

Emydine Conservation Symposium

July 2023



Survey Report



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The Emydine Conservation Symposium was supported by the Competitive State Wildlife Grants program (administered by the U.S. Fish and Wildlife Service) through an award to the Massachusetts Division of Fisheries and Wildlife and their partners.

Recommended Citation:

Meck, J. R., M.T. Jones, T.S.B. Akre, A. Badje, S. Buchanan, K. Gipe, J. Kleopfer, R. Nagle, K. Oxenrider, H.P. Roberts, J. Slacum, and L.L. Willey. 2023. Symposium Survey Report for the 3rd Emydine Conservation Symposium, Huntingdon, PA. July 10–12, 2023. American Turtle Observatory (americanturtles.org). 23 pp.

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Cover: Emydinae Turtles, Mike Jones (MassWildlife)

EMYDINE CONSERVATION SYMPOSIUM SYNOPSIS

The 2023 Emydine Conservation Symposium was held at Juniata College in Huntingdon, Pennsylvania on July 10–12th to advance conservation objectives on all species in the Emydine family, specifically the Wood (*Glyptemys insculpta*), Blanding’s (*Emydoidea blandingii*), Spotted (*Clemmys guttata*), and Box (*Terrapene* spp.) Turtle. A total of 145 turtle conservationists from 86 institutions attended the symposium to present research, provide regional updates, or contribute to conservation planning discussions (Fig. 1).

The first day consisted of an optional field trip led by Juniata College to a local research site monitoring freshwater turtle nesting. The site was restored by Juniata College and the U.S. Army Corps of Engineers to develop suitable nesting habitat for the local populations. Participants were able to explore the site and ask questions regarding the research and management logistics.

The following two days were devoted to presentations by 41 experts covering a diverse range of topics, including population assessments, genetics, illegal trade, headstarting, spatial ecology and general biology, and habitat management. In addition to presentations, two panel discussions were held by experts to bring attendees together and corroborate on issues and solutions around illegal trade and repatriation and conservation planning. During the conservation planning session and the end of Day 3, a live Mentimeter survey was given for participants to answer and start discussions. The results of that survey can be found in Appendix B.

Overall, the symposium served as an opportunity for many to foster new working relationships and initiate coordination among institutions, states, and regions. It was the third symposium held since 2016 and served as a great follow-up to on-going regional projects and collaborations. An objective of this year’s symposium was to expand partnerships between the Northeast, Midwest, Southeast, and Canada given the overlap of species and conservation needs. We are hopeful that these symposia will continue in the future on a triannual schedule to keep the momentum of conservation efforts and collaboration going for these charismatic species.

Following the conclusion of the symposium, the planning committee modified the electronic survey sent to attendees and experts in previous years (i.e., 2016 and 2019) to continue to 1) identify and gauge the relative threats to Wood, Blanding’s, Spotted, and Box Turtles, 2) prioritize conservation actions to guide partners in future conservation and management decisions and 3) continue to develop expert solicitation trend data related to perceived threats and required actions to maintain viable populations. The survey was distributed to all symposium attendees as well as other turtle conservationists working with Emydine species. The remainder of this report summarizes the survey results.



Figure 1. Participants of the 2023 Emydine Conservation Symposium at Juniata College.

SURVEY OVERVIEW

In total, 88 turtle experts from 71 different affiliations completed the survey, approximately 26% of whom did not attend the 2023 symposium. Twenty-three states and two Canadian provinces were represented with 58% of participants from the Northeast, 7% from the Southeast, 25% from the Midwest, and 10% from Canada (Table 1). The average number of years working with turtles was 15 (range: 1–65 years). The majority of participants identified as researchers (46), state biologists (22), and young professionals (e.g., students and technicians) (22) (Fig 2). Twenty-three identified as multiple professions (i.e., researcher and state biologist) resulting in 111 professions reported.

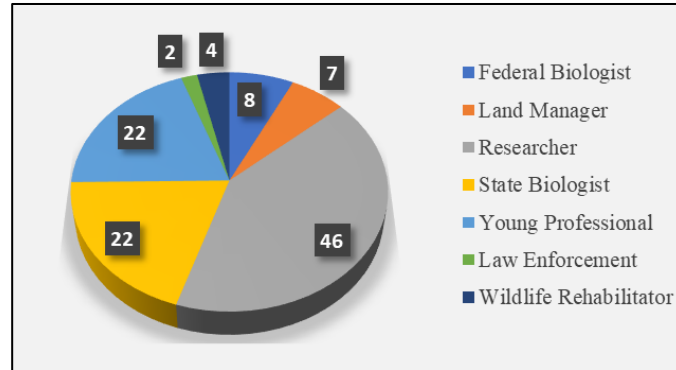


Figure 2. Professions of survey participants.

Survey participants were also asked to report which symposia they have attended and which species in the

Emydine family they have researched or managed. Of the 88 responses, 17 indicated they have not attended any symposia, 17 attended the 2016 symposium in Massachusetts, 39 attended the 2019 symposium in West Virginia, and 65 attended the 2023 symposium. As expected, the Wood (71), Spotted (57), and Blanding’s Turtle (52) had the most participants who have actively engaged with the species. The Box Turtle had 43 participants, the Bog Turtle had 31 and the Western Pond Turtle had the least number of participants with only three reported.

Table 1. Summary of regions used to examine how survey responses varied throughout each species’ range. Northeast, Southeast, and Midwest correspond to U.S. Fish and Wildlife Service (USFWS) and Association of Fish and Wildlife Agencies (AFWA) regions.

	Northeast, USA	Southeast, USA	Midwest, USA	Canada
States/Provinces Represented	CT, DE, ME, MD, MA, NH, NJ, NY, PA, VT, VA, WV	AL, GA, KY, NC, SC	IL, IA, MI, MN, OH, WI	NB, ON
Number of Respondents	51	6	22	9

Respondents were asked to only respond to the questions related to species they currently or previously have worked with and from the perspective of their region. They were then prompted to rank threats to the corresponding species on a scale of 0 (no threat) to 5 (major threat) and the conservation actions needed to maintain viable populations on a scale of 0 (unimportant) and 5 (very important). Results in the report are represented as the average of all regions combined, however, Appendix A provides the average of every action and threat for each region.

The final portion of the survey consisted of respondents ranking conservation actions needed for all Emydine species in the following categories: Inter-regional Coordination, Compiling Information and Data, Education, Illegal Collection and Trafficking, and Habitat Management. We hope the results of this survey will aid researchers, state biologists, and working groups in prioritizing conservation actions and management decisions for these species across their range.

WOOD TURTLE SURVEY RESULTS

Perception of Threats

A total of 68 individuals responded to the Wood Turtle survey section. Results indicated the top threats (≥ 4.0) for the Wood Turtle across their range were **habitat loss and fragmentation: development and stream degradation (4.2), elevated adult mortality: roads (4.1), and lack of reproduction/recruitment (4.0)**. Elevated adult mortality: agricultural machinery and illegal collection also ranked high with an average score of 3.9 (Fig. 3). These rankings were consistent across all regions (Appendix A). Threats that had the highest level of uncertainty among respondents were elevated adult mortality: prescribed fire (16%), emerging diseases (16%), genetic isolation/inbreeding (10%) and climate: increased temperatures (10%) (Appendix B).

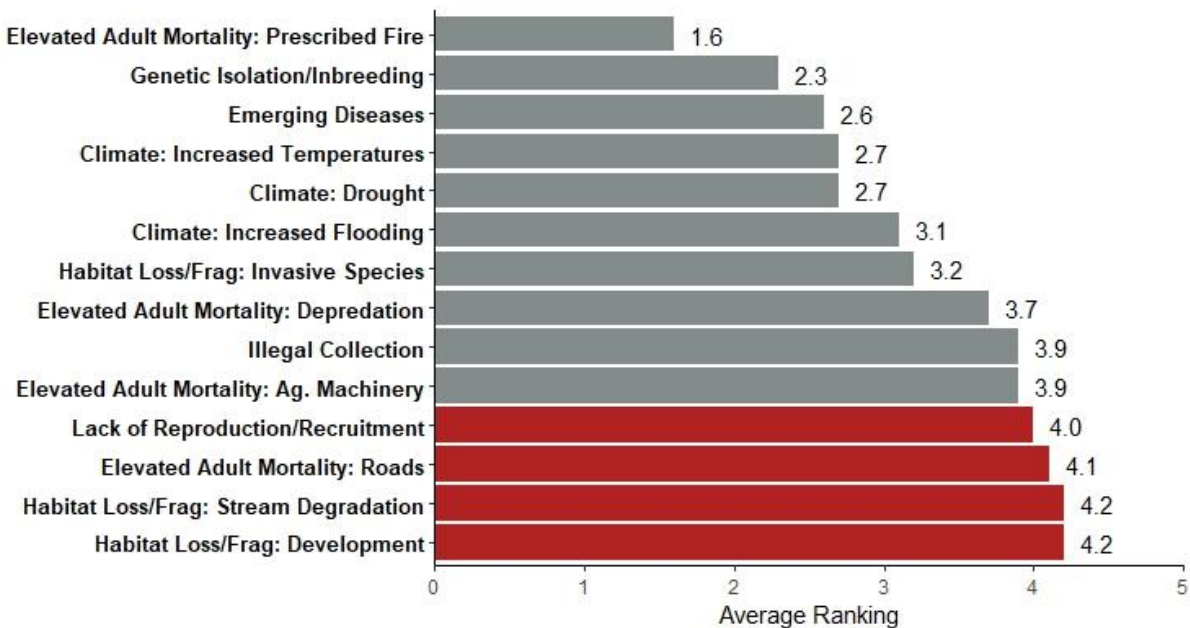


Figure 3. The average ranked threats on a scale of 0 (not a threat) to 5 (major threat) for Wood Turtles by the 68 respondents range wide.

Conservation Actions Needed

Land/riparian management (4.5), land protection (4.4), reduced elevated mortality (4.3), and addressing illegal collection (4.1) were ranked as the most important actions needed to maintain viable populations of Wood Turtles range-wide. The least important actions ranked were technical assistance and population management. (Fig. 4). The Midwest region (n=17 responses) indicated that nest protection and predator control (4.2) was the fourth most important conservation action followed by addressing illegal collection (Appendix A).

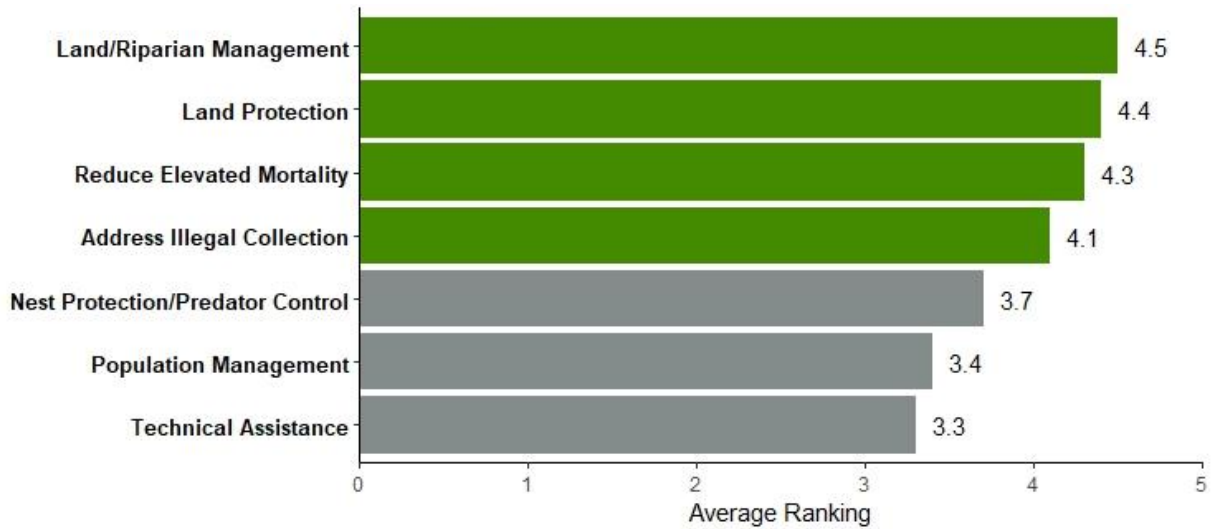


Figure 4. The average ranking of conservation actions needed for Wood Turtles on a scale of 0 (unimportant) to 5 (very important) from the 68 respondents range wide.

Conservation Actions Conducted

A total of 182 conducted conservation actions were reported across the Wood Turtle range. **Nesting habitat management/restoration** (n= 46) and **riparian/wetland restoration** (n=37) were the top two actions. Repatriation was the least reported action conducted (n=7) and only occurred in the Northeast (Fig. 5).

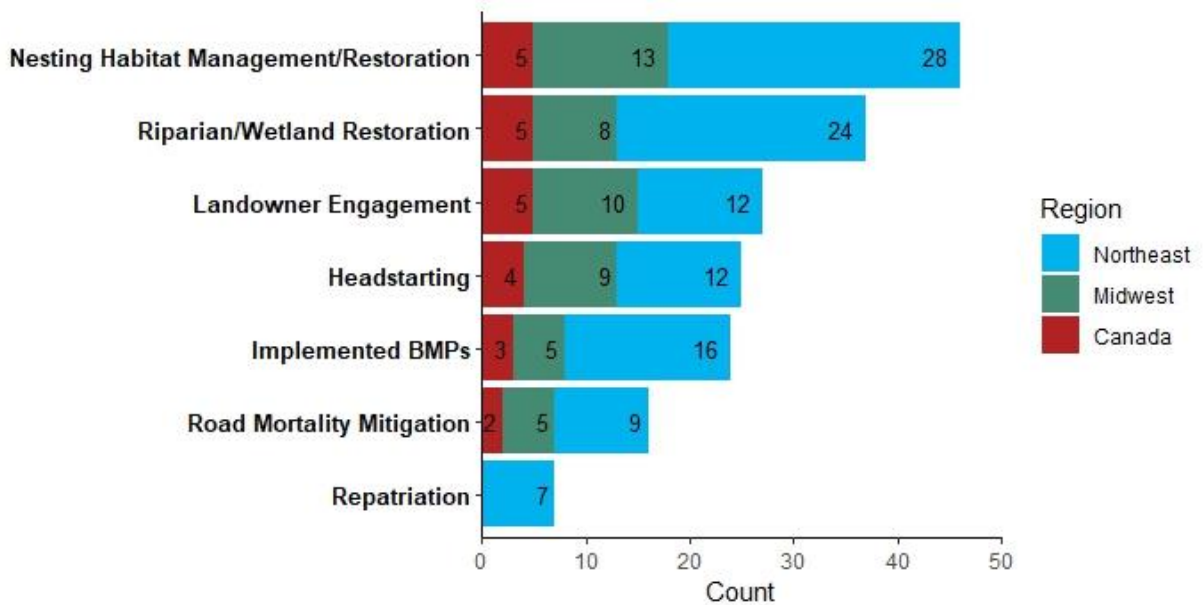


Figure 5. Reported conservation actions conducted in each region for the Wood Turtle.

BLANDING’S TURTLE SURVEY RESULTS

Perception of Threats

A total of 51 individuals responded to the Blanding’s Turtle section of the survey. The highest average ranked threats for the Blanding’s Turtle range-wide were **elevated adult mortality: roads (4.5)**, **habitat loss/fragmentation; development (4.3)**, and **lack of reproduction/recruitment (4.0)**. Habitat loss/fragmentation:wetland degradation was also ranked relatively high (3.9) (Fig. 6). Rankings were similar across all regions (Appendix A). Similar to the Wood Turtle, emerging diseases (16%), climate: increased temperatures (11%), and elevated adult mortality: prescribed fire (10%) were reported as the most uncertain threats among respondents (Appendix B).

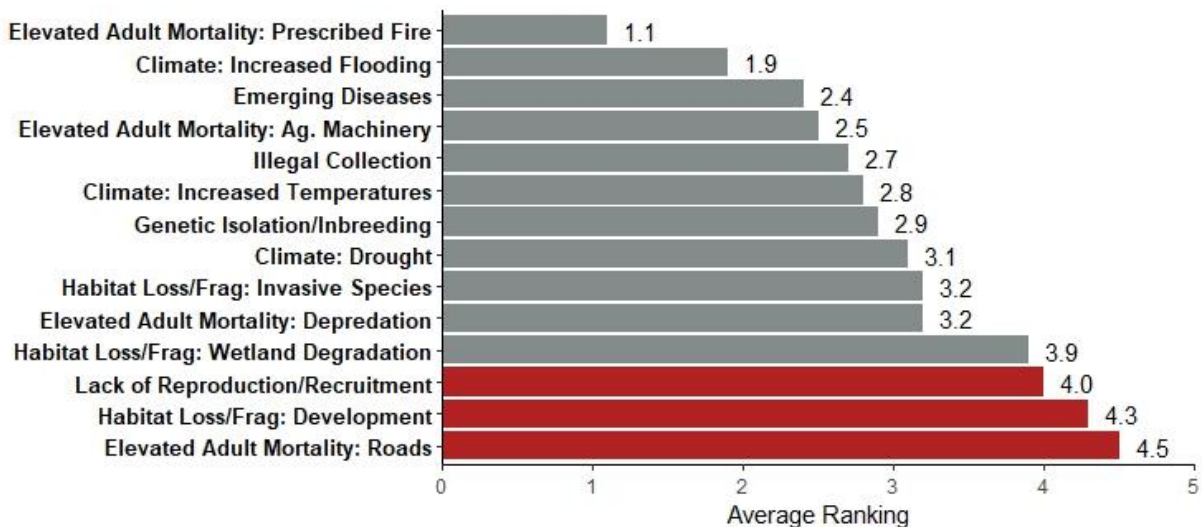


Figure 6. The average ranked threats on a scale of 0 (not a threat) to 5 (major threat) for Blanding’s Turtles by the 51 respondents.

Conservation Actions Needed

The most important conservation actions (≥ 4.0) needed as indicated by average responses from respondents for Blanding’s Turtles were **land protection, reduce elevated mortality, land/wetland management**, and **nest protection/predator control**. Technical assistance and addressing illegal collection were ranked as the least important actions (Fig. 7). Rankings were similar across all regions (Appendix A).

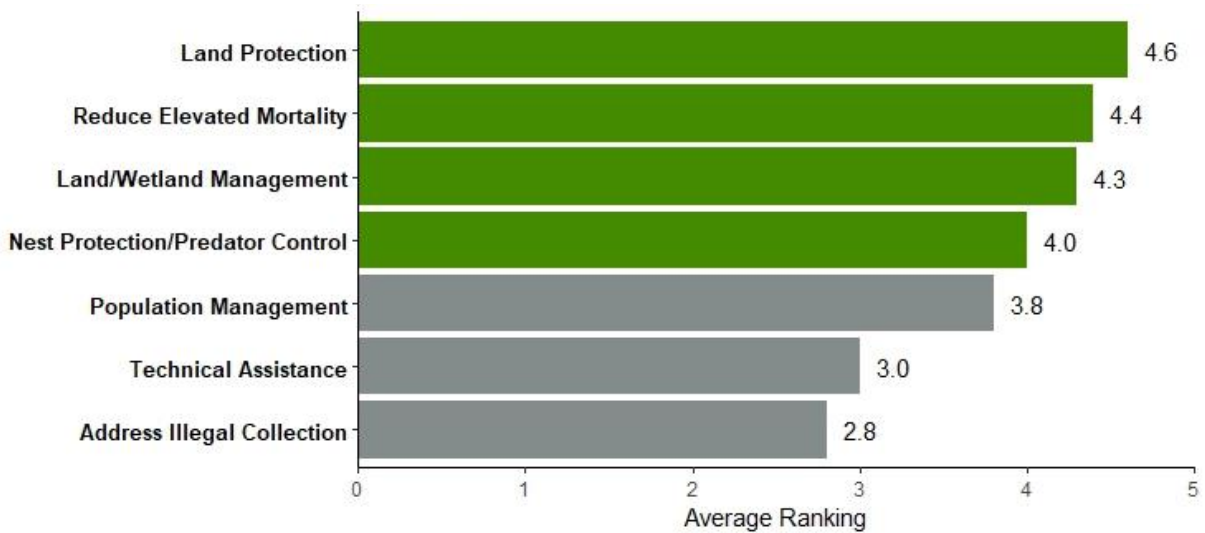


Figure 7. The average ranking of conservation actions needed for Blanding’s Turtles on a scale of 0 (unimportant) to 5 (very important) from the 51 respondents.

Conservation Actions Conducted

A total of 168 conducted conservation actions were reported across Blanding’s Turtle range. **Nesting habitat management/restoration** (n=32), **riparian/wetland restoration** (n=29), and **landowner engagement** (n=29) were the top actions. Repatriation was the least reported action conducted (n=13) and has occurred in all three regions (Fig. 8).

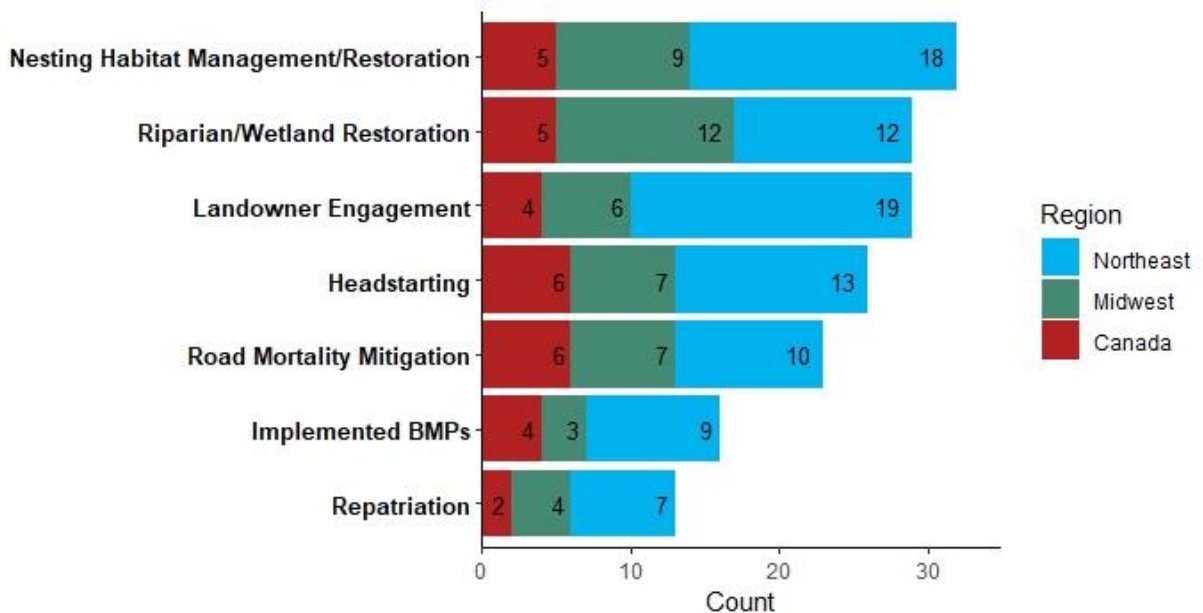


Figure 8. Reported conservation actions conducted in each region for the Blanding’s Turtle.

SPOTTED TURTLE SURVEY RESULTS

Perception of Threats

A total of 54 individuals responded to the Spotted Turtle section of the survey. Results indicated that respondents ranked **habitat loss/fragmentation: development (4.4)**, **illegal collection (4.2)**, and **habitat loss/fragmentation: wetland degradation (4.0)** as the top threats facing Spotted Turtle populations. Rankings were similar across the regions, apart from the Southeast (n=6) ranking genetic isolation/inbreeding (1.0) and lack of reproduction/recruitment (2.5) much lower than the other regions (Fig. 9). The threats with most uncertainty were emerging diseases (37%), elevated adult mortality: prescribed fire (30%), climate: increased temperatures (20%), and genetic isolation/inbreeding (19%) (Appendix B).

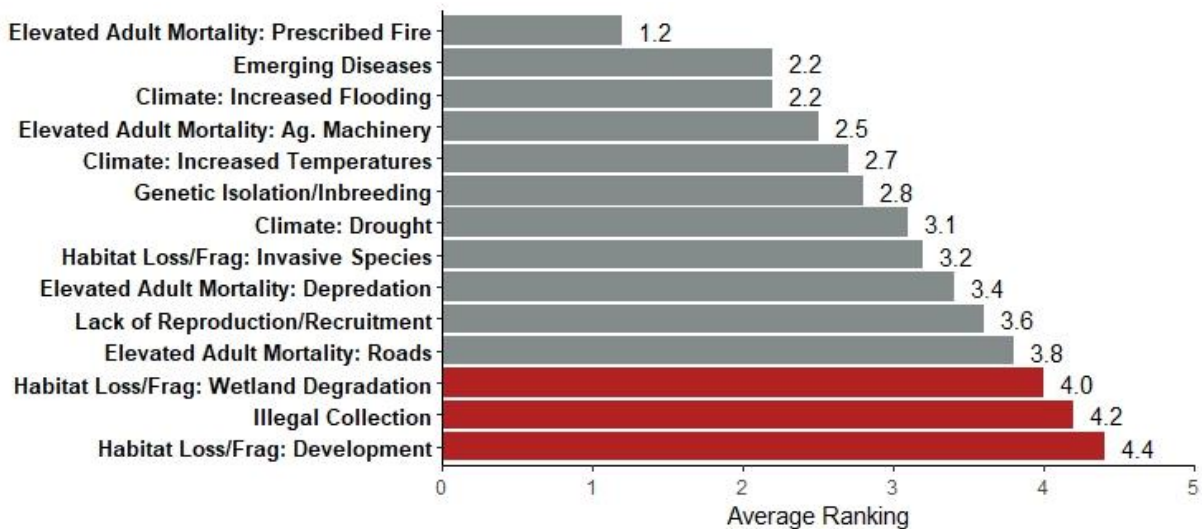


Figure 9. The average ranked threats on a scale of 0 (not a threat) to 5 (major threat) for Spotted Turtles by the 54 respondents.

Conservation Actions Needed

The top three conservation actions needed to maintain viable Spotted Turtle populations according to respondents were **land protection (4.6)**, **address illegal collection (4.3)**, and **land/wetland management (4.1)** (Fig. 10). Compared to the Northeast (n=35) and Midwest (n=8), nest protection/predator control were ranked significantly lower by the Southeast (n=6) and Canada (n=5), 0.8 and 1.6, respectively (Appendix A).

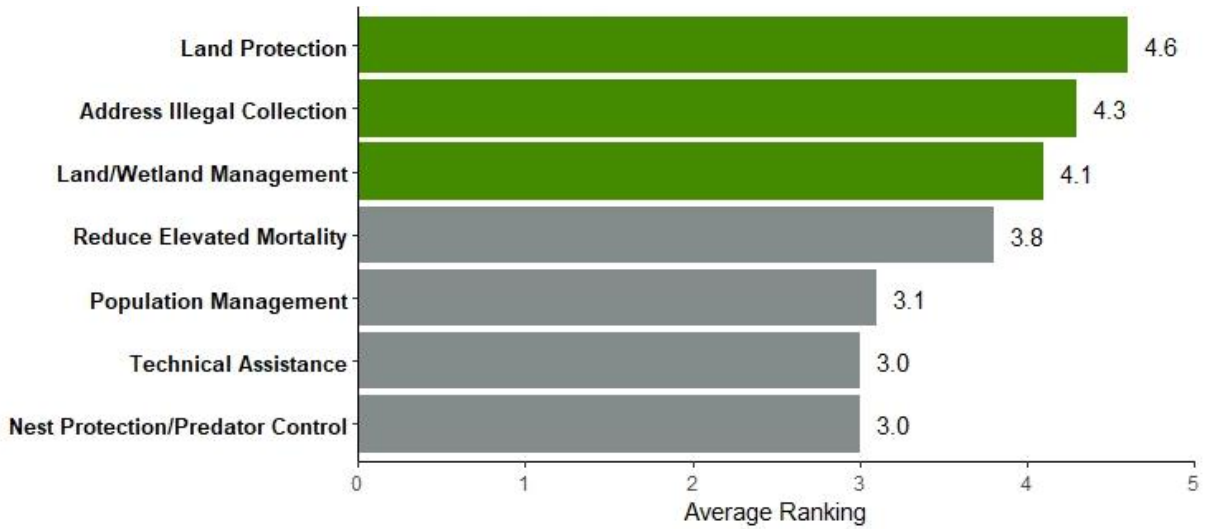


Figure 10. The average ranking of conservation actions needed for Spotted Turtles on a scale of 0 (unimportant) to 5 (very important) from the 54 respondents.

Conservation Actions Conducted

A total of 93 completed or ongoing conservation actions were reported across all four regions for the Spotted Turtle. **Landowner engagement** (n=26) and **riparian/wetland restoration** (n=22) were the top two actions, both primarily in the Northeast and Midwest (Fig. 11). Headstarting and repatriation are the least conducted actions reported among respondents.

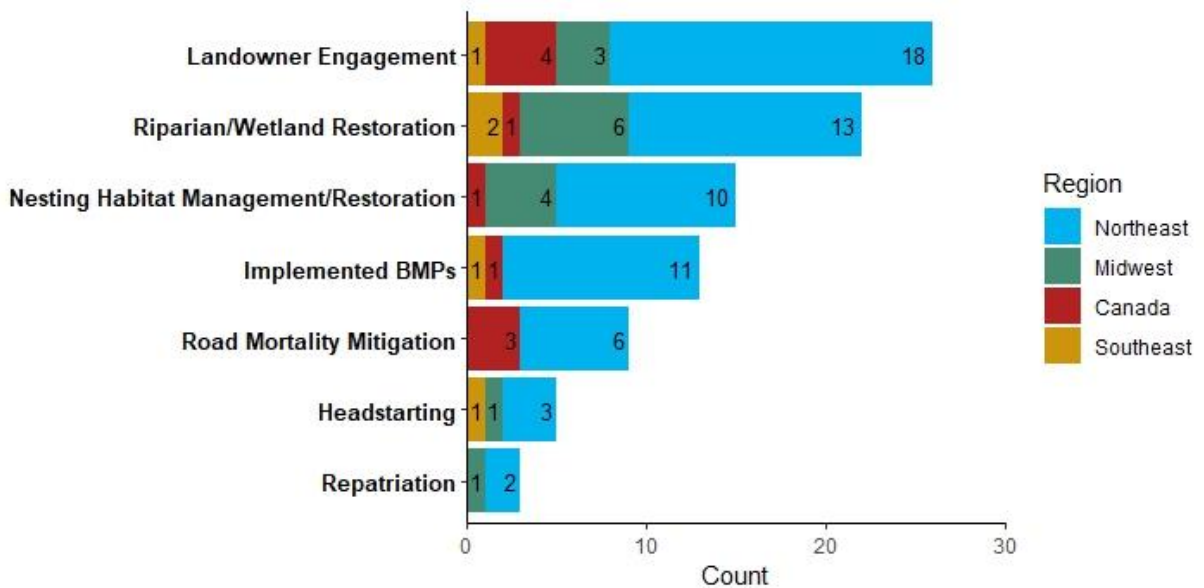


Figure 11. Reported conservation actions conducted in each region for the Spotted Turtle.

BOX TURTLE (*TERRAPENE* SPP.) SURVEY RESULTS

Perception of Threats

A total of 43 individuals responded to the Box Turtle section of the survey. Respondents ranked **habitat loss/fragmentation: development (4.6)**, **elevated adult mortality: roads (4.5)**, and **illegal collection (4.2)** as the top threats for Box Turtle populations (Fig. 12). The rankings did vary slightly across the regions, with the Midwest (n=8) ranking lack of reproduction/recruitment (4.3) as the top threat and the Southeast (n=5) ranking it at 1.8. Other differences among the regions included genetic isolation/inbreeding and habitat loss/fragmentation: invasive species (Appendix A). The threats with most uncertainty included climate: increased temperatures (23%), genetic isolation/inbreeding (16%), and climate: increased flooding (16%) (Appendix B).

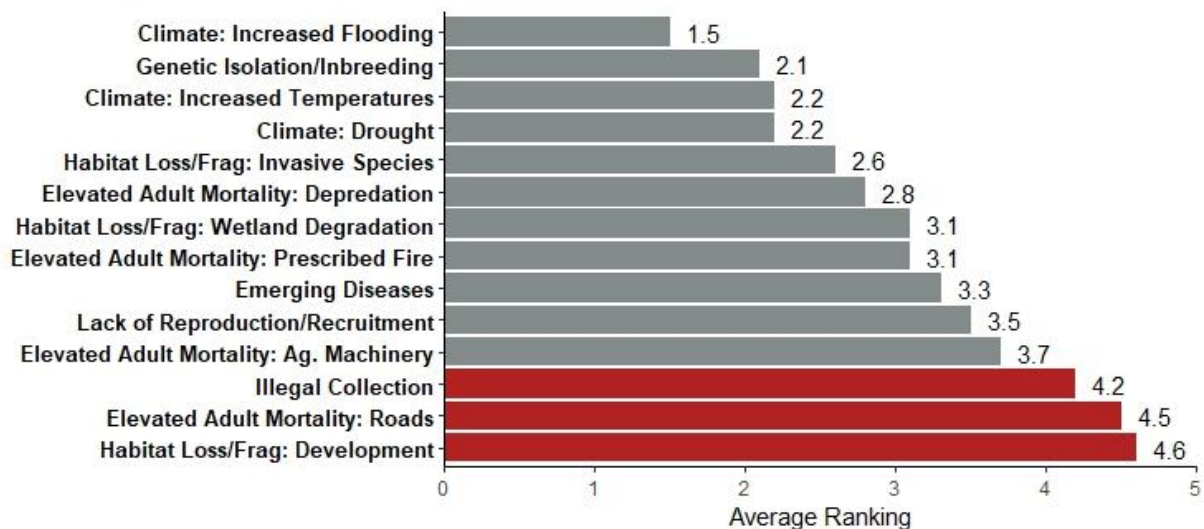


Figure 12. The average ranked threats on a scale of 0 (not a threat) to 5 (major threat) for Box Turtles by the 43 respondents.

Conservation Actions Needed

The top three conservation actions to maintain viable Box Turtle populations according to respondents are **land protection (4.4)**, **address illegal collection (4.4)**, and **reduce elevated mortality (4.1)** (Fig. 13). There were minor differences in rankings among the regions. The Southeast (n=5) ranked nest protection/predator control (1.6) as the least important conservation action. Additionally, the Southeast ranked reducing elevated mortality (2.6) much lower compared to the Northeast (n=30) (4.3) and the Midwest (n=8) (4.6).

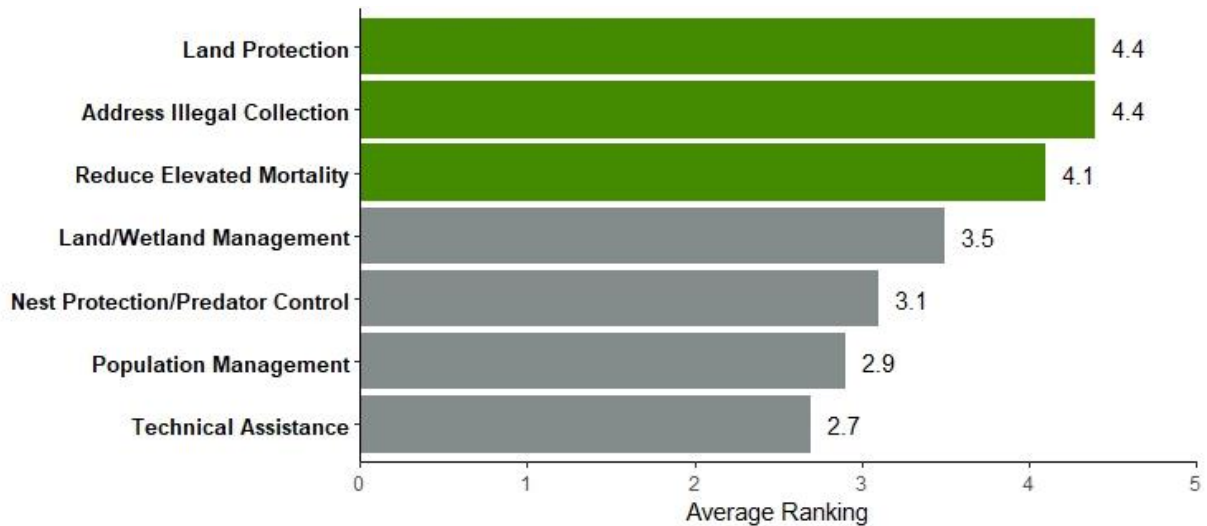


Figure 13. The average ranking of conservation actions needed for Box Turtles on a scale of 0 (unimportant) to 5 (very important) from the 43 respondents.

Conservation Actions Conducted

A total of 84 conducted conservation actions were reported among respondents across the three regions with Box Turtles. **General habitat restoration (n=20)** and **landowner engagement (n=19)** were the top two actions conducted. Repatriation and headstarting were the least reported actions (Fig. 14).

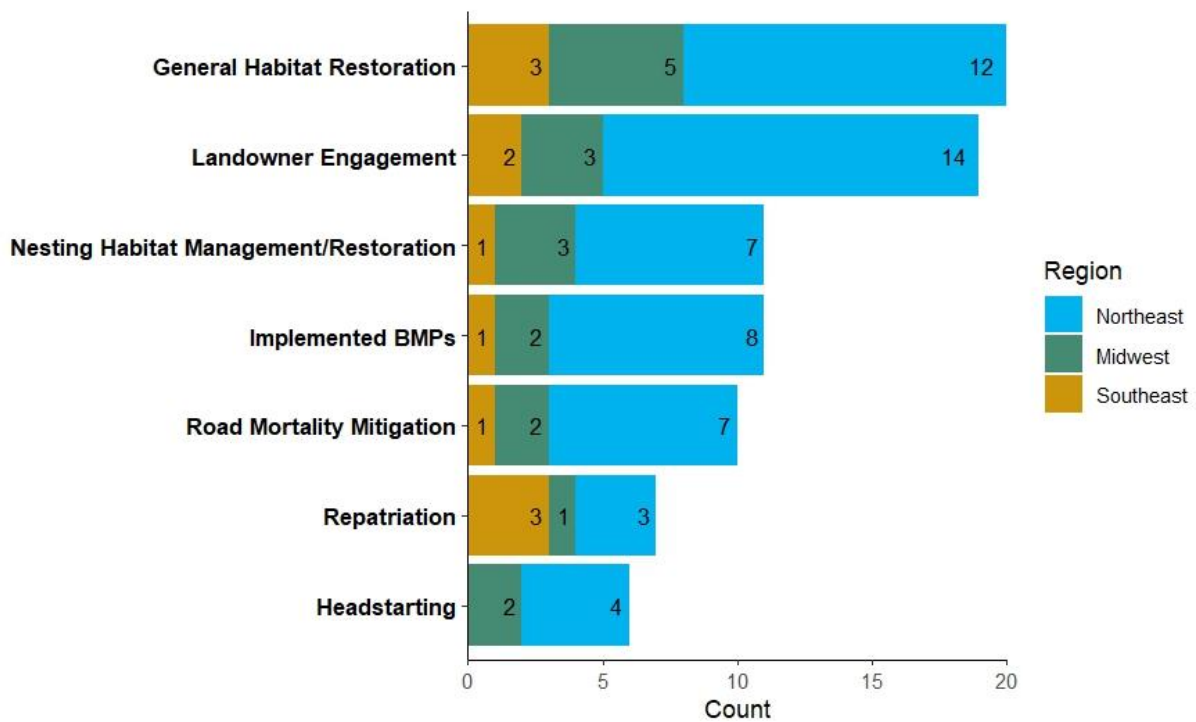


Figure 14. Reported conservation actions conducted in each region for the Box Turtle.

RANGE-WIDE ACTIONS NEEDED TO ACHIEVE CONSERVATION OBJECTIVES

The subsequent results represent the rankings of range-wide actions by all 88 respondents of this survey. The categories and options were developed by attendees of all symposia (2016, 2019, and 2023) to reflect the most urgent needs expressed by partners working on freshwater turtle conservation. These results are meant to aid working groups, agencies, and other collaborators prioritize next steps based on local and regional objectives on their species of interest.

Inter-Regional Coordination

All actions for inter-regional coordination were ranked relatively important, with **actively expand partnerships (4.3)** and **identify and prioritize data deficient sites (4.2)** ranking as the top two (Fig. 15). Developing new partnerships was a common theme during the 2023 Emydine Conservation Symposium, particularly during the regional updates session.

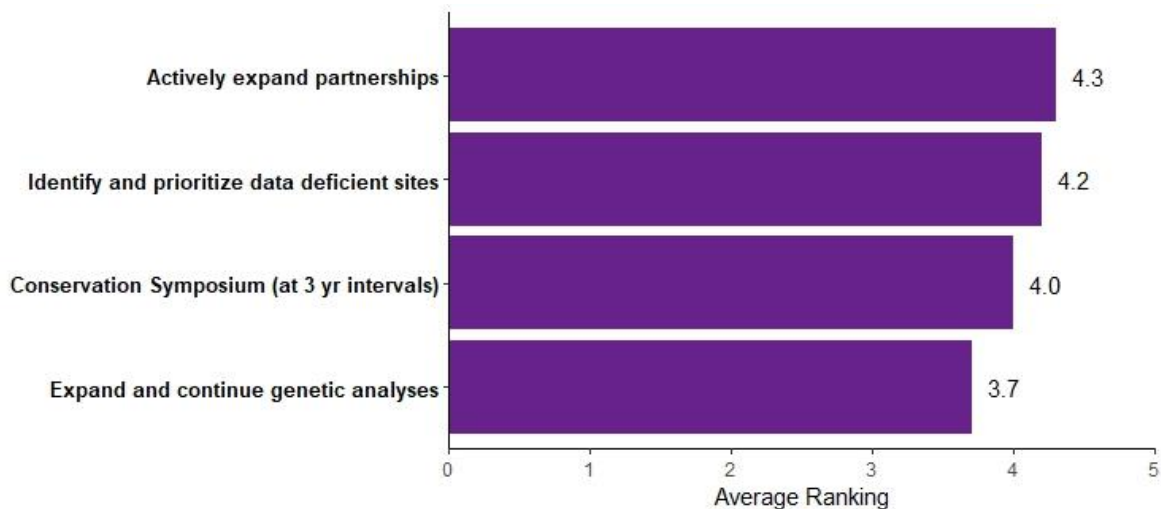


Figure 15. The average rankings of inter-regional coordination actions identified by respondents.

Compiling Information and Data

The most important actions identified by respondents related to information and data compilation were **develop BMPs for private landowners (3.9)**, **accessible range-wide genetics database (3.7)**, and **identification of emerging diseases (3.6)** (Fig. 16). All three of these actions were highlighted during the symposium and resulted in further discussions. Attendees heard from three geneticist working on three different methods for regional projects on the Blanding's Turtle, Wood Turtle, and Spotted Turtle. Additionally, several presenters highlighted the concern of emerging diseases among populations and the need for testing in confiscated individuals that could be candidates for repatriation.

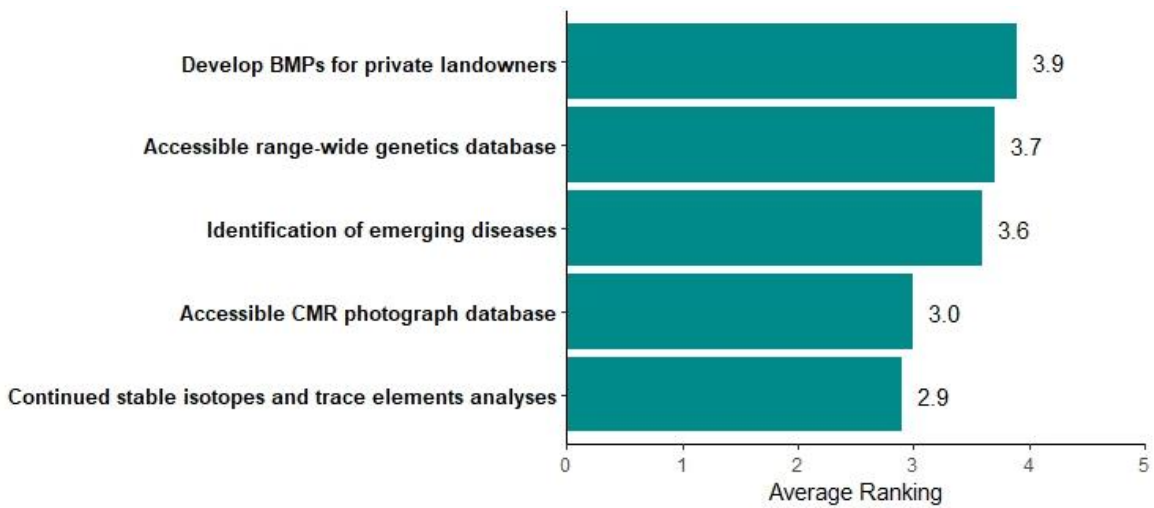


Figure 16. The average rankings of data compilation actions identified by respondents.

Education

All actions under education were ranked as relatively important. However, **increased outreach to state and federal land managers (4.4)** and **increased outreach to DOT/DOHs (4.4)** were ranked as the top two (Fig. 17).

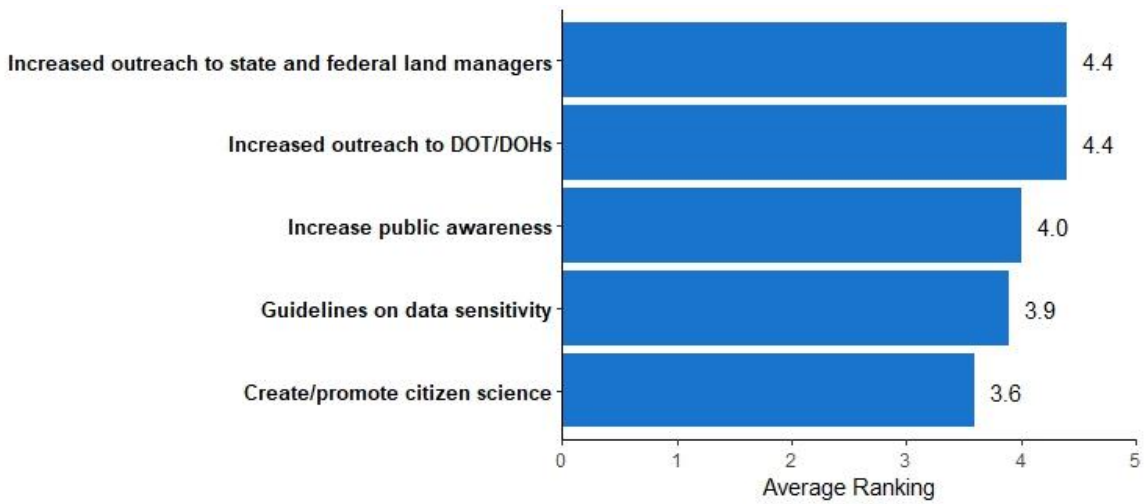


Figure 17. The average rankings of education actions identified by respondents.

Illegal Collection and Trafficking

Illegal collection has been a rising concern among turtle conservationists and in 2018 the national working group, Collaborative to Combat the Illegal Trade in Turtles (CCITT), was formed to increase awareness and prevent the illegal collection and trade of North America's native turtles. The 2019 and 2023 conservation symposia highlighted the efforts of this working group and incorporated potential next steps into the survey. Not surprisingly, all the actions were ranked as relatively important, but **law enforcement training (4.5)**, **outreach to state government officials (4.2)**, and **increased public awareness (4.2)** were ranked as the top three (Fig. 18).

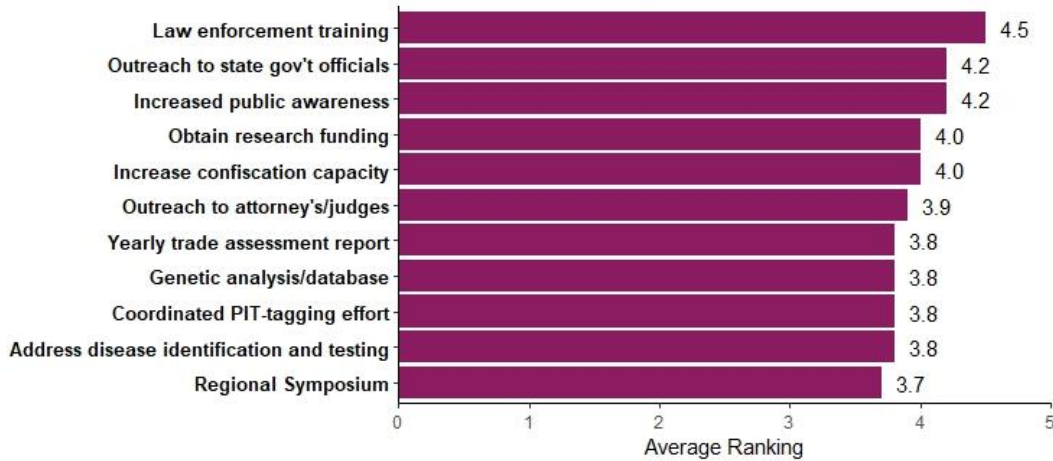


Figure 18. The average rankings of illegal collection and trafficking actions by respondents.

Habitat Management and Land Protection

Four of the five habitat management and land protection actions were ranked as important (Fig. 19). The top three actions were outreach to **land trusts/land purchasing agencies (4.4)**, **develop guidelines for wetland or riparian restoration (4.3)**, and **develop focused BMPs for land managers/agencies (4.3)**.



Figure 19. The average rankings of habitat management and land protection actions by respondents.

APPENDIX A

Regional Threats and Actions Summary

THREATS: The average ranking for each threat by species and region.

WOOD TURTLE

Threat	Northeast (n=45)	Southeast (n=0)	Midwest (n=17)	Canada (n=6)
Illegal Collection	3.8	N/A	3.9	4.3
Genetic Isolation/Inbreeding	2.2	N/A	2.4	2.4
Lack of Reproduction/Recruitment	3.8	N/A	4.4	4.0
Climate: Increased Flooding	3.1	N/A	3.2	2.6
Climate: Drought	2.8	N/A	2.5	2.0
Climate: Increased Temperatures	2.7	N/A	2.9	2.0
Elevated Adult Mortality: Depredation	3.4	N/A	4.2	4.3
Elevated Adult Mortality: Roads	4.2	N/A	4.1	4.0
Elevated Adult Mortality: Ag. Machinery	3.9	N/A	3.9	4.0
Elevated Adult Mortality: Prescribed Fire	1.4	N/A	2.0	1.2
Habitat Loss/Frag: Stream Degradation	4.3	N/A	4.1	3.6
Habitat Loss/Frag: Invasive Species	3.4	N/A	3.1	2.6
Habitat Loss/Frag: Development	4.3	N/A	4.2	4.0
Emerging Diseases	2.6	N/A	2.5	3.0

BLANDING'S TURTLE

Threat	Northeast (n=28)	Southeast (n=0)	Midwest (n=16)	Canada (n=7)
Illegal Collection	2.6	N/A	3.2	2.1
Genetic Isolation/Inbreeding	3.4	N/A	2.5	1.9
Lack of Reproduction/Recruitment	4.2	N/A	4.1	3.4
Climate: Increased Flooding	1.6	N/A	2.4	1.5
Climate: Drought	3.0	N/A	3.5	2.9
Climate: Increased Temperatures	2.6	N/A	3.1	2.3
Elevated Adult Mortality: Depredation	2.8	N/A	3.7	3.9
Elevated Adult Mortality: Roads	4.4	N/A	4.5	5.0
Elevated Adult Mortality: Ag. Machinery	2.6	N/A	2.9	1.3
Elevated Adult Mortality: Prescribed Fire	0.7	N/A	1.8	0.6
Habitat Loss/Frag: Wetland Degradation	3.7	N/A	4.4	3.7
Habitat Loss/Frag: Invasive Species	3.3	N/A	3.2	3.0
Habitat Loss/Frag: Development	4.4	N/A	4.4	4.0
Emerging Diseases	2.6	N/A	2.4	2.0

SPOTTED TURTLE

Threat	Northeast (n=35)	Southeast (n=6)	Midwest (n=8)	Canada (n=5)
Illegal Collection	4.1	4.4	4.3	4.8
Genetic Isolation/Inbreeding	3.0	1.0	3.3	2.5
Lack of Reproduction/Recruitment	3.7	2.5	3.9	3.2
Climate: Increased Flooding	2.3	1.8	2.0	2.3
Climate: Drought	3.1	3.6	3.0	2.8
Climate: Increased Temperatures	2.7	2.8	3.1	1.3
Elevated Adult Mortality: Depredation	3.4	2.8	4.3	2.8
Elevated Adult Mortality: Roads	4.0	3.4	3.6	3.6
Elevated Adult Mortality: Ag. Machinery	2.7	1.8	2.8	1.0
Elevated Adult Mortality: Prescribed Fire	1.3	0.8	1.8	0.3
Habitat Loss/Frag: Wetland Degradation	3.9	4.4	4.3	3.8
Habitat Loss/Frag: Invasive Species	3.2	2.8	3.4	3.0
Habitat Loss/Frag: Development	4.5	4.4	4.3	4.0
Emerging Diseases	2.3	2.0	2.0	1.3

BOX TURTLE

Threat	Northeast (n=30)	Southeast (n=5)	Midwest (n=8)	Canada (n=0)
Illegal Collection	4.4	4.6	3.4	N/A
Genetic Isolation/Inbreeding	2.3	0.6	2.8	N/A
Lack of Reproduction/Recruitment	3.5	1.8	4.3	N/A
Climate: Increased Flooding	1.5	1.0	1.6	N/A
Climate: Drought	2.1	2.3	2.3	N/A
Climate: Increased Temperatures	2.3	2.3	2.0	N/A
Elevated Adult Mortality: Depredation	2.9	1.5	3.3	N/A
Elevated Adult Mortality: Roads	4.5	4.6	4.3	N/A
Elevated Adult Mortality: Ag. Machinery	3.8	3.0	3.7	N/A
Elevated Adult Mortality: Prescribed Fire	3.1	2.2	3.5	N/A
Habitat Loss/Frag: Wetland Degradation	3.1	2.6	3.6	N/A
Habitat Loss/Frag: Invasive Species	2.7	1.6	3.0	N/A
Habitat Loss/Frag: Development	4.8	4.4	3.7	N/A
Emerging Diseases	3.2	3.8	3.0	N/A

ACTIONS: The average ranking for each action by species and region.

WOOD TURTLE

Action	Northeast (n=45)	Southeast (n=0)	Midwest (n=17)	Canada (n=6)
Land Protection	4.4	N/A	4.6	4.3
Address Illegal Collection	4.2	N/A	4.1	3.8
Land/Riparian Management	4.5	N/A	4.5	4.4
Reduce Elevated Mortality	4.2	N/A	4.5	4.2
Technical Assistance	3.5	N/A	3.1	2.3
Nest Protection/Predator Control	3.6	N/A	4.2	3.2
Population Management	3.3	N/A	3.6	3.6

BLANDING'S TURTLE

Action	Northeast (n=28)	Southeast (n=0)	Midwest (n=16)	Canada (n=7)
Land Protection	4.6	N/A	4.5	4.6
Address Illegal Collection	2.8	N/A	3.3	2.0
Land/Wetland Management	4.1	N/A	4.6	4.4
Reduce Elevated Mortality	4.2	N/A	4.4	5.0
Technical Assistance	3.5	N/A	2.5	2.3
Nest Protection/Predator Control	3.9	N/A	4.1	3.9
Population Management	3.7	N/A	3.9	3.9

SPOTTED TURTLE

Action	Northeast (n=35)	Southeast (n=6)	Midwest (n=8)	Canada (n=5)
Land Protection	4.5	4.8	4.6	4.6
Address Illegal Collection	4.1	4.6	4.3	4.8
Land/Wetland Management	4.0	3.8	4.6	4.2
Reduce Elevated Mortality	3.8	3.0	4.2	4.0
Technical Assistance	3.5	2.4	2.2	1.8
Nest Protection/Predator Control	3.4	0.8	3.6	1.6
Population Management	3.3	2.5	3.0	2.8

BOX TURTLE

Action	Northeast (n=30)	Southeast (n=5)	Midwest (n=8)	Canada (n=0)
Land Protection	4.4	4.2	4.7	N/A
Address Illegal Collection	4.6	4.0	3.9	N/A
Land/Wetland Management	3.4	3.2	3.9	N/A
Reduce Elevated Mortality	4.3	2.6	4.6	N/A
Technical Assistance	3.1	2.0	1.9	N/A
Nest Protection/Predator Control	3.2	1.6	3.9	N/A
Population Management	2.8	2.4	3.6	N/A

APPENDIX B

Summary of Threat Uncertainty

WOOD TURTLE

Threat	Percent Unsure
Elevated Adult Mortality: Prescribed Fire	16%
Emerging Diseases	16%
Genetic Isolation/Inbreeding	10%
Climate: Increased Temperatures	10%
Climate: Drought	7%
Elevated Adult Mortality: Depredation	4%
Elevated Adult Mortality: Ag. Machinery	4%
Lack of Reproduction/Recruitment	3%
Climate: Increased Flooding	3%
Habitat Loss/Degradation: Invasive Species	2%
Illegal Collection	1%
Elevated Adult Mortality: Roads	1%
Habitat Loss/Degradation: Development	1%
Habitat Loss/Degradation: Stream degradation (e.g., pollution, flooding)	0%

BLANDING'S TURTLE

Threat	Percent Unsure
Emerging Diseases	16%
Climate: Increased Temperatures	11%
Elevated Adult Mortality: Prescribed Fire	10%
Genetic Isolation/Inbreeding	9%
Elevated Adult Mortality: Ag. Machinery	8%
Climate: Increased Flooding	8%
Climate: Drought	5%
Illegal Collection	5%
Elevated Adult Mortality: Depredation	4%
Habitat Loss/Degradation: Invasive Species	4%
Elevated Adult Mortality: Roads	3%
Habitat Loss/Degradation: Wetland degradation (e.g., pollution, flooding)	3%
Lack of Reproduction/Recruitment	2%
Habitat Loss/Degradation: Development	2%

SPOTTED TURTLE

Threat	Percent Unsure
Emerging Diseases	37%
Elevated Adult Mortality: Prescribed Fire	30%
Climate: Increased Temperatures	20%
Genetic Isolation/Inbreeding	19%
Elevated Adult Mortality: Ag. Machinery	17%
Climate: Increased Flooding	17%
Elevated Adult Mortality: Depredation	17%
Climate: Drought	13%
Lack of Reproduction/Recruitment	13%
Illegal Collection	4%
Habitat Loss/Degradation: Invasive Species	2%
Elevated Adult Mortality: Roads	2%
Habitat Loss/Degradation: Wetland degradation (e.g., pollution, flooding)	0%
Habitat Loss/Degradation: Development	0%

BOX TURTLE

Threat	Percent Unsure
Climate: Increased Temperatures	23%
Genetic Isolation/Inbreeding	16%
Climate: Increased Flooding	16%
Elevated Adult Mortality: Prescribed Fire	14%
Climate: Drought	14%
Elevated Adult Mortality: Depredation	9%
Habitat Loss/Degradation: Wetland degradation (e.g., pollution, flooding)	7%
Habitat Loss/Degradation: Invasive Species	7%
Emerging Diseases	7%
Elevated Adult Mortality: Ag. Machinery	7%
Lack of Reproduction/Recruitment	5%
Illegal Collection	0%
Habitat Loss/Degradation: Development	0%
Elevated Adult Mortality: Roads	0%

APPENDIX C

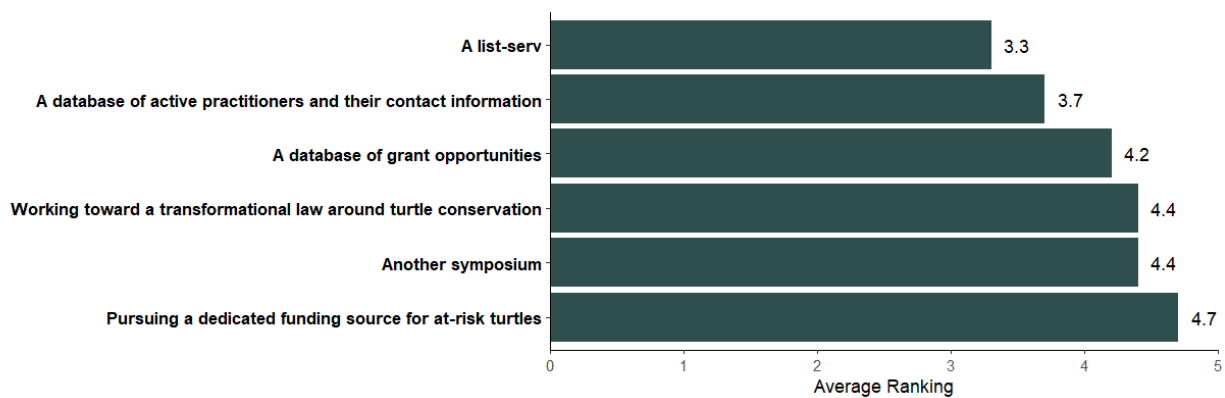
Mentimeter Results Summary

The following results are from the interactive Mentimeter survey given during the symposium. Results were condensed and compiled based on repeated or similar answers then ordered alphabetically. Weight (i.e., number of repeats per answer) was excluded to reflect equal importance of each answer provided. The number of respondents per question can be found below each table or figure.

What funding sources are available?
AZA Conservation Fund
DoD Legacy Program
Doris Duke Foundation
EPA – Compensatory Mitigation
Legislative-Citizen Commission on Minnesota Resources – Environment and Natural Resources Trust Fund (ENRTF)
NFWF – America the Beautiful
NFWF – Chesapeake WILD Grants Program
NFWF – Conservation Partners Program
NRCS – Conservation Effects Assessment Project (CEAP)
Round Up for Conservation
USFWS – Great Lakes Fish and Wildlife Restoration Act
USFWS – Competitive State Wildlife Grants Program
USFWS End of Year funds
Wildlife Crossings Pilot Program (WCPP) – Bipartisan Infrastructure Law

18 respondents

How much do you support the following actions that we could take on as a group?



64 respondents

What are the biggest challenges to Emydine conservation?	
Competitive colleagues	Long-term commitment
Data sensitivity	Long-term monitoring and datasets
Efficacy of predator control	Permitting/land use permits
Funding (general)	Political will
Funding to combat illegal collection/trade	Prioritizing
Grant administration	Private lands/landowner biases
Habitat management	Recruitment – predation
Illegal trade	Regulations across multiple jurisdictions
Invasive species	Road mortality
Lack of follow-up studies	Staff capacity
Lack of standardization	Steep match requirements
Legislative power	Travel
Local development/infrastructure	

40 respondents

What are the opportunities? What can we do together to advance Emydine conservation?
Additional symposia
Collaboration (between agencies, pooling funds, ideas, expertise)
Combine datasets (meta-analyses)
Connections between agencies – grow partnerships
Detection dogs for improved surveys/detection
Engage private landowners
Judicial education
Land acquisition
Larger BACI research experiments
Lobbying
Partner with zoos/AZA
Public involvement/community engagement/citizen science
Quality research
Regional coordinators to galvanize and organize efforts
Regional lab offering technical and quantitative services
Shared knowledge of successes and failures, plans, protocols, and BMPs
Social media outreach with Corwin-esque CCITT style messaging
Standardized collection/data sharing (Survey 123, EpiCollect, etc.)
Support state natural heritage programs

32 respondents

Which transmitter/GPS models have worked well for you?	
ATS L20 Solar GPS	Holohil Ri-2b
ATS VHF	Holohil VHF
Ecotone Crex-T	Lotek pinpoint 120
Holohil with TR8	Telonics

29 respondents

Are there any transmitters/GPS models you would not use again?	
ATS and Bluetooth	LL Electronics
Do it yourself (DIY)	Lotek
Cellular Tracking Technologies (CTT)	Telonics
Holohil	

15 respondents

What are promising technologies that haven't been discussed?	
Accelerometry	Machine learning
Camera traps	Pathtrack GPS tags
Cellular Tracking Technologies (CTT)	PIT tag scanning cables/array
Detection dogs	Sensor grid temperature loggers
Drone telemetry	Solar powered VHF
Environmental DNA (eDNA)	Story maps
LiDAR	Survey 123

30 respondents