MAINE'S WILDLIFE ACTION PLAN

2015

Element 5 - Monitoring & Element 6 - Periodic Review

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Element 5: Monitoring
Element 6: Periodic Review

LIST OF TABLES

KEY TO ACRONYMS

BwH	Beginning with Habitat
GIS	Geographic Information System
HMG	Habitat Management Guidelines
NMFS	National Marine Fisheries Service
MAMP	Maine Amphibian Monitoring Program
MARAP	Maine Amphibian and Reptile Atlasing Project
MBS	Maine Butterfly Survey
MBBA	Maine Bumble Bee Atlas
MDDS	Maine Damselfly and Dragonfly Survey
MDIFW	Maine Dept. of Inland Fisheries and Wildlife
MDMR	Maine Dept. of Marine Resources
NOAA-Fisheries	National Oceanic and Atmospheric Administration - Fisheries
PRISM	Program for Regional and International Shorebird Monitoring
SGCN	Species of Greatest Conservation Need
SMART	Specific, Measurable, Achievable, Results-oriented, and Time-bound
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grants
TRACS	Tracking and Reporting Actions for the Conservation of Species
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

5/6.0 ABSTRACT

In these elements, we outline the methods we will use to monitor Species of Greatest Conservation Need (SGCN) and their habitats, describe how we will monitor the progress made in implementing the Action Plan over the next ten years, and address the procedures we will use to review and update the Action Plan. To accomplish these goals, we work closely with federal, state, and private conservation partners to develop and participate in cooperative species monitoring programs. Where possible, monitoring programs target multiple species, usually within the same taxonomic group. In the pages that follow, we describe the monitoring programs that are in place or proposed for SGCN in Maine. We include a table for each of the five taxonomic groups that are referenced throughout this plan.

The Maine Dept. of Inland Fisheries and Wildlife (MDIFW) and partners also identified habitat-scale survey and monitoring needs during the development of conservation actions. We present these actions with examples of existing and general survey and monitoring techniques that could be used to achieve these habitat monitoring objectives.

Finally, MDIFW and partners developed 11 programmatic actions to help guide Action Plan implementation over the next ten years. Three of these actions address monitoring and are described in greater detail.

MDIFW will use the programmatic actions to monitor conservation action progress at least annually. MDIFW will also establish an Implementation Committee in the Fall of 2015, comprised of agency staff and conservation partners. This committee will review Action Plan accomplishments and address emerging issues or adaptive management needs. We will undertake a comprehensive plan review beginning in year eight of the 2015 Action Plan.

5/6.1 INTRODUCTION

In the previous chapter, we discussed Maine's strategies for conserving SGCN and their habitats across the state. Maine's approach is built on a foundation of habitat conservation, which is designed to ensure that adequate habitat remains available in perpetuity to support not only Maine's SGCN, but the full array of wildlife occurring in Maine. Those efforts are supplemented with species-specific conservation actions focused on priority stressors for Priority 1 and Priority 2 SGCN.

In this chapter, we outline the methods we will use to monitor SGCN and their habitats. We also describe how we will monitor the progress made in implementing the Action Plan over the next 10 years. Finally, we address the procedures we will use to review and update the Action Plan.

5/6.1.1 SIGNIFICANT DIFFERENCES FROM MAINE'S 2005 PLAN

In 2005, MDIFW identified the species-specific monitoring programs that were in place for SGCN, and provided extensive detail on the Department's approach to species planning (Chapters 6, 7, MDIFW 2005). MDIFW's species plans provide a framework for monitoring both

individual species and their habitats, and the 2005 Action Plan referenced this process as the primary mechanism by which we would conduct this work. For some species that had not been ushered through the formal species planning process, the 2005 Action Plan identified additional programs by which we would assess progress in achieving conservation outcomes. The 2005 Plan also described an approach for monitoring statewide changes in habitat, which focused on the use of satellite imagery to measure changes in land cover.

While this plan follows a similar framework as used in 2005 for monitoring SGCN and their habitats, we made several substantive revisions, including:

- Removed references to MDIFW's species planning process, which has evolved since 2005 and has been replaced by the State Wildlife Action Plan (SWAP) as the primary planning tool for SGCN conservation.
- Streamlined the descriptions of SGCN monitoring programs, and provided most of this information in tabular format rather than in the body of the text.
- Added a description of how we will monitor the success of implementing conservation actions.
- Describe the process we will use to review and update the Plan as required by Congress.

5/6.2 MONITORING SGCN

SGCN species run the gamut, from species for which we have little information to those that are intensively monitored through formal, multi-state initiatives. We work closely with federal, state, and private conservation partners to develop and participate in cooperative species monitoring programs. Where possible, monitoring programs target multiple species, usually within the same taxonomic group. In the pages that follow, we describe the monitoring programs that are in place for SGCN in Maine. We include a table for each of the following taxonomic groups (Tables 5/6-1 to 5/6-6):

> *"We work closely with federal, state, and private conservation partners to develop and participate in cooperative species monitoring programs."*

- Birds
- Amphibians and Reptiles
- Inland and Freshwater Invertebrates
- Inland Fish
- Mammals
- Marine species

Within each table, we use an 'O' for 'ongoing' to indicate that the species is currently being monitored with the referenced approach, and an 'N' for 'new' to indicate that the species is not currently monitored with the referenced approach, but it could be monitored using this methodology if resources become available. An 'I' entry indicates that the technique provides interim, preliminary data but the existing methodology is not an optimal strategy to monitor populations.

5/6.2.1 BIRDS

Currently, 14 distinct programs are used to monitor 101 of the 130 bird SGCN in Maine (Table 5/6-1). In addition, MDIFW monitors 16 SGCN birds using individual, species-specific protocols. Only 12 SGCN birds are not currently subject to some type of formal monitoring program, although monitoring protocols for 7 of these species (American Oystercatcher, Red Phalarope, Red-necked Phalarope, Solitary Sandpiper, Yellow Rail, Saltmarsh Sparrow, and Sedge Wren) may be implemented in the near future.

Many of these protocols are statewide in scope. Others, such as the Christmas Bird Count, and the Breeding Bird Survey, occur nationwide. The following describes some of these programs.

MDIFW staff collaborate with U.S. Fish and Wildlife Service (USFWS) to implement the Coastal Waterbird Survey, which provides information on the distribution and abundance of several waterbird SGCN nesting on coastal islands. This program consists of a series of both ground nest counts and aerial surveys of coastal waterbirds along the entire coast of Maine. Ideally, these surveys are designed to cover the entire coast once every five years.

The Maine Owl Survey uses a series of established survey routes to document the distribution and relative abundance of owls within the state. Trained observers make brief roadside stops along survey routes play short recordings of owl calls for 15 minutes at each survey point and note the owls responding.

A Canadian / U.S. Shorebird Working Group and the U.S. Shorebird Council (Bart et al. 2002) implement the Program for Regional and International Shorebird Monitoring (PRISM), based on Canadian and U.S. shorebird conservation plans (Brown et al. 2001, Donaldson et al. 2000). MDIFW is a participant in this monitoring program (Tudor 2002).

Annually, MDIFW conducts Maine Waterfowl Brood Counts and uses the results to develop a long-term index of the size of the breeding waterfowl population found in 36 wetlands (Corr 1988).

MDIFW conducts the Mid-winter Waterfowl Survey, an aerial inventory, annually during the first week of January. It is an index to the total number of waterfowl present in Maine each winter (Corr 1988).

The Vermont Institute of Natural Science (VINS) launched Mountain Birdwatch in the spring of 2000 to establish a monitoring program for Bicknell's Thrush and other montane forest birds. VINS uses these data to measure population trends, monitor changes in bird distribution, model potential breeding habitat, identify conservation opportunities, evaluate proposed development, and predict effects of climate change on mountain songbirds.

The annual island-nesting tern survey is a collaborative effort by the USFWS, the National Audubon Society, MDIFW, and others. The Gulf of Maine Tern Working Group has developed standardized census methods that surveyors use to estimate the total number of individual terns and species composition of terns using each island. Surveyors conduct the assessments annually in June.

Table 5/6-1. Status of Population Monitoring for Maine's Bird Species of Greatest Conservation Need.

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Accipitriformes (hawks, eagles, and vultures)																	
Aquila chrysaetos	Golden Eagle	2															
Buteo platypterus	Broad-winged Hawk	3															
Circus cyaneus	Northern Harrier	3							I								O
Anseriformes (waterfowl)																	
Aythya marila	Greater Scaup	2		O													
Bucephala islandica	Barrow's Goldeneye	1	O	I		I											
Clangula hyemalis	Long-tailed Duck	3		O		I											
Histrionicus histrionicus	Harlequin Duck	1	O														
Somateria mollissima	Common Eider	3	O												O		
Apodiformes (swifts and hummingbirds)																	
Chaetura pelagica	Chimney Swift	2		O	O												
Caprimulgiformes (nighthawks and nightjars)																	
Antrostomus vociferus	Eastern Whip-poor-will	2	O														
Chordeiles minor	Common Nighthawk	3		I													I

Table 5/6-1. *continued: page 2 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Charadriiformes (waders, gulls, and auks)																	
Alca torda	Razorbill	2								O							
Arenaria interpres	Ruddy Turnstone	2		O									O			N	
Bartramia longicauda	Upland Sandpiper	1	O		O			O									O
Calidris alba	Sanderling	2	O										O			N	
Calidris alpina	Dunlin	3											O			N	
Calidris canutus rufa	Red Knot	1	N										O			N	
Calidris maritima	Purple Sandpiper	1	O														
Calidris minutilla	Least Sandpiper	3											O			N	
Calidris pusilla	Semipalmated Sandpiper	2											O			N	
Charadrius melodus	Piping Plover	1	O														
Chlidonias niger	Black Tern	2	O						I								
Chroicocephalus philadelphia	Bonaparte's Gull	3		I													
Fratercula arctica	Atlantic Puffin	2								O							
Haematopus palliatus	American Oystercatcher	3	N														

Table 5/6-1. *continued: page 3 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Charadriiformes (waders, gulls, and auks) *continued*																	
Leucophaeus atricilla	Laughing Gull	3								O							
Limnodromus griseus	Short-billed Dowitcher	3											O			N	
Numenius phaeopus	Whimbrel	2	N										O			N	
Phalaropus fulicarius	Red Phalarope	3	N														
Phalaropus lobatus	Red-necked Phalarope	2	N														
Pluvialis squatarola	Black-bellied Plover	3		O									O			N	
Scolopax minor	American Woodcock	3	O														
Sterna dougallii	Roseate Tern	1								O							
Sterna hirundo	Common Tern	2								O							
Sterna paradisaea	Arctic Tern	1								O							
Sternula antillarum	Least Tern	1	O														
Tringa flavipes	Lesser Yellowlegs	1	N										O			N	
Tringa melanoleuca	Greater Yellowlegs	3											O			N	

Table 5/6-1. *continued: page 4 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Charadriiformes (waders, gulls, and auks) *continued*																	
Tringa semipalmata	Willet	3	N						N				O			N	
Tringa solitaria	Solitary Sandpiper	2	N														
Uria aalge	Common Murre	3															
Coraciiformes (kingfishers, bee-eaters, rollers, motmots, and todies)																	
Megaceryle alcyon	Belted Kingfisher	3		O	O												
Coccyzus americanus	Yellow-billed Cuckoo	2			O												
Coccyzus erythropthalmus	Black-billed Cuckoo	3			O												
Falconiformes (falcons and kestrels)																	
Falco peregrinus	Peregrine Falcon	1	O														
Falco sparverius	American Kestrel	3															I
Galliformes (game birds)																	
Falcipennis canadensis	Spruce Grouse	3				I											

Table 5/6-1. *continued: page 5 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Gaviiformes (loons)																	
Gavia immer	Common Loon	3	O	O													
Gavia stellata	Red-throated Loon	3		O		O											
Gruiformes (cranes and rails)																	
Coturnicops noveboracensis	Yellow Rail	2							N								
Fulica americana	American Coot	3		I					N								
Gallinula galeata	Common Gallinule	2		I					N								
Porzana carolina	Sora	3		I					N								
Passeriformes (passerines)																	
Ammodramus caudacutus	Saltmarsh Sparrow	1							N								
Ammodramus nelsoni	Nelson's Sparrow	2	O						N								
Ammodramus savannarum	Grasshopper Sparrow	1						O									O
Anthus rubescens	American Pipit	2	N				O										
Cardellina canadensis	Canada Warbler	2			O												

Table 5/6-1. *continued: page 6 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Passeriformes (passerines) *continued*																	
Catharus bicknelli	Bicknell's Thrush	1					O										
Catharus fuscescens	Veery	2			O												
Catharus ustulatus	Swainson's Thrush	3			O		O										
Cistothorus platensis	Sedge Wren	1							N								
Coccothraustes vespertinus	Evening Grosbeak	2			O	O											
Contopus cooperi	Olive-sided Flycatcher	2			O		O										
Contopus virens	Eastern Wood-Pewee	2			O												
Dolichonyx oryzivorus	Bobolink	3			O			O									O
Empidonax flaviventris	Yellow-bellied Flycatcher	3		I	O		O										
Empidonax minimus	Least Flycatcher	3		I	O												
Eremophila alpestris	Horned Lark	3			O	O		O									O

Table 5/6-1. *continued: page 7 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Passeriformes (passerines) *continued*																	
Euphagus carolinus	Rusty Blackbird	1	O														
Geothlypis philadelphia	Mourning Warbler	3			O												
Haemorhous purpureus	Purple Finch	3			O	O	O										
Hirundo rustica	Barn Swallow	2		O	O												I
Hylocichla mustelina	Wood Thrush	1			O												
Icterus galbula	Baltimore Oriole	3			O												
Icterus spurius	Orchard Oriole	3			O												
Loxia curvirostra	Red Crossbill	3			O	O	O										
Loxia leucoptera	White-winged Crossbill	3			O	O	O										
Melospiza lincolnii	Lincoln's Sparrow	3			O												
Mniotilta varia	Black-and-white Warbler	2			O		O										
Oreothlypis peregrina	Tennessee Warbler	2			O												

Table 5/6-1. *continued: page 8 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Passeriformes (passerines) *continued*																	
Parkesia motacilla	Louisiana Waterthrush	3			O												
Passerella iliaca	Fox Sparrow	3			O												
Perisoreus canadensis	Gray Jay	3			O	O											
Petrochelidon pyrrhonota	Cliff Swallow	3		O	O												
Pheucticus ludovicianus	Rose-breasted Grosbeak	3			O												
Pinicola enucleator	Pine Grosbeak	3			O	O											
Pipilo erythrophthalmus	Eastern Towhee	2			O			O									I
Piranga olivacea	Scarlet Tanager	3		I	O		O										
Poecile hudsonicus	Boreal Chickadee	2			O	O											
Progne subis	Purple Martin	2	N	I	O												
Regulus calendula	Ruby-crowned Kinglet	2			O		O										

Table 5/6-1. *continued: page 9 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Passeriformes (passerines) *continued*																	
Riparia riparia	Bank Swallow	1		O	O												I
Setophaga americana	Northern Parula	3			O												
Setophaga caerulescens	Black-throated Blue Warbler	3			O												
Setophaga castanea	Bay-breasted Warbler	3			O		O										
Setophaga discolor	Prairie Warbler	2			O												
Setophaga fusca	Blackburnian Warbler	3			O												
Setophaga pensylvanica	Chestnut-sided Warbler	2			O												
Setophaga petechia	Yellow Warbler	3			O												
Setophaga ruticilla	American Redstart	2			O												
Setophaga striata	Blackpoll Warbler	3			O		O										
Setophaga tigrina	Cape May Warbler	3			O		O										

Table 5/6-1. *continued: page 10 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Passeriformes (passerines) *continued*																	
Setophaga virens	Black-throated Green Warbler	3			O		O										
Spizella pusilla	Field Sparrow	3			O												O
Stelgidopteryx serripennis	Northern Rough-winged Swallow	3		O	O												I
Sturnella magna	Eastern Meadowlark	2			O			O									O
Tachycineta bicolor	Tree Swallow	2		O	O												I
Toxostoma rufum	Brown Thrasher	2			O			O									
Tyrannus tyrannus	Eastern Kingbird	2		O	O												I
Vermivora cyanoptera	Blue-winged Warbler	2	N		O			O									
Zonotrichia albicollis	White-throated sparrow	3			O		O										

Table 5/6-1. *continued: page 11 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Pelecaniformes (Pelicans, tropicbirds, and relatives)																	
Ardea herodias	Great Blue Heron	2		I								O					
Botaurus lentiginosus	American Bittern	3		I					N								I
Egretta caerulea	Little Blue Heron	3		I								N					
Egretta thula	Snowy Egret	3		I								N					
Ixobrychus exilis	Least Bittern	1		I					O								
Nycticorax nycticorax	Black-crowned Night-heron	2		I								O					
Piciformes (woodpeckers)																	
Colaptes auratus	Northern Flicker	3			O	O											
Picoides arcticus	Black-backed Woodpecker	3			O	O	O										
Picoides dorsalis	American Three-toed Woodpecker	3			O	O	O										
Podicipediformes (grebes)																	
Podiceps auritus	Horned Grebe	3				I											
Podilymbus podiceps	Pied-billed Grebe	3		I					N								

Table 5/6-1. *continued: page 12 of 12.*

Order Scientific Name	Common Name	Priority	Species-Specific Monitoring	Maine River Bird Survey	Breeding Bird Survey	Christmas Bird count	Mountain Birdwatch	Kennebunk Plains / TNC Annual Survey	Secretive Marsh Bird Surveys	Island Nesting Tern Survey	Maine Owl Survey	Wading Bird Colony Surveys and Monitoring	Migratory Shorebird Survey (PRISM/ISS)	Waterfowl Brood Counts	Mid-winter Waterfowl Survey	IFW regional shorebird surveys for SWH designation and mapping	Grassland Bird Surveys
Podicipediformes (grebes) *continued*																	
Oceanodroma leucorhoa	Leach's Storm-petrel	3															
Puffinus gravis	Great Shearwater	3															
Strigiformes (owls)																	
Asio flammeus	Short-eared Owl	2									I						O
Asio otus	Long-eared Owl	3									O						
Megascops asio	Eastern Screech-Owl	3									O						
Tyto alba	Barn Owl	3									O						
Suliformes (darters, frigatebirds, cormorants, shags, gannets, and boobies)																	
Phalacrocorax carbo	Great Cormorant	1	O														

5/6.2.2 REPTILES, AMPHIBIANS, AND INVERTEBRATES

Currently, biologists use 9 distinct programs to monitor 87 of the 148 (60%) reptile, amphibian, and invertebrate SGCN in Maine (Tables 5-2 and 5-3). In addition, biologists monitor 56 SGCN in these taxonomic groups using individual, species-specific protocols. Forty-six of the SGCN are not currently subject to some type of formal monitoring program, although species-specific monitoring protocols for four of these species (Big-tooth Whitelip, Gaspe Gazelle Beetle, Graceful Clearwing, and Spike-lip Crater) may be implemented in the near future.

Wood Turtles are one of Maine's priority SGCN species that is monitored using standardized regional protocols developed by a Northeast Wood Turtle Working Group.
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The Maine Amphibian Monitoring Program (MAMP) is a volunteer program that gathers information on the distribution and abundance of calling amphibians, including two SGCN, the Mink Frog and Northern Leopard Frog (Maine Audubon Society 2015). The MAMP is a component of the North American Amphibian Monitoring Program (NAAMP), and is ongoing in Maine since 1997. Currently, volunteers survey approximately 60 road-side routes across the state. Biologists recently analyzed data from the NAAMP and they detected several significant species-specific results in Maine (Weir et al. 2014), including negative population trends for Wood Frog, Spring Peeper, Bullfrog, Northern Leopard Frog, and American Toad.

The Maine Amphibian and Reptile Atlasing Project (MARAP) is one of the longest standing wildlife atlasing projects in Maine. Initiated in 1984, MARAP is currently a cooperative venture between MDIFW and the University of Maine. The MARAP database contains over 10,000 records for 35 terrestrial and freshwater species (33 native, 2 exotic), as well as marine turtles and the extirpated Timber Rattlesnake. As with many wildlife atlas datasets that are primarily designed to document distribution, biologists can use the MARAP database to indirectly infer population trends and range shifts by revisiting previously documented sites over time.

Monitoring of invertebrate SGCN lags behind that of reptiles, amphibians, and other vertebrate taxa. This is due to the high diversity of SGCN invertebrates, a lower level of knowledge about their distribution and habitat relationships, and limited MDIFW staff and resources to work with the group. Nevertheless, MDIFW and partners have increased their knowledge of SGCN invertebrates considerably since 2005, with special emphasis on Unionoida (freshwater mussels), Gastropoda (aquatic and terrestrial snails), Ephemeroptera (mayflies), Odonata (damselflies and dragonflies), Lepidoptera (butterflies and moths), Coleoptera (tiger beetles), and most recently Hymenoptera (bumble bees). A series of volunteer wildlife atlasing programs now provide distribution baselines for many of Maine's invertebrate

> *"Monitoring of invertebrate SGCN lags behind that of reptiles, amphibians, and other vertebrate taxa. This is due to the high diversity of SGCN invertebrates, and a lower level of knowledge about their distribution and habitat relationships…"*

SGCN. Biologists have designed the Maine Butterfly Survey (MBS), Maine Damselfly and Dragonfly Survey (MDDS), Maine Mussel Baseline Atlas, and Maine Bumble Bee Atlas (MBBA) to collect sighting information from trained volunteer citizen scientists, to help map the distribution and relative abundance of these species groups across the state. In many cases, these programs are among the first of their kind in the country, and have helped to gather critical information on these understudied and poorly understood taxa. In the future MDIFW hopes to collaborate with partners to develop the Maine Tiger Beetle Atlas, which would gather similar data on three additional SGCN: Cobblestone Tiger Beetle, Saltmarsh Tiger Beetle, and the White Mountain Tiger Beetle.

5/6.2.3 INLAND FISH

MDIFW monitors the 17 inland fish SGCN through the application of 17 distinct methodologies (Table 5/6-4). In most cases, MDIFW monitors individual species using multiple methods. Many of the monitoring approaches that apply to inland fish SGCN are components of MDIFW's larger fisheries management program implemented by regional biologists, and are not targeted towards specific species. However, species-specific monitoring protocols are in place for six species in this group. In addition, two new monitoring protocols (eDNA and Trawling) may be applicable to several SGCN in the future. In particular, eDNA, which relies on the detection of DNA in water samples to determine the presence or absence of species within the water body, could prove to be an extremely powerful approach for monitoring rare aquatic taxa as well as the presence of invasive fish species.

5/6.2.4 MAMMALS

Monitoring New England Cottontails with radiotelemetry. © Department of Inland Fisheries and Wildlife

Mammals often occur at relatively low densities and occupy large landscapes, making the application of comprehensive, multi-species monitoring protocols challenging. Of Maine's 15 mammal SGCN, four currently are subject to a species-specific monitoring protocol or a multi-species monitoring program (Table 5/6-5). In addition, MDIFW ultimately will use a new initiative, the North American Bat Survey, to monitor all eight bat SGCN. MDIFW has yet to develop monitoring protocols for three mammal SGCN (the Penobscot Meadow Vole, the Long-tailed Shrew, and the Northern Bog Lemming).

Table 5/6-2. Status of Population Monitoring for Maine's Amphibian and Reptile Species of Greatest Conservation Need.

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Amphibian Monitoring Project (MAMP)	NE Regional Blanding's and Wood Turtle Survey & Monitoring	Maine Amphibian & Reptile Atlasing Project (MARAP)	Maine Road Herp Hotspot Monitoring Project
AMPHIBIA (amphibians)							
Anura (frogs and toads)							
Lithobates pipiens	Northern Leopard Frog	2		O		O	N
Lithobates septentrionalis	Mink Frog	3		O		O	N
Caudata (salamanders)							
Ambystoma laterale	Blue-spotted Salamander	2	O			O	N
Gyrinophilus porphyriticus porphyriticus	Northern Spring Salamander	2	O			O	N
REPTILIA (reptiles)							
Squamata (lizards and snakes)							
Coluber constrictor constrictor	Northern Black Racer	1	O			O	N
Storeria dekayi dekayi	Northern Brownsnake	2				O	N
Thamnophis sauritus	Eastern Ribbon Snake	2	O			O	N
Testudines (turtles and tortoises)							
Clemmys guttata	Spotted Turtle	1	O			O	N
Emydoidea blandingii	Blanding's Turtle	1	O		O	O	N
Glyptemys insculpta	Wood Turtle	1	O		O	O	N
Terrapene carolina carolina	Eastern Box Turtle	2	O			O	N
Alasmidonta undulata	Triangle Floater	3	O				
Anodonta implicata	Alewife Floater	3	O				
Margaritifera margaritifera	Eastern Pearlshell	3	O				
Clemmys guttata	Spotted Turtle	1	O			O	N

Table 5/6-3. Status of Population Monitoring for Maine's Non Marine Invertebrate Species of Greatest Conservation Need.

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
BIVALVIA (mussels and clams)								
Unionoida (freshwater mussels)								
Alasmidonta undulata	Triangle Floater	3	O			O		
Alasmidonta varicosa	Brook Floater	1	O			O		
Anodonta implicata	Alewife Floater	3	O			O		
Lampsilis cariosa	Yellow Lampmussel	1	O			O		
Leptodea ochracea	Tidewater Mucket	1	O			O		
Margaritifera margaritifera	Eastern Pearlshell	3	O			O		
GASTROPODA (aquatic and terrestrial snails)								
Basommatophora (air-breathing freshwater snails)								
Stagnicola mighelsi	Bigmouth Pondsnail	1	O					
Stagnicola oronoensis	Obese Pondsnail	3	O					
Neotaenioglossa (mostly sea snails)								
Floridobia winkleyi	New England Silt Snail	3	O					
Stylommatophora (air-breathing land snails)								
Appalachina sayana	Spike-lip Crater	3	N					
Neohelix dentifera	Big-tooth Whitelip	3	N					
Vertigo malleata	Malleated Vertigo	3	O					
Vertigo morsei	Six-whorl Vertigo	1	O					
Vertigo paradoxa	Mystery Vertigo	2	O					
INSECTA (insects)								
Coleoptera (beetles)								
Cicindela ancocisconensis	White Mountain Tiger Beetle	2	O					N
Cicindela marginata	Salt Marsh Tiger Beetle	2	O					N

Table 5/6-3. *continued: page 2 of 8.*

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Coleoptera (beetles) *continued*								
Cicindela marginipennis	Cobblestone Tiger Beetle	1	O					N
Nebria nivalis gaspesiana	Gaspe Gazelle Beetle	3	N					
Ephemeroptera (mayflies)								
Ameletus browni	A Mayfly	3						
Baetisca berneri	A Mayfly	3						
Baetisca carolina	A Mayfly	3						
Baetisca lacustris	A Mayfly	3						
Baetisca rubescens	A Mayfly	3						
Epeorus frisoni	Roaring Brook Mayfly	1	O					
Hexagenia rigida	A Mayfly	3						
Metretopus borealis	A Mayfly	3						
Nixe horrida	A Mayfly	3						
Parameletus midas	A Mayfly	3						
Rhithrogena undulata	A Mayfly	3						
Siphlonisca aerodromia	Tomah Mayfly	1	O					
Siphlonurus barbaroides	A Mayfly	3						
Siphlonurus barbarus	A Mayfly	2						
Siphlonurus demaryi	A Mayfly	2						
Hymenoptera (ants, bees, wasps, and sawflies)								
Bombus affinis	Rusty-patched Bumble Bee	1					O	
Bombus ashtoni	Ashton's Cuckoo Bumble Bee	2					O	
Bombus citrinus	Lemon Cuckoo Bumble Bee	3					O	

Table 5/6-3. continued: page 3 of 8.

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Hymenoptera (ants, bees, wasps, and sawflies) continued									
Bombus fernaldae	Fernald's Cuckoo Bumble Bee	3					O	
Bombus fervidus	Yellow Bumble Bee	3					O	
Bombus griseocollis	Brown-belted Bumble Bee	3					O	
Bombus insularis	Indiscriminate Cuckoo Bumble Bee	2					O	
Bombus pensylvanicus	American Bumble Bee	2					O	
Bombus sandersoni	Sanderson's Bumble Bee	3					O	
Bombus terricola	Yellowbanded Bumble Bee	3					O	
Lepidoptera (butterflies, skippers, and moths)									
Atrytonopsis hianna	Dusted Skipper	3	O	O				
Boloria chariclea grandis	Purple Lesser Fritillary	2	O	O				
Boloria frigga saga	Frigga Fritillary	1	O	O				
Callophrys gryneus	Juniper Hairstreak	2	O	O				
Callophrys hesseli	Hessel's Hairstreak	1	O	O				
Callophrys lanoraieensis	Bog Elfin	3	O	O				
Catocala similis	Similar Underwing	3						
Chaetaglaea cerata	A Noctuid Moth	2						
Chaetaglaea tremula	Barrens Chaetaglaea	3						
Citheronia sepulcralis	Pine Devil	2						
Cucullia speyeri	A Moth	3						

Table 5/6-3. continued: *page 4 of 8.*

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Lepidoptera (butterflies, skippers, and moths) *continued*								
Cupido amyntula maritima	Western Tailed Blue	3		O				
Danaus plexippus	Monarch	3		O				
Erora laeta	Early Hairstreak	2	O	O				
Erynnis brizo	Sleepy Duskywing	2	O	O				
Hemaris gracilis	Graceful Clearwing	3						
Hemileuca lucina	New England Buckmoth	3	N					
Hemileuca maia maia	Eastern Buckmoth	2						
Hesperia leonardus	Leonard's Skipper	3		O				
Hesperia metea	Cobweb Skipper	3	O	O				
Lapara coniferarum	Southern Pine Sphinx	3						
Lepipolys perscripta	A Moth	3						
Lithophane lepida lepida	Pine Pinion	2						
Lycaena dorcas claytoni	Clayton's Copper	2	O	O				
Lycia rachelae	Twilight Moth	2						
Metarranthis apiciaria	Barrens Metarranthis Moth	2						
Nepytia pellucidaria	A Moth	3						
Oeneis polixenes katahdin	Katahdin Arctic	1	O	O				
Paonias astylus	Huckleberry Sphinx	3						

Table 5/6-3. continued: *page 5 of 8.*

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Lepidoptera (butterflies, skippers, and moths) *continued*								
Papilio brevicauda gaspeensis	Short-tailed Swallowtail	3	O	O				
Oeneis polixenes katahdin	Katahdin Arctic	1	O	O				
Paonias astylus	Huckleberry Sphinx	3						
Papilio brevicauda gaspeensis	Short-tailed Swallowtail	3	O	O				
Papilio troilus	Spicebush Swallowtail	3	O	O				
Plebejus idas	Northern Blue	2		O				
Plebejus idas empetri	Crowberry Blue	2	O	O				
Polygonia satyrus	Satyr Comma	3		O				
Psectraglaea carnosa	Pink Sallow	2						
Satyrium edwardsii	Edwards' Hairstreak	2	O	O				
Satyrium titus	Coral Hairstreak	3	O	O				
Satyrodes appalachia	Appalachian Brown	3		O				
Spartiniphaga inops	Spartina Borer Moth	3						
Speranza exonerata	Barrens Itame	2						
Thorybes bathyllus	Southern Cloudywing	3		O				
Xylena thoracica	Acadian Swordgrass Moth	3						
Xylotype capax	Broad Sallow	3						
Xystopeplus rufago	Red-winged Sallow	3						
Zale lunifera	Bold-based Zale Moth	3						

Table 5/6-3. continued: page 6 of 8.

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Lepidoptera (butterflies, skippers, and moths) *continued*								
Zale obliqua	Oblique Zale	3						
Zanclognatha martha	Pine Barrens Zanclognatha	1						
Odonata (dragonflies and damselflies)								
Aeshna juncea	Sedge Darner	2			O			
Aeshna sitchensis	Zigzag Darner	3			O			
Anax longipes	Comet Darner	3	O		O			
Argia translata	Dusky Dancer	3			O			
Arigomphus furcifer	Lilypad Clubtail	3			O			
Celithemis martha	Martha's Pennant	3			O			
Cordulegaster obliqua	Arrowhead Spiketail	3	O		O			
Enallagma carunculatum	Tule Bluet	3			O			
Enallagma durum	Big Bluet	3			O			
Enallagma laterale	New England Bluet	2	O		O			
Enallagma pictum	Scarlet Bluet	2	O		O			
Epiaeschna heros	Swamp Darner	3	N		O			
Erythrodiplax berenice	Seaside Dragonlet	3			O			
Gomphus quadricolor	Rapids Clubtail	2	O		O			
Gomphus vastus	Cobra Clubtail	3			O			
Ischnura hastata	Citrine Forktail	3			O			
Ischnura ramburii	Rambur's Forktail	3			O			
Lanthus vernalis	Southern Pygmy Clubtail	2			O			
Leucorrhinia patricia	Canada Whiteface	2	O		O			

Table 5/6-3. continued: page 7 of 8.

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Odonata (dragonflies and damselflies) continued								
Libellula needhami	Needhams Skimmer	3			O			
Libellula semifasciata	Painted Skimmer	3			O			
Nannothemis bella	Elfin Skimmer	3			O			
Neurocordulia michaeli	Broad-tailed Shadowdragon	3			O			
Ophiogomphus anomalus	Extra-striped Snaketail	3			O			
Ophiogomphus colubrinus	Boreal Snaketail	1	O		O			
Ophiogomphus howei	Pygmy Snaketail	2	O		O			
Progomphus obscurus	Common Sanddragon	3			O			
Rhionaeschna mutata	Spatterdock Darner	3	O		O			
Somatochlora albicincta	Ringed Emerald	3			O			
Somatochlora brevicincta	Quebec Emerald	2	O		O			
Somatochlora incurvata	Incurvate Emerald	3			O			
Somatochlora minor	Ocellated Emerald	3			O			
Stylurus spiniceps	Arrow Clubtail	3			O			
Tramea carolina	Carolina Saddlebags	3			O			
Tramea lacerata	Black Saddlebags	3			O			
Williamsonia lintneri	Ringed Boghaunter	1	O		O			

Table 5/6-3. *continued:* *page 8 of 8.*

CLASS Order Scientific Name	Common Name	Priority	Species-specific Monitoring	Maine Butterfly Survey (MBS)	Maine Damselfly & Dragonfly Survey (MDDS)	Maine Mussel Baseline Atlas & Surveys	Maine Bumble Bee Atlas (MBBA)	Maine Tiger Beetle Atlas
Plecoptera (stoneflies)								
Alloperla voinae	A Stonefly	3						
Neoperla mainensis	A Stonefly	3						
Pteronarcys comstocki	Spiny Salmonfly	3						
Trichoptera (caddisflies)								
Hydroptila blicklei	A Caddisfly	3						
Hydroptila parachelops	A Caddisfly	3						
Hydroptila tomah	A Caddisfly	3						
Ochrotrichia denningi	A Caddisfly	3						
MALACOSTRACA (crabs, krill, pill bugs, shrimp, and relatives)								
Decapoda (decapods)								
Orconectes limosus	Spinycreek Crayfish	3	N					

Table 5/6-4. Status of Population Monitoring for Maine's Inland Fish Species of Greatest Conservation Need.

Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Baitfish Dealer Inspections	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Telemetry/Marking	eDNA	Beach Seines	Minnow Traps/Pots	Fishway Traps	Trawling	SCUBA / Snorkeling	Experimental Angling	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys
Catostomus catostomus	Longnose Sucker	3	N			O	N	O	O	O					O					
Coregonus clupeaformis	Lake Whitefish	2	O	O	O		N	N	O	O					N	N	N	O		O
Culaea inconstans	Brook Stickleback	3	N				O				N	N	N	O	N					
Erimyzon oblongus	Creek Chubsucker	3	N			O	O	N	N	O	N	N	O	O	N					
Esox americanus americanus	Redfin Pickerel	2	O	O			O	N		N			N							
Etheostoma fusiforme	Swamp Darter	2	N				O						O				N			
Hybognathus regius	Eastern Silvery Minnow	3	N			O	O	O					O	O	N					
Lethenteron appendix	American Brook Lamprey	3	N				O						N	N						
Lota lota	Burbot	3	N	O	O		O	N	N	N	N	N			N			N		
Margariscus margarita	Pearl Dace	3	N			O	O	O					O	O	N					
Notropis bifrenatus	Bridle Shiner	2	N			O	O	O			N	N	O	O	N					

Table 5/6-4. *continued: page 2 of 2.*

Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Baitfish Dealer Inspections	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Telemetry/Marking	eDNA	Beach Seines	Minnow Traps/Pots	Fishway Traps	Trawling	SCUBA / Snorkeling	Experimental Angling	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys
Notropis heterolepis	Blacknose Shiner	3	N			O	O	O			N	N	O	O	N					
Prosopium cylindraceum	Round Whitefish	2	O	O	O		N	N	O	O					N	N	N	N		N
Rhinichthys cataractae	Longnose Dace	3	N			O	O	O					O	O	N					
Salvelinus alpinus oquassa	Arctic Charr	1	O	O	O				O	O	O	N					O	O		O
Salvelinus fontinalis	Brook Trout	3	O	O	O		O	O	O	O	O	N			O		O	O	O	O
Salvelinus namaycush	Lake Trout	3	O	O	O			O	O	O						N	O	O		O

Table 5/6-5. Status of Population Monitoring for Maine's Mammal Species of Greatest Conservation Need.

Scientific Name	Common Name	Priority	Species-specific Monitoring	North American Bat Survey	N England Cottontail Range-Wide Conservation Strategy Monitoring
Alces alces americanus	Moose	3	O		
Eptesicus fuscus	Big Brown Bat	2		N	
Lasionycteris noctivagans	Silver-haired Bat	2		N	
Lasiurus borealis	Eastern Red Bat	3		N	
Lasiurus cinereus	Hoary Bat	3		N	
Lynx canadensis	Canada Lynx	2	O		
Microtus pennsylvanicus shattucki	Penobscot Meadow Vole	2			
Myotis leibii	Eastern Small-footed Myotis	1		N	
Myotis lucifugus	Little Brown Bat	1		N	
Myotis septentrionalis	Northern Long-eared Myotis	1		N	
Ondatra zibethicus	Muskrat	3	O		
Perimyotis subflavus	Tri-colored Bat	2		N	
Sorex dispar	Long-tailed Shrew	3			
Sylvilagus transitionalis	New England Cottontail	1	O		O
Synaptomys borealis sphagnicola	Northern Bog Lemming	1			

5/6.2.5 MARINE FAUNA

Monitoring of marine SGCN occurs through a wide variety of programs, and includes the involvement of numerous conservation partners. In the pages that follow we summarize these monitoring programs according to broad taxonomic groupings of species that are monitored using similar methods. In addition, Table 5/6-6 provides a detailed list of the monitoring approaches that are used for each species.

Marine Mammals and Sea Turtles
Programs that monitor marine mammals and sea turtles occur largely through reports from entanglements and gear modification studies. The Maine Department of Marine Resources (MDMR) Marine Mammal Strandings and Sightings Program was a component of the conservation and monitoring work until the fall of 2011. The program did not receive the necessary federal funding through the Prescott Grant Program and without funds to support the program MDMR discontinued it. In collaboration with Maine's commercial fishing industries, MDMR developed a Comprehensive Marine Wildlife Conservation Strategy for Large Whales and Sea Turtles in the State of Maine to reduce the risk posed by these fisheries to Right Whales and other protected resources. The Bureau of Marine Patrol and the advanced trained lobsterman use special disentanglement tools, based on those created for the Large Whale Disentanglement Network. Recent efforts have focused on understanding baseline amounts of gear utilized seasonally, specifically vertical lines, in Maine's lobster fishery. These efforts have enabled both state and federal regulators the ability to focus potential regulations to areas where they make the most positive impact for reducing co-occurrence between whales and fishing gear.

MDMR and collaborators at the University of Maine also investigate whale habitat through a monitoring program that samples habitat characteristics in Midcoast and Downeast Maine using plankton and water column sampling. The project will help determine the inshore/offshore and seasonal distributions of Right Whale prey species. Additionally, MDMR completed a Dtag project in Maine coastal fishing habitats that successfully tagged two Humpback Whales near Mount Desert Island. Dive profiles show the whales diving to the bottom during foraging events in addition to using the upper 20 meters of the water column.

Finfish: Diadromous, Groundfish, and Ocean Migratory Fish
MDMR regularly performs both species-specific monitoring programs, as well as surveys that target multiple species, in Maine waters. The Inshore Trawl Survey is a fisheries-independent assessment of living resources inside the coastal waters of Maine. Until this survey began in 2000, Maine and New Hampshire were the only states on the east coast that did not conducti a near-shore assessment. While the U.S. Congress provided this funding for economic relief to the groundfish industry, the assessment is more than a groundfish survey. Marine biologists also assess lobsters, recreational finfish, and non-commercial species of ecological interest. This multispecies survey benefits decision makers confronted with a diverse array of fisheries management issues.

Monitoring programs also include port sampling and reporting from commercial and recreational fishers. During MDMR's commercial and recreational sampling efforts, it collects biological data including length, weight, and maturity from groundfish, river herring, scallops, urchins, shrimp, and other fished species. MDMR also collects scales and otoliths from fish for ageing.

Table 5/6-6. Status of Population Monitoring for Maine's Marine Species of Greatest Conservation Need.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
ACTINOPTERYGII (ray-finned fishes)																					
Acipenser brevirostrum	Shortnose sturgeon	1	O						O		O							O	O		
Acipenser oxyrinchus	Atlantic Sturgeon	1	O						O		O		O					O	O		
Anguilla rostrata	American Eel	2	O			O	O		O	O	O	O						O	O		N
Alosa aestivalis	Blueback Herring	1	O			O	O		O	O	O	O						O	O	N	
Alosa pseudoharengus	Alewife	2	O			O	O		O	O	O	O						O	O	N	N
Alosa sapidissima	American Shad	1	O	O	O		O		O	O	O	O	O					O	O		
Alcyonium digitatum	Dead Man's Fingers	3	N																N	N	N
Gadus morhua	Atlantic Cod	1	O	O	O	O							O					O			
Melanogrammus aeglefinus	Haddock	1		O	O	O							O					O	N		
Osmerus mordax	Rainbow Smelt	1	O	O	O	O			O	O			O					O	O	N	N
Ammodytes americanus	American Sand Lance	3											O								
Anarhichas lupus	Atlantic Wolffish	2											O					O	N		

Table 5/6-6. continued: page 2 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
ACTINOPTERYGII (ray-finned fishes) continued																					
Anarhichas minor	Spotted Wolffish	3	N																		
Morone saxatilis	Striped Bass	2	O	O	O						O		O						O	O		
Thunnus thynnus	Atlantic Bluefin Tuna	2		O	O	O													O			
Pseudopleuronectes americanus	Winter Flounder	2	O			O							O						O	O		O
Salmo salar	Atlantic Salmon	1	O				O					O		O			O	O	O	O	N	O
ANTHOZOA (anthozoans)																					
Crassostrea virginica	Eastern oyster	3	O			O													O	N	N	
Gersemia rubiformis	Sea Strawberry	2	O											O						N		N
ASTEROIDEA (sea stars)																					
Asterias forbesi	Forbes's Starfish	2	O											O						N		N
Asterias rubens	Common Sea Star	2	O										O	O						N		N
Stephanasterias albula	White Sea Star	2	O											O						N		N

Table 5/6-6. continued: page 3 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
ASTEROIDEA (sea stars) *continued*																					
Crossaster papposus	Common Sun Star	2	O										O	O					N		N
Solaster endeca	Purple Sunstar	2	O										O	O					N		N
BIVALVIA (mussels and clams)																					
Mya arenaria	Softshell Clam	3	O			O													O	N	N
Mya truncata	Gaper Clam	3	O											O					N	N	N
Zirfaea crispata	Atlantic Great Piddock	2	O											O					N		N
Mytilus edulis	Blue Mussel	3	O			O							O						O	N	N
Margaritifera margaritifera	Eastern Pearlshell	3	O											O					N		N
Chlamys islandica	Icelandic Scallop	3	O										O	O					N	N	N
Placopecten magellanicus	Atlantic Sea Scallop	3	O			O							O	O					O	N	N
Mercenaria mercenaria	Hard-shelled Clam	3	O			O							O						O	N	N
CHONDRICHTHYES (cartilaginous fishes)																					
Prionace glauca	Blue Shark	3	O	O																	

Table 5/6-6. continued: page 4 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
CHONDRICHTHYES (cartilaginous fishes) continued																					
Sphyrna zygaena	Smooth Hammerhead	3	O	O																	
Alopias vulpinus	Common Thresher Shark	3	O	O																	
Isurus oxyrinchus	Shortfin Mako	2	O	O																	
Lamna nasus	Porbeagle	2	O	O																	
Amblyraja radiata	Thorny Skate	2	O										O								
Dipturus laevis	Barndoor Skate	2	O										O								
Leucoraja ocellata	Winter Skate	2	O										O								
Malacoraja senta	Smooth Skate	2	O										O								
ECHINOIDEA (Sea urchins)																					
Strongylocentrotus droebachiensis	Green Sea Urchin	2	O			O							O	O					O	N	N
GASTROPODA (gastropods)																					
Arrhoges occidentalis	American Pelican Foot	2	O											O						N	N
Limneria undata	Wavy Lamellaria	3	O											O						N	N

Table 5/6-6. continued: page 5 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
GASTROPODA (gastropods) continued																					
Boreotrophon clathratus	Clathrate Trophon	2	O											O					N		N
Boreotrophon truncatus	Murex	2	O											O					N		N
Colus pygmaeus	Colus Snail	2	O											O					N		N
Ptychatractus ligatus	Spindle Shell	2	O											O					N		N
Limacina helicina	Limancina Snail	3	O											O					N		N
HOLOTHUROIDEA (sea cucumbers)																					
Cucumaria frondosa	Orange-footed Sea Cucumber	2	O			O							O								
Psolus fabricii	Psolus	2	O											O					N		N
Psolus phantapus	Psolus	2	O											O					N		N
Thyonidium drummondii	Sea Cucumber	2	O										O								
MALACOSTRACA (crabs, krill, pill bugs, shrimp, and relatives)																					
Lebbeus groenlandicus	Spiny Lebbeid Shrimp	2	O										O	O					N		N

Table 5/6-6. continued: page 6 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
MALACOSTRACA (crabs, krill, pill bugs, shrimp, and relatives)																					
Lebbeus polaris	Polar Lebbeid Shrimp	2	O										O	O					N		N
Pandalus borealis	Northern Shrimp	1	O			O							O						O		O
Balaenoptera borealis	Sei Whale	2	O													O			O		
MAMMALIA (mammals)																					
Balaenoptera musculus	Blue Whale	2														O					
Balaenoptera physalus	Finback Whale	2	O													O					
Eubalaena glacialis	North Atlantic Right Whale	1	O													O				O	
Megaptera novaeangliae	Humpback Whale	1	O													O				O	
Phocoena phocoena	Harbor Porpoise	2	O													O				O	
Physeter macrocephalus	Sperm Whale	2	O													O					

Table 5/6-6. continued: page 7 of 7.

CLASS Scientific Name	Common Name	Priority	Species-specific Monitoring	Clerk Creel Census	Voluntary Creel Census	Mandatory Reporting	Stream Electro Fishing	Lake Electro Fishing	Gill Netting	Trap Netting	Beach Seines	Fishway Traps	DMR trawl survey	SCUBA / Snorkeling	Experimental Angling	Voluntary Sightings network	Monitoring Salmon Traps & Lifts	Spawning Stock Surveys	Habitat Mapping	Species Interaction Studies	Environmental/Habitat Change Effect Studies
MAXILLIPODA (barnacles and copepods)																					
Calanus finmarchicus	A Copepod	3	N																	N	N
MEROSTOMATA (horseshoe crabs)																					
Limulus polyphemus	Horseshoe Crab	1	O																O		N
OPHIUROIDEA (brittle stars)																					
Gorgonocephalus arcticus	Northern Basket Starfish	2	O										O	O						N		N
REPTILIA (reptiles)																					
Caretta caretta	Loggerhead Seaturtle	2														O					
Chelonia mydas	Green Seaturtle	2														O					
Dermochelys coriacea	Leatherback Seaturtle	1														O					
Lepidochelys kempii	Kemp's Ridley Seaturtle	2														O					
RHYNCHONELLATA																					
Terebratulina septentrionalis	Lamp Shell	2	O											O						N		N

Annually, from May through October, MDMR interviews anglers to estimate the total number of fish caught, released, and harvested; the weight of the harvest; total number of angler trips; and number of people participating in marine recreational fishing in Maine. This effort is part of a National Marine Fisheries Service (NMFS) program (Marine Recreational Information Program) to estimate the impact of recreational fishing on marine resources. Sampling in Washington County continues with the assistance of Maine Sea Grant's Marine Extension Agent and students from the University of Maine at Machias. MDMR staff also monitor the winter Rainbow Smelt recreational fishery throughout the state through creel surveys and a catch card program.

MDMR's recreational fishing staff conduct the NMFS Large Pelagic Survey from July through October, annually, to monitor the catch and the effort expended by fishers to take tunas and sharks. This survey consists of dockside vessel interviews and telephone calls to Atlantic Tuna permit holders. Additionally, Volunteer Logbook Programs for Striped Bass and Rainbow Smelt monitor avid recreational fishers to collect additional information. In this program, anglers record information about fish harvested or released during each trip, time spent fishing, area fished, number of anglers, and target species.

Annually, from mid-May through August, MDMR conducts bi-weekly beach seine surveys in the estuary formed by the Kennebec and Androscoggin Rivers. MDMR uses these surveys to monitor the abundance of juvenile shad, alewives, and Blueback Herring, as well as Striped Bass, Rainbow Smelt, and other resident species. MDMR conducts the surveys at 14 permanent sampling sites in the tidal freshwater portion of the estuary and at six additional sites in the lower, salinity-stratified portion of the river. MDMR has conducted this survey since 1979 and it used the data to monitor species assemblages, population trends, and habitat use.

MDMR monitors diadromous fish passage efficiency through collaborative efforts between agencies, universities, and hydropower companies. For example, the U.S. Geological Survey (USGS) Conte Anadromous Fish Research Lab completed three years (2002-2004) of field work on a collaborative project with MDMR, the Penobscot Indian Nation, National Oceanic and Atmospheric Administration – Fisheries (NOAA-Fisheries), and the University of Maine, documenting the upstream migration of adult Atlantic Salmon in the Penobscot River. The research used Passive Integrated Transponder tag technology to gather data on movements of individual adult salmon, Fishery managers use this information to evaluate upstream movements and distribution of salmon within the drainage, the probability that fish are able to access spawning habitat, broodstock management, and the effectiveness of current juvenile stocking practices. Current projects (2014-2015) include monitoring American Shad passage at the Benton Falls Dam on the Sebasticook River and measuring the passage efficiency of fishways in Phippsburg and Bristol for alewife passage.

Monitoring diadromous fish in coastal Maine.
© Department of Marine Resources

MDMR conducts routine monitoring of the abundance and status of juvenile and adult diadromous fishes in most of Maine's large watersheds. MDMR operates traps to monitor adult returns on the Penobscot, Narraguagus, and Sebasticook rivers. Brookfield Renewable Energy Group operates traps in the upper Penobscot, Union, Kennebec, Androscoggin, and Saco rivers that provide counts of adult fish, and to a lesser extent, information on juveniles. The St. Croix Waterway Commission operates a trap on the St. Croix River and Algonquin Power operates a trap on the Aroostook River.

MDMR directs its Atlantic Salmon monitoring at determining the causes of the precipitous decline in Atlantic Salmon returning to Maine waters. The focus of ongoing projects is to determine survival among freshwater life stages and understanding the biological and environmental factors affecting survival. These include parr density and relative abundance, estimates of smolt emigration, smolt physiology, effects of marine and estuarine smolt trawling, and smolt tracking through estuaries. Redd counts are used to track spawning escapement in the Gulf of Maine Distinct Population Segment rivers without adult traps.

MDMR assess the population status of Shortnose and Atlantic Sturgeon on the Saco, Kennebec, Androscoggin, and Penobscot Rivers. They encompass determining sturgeon abundance, age structure and recruitment, sampling areas of historic sturgeon occurrence, documentation of seasonal distribution and essential habitat, development of criteria to identify critical habitat, designating identifiable habitat for sturgeon populations, ensuring fish passages, and examining the relationship between dam discharge levels and spawning success.

Annually, MDMR assesses spawning smelt runs to determine population status. The survey produces a fishery-independent index of abundance by collecting biological data from spawning runs, including information on size and age composition, catch-per-unit-effort, and mortality. As part of this project, fishery managers sample fyke-net stations at specific coastal rivers in Maine, New Hampshire, and Massachusetts. The project has collected standardized data since 2008.

MDMR monitors American Eel populations using two fishery-independent surveys; a young-of-year survey and yellow eel count. Each spring, for a period of six weeks, MDMR scientists enumerate all young-of-year (glass) eels that migrate upstream into West Harbor Pond and collect biological information (length, weight, pigmentation) on subsamples. From June to September each year, MDMR concuts the Yellow Eel survey in the Kennebec River watershed, at two hydropower facilities on the Sebasticook River and one facility on the Kennebec River. This survey provides an annual index of recruitment (multiple year classes) to the Kennebec River watershed.

Marine Invertebrates
State, federal, university, and non-governmental organizations collaboratively monitor marine invertebrates. In addition to the Nearshore Trawl Survey and Port Sampling programs described above, MDMR collects information about commercial species through fishery-independent surveys.

Marine scientists monitor the northern shrimp population using multiple surveys. Scientists from NMFS, Maine, New Hampshire, and Massachusetts collaborate to conduct a series of tows for northern shrimp in the Gulf of Maine each summer. The survey provides fishery-independent data that are an important component of the assessment of the Gulf of Maine shrimp stock. In the winter of 2014-2015, in an effort to collect information about winter populations of northern

shrimp during the fishery closure, MDMR worked with local fishermen in Maine to collect trawl and trap samples to document the species' maturity schedules and size distribution.

MDMR uses dive surveys to monitor Green Sea Urchins and assess the status of urchin larvae. MDMR and industry divers count and measure urchins at fixed and random sites each spring from Kittery to Eastport. This survey provides fishery-independent data that MDMR uses in stock assessments to describe the status of the resource and provide a scientific basis for the development of management measures. To monitor larval settlement, MDMR divers deploy settlement plates at Pemaquid Point each spring, collect them during the summer, and examine the plates in the laboratory to enumerate the number of new young-of-the-year sea urchins. This continues a time series begun at that site in the mid-1990s by the University of Maine, which tracks annual sea urchin larval settlement.

With the drastic depletion of the Horseshoe Crab in the Mid-Atlantic States and the resultant increased harvest in Maine, anecdotal information suggested that Maine's population had also experienced a decline. Since 2001, MDMR, several coastal watershed volunteer monitoring groups, and a private contractor have conducted annual surveys of Horseshoe Crab spawning populations and breeding sites. Biologists make a visual count of spawning Horseshoe Crabs at three sites along the coast annually during May and June spring tides. This survey relies on volunteers who walk a standard-survey transect at high tide counting crabs observed within a one meter band. Since 2005, MDMR has reduced the number of sites from 14 to three, and in recent years, relied entirely on volunteer monitoring. These surveys are intended to update the last assessment of Maine Horseshoe Crabs and breeding locations, which fishery managers conducted in 1977 for the Maine State Planning Office.

MDMR and industry partners survey the Maine scallop resource annually, rotating among coastal sites from southern Maine to Quoddy Head. Sampling occurs in October and November prior to the start of the scallop season in December. The surveys provide fishery-independent data that fishery managers use for stock assessments to describe the status of the resource and provide a scientific basis for the development of management measures. The surveys also provide information on the effectiveness of the areas closed to fishing in growing scallop populations and to guide re-opening strategies.

The National Park Service monitors rocky shores in Maine as part of their Northeast Temperature Monitoring Network that extends to the Boston Harbor Islands in Massachusetts. In Maine, field work is centered on Acadia National Park, specifically Ship Harbor, Bass Harbor, Otter Point, Schoodic Point, and Little Moose Island. Samplings also occurs at Metinic and Petit Manan islands. This is a long-term, annual program focuses on detecting changes in rocky-shore fauna and flora, monitoring tide pools, barnacle recruitment, vertical distributions of macroalgae and macroinveterates, and counting target species. It monitors alterations in oceanographic patterns and climate change on decadal time scales.

The New England Aquatic Nuisance Species Panel was established in 2001 to monitor nuisance species, create public outreach programs, suggest policy, and facilitate coordination of these activities among the New England states. While most efforts have targeted freshwater invasive species, scientists also monitor marine non-native macroalgae and macroinvertebrates as part of the Rapid Assessment Survey, conducted from New York City to Eastport, Maine (Pederson et al. 2005, Wells et al. 2014). Data from these surveys are available from the Massachusetts Invader Tracking and Information System (MITIS; http://mit.sea-grant.net/mitis/mitis_map). Citizen monitoring programs supply the scientific survey efforts that

increase the spatial and temporal coverage of the Rapid Assessment Survey from Rhode Island to Wells, Maine for an abridged list of invasive species. The data collected from 2008 to present are available at the Massachusetts Ocean Resource Information System http://maps.massgis.state.ma.us/map_ol/moris.php.

The incipient network of field station sites called the Field Station and Marine Lab network in the Northeast includes a number of nonprofit and university affiliated coastal stations that monitor rocky and unconsolidated shores in Maine. Some of these projects involve citizen-science programs with significant outreach and education. Current stations include the R.S. Friedman Field Station in Cobscook Bay, Hurricane Island in Penobscot Bay, Coastal Studies Center in Casco Bay, and several others.

5/6.3 MONITORING SGCN HABITATS

Many of the SGCN monitoring efforts above involve some component of habitat monitoring. For SGCN habitats, factors affecting habitat distribution and integrity often occur at regional or state-wide scales. For example, the health of a headwater stream and its resident SGCN are influenced, in part, by barriers downstream and the integrity of the watershed as a whole. Likewise, the future distribution of tidal marshes in response to sea level rise and marsh migration is driven by factors at multiple scales, from individual culverts restricting tidal flow in streams to dynamics of large-scale sediment accretion. For other types of habitats, especially marine systems, we simply do not have a clear understanding of current or historic distributions and therefore have limited baseline information to assess changes over time. To address these knowledge gaps, MDIFW and partners identified habitat-scale survey and monitoring needs during development of conservation actions. We present these actions in Table 5/6-7 with examples of existing programs (e.g., Stream Smart) and general survey and monitoring techniques (e.g., remote sensing) that could be used to achieve habitat monitoring objectives. This is not an exhaustive list of approaches, but rather a starting place to identify next steps and potential partnerships.

The Maine Bumble Bee Atlas, launched in 2015 with citizen scientists, will establish a baseline assessment for future monitoring of a potentially declining group of significant pollinators. © Kalyn Bickerman

Table 5/6-7. Proposed habitat monitoring approaches.

Habitat Group	Conservation Action Description (Action ID #)	Examples of Potential Monitoring and Survey Programs and Collaborations[1]
Freshwater Aquatic Habitats		
Headwaters and Creeks	• Identify high value native coldwater SGCN fish and other SGCN species habitats that may be vulnerable to watershed scale hydrology effects due to tree loss (#87)	SGCN and habitat surveys, GIS models, remote sensing, Maine Department of Environmental Protection (MaineDEP) water quality and bioindicator monitoring
Streams, Rivers, Lakes, and Ponds	• Complete a statewide inventory of the status and condition of road and railroad crossings, including on headwater streams (#146) • Conduct a statewide inventory of dams, including on headwater streams (#101) • Identify priority locations for ecological flow management in aquatic habitats (#102) • Increase habitat surveys & models for road stream crossings (#145) • Develop better methods to map potential barriers in priority watersheds (#103) • Track completed road stream crossing projects (#147)	Stream Smart, National Lakes Condition Assessment, stream barrier assessments, GIS models, remote sensing. MaineDEP water quality and bioindicator monitoring
Marine Habitats		
Coastal	• Work with municipalities to identify important SGCN nesting and migratory areas in rocky coast and coastal habitats during comprehensive planning with assistance from programs such as Beginning with Habitat (#167)	SGCN and habitat surveys, Beginning with Habitat
Intertidal	• Develop monitoring systems and rapid response plans to prevent the colonization of invasive/problematic species and diseases in intertidal, subtidal, and tidal marsh habitats (#217) • More frequently update intertidal and subtidal SGCN habitat maps and compare to historical maps to monitor changes in distribution over time (#248) • Continued underwater surveillance of potential and active aquaculture lease sites with a focus on SGCN and important habitats (new)	Maine Invasive Species Network, iMapinvasives, Beginning with Habitat, eel grass surveys, remote sensing, SGCN and habitat surveys

Table 5/6-7. *continued: page 2 of 4.*

Habitat Group	Conservation Action Description (Action ID #)	Examples of Potential Monitoring and Survey Programs and Collaborations[1]
Rocky Coast	• Identify and prioritize significant nesting, migratory, and wintering areas in rocky coast habitats for contingency planning (#157) • Work with municipalities to identify important SGCN nesting and migratory areas in rocky coast and coastal habitats during comprehensive planning with assistance from programs such as Beginning with Habitat (#158) • Identify invasive plant hot spots in rocky coast habitats (#162)	SGCN and habitat surveys, Beginning with Habitat, Maine Invasive Species Network, iMapinvasives
Subtidal	• Develop monitoring systems and rapid response plans to prevent the colonization of invasive/problematic species and diseases in intertidal, subtidal, and tidal marsh habitats (#273) • Continue to improve rapid response for oil and gas spills in intertidal and subtidal habitats, including state agencies efforts to have most up-to-date species maps, rapid response protocols in place, and regular scenario training (#266) • Expand surveys of recreational fishing efforts to include SGCN that are not targeted in current survey efforts (#283) • More frequently update intertidal and subtidal SGCN habitat maps and compare to historical maps to monitor changes in distribution over time (#307) • Continued underwater surveillance of potential and active aquaculture lease sites with a focus on SGCN and important habitats (new)	Maine Invasive Species Network, iMapinvasives, citizen scientist or volunteer monitoring programs, remote sensing, eel grass monitoring
Tidal Marsh	• Build upon and coordinate with existing monitoring efforts to establish a long term tidal marsh monitoring program, with emphasis on assessing sediment dynamics in the context of sea level rise (#177) • Develop monitoring systems and rapid response plans to prevent the colonization of invasive/problematic species and diseases in intertidal, subtidal, and tidal marsh habitats (#191) • Continue and expand monitoring programs that track tidal marsh changes over time (#185)	GIS models, remote sensing, sediment accretion monitoring (Rod Surface Elevation Tables), Saltmarsh Habitat and Avian Research Program, Maine Invasive Species Network, iMapinvasives, Global Programme of Action Coalition (GPAC), National Wetland Condition Assessment, baseline and long-term ecological marsh monitoring, LiDAR models

Table 5/6-7. *continued: page 3 of 4.*

Habitat Group	Conservation Action Description (Action ID #)	Examples of Potential Monitoring and Survey Programs and Collaborations[1]
Terrestrial and Freshwater Wetland Habitats		
Floodplain Forests	• Identify aggressive invasives in floodplain forests and pre-treat to prevent spread (#342)	Maine Invasive Species Network, iMapinvasives, citizen scientist or volunteer monitoring programs, National Wetland Condition Assessment, Ecological Reserve Monitoring, development of reference wetland dataset
Freshwater Marshes	• Identify high priority road segments/culverts for organism passage among freshwater wetlands (#60)	Road Watch, Beginning with Habitat, SGCN and habitat surveys, GIS models, remote sensing, National Wetland Condition Assessment, Ecological Reserve Monitoring, development of reference wetland dataset
Grassland-shrubland-early Successional	• Research and identify explicit areas and amounts of grassland, shrubland, and early successional habitats needed to conserve target SGCN (#347) • Assist municipal planning, through programs such as Beginning with Habitat, to identify key grassland, shrubland, and early successional SGCN habitats (#348) • Map and distribute information on existing ruderal habitats (#355) • Map potential ruderal habitats (#356)	GIS models, remote sensing, SGCN and habitat surveys, Beginning with Habitat

Table 5/6-7. *continued: page 4 of 4.*

Habitat Group	Conservation Action Description (Action ID #)	Examples of Potential Monitoring and Survey Programs and Collaborations[1]
Northern Forests and Swamps	• Assess conserved lands, especially northern forests and swamps and rocky summits/outcrops/mountaintops, for climate change resiliency and use this information to guide future conservation efforts (#31) • Identify and conserve boreal forest refugia associated with SGCN (#32) • Continue long-term monitoring of SGCN and SGCN habitats associated with northern forests and swamps (#38) • Continue monitoring for invasive and problematic species and diseases, especially forest insect pests, in northern forest and swamps and south-central forests and swamps (#34) • Continue stewardship/habitat monitoring on conserved northern forest and swamp lands (#30)	GIS models, remote sensing, SGCN and habitat surveys, Maine Invasive Species Network, iMapinvasives, Forest Inventory and Assessment, Ecological Reserve monitoring, National Wetland Condition Assessment
Rocky Summits-Outcrops-Mountaintops	• Assess conserved lands, especially northern forests and swamps and rocky summits/outcrops/mountaintops, for climate change resiliency and use this information to guide future conservation efforts (#15) • Continue habitat/recreational monitoring stewardship on conserved rocky summit, outcrop, and mountaintop SGCN habitats (#18)	GIS models, remote sensing, SGCN and habitat surveys, citizen science or volunteer monitoring programs
South-Central Forests and Swamps	• Continue monitoring for invasive and problematic species and diseases, especially forest insect pests, in northern forests and swamps and south-central forests and swamps (#74) • Undertake long-term monitoring of SGCN and their habitats in south-central forests and swamps (#71) • Partner with Maine Department of Transportation to identify invasive plant "hotspots" along roads and bridges, especially in south-central forests and swamps (#75)	Maine Invasive Species Network, iMapinvasives, citizen science or volunteer monitoring programs, Forest Inventory and Assessment, Ecological Reserve monitoring, National Wetland Condition Assessment

[1]This column contains examples of existing programs (e.g., Stream Smart) and general survey and monitoring techniques (e.g., remote sensing) that could be used to achieve habitat monitoring objectives. This is not an exhaustive list of approaches, but rather a starting place to identify next steps and potential partnerships.

5/6.3.1 STATEWIDE HABITAT AND CONSERVATION MONITORING

In addition to SGCN and habitat monitoring, we will track habitat trends and the effectiveness of broad conservation programs at the statewide scale. Several of these approaches are described below. We expect to add approaches as new assessment, mapping, landscape modeling, and remote sensing techniques emerge over the next decade.

1. **Beginning with Habitat (BwH)**
   a. **Description:** BwH is a <u>non-regulatory</u>, habitat-based model that provides wildlife and habitat information to local decision-makers, conservation organizations, and landowners interested in their local wildlife and habitats. BwH provides these individuals with the necessary habitat information to <u>voluntarily</u> balance growth with conservation of natural spaces needed for wildlife, recreation, agriculture, forestry, and other resources. In the first decade of the program, BwH worked closely with towns to fulfill this goal. Over the next ten years, BwH will continue to work with towns while also providing enhanced/updated online mapping resources, searchable information on SGCN and conservation actions, and increased technical assistance for landowners and others implementing voluntary SGCN conservation measures. Under the direction of the Action Plan Implementation Committee, the BwH Steering Committee will revise BwH's strategic plan over the next two years to include measurable objectives and performance measures to monitor delivery, utilization, and effectiveness of BwH in supporting local voluntary efforts to conserve Maine's wildlife resources.
   b. **Periodically Assessed Metrics**
      i. Number of towns and regions mapped.
      ii. Number of towns, land trusts, and landowners receiving BwH information and technical assistance.
      iii. Ease of access to up-to-date habitat data for all user groups (government agencies, towns, conservation groups, and landowners).
      iv. Number of users accessing online mapping tools.
      v. Development of improved outreach modules for different user groups, especially landowners.
      vi. Number of conserved acres (including easements) in BwH Focus Areas.
      vii. Number of acres in BwH Focus Areas in "Tree Growth" or "Farm and Open Space" current use tax programs.
      viii. Successful creation of new incentives for towns and landowners to conserve priority SGCN habitats.

2. **Spatial Data Updates**
   a. **Description:** Since Maine's 2005 Plan, multiple partners have updated or created numerous habitat-related spatial datasets. The Maine Office of Geographic Information System data catalog (http://www.maine.gov/megis/catalog/) provides many of these datasets to the public, and others are available directly from partners. MDIFW and BwH host and maintain several datasets, which are listed here. These datasets are updated regularly and can be queried to monitor statewide SGCN, land use, and habitat patterns over time.

    b. Periodically Assessed Metrics

      i. Impervious/Developed Areas: Areas of impervious surfaces including buildings and roads.

      ii. Rare, Threatened, and Endangered Wildlife Data (includes some SGCN): Includes known rare, Endangered, and Threatened species occurrences and/or the associated habitats based on species sightings.

      iii. Undeveloped Habitat Blocks: Blocks of undeveloped land, including those greater than 100 acres.

      iv. Habitat Connections: Modeled habitat areas needed to maintain or restore functional wildlife travel corridors between undeveloped habitat blocks greater than 100-acres and between higher value wetlands.

      v. Riparian Connectors: Modeled crossing locations for wetland dependent species moving between waterways and wetlands divided by roads.

      vi. Conserved Lands: The State of Maine's conserved lands database includes lands in federal, state, and non-profit ownership.

3. Habitat Management Guidelines

    a. Description: MDIFW and partners will develop voluntary, non-regulatory habitat management guidelines for priority habitats and species and make these available to landowners, land managers, towns, land trusts, and others. Several habitat conservation actions (see Element 4) address the need for habitat management guidelines (HMG). We include this topic here in order to monitor develop of HMGs statewide.

    b. Periodically Assessed Metrics

      i. The number of SGCN for which HMGs are developed and published.

      ii. The number of landowners, land managers, towns, land trusts, and others that receive HMGs.

      iii. The number of landowners, etc., that implement habitat management according to the guidelines.

4. Land Conservation, Stewardship, and Management

    a. Description: Cooperation with state and federal agencies, non-profit organizations, landowners, land trusts, municipalities, and other partners to conserve habitat for priority species using fee acquisition, conservation easements, purchase of development rights, cooperative management agreements, management plans, improved comprehensive planning, habitat restoration and enhancements, and other conservation tools. Several habitat conservation actions and themes (see Element 4) address habitat conservation and supporting/expanding landowner incentives. This is an extremely important aspect of Maine's efforts to conserve habitats for SGCN, and we have included this topic here in order to track efforts at a statewide scale.

    b. **Periodically Assessed Metrics:** To monitor the success of these efforts collectively, we will develop a way to periodically monitor the number of acres under habitat conservation through:

      i. Fee acquisition

      ii. Conservation easement

      iii. Purchase of development rights

      iv. Cooperative management agreements and management plans

5/6.4 PROGRAMMATIC MONITORING

MDIFW and conservation partners developed 11 programmatic actions to help guide Action Plan implementation over the next ten years (see Element 4, Table 4-21). Each is summarized below.

In addition, 3 of these -- Programs 7, 8, and 9 -- address monitoring. Programs 7 and 9 are described in detail.

Outreach and Engagement (Programmatic Actions 1-3): Actions to inform and engage the public and partners on Action Plan accomplishments and opportunities for involvement.

> **Program 1**: Establish an Action Plan implementation committee comprised of conservation partners and agency staff to help guide implementation of the 2015 Action Plan (short-term). (Elements 7/8)

> **Program 2**: Devise and implement outreach strategies, including periodic meetings, to inform and engage conservation partners and the general public on 2015 Action Plan information, accomplishments, and opportunities for involvement (mid-term). (Elements 7/8)

> **Program 3**: Develop a public survey of SWAP and non-game species awareness, concerns, and priorities (initial survey: short-term; second survey: long-term [tentative]). (Elements 7/8)

Funding and Tracking (Programmatic Actions 4-8): Actions to bolster funding, capacity, and tracking of SGCN-related projects.

> **Program 4:** This action supports efforts to establish stable state and federal funding sources for SGCN and habitat conservation. (Element 4)

> **Program 5**: Consider establishing a competitive small grants program to make a portion of State Wildlife Grant (SWG) funds available to partners implementing priority actions identified in the 2015 Action Plan (mid-term). (Elements 7/8)

> **Program 6:** This action focuses on increasing long-term agency staffing and capacity needs for Action Plan implementation. (Element 4)

> **Program 7:** Annually compile agency and partner expenditures and seek additional match opportunities to maximize efficiency and impact of 2015 Action Plan implementation (short-term). (Elements 5/6)

> **Program 8:** Track SWAP conservation action implementation accomplishments by agencies and partners (short-term). (Elements 5/6)

> *"Within the first few years of Plan implementation, MDIFW will work closely with partners to develop tracking systems for conservation expenditures and expenses. MDIFW will develop feedback mechanisms to track partner efforts and accomplishments and use this information to periodically assess the effectiveness of the 2015 Action Plan."*

With over 600 SGCN and habitat-related conservation actions, successful implementation of Maine's 2015 Action Plan will require collaborative efforts between MDIFW and its many conservation partners. Furthermore, State Wildlife Grant funds are limited and, as a state, we need to ensure these dollars are being spent efficiently to achieve desired conservation outcomes. Within the first few years of Plan implementation, MDIFW will work closely with partners to develop tracking systems for conservation expenditures and expenses. MDIFW will develop feedback mechanisms to track partner efforts and accomplishments and use this information to periodically assess the effectiveness of the 2015 Action Plan. MDIFW is currently developing a Tracking and Reporting Actions for the Conservation of Species (TRACS) compliant tracking system for agency projects and may develop a similar mechanism for partners. MDIFW also will highlight Action Plan progress and successes at periodic meetings with partners and through media as part of Programmatic Theme 2. To further leverage limited funds, MDIFW also will work with partners to maximize existing match opportunities and identify new ones, especially for volunteer time that MDIFW has not previously tracked. Additional information is provided in Section 5/6.5 below.

Action Development (Programmatic Action 9): This action relates to creating SMART (Specific, Measurable, Achievable, Results-oriented, and Time-bound) objectives for high priority SGCN and habitat conservation actions. (Elements 5/6)

MDIFW and partners developed a comprehensive menu of conservation actions to address Maine's most pressing SGCN and habitat needs. The list is long, despite taking several measures to include only the most important actions (e.g., only developing actions for medium or high level stressors). This is due to several reasons. First, Maine has a wide range of habitats, from subtidal mollusk reefs to high altitude alpine meadows. The stressors affecting these habitats and their SGCN are extremely nuanced and often habitat-specific. Furthermore, we are fortunate to have a broad partner base with diverse interests and missions, from habitat conservation and research to advocacy. Rather than present a restricted list applicable to only a subset of partners, we opted to present the full suite of actions so that partners across the state can find a nexus to some aspect of the plan.

We recognize that we cannot implement every action in the plan, even with broad partner support. In order to focus our efforts, we will use the prioritization approach presented in Element 4 to evaluate proposed conservation actions that are not already underway. We may first focus on the 20% of actions ranked as 'critical' for Biological Priority, but we also will consider lower-ranked partner-driven efforts. For actions determined to have sufficient biological impact and feasibility, we will establish SMART objectives to monitor action accomplishments over the next ten years and include this information in tracking programs developed under Programs 7 and 8 above. Additional information is provided in Section 5/6.5 below.

Regional Partnerships (Programmatic Actions 10-11): These actions address continued MDIFW and partner involvement in existing conservation efforts.

> **Program 10:** This action supports efforts to identify new and update existing SGCN Conservation Opportunity Areas (COAs). (Element 4)

> **Program 11:** This action supports MDIFW and partner participation.

5/6.5 MEASURING THE EFFECTIVENESS OF ACTIONS

In the sections above, we describe specific SGCN, habitat, and programmatic monitoring approaches we will use over the next ten years of Maine's 2015 Wildlife Action Plan. These monitoring programs provide crucial information on the effectiveness of our actions and progress toward our conservation goals.   In the sections below, we describe how these monitoring programs are incorporated into conservation action implementation and our overall approach to measuring the effectiveness of priority conservation actions. With over 600 conservation actions for SGCN and habitats and over 100 conservation partners implementing these actions, it is impractical to track progress on every conservation action in the Plan. Therefore, we present below a generalized approach for developing SMART objectives and measuring the effectiveness of individual priority conservation actions as well two spatially-explicit examples for two applied scenarios: 1) conservation of multiple SGCN habitats in a central Maine Wildlife Management Area (WMA) and, 2) conservation of New England Cottontail in a southern Maine WMA and surrounding lands.

A General Approach for Developing SMART Objectives and Effectiveness Measures for Priority Conservation Actions

Our 600-plus conservation actions reflect a strategic approach to conservation planning and reflect the best professional judgement of our partners and species specialists. However, most of our conservation actions are fairly general and require the development of SMART objectives to effectively track their impact. As described for Programmatic Action 9 above, SMART objectives will be developed with feedback from partners for a subset of priority conservation actions deemed 'critical' biological priority and for those that address an immediate or emerging need for an SGCN or habitat.

For individual actions or suites of related actions, we will first assess the feasibility and biological impact of the action(s) using the criteria for prioritizing conservation actions described in Element 4, Section 4.5.2. If an action is determined to be feasible and impactful, we will develop a results chain to address SMART objectives using the original SGCN or habitat targets and stressors originally identified by species specialists and conservation partners during development of Element 4. Results chains graphically depict and test the logic behind a 'theory of change', whereby a user can specify all the components needed for a conservation action to have a desired effect on a target. A generalized results chain for priority conservation actions is depicted in Figure 5/6-1.

Wherever possible, we will utilize existing results chain templates and indicators for common conservation actions developed by the Association of Fish and Wildlife Agencies (2011). For actions primarily within MDIFW jurisdiction, we will solicit feedback on our results chains from

our Steering Committee. For actions that are undertaken by other partners, we will work with partners to develop results chains based on their expertise and knowledge of the issue. As described below, we also intend to continue partnering with a University of Maine, Orono, graduate conservation planning course to develop results chains for our more complex conservation scenarios.

Figure 5/6-1. Generalized results chain for priority conservation actions and suites of actions (in cases where multiple, related actions are undertaken simultaneously to enhance effectiveness or feasibility). The monitoring programs described earlier in this chapter will be essential for tracking key indicators of conservation action effectiveness, both in examining the intermediate results of an action as well as the ultimate goal of improving or maintaining a certain SGCN or habitat condition. The two-way arrow between the conservation action and intermediate results suggests an adaptive management approach where the effectiveness of conservation actions will be continuously monitored and adjusted as needed to ensure they are meeting the objectives of the action.
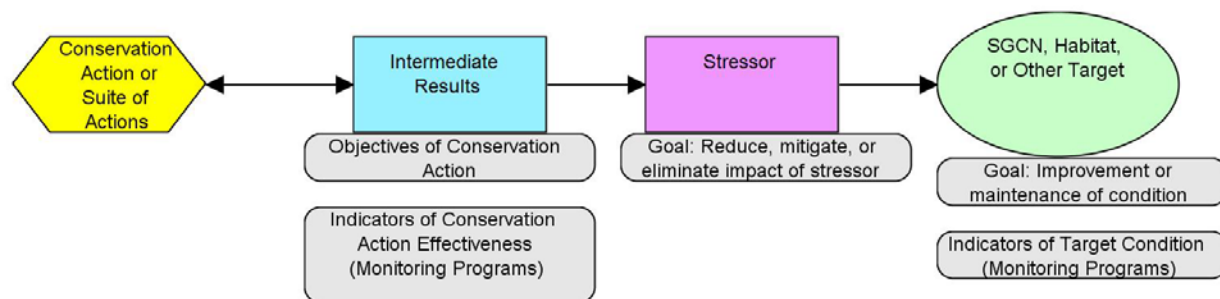
An Applied Approach for Developing SMART Objectives and Effectiveness Measures for Target SGCN and Habitats

In the examples that follow, we provide two scenarios for developing results chains that are likely more applicable to most planning efforts than the action-by-action approach described above. In March 2017, we partnered with a weeklong graduate level conservation planning course at the University of Maine, Orono to develop results chains for high priority conservation actions using the Open Standards for the Practice of Conservation (CMP 2013) for two WMAs owned and managed by MDIFW. With the help of coaches from the Conservation Coaches Network and MDIFW staff, graduate students developed conceptual model to identify priority SGCN and habitat conservation targets for each WMA and built results chains for relevant conservation actions. Because the course afforded us time to explore multiple issues in detail, these results chains are immediately transferable to other WMAs and high priority conservation actions in Maine's 2015 Plan. We hope to continue collaborating at least annually with the University of Maine to apply this process to additional conservation targets throughout the life of the Plan. We also intend to use the results chains produced by this collaboration as templates to help guide new internal and partner-led conservation projects.

Applied Case Study 1: Conservation of SGCN Habitats in a Central Maine Wildlife Management Area

Background: The Bud Leavitt Wildlife Management Area (BLWMA) encompasses over 6,500 acres spanning four towns (Dover-Foxcroft, Atkinson, Garland, Charleston) in central Maine. It is comprised predominately of forested habitats (e.g., northern hardwoods and conifers) but also grasslands and freshwater wetlands (e.g., domed bog ecosystem) (Figure 5/6-2). While there are few mapped SGCN occurrences in the BLWMA, there is a known Great Blue Heron (SGCN Priority 2) colony and predicted occurrences of freshwater wetland and early successional-associated SGCN. Bud Leavitt is management primarily for wildlife and timber, but it also provides recreational opportunities such as hunting and all-terrain-vehicle (ATV) trails (MDIFW 2006). The BLWMA is characteristic of many central and northern Maine forested landscapes that contain some habitat fragmentation and large data gaps for SGCN.

Results: Based on the 2015 Plan and MDIFW knowledge of the BLWMA, students determined that recreational activities (particularly unauthorized ATV use in off-trail areas) were the greatest stressor to SGCN habitats throughout the WMA. Students developed a conceptual model and associated results chains to engage ATV clubs and support law enforcement to reduce the impact of unauthorized recreational vehicle use on SGCN target habitats, including vernal pools, freshwater wetlands, streams, and grasslands (Figure 5/6-3). Each objective was developed based on SMART principles, and results chains contain several interrelated feedback loops that allow for adaptive management based on the effectiveness of actions.

Applied Case Study 2: Conservation of New England Cottontail in Southern Maine

Background: The Scarborough Marsh Wildlife Management Area (SMWMA) is an approximately 3,000 acre area owned and managed by MDIFW.   Most of the area is comprised of salt marsh or other wetlands, and the remainder includes wet meadows, old fields, shrublands, and mature forest (Figure 5/6-4). The SMWMA falls within the known historical range of New England Cottontail, a State Endangered species and SGCN Priority 1. SMWMA is within the Cape Elizabeth-Scarborough New England Cottontail focal area, and verified records of the species were documented on the property in 2009. It is the only MDIFW property with recent New England Cottontail records (MDIFW, proposed habitat management plan for SMWMA).

Results: Students identified New England Cottontail as the key conservation target for the SMWMA. Students identified increased New England Cottontail habitat acreage and enhanced habitat quality within SMWMA and adjacent properties as key indicators of success for this scenario. Students developed a conceptual model and multiple results chains (Figure 5/6-5) focusing on landowner engagement and public support for management activities to address New England Cottontail conservation and early successional habitat management. Like the BLWMA example, these results chains contain SMART objectives that provide detailed approaches for strategic implementation of several high and critical priority conservation actions.

Figure 5/6-2. Habitat types (macrogroups) within the Bud Leavitt Wildlife Management Area based on the Northeast Habitat Terrestrial Classification System.
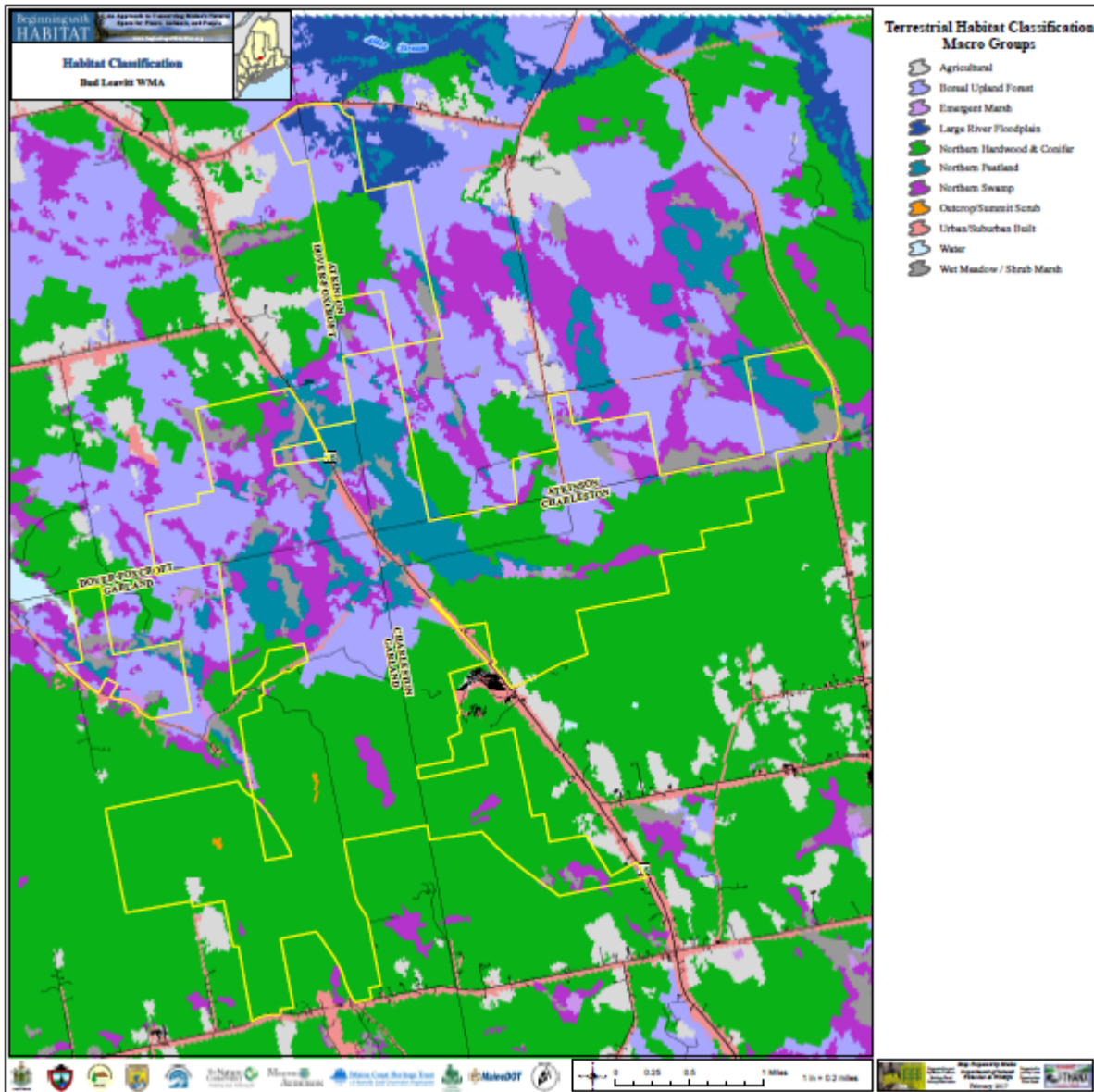
Figure 5/6-3. Example conceptual model and results chains to address unauthorized recreational vehicle impacts to SGCN habitats in the Bud Leavitt Wildlife Management Area.
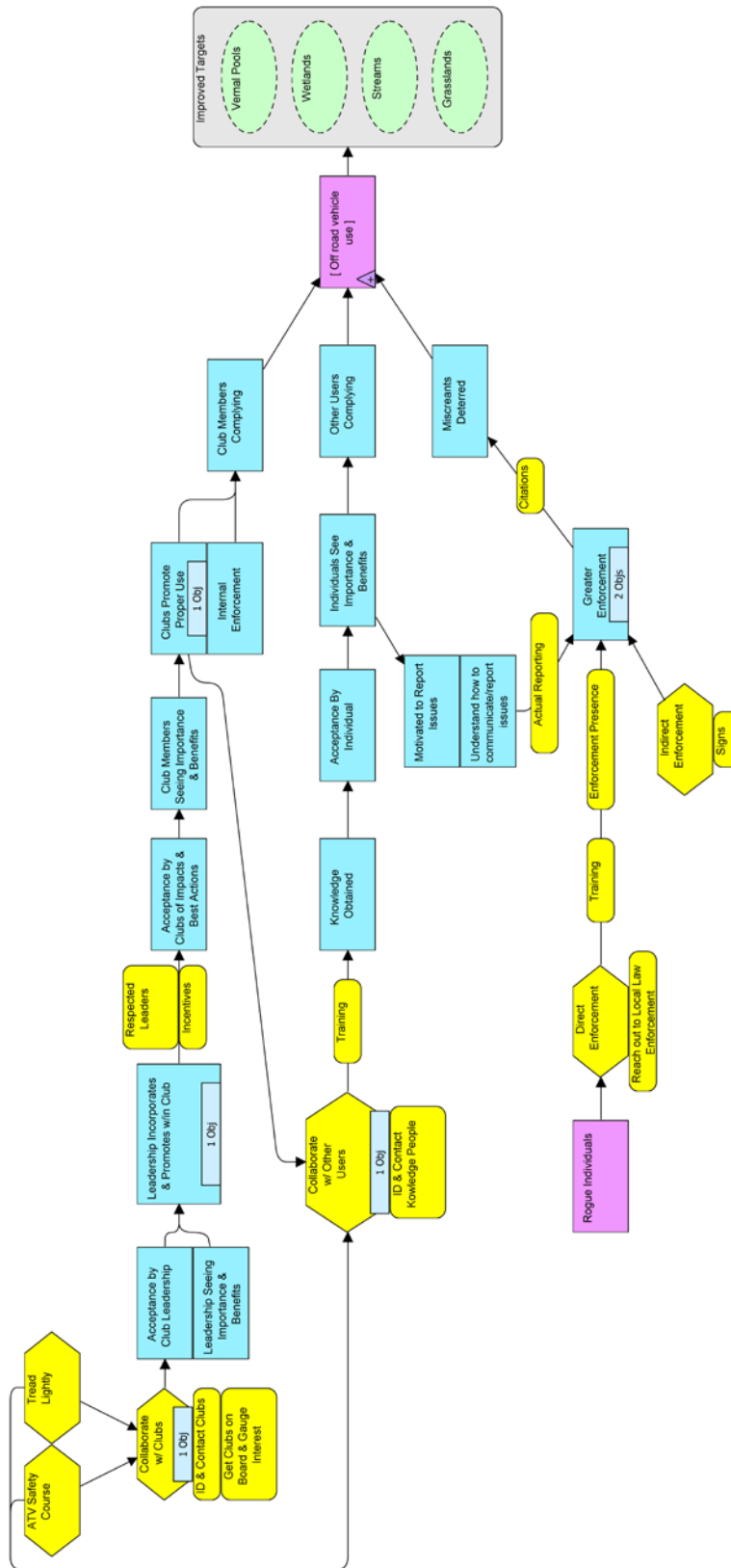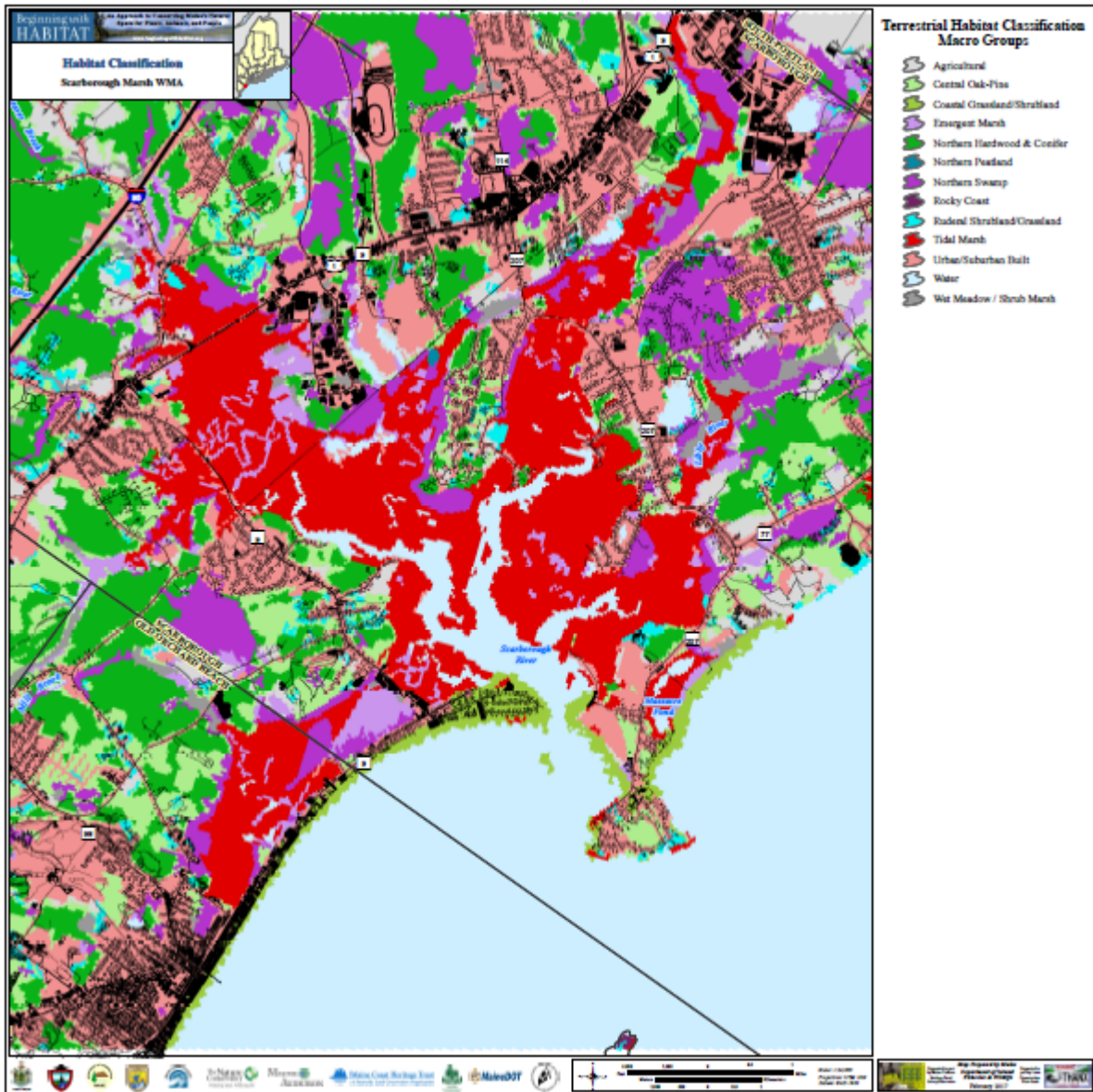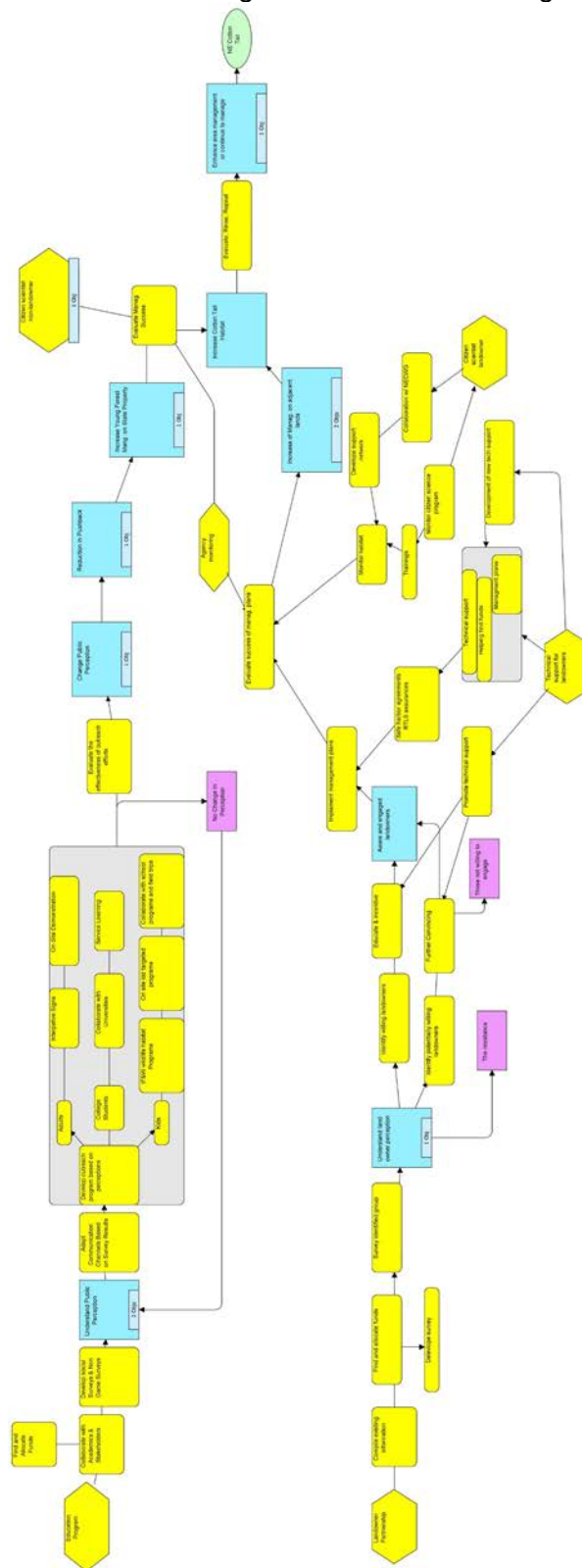
Figure 5/6-4. Habitat types (macrogroups) within the Scarborough Marsh Wildlife Management Area based on the Northeast Habitat Terrestrial Classification System.

Figure 5/6-5. Example conceptual model and results chains for improving and expanding New England Cottontail habitat in the Scarborough Marsh Wildlife Management Area

Monitoring Effectiveness of Conservation Actions

The monitoring programs detailed in the first part of this chapter provide periodic SGCN and habitat condition information that will help us determine the effectiveness of conservation actions. Where our monitoring programs indicate a condition is not improving or is worsening, results chains allow us to identify where exactly our theory of change was incorrect or insufficient, and we can adapt our approach accordingly. While we are still developing a formal tracking system that accommodates partner input (see Program Action 8), we intend to meet at least annually with partners to review the status of partner-led actions and monitoring programs. Within MDIFW, we will continue to assess project status at least annually with MDIFW staff and our Steering Committee and communicate progress through our regular reporting procedures to USFWS.

5/6.6 PLANS FOR REVISION

States are required to review and revise, as appropriate, State Wildlife Action Plans (SWAP) at least every ten years. In addition to a major plan revision every 10 years, MDIFW is committed to assessing regularly the progress made in implementing the Action Plan. MDIFW will use the programmatic actions described above to monitor conservation action progress at least annually, and will summarize this information in annual reports to USFWS as required by the State Wildlife Grant Program. As described in Elements 7/8, MDIFW will also establish an Implementation Committee in the Fall of 2015 comprised of agency staff and conservation partners. This committee will meet at least annually to review Action Plan accomplishments and to address any emerging issues or adaptive management needs. We will undertake a comprehensive plan review beginning in year eight of the 2015 Action Plan that will include reviewing the criteria and literature used for designating SGCN. We will revisit the stressor levels assigned to SGCN and habitats and determine if our actions sufficiently prevented additional declines or actually improved stressor rankings. MDIFW and its conservation partners will develop a revised Action Plan by October 1, 2025 for submission to USFWS.

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