Description of the Basin

The Susquehanna Basin covers an area of 4 million acres in south-central New York. The basin is within the Appalachian Highlands, or High Allegheny Plateau ecoregion, and includes 2 major sub-watersheds, the Upper-Susquehanna and Chemung. The major municipalities within the basin are Binghamton, Cortland, Elmira, and Oneonta. The basin encompasses parts of 19 counties and there were an estimated 775,000 people basin-wide in 2000. Although only 35% of the basin's human population resides in the Chemung sub-watershed, the population density (people/square mile) is greater than that of the Upper-Susquehanna sub-watershed, which contains 65% of the total population.

The Susquehanna Basin is the second largest river basin east of the Mississippi, and the largest on the Atlantic seaboard. The 444-mile river drains 27,500 square miles including portions of New York, Pennsylvania, and Maryland before emptying into the Chesapeake Bay (NYSDEC, 2002). The New York portion of the basin drains over 6,000 square miles and includes approximately 20,000 acres of lakes and 11,000 miles of mapped streams. Land use within the watershed has changed significantly since the late 19th Century when greater than 90% of the watershed was cleared for agriculture. Today the predominant land cover classifications are deciduous, mixed, and evergreen forest (70%) and agricultural lands (27%) according to the U.S. Environmental Protection Agency's Multi-Resolution Land Classification (MRLC) map information (Susquehanna Table 1, Susquehanna Figure 1). Just over 2.5% of the basin is classified as developed land. Agricultural lands include row crops and pasture/hay lands based on MRLC interpreted data. The MLRC data distinguishes between natural grassland and old fields, hay, pasture, and row crops. There are no lands classified as natural grasslands in the basin. However, in NY, our pasture/hay lands and row crops are often referred to as grasslands by many management agencies, including DEC. The data provided above relate to the entire Susquehanna basin, but since the 2 sub-watersheds in the basin are somewhat different from each other, more detailed information is provided below.

According to the Susquehanna River Basin Commission (SRBC), most of the Upper-Susquehanna sub-watershed is steeply sloped with forested (70%) hills and ridges and large wide valleys scattered with agricultural (26%) activity (SRBC, 2002). The major river in this sub-watershed is the Susquehanna River; its major tributaries are the Chenango, Unadilla, Otselic, and Tioughnioga Rivers. These rivers drain 4,500 square miles, including most of Broome, Chenango, Cortland, Otsego, and Tioga counties; parts of Delaware, Madison, and Chemung counties; and small portions of Schuyler, Tompkins, Onondaga, Oneida, Herkimer, and Schoharie counties. Major population centers within the sub-watershed include Binghamton, Cortland, Norwich, and Oneonta. In 2000, the impervious surface of the sub-watershed was estimated to be 0.63% (Chesapeake Bay Program, 2004).

The Chemung River sub-watershed is typical of glaciated areas, and is comprised of rolling to flat-topped uplands with steep alluvial valleys in which the main rivers flow. Forests (66%) occupy the steeper hillsides bordering stream valleys, while agriculture (31%) dominates the flatter hilltops and valleys. The major tributaries of the Chemung River are the Tioga (flowing north from Pennsylvania), Cohocton, and the Canisteo Rivers. The drainage area of 1,500 square miles

encompasses most of Steuben and Chemung counties, a significant portion of Schuyler County, and smaller parts of Allegany, Livingston, Ontario, and Yates counties. Major population centers in the sub-watershed include Elmira, Corning, and Hornell. Impervious surface of the Chemung in 2000 was estimated to be 0.81% (Chesapeake Bay Program, 2004). In both the Chemung and Upper-Susquehanna sub-watersheds flooding has been a major problem in low lying areas. Flood walls and levees have been constructed near many cities in these basins to confine the larger rivers and minimize flood damage. Additionally, many smaller streams have been channelized and bermed by landowners and highway departments to protect farm fields and other structures. The result of these alterations has been a significant reduction in the amount of functional flood plain in the basin, which in turn has resulted in increased stream velocities, streambank erosion, and degradation of stream habitats.

There are 9 state parks in the basin, comprising a total of 6,174 acres (Susquehanna Table 2). These parks provide upland and wetland habitats for many Species of Greatest Conservation Need (SGCN).

Four areas have been designated within the Susquehanna as draft Important Bird Areas (IBA) by Audubon (Susquehanna Table 3). Two of those areas (Pharsalia and Long Pond) are also designated as state Bird Conservation Areas. The Cannonsville/Stream Mill IBA is located in Broome, Chenango, and Delaware Counties. It was designated for species at risk (bald eagle) and forest cover, which includes Appalachian oak-pine, deciduous wetland, evergreen northern hardwood, and successional hardwoods. Protection is needed to prevent fragmentation from development and preserve habitat for the Canada warbler. The Long Pond State Forest IBA is located in Chenango County, and was designated for a species at risk (Henslow's sparrow). Within this state forest there is a diversity of habitats, including grassland, scrubland, mature hardwoods, and wetlands. Pharsalia Woods IBA is located in Chenango County, and is noted for its forest habitat which supports Canada warbler. The area is mostly hardwood forest surrounded by open farmland. Designation of the Tioughnioga River/Whitney Point Reservoir IBA, located in Broome and Cortland counties, is based primarily on its shrub/scrub habitat. It is also an important waterfowl stopover location, and host to raptors and shorebirds.

There are 5 state designated Critical Environmental Areas (CEA) in the basin (Susquehanna Table 4). CEAs are traditionally designated by DEC to protect drinking water supplies. These may be either surface waters or ground water aquifers. These sites are located in DEC Regions 7 and 8, and although they primarily serve to protect drinking water, they may also provide habitat for some SGCN. Other government bodies may designate CEAs for other reasons.

Within the basin there are approximately 290,000 acres of DEC lands (Susquehanna Table 5) located in DEC Regions 4, 7, and 8. Included are 136 state forests that total 260,395 acres which are prime areas for protection and management of multiple species. Also included are 10 wildlife management areas (WMA) and 1 unique area that range in size from 69 acres to almost 12,000 acres. These areas provide multiple habitats for fish and wildlife, including upland and wetland systems. These lands should include habitat management regimes for SCGN.

There are 77 state classified inactive hazardous waste sites in the basin. Most of those sites are in Broome, Chemung, Chenango, and Tioga counties. Site classifications range from Class 2 to Class 4, with the majority of them being Class 2 sites that pose a significant threat to the public health or environment and require action. Class 3 sites do not present a significant threat to the public health or environment, and Class 4 sites are those that are properly closed but require continued management.

Critical Habitats of the Basin and the Species That Use Them

DEC staff members who compiled the SGCN information in the State Wildlife Grants database were asked to indicate habitats associated with critical life stages and activities for those species. During the analysis for each basin a listing of species occurring in the basin and the critical habitats associated with their life cycle at the system and subsystem level was extracted from the database. The resulting aquatic and terrestrial habitats are summarized in Susquehanna Tables 6 and 7. The last column of the table indicates the number of species that indicated the System-Subsystem as critical habitat. The habitat classifications in the database were adapted from the New York Natural Heritage Program's *Ecological Communities of New York State, Second Edition* (Edinger et al., 2002). In most cases the habitats were simplified from the many vegetation associations listed in the community classifications. In the case of the lacustrine and riverine systems, the subsystems were modified to reflect the classifications most often used by DEC fisheries managers, e.g., "cold water-shallow". There are 3 aquatic habitat systems in the Susquehanna (lacustrine, palustrine, and riverine), which are further refined into 10 subsystems. Within the terrestrial habitat system are 4 subsystems that support SGCN in this basin.

Each of these systems and subsystems are further refined into a habitat category in the SWG species database and can be viewed in the Species Group Reports in Appendix A. The habitat categories are excluded here for the sake of simplicity, but were considered during the basin analysis. A complete listing of habitat types used in the preparation of the CWCS can be found in Appendix B. These critical habitats are not a comprehensive listing of all the habitat associations found in the basin, rather it is a subset of the habitats deemed critical to SGCN that occur in the basin (Susquehanna Tables 6 and 7). In addition, a single species may require multiple habitats throughout its life cycle, so the total of the final columns may exceed the 109 SGCN that presently or historically occurred in the basin.

Overall Trends in the Basin

As noted previously, agricultural lands make up a significant portion of the basin; 26% in the Upper-Susquehanna sub-watershed, and 31% in the Chemung sub-watershed. Not surprisingly, a majority of the Chemung, and portions of Madison and Chenango counties in the Susquehanna sub-watershed, are designated as grassland wildlife zone by the U.S. Department of Agriculture, and is considered one of the most important grassland areas of the state. Also, the NY Natural Heritage Program (NYNHP) considers portions of Steuben and Chemung counties as having high grassland related biodiversity.

According to DEC data, wetland types of the Appalachian highlands during the 1990s were 59% forested, 22% shrub, 11% emergent, and 8% open water. These wetland areas, totaling 446,000 acres, provide critical habitat for many SGCN in the basin. It must be noted that much of the wetland acreage is composed of many relatively small units (less than 12.5 acres) which are not afforded protection under DEC's regulatory wetland program.

The NYNHP database indicates the Susquehanna Basin is biologically diverse for a number of taxa groups that are tracked by the program. Susquehanna Table 8 provides a summary of species diversity in the Susquehanna Basin relative to the total number of SGCN statewide. The Upper Susquehanna sub-watershed contains a high number of mollusks and insects, and a moderate number of fish taxa, and both the Upper Susquehanna and Chemung are important for herpetofauna.

There are 90 SGCN species that currently occur in the basin and 19 species that historically occurred in the basin but are now believed to be extirpated (Susquehanna Tables 9-10). Of those 90 SGCN currently occurring in the basin, it is believed that the populations of 30 species are decreasing, 6 are increasing, 7 are stable, and 47 are of unknown status.

In order to prioritize SGCN and the actions necessary to conserve them, the species were ranked based on ecological significance and special local circumstances, as being most critical, critical, and important. Susquehanna Table 11 denotes the most critical species in the Susquehanna Basin.

According to the Species Group Reports in Appendix A, 6 bird, 4 insect, 4 mollusk, 3 mammal, 1 herpetofauna, 1 marine fish, and 1 crustacea species of greatest conservation need that historically occurred in the basin are no longer found there. There are some species, such as swallowtail shiner, subarctic darner, hellbender, coal skink, short-headed garter, cobra clubtail, and 2 species of mayfly that are found in very limited distribution statewide. A few of these species only occur in the Susquehanna Basin, and the rest are found only in 1-2 other basins statewide.

The human population of the Upper Susquehanna sub-watershed increased only 3% over the past 30 years, and will most likely continue at that rate for the near future (CBF, 2004). Meanwhile, housing densities increased 35%, and urban areas grew by 20%. Conversely, the Chemung sub-watershed saw a population decrease of 1.5% from 1970-1990; future projections indicate the human population will

increase by 1.5% over the next 15 years. Interestingly, the housing densities increased 29%, and urban areas grew by 15%. The sharper increase in housing densities in both sub-watersheds is a result of an increase in second homes that have sprung up in rural areas. This trend is expected to continue.

Reduction of agricultural land results in loss of grasslands used for haying and pasture. The amount of land used for agriculture in this basin has been reduced from about 92% of the total land cover in 1900 to 27% in 2002. According to CBP, 277 square miles of agricultural lands were lost between 1970 and 1990 in the Upper Susquehanna sub-watershed; 379 square miles were lost during the same time period in the Chemung sub-watershed. The nature of the remaining agriculture has changed as well. Cropland diversity has decreased as row crop monocultures have become the dominant agricultural land-use practice. As smaller farms have been consolidated into larger units, monocultures have become more expansive. Consequently, adjacent edge habitats in the form of grasslands, woodlands, and strip cover (e.g., fencerows, hedgerows) have either been lost outright or dramatically altered in size and shape. This loss of habitat not only affects resident wildlife communities but may also have played a role in the decline of migratory species such as Neotropical migratory birds that breed in the basin.

The Upper Susquehanna sub-watershed has become dominated by deciduous, mixed, and evergreen forest cover. Of the 277 square miles of agricultural land lost between 1970 and 1990, 82% has reverted back to forest cover. In the Chemung, 96% of the 379 square miles of agricultural land lost during the same period has reverted back to forest cover. Increases in forest cover are a direct result of the decline in agricultural acreage statewide.

Emergent marshes in the Appalachian Highlands have declined since the 1900s. Wetlands in the entire region increased by an estimated 3,000 acres between the 1980s and 1990s, according to DEC Bureau of Habitat information on statewide wetland trends. However, there were notable changes in the wetland plant communities in wetlands in this region of the state as the cover type on wetlands shifted. Shrub swamp declined as a cover type by approximately 5,000 acres and emergent marsh as a cover type declined by an estimated 16,000 acres during that same period. Open water associated wetland and forested wetland increased as cover types by an estimated 7,000 and 17,000 acres, respectively. Not surprisingly, populations of freshwater marsh nesting birds, grassland birds, lizards and salamanders in the Susquehanna Basin are generally in decline, while species associated with forest habitat are more secure.

Threats

DEC staff members who compiled the SGCN information in the CWCS planning database were asked to indicate threats to SGCN and their habitats. During the analysis for the basin, a listing of threats for each species occurring in the Susquehanna Basin was extracted from the database. The threats and summary figures compiled here are not listed in order of importance. The magnitude of a threat is measured by several variables including the species life history traits (i.e., its vulnerability), population trends, specific habitat type and geographic locale, and other rationales. The information provided does not quantify the magnitude of a particular threat. The information provided is intended only to paint a broad picture of the proportion of species/species groups to which a particular threat applies, and the frequency with which a particular threat was mentioned in the database. The purpose of this information is not to compare the severity of one threat against another.

General Discussion

The major environmental stressors in the Susquehanna Basin are related to agriculture, stream corridor manipulation, streambank erosion, roadside ditch maintenance, urban sprawl, and forest fragmentation. The negative effects of these stressors on natural resources include riparian buffer loss resulting in excessive nutrient and sediment loading to water bodies, reduced water quality, loss of connectivity between habitats, and loss of natural habitat to development.

Some smaller communities in the basin still face surface and groundwater contamination issues related to on-site septic systems. Both large and small communities are also faced with surface water quality degradation that is related to storm water runoff problems, but both tend to be localized problems of a small scale. These stressors are mentioned in the New York State 305(b) Water Quality Report (NYSDEC, 2002) and a joint project of the U.S.D.A. Forest Service and Society of American Foresters (SAF) (“Forest Fragmentation,” 1998).

The above stressors are comparable in both sub-watersheds of the basin. In the more densely populated areas of the basin, degraded water quality from nutrients and toxic substances, and habitat destruction are of greater magnitude and are related to residential, commercial and industrial development. In areas of the basin dominated by agriculture, manure, fertilizer, pesticide, and herbicide runoff, and soil erosion are issues of greater magnitude. In these more rural areas, on-site septic systems leach nutrients into aquifers and surface waters. Rural areas within a short distance of urban centers are also most prone to sprawl, a driving factor in habitat fragmentation.

The Susquehanna Basin is one of the most flood-prone regions in the nation, with major flooding damage on the average of once every 20 years. This is attributable to topography that features short, steeply sloping tributary valleys, higher gradient streams in the lower basin, and highly erodible soils related to glaciation. The flooding and high energy of the flowing water off of the steep hill slopes are major threats directly and indirectly. The flooding re-suspends sediments that have been deposited from previous events and from historical time when land clearing was ubiquitous.

According to SAF ("Forest Fragmentation," 1998), forests once covered more than 95% of the Chesapeake Bay watershed. It was a continuous mosaic of forest types and successional stages. For nearly 2 centuries, the forest was reduced tremendously by timber harvesting and land clearing for agriculture. However, a reversal and steady increase in forest land began in the mid- to late-19th century. This reforestation continued until about the mid-1970s. Since then, increasing population, changing ownership patterns (i.e., farms being subdivided into smaller parcels), and sprawl are causing increased fragmentation of forested areas, primarily downstream of the New York portion of the Susquehanna Basin.

Specific Threats to SGCN

The most frequently cited threat to species groups occurring in the Susquehanna Basin was outright loss of habitat via conversion to a human dominated land use (Susquehanna Table 12). This threat was the most frequently listed for both terrestrial and aquatic species. For purposes of discussion, this threat includes hardening of the landscape with buildings and roads, but can also include activities like land clearing and wetland draining for agriculture and mining. Loss of habitat for some SGCN is attributable to declines in grasslands as agricultural lands revert back to forest. Management of agricultural lands for grassland species may offset shift of cover types to forest; however, when agricultural management activities like hayfield mowing conflict with the grassland nesting bird season, species may be disturbed or killed.

Although toxic contaminants were listed as the second most common threat to terrestrial and aquatic species in the basin (Susquehanna Table 12), this threat may be overstated. Degradation of water quality, which may include contaminants, was the third most common threat listed to aquatic species groups in the basin. American Rivers recently listed the Susquehanna as one of the nation's endangered rivers due to sewer pollution and dam construction. Pathogens and ammonia from municipal plant discharges and raw sewage from combined sewer overflows are impairing aquatic life in the Susquehanna River in the Binghamton-Johnson City-Endicott area (NYSDEC, 2002), but the plant is currently being upgraded and should be meeting all water quality standards in 2006.

Pesticide use on agricultural lands, particularly those that border wetlands and streams, are of concern for herpetofauna, insects, mussels and freshwater crustacea. Agricultural pesticides are generally broad in their action, meaning that they can kill off benign and beneficial invertebrate species as well as the target pests. Amphibians are particularly susceptible to some pesticides.

Degradation of water quality also comes from soil erosion and runoff, nutrient-induced algal blooms, and reduced dissolved oxygen caused by excessive algae decay or increased temperatures. Siltation negatively affects fish populations by decreasing spawning areas. In association with degradation of water quality is altered hydrology, which is the 5th most common threat to aquatic resources. Alterations to water flow can be caused by floodplain alteration, barriers (dams, weirs, culverts, bridges), and water withdrawal/management. Ultimately, loss of aquatic habitat is lost due to alterations of water flow.

Habitat fragmentation was mentioned as a significant threat to terrestrial species in this basin (Susquehanna Table 12). The overall human population of the

Susquehanna River Basin has not increased significantly in the last 30 years and projections to 2020 show that this trend will remain unchanged (CBF, 2004). At first glance this would appear to indicate no increase in development threats in this basin. However, humans in the watershed are in fact developing more and more of the landscape, creating a "sprawl" effect unrelated to population growth. The result is increased fragmentation of habitats by roads and other infrastructure. Fragmentation of forests in the basin may also be offset by the afforestation occurring, wherein large blocks of forest previously fragmented by agricultural lands are reconnected as early regrowth forest patches mature.

Human disturbance is considered a significant threat to both aquatic and terrestrial species in the Upper Susquehanna and Chemung sub-watersheds. The development of roads and utility rights-of-way directly affects the number of species struck by cars on roads and colliding with power lines, cell and radio towers, and wind towers. In the aquatic arena, what currently may be the cause of greater problems is the stream destabilization caused by a variety of issues. Included among these are "stream cleaning" after storms to remove gravel, and poor highway maintenance practices, especially relating to culverts, road ditches and bridges. Dairy and beef operations that allow cattle in the creek can cause banks to destabilize due to the removal of riparian vegetation and the tremendous erosive power of cattle hooves on steep stream banks. A lack of zoning in many towns results in buildings being placed too close to streams, which, in this basin, have a great tendency to migrate. The resulting problems of stream encroachment on roads, driveways, septic systems, and buildings often results in drastic emergency measures, which often compound the unstable stream conditions. Creation of berms along stream banks, over-widening of stream channels, removal of streamside vegetation, armoring of stream banks, straightening of stream reaches, draining road ditches directly into streams, hanging culverts, removal of gravel bars and islands, and other similar projects all lead to long-term, unstable stream conditions and effects on the aquatic community. Additionally, dams have blocked migratory paths of marine species like American shad and American eel as well as resident species in the drainage.

Priority Issues in the Basin

- Stream protection including sedimentation and nutrient reduction
- Protection and management of large forest blocks for SGCN
- Protection of contiguous forest stands
- Management, restoration, and protection of stream buffers to protect SGCN
- Improved local land use planning

Vision, Goals and Objectives for the Basin

Vision

The Susquehanna Basin will continue to have functioning habitats that support healthy biotic communities, of which SCGN are a part.

Land use practices and development in the basin will be undertaken according to current best management practices.

Goals and Objectives

- Restore natural stream geomorphology to reduce excessive erosion and to provide good quality riparian habitats.
- Protect, restore, and manage functional blocks of large contiguous, mature forest.
- Contain and/or reduce the spread of exotic invasive species and prevent the introduction of new species. Implement the recommendations of the Invasive Species Task Force.
- Monitor the quality and quantity of habitats on a 10-year rotational cycle.
- Work toward Chesapeake Bay Program nutrient and sediment reduction targets by increasing functioning wetlands and adequate riparian zones.
- Identify, manage, and maintain specific areas of high quality grasslands for use by grassland nesting species. This goal should be focused on specific agricultural areas and key grassland areas, and should not be undertaken at the expense of re-establishing native forest cover.
- Protect existing wetland habitat and increase total wetland habitat in the basin by 9,000 acres as recommended by the Upper Susquehanna Coalition and the Chesapeake Bay Program.
- Identify specific threats to and goals for SGCN in order to prioritize habitat protection and restoration efforts.

Priority Strategies/Actions for Basin-wide Implementation

The following recommendations do not appear in any priority order. All of these recommendations are intended to be of high priority to implement in this basin in the coming 5 to 10 years for the benefit of the most critical SGCN in the state. See the discussion of "*Development of Conservation Recommendations for Species of Greatest Conservation Need and their Habitats*" and their prioritization in the Introduction. All of the recommendations for SGCN found in this basin can be viewed in Appendix A.

Data Collection Recommendations for Habitats

FRAGMENTATION

Fragmentation and loss of habitats in the basin is a common threat to several species groups. There are many issues that influence the effects and severity of fragmentation on given species groups. These include patch size and shape, edge effects, and connectivity of remaining habitat patches.

Juxtaposition of wetland and grassland habitats has been shown to positively influence wildlife species diversity. This basin contains significant amounts of both habitat types and provides opportunity for landscape management of species that depend on these systems. This basin was historically forested and an emphasis should be placed on large, unfragmented forest blocks for SGCN. Development of maps delineating habitat zones of forest and grassland areas is appropriate to coordinate management of these two habitat types and reduce conflicting management goals.

Fragmentation is a threat to aquatic species as well. Altered hydrology in the watershed prevents or hinders migration and dispersal of a variety of aquatic species including freshwater bivalves and migratory fish species. Isolated populations are more vulnerable to extirpation by both natural and anthropogenic events.

- Specific recommendations for freshwater marsh nesting birds and grassland birds include controlled experiments to identify management actions effective in producing suitable habitat. Invasive species that may affect marsh birds need to be identified. High priority species for freshwater marsh nesting birds are pied-billed grebe and American bittern. High priority species for grassland birds are Henslow's sparrow, upland sandpiper, Northern harrier, short-eared owl, and sedge wren.

- Specific recommendations for freshwater bivalves include investigations into the flow requirements of freshwater bivalves and modeling the effects of flow changes both in volume and timing. Additional research is needed on population dynamics of listed mussel species (including connectivity and genetic distinctiveness of populations and subpopulations) and controlling exotic bivalve species. The highest priority species within this group are green floater and brook floater.

- Specific recommendations for other butterflies include investigations of metapopulation dynamics for those species with distinct populations. High priority species within this group are frosted elfin, Persius duskywing, regal fritillary, and southern grizzled skipper.

- A specific recommendation for early successional forest/shrubland birds is research into causes for declines of Canada warbler and potential for forestry practices to be beneficial by opening up the canopy and promoting ground growth and thickets. The effects of viburnum leaf beetle on applicable habitats and species utilizing them also needs to be determined. High priority species within this group are golden-winged warbler, whip-poor-will, and Canada warbler.

HABITAT DEGRADATION

Habitat loss and degradation in various forms is a threat to more than 20 species groups in the basin. Habitat degradation may be caused by streambank alterations and by placement of structures including communications towers and wind turbines.

- A specific recommendation for stoneflies/mayflies of lotic waters is to monitor activity for disturbance effects in the riparian zone and waters where these species (may) occur. High priority species within this group are both mayflies: *Ameletus tarteri* and *Ameletus tertius*.

- A specific recommendation for forest breeding raptors is to monitor wind farms for mortality.

- Work with the agricultural community to implement best management practices (BMP) to decrease soil erosion and minimize nutrient and pesticide runoff from farm fields and barnyards.

INTERSPECIFIC INTERACTIONS

Interspecific interactions are a common threat to 7 species groups in a number of taxa. Such interactions result in loss of host species, disrupted predator/prey cycles, competition for life support from non-natives species or species in places or numbers not historically found, detrimental hybridization, and parasites.

- Specific recommendations for other butterflies include determining the precise habitat needs of all life stages, ascertaining food plants, and determining the relationship between food availability and species numbers. Additional identification of species which negatively affect butterfly populations is also needed, along with determining the best control method for those exotic species. High priority species within this group is frosted elfin, Persius duskywing, regal fritillary, and southern grizzled skipper.

- A specific recommendation for freshwater marsh nesting birds is to investigate diet and nutrition in relation to breeding habitat quality and prey populations. High priority species within this group are pied-billed grebe and American bittern.

- A specific recommendation for lake/river reptiles, lizards, and woodland/grassland snakes is to document life history parameters, including predator/prey relationships. High priority (and only) species within the lake/river reptiles group are Eastern ribbonsnake and wood turtle. High priority (and only) species within the lizards group is coal skink. High priority species within the woodland/grassland snakes group is timber rattlesnake, Eastern hognose, and short-headed garter.

- Specific recommendations for early successional forest/shrubland birds are to monitor status and trends and develop habitat management guidelines for golden-winged warblers, including those techniques that can favor golden-winged over blue-winged.

- A specific recommendation for freshwater bivalves is to research potential interbreeding between brook floater (the high priority SGCN) and elktoe, and evaluate the potential threat to brook floater population integrity.

Data Collection Recommendations for SGCN

General Data Collection

There are a number of priority species and groups that need population, habitat, and life history research to address critical data gaps. This information will help more clearly identify threats and establish baseline information for these most critical species. Only those most critical species not yet identified in text will be listed here within each group; the reader can refer to previous sections for most critical species already identified. The research items are listed below by species group. This type of data collection will address multiple threats to many species.

- A specific recommendation for Eastern hellbenders and stream salamanders relating to susceptibility to stochastic events is to periodically evaluate the status of rare species to determine appropriate status listing. High priority species are hellbenders and longtail salamander.

Early successional forest/shrubland birds

- Complete an inventory and analysis for high priority species that identifies core habitats within the basin.
- Monitor trends of all species.
- Develop a long term monitoring program for golden-winged warblers.
- Encourage full completion of Breeding Bird Survey routes.

Freshwater marsh nesting birds

- Initiate a baseline population survey to determine abundance and distribution. Refine monitoring techniques to better detect population trends
- Inventory breeding sites and map at a coarse scale to select key monitoring locations. Analyze habitats at multiple scales to better understand characteristic important to nest site selection. Identify key migratory staging, molting, and wintering areas.

Grassland birds

- Complete an inventory of existing grassland habitat including species present, distribution, and relative abundance of priority species. Develop and implement monitoring program to supplement BBS for grassland bird species to determine population trends and evaluate effectiveness of conservation efforts in the basin.

Other butterflies

- Identify best management regimes.
- Conduct an inventory of species within historical ranges and survey all species for appropriate listing.

Lake/river reptiles

- Document life history parameters specific to this species in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and wetland-upland habitat requirements.
- Periodically resurvey areas of known occurrence to detect population trends.
- Develop standardized habitat and population survey protocols to document the character, quality, and extent of occupied habitat.

Uncommon turtles of wetlands *(High priority species is spotted turtle)*

- Develop standardized habitat and population survey protocols to document the character, quality, and extent of occupied habitat.
- Periodically resurvey areas of known occurrence to detect population trends.
- Determine specific threats to populations.

Vernal pool salamanders *(High priority species are blue spotted salamander and Jefferson salamander)*

- Conduct research to document the extent of upland habitat required by vernal pool breeding salamanders.
- Develop standardized habitat and population survey protocols to document the character, quality, and extent of occupied habitat.
- Document life history parameters specific to this species in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and wetland-upland habitat requirements.
- Periodically resurvey areas of known occurrence to detect population trends.
- Determine significance of specific threats to populations of vernal pool salamanders and develop management recommendations to address significant threats.
- Determine locations of suitable but unoccupied habitat on DEC land for potential introduction of adults and/or eggs.

Woodland/grassland snakes

- Document life history parameters specific to this species in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and wetland-upland habitat requirements.
- Develop standardized habitat and population survey protocols to document the character, quality, and extent of occupied habitat.

- Determine significance of specific threats to populations of species in this group and develop management recommendations to address significant threats.
- Periodically resurvey areas of known occurrence to detect population trends.

Odonates of river/streams (*High priority species is cobra clubtail)*

- Continue habitat monitoring to complete baseline assessment of habitat quality and threats, and guide future monitoring, restoration, and protection efforts.
- Conduct surveys to obtain relative abundance estimates

Odonates of bogs/fens/ponds (*High priority species is subarctic darner)*

- Define preferred habitat in order to guide future monitoring, restoration, and protection efforts.
- Conduct surveys to obtain relative abundance estimates.

Eastern hellbender

- Develop standardized habitat survey protocols to document the character, quality, and extent of occupied habitat. Document use by juveniles.
- Document life history parameters specific to this species (including juveniles) in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and stream habitat requirements.
- Develop population survey protocols to determine extent of occupied habitat.
- Periodically re-survey known sites in order to detect population trends.

Lizards *(High priority species is coal skink)*

- Develop standardized habitat survey protocols to document the character, quality, and extent of occupied habitat.
- Document life history parameters specific to this species in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, habitat requirements.
- Develop population survey protocols to determine extent of occupied habitat.
- Periodically re-survey known sites of coal skink occurrence in order to detect population trends.

Stream salamanders (*High priority species is longtail salamander)*

- Develop standardized habitat survey protocols to document the character, quality, and extent of occupied habitat.
- Document life history parameters specific to this species in NY including age and sex ratios, longevity, age at sexual maturity, survivorship of young, predator-prey relationships, and wetland-upland habitat requirements.
- Develop population survey protocols to determine extent of occupied habitat.
- Periodically re-survey known sites of longtail salamander occurrence in order to detect population trends.

Freshwater bivalves

- Evaluate threats to mussels and prioritize areas within the basin for remedial action.
- Develop standard survey protocols for development projects in the basin to prevent further decline of these species.
- Investigate the best survey methods to detect rare species and evaluate status and trends of all species that occur in the basin. Determine population distribution and abundance of freshwater bivalve species-at-risk in this basin.
- Conduct research to determine the habitat parameters necessary to sustain populations of at risk mussel species including temperature, substrate, flow, fish hosts, and forage base.
- Determine breeding phenology necessary for successful mussel reproduction including mussel density, abundance and diversity of fish hosts, water temperature, and flow.

Stoneflies/mayflies of lotic waters

- Determine the critical habitats and survey within the historical range of these species.

Swallowtail shiner, comely shiner, and blackchin shiner

- Continue sampling streams these species have historically occupied in the Susquehanna basin to determine their presence and distribution.
- Continue sampling lakes, including Otsego, Canadarago and Tully Lakes which were previously inhabited by blackchin shiners.

Tree bats (*High priority species are Eastern red, hoary, and silver-haired bats)*

- Survey migrants to determine the timing, distribution, species composition, and elevation of migrating bats.
- Conduct summer surveys.
- Research threats to critical habitats and populations.

CONTAMINANT MONITORING

Contaminant monitoring in fauna is recommended for species in 7 species groups in a number of taxa. As outlined in the Threats section above, contaminants (pathogens, ammonia, endocrine disrupting compound discharges below waste water treatment plants, mercury) and pesticides are of concern in this basin. Due to the high agricultural land use in this basin, monitoring the effects of pesticides on sensitive species is warranted, especially since many of these species are dependent upon remaining agricultural lands for habitat.

❖ Specific recommendations for freshwater marsh nesting birds include a recommendation to periodically monitor the levels of contaminants in marsh birds and their eggs to assess trends and determine effects on eggshell thinning, behavioral modification, chick development, nesting success, and juvenile survival. The highest priority (and only) species within this group are pied-billed grebe and American bittern.

❖ Specific recommendations for freshwater bivalves and the host fish species of their larvae include a recommendation to research effects of pesticides and other chemicals, including ammonia, on all life stages of freshwater bivalves:

sperm/egg, glochidia, larva, and adults. The highest priority species within this group are brook floater and green floater.

- Specific recommendations for other butterflies include a recommendation to determine the sensitivity of species to chemical formulations, particularly diflubenzuron and other commonly used agricultural pesticides. In addition, determine the effect of *Bacillus thuringiensis kurstaki* (BTK) used in Gypsy moth sprayings on other butterfly species. The highest priority species in this group are frosted elfin, Persius duskywing, regal fritillary, and southern grizzled skipper.

POPULATION RESTORATION

- A specific recommendation for American shad is monitoring the re-establishment efforts for this species.

Planning Recommendations

EXISTING PLANNING DOCUMENTS

There are several existing management plans that address natural resource conservation issues within the basin (Susquehanna Table 12). The goals and objectives of these plans vary in their focus (e.g., water quality, planning and development, fish and wildlife), spatial and temporal scale, and cooperating partners; however, they all provide valuable information on conservation threats and strategies in this region of New York State and should be consulted before implementing recommended actions.

NEW PLANNING RECOMMENDATIONS

There is a clear need for a habitat management plan for the basin that focuses on the natural restoration of large patches of mature forest and protection of existing wetlands while facilitating the management of grassland, shrublands, and early successional forests where opportunity provides and when such efforts to retard natural succession do not interfere with re-establishment of healthy forests. Of the 90 SGCN occurring in the basin, 36 depend on grasslands, 15 depend on barrens and woodlands, 38 depend on forested habitat, and 22 depend on wetlands. Some species depend on all 5 of these habitat types at some point in their life cycle. All of these habitats have competing needs and priorities. The balance and active cooperative management of all of these habitat types is vital to the health and abundance of many of the SGCN currently living in this basin.

The management of public lands needs to be carried out with the cooperation of many agencies. Key partners to include are DEC, NYS OPRHP, USFWS, NPS, NRCS, SWCDs and local governments. Private lands comprise 85% of the total land area of the state. Use of cooperative management programs like the Landowner Incentive Program, Wildlife Habitat Improvement Program, and others will be important to achieve effective habitat protection and enhancement for many SGCN. Partners in these efforts should include: Upper Susquehanna Coalition, Susquehanna River Basin Commission, Audubon NY, TNC and the Natural Heritage Program, local land trusts, New York Forest Owners Association, Ducks Unlimited, Inc., Pheasants Forever, National Wild Turkey Federation, and others.

Forest Management Planning

The basin is dominated by deciduous and mixed forest cover. Trends toward afforestation are resulting in opportunities for reducing fragmentation of the forest and this trend should be encouraged with good silvicultural practices. However, where appropriate, it may be desirable to integrate the needs of early successional forest/shrubland birds, forest breeding raptors, tree bats, woodland snakes, and vernal pool salamanders. These species often need heterogeneous forest structure during different life stages. Herpetofauna also need wetlands within the forest to breed.

The birds mentioned above all require varying types of vertical forest structure. Wildlife biologists and researchers should develop habitat management guidelines for forest stages important to SGCN that include patch size and distribution in the landscape, timing of management actions, and microhabitat characteristics. These guidelines should be considered by forest managers on public lands and made

available to private forest owners interested in wildlife management. Specific recommendations include:

- ❖ Determine where it is most appropriate for management of these species to occur, and then develop a management plan that provides guidance on maintaining, enhancing, and restoring early successional forest/shrub habitat for Canada warbler and golden-winged warbler.

Grassland and Wetland Planning

Portions of the basin are dominated by grasslands with several large wetland complexes interspersed in the landscape. This is an opportunity to integrate the needs of wetland and grassland-dependant species into a holistic management plan for the basin. Components of this larger picture are:

- ❖ Develop a management plan for the basin that includes land acquisition, cooperative working relationships with landowners and habitat management targets for all wetland and grassland-dependent SGCN. Minimum management area sizes for various animal classes should be determined, targets for acquisition, and temporal and spatial targets for management actions (mowing, water control) should be set. This should be a component of the above mentioned habitat management plan, and incorporate basin specific objectives from a statewide grassland bird management plan (already being developed by DEC staff) and existing wetland planning efforts including North American Waterbird Plan, Bird Conservation Regional Plans, and others. Specific tasks associated with this planning include:
  - Review state park master plans and DEC land unit management plans in this basin for opportunities to better manage state lands for SGCN in this basin.
  - Develop habitat management guidelines and actions for high priority grassland bird species in the Susquehanna (Henslow's sparrow, upland sandpiper, Northern harrier, and short-eared owl) for incorporation in the above management plan and the NYS Open Space Conservation Plan in order to better coordinate conservation actions. Identify opportunities in the plan for directing federal funds to grassland habitat.
  - Continue participation in North American waterbird planning. Focus on and refine recommendations for American bittern and pied-billed grebe.
  - Work with USDA and other partners to develop grassland management incentives, in appropriate areas, that benefit SGCN in this basin.

DEC Unit Management Planning

- ❖ Review DEC land unit management plans for opportunities to better manage state lands for SGCN in this basin, including control of invasive and non-native species.
- ❖ Develop a monitoring and control plan that includes measures to detect invasive bivalves and actions to control them before they become threats.
- ❖ Incorporate freshwater mussel goals and objectives into regional water quality and fish management plans and policies.
- ❖ Facilitate the development of wetlands on DEC lands where appropriate.

Land Protection Recommendations

This category of actions encompasses a variety of protection mechanisms such as easements, cooperative agreements, fee title acquisition, donations, development rights acquisition, and others. The type of protection should be determined by the interested parties based on their means and conservation goals. Interested parties may be one or more government entities or non-governmental organizations.

WATER QUALITY

A common threat to many SGCN in this basin is the degradation of water quality in aquatic habitats. This can be a result of siltation, nutrient runoff, temperature increases, toxics, and lowered dissolved oxygen. Land acquisition can be used to prevent or remediate these effects.

- In key locations, acquire development rights to protect water quality for listed mussel populations. The high priority species group that will benefit from this recommendation is freshwater bivalves.

HABITAT LOSS

A common threat to many SGCN in this basin is the loss of habitat due to anthropogenic changes like development, dredging, wetland draining, and shoreline hardening. These changes result in loss of habitat quantity and often disrupt the function of remaining habitat. Connections between patches of similar or different, yet complementary habitats are needed for migration and dispersal. Isolated patches do not allow for effective metapopulation dynamics and make species vulnerable to extirpation from a variety of causes. Reduction of patch size also results in increased negative edge effects, predation, reduction in population, and reduction in the types of species the patch can support. Habitats fragmented by roads and power lines increase direct mortality of animals due to collisions. Smaller dams are detrimental to SGCN by being a physical barrier to dispersal and migration of young and adults.

- The lands owned by the state and federal government in the basin are primarily forest and wetland. There is a need to acquire, through fee title or easements, grasslands, especially adjacent to existing public forest stands. This will enable better management and protection of these habitats for grassland species. Acquisitions should reflect the recommendations of priority grassland focus areas from the NYS grassland bird management plan. Priority species that would benefit from these acquisitions include grassland birds, early successional forest/shrubland birds, and woodland/grassland snakes.

- Acquisition of forested and grassland upland tracts adjacent to wetland properties is critical to protection and restoration of amphibian, reptile, and freshwater marsh nesting bird species in this basin. Ideally these will be parcels where road building has not fragmented the 2 cover types. Identification of candidate parcels with these characteristics should occur immediately. Priority species groups that would benefit from these acquisitions are vernal pool salamanders, uncommon turtles of wetlands, freshwater marsh nesting birds, lizards, odonates of bogs/fens/ponds, and other butterflies.

- Support acquisition of Horseheads Marsh property, which is a Class I wetland in Region 8 and the largest wetland in Chemung County. This acquisition priority appears in the Open Space Conservation Plan of 2002. The site provides habitat for many species of SGCN.

- Support acquisition of West Hill Lands property in Region 8, identified in the Open Space Conservation Plan of 2002. This site adjoins the Erwin Hollow State Forest, and includes 2 major habitat types; oak-hickory forest and Hodgman's Creek gorge. This area is considered a threatened, sensitive element, and provides habitat for timber rattlesnakes.

- Support protection of ecoregional conservation targets identified in The Nature Conservancy's High Allegheny Plateau ecoregional plan.

Management and Restoration Recommendations

HABITAT LOSS AND ALTERATION

A common threat to many SGCN in this basin is the loss of habitat due to anthropogenic changes like development, dredging, wetland draining, and shoreline hardening. These changes result in loss of habitat quantity and often disrupt the function of remaining habitat. Connections between patches of similar or different, yet complementary, habitats are needed for migration and dispersal. Isolated patches do not allow for effective metapopulation dynamics and make species vulnerable to extirpation from a variety of causes. Reduction of patch size also results in increased negative edge effects, predation, reduction in population, and reduction in the types of species the patch can support.

Habitats fragmented by roads and power lines increase direct mortality of animals due to collisions. Smaller dams are detrimental to SGCN by being a physical barrier to dispersal and migration of young and adults.

Overall alteration of the landscape since European settlement has disrupted the natural cycle of habitat disturbance (e.g. fire, wind throw, etc.); however, some of the alterations to the landscape provide important habitat, as in the case of hay and pasture lands, and early successional habitats such as old fields.

Specific recommendations to benefit SGCN include:

Early Successional Forest/Shrubland Birds

- Conduct sustainable silvicultural operations with a goal of creating or maintaining early successional habitat where it is deemed appropriate and desirable, and where such management does not jeopardize priority afforestation. Maintain, restore, and enhance early successional habitats through the use of multiple management options.
- Forest structure management; maintain various maturity stages in forest stands to benefit forest dwelling SGCN. Maintain understory trees for lower altitude nesters like black-crowned night heron. Create small openings with wetlands or small (~0.25 acre) ponds to benefit forest breeding raptors and herps.

Forest Breeding Raptors

- Maintain appropriate breeding habitat for forest breeding raptors around occupied nest sites.

Freshwater Marsh Nesting Birds

- Restore emergent marsh to benefit freshwater marsh nesting birds.

Grassland Birds

- Manage vegetative structure of established grasslands through appropriate management techniques. This should be incorporated into Landowner Incentive and Farm Bill programs.
- Resolve conflicts with issue of grassland management in vicinity of rattlesnake dens.

Lake and River Reptiles

- Manage uplands adjacent to aquatic habitat to provide adequate and secure nesting sites and dispersal routes for migrating animals.

Uncommon Turtles of Wetlands

- Employ a variety of habitat management techniques to control vegetative succession in order to preserve wetland suitability for these turtles, especially spotted turtles.
- Develop and implement mitigation strategies to counteract adverse effects of habitat fragmentation.
- Manage egg predators to increase turtle populations.

Woodland and Grassland Snakes

- Develop and implement mitigation strategies to counteract adverse effects of habitat fragmentation.
- Acquire known den sites of timber rattlesnake.

Hellbender

- Manage land use practices in riparian areas to decrease degradation of stream quality.
- Develop and implement mitigation strategies to counteract adverse effects of habitat fragmentation, including captive breeding, head starting, nest protection, and relocation strategies.

Freshwater Mussels

- Restore degraded habitat sites to allow for recolonization or reintroduction of listed mussels.

Lizards

- Manage vegetative succession to maintain habitat suitability for coal skink.

American shad

- Maintain or increase the level of shad fry stocking in NY portions of the Susquehanna Basin and advocate for improvements in fish passage facilities at Chemung and Susquehanna dams, including the Rock Bottom Dam in Binghampton.

WATER QUALITY

A common threat to many SGCN in this basin is the degradation of water quality in aquatic habitats. This can be a result of siltation, nutrient runoff, temperature increases, toxics, and lowered dissolved oxygen.

- Implement Best Management Practices for forest management in riparian areas in order to maintain, enhance, and restore early successional forest/shrublands. Identify opportunities in the plan for directing federal funds into such habitats.

Lake and River Reptiles

- Manage water borne pollutants that adversely affect lake and river reptiles.

Freshwater Bivalves

- Manage or restore areas of important mussel populations by controlling degradation factors including, livestock access, point and nonpoint source pollution, and flow alterations.

Uncommon Turtles of Wetlands

- Manage contaminant inputs to preserve habitat.

Swallowtail and Comely Shiner

- Manage and protect areas with significant shiner populations like the section of Catatonk Creek at the junction of Willseyville Creek.

INVASIVE SPECIES

Invasive species threaten many SGCN in the Susquehanna Basin. This threat may be through direct competition for nesting sites, prey, and other limited resources, or by alteration of the structure and quality of habitat, as in the case of invasive plants like purple loosestrife. Displacement of native species by invasive species disrupts ecological processes.

Freshwater Marsh Nesting Birds

- Control purple loosestrife where it is known to have a negative effect on marsh nesting birds. Techniques could include biological controls.

Lake and River Reptiles

- Control invasive aquatic plants where they are negatively affecting lake and river reptiles. Techniques could include biological, chemical, and mechanical means.
- Control spread of Japanese knotweed which threatens to take over significant area of riparian corridors in the basin.

Vernal Pool Salamanders

- Limit introductions of fish and other predatory species into habitats critical to vernal pool salamanders.
- Create vernal pool habitat in suitable locations on DEC and private lands.
- Relocate adult salamanders and/or eggs to suitable but unoccupied habitats on DEC lands.

Uncommon Turtles of Wetlands

- Control invasive species to preserve suitable wetland habitat.

Swallowtail and Comely Shiner

- Control invasive species of minnows which could be detrimental to these shiners.

HUMAN-WILDLIFE INTERACTIONS

There are a variety of threats to SGCN in the basin from direct interactions with humans. These include vehicle and structure collisions, and illegal and unregulated harvest. Species that are most susceptible to these threats are those that disperse across the landscape like migrating birds and bats, and herpetofauna traversing from the upland to wetlands. Often fragmentation of habitats by structures, such as power lines, transmission towers, and roads are a significant

source of mortality. Collection of wild animals for pets and food also may contribute to species declines.

Specific recommendations to benefit SGCN include:

Vernal Pool Salamanders

- Reduce habitat destruction and collisions by off-road vehicles in vernal pools occupied by salamanders.
- Limit logging activities around known breeding areas during the breeding and larval development period.

Uncommon Turtles of Wetlands

- Manage human access to preserve wetland suitability.
- Manage vehicle use in critical habitats to decrease direct effects.

Hellbender

- Manage water pollutants and sediment loading to streams in the Susquehanna.
- Research feasibility of removal of some dams blocking movement of hellbenders.

Stream Salamanders

- Restore habitat quality in degraded streams.

Information Dissemination Recommendations

Sharing of information allows stakeholder groups to make informed decisions about activities that may help or harm SGCN. Sharing of information may take many forms including best management practices, fact sheets, and educational outreach programs.

RARE SPECIES

Information about most SGCN is maintained in DEC's Master Habitat Databank. It is critical that the availability of this information be made known to land managers and decision makers. The Natural Heritage Program should have the capacity to maintain current data and to disseminate such data in a timely manner so that it is readily useable. In addition, NHP should continue to develop interpreted data products, such as maps and conservation guides, for use by decision makers so they can accommodate the conservation needs of SGCN early in project design

AGRICULTURE AND SILVICULTURE

Traditional agricultural and silvicultural operations may lack wildlife based objectives, thus may have detrimental effects to some species of wildlife. Providing information to public and private land managers may help mitigate detrimental practices. Specific recommendations include:

- Make information available to public and private land managers regarding the benefits and need for early successional habitat, including even-aged forest stand management and sustainable silvicultural practices.
- Work with public utilities to manage rights-of-way to provide maximum habitat benefits to early successional forest/shrubland birds.
- Develop an outreach program for public and private land managers to increase awareness of the benefits of grasslands and wildlife-friendly agricultural practices. Species groups that will benefit include freshwater marsh nesting birds and grassland birds.
- Promote the establishment of vegetated buffers around agricultural fields to protect wetlands and streams from runoff and benefit freshwater marsh nesting birds.
- Provide education and outreach to forest managers regarding silvicultural practices compatible with forest breeding raptors and early successional forest/shrubland birds.
- Provide education and outreach to local governments about the effects of stream channel alterations.

EXOTIC SPECIES

Introduction and spread of exotic species can often be minimized or prevented through increased awareness of natural resource users to the negative effects of these species on native wildlife. Awareness should be accompanied by specific actions that natural resource users can employ to prevent spread of invasive and exotic species. Specific recommendations include:

- Implement outreach recommendations of the Governor's Invasive Species Task Force.
- Post educational signs at boater access sites to highlight the dangers to native mussel populations posed by spread of exotic mussels, and the role of boats in their spread.

HUMAN-WILDLIFE INTERACTIONS

Human behavior can be altered by education and outreach. Providing information about negative effects of human disturbance on wildlife can help reduce detrimental interactions. Specific recommendations include:

- Enhance public education to curtail collection and translocation of turtles and snakes. This includes dispelling common myths about the dangers posed to people and pets by native snakes. Provide information about hellbenders to anglers to encourage them to release any animals caught on fishing lines.
- Develop an outreach and education tool to highlight the possible detrimental effects of human disturbance on wetland dependant wildlife. An example could be off-road vehicle effects on vernal pool and marsh nesting species.

OTHER RECOMMENDATIONS

- Develop outreach material to educate the public about the benefits of grasslands, freshwater mussel life history, American shad, and at-risk Lepidoptera.
- Review and respond to projects involving tall structures that may adversely affect tree bats.

Regulatory and Legislative Recommendations

Regulatory proposals will likely be made at the statewide level,though local governments have opportunities to modify or create laws and regulations to enhance local protection of SGCN. Local zoning and taxation policies can be used to discourage sprawl and habitat fragmentation without growth, an issue of particular importance in this basin.

HABITAT LOSS

- Pursue protection of wetlands less than 12.4 acres that provide habitat for SGCN under the 'unusual local significance' provisions of Article 24 of the ECL. In addition, enhance the protection of upland buffers around all wetlands used by herpetofauna SGCN to provide quality foraging habitat. High priority species that will benefit are spotted turtle, blue spotted salamander, and Jefferson salamander.
- Review the protection status of all wetland sites currently or historically used by endangered, threatened, or rapidly declining freshwater marsh nesting birds, regardless of wetland size. Wetlands locally important for these species could receive expanded protection either under existing provisions of Article 24 of the ECL or by local ordinance.
- Enhance regional permit review of development and highway projects that may affect freshwater bivalves and other aquatic species. Utillize existing authority (where it exists) to specify permit conditions such as:
  - Creation or retention of a minimum 30' buffer area along both banks of all streams.
  - Minimize disturbance to the bed and banks of all streams.
  - Protect all aquatic sites with known populations of SGCN such as Tully Lake where blackchin shiners have been found.
  - Provide all State/Town/County/City machine operators and supervisors a stream alteration education session prior to issuance of a Memorandum of Understanding for work in lakes and streams.

WATER QUALITY

- Limit the use of pesticides on publicly-owned marshes to prevent reduction of insect populations and contamination of wetlands used by SGCN, including freshwater marsh nesting birds. Explore replacing manufactured pesticides with integrated pest management techniques.
- Require testing of all new pesticides, consistent with existing DEC and EPA guidelines, for effects on all life stages of freshwater bivalves prior to approval for use in the state. Enhance testing as new information about sensitivity of these species is learned.
- Afford protected stream status under §608.2 of the ECL to Class D non-navigable streams in the basin.

UNCONTROLLED COLLECTION AND/OR HARVEST OF SGCN

- Enforce pending state legislation providing small game protections for hellbender, coal skink, longtail salamander, spotted turtle, timber rattlesnake, short-headed garter. Protection should also be extended to freshwater bivalves.

- Enhance law enforcement to limit collection and translocation of wood turtles, and coal skink.
- Review the status of odonate SGCN in the basin and recommend imperiled odonates of bogs/ponds/fens and rivers/streams for state listing if warranted.

Incentives

- Explore an amendment of §480a of the Real Property Tax Law that may provide for wide-ranging holistic stewardship on eligible tracts of private property. Consider the establishment of a Habitat Reserve component to encourage land owners to voluntarily conserve and manage significant habitats for wildlife and fish located on their lands through Real Property Tax exemptions.

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Tables and Figures

Tables

Figures