

5. Determining Conservation Issues and Actions

Conservation Issues, sometimes known as “threats” or “stresses,” are human actions that adversely impact wildlife, native plants and natural communities, and the ecological processes that sustain them. Conservation Actions are the measures taken to eliminate or minimize these impacts, or to mitigate their effects. For this Plan, determination of Conservation Issues and Actions began with the preparation of standardized “taxonomies” for organizing information. Taxonomies developed by the Conservation Measures Partnership were modified to better reflect circumstances in Delaware. The initial list of issues and actions was then derived from a review of existing state, regional and national plans for relevant items:

- American Fisheries Society – Marine Stock Criteria and Policy 31b-Management of Sharks and Their Relatives
- Atlantic States Marine Fisheries Commission – Fishery Management Plans
- Bat Conservation International – Bats in Eastern Woodlands
- Delaware Green Infrastructure Initiative
- Delaware National Estuarine Research Reserve Management Plan 2004-2009
- Defenders of Wildlife – Second Nature: Improving Transportation Without Putting Nature Second and Voluntary Conservation Tools and Programs
- Delaware Invasive Species Management Plan
- DNREC – Pea Patch Island Special Area Management Plan
- Environmental Law Institute – Protecting Delaware's Nature Heritage: Tools for Biodiversity Conservation, Protecting Delaware's Forests for Biodiversity, and Innovative State Strategies for Biodiversity Conservation
- Mid-Atlantic Bird Conservation Initiative – BCR 30 Plan
- Mid-Atlantic Fishery Management Council – Fishery Management Plans
- National Audubon Society – Important Bird Areas Program
- National Marine Fisheries Service – Highly Migratory Species Fisheries Management Plans
- National Wildlife Federation – Endangered by Sprawl
- North American Bat Conservation Partnership – State Planning Guide for Bats
- North American Waterbird Conservation Plan
- North American Waterfowl Management Plan
- Northeast Endangered Species and Wildlife Diversity Technical Committee – Wildlife Species of Regional Conservation Concern in the Northeastern United States
- Partners for Amphibian and Reptile Conservation, Northeast Working Group – Habitat Management Guidelines
- Northern Bobwhite Conservation Initiative
- Our Natural Legacy – Delaware's Biodiversity Conservation Partnership
- Partners in Flight – MidAtlantic Coastal Plain, MidAtlantic Piedmont, and North American Landbird Conservation Plans
- The Nature Conservancy – North Atlantic Coast, Lower New England-Northern Piedmont, and Chesapeake Bay Lowlands Ecoregion Plans, and Blackbird-Millington Corridor Conservation Area Plan

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- U.S. Commission on Ocean Policy – "Oceans Report"
- U.S. Fish & Wildlife Service – Chesapeake Bay Nutria Control program, Draft Environmental Impact Statements for light goose and resident Canada goose management, and Endangered Species recovery plans
- U.S. Shorebird Conservation Plan
- Virginia Department of Environmental Quality – Neotropical Migratory Songbird Coastal Corridor Study

A few additional issues and actions were developed as needed.

5.1. Issues

The final suite of Conservation Issues for Delaware wildlife is grouped into the following general categories:

- Habitat Loss or Fragmentation
- Residential and Commercial Development Practices
- Agricultural and Forestry Operations
- Shoreline Protection Practices
- Industrial Operations
- Transportation and Utility Operations and Maintenance
- Invasive Species, Nuisance Animals and Wildlife Diseases
- Water Use
- Solid Waste Disposal
- Changes in Fire Regimes
- Climate Change
- Energy Production
- Recreational Activities
- Airport Operations
- Wildlife Harvesting
- Resource Management
- Resource Protection
- Information Management
- Monitoring and Adaptive Management
- Division Operations
- Private Lands Conservation
- Natural Resource Management Planning
- Education and Outreach
- Nuisance Wildlife Management

While virtually all specific Conservation Issues had their origins in the plans mentioned above, most of them were somewhat modified to make them applicable to particular circumstances in Delaware. These specific issues, arranged by category, are described in the tables below.

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5.1.1. Issues Impacting Key Habitats and SGCN

<p>Habitat Loss or Fragmentation (impacts from the actual footprints of structures, facilities and land uses; off-site impacts are covered in other issues)</p>
<p>Residential and Commercial Structures</p> <p><i>Conversion of forests, early successional habitats and wetlands, destruction of buffers, and increased edge effects.</i> Residential and commercial development pressure is probably the most significant issue facing wildlife habitats in Delaware. Long confined mainly to the northern part of the state and the vicinity of a few cities and towns, it has now spread throughout the state. It is perhaps most intense in southern New Castle County, central Kent County, and eastern Sussex County. Types of impacts vary among habitats, with loss and fragmentation most significant in uplands and non-tidal wetlands, and degradation from buffer loss most significant in tidal wetlands. However, there is some incremental loss of tidal wetlands through permitted activities, the cumulative impact of which has not been assessed. See Figure 18 for a view of developed and developing areas vs. Key Wildlife Habitats.</p>
<p>Farmland</p> <p><i>Conversion of forests, early successional habitats and wetlands, destruction of buffers, and increased edge effects.</i> Large-scale conversion to agriculture is no longer occurring in Delaware, and, in fact, farmland is being lost to residential and commercial development. Changes in the type of agriculture – such as the construction of poultry houses – may result in some loss and fragmentation of upland habitats. However, escalating economic pressures steadily increase the intensity of crop farming, meaning that more stream and wetland buffers are cleared for crops, resulting in degradation of those habitats.</p>
<p>Industrial Facilities (includes all types of manufacturing, warehousing and quarrying)</p> <p><i>Conversion of forests, early successional habitats and wetlands, loss of buffers, and increased edge effects.</i> Habitat loss and fragmentation effects from industrial development are similar to residential and commercial development; however, impacts from construction and expansion of industrial facilities are not as widespread and are primarily directed toward growth areas rather than undeveloped areas distant from supporting infrastructure. Delaware's Coastal Zone Act of 1971 (7 Del. Code, Chapter 70) has helped to limit the spread of industrial facilities along the Delaware River and Bay.</p>
<p>Transportation Infrastructure</p> <p><i>Conversion of forests, early successional habitats and wetlands, destruction of buffers, and increased edge effects.</i> Impacts include those from the initial construction of roadways, bridges, culverts and other infrastructure, as well as from ongoing maintenance and repair. Fragmentation impacts from roads are especially widespread for some taxa, where even narrow secondary roads may present formidable barriers to insects and small vertebrates. Delaware's rapid growth forces a seemingly endless cycle of road projects of all sizes, including rerouting of major highways, expansion of many secondary roads, and frequent replacement of culverts and bridges.</p>
<p>Utility Corridors</p> <p><i>Conversion of forests, early successional habitats and wetlands, destruction of buffers, and increased edge effects.</i> With increased development and population growth, there has been a concurrent increase in demand for power, overloading existing capacity and causing power outages and imposed rolling blackouts. As a result, major utility corridors are created or expanded – lengthen and widened – to increase capacity for power delivery. Construction and maintenance of major regional corridors and smaller local corridors can exacerbate habitat loss and fragmentation. Though utility corridors have the potential to provide early successional habitat timing and methods of maintenance can effectively decrease habitat suitability.</p>

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Habitat Loss or Fragmentation (impacts from the actual footprints of structures, facilities and land uses; off-site impacts are covered in other issues)
Dredge Spoil Disposal <i>Conversion of forests, early successional habitats and wetlands, and degradation of beaches and Subaqueous lands.</i> Large-scale dredging projects (e.g., Delaware Bay main channel) generate massive volumes of spoil, for which there may be insufficient existing disposal-site capacity. New disposal sites would need to be identified on land and in water, potentially smothering or converting upland, wetland and/or subaqueous lands, or causing habitat degradation if sediment quality is poor and/or contaminated with toxins.
Dams <i>Fragmentation of streams.</i> Stream habitats are effectively fragmented when migration and movement of aquatic species past a barrier is prevented. Barriers may consist of dams, weirs and other water control structures, as well as stream crossings for roads and underground utilities.
Landfill Facilities <i>Conversion of forests, early successional habitats and wetlands, destruction of buffers, and increased edge effects.</i> With increased development and population growth, there is an increasing need for landfill capacity, either through expansion of existing facilities or construction of new landfills. Landfills are often sited away from developed areas due to offensive odors, noise and high volume truck traffic. Forested areas may be preferred because they screen landfill operations from view and provide a noise buffer. Capped landfills may provide early successional habitat because trees often cannot be planted if roots can penetrate the cap.
Wind Farm Facilities <i>Conversion of forests, early successional habitats and nearshore habitats.</i> Impacts to terrestrial habitats result from construction of towers and related infrastructure, while impacts to nearshore habitats result from tower footings and cables fragment habitat and displace benthic organisms. Wind farms have been proposed for sites as far flung as Piedmont ridges in New Castle County, Coastal Plain flats in Kent County, and off Sussex County in both the Delaware Bay and Atlantic Ocean.
Residential and Commercial Development Practices
Altered Hydrology <i>Degradation of streams and wetlands from hydrologic changes caused by runoff from impervious surfaces</i> (other issues for roads are under Transportation and Utility Operations and Maintenance). In addition to increasing the size and frequency of high stream flows during storm events, impervious surfaces often decrease base flows by inhibiting recharge of groundwater. In severe cases, this may result in headwater streams changing from permanent to intermittent flow regimes. Major impacts exist in heavily developed northern Delaware, and are increasing in many other parts of the state. Even “relatively” undeveloped areas, such as the Blackbird-Millington Corridor, are approaching the 10% impervious surface threshold at which effects become noticeable.
Nutrients and Sediments (includes nutrients from fertilizers; nutrients from sewage and septic systems are covered in Industrial Development and Operations under Routine Sewage Discharges) <i>Degradation of streams, wetlands and nearshore habitats from excessive nutrients and sediments.</i> Sedimentation from land-clearing activities reduces sunlight penetration, raises water temperature, decreases the dissolved oxygen level, and alters substrate composition. In the short term, nutrient enrichment from lawn fertilizers causes algal blooms that may seriously deplete dissolved oxygen levels. Over time, nutrient enrichment may cause subtle but important changes in natural community structure and function.

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Residential and Commercial Development Practices
Pesticides
<i>Lethal or sub-lethal effects of residential pesticides on aquatic and wetland species.</i> In general, pesticides are applied at even higher rates to residential land than to agricultural land, and they are frequently detected in surface water and groundwater at levels that are injurious to aquatic organisms. This issue has not been well studied in Delaware, where the focus has been on agricultural pesticides.
Outdoor Lighting
<i>Mortality or disturbance of sphinx moths and waterbirds from outdoor lighting.</i> Sphinx moths are strongly attracted to artificial lights, where they may become disoriented and are less able to evade predation by bats. Many waterbirds – especially young – are attracted to outdoor lights in coastal developments and on boats, ships and structures near shore, where they become disoriented and may be killed from collisions. Also, increased predation of these birds by gulls has been observed in the presence of outdoor lighting.
Buildings
<i>Mortality of migratory birds from collisions with buildings.</i> Since the widespread construction of curtain glass office buildings beginning in the 1960s, window collisions have become a major source of mortality for birds. Songbirds are most often involved, and mortality is substantially greater at night when buildings are lit, and in conditions of fog, mist or low cloud cover. Some impacts have been noted at buildings in Wilmington, although the full extent of the issue has not been assessed.
Piers and Docks
<i>Degradation of beach and dune habitats and wetlands by piers and docks.</i> Although the impacts of individual piers and docks may be minimal, the cumulative impact can be substantial.
Agricultural and Forestry Operations (includes “hobby farms” and – for land use purposes only – poultry houses and other Confined Animal Feeding Operations [CAFO]. Effluent discharges from CAFOs are covered in “Routine sewage discharges...” under Industrial Development and Operations.)
Agricultural Harvesting Practices
<i>Mortality or disturbance of box turtles, milksnakes and early successional birds from harvesting of crops during nesting season or at other critical times.</i> Several species are known to nest in crop or hay fields, which may be harvested while these birds are on the nest. Also, box turtles sometimes nest in fields, where the adults, eggs and hatchlings may be killed during harvesting.
Livestock Grazing
<i>Degradation of upland and wetland forests from livestock grazing.</i> Long-term grazing in forests depletes herbaceous species and shrubs, and in more severe cases may inhibit regeneration of trees.
Ditching and Draining
<i>Degradation of streams and wetlands from ditching for agricultural operations.</i> Ditched streams are impacted by loss of aquatic and riparian vegetation, alteration of substrate composition, increased flow rates and elevated water temperatures. Adjacent wetlands are often drained because of the lower water surface elevation in ditched streams.
Altered Hydrology
<i>Degradation of streams and wetlands from hydrologic changes caused by increased runoff.</i> Greater runoff from cropland and cleared forests boosts the size and frequency of high stream flows during storm events.

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<p>Nutrients and Sediments</p> <p><i>Degradation of streams, wetlands and nearshore habitats from excessive nutrients and sediments.</i> Row crop agriculture produces substantial amounts of sediments, even when no-till planting is used. Sedimentation reduces sunlight penetration, raises water temperatures and alters substrate composition. In the short term, nutrient enrichment from lawn fertilizers causes algal blooms that may seriously deplete dissolved oxygen levels. Over time, nutrient enrichment may cause subtle but important changes in natural community structure and function.</p>
<p>Pesticides</p> <p><i>Lethal or sub-lethal effects of agricultural pesticides on early successional, aquatic and wetland species.</i> Agricultural pesticides may directly impact some early successional birds at time of application, but more often they are found in surface water and groundwater at levels that are injurious to aquatic organisms.</p>
<p>Clearcutting and Other Forestry practices</p> <p><i>Loss, fragmentation or degradation of upland and wetland forests from clearcutting, selective harvest, short rotation, conversion to pine plantation and other practices.</i> Clearcutting results in at least temporary loss of natural forest structure and function. The loss becomes essentially permanent if areas are cut on a short rotation or converted to pine plantations, which have limited value as wildlife habitat. Even with selective harvest, use of heavy equipment may destroy shrub and herbaceous vegetation, compact soil, cause erosion, or facilitate colonization by invasive plants.</p>
<p>Shoreline Protection Practices</p>
<p>Jetties and Groins</p> <p><i>Degradation of beach and dune habitats by disruption of littoral drift.</i> By blocking longshore sand transport, jetties and groins decrease beach erosion in some areas while increasing it in others, which eventually impacts the natural formation of dunes.</p>
<p>Beach Renourishment</p> <p><i>Degradation of beach and nearshore habitats from sand dredging and pumping.</i> While beach and dune habitats usually benefit from renourishment in the long term, some wildlife may experience short term negative impacts. Also, many potential source sites – sand bars and flats – are important habitats, although source area impacts are also usually short term.</p>
<p>Dune Construction/Stabilization</p> <p><i>Degradation of overwash habitats from dune construction, vegetation plantings and fences.</i> Although dune construction and stabilization is often beneficial for a variety of wildlife, some species of tiger beetles and waterbirds require overwashes – unvegetated areas formed when storms breach dunes – for nesting or other life cycle stages. Constructing or stabilizing dunes causes overwashes to revegetate at an accelerated rate.</p>
<p>Artificial Shoreline Hardening (includes bay and ocean beaches, wetland shorelines and stream banks)</p> <p><i>Degradation of beaches, wetlands and streams from construction of bulkheads and other structures to prevent erosion.</i> Paradoxically, these structures often exacerbate the erosive forces of waves, tides and currents such that they are quickly undermined. Also, in streams they deflect the energy of currents rather than absorbing it, which increases erosion downstream.</p>

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Industrial Operations
Air Pollution <i>Degradation of multiple natural habitats from air pollution.</i> Impacts accrue to many habitats from airborne forms – e.g. ozone damage to vegetation – as well as from precipitation onto land and water, such as acidification of soils from SO _x and nitrogen enrichment of water bodies from NO _x . Heavy metals including mercury and persistent organic pollutants (e.g., PCBs, pesticides such as DDT, chlordane and toxaphene, and by-products such as dioxins and furans) can affect wildlife and humans through bio-accumulation, and direct poisoning through the disruption of endocrine function, organ injury, increased vulnerability to stress and disease, lower reproductive success, and death.
Accidental Spills of Toxins and Sewage <i>Degradation of beach and dune habitats, wetlands and nearshore habitats – and wildlife mortality – from “catastrophic” releases of oil, industrial chemicals and untreated sewage.</i> The Delaware River and Bay are home to the fifth largest port complex in the United States in terms of total waterborne commerce. Every year, over 70 million tons of cargo move through the tri-state port complex, which includes the ports of Philadelphia, Pennsylvania; Camden, Gloucester City, and Salem, New Jersey; and Wilmington, Delaware. It is the second largest oil port in the United States, handling about 85% of the East Coast's oil imports. Due to this high volume of shipping, potential for catastrophic spills is high. In addition, inadequate capacity, outdated or flawed design of sewage treatment systems cause raw sewage outflow into aquatic systems degrading water quality, introducing contaminants, and creating anoxic conditions.
Chronic Water Pollution <i>Degradation of aquatic and wetland habitats, and lethal or sub-lethal effects on aquatic and wetland species, from routine discharges and persistent leaks of sewage and toxins.</i> Discharges and leaks may come from municipal treatment plants, industrial effluent, septic systems or Confined Animal Feeding Operations (CAFO) such as poultry houses. In the short term, nutrient enrichment from sewage causes algal blooms, and over time may change natural community structure and function. PCBs, heavy metals, dioxin and other toxins may occasionally cause direct mortality, but more often have sub-lethal impacts on growth, reproductive physiology or behavior, especially those substances that bio-accumulate.
Impingement/Entrapment/Entrainment at Water Intakes <i>Mortality or disturbance of estuarine fish and sea turtles from temporary or permanent capture.</i> Cooling-water intakes at industrial sites and power-generating facilities along the Delaware River and Bay, Indian River and Inland Bays pose a potential risk to fisheries and wildlife resources.
Sediments from Sand and Gravel Quarrying <i>Degradation of wetlands and aquatic habitats from excessive sediments.</i> Sedimentation reduces sunlight penetration, raises water temperatures and alters substrate composition.
Transportation and Utility Operations and Maintenance
Altered Hydrology <i>Degradation of streams and wetlands due to increased flooding from undersized culverts.</i> Although this issue is recognized as a problem in a few areas of high conservation value like the Blackbird region, the extent of impacts to habitat are not well quantified throughout the state. Problems caused by undersized culverts are often identified only when property is damaged or roads are flooded.
Road Salt <i>Lethal or sub-lethal effects of road salt on aquatic species.</i> Road salt can affect soil and water chemistry, vegetation composition and may cause direct mortality of vertebrates and invertebrates. However, Delaware receives less than 20 inches of snowfall annually, thus road salt application is relatively infrequent. Nonetheless, when snowfall averages higher than normal statewide or in localized areas, the effects of road salt on key habitats and species can be detrimental.

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Transportation and Utility Operations and Maintenance
<p>Vehicles</p> <p><i>Mortality of salamanders and reptiles from collisions with vehicles.</i> Virtually every taxonomic group of wildlife is vulnerable to road mortality in Delaware. With more than 12,000 lane-miles of roads and an increasing capacity for traffic through road widening and other improvements, the risk of mortality will likely increase. Mortality can be clustered where vegetation is close to the road or where roads bisect breeding habitat.</p>
<p>Commercial Ships and Boats (includes cargo vessels of all types and commercial fishing boats)</p> <p><i>Degradation of streams and wetlands due to increased erosion from wakes, and mortality of estuarine fish, sea turtles and marine mammals from collisions.</i> Significant wake impacts are obvious in the Nanticoke River, but may occur elsewhere. Collision-related mortality is noted in the few carcasses that surface or wash ashore, but the full extent of the issue may be much greater.</p>
<p>Communications Towers and High-Tension Electric Lines</p> <p><i>Mortality of waterfowl, raptors, migratory birds and bats from collisions with towers and lines.</i> Collisions with tall towers, whether for radio, television, cellular or (formerly) telephone, may kill hundreds of birds in a single night, especially under conditions of fog, mist or low cloud cover. The degree of impacts depends on geographic location and topographic position. Raptors are especially vulnerable to electrocution from high-tension lines.</p>
<p>Channel Dredging</p> <p><i>Degradation of streams and nearshore habitats from dredging of shipping channels.</i> Potential impacts from dredging operations include sedimentation, re-suspension of toxic pollutants, damage to spawning or nursery habitats, direct mortality associated with dredging equipment, and altered hydrology.</p>
Invasive Species, Nuisance Animals and Wildlife Diseases
<p>White-tailed Deer</p> <p><i>Degradation of dune shrublands and upland and wetland forests from excessive herbivory.</i> Intense browsing depletes – or even eliminates – herbaceous species and shrubs, and in severe cases may prevent regeneration of forest canopy and understory trees. Also, deer may exacerbate impacts of invasive plants by browsing preferentially on native species.</p>
<p>Nutria</p> <p><i>Degradation of tidal wetlands from excessive herbivory.</i> Impacts have been minimal to date, but enormous damage has occurred nearby in Maryland. Nutria have begun colonizing Delaware relatively recently, so impacts may increase substantially.</p>
<p>Gypsy Moth</p> <p><i>Degradation of upland and wetland forests from excessive herbivory.</i> Impacts to forests in Delaware have been minimal to date, but the potential exists for major problems as experienced by some surrounding states.</p>
<p>Snow Goose and Resident Canada Goose</p> <p><i>Degradation of tidal wetlands, streams, ponds and impoundments from excessive herbivory and nutrification.</i> Impacts to wetlands and aquatic habitats from burgeoning populations have become so pervasive that the USFWS is proposing to substantially liberalize regulations for managing both species.</p>
<p>Mute Swan</p> <p><i>Degradation of wetlands from excessive herbivory and disturbance of wildlife by aggressive behavior.</i> Minimal impacts to aquatic vegetation and nesting waterfowl and waterbirds have been recorded in Delaware so far, but significant impacts have occurred nearby in Maryland.</p>
<p>Green Crab and Japanese Shore Crab</p> <p><i>Degradation of nearshore habitats from predation of clams and mussels.</i> Although both crabs are present in Delaware, impacts have not yet been detected. However, clam and mussel beds in New England have been decimated by these species.</p>

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Invasive Species, Nuisance Animals and Wildlife Diseases
<p>Control of Mosquitoes and Forest Pests by Aerial Application of Pesticides</p> <p><i>Mortality of non-target forest insects and reduction in the prey base for insectivorous forest birds, small mammals and bats.</i> Non-target insects are susceptible to both biological and chemical larvicides and adulticides, depending on insect growth stage and pesticide type. This may impact wildlife either through direct mortality or by reducing the number and type of prey available to insectivorous species.</p>
<p>Control of Mosquitoes with Open Marsh Water Management and Impoundment Management</p> <p><i>Degradation of tidal high marshes from changes to marsh surface water patterns, and to impoundments from manipulation of water levels.</i> These practices have positive benefits related to mosquito control and reduction in pesticide use; however, impacts to high saltmarsh communities, as a result of altered flooding frequency, and associated SGCN including black rail require further evaluation to ensure unique natural communities and associated SGCN are not adversely affected by these practices.</p>
<p>Pets and Subsidized Predators (animals whose populations have increased due to food and shelter provided directly or indirectly by humans; includes native species and feral pets)</p> <p><i>Mortality or disturbance of turtles, shorebirds, waterbirds and ground-nesting birds and bats from dogs, cats, raccoons, foxes, gulls, crows and others.</i> Increased development, population growth, habitat fragmentation and edge effects benefit some native wild animals resulting in increasing populations that may prey upon or compete with SGCN for resources. Increasing trends in maintaining feral cat “colonies” and inappropriate or illegal release of exotic pets (e.g., snakes, turtles) in natural areas introduce sources of predation, potential for disease transmission and competition for food and other resources needed by native species.</p>
<p>Asiatic Clam</p> <p><i>Mortality of freshwater mussels from competition for space and food.</i> In some streams, populations of Asiatic clams are so high that they monopolize the substrate and filter out a substantial portion of the plankton that also serves as a food source for freshwater mussels.</p>
<p>European Starling</p> <p><i>Mortality or disturbance of cavity-nesting birds from competition for nest cavities.</i> Delaware’s fragmented habitats and agricultural landscape provide ideal habitat conditions for European starlings. Breeding bird surveys in Delaware estimate a minimum of 30,000 pairs of starlings in the state. Birds that nest in open or edge habitats, including the red-headed woodpecker and eastern bluebird, are particularly susceptible to competition for nest sites.</p>
<p>Invasive Earthworms</p> <p><i>Degradation of forests from depletion of the soil organic layer.</i> Earthworm impacts are not known in Delaware. However, significant impacts have been noted in nearby Pennsylvania and through the northeast and Midwest.</p>
<p>Infectious Diseases</p> <p><i>Mortality of waterfowl and shorebirds from botulism, oysters from Dermo and MSX, raptors from West Nile virus, and others from emerging diseases.</i> Delaware hosts significant concentrations of migratory shorebirds and waterfowl, with significant proportions of some species’ populations using Delaware Bay as a stopover site. High densities of birds increase the risk of disease transmission, and long-distance migrants can transport disease organisms globally.</p>
<p>Invasive Plants</p> <p><i>Degradation of multiple natural habitats.</i> A wide variety of invasive grasses, forbs, shrubs, trees and vines proliferate in virtually all habitats. Impacts range from depletion of native plants to changes in habitat structure and function.</p>

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Water Use
Dam Operations
<i>Degradation of streams and wetlands.</i> Water impounded upstream of dams degrades pre-existing stream and wetland habitats, and water releases from dams can alter the hydrology of downstream habitats and increase sedimentation.
Dam Removal
<i>Degradation of streams and wetlands from release of sediments.</i> Sediments that accumulate behind dams are released upon removal of the structure, leading to downstream siltation, nutrient enrichment and possibly pollution by toxins.
Groundwater Withdrawals
<i>Degradation of wetlands and streams from lowering of the water table.</i> Excessive withdrawals for drinking water, irrigation and industrial processes reduce base flows of streams and dewater groundwater-fed wetlands. Excessive withdrawals over an extended period may eventually cause saltwater intrusion into aquifers in coastal areas.
Surface Water Withdrawals
<i>Degradation of wetlands and streams from decreased stream flows.</i> Excessive withdrawals for drinking water, irrigation and industrial processes during dry periods may drop stream flows below the minimum required to sustain aquatic organisms. This in turn may dewater adjacent surface water-fed wetlands.
Solid Waste Disposal
Trash Ingestion
<i>Mortality of aquatic life from ingestion of trash.</i> Careless or intentional trash disposal in and near aquatic, especially marine, habitats pose a risk to sea turtles, marine mammals and birds that may accidentally ingest or become entangled in the debris. Helium balloons, plastic bags, 6-pack rings and pelletized plastic persist in the environment and continue to cause problems for aquatic wildlife.
Beach Cleanup Activities (raking, events)
<i>Degradation of beach and dune habitats and mortality or disturbance of shorebirds and waterbirds from regular or episodic mechanical or manual cleanup.</i> Equipment used to remove debris (natural or unnatural) from sandy beaches can cause disturbance to migratory or resident nesting birds. Compaction of sand and removal of wrack vegetation by heavy equipment can cause a reduction in food for birds, invertebrates, and other animals in foredune and beach habitats. Seeds trapped in the wrack line and sand may also be removed thus changing vegetation patterns in these habitats as well.
Changes in Fire Regimes
Fire Suppression
<i>Degradation of early successional habitats and forests from suppression of regular fires.</i> Early successional habitats require frequent “disturbance” – historically provided by wildfires and intentional burning by Native Americans – to prevent them from reverting to forests. Also, most upland forests in Delaware depend on regular, although less frequent, fire to maintain the dominance of oak species. Fire suppression practices that stem from public safety concerns, and from misunderstandings about the role of fire in natural systems, cause the degradation of both of these habitat types.
Firefighting Practices
<i>Degradation of forests, early successional habitats and wetlands from efforts to control unplanned fires.</i> Clearing of firebreaks and other uses of heavy equipment for controlling wildfires may cause structural and functional changes to habitats from soil compaction or erosion and loss of vegetation.

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Climate Change

Sea Level Rise

Degradation of beaches and dunes, tidal wetlands and coastal forests from inundation. Estimates of sea-level rise along the U.S. coastline over the next century range from inches to several feet. Hardening of the shoreline and construction along beaches and marsh fringes allow little room for natural landward migration of these habitats.

Energy Production

Wind Farm Towers

Mortality of waterfowl, raptors, shorebirds, waterbirds, migratory songbirds and bats from collisions with tower blades and masts. Demands for alternative renewable energy sources have led to an increased interest in developing wind farms in Delaware. Placement of wind farms in areas used regularly by large numbers of migratory birds and bats, including the Delaware Bay, nearshore Atlantic Ocean, coastal terrestrial habitats increases the risk of mass mortality.

Tidal Turbines

Mortality of estuarine and marine fish and sea turtles from collisions with turbine blades. As with wind power, interest in harnessing strong tidal currents as a renewable energy source has led to consideration of placing tidal turbines in Indian River Inlet. However, impacts on local fisheries, including SGCN, are not clearly understood.

Thermal Pollution from Power Plants

Degradation of nearshore open water habitat from discharge of heated effluent. Large inputs of heated water can have harmful effects on aquatic life by causing sharp changes in water temperature, particularly when volumes of effluent fluctuate over short periods. Warmer temperatures lower dissolved oxygen in the water, increase respiration rates of organisms, and increases fish and wildlife susceptibility to disease, parasites, and toxic chemicals. Discharge of heated water into shallow areas near the shore may impact spawning and kill young fish.

Recreational Activities

Recreational Use on Foot

Degradation of beach and dune habitats and mortality or disturbance of shorebirds and waterbirds from beach users, birders, fishers, and others on foot. Increased participation in hiking, birding, fishing, and walking brings people into sensitive natural areas. Areas without designated or well marked trails or access points expose resources to increased levels of disturbance and degradation.

Pleasure Boats and Personal Watercraft

Degradation of tidal marshes and streams from pollution and wakes, mortality of estuarine fish, sea turtles and terrapins from collisions, and disturbance of shorebirds and waterbirds from harassment. Increased popularity of personal watercraft and pleasure boating has resulted in a larger number of watercraft in relatively small areas like the Inland Bays, Nanticoke River, millponds and other water bodies throughout the state. Boaters seeking less crowded areas to anchor, fish, sunbath or swim are increasingly using shallow water areas and marsh islands for recreational use, potentially causing increases in turbidity, bottom scouring, pollution, and disturbance to wildlife.

Off-Road Vehicles

Degradation of forests and early successional habitats from erosion, and disturbance of tiger beetles, shorebirds and waterbirds, from legal and illegal use. Legal and illegal use of off road vehicles causes compaction of soils, destruction of vegetation, disturbance to and direct mortality of wildlife, and increases in air and noise pollution.

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Airport Operations
Overflights
<i>Disturbance of waterfowl, shorebirds and waterbirds from aircraft overflights. Aircraft from Dover Air Force Base and other regional military facilities, planes towing advertising banners, aerobatic planes and helicopters often fly at low altitudes over beaches, marshes and coastal impoundments causing large flocks of birds to flush repeatedly, particularly during critical migratory period.</i>
Bird Strike Hazard Management
<i>Degradation of early successional habitats from frequent mowing. Collisions between birds and planes can result in costly damage to aircraft and loss of human life. As a result, airports manage vegetation around runways to limit bird populations to the greatest extent possible (including mowing throughout breeding and migration).</i>
Wildlife Harvesting
Inappropriate Hunting and Fishing
<i>Mortality of game species and sportfish from illegal or inadequately managed harvest. Poaching, insufficient enforcement and setting harvest levels with inadequate data on population dynamics increases the risk of serious decline, and local or regional species extirpation.</i>
Inappropriate Collection for the Pet Trade or for Bait
<i>Mortality of fish, amphibians and reptiles from illegal or inadequately managed collection. Poaching, insufficient enforcement and setting harvest levels with inadequate data on population dynamics increases the risk of serious decline, and local or regional species extirpation.</i>
Lead Shot Ingestion
<i>Mortality of waterfowl, raptors and early successional birds from primary or secondary ingestion of shot. Although it is illegal to use lead shot while hunting waterfowl, small-sized lead shot may be used for upland game. Spent lead shot can accumulate in soils and vegetation and may be ingested by upland birds causing poisoning or death. Secondary poisoning of raptors or others predators may result from feeding on birds containing lead shot.</i>
Commercial Shellfish Dredging
<i>Degradation of nearshore habitats from dredging gear. Substantial impacts to the structure of oyster reefs, clam beds, and sand bars and flats can occur from repeated dredging.</i>
Fishing Gear Entanglement
<i>Mortality of estuarine fish, sea turtles and osprey from lost or discarded nets, lines and traps. Impacts from commercial and recreational fishing gear (including pot gear, gill nets and hook and line fisheries) operating in Delaware waters are not well documented due to lack of monitoring, coordination, under-reporting, or the absence of reporting requirements.</i>
Fisheries Bycatch
<i>Mortality of estuarine and marine fish, sea turtles and terrapins from unintended capture by fishing gear. 'Bycatch' is discarded or retained incidental catch due to a direct encounter with fishing gear. In general, bycatch impacts to non-target species are not well documented, except for diamondback terrapin, due to lack of monitoring, under-reporting or the absence of reporting requirements.</i>
Nuisance Wildlife Management
<i>Mortality of snakes and bats as a result of nuisance control. Among wildlife that are considered "pests" by the general public, there are many native species that are harmless and / or beneficial. Because of the sense of fear they instill, large numbers of snakes, bats and other native wildlife are destroyed by homeowners and business owners.</i>

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Resource Management
Habitat/Wildlife Management
<i>Degradation of early successional habitats, forests, freshwater and tidal marshes, streams and impoundments from manipulations to benefit particular habitats or species. Active management of habitats or wildlife invariably leads to trade-offs among the particular needs of different resources. The potential for conflict is greatest when conducting single-species management, such as for game animals, sport fish or endangered species, although it can never be entirely avoided even when managing for broad habitat types on a landscape level. Historically, most management in Delaware has focused on individual species that are hunted and fished, and the impacts of this on key habitats and SGCN has not been assessed.</i>
Facility and Program Operations
<i>Degradation of early successional habitats, upland forests, tidal marshes, streams and impoundments, and disturbance of wildlife, from facilities and operations unrelated to habitat/wildlife management. Public lands are managed for a variety of purposes, and therefore are subject to impacts from uses that are incompatible with conservation of key habitats and SGCN. Most prominent among these are visitors centers, active recreation facilities, roads, trails and related amenities.</i>

5.1.2. Issues Affecting Institutional Capacity

Resource Protection
Funding for open space acquisition to protect key habitats and SGCN
State planning staff has estimated that the total cost for permanently protecting the recommended 258,000 acres of “green infrastructure” – natural resources, recreational lands and working lands that contain the majority of key habitats and SGCN – is \$554 million. Currently, the Open Space Program for acquisition is funded at \$9 million/year for 17 years. At this rate of funding, the targeted acreage will never be reached because of the rapid pace of land development.
Enforcement capacity
Additional enforcement capacity is needed to focus on specific areas where SGCN and key habitats are especially vulnerable to disturbance, and to address general collection, possession and sale of native wildlife species.

Information Management
Information management for SGCN, key habitat, conservation issue and conservation action data to support adaptive management
The state currently lacks a comprehensive spatial and tabular data management system for all wildlife, habitat, issue and action data and information. In addition, resources are lacking to ensure such a system is readily available to land managers, planners, and other decision makers, both within the state government and among conservation partners.

Monitoring and Adaptive Management
Monitoring of SGCN, key habitats, impacts from conservation issues and outcomes of conservation actions
Existing monitoring protocols and procedures are often limited to game animals, sportfish, endangered species and a few SGCN, and yet even these efforts are not adequate, primarily due to lack of staff and funding. Monitoring of key habitats is also limited, and the impacts of only a few conservation issues are monitored. Some “direct threat” issues, like pollution from point source wastewater discharges, are monitored extensively, but many others are not monitored at all. There is also limited monitoring of the results of species and habitat management and other conservation actions.

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Monitoring and Adaptive Management

Quantitative measures of success for assessing DEWAP implementation

Most existing measures of success consist of population targets or “bag limits” for harvested species, such as waterfowl and sportfish. No measures exist for the great majority of species and for virtually all habitats. Measures must also be developed to gauge the success of DEWAP implementation itself in order to maximize accountability.

Adaptive management framework for modifying conservation actions

Although sometimes practiced informally, there is no systematic employment of adaptive management to improve the results obtained from conservation actions. A formal approach to adaptive management is critical to taking maximum advantage of limited staff, time and funding to achieve conservation goals.

Division Operations

DFW funding, staffing, administrative structure and/or procedures for DEWAP implementation

Historically, fish and wildlife agencies were established primarily to address conservation and management of harvested species, and agency structure typically reflects an administrative configuration that addresses “game” and “nongame” issues separately. As described in this plan, there is increasing overlap of conservation issues affecting both aquatic and terrestrial harvested and non-harvested species. Greater coordination among staff, programs, projects, and information management is necessary to fully and successfully implement DEWAP.

Private Lands Conservation

Incentives for landowners

Although new programs like the Landowner Incentive Program and Farm Bill programs are providing funding to work with private landowners on wildlife restoration and enhancement projects, more flexibility and additional options for program application are needed to entice landowners to participate.

Coordination among private lands conservation programs

With increasing funds available for private lands conservation, and a variety of agencies and organizations implementing private lands programs, there is a need to improve communication and coordination to ensure appropriate activities are recommended to landowners, funding is efficiently and effectively invested, and landowner confusion is avoided.

Natural Resource Management Planning

Baseline information

Despite considerable work with many rare species and most harvested species, much remains to be learned about the status and distribution of Delaware’s wildlife. Certain groups of species and many key habitats remain poorly understood, which hampers efforts to plan for comprehensive conservation.

Conservation planning process

DEWAP represents a major milestone in Delaware’s comprehensive planning for wildlife diversity. However, much work remains to refine this plan, and the state still lacks a coordinated, standardized process for strategic planning – prioritizing the conservation actions in DEWAP; “stepping down” the broader plan to species, habitat and managed area plans; and allocating staff, funding and other logistical resources to the highest priorities. This process is essential to ensure the long-term success of wildlife diversity conservation in Delaware.

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Education and Outreach

Training, education and outreach programs

Division program topics are currently limited in scope and audiences targeted, including hunter education, boating safety, fishing programs and aquatic resource education. Although all of these programs are beneficial and necessary, additional training, education and outreach is needed for a broad audience of professionals (state and local governments, private business community), schools, and the general public on key habitat ecology, SGCN biology, and conservation issues and actions.

Nuisance Wildlife Management

Dedicated response staff

The Division does not currently have the capacity to respond to complaints about nuisance wildlife, real or perceived, by the public. As development continues to increase and loss of habitat displaces a variety of native wildlife, the general public is coming into closer proximity with injurious and injured wildlife as well as harmless wildlife in and around their homes, businesses and communities. A structured system for responding to the public's concerns can help identify and address issues related to SGCN and habitat as well as educate the public on how to co-exist with wildlife thus reducing some types of complaints over time.

5.2. Actions

Conservation Actions to address these issues can be grouped as follows (note that this grouping was used only for generating a list of actions, not for the format of the Plan, which is organized according to issues rather than actions):

- Land and Water Protection
 - Publicly-Owned Protected Areas
 - Privately-Owned Protected Areas
 - Easements
- Land, Water and Species Management
 - Protected Area Management
 - Compatible Resource Use
 - Invasive Species Control and Prevention
 - Habitat Restoration
 - Natural Processes Restoration
 - Species Restoration
 - Ex-Situ Conservation
- Law and Policy
 - Legislation
 - Regulations, Policies and Procedures
 - Natural Resource Management Planning
 - Land Use Planning and Zoning
 - Standards
 - Compliance and Enforcement
- Research and Monitoring
 - Research
 - Monitoring
- Education and Outreach

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- Formal Education
- Training, Workshops, Learning Networks, etc.
- Lifelong Learning
- Awareness Raising and Communications
- Moral Confrontation
- Economic and Other Incentives
 - Linked Enterprises
 - Substitution
 - Market Forces
 - Conservation Payments
 - Non-Monetary Values
- Capacity Building
 - Institutional Development
 - Alliance Development
 - Conservation Finance

Because specific Conservation Actions are self-explanatory, they are not described here. They can be found with their corresponding issues in Section 6.