

Appendix E-77: Mussels

6. Please rank the following threats to ALL mussels in ALL habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total
Invasive/non-native species	20% (2)	10% (1)	20% (2)	40% (4)	10% (1)	0% (0)	10
High sensitivity to pollution	0% (0)	70% (7)	30% (3)	0% (0)	0% (0)	0% (0)	10
Bioaccumulation of contaminants	0% (0)	0% (0)	20% (2)	0% (0)	0% (0)	80% (8)	10
Predators (native or domesticated)	0% (0)	0% (0)	30% (3)	50% (5)	20% (2)	0% (0)	10
Dependence on other species (mutualism, pollinators)	20% (2)	30% (3)	20% (2)	10% (1)	20% (2)	0% (0)	10
Diseases/parasites (of the species itself)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (10)	10
Regulated hunting/fishing pressure (too much)	0% (0)	0% (0)	20% (2)	0% (0)	80% (8)	0% (0)	10
Species over population	0% (0)	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Unintentional take/ direct mortality (e.g., vehicle collisions, power line collisions, by-catch, harvesting equipment, land preparation machinery)	10% (1)	60% (6)	10% (1)	0% (0)	20% (2)	0% (0)	10
Unregulated collection pressure	0% (0)	0% (0)	0% (0)	20% (2)	80% (8)	0% (0)	10
Dependence on irregular resources (cyclical annual variations) (e.g., food, water, habitat limited due to annual variations in availability)	0% (0)	0% (0)	10% (1)	30% (3)	0% (0)	60% (6)	10
							Total Respondents
							110

7. Please also rank these threats to ALL mussels in ALL habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total
Habitat loss (breeding range)	30% (3)	60% (6)	10% (1)	0% (0)	0% (0)	0% (0)	10
Habitat loss (feeding/foraging areas)	30% (3)	60% (6)	10% (1)	0% (0)	0% (0)	0% (0)	10
Small native range (high endemism)	10% (1)	0% (0)	0% (0)	10% (1)	80% (8)	0% (0)	10
Near limits of natural geographic	0% (0)	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10

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range								
Large home range requirements	0% (0)	0% (0)	0% (0)	0% (0)	90% (9)	10% (1)	10	
Viable reproductive population size or availability	30% (3)	30% (3)	20% (2)	10% (1)	0% (0)	10% (1)	10	
Specialized reproductive behavior or low reproductive rates	20% (2)	70% (7)	10% (1)	0% (0)	0% (0)	0% (0)	10	
Degradation of movement/migration routes (overwintering habitats, nesting and staging sites)	0% (0)	0% (0)	10% (1)	0% (0)	40% (4)	50% (5)	10	
Genetic pollution (hybridization)	0% (0)	0% (0)	20% (2)	10% (1)	50% (5)	20% (2)	10	
Unknown	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (7)	7	
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (2)	2	
							Total Respondents	99

8. Other threats to ALL mussels in ALL habitats in Indiana.

No responses were entered for this question.

Total Respondents **0**

(skipped this question) 10

9. Please briefly describe the top two threats to ALL mussels in ALL habitats in Indiana identified above.

- dredging of headwater streams
1. alterations of hydrology from land-use changes
2.
 1. Runoff introducing sediments, even if only temporary
 2. In-stream modifications
3.
 1. Zebra mussels
 2. Instream dredging
4.
 1. Zebra mussels
 2. Instream modifications
5.
 1. Runoff
 2. Habitat modification
6.
 1. Runoff, mostly agricultural
 2. Instream modifications

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7. 1. Runoff
2. Habitat modification

8. 1. Pollution within the Tippecanoe River system in Indiana.
2. Any factor which reduces the reproductive population size.

9. 1. Insuring that populations maintain critical larva-host connections.

10. habitat loss/unintentional take-'cleaning' and dredging of streams of the Kankakee drainage can result in a large amount of creek heelsplitters being lost dependence on other species-require fish host to reproduce; if fish populations decrease for any of a variety of reasons, then creek heelsplitter reproduction could decrease substantially

Total Respondents 10

10. Please rank the following threats to the HABITAT of ALL mussels in ALL habitats in Indiana.

	Critical threat	Serious threat	Somewhat of a threat	Slight threat	No threat	Unknown	Response Total	
Commercial or residential development (sprawl)	10% (1)	30% (3)	20% (2)	40% (4)	0% (0)	0% (0)	10	
Counterproductive financial incentives or regulations	10% (1)	0% (0)	0% (0)	0% (0)	0% (0)	90% (9)	10	
Invasive/non-native species	20% (2)	0% (0)	0% (0)	60% (6)	20% (2)	0% (0)	10	
Nonpoint source pollution (sedimentation and nutrients)	30% (3)	50% (5)	20% (2)	0% (0)	0% (0)	0% (0)	10	
Habitat fragmentation	20% (2)	50% (5)	20% (2)	10% (1)	0% (0)	0% (0)	10	
Successional change	0% (0)	10% (1)	0% (0)	10% (1)	50% (5)	30% (3)	10	
Diseases (of plants that create habitat)	0% (0)	0% (0)	10% (1)	0% (0)	20% (2)	70% (7)	10	
Habitat degradation	40% (4)	50% (5)	0% (0)	10% (1)	0% (0)	0% (0)	10	
Climate change	0% (0)	0% (0)	0% (0)	10% (1)	90% (9)	0% (0)	10	
Stream channelization	40% (4)	50% (5)	0% (0)	10% (1)	0% (0)	0% (0)	10	
Impoundment of water/flow regulation	30% (3)	20% (2)	20% (2)	30% (3)	0% (0)	0% (0)	10	
Agricultural/forestry practices	10% (1)	60% (6)	20% (2)	10% (1)	0% (0)	0% (0)	10	
Residual contamination (persistent toxins)	20% (2)	0% (0)	10% (1)	0% (0)	0% (0)	70% (7)	10	

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White River where relic valves are common, but the living species is absent.

9. habitat degradation, stream channelization-cause temporary loss of habitat and impact the mussels directly by killing them or taking them out of the habitat

Total Respondents 9

(skipped this question) 1

13. What current monitoring efforts by state agencies are you aware of for ALL mussels in ALL habitats in Indiana?

	Yes, these efforts occur	Not aware of these efforts occurring	Response Total
Statewide year-round monitoring conducted by state agencies	0% (0)	100% (10)	10
Statewide once a year monitoring conducted by state agencies	0% (0)	100% (10)	10
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	0% (0)	100% (10)	10
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	30% (3)	70% (7)	10
Regional or local year-round monitoring conducted by state agencies	0% (0)	100% (10)	10
Regional or local once a year monitoring conducted by state agencies	0% (0)	100% (10)	10
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	0% (0)	100% (10)	10
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	90% (9)	10% (1)	10
		Total Respondents	80

14. What current monitoring efforts by other organizations are you aware of for ALL mussels in ALL habitats in Indiana?

	Yes, these efforts occur	Not aware of these efforts occurring	Response Total
Statewide year-round monitoring conducted by other organizations	0% (0)	100% (10)	10
Statewide once a year monitoring conducted by other organizations	10% (1)	90% (9)	10

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Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	100% (10)	10
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	0% (0)	100% (10)	10
Regional or local year-round monitoring conducted by other organizations	0% (0)	100% (10)	10
Regional or local once a year monitoring conducted by other organizations	10% (1)	90% (9)	10
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	100% (10)	10
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations	80% (8)	20% (2)	10
Total Respondents			80

15. How crucial are these monitoring efforts by state agencies for the conservation of ALL mussels in ALL habitats in Indiana?						Response Total
	Very crucial	Somewhat crucial	Slightly crucial	Not crucial	Unknown	
Statewide year-round monitoring conducted by state agencies	0% (0)	0% (0)	40% (4)	60% (6)	0% (0)	10
Statewide once a year monitoring conducted by state agencies	20% (2)	20% (2)	30% (3)	30% (3)	0% (0)	10
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by state agencies	20% (2)	50% (5)	30% (3)	0% (0)	0% (0)	10
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by state agencies	0% (0)	60% (6)	10% (1)	30% (3)	0% (0)	10
Regional or local year-round monitoring conducted by state agencies	0% (0)	20% (2)	50% (5)	30% (3)	0% (0)	10
Regional or local once a year monitoring conducted by state agencies	10% (1)	30% (3)	30% (3)	30% (3)	0% (0)	10
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by state agencies	10% (1)	60% (6)	20% (2)	10% (1)	0% (0)	10
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by state agencies	30% (3)	40% (4)	0% (0)	30% (3)	0% (0)	10

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Total Respondents 80

16. How crucial are these monitoring efforts by other organizations for the conservation of ALL mussels in ALL habitats in Indiana?

	Very crucial	Somewhat crucial	Slightly crucial	Not crucial	Unknown	Response Total
Statewide year-round monitoring conducted by other organizations	0% (0)	0% (0)	60% (6)	40% (4)	0% (0)	10
Statewide once a year monitoring conducted by other organizations	10% (1)	0% (0)	50% (5)	40% (4)	0% (0)	10
Periodic statewide (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	10% (1)	50% (5)	40% (4)	0% (0)	10
Occasional statewide (less than once a year and not regularly scheduled) monitoring conducted by other organizations	0% (0)	10% (1)	50% (5)	40% (4)	0% (0)	10
Regional or local year-round monitoring conducted by other organizations	0% (0)	0% (0)	60% (6)	40% (4)	0% (0)	10
Regional or local once a year monitoring conducted by other organizations	10% (1)	0% (0)	50% (5)	40% (4)	0% (0)	10
Periodic regional or local (less than once a year but still regularly scheduled) monitoring conducted by other organizations	0% (0)	30% (3)	30% (3)	40% (4)	0% (0)	10
Occasional regional or local (less than once a year and not regularly scheduled) monitoring conducted by other organizations	20% (2)	40% (4)	20% (2)	20% (2)	0% (0)	10
Total Respondents						80

17. Regional or local state agency monitoring for ALL mussels in ALL habitats in Indiana.

1. IDNR non-game biologist does mussel surveys. But, he is only one person and there are thousands of miles of streams in state.
2. Tippecanoe River, Maumee system
3. Ohio River, Wabash system
4. Ohio River, Wabash

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5. ? Wabash system
6. Maumee system
7. Wabash system
8. Periodic (usually annual) monitoring in the Tippecanoe River by IDNR.

IDNR nongame biologist continually monitors fishes and mussels throughout the state, including Yellow Sandshell habitat. Two surveys have been done- ten years apart, completed last year - by IDNR biologists in the Wabash, Tippecanoe, and East Fork White Rivers; results are pending. This is in prime Yellow Sandshell habitat.
- 9.
10. random locations within the Kankakee drainage

Total Respondents **10**

18. Regional or local monitoring by other organizations for ALL mussels in ALL habitats in Indiana.

1. Commonwealth Biomonitoring frequently does habitat evaluations in small streams as part of watershed studies. If I happen to see a shell, I make a note of it in field notes. These are NOT official mussel surveys.
2. Tippecanoe River, Maumee system
3. Ohio River
4. Ohio River, Wabash
5. ? Wabash system
6. Maumee system
7. Wabash system
8. Uncertain.
9. none

Total Respondents **9**

(skipped this question) 1

19. Please list organizations that are monitoring ALL mussels in ALL habitats in Indiana.

1. None than I know of. Most mussel surveys are on bigger rivers. I was contacted by a college prof. interested in taking a class out to a small stream to learn about mussels. I discouraged him from doing so unless he followed DNR regulations concerning collectors' permits. I haven't heard any

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doing so unless he followed DNR regulations concerning collectors' permits. I haven't heard any more from him.

2. TNC, USFWS
3. USFWS
4. USFWS consultants
5. consultants, perhaps TNC
6. TNC
7. consultants
TNC
8. Uncertain.
9. none

Total Respondents **9**

(skipped this question) **1**

20. What are the current monitoring techniques for ALL mussels in ALL habitats in Indiana?

	Frequently used	Occasionally used	Not used but possible with existing technology and data	Not used and not possible with existing technology and data	Not economically feasible	Unknown	Response Total
Radio telemetry and tracking	0% (0)	0% (0)	0% (0)	0% (0)	88% (7)	12% (1)	8
Modeling	0% (0)	11% (1)	22% (2)	44% (4)	0% (0)	22% (2)	9
Coverboard routes	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (6)	6
Spot mapping	11% (1)	56% (5)	0% (0)	0% (0)	0% (0)	33% (3)	9
Driving a survey route	14% (1)	0% (0)	0% (0)	14% (1)	0% (0)	71% (5)	7
Reporting from harvest, depredation, or unintentional take (road kill, bycatch)	0% (0)	0% (0)	0% (0)	75% (6)	12% (1)	12% (1)	8

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Mark and recapture	0% (0)	78% (7)	0% (0)	0% (0)	0% (0)	22% (2)	9
Professional survey/census	10% (1)	90% (9)	0% (0)	0% (0)	0% (0)	0% (0)	10
Volunteer survey/census	0% (0)	67% (6)	22% (2)	0% (0)	0% (0)	11% (1)	9
Trapping (by any technique)	0% (0)	0% (0)	0% (0)	20% (1)	0% (0)	80% (4)	5
Representative sites	12% (1)	88% (7)	0% (0)	0% (0)	0% (0)	0% (0)	8
Probabilistic sites	22% (2)	11% (1)	56% (5)	0% (0)	0% (0)	11% (1)	9
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (4)	4
Total Respondents							101

21. Other monitoring techniques for ALL mussels in ALL habitats in Indiana.

No responses were entered for this question.

Total Respondents **0**

(skipped this question) 10

22. What one or two monitoring techniques would you recommend for effective conservation of ALL mussels in ALL habitats in Indiana?

1.
 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
 2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
2.
 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
 2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
3.
 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
 2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
4.
 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
 2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some mussels. See same for protocols.

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5. 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of some mussels. See same for protocols.
6. 1. Intensive quantitative sampling of known populations. Need to understand demography of the clubshell. See Strayer & Smith, 2003. AFS Monogr. 8.
2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of the clubshell. See same for protocols.
7. 1. State DNR or professional census at representative or probabilistic sites.
2. Development of trained, select volunteer core to undertake surveys at probabilistic sites, particularly where the species should, or could occur and has not been documented in recent years.
8. 1. Systematic monitoring of probabilistic sites (professional).
2. Use of volunteer census/monitoring.
9. professional surveys using timed searches, systematic sampling (Strayer and Smith 2003)-A guide to sampling freshwater mussel populations. American Fisheries Society Monograph 8. American Fisheries Society. Bethesda, Maryland. 103 pp.

Total Respondents 9

(skipped this question) 1

23. What current HABITAT inventory and assessment efforts or activities by state agencies are you aware of for ALL mussels in ALL habitats in Indiana?

	Yes, these efforts occur	No effort that I'm aware of	Response Total
Statewide annual inventory and assessment conducted by state agencies	0% (0)	100% (10)	10
Statewide once a year inventory and assessment conducted by state agencies	0% (0)	100% (10)	10
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	100% (10)	10
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	0% (0)	100% (10)	10
Regional or local year-round inventory and assessment conducted by state agencies	0% (0)	100% (9)	9
Regional or local once a year inventory and assessment conducted by state agencies	0% (0)	100% (10)	10
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by	0% (0)	100% (10)	10

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state agencies

Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies

70% (7)

30% (3)

10

Total Respondents

79

24. What current HABITAT inventory and assessment efforts or activities by other organizations are you aware of for ALL mussels in ALL habitats in Indiana?

	Yes, these efforts occur	No effort that I'm aware of	Response Total
Statewide year-round inventory and assessment conducted by other organizations	0% (0)	100% (10)	10
Statewide once a year inventory and assessment conducted by other organizations	0% (0)	100% (9)	9
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	0% (0)	100% (10)	10
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	0% (0)	100% (10)	10
Regional or local year-round inventory and assessment conducted by other organizations	0% (0)	100% (10)	10
Regional or local once a year inventory and assessment conducted by other organizations	0% (0)	100% (9)	9
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by other organizations	0% (0)	100% (10)	10
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by other organizations	70% (7)	30% (3)	10
	Total Respondents		78

25. How crucial are these HABITAT efforts by state agencies for the conservation of ALL mussels in ALL habitats in Indiana?

	These efforts are very crucial for this HABITAT	These efforts are somewhat crucial for this HABITAT	These efforts are slightly crucial for this HABITAT	These efforts are not crucial for this HABITAT	Unknown	Response Total
Statewide annual inventory and						

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assessment conducted by state agencies							
Statewide once a year inventory and assessment conducted by state agencies	20% (2)	20% (2)	20% (2)	40% (4)	0% (0)		10
Periodic statewide (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	30% (3)	30% (3)	20% (2)	20% (2)	0% (0)		10
Occasional statewide (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	20% (2)	20% (2)	30% (3)	30% (3)	0% (0)		10
Regional or local year-round inventory and assessment conducted by state agencies	0% (0)	20% (2)	40% (4)	40% (4)	0% (0)		10
Regional or local once a year inventory and assessment conducted by state agencies	10% (1)	20% (2)	40% (4)	30% (3)	0% (0)		10
Periodic regional or local (less than once a year but still regularly scheduled) inventory and assessment conducted by state agencies	10% (1)	40% (4)	30% (3)	20% (2)	0% (0)		10
Occasional regional or local (less than once a year and not regularly scheduled) inventory and assessment conducted by state agencies	30% (3)	30% (3)	20% (2)	20% (2)	0% (0)		10
						Total Respondents	80

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2. ? Ohio River, Wabash system
3. Ohio River, Wabash
4. ? Wabash system
5. Maumee system
6. Wabash system
7. (Usually wildlife species inventories are made, with relevant habitat information)
8. IDNR primarily monitors mussel species, making habitat notations. No real habit monitors made. However, Indiana Department of Environmental Management, IDNR Division of Water do monitor water quality (as a component of habitat).
9. none

Total Respondents	9
(skipped this question)	1

28. Regional or local HABITAT inventory and assessment by other organizations for ALL mussels in ALL habitats in Indiana.

1. We (Commonwealth Biomonitoring) do habitat evaluations on small streams as part of watershed studies. These evaluations are not specific to mussels, but are Ohio EPA QHEI methods.
2. ? Tippecanoe River and Maumee system
3. Ohio River
4. Ohio River, Wabash
5. ? Wabash system
6. Maumee system
7. Wabash system
8. none

Total Respondents	8
(skipped this question)	2

29. Please list organizations that are monitoring this HABITAT for ALL mussels in ALL habitats in Indiana.

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1. TNC, USFWS
2. USFWS
3. USFWS consultants
4. consultants, perhaps TNC
5. TNC
6. consultants TNC
7. none

Total Respondents **7**
(skipped this question) 3

30. What are the current HABITAT inventory and/or assessment techniques for ALL mussels in ALL habitats in Indiana?

	Frequently used	Occasionally used	Not used but possible with existing technology and data	Not used and not possible with existing technology and data	Not economically feasible	Unknown	Response Total
GIS mapping	0% (0)	70% (7)	10% (1)	0% (0)	0% (0)	20% (2)	10
Aerial photography and analysis	0% (0)	0% (0)	0% (0)	50% (5)	10% (1)	40% (4)	10
Systematic sampling	0% (0)	70% (7)	0% (0)	0% (0)	0% (0)	30% (3)	10
Property tax estimates	0% (0)	0% (0)	0% (0)	0% (0)	11% (1)	89% (8)	9
State revenue data	0% (0)	0% (0)	0% (0)	0% (0)	11% (1)	89% (8)	9
Regulatory information	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (9)	9
Participation in landuse programs	0% (0)	67% (6)	11% (1)	0% (0)	0% (0)	22% (2)	9
Modeling	0% (0)	67% (6)	11% (1)	0% (0)	0% (0)	22% (2)	9

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Voluntary landowner reporting	0% (0)	67% (6)	0% (0)	0% (0)	22% (2)	11% (1)	9
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (4)	4
							Total Respondents 88

31. Other HABITAT inventory and assessment techniques for ALL mussels in ALL habitats in Indiana.

1. Water quality monitoring

Total Respondents 1

(skipped this question) 9

32. What one or two HABITAT inventory and assessment techniques would you recommend for effective conservation of ALL mussels in ALL habitats in Indiana?

1. 1. CREP, farmer incentives for no-till, riparian corridors, etc.
2. Strictly control instream modifications: mining, snagging, etc.
2. 1. Assess zebra mussel infestations. Contact P. Morrison, USFWS, Parkersburg, WV
3. 1. Zebra mussel assessment. Contact P. Morrison, USFWS, Parkersburg, WV
4. 1. Assess riparian corridor presence
2. Water quality
5. 1. Assess riparian corridor
2. Water quality
6. 1. Assess riparian corridor
2. Water quality monitoring
7. 1. More extensive use of GIS- modeled habitat probabilities.
8. 1. To look at saturation of potential habitat: with GIS construction of existing potential habitat(based upon known factors)and overlaying the current distribution of the Yellow Sandshell.
9. don't really think that a habitat inventory of any kind is necessary for creek heelsplitter habitat in the Kankakee drainage

Total Respondents 9

(skipped this question) 1

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33. What is the current body of science for ALL mussels in ALL habitats in Indiana?

		Response Total	Response Percent
Complete, up to date and extensive		0	0%
Adequate		2	20%
Inadequate		8	80%
Nonexistent		0	0%
Other (please explain below)		0	0%
Total Respondents		10	

34. Please provide a citation (title, author, date, publisher) that would give the best overview of ALL mussels in ALL habitats in Indiana, if available. This resource may be used if further detail is needed.

Title = Occurrence and distribution of freshwater mussels in the small streams of Tippecanoe County, Indiana;
 Author = Myers-Kinzie, M., S. Wente, & A. Spacie;
 Date = 2001;
 Publisher = Proc. Ind. Acad. Sci.

Title = Federal Recovery Plan;
 Author = USFWS;
 Date = 1993;
 Publisher = USFWS

Title = Freshwater mussels of Tennessee;
 Author = Parmalee & Bogan;
 Date = 1998;
 Publisher = U of Tennessee Press

Title = Naiades of Pennsylvania;
 Author = Ortmann;
 Date = 1919;
 Publisher = Carnegie Museum

Title = 'Clubshell';
 Author = USFW, Division of Endangered Species;
 Publisher = Online

Title = (Numerous internet sites, including USF&W)

35. If possible, please provide a second citation (title, author, date, publisher) that would give another good overview of ALL mussels in ALL habitats in Indiana. This resource may also be used if further detail is needed.

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Title = Field guide to freshwater mussels of Midwest;
 Author = Cummings & Mayer;
 Date = 1992;
 Publisher = INHS

Title = Life history and propagation...;
 Author = Jones & Neves;
 Date = 2002;
 Publisher = JNABS

Title = Freshwater mussels of the Midwest;
 Author = Cummings & Mayer;
 Date = 1992;
 Publisher = INHS

Title = Freshwater Mollusca of WI;
 Author = Baker;
 Date = 1919;
 Publisher = WI Geol. Nat. Hist. Surv.

36. What is the current HABITAT body of science for ALL mussels in ALL habitats in Indiana?

		Response Total	Response Percent
Complete, up to date and extensive		0	0%
Adequate		3	30%
Inadequate		7	70%
Nonexistent		0	0%
Other (please explain below)		0	0%
Total Respondents		10	

37. Please provide a citation (title, author, date, publisher) that would give the best HABITAT overview of ALL mussels in ALL habitats in Indiana, if available. This resource may be used if further detail is needed.

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Title = Federal Recovery Plan;
 Author = USFWS;
 Date = 1993;
 Publisher = USFWS

Title = Federal Recovery Plan;
 Author = USFWS;
 Date = 1991;
 Publisher = USFWS

Title = Freshwater Mollusca of WI;
 Author = Baker;
 Date = 1928;
 Publisher = WI Geol. Nat. Hist. Surv.

Title = Naiades of Pennsylvania;
 Author = Ortmann;
 Date = 1919;
 Publisher = Carnegie Museum

38. If possible, please provide a second citation (title, author, date, publisher) that would give another good HABITAT overview of ALL mussels in ALL habitats in Indiana. This resource may also be used if further detail is needed.

Title = Naiades of Pennsylvania;
 Author = Ortmann;
 Date = 1919;
 Publisher = Carnegie Museum

Title = Freshwater Molluscs of WI;
 Author = Baker;
 Date = 1928;
 Publisher = WI Geol. Nat. Sci. Surv.

Title = Freshwater Mollusca of WI;
 Author = Baker;
 Date = 1929;
 Publisher = WI Geol. Nat. Sci. Surv.

39. What are the research needs for ALL mussels in ALL habitats in Indiana?

	Urgently needed	Greatly needed	Needed	Slightly needed	Not needed	Unknown	Response Total
Life cycle	40% (4)	10% (1)	20% (2)	20% (2)	10% (1)	0% (0)	10
Distribution and abundance	30% (3)	0% (0)	70% (7)	0% (0)	0% (0)	0% (0)	10
Limiting factors (food, shelter, water, breeding sites)	20% (2)	30% (3)	50% (5)	0% (0)	0% (0)	0% (0)	10
Threats (predators/competition,	20% (2)	40% (4)	30% (3)	10% (1)	0% (0)	0% (0)	10

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contamination)								
Relationship/dependence on specific habitats	10% (1)	30% (3)	60% (6)	0% (0)	0% (0)	0% (0)	10	
Population health (genetic and physical)	20% (2)	30% (3)	50% (5)	0% (0)	0% (0)	0% (0)	10	
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (5)	5	
							Total Respondents	65

40. Other research needs for ALL mussels in ALL habitats in Indiana.

- Habitat needs are not completely understood. I have seen fresh dead cylindrical papershell in channelized ag ditches. Other small streams with good habitat have only weathered dead fragments.
- To find out why the Clubshell has depopulated most of its former distribution in Indiana. Developing some sort of timeline (late Pleistocene, Holocene (usually archaeological), or historic) for relic valve distribution might narrow the possibilities of critical limiting factors (post-settlement siltation, etc.).

Total Respondents **2**

(skipped this question) **8**

41. What are the HABITAT research needs for ALL mussels in ALL habitats in Indiana?

	Urgently needed	Greatly needed	Needed	Slightly needed	Not needed	Unknown	Response Total	
Successional changes	0% (0)	0% (0)	10% (1)	20% (2)	60% (6)	10% (1)	10	
Distribution and abundance (fragmentation)	30% (3)	30% (3)	20% (2)	0% (0)	10% (1)	10% (1)	10	
Threats (land use change/competition, contamination/global warming)	30% (3)	50% (5)	10% (1)	0% (0)	10% (1)	0% (0)	10	
Relationship/dependence on specific site conditions	10% (1)	30% (3)	50% (5)	10% (1)	0% (0)	0% (0)	10	
Growth and development of individual components of the habitat	0% (0)	10% (1)	60% (6)	20% (2)	10% (1)	0% (0)	10	
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	100% (5)	5	
							Total Respondents	55

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42. Other HABITAT research needs for ALL mussels in ALL habitats in Indiana.

No responses were entered for this question.

Total Respondents **0**
(skipped this question) 10

43. How well do the following conservation efforts address the threats to ALL mussels in ALL habitats in Indiana?

	Very well	Somewhat	Not at all	Not used	Unknown	Response Total
Habitat protection (use below for details)	0% (0)	60% (6)	10% (1)	10% (1)	20% (2)	10
Population management (hunting, trapping)	0% (0)	20% (2)	0% (0)	60% (6)	20% (2)	10
Population enhancement (captive breeding and release)	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Reintroduction (restoration)	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Food plots	0% (0)	0% (0)	0% (0)	40% (4)	60% (6)	10
Threats reduction	0% (0)	50% (5)	0% (0)	30% (3)	20% (2)	10
Native predator control	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Exotic/invasive species control	0% (0)	0% (0)	50% (5)	30% (3)	20% (2)	10
Regulation of collecting	0% (0)	30% (3)	60% (6)	0% (0)	10% (1)	10
Disease/parasite management	0% (0)	0% (0)	0% (0)	70% (7)	30% (3)	10
Translocation to new geographic range	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Protection of migration routes	0% (0)	0% (0)	0% (0)	30% (3)	70% (7)	10
Limiting contact with pollutants/contaminants	0% (0)	70% (7)	10% (1)	10% (1)	10% (1)	10
Public education to reduce human disturbance	0% (0)	70% (7)	10% (1)	0% (0)	20% (2)	10
Culling/selective removal	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Stocking	0% (0)	0% (0)	0% (0)	100% (10)	0% (0)	10
Other (please specify below)	0% (0)	0% (0)	0% (0)	20% (1)	80% (4)	5
				Total Respondents		165

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44. Other current conservation practices for ALL mussels in ALL habitats in Indiana.

Total Respondents **0**
(skipped this question) 10

45. What one or two specific practices would you recommend for more effective conservation of ALL mussels in ALL habitats in Indiana?

1. The following applies to all mussel species. Educate anglers that it is ILLEGAL to use mussels as fishing bait.
2.
 1. Strict enforcement of laws regulating instream modification; incentives to farmers.
 2. Propagation
3.
 1. Strictly limit instream modifications
 2. Remove existing dams wherever possible
 See Watters, 2000. Proc. 1st FMCS Symposium
4.
 1. Limit instream modification.
 2. Restore free-flowing systems
 See Watters, 2000. Proc. 1st FMCS Symposium
5.
 1. CREP, other incentives for BMP's
 2. Limit instream modifications
 See Watters, 2000. Proc. 1st FMCS Symposium
6.
 1. Intensive quantitative sampling of known populations. Need to understand demography of species. See Strayer & Smith, 2003. AFS Monogr. 8.
 2. Less intensive qualitative sampling of new or not recently surveyed areas. Need to determine distribution and status of species. See same for protocols.
7.
 1. Eliminate instream modifications, including inpoundment
 2. Restore riparian corridor
 See Watters, 2000. Proc. 1st FMCS Symposium
8. Protect the shallow sand/gravel habitat from siltation and channelization, and keep the waters free of pollutants and toxins.
9.
 1. Protection of the habitat against pollutants and toxins.
10. protect habitat by limiting the amount of dredging that occurs in the Kankakee watershed

Total Respondents **10**

46. How well do the following conservation efforts address the HABITAT threats to ALL mussels in ALL habitats in Indiana?

Very Somewhat Not at all Not used Unknown Response



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	well					Total
Habitat protection through regulation	0% (0)	60% (6)	10% (1)	0% (0)	30% (3)	10
Habitat protection on public lands	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Habitat protection incentives (financial)	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Habitat restoration through regulation	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Habitat restoration on public lands	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Habitat restoration incentives (financial)	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Artificial habitat creation (artificial reefs, nesting platforms)	0% (0)	0% (0)	0% (0)	90% (9)	10% (1)	10
Selective use of functionally equivalent exotic species in place of extirpated natives	0% (0)	0% (0)	0% (0)	90% (9)	10% (1)	10
Succession control (fire, mowing)	0% (0)	0% (0)	0% (0)	90% (9)	10% (1)	10
Corridor development/protection	0% (0)	70% (7)	0% (0)	10% (1)	20% (2)	10
Managing water regimes	0% (0)	60% (6)	0% (0)	10% (1)	30% (3)	10
Pollution reduction	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Protection of adjacent buffer zone	0% (0)	70% (7)	0% (0)	10% (1)	20% (2)	10
Restrict public access and disturbance	0% (0)	30% (3)	10% (1)	40% (4)	20% (2)	10
Land use planning	0% (0)	70% (7)	0% (0)	0% (0)	30% (3)	10
Technical assistance	0% (0)	70% (7)	0% (0)	10% (1)	20% (2)	10
Cooperative land management agreements (conservation easements)	10% (1)	60% (6)	0% (0)	0% (0)	30% (3)	10
Other (please specify below)	0% (0)	0% (0)	0% (0)	0% (0)	100% (4)	4
						Total Respondents
						174

47. Other current HABITAT conservation practices for ALL mussels in ALL habitats in Indiana.

No responses were entered for this question.

Total Respondents **0**

(skipped this question) 10

48. What one or two specific HABITAT practices would you recommend for more effective conservation of ALL mussels in ALL habitats in Indiana?

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1. Treat small streams as biological resources and not just drainage ditches. At the very least, require that a mussel survey be done before dredging.
2. 1. No instream modifications.
2. Limit runoff through incentives or other means.
See Watters, 2000. Proc. 1st FMCS Symposium.
3. 1. Restrict instream modifications
2. Restore free-flowing systems
4. 1. Eliminate habitat modifications (in-stream dredging, channelization, etc.)
See Watters, 2000. Proc. 1st FMCS Symposium
5. 1. Promote riparian corridor
2. Limit habitat modifications
6. 1. Assess riparian corridor
2. Water quality monitoring
See Watters, 2000. Proc. 1st FMCS Symposium
7. 1. CREP and other incentives for BMP's
2. Restrict instream modifications
See Watters, 2000. Proc. 1st FMCS Symposium
8. Manage pollutants and toxins, maintain available habitat through regulation and buffer zones, increase habitat through incentives, technical assistance and restoration.
9. 1. Manage water quality and pollutants.
2. Protection of adjacent buffer zones.
10. any type of habitat protection/restoration-eliminate dredging

Total Respondents

10

49. Do you have any additional comments or information on ALL mussels in ALL habitats that you feel would be useful in the development of the Indiana Comprehensive Wildlife Strategy?

1. N/A
2. N/A
3. N/A
4. N/A
5. N/A
6. N/A

1. To find out just why the Clubshell depopulated so much of its former range, which once included much of the interior of Indiana. Knowing this "why" should disclose a critical limiting factor, and

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much of the interior of Indiana. Knowing this "why" should disclose a critical limiting factor, and could lead to its future preservation.

2. There is a great potential source for select avocational technical assistance (= volunteers) to undertake monitoring and survey where funding falls short.

8. The Yellow Sandshell appears to be a resilient species that is relatively tolerant of some silt; it has expanded beyond rivers and streams and has taken up residence in reservoirs. If we afford it the broad protection (i.e., against pollutants and habitat destruction) that we attempt to give to mussels in general and to other components of our wildlife and environment, it should do well.

Total Respondents **8**

(skipped this question) **2**