Chapter 5

Monitoring Connecticut's SGCN, SAPS, Habitats, and Conservation Actions

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Summary

This chapter provides a comprehensive overview of the monitoring context, programs, priorities, gaps, and next steps necessary to support the 2025 Wildlife Action Plan and its implementation through 2035. Each section integrates input from regional frameworks, CT DEEP biologists, and the state's Taxa Teams, ensuring that the monitoring strategy reflects the best scientific practices, the most current data, and Connecticut-specific conservation needs. This chapter emphasizes monitoring as a scientific and

management tool, supporting evaluation of SGCN and SAPS status, habitat condition, and the outcomes of implemented conservation actions.

Species monitoring is prioritized based on conservation urgency, feasibility, and data gaps, with an emphasis on at-risk and/or understudied groups, including plants, invertebrates, cryptic vertebrates, and species dependent on coastal or wetland habitats. Guild- and community-level monitoring is used where individual tracking is impractical, often supported by CT DEEP programs (e.g., trawl surveys, acoustic monitoring) or national datasets (e.g., eBird, TRACS). The plan also expands evaluation of conservation action outcomes, using logic models and structured metrics to link implementation to ecological response. Data gaps are identified, with clear documentation where monitoring is not feasible. Coordination with academic, agency, and community science partners underpins much of the monitoring infrastructure. Future directions highlight emerging technologies, underrepresented taxa, and increased standardization to support long-term adaptability.

Introduction

Monitoring is the foundation of evidence-based wildlife conservation. As required under Element 5 of the State Wildlife Action Plan framework, Connecticut's monitoring strategy is designed to assess the status of Species of Greatest Conservation Need (SGCN), evaluate habitat condition, and track the outcomes of conservation actions outlined in Chapter 4. Monitoring supports CT DEEP's ability to measure progress toward statewide management goals, detect emerging threats, and refine priorities when presented with new information or changes in conditions.

Connecticut's approach to monitoring builds on existing programs while addressing persistent information gaps, particularly for understudied taxa and habitats. Monitoring occurs at multiple ecological and geographic scales, including individual species, guilds, and communities, and incorporates biological and environmental indicators. Where species-level monitoring is infeasible, surrogate metrics—such as habitat condition or presence of indicator taxa—are used to infer status and trend. Monitoring also includes post-implementation assessments of conservation actions, ensuring that resource investments yield measurable ecological benefits (see Table 5.1 for a list of ongoing monitoring projects throughout the state).

To the extent possible, CT DEEP integrates its monitoring efforts with ongoing regional and national programs, including those of the U.S. Geological Survey, NABat, and the U.S. Fish and Wildlife Service, as well as community science initiatives such as eBird and iNaturalist. Taxa Team members across all taxonomic groups emphasized the need to

expand these partnerships to improve data quality and coordination, especially for taxa with limited resources (e.g., invertebrates, non-vascular plants). The monitoring strategy also aligns with the adaptive management framework presented below, allowing CT DEEP and its partners to respond to new information and emerging conditions with revised conservation actions.

Table 5.1 – List of active and ongoing monitoring programs and projects in Connecticut

			Level of Monitoring			
Monitoring Program or Action	**Implementation Lead**	**Target(s)**	**Species**	**Guild**	**Habitat**	**Action Effectiveness**
New England marine mammal, sea turtle and seabird survey	NOAA	Marine mammals, sea turtles, seabirds	X			
NOAA Restoration Center Programs	NOAA, CT DEEP	Oil spill and contaminant release response and restoration	X	X	X	
Christmas Bird Counts	Audubon Connecticut	Birds	X	X		
American Shad studies	CT DEEP, USFWS	American shad	X		X	
White Memorial Fish and Wildlife Monitoring Programs	White Memorial Foundation	Birds, amphibians, reptiles, invertebrates, fish	X	X	X	
Long Island Sound Trawl Survey	CT DEEP	Fin fish, squid and crustaceans	X	X	X	
Shorebird Monitoring Survey	CT DEEP	Shorebirds	X	X		
Summer Canada Geese Program	CT DEEP	Canada Geese	X			
Monitoring Avian Productivity and Survivorship (MAPS)	Institute for Bird Populations volunteers	Migratory birds	X	X		
BirdSource (national monitoring program)	National Audubon Society and Cornell Lab of Ornithology	Birds		X		
School Yard Habitat Program	Audubon Connecticut, USFWS	Habitat, birds, bees	X	X	X	
Forest Bird Initiative	Audubon Connecticut,	Songbirds	X	X	X	

	Ferruci & Walicki LLC, Connecticut Agricultural Experiment Station					
Osprey Nation	Connecticut Audubon Society, CT DEEP	Ospreys	X		X	
Stream and River Survey	CT DEEP	Fish	X	X		
Diadromous Fisheries Assessment and Restoration Program	CT DEEP, USFWS	Diadromous fish	X		X	
Eight Mile River Sampling (water quality)	Three Rivers Community College	Water quality monitoring		X	X	
Rapid Bioassessment Monitoring Stream Surveys	CT DEEP	Macroinvertebrates		X	X	
Oceanology Programs in Little Narragansett Bay and Pawcatuck River estuaries	Pine Point School	Benthic surveys, water quality monitoring		X	X	
Long Island Sound Water Quality Survey	CT DEEP	Water quality monitoring			X	
Private Landowner Assistance Program	CT DEEP	Forest management			X	
Air Quality Monitoring (various locations)	CT DEEP	Air quality monitoring			X	
Water Quality Monitoring (various locations)	CT DEEP	Water quality monitoring			X	
Farmington River Biodiversity Project	Farmington River Watershed Association	Water quality monitoring			X	
US Geological Survey Long Island Sound	US Geological Survey	Benthic mapping			X	

Environmental Studies Program						
US Geological Survey Water Resources Division Monitoring	US Geological Survey	Water quality and quantity monitoring			X	
EPA Long Island Sound Study project	EPA, CT DEEP	Water quality and benthic monitoring			X	
Coastal 2000/EMAP	EPA	Coastal ecosystem health		X	X	
Salt Marsh Migration Analysis	UConn CLEAR, TNC	Long Island Sound salt marshes			X	
Long Island Sound Ecological Assessment	TNC	Coastal habitats			X	
Shifting environmental conditions, coastal saltwater intrusion Studies	UConn, DEEP, NOAA	Coastal habitats			X	
Forest Inventory and Analysis	US Forest Service	Forest Habitats			X	
Sediment Elevation Tables Marsh Surveys (various locations)	Yale University	Tidal marsh habitat			X	
Audubon Alliance for Coastal Waterbirds	National Audubon Society	Coastal birds	X	X		
Open Marsh Water Management Program	CT DEEP	Marsh habitat			X	
Connecticut Terrapin Tracking Team	Western Connecticut State University / CT DEEP / Maritime Aquarium	Diamondback Terrapins	X			
FrogWatch	Connecticut's Beardsley Zoo	Anurans	X	X		
Riverine Habitat Monitoring (Pomperaug River Watershed)	Pomperaug River Watershed Coalition	Riverine Habitat, water quality, macroinvertebrates, invasive plants		X	X	

Bent of the River Sanctuary Survey	Audubon Connecticut	Forest and shrubland birds	X	X	X	
CT Bee Atlas	CT DEEP	Bees	X	X		
Tiger Beetle Monitoring	CT DEEP	Tiger Beetles	X	X		
Invasive Plant Monitoring	IPANE	Invasive Plants			X	X
Pest Surveys	CT Ag Station	Emerald Ash Borer, Spotted Lanternfly, etc.				X
Lake and Pond Monitoring	CT DEEP Fisheries	Freshwater fish, crayfish, and mussels	X	X		
4th of July Butterfly Count	North American Butterfly Association	Butterflies	X	X		
Freshwater habitat monitoring	CT DEEP Fisheries	Lake, River, and Stream Habitat			X	
eDNA sampling	Trout Unlimited	Salmonids in lower Fairfield County	X	X		
Orchid Monitoring	CT Botanical Society	Uncommon orchid species in Deep River	X			

Regional and National Monitoring Context

Connecticut's monitoring approach is part of a broader network of regional and national initiatives designed to ensure data consistency, coordinate conservation outcomes, and reduce redundancy across jurisdictional boundaries. At the regional scale, Connecticut participates in the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) and the Northeast Association of Fish and Wildlife Agencies (NEAFWA), both of which have developed shared monitoring and performance reporting frameworks, including the Northeast Lexicon (Crisfield & NEFWDTC, 2022) and Conservation Measures Partnership (CMP) indicators (CMP, 2022). These tools promote standardized terminology, enabling states to report on common metrics across conservation actions, taxa, and habitats.

Connecticut also contributes data and engages in coordinated monitoring through the Regional Conservation Needs (RCN) program (link). This program has supported multi-state survey protocols for shrubland birds, vernal pool amphibians, and the restoration of early successional habitats. These programs provide templates for expanding taxon-specific protocols in Connecticut and inform the development of priority actions.

At the national level, the U.S. Fish and Wildlife Service's TRACS (Tracking and Reporting Actions for the Conservation of Species) database captures state wildlife grant investments and, increasingly, includes fields for documenting biological outcomes. The U.S. Geological Survey (USGS) and Environmental Protection Agency (EPA) also maintain habitat and water quality monitoring programs that intersect with SGCN habitats, including the National Water Quality Assessment Program and the National Wetland Condition Assessment. Coordinating these efforts allows CT DEEP to draw from nationally vetted methodologies while ensuring local relevance.

Connecticut's alignment with these initiatives ensures its monitoring strategy is compatible with broader conservation performance tracking while retaining the flexibility to address the state's unique ecological conditions. Many of these regional frameworks are referenced throughout this chapter and directly inform monitoring recommendations for the 2025 Wildlife Action Plan.

Connecticut's Monitoring Framework

Species and Habitat Monitoring

Connecticut's monitoring framework integrates species, habitat, and action effectiveness monitoring under a unified structure designed to support adaptive management, accountability, and cross-scale conservation planning. Monitoring is conducted through multiple mechanisms, including long-term biological surveys, environmental condition assessments, post-implementation conservation project monitoring, and structured data sharing agreements with partner organizations.

The DEEP Wildlife Division leads species-level monitoring, often collaborating with other state and federal agencies, academic institutions, and partners. Programs such as the Long Island Sound Trawl Survey, diadromous fish telemetry survey, vernal pool assessments, the recent pollinator atlas (Zarrillo et al., 2025), and the CT Bird Atlas reflect the agency's commitment to standardized, repeatable, and ecologically relevant data collection. Additional efforts, including acoustic monitoring for bats and road mortality surveys for reptiles and amphibians, provide scalable options for community science participation.

Habitat monitoring is coordinated through the Bureau of Natural Resources and CT DEEP's Water Quality Monitoring Program (link). These programs use a combination of field-based assessments and remotely sensed data to track trends in forest, wetland, stream, and coastal systems. Increasingly, Connecticut is working to integrate habitat

quality metrics (e.g., canopy condition, hydroperiod, connectivity) that are ecologically meaningful for SGCN.

Conservation Action Monitoring

Conservation Action Tracker

The Connecticut Conservation Action Tracker (CAT) will provide a centralized, web-based portal that enables CT DEEP and its conservation partners to document, visualize, and share projects that advance the State Wildlife Action Plan. Through a streamlined, self-service login at ctactions.org, partners can quickly enter a project title, objectives, target taxa or habitats, geographic footprint, and anticipated metrics. Once submitted, each project instantly populates an interactive dashboard and public landing page, complete with intuitive filters for project type, habitat, species group, and threat category. This allows both agency staff and external stakeholders to explore ongoing work without needing an account.

By aggregating previously isolated efforts into a single, searchable platform, the CAT will enhance coordination among state agencies, municipalities, nonprofit organizations, and community groups. Spatial overlay options, such as existing CT DEEP properties and conserved open spaces, provide critical context for landscape-scale planning, while real-time visibility reduces redundant or misaligned actions. By highlighting projects that address key challenges, ranging from habitat fragmentation and invasive species to hydrological changes, the Action Tracker will not only streamline resource allocation but also facilitate public engagement by identifying local volunteer and partnership opportunities. In doing so, it shifts Connecticut's Wildlife Action Plan from a static policy document into a dynamic network of coordinated conservation actions.

TRACS

To evaluate the effectiveness of conservation actions, the state utilizes logic models and results chains to link actions with expected ecological outcomes (see NEAFWA 2008; AFWA 2012 for guidance on results-based conservation planning). These models are especially useful for multi-species or habitat-based projects, where response variables may vary across different taxonomic groups. Performance metrics are increasingly embedded into project design and reporting requirements, especially for actions funded through the State Wildlife Grants program and tracked in TRACS.

This framework is designed to be adaptive, with monitoring results feeding directly into action evaluations and priority setting. This enables CT DEEP and its partners to adjust strategies based on what is happening on the ground. Integration with federal and regional

platforms enhances consistency, while local implementation retains the flexibility necessary to address Connecticut's conservation priorities effectively.

Monitoring SGCN and SAPS

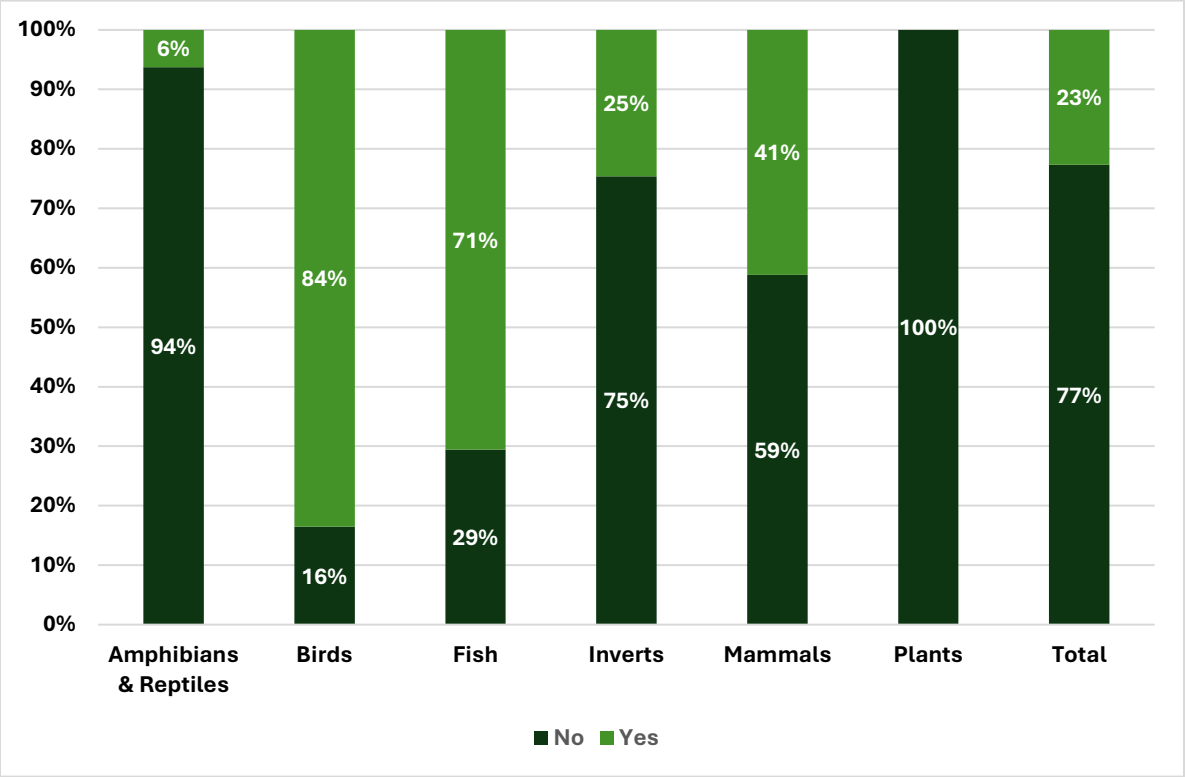

Figure 5.1 – Proportion of each taxonomic group's SGCN with (yes) and without (no) established monitoring plans.

Connecticut's approach to monitoring SGCN and SAPS reflects the state's diverse species groups and the uneven availability of information across the different groups. Among the 573 SGCN and 515 SAPS identified in the 2025 Wildlife Action Plan, over half were flagged by Taxa Teams as requiring additional monitoring to fill gaps in distribution, abundance, or trend data (see Chapter 4). This includes nearly all invertebrates and plants, as well as many cryptic or low-detectability vertebrates, and a subset of marine fish and birds that are tracked regionally but not consistently assessed within state boundaries. However, only approximately 23% of all SGCN and 14% of SAPS currently have an explicit monitoring plan identified by Connecticut's taxonomic experts (Figure 5.1; see Appendix 5.1 for the complete list of SGCN and SAPS monitoring information).

Monitoring is prioritized at three ecological scales: individual species, taxonomic guilds, and natural communities. Individual species tracking is emphasized for high-priority

taxa such as Saltmarsh Sparrow, Eastern Box Turtle, and Rusty-patched Bumble Bee, which are of regional concern and feasible to monitor through standardized protocols. Guild-level approaches are employed for freshwater mussels, shrubland birds, migratory bats, and diadromous fish, where groups of species share common habitats and threats, allowing for bundled monitoring designs. Community-level surveys, such as vernal pools or benthic invertebrate assemblages, are used in systems with high species richness or limited taxonomic resolution.

Monitoring varies significantly by taxonomic group. Amphibian & Reptile monitoring remains highly variable (Figure 5.2). Targeted species, such as the Wood Turtle, Eastern Box Turtle, and Spotted Turtle, have benefited from telemetry, mark-recapture, and road mortality monitoring (Klemens et al., 2021). Yet, due to their short activity windows and limited habitat access, most vernal pool and fossorial species (e.g., the Eastern Spadefoot and the Four-toed Salamander) are poorly detected. The Herp Taxa Team flagged many species as being known from a handful of historic records, or only from areas where targeted efforts occurred. Additionally, only 6% of Amphibian & Reptile SGCN have established monitoring protocols, underscoring a pressing need for statewide survey standardization (Figure 5.2).

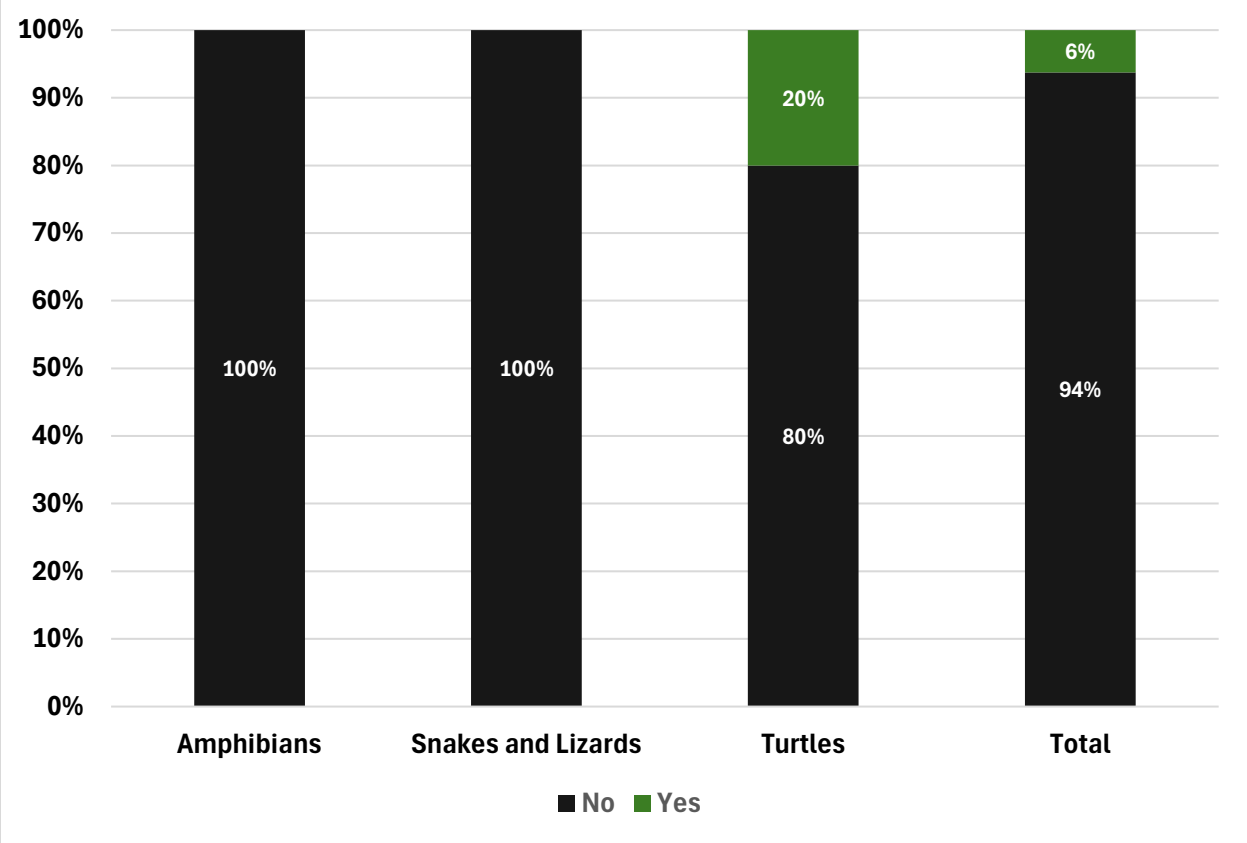

Figure 5.2 – Proportion of each Amphibian & Reptile subgroup's SGCN with (yes) and without (no) established monitoring plans.

The Bird Taxa Team emphasized that while many species are captured by long-running regional programs (e.g., CT Bird Atlas, Breeding Bird Survey, Motus, Christmas Bird Count), other SGCN, especially cryptic species and certain coastal migrants, may be difficult to detect using standard monitoring strategies. The Connecticut Bird Atlas filled major gaps between 2018 and 2022, with over 25,000 volunteer hours resulting in high-resolution occupancy and relative abundance data (COA Bulletin, 2022). Despite some data gaps, Bird SGCN have the highest proportion of established monitoring plans (83%) of any other taxonomic group (Figure 5.3).

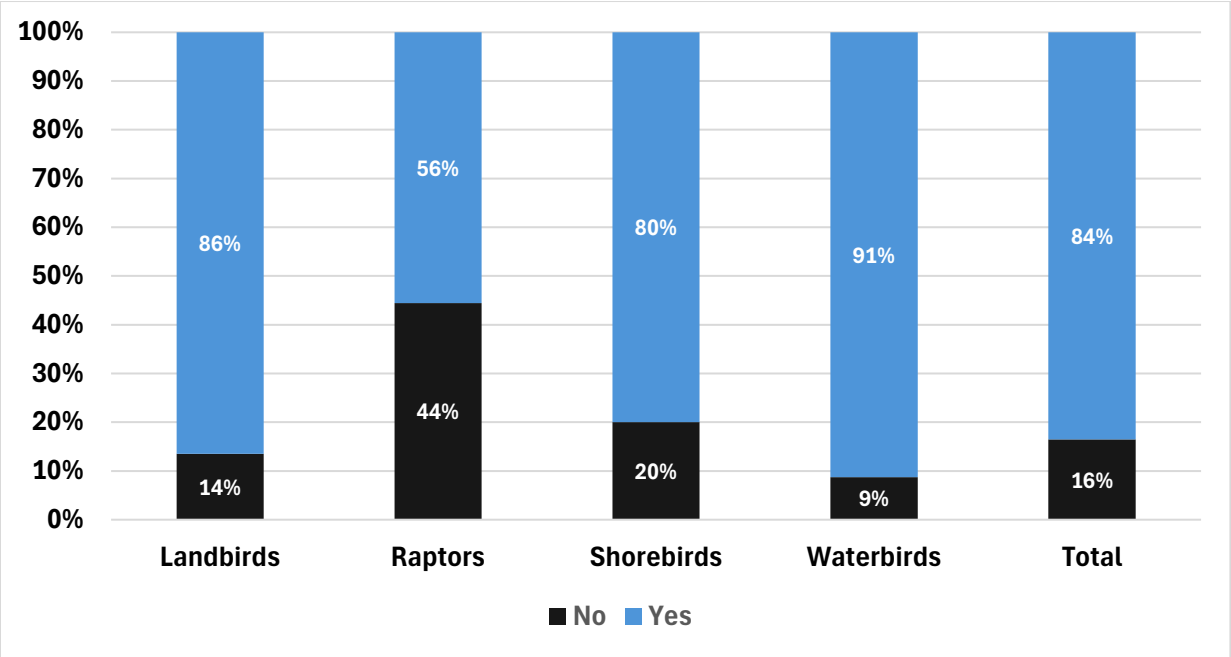

Figure 5.3 – Proportion of each Bird subgroup's SGCN with (yes) and without (no) established monitoring plans.

Fish monitoring is relatively strong due to long-running programs from DEEP Fisheries. The Long Island Sound Trawl Survey, freshwater electrofishing, and diadromous telemetry programs provide trend data for many SGCN, including Alewife, American Shad, Atlantic Herring, and Shortnose Sturgeon. However, the Fish Taxa Team noted that data and monitoring protocols for estuarine species and freshwater nongame fish (e.g., Swamp Darter, Banded Sunfish, Bridle Shiner, American Brook Lamprey, and Burbot.) are sparse, and that many stream systems lack systematic surveys, especially for species with narrow thermal or flow preferences (Figure 5.4). Despite the relative gap in freshwater and estuarine coverage, most Marine and Diadromous SGCN have established monitoring plans (Figure 5.4).

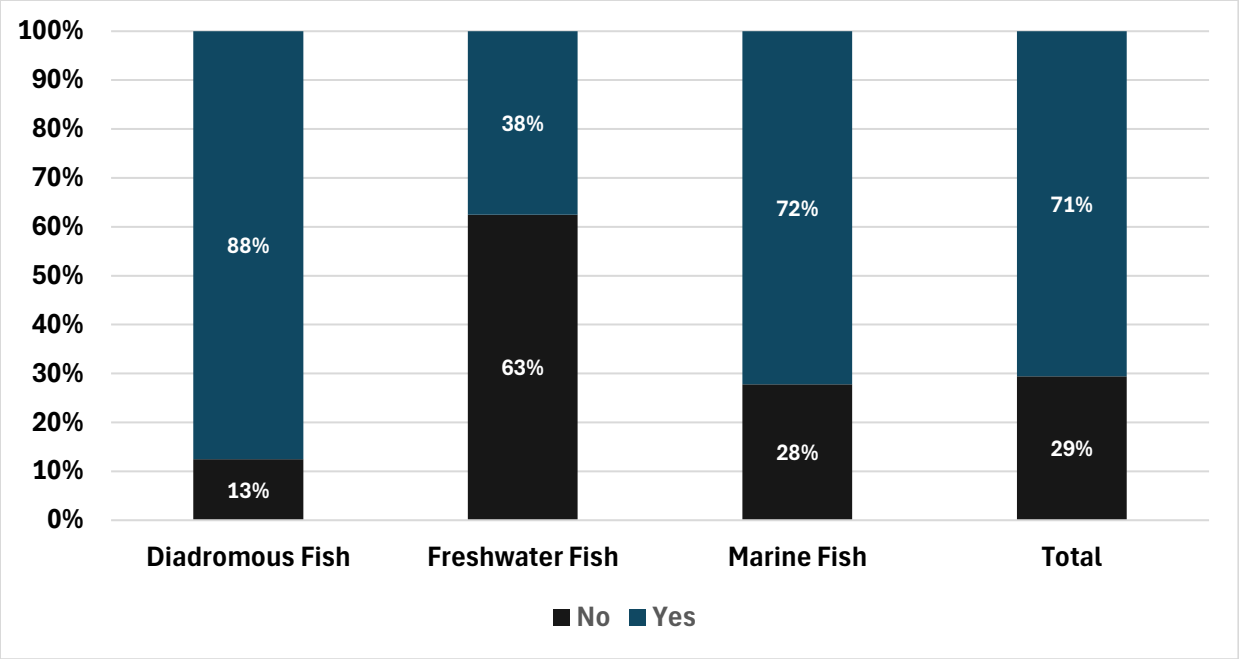

Figure 5.4 – Proportion of each Fish subgroup's SGCN with (yes) and without (no) established monitoring plans.

Invertebrates face the most pronounced gaps in monitoring. The Invertebrate Taxa Team reported that many SGCN in this group are known from fewer than five records, often based on opportunistic collections. Even relatively conspicuous groups, such as tiger beetles, dragonflies, and butterflies, are under-surveyed due to taxonomic constraints, funding limitations, and a lack of consistent sampling coverage. Micromoths are especially underrepresented in existing datasets, with several species considered possibly extirpated due to an absence of records in modern sources (e.g., iNaturalist, Peabody collections). The team recommended prioritizing species that serve as habitat indicators (e.g., Dune Noctuid Moth) or represent imperiled systems such as coastal dunes, barrens, and sandplains. While monitoring plans and protocols exist for many of the marine invertebrate SGCN (87%), terrestrial invertebrates, especially insects, generally lack monitoring plans (Figure 5.5)

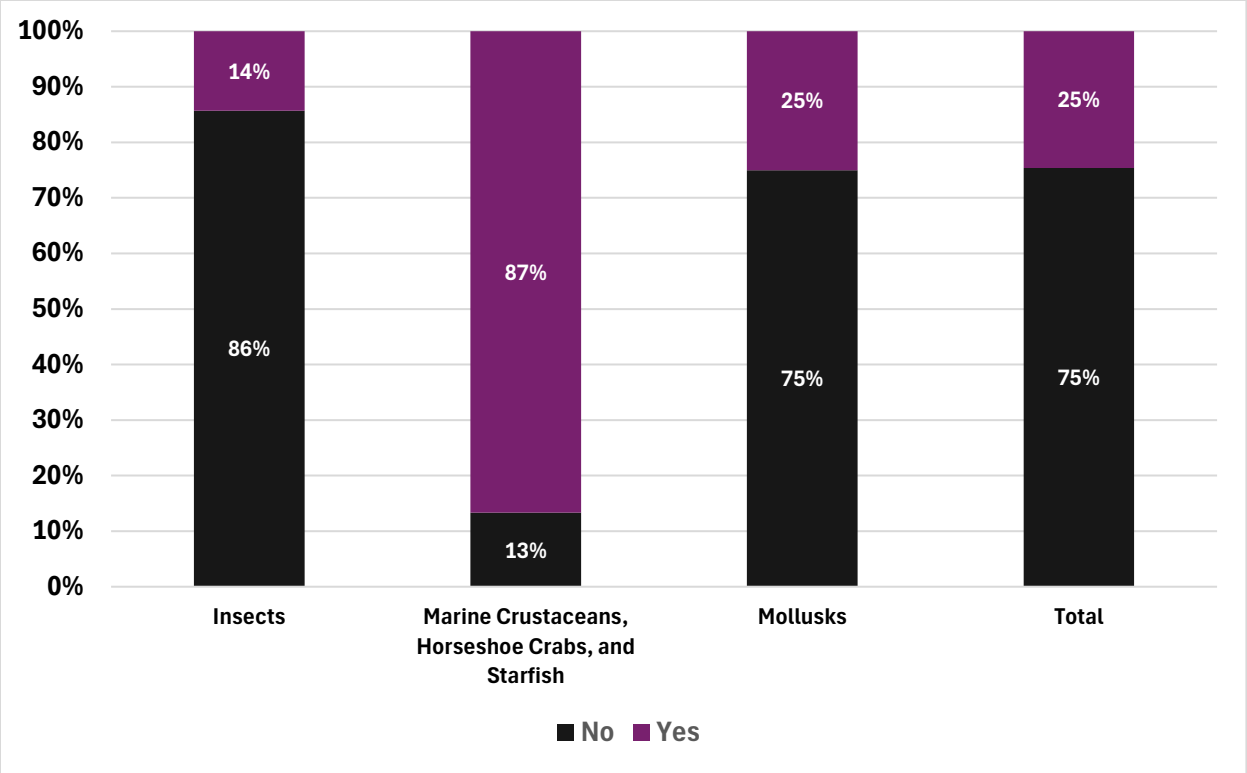

Figure 5.5 – Proportion of each Invertebrate subgroup's SGCN with (yes) and without (no) established monitoring plans.

Mammal monitoring is limited for small-bodied and rare species. The Mammal Taxa Team highlighted a range of SGCN and SAPS with either severely outdated or nonexistent survey data, including the Northern Flying Squirrel, Southern Bog Lemming, North American Deermouse, and Mustelids. Several species, such as Woodland Jumping Mouse and Hairy-tailed Mole, may be widespread, but their real distribution remains unknown due to habitat fragmentation, limited detectability, or outdated methods. In contrast, bat monitoring is comparatively advanced, with ongoing acoustic and maternity surveys for the Big Brown Bat, Red Bat, and other species. However, Taxa Team members expressed concern over erratic phenology and late birth pulses, which are potentially linked to shifting environmental conditions. Monitoring plans exist for roughly half of Connecticut's Mammal SGCN, reflecting the state's emphasis on Bat monitoring, as there are no established monitoring plans for Marine Mammals (Figure 5.6).

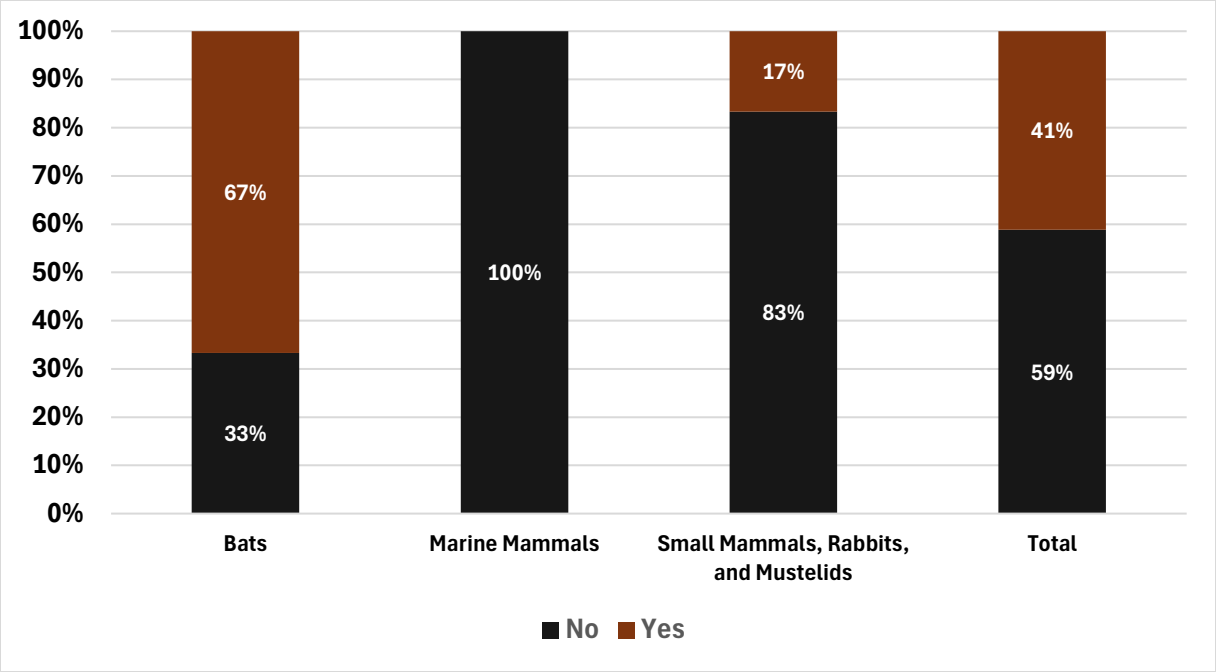

Figure 5.6 – Proportion of each Mammal subgroup's SGCN with (yes) and without (no) established monitoring plans.

In Connecticut, Plant monitoring is limited primarily to opportunistic observations, herbarium records, and informal field notes. The Plant Taxa Team noted that no SGCN or SAPS are subject to structured population monitoring (see Figure 5.1 above), and that even for some SGCN with known ecological value (e.g., host plants for rare invertebrates), presence/absence data are outdated or incomplete. There is an urgent need for targeted monitoring of species such as the Northern Pitcher Plant, Scrub Oak, and saltmarsh-dependent taxa, especially in habitats threatened by succession or coastal saltwater intrusion.

Where species-level monitoring is not feasible, surrogate or habitat-based indicators can be used to inform population condition. For example, monitoring hydroperiods in vernal pools, logging stream temperatures, and conducting vegetative structure assessments in shrublands provide indirect evidence of SGCN habitat quality and potential occupancy by vernal pool-dependent species. In some cases, monitoring gaps are addressed through future action items rather than current protocols. These decisions, particularly for SAPS or species with low detectability, are documented in the action tables and taxa-specific sections of Chapter 4.

Habitat and Environmental Condition Monitoring

CT DEEP and its partners assess habitat change using a combination of field-based assessments, remote sensing, and long-term environmental datasets. These efforts prioritize habitat types that support multiple SGCN or are particularly sensitive to shifting environmental conditions, fragmentation, or development. Several taxa teams emphasized the need to strengthen habitat-based monitoring as a complement to species monitoring and as a surrogate for taxa with low detectability.

Forest habitat monitoring remains the most extensive, supported by the U.S. Forest Service's Forest Inventory and Analysis program and the 2020 Connecticut Forest Action Plan. These data characterize forest composition, age structure, regeneration, pest impacts, and disturbance regimes. Both the Mammal and Bird Taxa Teams noted that many SGCN (e.g., Northern Flying Squirrel, Cerulean Warbler) are closely tied to late-successional or structurally complex forest conditions, which are poorly captured by general canopy cover metrics. Both groups recommended increasing spatial resolution and incorporating structural metrics (e.g., coarse woody debris, snag density) where feasible. Monitoring early successional forest and shrubland habitats, which support declining species such as the New England Cottontail and Prairie Warbler, is largely project-based and lacks consistent statewide coverage.

Wetland and vernal pool monitoring is particularly important for amphibians and invertebrates. The Herp Taxa Team identified vernal pool hydroperiod, canopy cover, and connectivity as key drivers of habitat quality for species like the Blue-spotted Salamander and the Spotted Turtle. While DEEP maintains some vernal pool mapping and condition data, standardized, long-term monitoring across pool types and regions is lacking; however, there have been recent efforts by municipalities to map existing vernal pools in their towns. Opportunities to standardize, coordinate, and promote these efforts through CT DEEP and other partner organizations may help this effort. Similarly, the Invertebrate Taxa Team noted that many SGCN (e.g., Creeper mussel, rare dragonflies, and caddisflies) depend on well-oxygenated, slow-flowing wetland and stream margins. Yet, few of these habitats are included in ongoing assessment programs. Additionally, the Taxa Teams emphasized that groundwater-fed wetlands and coastal fens, both high-priority habitats for plants and invertebrates, are particularly under-monitored due to limited access and a lack of baseline mapping.

CT DEEP's Water Quality Monitoring Program assesses physicochemical parameters, benthic macroinvertebrate communities, and habitat metrics across wadeable streams throughout the state. Temperature loggers are deployed in coldwater streams to evaluate thermal refugia. However, the Fish and Herp Taxa Teams identified

significant gaps in monitoring intermittent and headwater streams, particularly for species associated with spring-fed or ephemeral flow regimes. Additionally, integrating standard techniques for salamander sampling in streams could be an added benefit. In marine systems, habitat conditions are inferred from community-level trawl survey data and temperature/salinity profiles collected alongside fisheries assessments. Still, there is limited direct monitoring of estuarine substrate, submerged aquatic vegetation, or hypoxic events that may affect SGCN distributions.

Plant-associated habitat monitoring is largely indirect. The Plant Taxa Team emphasized that changes in plant communities often signal broader ecological shifts; yet, few monitoring programs track community composition over time in key systems, such as traprock ridges, coastal grasslands, or acidic barrens. While some federally listed plant populations are monitored, most SAPS plants lack any form of regular census or demographic tracking. This limits the ability to detect early warning signs of habitat degradation, invasive species encroachment, or range shifts. In sandplain and dune systems, the absence of permanent vegetation plots and soil condition monitoring was highlighted as a major barrier to tracking species and habitat health across taxa.

Habitat condition metrics are also central to evaluating Conservation Opportunity Areas (COAs – see Chapter 4), where CT DEEP has focused its restoration and management efforts. While some COAs have received site-specific monitoring (e.g., saltmarsh elevation and vegetation, pollinator habitat structure), most are not part of a routine, statewide assessment program. Several taxa teams advocated using remote sensing products and standardized habitat assessment protocols (e.g., NRCS Habitat Evaluation Procedures, Rapid Ecological Integrity Assessments) to track condition over time and detect areas of rapid change. These tools are especially valuable for detecting transitions associated with shifting environmental conditions, such as woody encroachment in grasslands, drying of wetlands, or marsh migration into uplands.

Monitoring Conservation Action Outcomes

In Connecticut, monitoring the outcomes of conservation efforts is structured around a results-based framework that links specific actions, identified in Chapter 4, with measurable indicators of ecological response. This approach is grounded in regional guidance, including the Northeast Monitoring and Performance Reporting Framework (NEAFWA, 2008), and best practices from the Association of Fish and Wildlife Agencies (AFWA, 2012), which emphasize outcome-based metrics over purely effort-based reporting.

Monitoring action effectiveness occurs at two primary levels: (1) direct biological outcomes, such as changes in species occupancy, abundance, or demographic rates, and (2) indirect habitat-based or threat-reduction metrics that serve as proxies where species-level data are unavailable or infeasible. For example, for road-stream crossing improvement projects targeting coldwater fish, such as Brook Trout, or diadromous fish like the American Eel, outcomes may be assessed using measures like passage efficiency, stream temperature stabilization, or colonization by target species. In cases like invasive species control, metrics may include cover reduction of target taxa, native vegetation response, and recolonization by SGCN. For grassland restoration projects targeting declining bird populations, outcomes can be evaluated through breeding activity, territory density, or nest success over time.

Several existing frameworks and databases support this type of outcome tracking. The national TRACS system (Tracking and Reporting Actions for the Conservation of Species) allows for standardized reporting of project outputs and, increasingly, biological results. At the regional scale, efforts such as the Conservation Evidence database (Sutherland et al., 2020) and the *What Works in Conservation* initiative provide synthesized effectiveness ratings for common conservation actions, offering context for expected outcomes and comparative benchmarks. Connecticut's use of structured action codes and classification framework in Chapter 4 helps integrate with these new systems and provides a platform for repeatable, statewide performance tracking.

Many conservation actions, particularly those related to habitat restoration or long-term landscape processes, lack short-term biological indicators that can be easily monitored. In such cases, CT DEEP and partners often rely on a tiered approach that begins with implementation verification (e.g., acres treated, structures installed), followed by monitoring of habitat response (e.g., vegetation structure, hydrology), and then species responses where feasible. Where appropriate, Connecticut is working to incorporate results chains and logic models into future grant planning and evaluation efforts, especially for larger, landscape-scale initiatives. These models help clarify assumptions, identify critical uncertainties, and specify measurable outcomes that can inform monitoring design and adaptive response.

As part of this strategy, CT DEEP is also investing in building institutional capacity to consistently evaluate conservation effectiveness. A big part of this effort involves setting up the Conservation Action Tracker (see above), which will provide a web portal for state agencies, NGOs, and other groups conducting conservation monitoring and actions to upload their information to a centralized place, making the information easily accessible. CT DEEP also plans to expand post-project monitoring, improve coordination with

academic partners and practitioners, and ensure that funding proposals and conservation plans explicitly identify measurable outcomes.

Data Gaps and Monitoring Limitations

Despite significant progress in expanding Connecticut's monitoring infrastructure, substantial data gaps remain that limit the state's ability to fully assess the status of many SGCN and SAPS and evaluate the effectiveness of conservation actions (Figures 5.1 and 5.7). These limitations stem from various factors, including insufficient baseline data, low detectability of certain target species, inconsistent survey coverage, shortages in taxonomic expertise, and a lack of standardized monitoring protocols across taxa and habitats.

The taxa with the most severe information deficits include invertebrates, plants, and small or cryptic vertebrates (e.g., some amphibians, volant mammals, subterranean invertebrates). Abundance and trend data are often lacking for these groups, and distribution records are sparse, outdated, or anecdotal. For example, more than 80% of SGCN invertebrates were identified by Taxa Teams as requiring additional monitoring; yet, only 30% are included in structured survey programs (Figure 5.1). Many freshwater mussels, pollinators, and stoneflies remain poorly known despite being tied to some of the state's most imperiled aquatic systems. Plants, which typically lack population monitoring outside of rare plant surveys for regulatory or land-use planning purposes, do not have any established monitoring protocols for any SGCN or SAPS (Figures 5.1, 5.7). Some gaps persist in even better-studied taxa, such as birds and fish, for species with specialized habitat requirements, episodic detectability, or marginal range distributions.

Habitat monitoring is similarly uneven. While forest and aquatic systems are relatively well characterized through existing programs (e.g., FIA plots, stream temperature logging, water quality assessments), other systems, particularly wetlands, vernal pools, coastal grasslands, and trap rock ridges, lack consistent monitoring outside of project-specific contexts (see Chapter 2). Likewise, metrics for ecological integrity, habitat function, and vulnerability to shifting environmental conditions are rarely applied across habitat types in a standardized way, complicating comparisons over time or between sites. These limitations are further compounded in private lands, where access restrictions limit monitoring coverage even though many SGCN habitats occur on privately owned landscapes.

In some cases, monitoring is not currently identified for specific species or species groups because it is not appropriate, necessary, or feasible. For example, tracking highly

mobile migratory birds may be redundant with ongoing national programs, such as eBird, the Breeding Bird Survey, or Motus. Other species, particularly those with highly ephemeral or unpredictable emergence patterns (e.g., Spadefoot Toads, certain dragonflies), may be difficult to survey reliably without major investment. For SAPS, which by definition require assessments that require monitoring, large gaps exist in monitoring plans, with most SAPS (aside from Birds and Fish) lacking plans (Figure 5.7). For more information, please review the habitat-specific sections of Chapter 2 and the taxon-specific summaries in Chapter 4.

Addressing these data gaps requires a combination of strategies, including targeted baseline surveys, the development and dissemination of standardized protocols, the expanded use of community science, and investment in taxonomic training and monitoring infrastructure. Given limited resources, prioritizing where new data collection will have the greatest impact on conservation outcomes is critical. One action identified through the 2025 Wildlife Action Plan revision process is to create a series of basic biodiversity survey protocols that property owners, such as land trusts, municipalities, and private landowners, can use to inventory the species found on their property, and establish a web portal to share this data with CT DEEP and other partners. Connecticut's plan aims to prioritize monitoring investments based on species status, ecological function, the severity of the threat, and the potential for near-term conservation benefits.

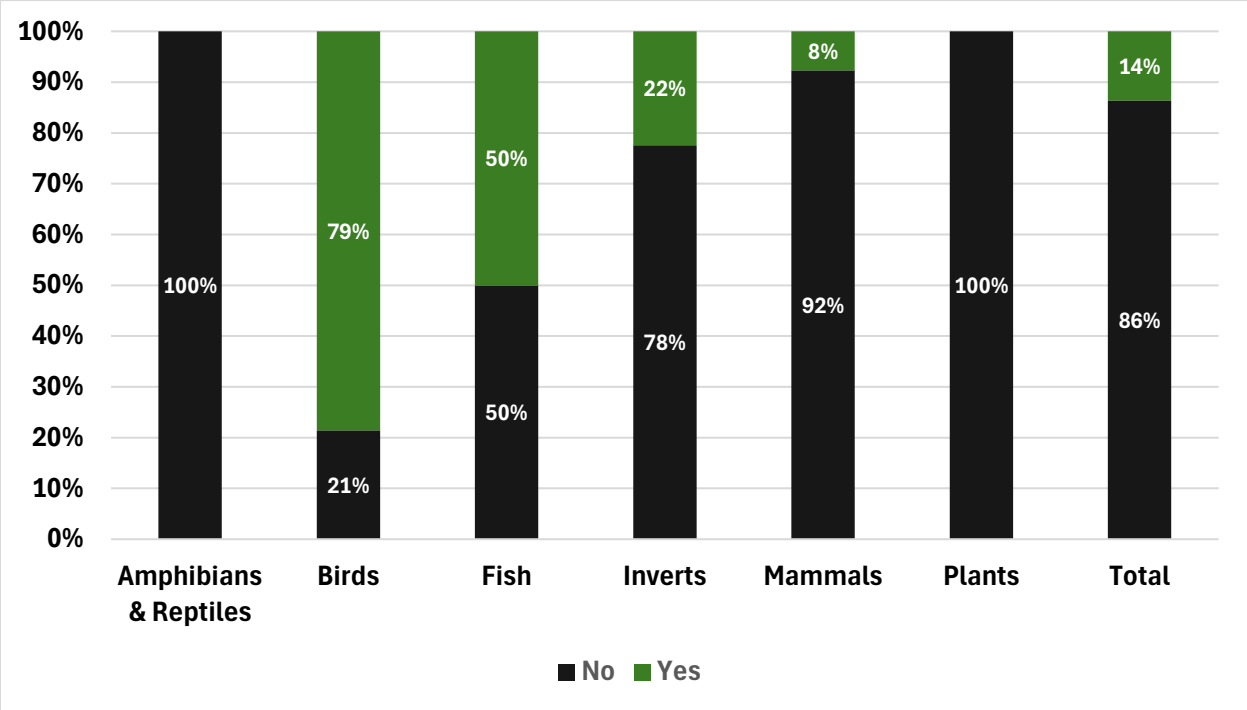

Figure 5.7 – Proportion of each taxonomic group's SAPS with (yes) and without (no) established monitoring plans.

Building on Existing Monitoring Programs

Connecticut's monitoring strategy builds heavily on the foundation of existing programs, many implemented in partnership with federal agencies, academic institutions, and regional collaborators. Leveraging these established systems enhances efficiency, reduces redundancy, and ensures data collection aligns with broader regional and national frameworks. Several agency-led programs provide core support for species and habitat monitoring. The Long Island Sound Trawl Survey, conducted by CT DEEP's Fisheries Division, has provided multi-decadal data on marine and estuarine fish communities and is one of the longest-running datasets in the Northeast. Freshwater fish populations are monitored through electrofishing, angling surveys, diadromous fish telemetry, and egg mat surveys, with particular attention to species such as Alewife, American Shad, American Eel, and Brook Trout. For wildlife, the Breeding Bird Atlas, Winter Raptor Survey, and participation in the Motus Wildlife Tracking System provide high-resolution spatial and temporal data on birds, including many SGCN such as Saltmarsh Sparrow and American Woodcock. Bats are monitored through acoustic surveys and hibernaculum counts, supporting long-term tracking of the impacts of white-nose syndrome on species such as the Little Brown Myotis and the Tricolored Bat (Table 5.1).

Connecticut also contributes to national monitoring frameworks coordinated by the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), the Environmental Protection Agency (EPA), and the National Oceanic and Atmospheric Administration (NOAA). These frameworks include the Breeding Bird Survey, the North American Bat Monitoring Program (NABat), the National Wetland Condition Assessment, and the National Aquatic Resource Surveys, which inform status and trend assessments for Species of Greatest Conservation Need (SGCN) or their habitats. Through the TRACS (Tracking and Reporting Actions for the Conservation of Species) system, conservation actions funded by the State Wildlife Grants program are also tracked with increasing emphasis on biological outcomes.

Regional tools further support Connecticut's monitoring strategy. The Northeast Lexicon and the Monitoring and Performance Reporting Framework, developed by NEFWDTC and NEAFWA, respectively, offer standardized terminology and indicators, facilitating cross-state comparisons. The Conservation Evidence database provides synthesized evaluations of action effectiveness, offering guidance for monitoring design. Through the RCN (Regional Conservation Needs) program, Connecticut has participated in multi-state efforts to develop protocols for monitoring early successional habitats, assessing vernal pools, and conducting rare reptile surveys, many of which remain active or are transferable to other projects.

Community science and non-profit partnerships are another vital component. Platforms like eBird, iNaturalist, and the Pollinator Pathway initiative provide supplemental data for species detection and habitat use, especially for widespread but under-surveyed taxa such as pollinators, amphibians, and plants (see Chapter 1 for an exhaustive list of citizen science projects by taxon). Local land trusts, universities, and conservation districts contribute to site-specific monitoring of habitats and populations, often in priority Conservation Opportunity Areas (COAs, see Chapter 4). CT DEEP continues to explore opportunities to formalize these collaborations through data-sharing agreements, joint protocols, and capacity-building.

Adaptive Management Framework

Adaptive management is the foundation of Connecticut's Wildlife Action Plan implementation strategy and is embedded throughout its monitoring approach. Adaptive management involves gathering and examining successive observations or measurements to assess changes in condition and track progress toward management objectives, coupled with the explicit use of that information to revise and improve future actions (AFWA, 2012). This iterative process ensures that conservation investments remain responsive to changing ecological conditions, management outcomes, and emerging scientific knowledge.

Connecticut applies adaptive management at two primary levels: (1) species and habitat conservation implementation, and (2) strategic plan evaluation and revision. At the implementation level, the state uses taxon-specific monitoring results and action evaluations (as detailed in the sections above) to determine whether conservation targets are being met and whether underlying assumptions remain valid. For instance, site selection criteria or restoration techniques can be revised if shrubland restoration projects intended to support New England Cottontail do not yield occupancy increases or suitable vegetative structure. Similarly, post-installation monitoring of aquatic connectivity projects can inform refinements in culvert sizing, placement, or prioritization based on observed fish passage outcomes.

CT DEEP uses an internal review process informed by annual reporting, SWG performance tracking (via TRACS), and periodic synthesis of monitoring data to adjust conservation priorities and update action plans. This includes mid-cycle evaluations of implementation effectiveness, trends in habitat condition, and updates on SGCN status, which may result in adjustments to resource allocation, partner engagement, or research emphasis. The plan's flexible structure, organized by conservation action rather than by

static species lists, enables adaptation to shifting environmental baselines, novel threats (e.g., emerging pathogens), and changes in species distributions or legal status.

Results chains, conceptual models, and logic frameworks are increasingly important in Connecticut's adaptive management approach, especially for landscape-scale initiatives or multispecies actions. These tools determine expected causal relationships, identify critical assumptions and potential failure points, and help define appropriate monitoring indicators. Several examples from the 2015 Plan remain relevant today, such as the New England Cottontail results chain, which links shrubland restoration to increased occupancy, and the Long Island Sound trawl chain, demonstrating how fish assemblage data inform estuarine management. Future actions will incorporate similar modeling during project design, improving evaluation and adaptability where feasible.

Crucially, adaptive management requires an institutional commitment to learning. This includes allocating funding for post-implementation monitoring, supporting staff time for evaluation, and fostering a culture where iteration is viewed as progress, not failure. Connecticut's Wildlife Action Plan reaffirms this commitment and outlines clear mechanisms for incorporating monitoring findings into conservation delivery. By maintaining an evidence-based, feedback-driven approach, the state ensures that its conservation strategies remain relevant, effective, and grounded in the best available science.

Coordination with Partners and the Public

Effective monitoring in Connecticut depends on sustained collaboration with a broad network of conservation partners, including federal and state agencies, academic institutions, land trusts, conservation districts, non-profit organizations, municipalities, and tribal governments. These partnerships extend the reach of CT DEEP's monitoring efforts, fill data and capacity gaps, and support the implementation of species and habitat-level tracking at multiple geographic scales.

Partner coordination is particularly important for regional monitoring programs that span state lines or require consistency across boundaries. Connecticut actively participates in regional initiatives coordinated by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) and the Northeast Association of Fish and Wildlife Agencies (NEAFWA), including the Regional Conservation Needs (RCN) program and the development of shared monitoring protocols. These frameworks facilitate joint data collection, promote consistency in methods and terminology (via the Northeast Lexicon; Crisfield & NEFWDTC, 2022), and enable comparison of conservation outcomes across the

region. Multi-state collaboration also supports cost-sharing for expensive or logistically complex monitoring efforts, such as rare turtle telemetry, early successional habitat assessments, and long-distance migratory bird tracking via the Motus network (TCI & NEFWTDC, 2023).

At the in-state level, universities and colleges provide essential technical support, from biodiversity inventories to statistical modeling and protocol development. CT DEEP maintains relationships with faculty researchers and student interns to support vernal pool monitoring, acoustic surveys, GIS-based habitat assessments, and other specialized efforts. Conservation NGOs and land trusts contribute on-the-ground expertise and access to properties that might otherwise be inaccessible for monitoring. Many partners, especially local landowners and towns, also play critical roles in maintaining or restoring habitats where monitoring is conducted, such as impounded wetlands, road-stream crossings, or managed grasslands. Additionally, engaging with municipal conservation commissions and the Connecticut Land Conservation Council, as well as promoting Natural Resource Inventories and mapping, offers many opportunities. However, these initiatives will require training and support, especially in establishing guides and conducting training for biodiversity surveys on town- and land-trust-owned properties (see Chapters 4 and 6).

Citizen science plays an increasingly prominent role in Connecticut's monitoring strategy. Programs like eBird, iNaturalist, the North American Amphibian Monitoring Program (NAAMP), and the Bumble Bee Watch engage trained volunteers in data collection that complements professional surveys. While these efforts may require validation and filtering, they substantially expand the temporal and spatial scope of biodiversity monitoring, especially for widely distributed or seasonally conspicuous taxa. Several of these platforms are already linked to SGCN or SAPS tracking (e.g., Saltmarsh Sparrow, Eastern Spadefoot, Rusty-patched Bumble Bee). CT DEEP continues to explore mechanisms for formally integrating vetted community data into agency workflows. Conducting workshops on using these tools could also lead to better data quality and more engagement, helping to narrow the considerable data gaps identified in this Plan.

Public engagement is also crucial for raising awareness of species status, habitat condition, and the objectives of conservation actions. Many landowners who host monitoring sites, especially in rural or suburban areas, benefit from direct outreach, technical assistance, or access to monitoring results. Similarly, transparency regarding the outcomes of conservation actions (e.g., stream restoration effectiveness, species rediscovery, or trend reversals) can foster public support and promote stewardship. The

Wildlife Action Plan encourages continued expansion of public participation and partner coordination to build a resilient, inclusive, and scalable monitoring network statewide.

Differences between the 2015 and 2025 CT Wildlife Action Plan

Since 2015, Connecticut has made substantial progress in expanding the scope and resolution of monitoring efforts across multiple taxa and habitats. Although the methods used to identify monitoring accomplishments and needs within the state remained unchanged between the two Wildlife Action Plans, CT DEEP and its partners have made numerous key advances in monitoring within the state. Some of these advances include the completion of the Connecticut Bird Atlas, the expansion of acoustic and telemetry monitoring for bats and turtles, the establishment of long-term datasets from marine and freshwater fish surveys, and the development of new statewide inventories of bee biodiversity (Zarillo et al., 2025) and amphibians and reptiles (Klemens et al., 2021). These efforts fill gaps identified in the 2015 plan and provide a stronger empirical foundation for prioritizing monitoring needs.

Like in 2015, the Taxa Team process clarified where monitoring is underway, efforts are emerging, and gaps persist. In many cases, species previously lacking recent data, such as shrubland birds, vernal pool amphibians, or native bumble bees, are now represented in structured surveys or state-level assessments. Additionally, new datasets have made it possible to assess not only species status but also the effectiveness of conservation actions. Monitoring linked to habitat restoration (e.g., shrubland, tidal marsh), invasive species removal, and aquatic connectivity has matured to the point where CT DEEP and its partners can evaluate ecological responses and adapt strategies as new information is collected.

Looking Forward

One key future direction is the targeted expansion of monitoring for underrepresented taxa, particularly invertebrates and plants. These groups comprise most of Connecticut's SGCN and SAPS, yet remain under-surveyed due to gaps in taxonomic expertise, limited detection methods, and historically lower visibility in conservation planning. The state aims to prioritize protocol development and baseline surveys for priority taxa, including pollinators, freshwater mussels, and rare wetland plants, and to integrate their monitoring into broader habitat assessments, building on recent momentum, especially for pollinators (see Zarrillo et al., 2025). Similarly, amphibians,

reptiles, and small mammals require expanded survey coverage, particularly in marginal or ephemeral habitats (e.g., vernal pools, forested wetlands, caves), which are currently underrepresented in monitoring frameworks.

Improving the spatial and temporal resolution of habitat monitoring is another priority. Forest condition, aquatic connectivity, and tidal marsh dynamics are currently tracked through a combination of state programs and partner datasets. However, other habitat types, including traprock ridges, mesic meadows, and shrublands, lack consistent landscape-scale data (see Chapter 2). Integrating remote sensing, long-term vegetation plots, and environmentally informed indicators into habitat monitoring protocols may help facilitate the early detection of degradation or transitions (e.g., due to invasive species, succession, or coastal saltwater intrusion). Monitoring within Conservation Opportunity Areas (COAs) will remain a focal point, providing high-priority landscapes for testing indicators and informing adaptive management.

New technologies may offer substantial, yet cost-effective, methods for monitoring wildlife. Tools such as environmental DNA (eDNA), passive acoustic recorders, automated camera arrays, and real-time data platforms can enhance detection rates for elusive species, reduce labor costs, and enable broader coverage over space and time. These methods are particularly suited for taxa such as bats, frogs, freshwater fish, and cryptic invertebrates, where traditional survey methods are costly or invasive. Incorporating these tools into long-term monitoring programs will require pilot testing, methodological standardization, and careful integration with existing datasets.

Connecticut will strengthen institutional infrastructure to sustain and coordinate monitoring efforts, starting with the implementation of the Conservation Action Tracker. This also includes building data management and analysis capacity, establishing durable partnerships with academic and non-profit collaborators, and improving the integration of monitoring with planning and funding cycles. By embedding monitoring into the conservation delivery process, from goal setting to implementation and evaluation, Connecticut will continue to use monitoring to ensure evidence-based, dynamic, and actionable conservation in the face of continued environmental change.

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