representative collection for the community. From which habitats did the most common species come? the rarest? (**Note:** plants can be dried & preserved by pressing them between sheets of newspaper & cardboard with some weights placed on the cardboard).

c) Try to identify the plants by using common field guides, wildflower guides, etc., (available in most libraries) and determine the kind of distribution each species has (e.g., "widespread in Eastern U.S.", "marshes of mid-Atlantic region", etc.). For "rare" species, discuss **why** they might be rare (i.e., natural rarity vs. human-caused).

d) Have students make up a list of animals (mammals, birds, reptiles, etc.) and then rank them as to which they're most likely to see in their neighborhood (i.e., common species) and which they're least likely to see ("rare" species). Again, have them discuss **why** certain species might be rare.

e) If you're really ambitious, try a-c with insects! You'll need insect nets, killing jars and a few other supplies (good descriptions of insect-collecting methods are provided in the field guides).

3) Discuss the **six types** of human-related causes of rarity & extinction. Have students rank these activities in the order which they have impacted their community, or threaten to impact local native species in the future.

4) Obtain copies of the Endangered and Threatened Wildlife & Plants list from the Endangered Species Program of the U.S. Fish & Wildlife Service, and have students determine which species of listed plants and animals occur in Maryland. Discuss which species might occur in the local area. Do the same with the lists of Maryland's rare, threatened and endangered species put out by the **Maryland Natural Heritage Program**.

a) Ask the students to pick individual species that are on the federal list or that have already gone extinct in the U.S. and try to determine **why** the species went extinct, what human-related or natural factor(s) caused the loss.

b) Compile the information from a above and see if there are any patterns indicating that certain factors are more significant than others.

ACTIONS STUDENTS CAN TAKE TO HELP PROTECT RARE SPECIES

1) Write to legislators telling them that you are concerned about rare species and human-related activities leading to rarity, local extirpation, and extinction of native species. Ask them what they are doing to address these concerns.

2) Join a conservation group and keep informed about rare species issues. Some of the best organizations concerned with rare species issues are: **The Nature Conservancy, the National Wildlife Federation, the Audubon Society, the Natural Resources Defense Council and the World Wildlife Fund.**

3) Encourage your parents to contribute to the **Chesapeake Bay and Endangered Species Fund** (line 63 on the State Income Tax form). A portion of this money goes directly to rare species protection.

4) Volunteer for special projects (habitat clean-up & restoration, installing signs or fences, etc.) at local parks, preserves, nature centers and natural areas.

5) Write or call your city or county planning office and encourage them to include habitat for natural areas and open spaces in the planning process for the local area.

6) Visit local parks and natural areas and think about how they differ from the developed areas around your school. Talk with friends about parts of the natural world you enjoy.

7) Take responsibility for your actions. It is easy to worry about rare species without thinking about what you have done that may be harmful to natural habitats and the environment.

REFERENCE MATERIALS

1) **Maps:** U.S.G.S. topographic maps are available from a number of government and commercial sources, and college and government libraries also have copies on file. Maps can be ordered from:

Map Distribution Center	Maryland Geological Survey
U.S. Geological Survey	2300 St. Paul Street
Box 25286, Federal Center	Baltimore, MD 21218
Denver, Colorado 80225	410-554-5524

2) **Species Lists:** Copies of threatened and endangered species lists are available from:

Federal: Publication Unit
U.S. Fish & Wildlife Service
130-ARLSQ
Washington, D.C. 20240

State: MD Natural Heritage Program
Tawes State Office Bldg., E-1
Annapolis, MD 21401
410-974-2870

3) **Field Guides:** Numerous field guides are available that cover plants & animals in Maryland. The best known are the *Golden Guide to...* series, the *Peterson Field Guide to...* series and the *Audubon Society Field Guide to North American...* series. Volumes are available at most bookstores and libraries. One of the more popular plant guides is *Newcomb's Wildflower Guide*, by Lawrence Newcomb. An excellent guide for mammals is *Mammals of the Carolinas, Virginia, and Maryland* by W.D. Webster, J.F. Parnell and W.C. Biggs, Jr.

4) **Books:** Many books on threatened and endangered species have been published in the last few years, although most are written for adult readers. Relevant volumes include:

- *The Sinking Ark* by Norman B. Myers
- *The Last Extinction* by Les Kaufman & Kenneth Mallory
- *Extinction* by Paul and Anne Ehrlich
- *The Diversity of Life* by Edward O. Wilson
- *The Rainforest Book* by Scott Lewis
- *State of the Ark* by Lec Durrell
- *Preserving Eden* by The Nature Conservancy
- *Last Chance to See* by Douglas Adams and Mark Carwardine

Classic texts, books of local interest and naturalist guides include:

- *A Sand County Almanac* by Aldo Leopold
- *Silent Spring* by Rachel Carson
- *Life and Death of the Salt Marsh* by John and Mildred Teal
- *Bay Country* by Tom Horton
- *Turning the Tide* by Tom Horton & W.M. Eichbaum
- *The Field Guide to Wildlife Habitats* by Janine M. Benyus
- *The Naturalist's Path: Beginning the Study of Nature* by Cathy Johnson

5) Other References

Many other sources of information on rare species, nature, conservation and the environment are available. Particularly relevant here in Maryland are:

a) *Directory of Maryland's Environmental Education Resources*, available from the Tidewater Administration, Department of Natural Resources. Contact Kelly Spencer at 410-974-2926 for information.

b) Annual workshops conducted by Janet Greenfeld, Aquatic Resources Education Coordinator, Tidewater Administration, for school teachers around the state. Contact Janet (410-974-3765) for schedules and details.

c) Numerous fact sheets, teachers' guides and activity booklets available from the **Chesapeake Bay Estuary Program**, U.S. Fish & Wildlife Service. Contact Kathi Bangert at 410-224-2732 for information.

d) Free copies of illustrated fact sheets available from the Maryland Natural Heritage Program:

- #1 - *The Dwarf Wedge Mussel*
- #2 - *Endangered Tiger Beetles*
- #3 - *The Maryland Darter*
- #4 - *Harperella Fact Sheet*
- #5 - *Bewick's Wren Fact Sheet*
- #6 - *Swamp Pink*
- #7 - *Sandplain Gerardia Fact Sheet*
- #8 - *Serpentine Grasslands*
- #9 - *Coastal Plain Bogs*

For more information please contact:
Maryland Natural Heritage Program
Department of Natural Resources
Tawes State Office Building, E-1
Annapolis, MD 21401
410-974-2870

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CHECKLIST OF MARYLAND'S TERRESTRIAL VERTEBRATES

Amphibians

Jefferson salamander
 Spotted salamander
 Marbled salamander
 Eastern tiger salamander
 Hellbender
 Green salamander
 Dusky salamander
 Seal salamander
 Mountain dusky salamander
 Two-lined salamander
 Longtail salamander
 Spring salamander
 Four-toed salamander
 Redback salamander
 Slimy salamander
 Valley and ridge salamander
 Wehrle's salamander
 Mud salamander
 Red salamander
 Mudpuppy
 Eastern newt
 American toad
 Woodhouse's toad
 Northern cricket frog
 Cope's gray treefrog
 Green treefrog
 Barking treefrog
 Gray treefrog
 Mountain chorus frog
 Striped chorus frog
 Spring peeper
 Eastern narrow-mouthed toad
 Eastern spadefoot
 Bullfrog
 Green frog
 Pickerel frog
 Northern leopard frog
 Wood frog
 Carpenter frog

Reptiles

Snapping turtle
 Painted turtle
 Spotted turtle
 Wood turtle
 Bog turtle
 Map turtle
 Diamondback terrapin
 Redbelly turtle
 Eastern box turtle
 Slider
 Eastern mud turtle
 Stinkpot
 Eastern spiny softshell
 Eastern fence lizard
 Northern coal skink
 Five-lined skink
 Broadhead skink
 Ground skink
 Six-lined racerunner
 Worm snake
 Eastern scarlet snake
 Racer
 Ringneck snake
 Corn snake

Rat snake
 Rainbow snake
 Eastern hognose snake
 Prairie kingsnake
 Common kingsnake
 Milk snake
 Northern water snake
 Rough green snake
 Smooth green snake
 Northern pine snake
 Queen snake
 Brown snake
 Redbelly snake
 Eastern ribbon snake
 Common garter snake
 Mountain earth snake
 Copperhead
 Timber rattlesnake

Birds

Red-throated loon
 Common loon
 Pied-billed grebe
 Horned grebe
 Northern gannet
 Brown pelican
 Great cormorant
 Double-crested cormorant
 American bittern
 Least bittern
 Great blue heron
 Great egret
 Snowy egret
 Little blue heron
 Tricolored heron
 Cattle egret
 Green-backed heron
 Black-crowned night-heron
 Yellow-crowned night-heron
 Glossy ibis
 Tundra swan
 Mute swan*
 Greater white-fronted goose
 Snow goose
 Brant
 Canada goose
 Wood duck
 Green-winged teal
 American black duck
 Mallard
 Northern pintail
 Blue-winged teal
 Northern shoveler
 Gadwall
 American wigeon
 Canvasback
 Redhead
 Ring-necked duck
 Greater scaup
 Lesser scaup
 Common eider
 King eider
 Harlequin duck
 Oldsquaw
 Black scoter
 Surf scoter
 White-winged scoter

Common goldeneye
 Bufflehead
 Hooded merganser
 Common merganser
 Red-breasted merganser
 Ruddy duck
 Black vulture
 Turkey vulture
 Osprey
 Bald eagle
 Northern harrier
 Sharp-shinned hawk
 Cooper's hawk
 Northern goshawk
 Red-shouldered hawk
 Broad-winged hawk
 Red-tailed hawk
 Rough-legged hawk
 Golden eagle
 American kestrel
 Merlin
 Peregrine falcon
 Ring-necked pheasant*
 Ruffed grouse
 Wild turkey
 Northern bobwhite
 Black rail
 Clapper rail
 King rail
 Virginia rail
 Sora
 Common moorhen
 American coot
 Black-bellied plover
 Lesser golden-plover
 Wilson's plover
 Semipalmated plover
 Piping plover
 Killdeer
 American oystercatcher
 Black-necked stilt
 American avocet
 Greater yellowlegs
 Lesser yellowlegs
 Solitary sandpiper
 Willet
 Spotted sandpiper
 Upland sandpiper
 Whimbrel
 Hudsonian godwit
 Marbled godwit
 Ruddy turnstone
 Red knot
 Sanderling
 Semipalmated sandpiper
 Western sandpiper
 Least sandpiper
 White-rumped sandpiper
 Baird's sandpiper
 Pectoral sandpiper
 Purple sandpiper
 Dunlin
 Stilt sandpiper
 Buff-breasted sandpiper
 Short-billed dowitcher
 Long-billed dowitcher
 Common snipe
 American woodcock
 Wilson's phalarope

Red-necked phalarope
 Red phalarope
 Laughing gull
 Little gull
 Common black-headed gull
 Bonaparte's gull
 Ring-billed gull
 Herring gull
 Iceland gull
 Lesser black-backed gull
 Glaucous gull
 Great black-backed gull
 Gull-billed tern
 Caspian tern
 Royal tern
 Sandwich tern
 Common tern
 Forster's tern
 Least tern
 Black tern
 Black skimmer
 Rock dove*
 Mourning dove
 Black-billed cuckoo
 Yellow-billed cuckoo
 Common barn-owl
 Eastern screech-owl
 Great horned owl
 Barred owl
 Long-eared owl
 Short-eared owl
 Northern saw-whet owl
 Common nighthawk
 Chuck-will's-widow
 Whip-poor-will
 Chimney swift
 Ruby-throated hummingbird
 Belted kingfisher
 Red-headed woodpecker
 Red-bellied woodpecker
 Yellow-bellied sapsucker
 Downy woodpecker
 Hairy woodpecker
 Northern flicker
 Pileated woodpecker
 Olive-sided flycatcher
 Eastern wood-pewee
 Yellow-bellied flycatcher
 Acadian flycatcher
 Alder flycatcher
 Willow flycatcher
 Least flycatcher
 Eastern phoebe
 Great crested flycatcher
 Eastern kingbird
 Horned lark
 Purple martin
 Tree swallow
 Northern rough-winged swallow
 Bank swallow
 Cliff swallow
 Barn swallow
 Blue jay
 American crow
 Fish crow
 Common raven
 Black-capped chickadee
 Carolina chickadee
 Tufted titmouse

CHECKLIST OF MARYLAND'S TERRESTRIAL VERTEBRATES

Red-breasted nuthatch
 White-breasted nuthatch
 Brown-headed nuthatch
 Brown creeper
 Carolina wren
Bewick's wren
 House wren
 Winter wren
 Sedge wren
 Marsh wren
 Golden-crowned kinglet
 Ruby-crowned kinglet
 Blue-gray gnatcatcher
 Eastern bluebird
 Veery
 Gray-cheeked thrush
 Swainson's thrush
 Hermit thrush
 Wood thrush
 American robin
 Gray catbird
 Mockingbird
 Brown thrasher
 Water pipit
 Cedar waxwing
 Northern shrike
 Loggerhead shrike
 European starling*
 White-eyed vireo
 Solitary vireo
 Yellow-throated vireo
 Warbling vireo
 Philadelphia vireo
 Red-eyed vireo
 Blue-winged warbler
 Golden-winged warbler
 Tennessee warbler
 Orange-crowned warbler
 Nashville warbler
 Northern parula
 Yellow warbler
 Chestnut-sided warbler
 Magnolia warbler
 Cape may warbler
 Black-throated blue warbler
 Yellow-rumped warbler
 Black-throated green warbler
Blackburnian warbler
 Yellow-throated warbler
 Pine warbler
 Prairie warbler
 Palm warbler
 Bay-breasted warbler
 Blackpoll warbler
 Cerulean warbler
 Black-and-white warbler
 American redstart
 Prothonotary warbler
 Worm-eating warbler
 Swainson's warbler
 Ovenbird
 Northern waterthrush
 Louisiana waterthrush
 Kentucky warbler
 Connecticut warbler
 Mourning warbler
 Common yellowthroat
 Hooded warbler
 Wilson's warbler

Canada warbler
 Yellow-breasted chat
 Summer tanager
 Scarlet tanager
 Northern cardinal
 Rose-breasted grosbeak
 Blue grosbeak
 Indigo bunting
 Dickcissel
 Rufous-sided towhee
 American tree sparrow
 Chipping sparrow
 Field sparrow
 Vesper sparrow
 Savannah sparrow
 Grasshopper sparrow
Henslow's sparrow
 Sharp-tailed sparrow
 Seaside sparrow
 Fox sparrow
 Song sparrow
 Lincoln's sparrow
 Swamp sparrow
 White-throated sparrow
 White-crowned sparrow
 Dark-eyed junco
 Lapland longspur
 Snow bunting
 Bobolink
 Red-winged blackbird
 Eastern meadowlark
 Rusty blackbird
 Boat-tailed grackle
 Common grackle
 Brown-headed cowbird
 Orchard oriole
 Northern oriole
 Purple finch
 House finch*
 Common redpoll
 Pine siskin
 American goldfinch
 Evening grosbeak
 House sparrow*
Mammals
 Virginia opossum
 Common shrew
 Southeastern shrew
 Southern water shrew
 Smoky shrew
 Long-tailed shrew
 Southern pygmy shrew
 Maryland shrew
 Northern short-tailed shrew
 Least shrew
 Hairy-tailed mole
 Eastern mole
 Southeastern star-nosed mole
 Little brown bat
Indiana bat
Eastern small-footed bat
 Northern long-eared bat
 Silver-haired bat
 Eastern pipistrelle
 Big brown bat
 Red bat

Hoary bat
 Evening bat
 Eastern cottontail
New England cottontail
Snowshoe hare
 Eastern chipmunk
 Woodchuck
 Gray squirrel
 Fox squirrel
Delmarva fox squirrel
 Red squirrel
 Southern flying squirrel
 Beaver
 Marsh rice rat
Eastern harvest mouse
 Deer mouse
 White-footed mouse
Eastern woodrat
 Southern red-backed vole
 Meadow vole
Southern rock vole
 Woodland vole
 Muskrat
 Southern bog lemming
 Black rat*
 Norway rat*
 House mouse*
 Meadow jumping mouse
 Woodland jumping mouse
Porcupine
Nutria*
 Coyote
 Red fox
 Gray fox
 Black bear
 Raccoon
 Fisher
Least weasel
 Long-tailed weasel
 Mink
 Eastern spotted skunk
 Striped skunk
 River otter
Bobcat
 Sika deer*
 White-tailed deer

* These species are exotic in Maryland.

** Highlighted species are listed as Endangered, Threatened, or In Need of Conservation by the State of Maryland.

Extirpated and Extinct Maryland Vertebrates

Amphibians

Greater siren

Birds

Greater prairie-chicken
 Roseate tern
 Red-cockaded woodpecker
 Passenger pigeon
 Carolina parakeet
 Bachman's sparrow
 Lark sparrow

Mammals

Gray wolf
 Eastern cougar
 American elk
 Bison

Habitat FRAGMENTATION

What do highways, homes and businesses, dams, farm fields, mines and logging have in common? All can have positive effects upon our health, comfort, and security.

But they can have negative effects upon us as well, by damaging our natural environment. Among the most serious of these effects is habitat fragmentation, a term for the shrinking and isolating of our remaining natural landscape.

Associations of plants and animals that have existed for thousands of years are reduced and disconnected by many human activities, from logging and mining to the development of suburbs and cities. The remaining "islands" are susceptible to invasion by exotic species, local climate changes, and inbreeding of stranded native species. Habitat fragmentation is so widespread it has become a major threat to biological diversity - the variety of life on which we depend.

Biological diversity includes ecosystems as large as the Chesapeake Bay, but is also made up of natural communities, species, genes within species, and the interactions between all these parts. We rely upon these relationships to create and stabilize soil, supply clean air and water, provide recreation, limit flooding and control climate. Many of our food crops, fibers, drugs, and research materials come from native plants and animals and the genetic information within them. The variety of life also gives us a sense of place and individual identity.

Today, more than 400 species are Endangered, Threatened, or In Need of Conservation in Maryland, and several natural communities are also in danger. Most have been influenced by habitat fragmentation and for some it is a primary threat. Even many still-common species and natural communities are diminished owing to fragmentation.

Fragmentation and Habitat Loss

Studies of land use in Maryland show population is rising, while the amount of land used by each resident is rising as well. This in turn increases pressures on natural habitats such as beaches, rivers, and forests.

When land is fragmented by a new field, road, house, or business, or when water features are fragmented by a dam or channelization, the living places (habitat) available for many plants and animals is reduced. But there are also more subtle impacts that disrupt the remaining habitat, and which may take many years to be revealed - as demonstrated in several western National Parks that continued to lose mammal species decades after protection.

Because direct habitat destruction has already received much public attention, we will focus on the less widely known effects of fragmentation. Because virtually all of Maryland's landbase is subject to some type of active management, these effects are common.

Natural Disturbance

Recent studies indicate that some forests dominated by oak trees (Quercus spp.), such as those in parts of central and western Maryland, are the result of periodic fire, originally started by lightning strikes or Native Americans. Larger oaks of some species have thick bark and other characteristics that help them resist fire, and oak forests in which fires are suppressed gradually change to non-resistant trees, such as red maple (Acer rubrum). The prohibition of fire in areas fragmented by development can eventually lead to fewer oaks.

Many other natural communities in Maryland depend upon disturbances for their continuation as well. Barrier beaches move inland or seaward with gradually changing ocean levels, and stream channels move as floods scour some areas and deposit soil in others. Beaver (Castor canadensis) dams raise stream water levels, drowning trees to create open marshes. Fragmentation can lead to stabilization of coasts and rivers, and control of Beaver activity, resulting in the decline of species adapted to these disturbances.

Human land management rarely imitates natural disturbances. Development creates a sort of permanent disruption which does not allow natural communities to recover. Studies of clearcutting in Appalachian forests show herbaceous plant diversity and salamander numbers don't rebound before the next cycle of logging begins.

Travel and Migration

When Europeans first arrived, millions of American shad (Alosa sapidissima) swam up the Susquehanna River from the Chesapeake Bay each spring, to mate and lay eggs in freshwater streams. Today, dams that block migration routes contribute to the problems in restoring this species, now down to about one percent of its former numbers.

Fragmentation by obstacles such as dams can make it harder for many native animals or plants to move by creating barriers between suitable habitats. Highways, for example, stop many creatures, and increase the risks for those that are able to cross. Being hit by vehicles is a major cause of death for Black Bears (Ursus americanus) in Western Maryland, and any driver knows huge numbers of insects are killed.

Shutting off travel routes leaves many plants and animals isolated on "islands" of habitat. These small populations cannot be replenished and so are sensitive to special problems, including inbreeding, genetic drift, and chance catastrophes. Inbreeding occurs when closely related individuals are mated, harmful genetic characters accumulate and thwart reproduction or reduce survival of offspring. Genetic drift is the chance loss of needed genetic variation within a small group.

Small populations are also more easily wiped out by unpredictable events like flood, drought, or disease, or by further human impacts. Special propagation was needed to perpetuate the Maryland wetland plant Canby's dropwort (Oxypolis canbyi) after a series of droughts in the 1980's reduced its remaining colony from hundreds of plants to three.

Agricultural or developed areas create unsuitable habitats for native plant communities, which in the past moved continuously over land as global or regional climates changed. For example, parts of Maryland were tundra as the last Ice Age ended 14,000 years ago, but the tundra community of low plants has since crept north as the earth warmed. Scientists project that species unable to "jump" heavily fragmented areas may die out as climate changes in the future.

Non-native Species

Imagine a floodplain forest somewhere along the Potomac River. Cows are put out to graze, damaging some trees and increasing gaps in the forest canopy. Seeds of an Asian vine, an ornamental groundcover on nearby developed lands, are spread through bird droppings and begin growing in sunny patches of disturbed soil. This Japanese honeysuckle (Lonicera japonica) pulls down seedlings and has a dense web of leaves that shades out other plants. After several decades it covers acres of floodplain once occupied by a variety of native plants.

Japanese honeysuckle is just one of thousands of non-natives which can invade fragmented areas - from the plants multiflora rose (Rosa multiflora) and garlic mustard (Alliaria officinalis), to mammals such as nutria (Myocastor coypus) and birds such as starlings (Sturnus vulgaris) and house sparrows (Passer domesticus). House cats (Felis domesticus) are exotics which have been estimated to kill millions of songbirds, small mammals, and snakes each year.

Experts are concerned about the homogenization of natural communities through introductions. Exotic plant species are frequently planted as ornamentals or for reclamation of disturbed areas, using habitat that might support natives. Even when native species are planted they often differ genetically from local stock. This can lead to reduced differences within a species, which may lower chances to fight disease or adapt to new conditions.

Predators, Parasites, and Competitors

Picture a suburban housing development springing up in a Prince Georges County woodlot outside of Washington, D.C. Although some woods are left, in the years following some of the woods' bird species decline or disappear. Among the forest birds visitors are less likely to hear are the hooded (Wilsonia citrina), Kentucky (Oporornis formosus), worm-eating (Helminthos vermivorus), and northern parula (Parula americana) warblers. Already abundant birds that prosper in disturbed areas increase.

Nesting success is lower for forest birds in small or irregular patches of woods because the increased proportion of forest edge allows higher rates of predation and nest parasitism. Several nest predators that increase with fragmentation, such as opossums (Didelphis virginiana), raccoons (Procyon lotor), blue jays (Cyanositta cristata), and crows (Corvus brachyrhynchos), hunt along wood edges. The brown-headed cowbird (Molothrus ater), also found at forest edges, tricks other birds into raising cowbird eggs and young at the expense of their own offspring.

Competitive interactions are also altered by fragmentation. For example, logging in high elevation areas can increase tree sprout browse for New England cottontails (Sylvilagus transitionalis), a species In Need of Conservation in Maryland. But this habitat change also promotes the invasion of eastern cottontails (Sylvilagus floridanus) into forests through logged areas and along the sides of new roads, and this common species appears to be incompatible with New England cottontails.

White-tailed deer (Odocoileus virginianus) thrive in many heavily fragmented areas of the state - eating crops on farmland, shrubs in yards, and tree sprouts in forests. In some places deer overbrowsing slows the regeneration of logged woods and can shift the composition of tree species to reflect those deer don't like to eat. Plants deer prefer, such as Canada yew (Taxus canadensis) and eastern hemlock (Tsuga canadensis), may be locally eliminated, and the overall variety of shrubs and herbs reduced tenfold.

Microclimate Changes

Disruptions from wind or fire, caused by Native Americans or natural forces, once occurred as patches within huge forests. Now however, the situation is reversed in many places, with forest patches surrounded by disturbed land. The size and shape of remaining forests determine the extent of changes in local climate, or microclimate, and other fragmentation effects. Narrow or irregular patches of habitat have a greater proportion of edge and a smaller interior, meaning little habitat for creatures requiring undisturbed places. Larger, rounder forest shapes do not allow light and temperature influences from nearby lands to penetrate as deeply.

In a Garrett County forest a road was built near a rock outcrop where green salamanders (Aneides aneus) laid eggs in certain crevices, taking advantage of subtle temperature and humidity conditions. Cleared areas such as roads tend to make places warmer and drier and roads can divert groundwater, altering the microclimate. Numbers of this State Endangered salamander soon fell, and the habitat is now unoccupied. Researchers have found that many aspects of microclimate, including light, ground water, wind, temperature, and humidity within forests are influenced by cleared land nearby.

Increased Human Contact

On Assateague Island National Seashore some areas have been closed to people during summer breeding season to protect the federally Threatened piping plover (Charadrius melodus). This shy bird nests in open beach habitats, and its camouflaged eggs and chicks are so hard to see that they can be unknowingly stepped on or run over by off-road vehicles. Incubating adults are often flushed from their nests by beach walkers, causing their exposed eggs to overheat in the sun. Disturbances may also prevent the chicks from feeding as often as they need.

Smaller patches of habitat combined with more roads often leads to more human use of undeveloped places. People can disrupt the breeding of animals, trample rare plants, or make paths which

trigger the erosion of fragile glades or beach dunes.

Solutions

Research so far has revealed that protecting large areas of native habitats is important in maintaining biological diversity, usually the larger, the better. If a few large reserves are compared to many small reserves, the larger areas hold a greater variety of native species and communities, better absorb natural disturbances, and are insulated against the effects of habitat fragmentation. Preserving wide links between isolated natural communities also conserves biological diversity by allowing species to travel for food, cover, mating, migration, or refilling vacant habitat. Special management may be necessary to maintain some fragmented habitats.

To address these issues, effective land use planning considers native ecosystems, and protects unique species and habitats and their links. It also encourages the redevelopment of existing sites instead of new building, and focuses new development to minimize suburban sprawl.

Anyone can become involved in county land use planning by attending public meetings and submitting written comments when their county's comprehensive plan is reviewed (contact the county or State Planning Office to learn more). The public is also invited to comment during the regular review of plans for state park and forest lands managed by the Maryland Department of Natural Resources.

State programs such as Program Open Space and the Maryland Environmental Trust, local land trusts, and private conservation groups such as The Nature Conservancy work to buy or otherwise protect land that contains the best examples of our biological diversity. These groups depend upon citizen interest and support.

Individuals can take many conservation measures which reduce habitat fragmentation, such as avoiding rivers, large forest chunks, and other special areas when building roads or houses. Recycling solid waste and other at-home conservation measures reduce human land impacts, indirectly limiting fragmentation.

Through personal action and public involvement, you can help reduce the threats from landscape fragmentation and ensure that our rich natural heritage is passed on to future generations of Marylanders.

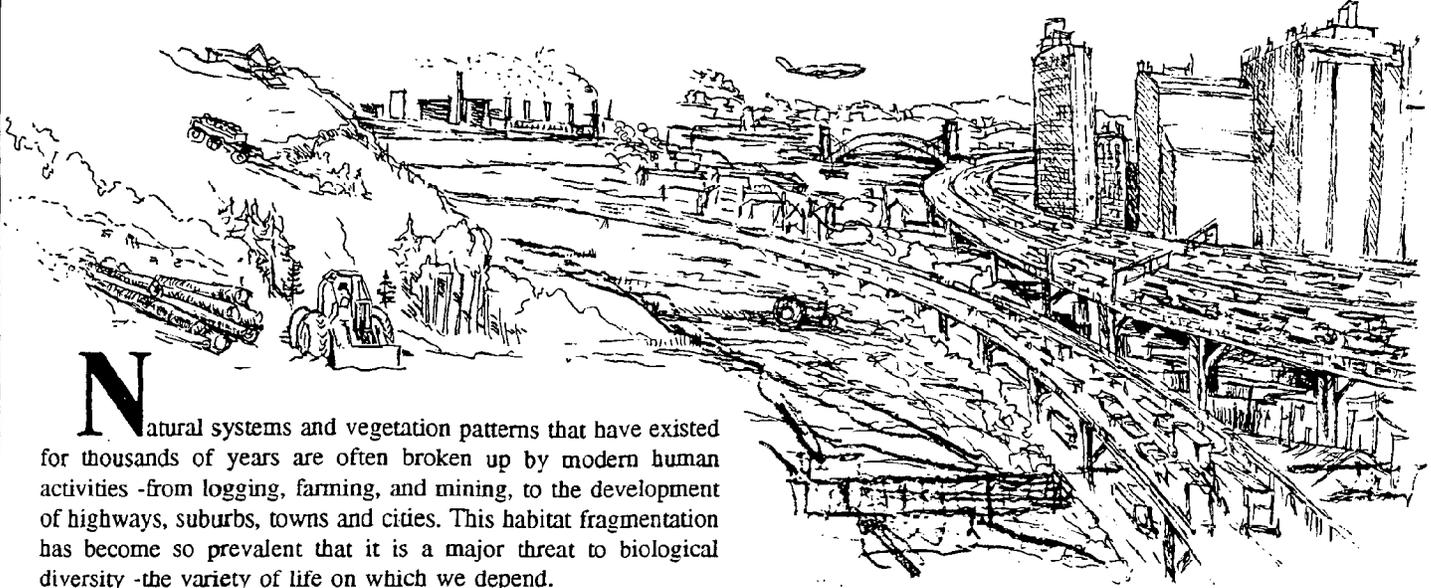


M · A · R · Y · L · A · N · D · 'S

NATURAL HERITAGE

No. Information About Rare Species and Significant Habitats

H-A-B-I-T-A-T F-R-A-G-M-E-N-T-A-T-I-O-N



Natural systems and vegetation patterns that have existed for thousands of years are often broken up by modern human activities -from logging, farming, and mining, to the development of highways, suburbs, towns and cities. This habitat fragmentation has become so prevalent that it is a major threat to biological diversity -the variety of life on which we depend.

We rely upon groups of interacting microorganisms, plants, and animals to create and stabilize soil, supply clean air and water,

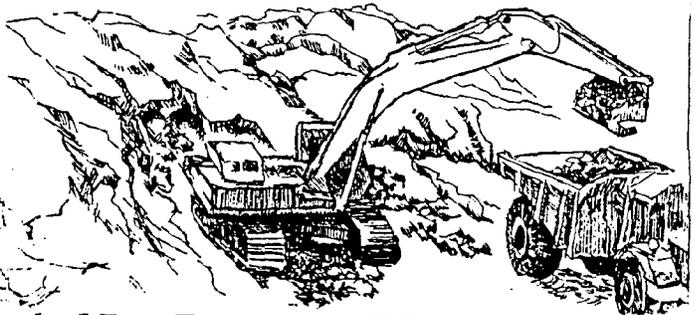
Habitat Loss and Habitat Fragmentation

When land is altered to create a field, road, house, or business, a certain amount of habitat is lost, along with plants and animals which are unable to get out of the way. But there are also more subtle habitat fragmentation impacts that disrupt the surrounding system of plants and animals, and which may take many years to be revealed. For example, decades after protection several western U.S. National Parks continued to lose mammal species.

Habitat fragmentation effects include control of normal riverbank flooding, invasion of alien species, and blockage of animal travel routes. Although habitat loss and fragmentation effects both result from land clearing activities, many experts now consider fragmentation to be the more serious threat -in part because it can influence a larger area or entire ecosystem, such as a wetland, stream, or forest. Because virtually all of Maryland's landbase is subject to some type of active management, habitat fragmentation effects are widespread.

provide recreation, limit flooding, and control climate. Many of our food crops, fibers, drugs, and research materials come from the genetic storehouse of biological diversity. This variety of genes, species, natural communities, and ecosystems also gives us a sense of place and individual identity.

Today, more than 400 species are Endangered, Threatened, or In Need of Conservation in Maryland, and several natural communities are also in danger. Most suffer from habitat fragmentation, and for some it is a primary threat. Even common species and communities are greatly diminished owing to habitat fragmentation.





Control of Natural Disturbance

Many natural communities in Maryland depend on periodic disturbance for their continuation. In unmanaged forest the most common disturbances are gaps created by dying trees, with occasional fire or windthrow disrupting larger areas. Barrier beaches move inland or seaward with gradually changing ocean levels. Stream channels move as floods scour some areas and deposit soil in others. Beaver dams raise stream water levels, drowning trees to create open marshes. Habitat fragmentation through development leads to suppression of fire, stabilization of coasts and rivers, and control of Beaver activity in remaining undeveloped areas, causing further species and habitat loss.



Agricultural or developed areas create unsuitable habitats for native plant communities, which in the past moved continuously over land as global or regional climates changed. For example, parts of Maryland were tundra as the last Ice Age ended 14,000 years ago, but the tundra community of low plants has since crept north. Scientists predict that species unable to "jump" heavily fragmented areas may die out as climate changes.

Non-native Species

Imagine a floodplain forest somewhere along the Potomac River. Cows are put out to graze here, damaging some trees and increasing gaps in the forest canopy. Seeds of an Asian vine, planted as an ornamental ground cover, are spread through bird droppings, and begin growing in sunny patches of disturbed soil. This Japanese Honeysuckle pulls down seedlings and creates such a dense web of leaves that other plants can't get enough light or space. After several decades it covers acres of floodplain once that was once occupied by a variety of native plants.



Japanese Honeysuckle is just one of dozens of non-natives which can invade an area - from that plants of Multiflora Rose and Garlic Mustard, to mammals such as Nutria, and birds such as Starlings and House Sparrows. House Cats are exotics which have been estimated to kill millions of songbirds, small mammals, and snakes each year.

Human land management rarely imitates natural disturbances. Development creates a sort of permanent disturbance which does not allow natural communities to recover. Studies of clear cutting in Appalachian forests show herbaceous plant diversity and salamander numbers don't rebound before the next cycle of logging begins.

Travel and Migration

Habitat fragmentation can make it harder for native animals or plants to move by creating barriers between suitable habitats. Highways, for instance, block many plants and animals, and increase the risk of death for those animals which are able to cross. Being hit by vehicles is a major cause of death for Black Bears in Western Maryland, and any driver knows huge numbers of insects are killed.



Experts are concerned about the homogenization of natural communities through introductions. Exotic plant species are frequently planted as ornamentals or for reclamation of disturbed areas, using habitat that might support natives. Even when native species are planted they often differ genetically from local stock. This can lead to reduced differences within species, which means lower chances to fight disease or adapt to new conditions.

Predators, Parasites, and Competitors

Picture a suburban housing development springing up in Prince Georges County outside of Washington, D.C., turning a 100-acre woodlot into a 50-acre woodlot. In the years following, some of the woods' bird species decline or disappear, and already abundant birds that prosper in disturbed areas increase. Among the forest birds visitors are less likely to hear are the Hooded, Kentucky, Worm-eating, and Northern Parula Warblers.

Cowbird *Hooded Warbler*

Nesting success is lower for forest birds in smaller patches of woods because the increased proportion of forest edge allows higher rates of predation and nest parasitism. Several nest predators that increase with fragmentation, such as Opossums, Raccoons, Blue Jays, and Crows, hunt along wood edges. The Brown-headed Cowbird, also found at forest edges, tricks other birds into raising Cowbird eggs and young at the expense of their own offspring.

Competitive interactions are also altered by fragmentation. For example, logging in high elevation areas can increase tree

New England Cottontail
Eastern Cottontail

sprout browse for New England Cottontails, a species In Need of Conservation in Maryland. But this habitat change also promotes the invasion of Eastern Cottontails into forested areas through cuts and along the sides of new roads, and this common species appears to be incompatible with New England Cottontails.



House cats are a non-native species

White-tailed deer thrive in many heavily fragmented areas of the State -eating crops on farmland, shrubs in yards, and tree sprouts in forests. In some places deer overbrowsing slows the regeneration of logged woods and can shift the composition of tree species to reflect those which deer don't like to eat. Plants deer prefer, such as Canada Yew and Eastern Hemlock, may be locally eliminated, and overall variety of shrubs and herbs reduced tenfold.

White-tailed deer
& browse plant

Microclimate Changes

Ground water levels, wind, temperature, and humidity in a small area make up the microclimate, which can be influenced by habitat fragmentation. In Garrett County a road was built near a

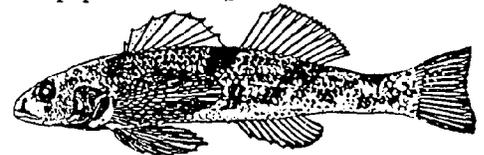
Green Salamander

rock outcrop where Green Salamanders laid eggs in certain crevasses to take advantage of subtle temperature and humidity conditions. Cleared areas such as roads tend to create a warmer, drier local climate. Numbers of this State Endangered salamander soon fell, and the habitat is now unoccupied. In a similar situation, the loss of individuals from a cluster of State Endangered Lobed Spleenwort ferns was correlated with the opening of the tree canopy.

Small Populations

Water pollutants from agriculture and industry, along with damming and stream channelization, have isolated populations of many species, including the Dwarf Wedge Mussel. This Federally Endangered shellfish, now living in four streams in Caroline, Queen Anne's, Charles, and St. Mary's Counties, was once found in streams all over Maryland's coast.

Plant or animal populations that become very small or localized are sensitive to special problems, including inbreeding, genetic drift, and chance catastrophes. When closely related individuals are mated, harmful genetic characters accumulate and thwart reproduction or reduce survival of offspring. Genetic drift occurs when natural genetic mutations quickly pass along harmful traits through the entire population.



Small groups are more easily wiped out by unpredictable events like flood, drought, or disease. The last of the Maryland Darter fish were apparently destroyed by the single failure of a riverside manure impoundment. Larger populations are less vulnerable to any single event.

Increased Human Contact

Smaller patches of habitat combined with more roads often lead to more human use of undeveloped areas. On Assateague Island National Seashore some areas have been closed to people during summer breeding season to protect the Federally Threatened Piping Plover. This shy bird nests in open beach habitats, and its camouflaged eggs and chicks are so hard to see that they can be unknowingly stepped on or run over by off-road vehicles.

approach
birds

Incubating adults are often flushed from their nests by beach walkers, and their exposed eggs may overheat in the sun. Disturbance may also prevent the chicks from feeding as often as they need.

People can also disrupt the breeding of other animals, trample rare plants, or make paths which trigger the erosion of fragile glades or beach dunes.

Solutions

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preserved
habitat
management
progress

To address these issues, effective land use planning considers native ecosystems and protects unique species and habitats and their links. It also encourages the redevelopment of existing sites instead of new building, and focuses new development to minimize suburban sprawl.

forestry
public
meeting

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TNC
protection
sign

State programs such as Program Open Space and the Maryland Environmental Trust, local land trusts, and private conservation groups such as The Nature Conservancy work to buy or otherwise protect land that contains the best examples of biological diversity. These groups depend upon citizen interest and support.

coastal plan

Individuals can take many conservation measures which reduce habitat fragmentation, such as avoiding rivers, wetlands, glades, and larger forest areas when building roads or houses. Recycling solid waste and other at-home conservation measures reduce human land impacts, indirectly limiting habitat fragmentation.

Through personal action and public involvement, you can help reduce the threat of habitat fragmentation and ensure that our rich natural heritage is passed to future generations of Marylanders.

FOR MORE INFORMATION PLEASE CONTACT - Maryland Natural Heritage Program, DNR, Fish, Heritage, and Wildlife Service, Tower State Office Building, E-1, Annapolis, MD 21401. Phone 410-2870.

ACKNOWLEDGEMENTS - Text by Ken Hotopp and other staff of the Natural Heritage Program. Type composition, illustration, and layout by Josephine Thoms

Text for mobile educational display

**VANISHING SPECIES AND HABITATS
OF MARYLAND'S COASTAL PLAIN**

Maryland Natural Heritage Program [with logo]
Maryland Department of Natural Resources [with logo]

PHOTO (or drawing where
indicated)

TEXT

CENTER PANEL:

Map of MD with Coastal Plain
shaded and labelled

Endangered species and threatened habitats are problems not only of such faraway places as tropical rainforests. As humans dominate more and more of the earth's landscape, we are losing species and habitats everywhere, including our own region -- Maryland's Coastal Plain.

Swamp Pink, Eastern Tiger
Salamander, Sweet Pinesap,
Black Skimmer

These are just a few of Maryland's rare Coastal Plain species. The remainder of this display examines three of the many threatened habitats that support rare species in Maryland: Delmarva bays, fragmented forests, and Coastal Plain bogs.

large heading; no photo

DELMARVA BAYS

Map showing region where
Delmarva bays are found

Delmarva bays occur primarily in the region
of the Eastern Shore shaded on this map.

Dorchester Pond in April
Dorchester Pond in July

Delmarva bays are seasonal ponds vegetated with shrubs and herbs. Filled with water in winter and spring, the ponds transform to meadows as the water recedes in summer.

Rose Coreopsis,
Red-root,
Featherfoil

Many rare plants germinate on the exposed mudflat as the pond dries. Red-root and Rose Coreopsis flower and fruit in late summer, but Featherfoil overwinters as seedlings, and flowers in the flooded pond the next spring.

Barking Treefrog

Adult Barking Treefrogs spend much of their time in shrubs and trees at the perimeter of a Delmarva bay, but they enter the pond to breed. The frogs seem to stand on water as they perch on the fallen stems of the previous summer's sedges and grasses to give their strange mating call.

Aerial photo showing Delmarva Bays converted to farm fields

Changes in ground and surface water patterns due to ditching, forest clearing and agricultural conversion have destroyed many Delmarva bays, and many that remain are threatened by similar activities. This aerial view of part of Caroline County includes many Delmarva bays that have been drained, cleared, and made part of farm fields.

LEFT PANEL:

Large heading; no photo

FRAGMENTED FORESTS

Map showing % land area forested, by county

Although much of Maryland is forested, its forests are often fragmented into small blocks by agriculture and by residential, commercial, and industrial development. Few large tracts of forest remain.

Graph of # of forest tracts of various sizes in Coastal Plain

Old growth forest (habitat photo)

Small forest fragments have a higher ratio of "edge" to "interior" habitat than do large, unbroken forests. Many bird species do not survive or reproduce well in areas near forest edges, where forests meet fields, backyards, clearcuts, or commercial development. They are adapted to the conditions present deeper in the forest, and are called "FID" (forest interior dwelling) species.

Swainson's Warbler (drawing)

The rarest Maryland forest interior bird is the Swainson's Warbler, which lives on the lower Eastern Shore in large tracts of mature wet forest with a dense shrub layer.

Raccoon

As forest edge increases, so do the populations of edge species that are harmful to forest interior birds. These edge species include generalist predators such as Blue Jays and Raccoons, which prey upon eggs and young of forest interior birds that are forced to live near forest edges.

Brown-headed Cowbird

Another edge species, the Brown-headed Cowbird, is known as a nest parasite because it lays its eggs in the nests of other birds. The host bird is tricked into raising the cowbird's young at the expense of its own chicks.

Scarlet Tanager

Ovenbird

Populations of neotropical migrant birds such as the Scarlet Tanager and Ovenbird have declined severely as forests have become fragmented. Ovenbirds nest on the ground, making them vulnerable to predation by roving domestic cats or raccoons, or to inadvertent trampling by humans.

Black Bear

Centuries ago, Maryland's Coastal Plain forests were large enough to support large mammals like the Black Bear that require extensive territories. Today, the Maryland portion of the Black Bear's range is limited to the more heavily forested western counties.

Japanese Honeysuckle

Wister's Coralroot

Many plants also require forest interior habitat. When parts of forests are cleared, soil disturbance and increased sunlight allows non-native species such as Japanese Honeysuckle to invade the forest. Its choking vines inhibit tree regeneration and crowd out native spring wildflowers such as Bloodroot, Windflower, and the State Endangered Wister's Coralroot.

Aerial view of part of Anne Arundel County (from USGS NHAP photo)

Housing development

This aerial view of part of Anne Arundel County shows the small blocks of forest and narrow forest corridors that remain in the wake of development for agriculture, homes and industry. Forests along streams absorb upland runoff, shade and cool stream water, and provide recreation. However, these narrow strips of woods also promote the invasion of native and non-native edge species because of the high ratio of edge to forest interior habitat.

RIGHT PANEL:

large heading; no photo

COASTAL PLAIN BOGS

Map of Maryland (or just CP) with area shaded to show distribution of CP bogs

Early in this century, naturalists reported more than 30 "magnolia bogs" in Prince George's and Anne Arundel Counties. Species characteristic of bogs were reported to commonly occur in wet areas on the Eastern Shore as well. Today, only a few Coastal Plain bogs remain. They are found primarily in the areas shaded on the map.

Sphagnum Moss

Bogs are open wetlands with a vegetation mat of decaying plants, peat, and sphagnum moss. Sphagnum moss acts as a sponge, holding up to twenty times its weight in water. On this spongy mat grow wildflowers, sedges, and heath shrubs.

Gumbottom Wetland habitat photo

Many bogs are disappearing as they are invaded by trees, ultimately changing the bogs into swamps or even dry forest. Historically, new bogs were created by fires and by damming of streams by beaver. Fire suppression, decimation of beaver populations, and urbanization have contributed to the loss of bogs and prevented the natural formation of new bogs.

Northern Pitcher Plant (2 photos, one of pitchers and one of flowers)

Bogs are acidic, with few of the nutrients most common plants need to survive. Adapted to the low nutrient levels in bogs, the Northern Pitcher Plant absorbs extra nitrogen from insects it traps and digests in vase-shaped leaves. The pitcher plant's unusual red flowers decorate the bog in spring.

Tawny Cottongrass

Uncommon sedges abound in Coastal Plain bogs. Tawny Cottongrass waves its cotton-like flowers above the bog mat in summer.

Leatherleaf

Leatherleaf, a dominant shrub in Maryland's Coastal Plain bogs, has thick evergreen leaves and delicate, urn-shaped flowers. A member of the Heath family, Leatherleaf is common in bogs of the northern states and Canada, but is Threatened in Maryland.

Yellow-fringed Orchid

The beautiful Yellow-fringed Orchid thrives in the wet, acidic soil of bogs. Its long-spurred flowers are pollinated by butterflies.

Handout Box

**HOW YOU CAN SUPPORT
PRESERVATION OF RARE
SPECIES AND SPECIAL
HABITATS IN MARYLAND**

TAKE ONE

**Large horizontal habitat photo
of beaver pond**

**Funded by the DNR Coastal and Watershed
Resources Division through a grant from
OCRM, National Oceanic and Atmospheric
Administration, and by citizen contributions
to the Chesapeake Bay and Endangered
Species Fund through the state income tax
check off.**

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