



Conservation Guidance for Species in Greatest Need of Conservation (SGNC): Final Report

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Final Summary Report

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Goals/ Objectives:(1). Engage IDNR staff and other stakeholders to identify conservation guidance needs; (2). Develop a consistent process for assembling conservation guidance documents for state-listed species that complements the IWAP; (3). Develop a series of conservation guidance documents for SGNC that are frequently subject to ITA requests; (4). Design a conservation plan form coordinated with the species guidance documents, to be used by project developers in planning to reduce development impacts to state-listed species/SGNC for Incidental Take Authorization (ITA).

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Narrative:

The Illinois Department of Natural Resources (IDNR) is responsible for providing guidance on avoidance and minimization of impacts to State-listed species, all of which are SGNC (520 ILCS 10/11), but previously IDNR had not developed specific guidelines for avoidance, minimization, mitigation, and management of individual species making the consultation and Incidental Take Authorization (ITA) process burdensome and inconsistent. Species-specific conservation guidance documents were needed to rectify this shortcoming and provide common ground for developers, consultants, and IDNR to work together using current scientific knowledge. The purpose of this project was to identify conservation guidance needs, to develop a process to provide such guidance, and to produce guidance for a selected subset of species. This final report includes documentation of the approaches, methods, and results of our efforts.

The first part of the project focused on identifying guidance needs through review of conservation planning documents (job 2) and interviews with stakeholders inside and outside IDNR (jobs 1 and 3). We identified information that is used in conservation planning and information that is lacking but would improve the conservation planning process.

Using information from the first step, a process for developing conservation guidance was created. The elements needed for sound conservation guidance were identified (job 4) and detailed in a Conservation Guidance Template (job 5) to be used to guide the production of guidance documents for listed species in Illinois. The Conservation Guidance Template was used to guide the development of conservation guidance documents and was refined in the process. In addition, a Conservation Plan template that will be used by ITA applicants was developed (job 9) based on regulatory requirements and information found in conservation guidance documents (job 8). The Endangered Species Program has been using the Conservation Plan Template since mid-2016 with positive feedback.

An analysis of SGCN was conducted to identify priority species for conservation guidance based on the frequency of consultation and ITAs (job 6). Species selected for initial guidance documents include Illinois Chorus Frog, Blanding's Turtle, King Rail, Yellow-headed Blackbird,

Indiana Bat, Black Sandshell, Clubshell, and Regal Fritillary Butterfly. Species guidance documents were compiled for these selected species from primary literature and IDNR documents (job 7). The documents were sent to reviewers, such as practitioners, scientists, and stakeholders, and were revised according to their comments and suggestions. Final documents have been published as INHS technical reports.

Job 1. Plan and prepare for stakeholder research.

Interview questions were developed to elicit stakeholder experiences and needs surrounding endangered species consultation and incidental take authorization. We applied for and received approval of the research protocol by the University of Illinois Internal Review Board. Interview questions were pilot tested with one interviewee and revised to streamline the interviews. Twelve (12) interviewees were contacted and 11 gave consent to participate in the research. Approved interview questions can be found in Table 1.

Job 2. Review conservation planning documents and conduct discourse analysis.

Incidental Take Authorizations, Conservation Plans, and Consultation Letters are all documents that play a role in conservation planning for listed species. Consultation Letters are prepared by the IDNR Environmental Review section to inform project developers of sensitive natural resources they are likely to impact based on the project footprint submitted to IDNR. Project developers may prepare a Conservation Plan as an application for Incidental Take Authorization. IDNR writes an Incidental Take Authorization document to allow project developers to ‘take’ listed species. Obviously, these documents play different, but related, roles, but it is important that they work from a common understanding of the species and its needs. To identify the types of information that would be most useful in conservation guidance documents, we collected data from Consultation Letters, Conservation Plans, and Incidental Take Authorizations.

Conservation plans, Incidental Take Authorizations, and consultation letters were gathered from eight development projects that were determined likely to have impacts on listed species. Projects were selected to represent different types of activities (bridge replacement, water line, transmission line, alternative thermal standards, drainage channel relocation, road improvements, barge dock, and wind power operation) and different types of applicants (state government, local government, private industry, and public utility). All projects were authorized in 2014 or 2015 and had all documents available.

Themes related to conservation planning for listed animal species were identified and extracted from the documents. The program Atlas.ti was used to code the documents using grounded theory to allow codes to emerge from the documents (Strauss and Corbin 1990). Consultation Letters, Conservation Plans, and Incidental Take Authorizations were compared to identify similarities and differences in conservation planning and species guidance needs. Concepts that emerged from the analysis are described below (codes are underlined for easy identification).

These elements have been identified as important to the conservation review and planning process and the percent of each document that includes each element is discussed. However, not all statutory elements are required in each of the documents. The elements are separated into two parts: elements with potential to be included in conservation guidance documents and concepts that should be incorporated into the conservation plan template.

Information about a species life history is necessary for planning and evaluating the impacts of a project. This type of information was included in 25, 67, and 63 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. The amount of information included varies considerably from a single sentence to pages of description. This information included things like diet, reproductive cycles, and seasonal movements, often focusing on when and where certain activities take place. For example, “It is usually only seen above ground during the spring breeding season (February – April); they prefer to be below ground from May to January. The species hibernates in burrows, and breeds in flooded fields, ditches, and vernal pools.” The timing of species’ life events (phenology) and the spatial delineation of species movements, in particular, can greatly improve conservation planning efforts. Completing work when the species is not present or at an appropriate distance from certain habitat attributes can greatly reduce impacts. Information on phenology was included in 25, 56, and 25 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Information on species movements was included in 13, 22, and 13 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. A physical description of the species was included in 28% of the documents.

Species abundance is notoriously difficult to assess for rare species, yet information on population size is very important for understanding the severity of an impact to a population. Unfortunately, the only information available is often based on the number of coincidental observations. Some 50, 89, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively, contained some form of statement about the abundance of the species. Species abundance is often explained in vague terms, such as “large numbers”, “abundant”, “collected twice”, or “occupied”. Some documents contained estimates of take based on survey results or best guesses. Incidental Take Authorizations often contained information on the statewide number of Element Occurrence Records (populations) from the Natural Heritage Database. Some documents provide the year that the species was last observed as an indicator of abundance. Twenty percent of documents suggested surveys to better understand species abundance and forty percent of documents describe surveys that were conducted specifically for the project.

Information on species distribution on a large scale is readily available via organizations such as NatureServe or IUCN, yet information on local distribution can be spotty. Most of the documents reviewed mentioned the overall range of the species, the counties it has been observed in, or

more specific location information, such as “along the toe of the river bluffs.” Some form of distribution information was included in 25, 67, and 88 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Information on habitat characteristics can be important for understanding species distribution on a more local scale to better evaluate potential impacts to a species. Furthermore, information on habitat characteristics are essential for providing conservation benefit. Habitat information was described in 25, 78, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Descriptions included information on the natural community, specific host species, habitat structure, and/or abiotic factors, such as soil type, stream flow, or temperature.

Information on threats to a species survival in general, and information on specific threats due to project impacts can be useful in evaluating project plans. General threats were discussed in 13, 67, and 88 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. General threat statements varied from providing information on major to minor threats to the species, such as habitat loss, invasive species, and pesticide use. Incidental Take Authorizations provided information on the types of activities that have received Incidental Take Authorization in the past. Information on specific impacts of a project to a species varied from general statements that the project may impact the species to specific statements on the form of impact including loss of habitat, reduced recruitment, and direct mortality due to vehicle traffic or crushing. Information on project impacts was included in 63, 89, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively.

Avoidance measures are an important part of conservation planning. These measures include reducing or relocating the project footprint. However, these measures are only discussed in 13, 44, and 38 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. This may be due to the late stage at which environmental impacts are sometimes considered in the planning process. Some statements described the difficulty of avoiding impacts do to the wide ranging movements of the species.

Minimization measures are another important part of conservation planning. The importance of these measures to conservation planning is obvious in their prevalence in 50, 100, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Minimization measures from Consultation Letters included educating site personnel about the sensitive species and seeking an Incidental Take Authorization to incorporate species needs into project plans. Minimization measures included in Conservation Plans and Incidental Take Authorizations were more numerous, including limiting project activities to less sensitive seasons, educating site personnel, altering project structure/operation to incorporate species needs, relocating or excluding the species from the project site, erosion and sediment control, and preventing the spread of invasive species.

Mitigation measures are another important part of conservation planning. These measures are incorporated into planning later than other measures as is evident in their inclusion in 0, 78, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. These measures include activities that are taken to compensate for the impact to the listed species by providing some form of conservation benefit. Mitigation measures included habitat restoration/improvement, compensatory payment, forming a conservation partnership, species research, species propagation, host species propagation, and invasive species management.

Monitoring is important for understanding the impacts of a project on a species. Similar to mitigation measures, monitoring often does not appear in early planning documents. Information on monitoring is included in 0, 67, and 100 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Monitoring activities can target either the species directly or the minimization measures. Monitoring efforts detailed in the documents included pre-construction species surveys, species relocation surveys, presence-absence surveys, habitat monitoring, host species monitoring, post-construction species monitoring for one or more years, monitoring the implementation of minimization and mitigation measures, or no monitoring required. Most of the requirements appear very inconsistent and inappropriately designed to determine impacts. Some monitoring is tied to adaptive management triggers.

Information on regulations that apply to the species can prove useful in fulfilling legal requirements related to conservation planning. It is not surprising that all of the documents mentioned regulations as they applied to the project or species. The wide range of regulations that were relevant to conservation planning was surprising though. Some regulations applied specifically to endangered species, while others were relevant to other aspects of the projects. Information on regulations included US laws (Endangered Species Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, National Environmental Policy Act, Clean Water Act, Nuclear Regulatory Commission, Fish and Wildlife Coordination Act, National Historic Preservation Act, Archaeological and Historic Preservation Act, River and Harbors Act), state laws (Illinois Endangered Species Protection Act, Illinois Interagency Wetland Policy Act, Illinois Natural Areas Preservation Act, Illinois Human Skeletal Remains Protection Act), and local laws (county floodplain development permit)

In addition to these elements, which can be incorporated into species guidance documents; there are a number of other elements that were recognized as important for inclusion in the conservation plan template. These elements are more procedural in nature and not specific to species; therefore they are more appropriate for the conservation plan template than for conservation guidance documents.

Adaptive management is described as a way to make decisions in the face of uncertainty by monitoring the uncertain element over time and adjusting to the new information. To be useful, adaptive management requires identifying objectives and uncertainties, thinking through a range of potential outcomes, developing triggers that will lead to different actions being taken, and monitoring to detect those triggers (Nie and Schultz 2012). Some form of adaptive management statement is included in 0, 67 and 50 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Unfortunately, the adaptive management included in these documents is frequently poorly conceived, as it fails to identify uncertainties, potential outcomes, triggers, and monitoring actions. Most documents include little more than statements such as, “If an unforeseen circumstance that affects the effectiveness of the measure instituted to minimize or mitigate the effects of the proposed action on the chorus frog, the job will shut down until the owner can consult with IDNR to further discuss the situation and their options.” However, other projects, specifically wind power, have well defined uncertainties, triggers, and monitoring actions, perhaps due to the ongoing nature of the take.

Consideration of alternative actions is an important tool in conservation planning as it allows for thinking of other options and evaluating the potential outcomes in terms of all relevant objectives. However, to be useful it requires creativity and systematic analysis. Alternative actions are mentioned in 0, 89, and 25 percent of Consultation Letters, Conservation Plans, and Incidental Take Authorizations, respectively. Alternatives considered varied greatly from considering different locations to considering different structures. Although some documents use multiple objectives, such as natural resources, listed species, cultural resources, and costs, to evaluate alternatives, others limited their objectives considerably to safety or costs.

This job was completed to identify conservation guidance elements that are frequently used in Consultation Letters, Conservation Plans, and Incidental Take Authorizations. Elements that have been identified for inclusion in species guidance documents include: species’ life history, movements, phenology, abundance, distribution, habitat characteristics, threats, project impacts, avoidance measures, minimization measures, mitigation measures, monitoring, and regulations. In addition, instruction on developing adaptive management and alternative actions should be incorporated into conservation plan templates to improve these procedural elements.

Job 3. Conduct interviews of stakeholders and analyze transcripts using discourse analysis.

Conservation planning for listed species involves numerous processes and stakeholders. Species guidance documents should provide information that is useful across the range of stakeholders. To better understand the conservation guidance needs of stakeholders, we conducted interviews with individuals involved in the Environmental Review/Incidental Take Authorization process.

Eleven semi-structured interviews were conducted with stakeholders from the IDNR Environmental Review Section (5), the IDNR Endangered Species Program (1), other state agencies (3) and private consultants (2). Open-ended interview questions developed under Job 1 were used to direct the conversation; a sub-set of the interview questions with more general applicability were used for stakeholders outside IDNR. Interviews were recorded and transcribed. Grounded theory analysis was used to allow codes to emerge from the text (Strauss and Corbin 1990). The program Atlas.ti was used in coding and analysis of the transcripts. Themes related to species conservation guidance were identified and extracted from the coded transcripts. Below is a description of the main concepts discussed including overall thoughts on the conservation planning process, specific elements to include in guidance documents, and guidance for conservation plans.

General process insights

In general, interviewees described a good review as having two elements: reducing the impact to the species and allowing the project to move ahead. They believed the strengths of the review process were communication, cooperation, and coordination, both among reviewers and with project developers. A few interviewees described how important it was to be able to have face-to-face meetings to discuss projects and species to identify concerns and provide recommendations and guidance. Some interviewees thought this open dialogue was really important for identifying issues early, adjusting for them, and avoiding time delays. Another interviewee suggested the standardized documentation of the process was important for providing clarity throughout the process.

Interviewees described bad environmental reviews as those involving conflicting interests, political influence, uncertainty surrounding impacts/practices, or underfunded project developers, who cannot afford to implement recommendations. Overall, interviewees thought the process was a good one, yet a variety of weaknesses were identified. Some interviewees suggested that the process needs to be easier, faster, or more streamlined. For example, regulations around mussel relocation require mussels to be located twice, which is considered overly burdensome. Another weakness was a lack of coordination, especially when multiple stakeholders were involved, such as federal and state agencies. Interviewees suggested unexpected changes that occur late in the planning process are a challenge to project developers and an informed public. One interviewee suggested, the scope of the review is too narrow, "We need to be looking at habitat destruction in a more comprehensive fashion and not just focusing on listed species." Interviewees also suggested that IDNR staff workloads are too large and are a challenge to the process.

A frequently mentioned challenge was the limitation of the available information. For example, IDNR does not provide clear instruction and guidance to project developers. Also, relevant information about the species and project impacts could not be found all in one place.

Limitations included spatial and experiential information; one interviewee said, “We just don’t know that much about where [listed species] are”, while another explained their understanding of a project was limited by not seeing it in-person. In addition, limited follow-up monitoring for some projects means information availability does not improve regarding species or the effectiveness of conservation practices. One interviewee explained he would like to have evidence for their recommended measures, but he often needs to give recommendations based on his best judgment.

Interviewees suggested they have a fair amount of discretion in their work, though administrative rules set constraints and science provides some guidance. One interviewee described what they do as, “a science-based art.” One interviewee explained that species information is so variable that different recommendations may be made, while another interviewee explained that reviews vary depending on the “conviction” of the reviewer. Despite this variety interviewees suggested that consistency is important. Interviewees described using their past experience and group norms to provide consistency. One interviewee explained, “We have the resource of looking back at how other people have dealt with similar situations.” Another interviewee said, “We will use, for our templates, recent ITAs, you know fully executed ITAs, so we know, well that one passed inspection with DNR, so it must be alright.”

Elements for documents

Interviewees identified multiple elements that should be included in species guidance documents. First, basic species information is required to understand the species needs. Interviewees explained that sometimes this information is not known for rare species. Interviewees mentioned basic species information including habitat requirements, diet, reproductive cycle, and behavior.

Second, information about how species are potentially impacted by development projects is needed. This information consists of both species sensitivity and project hazards. Information on species sensitivity includes sensory ecology, or what the species perceives including noise, chemical, and light pollution. Interviewees also pointed out that information on reproductive cycles and activity patterns can improve understanding of what stage or time the species is most sensitive. This information is related to identifying date restrictions that should be placed on different types of activities in different locations. Temperature restrictions were also discussed but were considered impractical for project developers to manage. Interviewees discussed needing information on avoidance and minimization measures for development activities and information on the effectiveness of these measures.

Third, information on conservation opportunities is needed to guide conservation efforts. Interviewees described wanting to benefit the species through conservation actions, such as those required for mitigation. Identifying mitigation/conservation projects requires considerable effort

and coordination. Partnerships were mentioned as providing useful opportunities for mitigation, and potential partner organizations can be identified in guidance documents.

Fourth, guidance on monitoring protocols will improve the information collected on the species. Interviewees suggested that current monitoring efforts do not provide enough information and that survey efforts should be more standardized and comparable.

Fifth, identification of information gaps or research needs is necessary to guide research to fill these gaps. One interviewee suggested that researchers do not know the questions regulators have and that these questions should be identified on guidance documents. These gaps largely consist of uncertainties in the previous four elements. Interviewees described information gaps in habitat requirements, species distribution, population size, habitat restoration methods, best management practices, and impacts of hazardous waste, chemicals, air quality, and traffic noise on species.

Sixth, scientific references that support or justify actions need to be identified. Some interviewees explained that documentation was important for their work so they could justify their decisions. One interviewee explained, “I always try to get the best scientific documentation on what is on the project, because whatever decision I make professionally on a project, whether it is a small project or a large project, I want to be able to go to court and defend my decision and I want to have the scientific documentation to back me up.”

Seventh, additional sources of information should be included on guidance documents. Interviewees mentioned using numerous sources of information in conservation planning. Many of the sources provided spatial information, such as the Illinois Natural Heritage database, National Wetland Inventory, topography, current and historical aerial imagery, soil maps, and Bing/google maps. Interviewees also mentioned primary scientific literature, reports from site surveys, species guidance documents provided by Missouri or Wisconsin, or other information found online. All interviewees described obtaining information and guidance from experts, such as IDNR staff, USFWS staff, consultants, or academic researchers, especially Illinois Natural History Survey.

Guidance for conservation plans

The handling of uncertainty is a challenge that should be addressed in the conservation plan template. As previously described, uncertainty was a frequently mentioned issue as there is a lack of information on the species in general and the project impacts in particular. Numerous interviewees mentioned that they themselves are not experts. “My lead into most conversations is that I am an expert in none and jack of all. “ One interview explained, “There are too many things to be an expert in.”

Interviewees had different ways of dealing with uncertainty. Some interviewees explained that they just have to accept uncertainty, “We live with it” and “You deal with it... you get your information and you make a decision. I don’t know what else to tell you.” Other interviewees explained that they use the precautionary principle and always try to error on the side of estimating greater impact saying, “Estimating take is always a breathtaking experience for me. It’s tough, so I always estimate on the high side and that way I figure we are covered.” One interviewee explained that he managed uncertainty by trying to anticipate uncertainties and by providing some flexibility in planning.

Most commonly interviewees mentioned that they relied on experts to deal with uncertainties. One interviewee explained, “I will turn it to an expert and rely on their opinions.” The experts commonly referred to were IDNR biologists, Illinois Natural History Survey scientists, and US Fish and Wildlife Service biologists. Experts were very highly regarded, as one interviewee explained, “We rely on them. They are experts. They have been there... The Illinois Natural History Survey is regarded statewide and nationwide and internationally with some taxa and some species as the experts. So we don’t have any qualms.” Some interviewees mentioned treating expert opinions with caution because it could be based on anecdotal evidence or research. One interviewee explained, “I am not sure how they are getting that information. Sometimes it a best guess, maybe. “

The identification and treatment of uncertainty should be addressed in conservation plans. A template will be able to guide applicants to indicate where there is uncertainty, place reasonable bounds around the uncertainty, and describe how they were determined. Monitoring surveys should then be targeted at reducing this uncertainty

Conclusions

Some of the challenges identified in interviews may be improved by conservation guidance documents. Species information that is synthesized and undergone stakeholder review ahead of time may improve coordination by increasing common ground, consistency, and predictability. In addition, species guidance documents may increase the quality of information used. The combination of being limited by the information available and being guided by group norms can be dangerous for species conservation (Morgan 2014). For example, ineffective recommendations could be made due to lack of information and those recommendations may gain credibility due to their repeated use despite having little supporting evidence. Although guidance documents are unlikely to eliminate uncertainties, they should be able to identify supporting evidence or a lack thereof.

Conservation planning for rare species is always difficult due to the uncertainty surrounding these species. Although it is impractical to expect species guidance documents to eliminate uncertainty, they may be able to provide ways to deal with it more productively. The uncritical

use of expert opinion should be evaluated. Research has shown that expert opinion can be erroneous, especially under certain conditions, such as when they are not asked to indicate the bounds of their knowledge or when they become increasingly confident by repeating their opinion without receiving feedback as to its quality (Morgan 2014). By recognizing uncertainty, we will be able to target it to improve our information for future decisions (Martin et al. 2012).

One interviewee commented that he didn't find research papers useful because he didn't feel qualified to evaluate if the research was sound. He said, "What good does it do for me to read a research paper on something and one of my coworkers to read a research paper on that same species by someone else and that the information or the conclusions they arrive at are different? So there is then no consistency. I don't know what is valid or good when it comes to what research paper I should pick and choose from. If people at higher levels wanted the research papers to be used, and they said we will use this because we believe it to be valid with regard to this situation or this species or this resource, then that would be probably an optimal resource." This comment led us to further explore this topic with a survey that has been sent to IDNR practitioners to determine their preferred sources of information (Appendix 1). Responses to the survey were collected and analyzed. A report was prepared for an internal IDNR newsletter (@ORC) to inform IDNR of the sources of information used and preferred by IDNR staff. The report was also published as an INHS report (http://www.inhs.illinois.edu/files/3114/7259/1138/INHSReports_Sept2016.pdf) and as a poster at the Conservation Biology conference in Madison, WI in July 2016.

Job 4. Identify elements necessary for conservation guidance documents.

Conservation guidance documents should include all elements that would be useful to different stakeholders. Document review (Job 2) and stakeholder interviews (Job 3) were used to improve our understanding of conservation guidance needs. In addition, participant observation with the Endangered Species Program and various recovery teams was also used to identify conservation guidance needs. Additional lessons were learned during collaborative production of documents with taxa experts. Specifically, it can be challenging to produce a useful guidance document when a recovery plan is not in place. However, guidance documents may be seen as a precursor to a recovery plan and as such contain more general information and recommendations. In addition, guidance documents take considerable time (six months or more) to produce with the diversity of information compiled in the documents coming from many sources and different types of expertise and allowing time for the review processes.

Although guidance documents are intended to provide species-specific information, an exception was made for freshwater mussels at the suggestion of reviewers due to the lack of species specific information available. Discussions were held about how to strategically cover more species considering the lack of species-specific information available on mussels and the overlap in information that is provided in each document. As a result we have produced a General Mussel Conservation Guidance Document and accompanying shorter, species-specific documents. The general document and accompanying species-specific documents follow the conservation guidance template and attempt to provide the same information in the same format

as other documents. This approach should streamline production, reduce redundancy and prevent the need to revise many documents when new information becomes available.

Below is a list of the elements that should be included in guidance documents with a general description of each. It is acknowledge that some of these elements may not apply to all species and that each species will have its own particular characteristics that should be discussed. These elements are meant to guide development of conservation guidance to ensure information needs of all parties are met.

1. Species characteristics
 - a. Physical description of the species similar to description in a field guide with field cues. It should include key identification traits and how can you tell look-a-likes apart. It should include a photo or illustration.
2. Habitat
 - a. Description of habitat characteristics including biotic and abiotic factors. Describe the environment where the species has been found, including perhaps less than ideal environments such as those in Natural Heritage Database record descriptions. If known, habitat limitations should be indicated. Are there different habitat requirements at different life stages?
 - b. If possible, provide of map of a habitat model, such as one created by IDNR or from the USGS Gap analysis: <http://gapanalysis.usgs.gov/species/data/download/>.
3. Distribution, Taxonomy and Status
 - a. Species distribution on a large scale is readily available via organizations such as NatureServe or IUCN and should be shown on a range map. Information on state distribution can be shown by mapping records from the Natural Heritage database; the point locations should be enlarged so as to conceal potentially sensitive information. If there are different winter and summer ranges, this should be described. If we know what limits their range, this should also be described
 - b. What is the global IUCN status of the species? What is the statewide status and why? If it is possible indicate local population sizes.
 - c. Some species will be divided into subspecies and differentiation should be described, physically and geographically. If the species has multiple scientific names proposed, identify them (See the Integrated Taxonomic Information System). Indicate which one is used by the Illinois Endangered Species Protection Board
4. Species biology
 - a. Does the species migrate or move between habitats? When? Why? How far do they move (typical and maximum)? What is a typical, large, and small home range size? What effects home range size? Do they show site fidelity?
 - b. What is the timing of various life events and how are they triggered?

- c. What is their reproductive cycle/system? Indicate when and where certain activities take place.
 - d. How do they overwinter?
 - e. Diet - What do they eat? Does it vary by life stage?
 - f. What are the population dynamics? Indicate specific fecundity, recruitment, mortality, and longevity rates. Include population age and sex structure. What is the first age at reproduction? Have there been population viability studies? What life stage drives population trends?
5. Species threats
- a. Include information on general threats to the species. If possible, indicate the significance of each threat. Consider threats such as habitat loss, invasive species, predators, parasites, diseases harvest, pollution (sounds, light, and chemical), etc. Include anticipated climate change impacts, which may be found in: “Adapting Conservation to a Changing Climate: An Update to the Illinois Wildlife Action Plan”
 - b. Describe threats due to development project impacts. For example, is the species susceptible to road mortality, erosion, sedimentation, noise pollution, soil compaction, structure collision, shadow flicker, etc.
 - c. Identify the types of impacts due to past INDR Incidental Take Authorizations. Information can be found in the IDNR ITA database.
 - d. Provide information on species sensitivity, such as what the species perceives including noise, chemical, and light pollution.
6. Current conservation efforts
- a. What has been done to conserve the species? Describe current efforts such as recovery plans, land protection, propagation efforts, research projects, etc. Who is working on these projects?
 - b. Goals- Have goals been identified for the species? Are there delisting triggers?
7. Monitoring and Survey guidelines
- a. Identify different survey objectives, such as determining presence/absence, estimating population size, evaluating project impacts, or assessing habitat. Describe specific methods and effort required for different survey objectives. What are the detection rates of these survey methods? How much survey effort is required to acquire 90% confidence? How many years/sites need to be included in surveys? What is the best time of year to conduct surveys? Include references that document methods
8. Stewardship recommendations
- a. How do you maintain or enhance habitat for this species? If prescribed burning is recommended include date or weather restrictions. What structure or dietary needs can to be managed for? Are there host species that should be increased? Are

there specific metrics, such as water quality, that can be targeted? Are there invasive species and predators that may need to be controlled?

9. Avoidance measures

- a. How can impacts to the species be avoided? Describe habitat avoidance or other measures that are shown to be affective or may have merit. Note: Timing of habitat destruction will generally minimize impacts, not avoid them.

10. Minimization measures

- a. How can impacts to the species be minimized? Describe practices or timing that reduces impact to the species. If possible, provide information on the effectiveness of these measures. If possible, include estimated costs of measures.
- b. Identifying date restrictions for different types of activities in different locations, such as tree clearing or dewatering. Temperature restrictions may be more appropriate and should be described, yet they may be considered impractical for project developers to manage.
- c. Include practices from past ITAs, such as educating site personnel about the sensitive species, limiting project activities to less sensitive seasons, altering project structure/operation to incorporate species needs, relocating or excluding the species from the project site, erosion and sediment control, and preventing the spread of invasive species.

11. Mitigation and conservation opportunities

- a. Provide suggestions of conservation actions that will benefit the species. If a recovery plan has been developed, include the identified actions. Actions may include land protection, restoration, propagation, research projects, producing a recovery plan, or invasive species management. If possible, include estimated costs of various efforts
- b. Identify conservation groups that work in the area of the species that could be potential partners, including federal, state and local government conservation groups. Check the Prairie State Conservation Coalition website for land trusts. Request permission prior to identifying groups on the document.

12. Regulations

- a. Identify regulations that apply to the species. This will likely be similar for most Illinois listed species. Describe ITA, possession permits, research permits, scientific collector permits, consultation, etc.

13. Research needs

- a. Most of the research gaps should be identified in researching the previous sections and can then be compiled here in the form of questions. Although there may be basic research questions about the species, these research questions should target the needs of regulators.

14. Additional resources

- a. Identify other sources of information on the species, such as INHS or NatureServe species profile pages.
- b. Also identify spatial information that may be relevant to the species/habitat such as National Wetland Inventory (<http://www.fws.gov/wetlands/Data/Mapper.html>) or NRCS soil maps (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>).

15. References

- a. References that provide supporting evidence need to be identified. References should be mentioned throughout the document. Experimental and experiential info can be included but it should be identified as such.

Job 5. Develop a template with instructions for producing conservation guidance documents.

We compiled the necessary elements for conservation guidance in Job 4. In addition, we reviewed the format of species documents from Minnesota, Wisconsin, and Michigan, and spoke with professionals at Wisconsin DNR, Minnesota DNR, and Michigan DNR to learn about their experience producing and using species guidance/profiles/abstracts. We developed a template, which describes the elements, to be used to produce a set of complementary documents. As draft guidance documents were produced and reviewed by stakeholders and species experts, their comments have provided additional information on how to improve the template and the template has been revised to reflect these insights. In addition, the first four guidance documents produced were compared to identify inconsistencies and gaps, so that these areas can be identified more explicitly in the template. The template can be found in Appendix 2.

Job 6. Select eight target species for conservation guidance documents

We collected data on the number of requests of consultation by species and the number of applications for Incidental Take Authorization. We then ranked species by the number of consultation hits and the number of ITAs. We combined these rankings to develop an overall ranking of guidance need (Table 2). When deciding which species to develop guidance documents for as part of this project, in addition to these rankings we considered the funds used for this project, taxonomic diversity, the current availability of guidance information, and the need for background information for recovery planning to select species that would be top priority for guidance document production. We and our collaborators have produced guidance documents for: Blanding's Turtle, Illinois Chorus Frog, Yellow-Headed Blackbird, King Rail, Indiana Bat, Black Sandshell mussel, Clubshell mussel, and Regal Fritillary Butterfly. In addition, 37 other species have guidance documents currently being produced or there are arrangements for guidance documents to be produced through other project efforts.

Job 7. Produce eight conservation guidance documents.

A draft Illinois Chorus Frog Guidance Document was sent to 44 potential reviewers. Reviews were received from the following 19 reviewers: Mark Phipps, Scott Ballard, Michelle Simone, Ray Geroff, Eric Smith, Lisa Hebenstreit, Bob Bluett, Keith Shank, Pat Malone, and Nathan Grider (IDNR); Tom Lerczak (INPC); Eric Golden (SWCD); Brian Metzke, and Chris Phillips (INHS); Malcom McCallum; Stanley Trauth (Arkansas State University); Richard Essner (Southern Illinois University Edwardsville); Jacob Randa (USFWS); Brian Smith (AECOM); and Felecia Hurley (IDOT). The document was revised to incorporate comments and suggestions. The final draft was published as an INHS technical report and can be found here: <http://hdl.handle.net/2142/95126>

A draft of the Blanding's Turtle Guidance Document was sent to 57 potential reviewers as well as the Blanding's Turtle working group. Comments and suggestions were received from the following 17 reviewers: Brad Semel, Eric Smith, and Tara Kieninger (IDNR); Kelly Neal and Tom Lerczak (INPC); Gary Glowacki (Forest Preserve District of Lake County); Cindi Jablonski (McHenry County Conservation District); Dan Thompson (Forest Preserve District of DuPage County); Mike Redmer (USFWS); Whitney Anthonysamy (University of Arkansas); Andrew Kuhns (INHS); Rich King (NIU); Caleb Hasler (UIUC); Jeff Frantz, Karen Munson, and Stephen Chu (CH2M); and Kimberly Kessinger (IDOT). The document was revised to reflect their comments and suggestions. The final draft was published as an INHS technical report and can be found here: <http://hdl.handle.net/2142/95102>

A draft of the King Rail Guidance Document was sent to 55 potential reviewers. Comments and suggestions were received from the following 8 reviewers: Randy Smith, Tara Kieninger, and Mark Phipps (IDNR); Tom Lerczak (INPC); Greg Soulliere, Jacob Randa, and Mike Budd (USFWS); and Gary Glowacki (Forest Preserve District of Lake County). The document was revised to reflect their comments and suggestions. The final draft was published as an INHS technical report and can be found here: <http://hdl.handle.net/2142/95106>

A draft of the Yellow-Headed Blackbird Guidance Document was sent to 61 potential reviewers. Comments and suggestions have been received from the following 8 reviewers: Randy Smith, Keith Shank, and Natalia Jones (IDNR); Tom Lerczak (INPC); Randall Schietzelt (ESPB); Mike Ward (INHS); Cindi Jablonski (McHenry County Conservation District); and Kim Kessinger (IDOT). The document was revised to reflect their comments and suggestions. The final draft was published as an INHS technical report and can be found here: <http://hdl.handle.net/2142/97219>

A draft of the Indiana Bat Guidance Document was sent to 54 potential reviewers. Comments on the draft were received from the following 7 reviewers: Joe Kath, Jenny Skufca, Keith Shank (IDNR), Joyce Hofmann (ESPB/INHS), Tara Hohoff (INHS), Angelo Capparella (ISU), Justin Boyles (SIU). The document was revised to reflect their comments and suggestions. The final draft was published as an INHS technical report and can be found here: <http://hdl.handle.net/2142/97940>

Guidance documents were drafted in collaboration with Sarah Douglass, Alison Stodola, and Jeremy Tiemann of INHS for two mussel species (Black Sandshell and Clubshell). The Black Sandshell guidance document was sent out to 65 reviewers for review. Comments on the draft

were received from the following 11 reviewers: Jenny Skufca, Jeannie Barnes, Diane Shasteen, Trent Thomas, Keith Shank (IDNR); Justin Dillard (INPC); Bob Szafoni, Kimberly Kessinger (IDOT), Steve McMurray (MDC); Brant Fisher (Indiana DNR); Teresa Newton (USGS). The Clubshell guidance document was sent out to 55 reviewers for review. Comments on the draft were received from the following 9 reviewers: Jenny Skufca, Eric Smith, Diane Shasteen, Trent Thomas (IDNR); Bob Szafoni; Adam Wyant (Champaign and Vermilion County SWCD); Greg Zimmerman (EnviroScience); Brant Fisher (Indiana DNR); Teresa Newton (USGS). Comments and suggestions from reviewers led to the creation of a General Mussel Conservation Guidance document with information relevant to all species and accompanying short species-specific documents for Black Sandshell and Clubshell. Drafts of these documents can be found in Appendix 3. Also during this year, project staff has worked closely with IDNR to develop and revise standardized mussel survey guidelines that will be used by the department and in all mussel guidance documents. The survey protocol has not yet been finalized by IDNR.

A Regal Fritillary Butterfly guidance document has been drafted in collaboration with Angella Moorehouse (INPC) and undergone internal review. It is in the process of being prepared for external review. A copy of the draft can be found in Appendix 4.

In addition, a draft Iowa Darter guidance document has been produced by Phillip Willink and Jim Bland of the Shedd Aquarium. An internal review of the document has been conducted, and revisions to the document are ongoing. The final document will be submitted by Dr. Willink.

A draft guidance document for Franklin's Ground Squirrel has been produced by IDNR. An internal review of the document by project staff has been conducted, and revisions to the document are ongoing. The final document will be produced by IDNR.

A landing page for guidance documents has been created on the IDNR website: <https://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/EndangeredandThreatenedSpecies.aspx>. However, documents have not been posted on the IDNR webpage at the request of IDNR so that they can complete an internal approval process prior to posting.

Job 8. Review ITA related regulations and documents.

Endangered Species Act and Administrative Rules have been reviewed to identify legal requirements of conservation plans. In addition, conservation plans and incidental take authorizations were reviewed (Job 2), stakeholders were interviewed (Job 3), and participant observation with the endangered species program was performed to identify typical shortcomings of conservation plans and information that will improve review of plans. Below (in bold) is the legally mandated requirement of a conservation plan from the administrative code Illinois Administrative Code Title 17, Chapter 1, Subchapter c, Section 1080.10. Additional comments (non-bold) clarify what is needed for more robust conservation plans and project assessment.

A conservation plan submitted to the Department's Office of Resource Conservation as the application for authorization for incidental taking of an endangered or threatened species shall, at a minimum, include:

- 1) A description of the impact likely to result from the proposed taking of the species that would be covered by the authorization, including but not limited to:**
 - a. legal description, if available , or detailed description including street address and map of the area to be affected by the proposed action and indicia of ownership or control of affected property;**
 - i. In addition a GIS shapefile and photos of the area will facilitate assessment of the project.
 - b. biological data on the affected species; on request of the applicant, the Department shall provide biological data in the Department's possession on the affected species;**
 - i. If applicable, attach survey reports completed for the project.
 - ii. IDNR may provide the number of species records in the Natural Heritage Database
 - iii. Include relevant information on the species life history needs and habitat characteristic as they apply to the project. For example, What habitat characteristics are found at the project site? Are there host species on site?
 - c. description of taking of species; and the activities that will result in the taking of endangered or threatened species**
 - i. Describe practices to be used in layman's terms and a timeline of proposed activities
 - ii. Consider all potential impacts such as noise, vibration, light, predator/prey alterations, habitat alterations, increased traffic, etc
 - iii. Include any permitting reviews, such as a USFWS biological opinion or USACE wetland review.
 - d. explanation of the anticipated adverse effects on listed species.**
 - i. Describe how the proposed actions will impact the species. Be sure to address each life cycle stage.
 - ii. Include information on the species life history strategy (life span, age at first reproduction, fecundity, recruitment, survival) to indicate the most sensitive life history stages (reference on life history strategy)
 - iii. Identify where there is uncertainty, place reasonable bounds around the uncertainty, and describe how the bounds were determined. For example, indicate if it is uncertain how many individuals will be taken, make a reasonable estimate with high and low bounds, and describe how those estimates were made.

- 2) **Measures the applicant will take to minimize and mitigate that impact and the funding that will be available to undertake those measures, including, but not limited to:**
- a. plans to minimize the area affected by the proposed action, the estimated number of individuals of an endangered or threatened species that will be taken and the amount of habitat affected;**
 - i. Provide an estimate of the area of each habitat type effect.
 - b. plans for management of the area affected by the proposed action that will enable continued use of the area by endangered or threatened species;**
 - i. How will suitable habitat be maintained or re-established. For example, native species planting, invasive species control, use of other best management practices, restored hydrology, etc.
 - c. description of all measures to be implemented to minimize or mitigate the effects of the proposed action on endangered or threatened species ;**
 - i. Avoidance measures include working outside the species' habitat.
 - ii. Minimization measures include timing work when species is less sensitive or reducing the project footprint.
 - iii. Mitigation is additional beneficial actions that will be taken for the species such as needed research, conservation easements, propagation, habitat work, or recovery planning.
 - iv. It is the applicant's responsibility to propose mitigation measures. IDNR expects applicants to provide species conservation benefits 5.5 times larger than their adverse impact.
 - d. plans for monitoring the effects of measures implemented to minimize or mitigate the effects of the proposed action on endangered or threatened species ;**
 - i. For example, species and habitat monitoring before and after construction include a plan for follow-up reporting to IDNR.
 - ii. Monitoring surveys should be targeted at reducing uncertainty identified in section 1 d
 - e. adaptive management practices that will be used to deal with changed or unforeseen circumstances that affect the effectiveness of measures instituted to minimize or mitigate the effects of the proposed action on endangered or threatened species ;**
 - i. Adaptive management is a way to make decisions in the face of uncertainty by monitoring the uncertain element over time and adjusting to the new information. Adaptive management requires identifying objectives and uncertainties, thinking through a range of potential outcomes, developing triggers that will lead to different actions being taken, and monitoring to detect those triggers.

- ii. Consider environmental variables such as flooding, drought, and species dynamics as well as other catastrophes. Management practices should include contingencies and specific triggers. Note: Not foreseeing any changes does not qualify as an adaptive management plan.
 - a. **verification that adequate funding exists to support and implement all mitigation activities described in the conservation plan. This may be in the form of bonds, certificates of insurance, escrow accounts or other financial instruments adequate to carry out all aspects of the conservation plan.**
- 3) **A description of alternative actions the applicant considered that would not result in take, and the reasons that each of those alternatives was not selected. A "no-action" alternative shall be included in this description of alternatives.**
 - a. Consideration of alternative actions is an important tool in conservation planning as it allows for thinking of other options and evaluating the potential outcomes in terms of all relevant objectives. However, to be useful it requires creativity in developing alternatives, and systematic analysis in evaluating the alternatives.
 - b. In evaluating alternatives, describe the economic, social, and ecological tradeoffs of each.
- 4) **Data and information to indicate that the proposed taking will not reduce the likelihood of the survival of the endangered or threatened species in the wild within the State of Illinois , the biotic community of which the species is a part or the habitat essential to the species existence in Illinois .**
- 5) **An implementing agreement, which shall include, but not be limited to:**
 - a) **the names and signatures of all participants in the execution of the conservation plan;**
 - b) **the obligations and responsibilities of each of the identified participants with schedules and deadlines · for completion of activities included in the conservation plan and a schedule for preparation of progress reports to be provided to the Department;**
 - c) **certification that each participant in the execution of the conservation plan has the legal authority to carry out their respective obligations and responsibilities under the conservation plan;**
 - d) **assurance of compliance with all other federal, State and local regulations pertinent to the proposed action and to execution of the conservation plan; and**
 - e) **copies of any final federal authorizations for a taking already issued to the applicant, if any.**

Job 9. Produce conservation plan form and instructions.

Document review (Job 2), stakeholder interviews (Job 3), and review of regulations (Job 9) improved our understanding of conservation planning for Incidental Take Authorization. Participant observation with the Endangered Species Program and species recovery teams were also used to identify needs. A workshop was attended to learn about dealing with uncertainty using a structured decision making approach. A conservation plan template was created based on the information collected (Appendix 5). The form has been in use by the Endangered Species Program in 2016 with positive feedback from the program due to the consistent format and nature of information being provided by applicants.

Job 10. Complete final report to FWS and IDNR.

All Quarterly Reports, annual reports, and this final report were prepared. In addition, an @ORC newsletter, INHS technical report, and professional poster were produced on the Sources of Information used by IDNR. Two presentations were given at Annual IDNR Natural Heritage meetings regarding the project.

References

- Martin, T. G., Burgman, M. A., Fidler, F., Kuhnert, P. M., Low-Choy, S., McBride, M. and Mengersen, K. (2012), Eliciting Expert Knowledge in Conservation Science. *Conservation Biology*, 26: 29–38.
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- Strauss, A. and J. Corbin. 1990. *Basics of qualitative research*. Newbury Park, CA: Sage.

Reports:

Annual report 2016:

Henning, B.M. and Hinz Jr. L.C. 2017. Conservation Guidance for Species in Greatest Need of Conservation (SGNC): 2016 Annual Report. INHS Technical Report 2017 (05)

Annual report 2015:

Henning, B.M. and Hinz Jr. L.C. 2016. Conservation Guidance for Species in Greatest Need of Conservation (SGNC). INHS Technical Report 2016 (09)

A report was prepared for an internal IDNR newsletter (@ORC) to inform IDNR of the sources of information used and preferred by IDNR staff.

A report was also published as an INHS report

http://wwx.inhs.illinois.edu/files/3114/7259/1138/INHSReports_Sept2016.pdf.

Presentations:

Henning, B. and L Hinz. 2016. How do they know? Conservation practitioners' Information sources. North American Congress for Conservation Biology, Madison, WI. July 17-20, 2016.

Henning, B. and L Hinz. 2017. Species Conservation Guidance. Illinois Department of Natural Resources, Division of Natural Heritage Annual Meeting, May 17, 2017.

Skufca, J. and B. Henning. 2015. Incidental Take Authorization. Illinois Department of Natural Resources, Division of Natural Heritage Annual Meeting, January, 2015.

Tables

Table 1 interview questions

Interview questions (Job2)

Introduction to interview: “Thank you for taking the time to participate in this research to help improve conservation guidance in Illinois. We are trying to gain an understanding of the approach and resources used by various stakeholders and their experiences with the environmental review process This not an assessment of IDNR employee performance, and the results of this work will not be used in that capacity. The end goal of the project is to improve conservation guidance and to create species specific documents providing stakeholders with the information they need to best avoid, minimize, and mitigate impacts. Participation in the interview is voluntary and you may choose to end the interview at any time. All of your responses will be kept confidential within reasonable limits.”

1.	How long have you held your position?
2.	What is your highest degree? In what field?
3.	Simply stated, what is the goal of your work?
4.	What are the challenges or issues you face in achieving this goal?
5.	How many ITAs have you played a part in? Estimate if necessary.
6.	Can you describe all of the steps of the process, starting with planning for the project to completion of the project? Please include what your role is in the process?
7.	How much organizational guidance vs personal/ professional discretion are you given in this process?
8.	In general, does the “consultation and incidental take process” do an adequate job of protecting listed species?
9.	What works well in the process or what the strengths of the process?
10.	What doesn’t work well in the process or what are its weaknesses?
11.	How important is public perception and input?
12.	What sources of information and data do you use in the environmental review process?
13.	In an ideal world what would you like to know about a species and a project before making a determination?
14.	How much of that information is missing from scientific knowledge?
15.	Has scientific research provided adequate information for your work?
16.	How do you handle risk and uncertainty?
17.	In general, is the regulatory community knowledgeable about environmental impacts?
18.	In general, is the regulated community knowledgeable about environmental impacts?
19.	Describe a good environmental review experience you have had.
20.	Describe a bad environmental review experience.
21.	Does your organization focus more on environmental outcomes or following proper procedures?
22.	Do you have any additional comments or concerns about that we have not discussed that you would like to share?

Table 2. Conservation guidance priorities

Species list indicating the number of consultations between 2010-2014 and the number of applications for Incidental Take Authorization through May 2017. Dark gray highlighting indicates species guidance documents being drafted for this project and light gray indicates guidance documents that are being or are planning to be produced through other projects.

Common Name	Consultation hits 2010-2014	ITAs thru May 2017	Overall priority
Blanding's Turtle	1948	15	1
Black Sandshell	1138	28	2
Slippershell	421	16	4
River Redhorse	548	13	4
Black-Crowned Night Heron	1713	1	5
Yellow-Headed Blackbird	1612	1	6
Least Bittern	1532	1	7
Butterfly	386	12	8
Common Moorhen	1208	0	9
Peregrine Falcon	998	1	10
Indiana Bat	390	6	12
Loggerhead Shrike	547	3	12
Iowa Darter	421	3	14
Black Tern	745	0	14
Spike	351	7	15
Purple Wartyback	284	11	17
Upland Sandpiper	394	2	17
Barn Owl	366	2	18
Franklin's Ground Squirrel	258	7	19
Greater Redhorse	258	6	20
Starhead Topminnow	320	2	22
Gravel Chub	327	1	22
Timber Rattlesnake	246	4	25
Hine's Emerald Dragonfly	253	3	25
King Rail	283	1	25
Rice Rat	229	6	26
Banded Killifish	233	4	27
Yellow-Crowned Night Heron	242	1	28
Blackchin Shiner	233	1	29
Ornate Box Turtle	205	6	32
Kirtland's Snake	207	5	32

Northern Harrier	224	3	32
Black-Billed Cuckoo	196	5	34
Lake Sturgeon	225	0	34
Little Blue Heron	215	1	35
Higgins Eye	195	4	36
Short-Eared Owl	188	3	37
Sheepnose	160	7	39
Eastern Massasauga	171	6	39
Ebonysheell	181	2	40
Western Sand Darter	174	2	41
Wavy-Rayed Lampmussel	156	6	43
Swainson's Hawk	181	0	43
Osprey	173	0	44
Salamander Mussel	159	0	45
Little Spectaclecase	138	6	48
Ironcolor Shiner	150	1	48
Blacknose Shiner	152	0	48
Eastern Sand Darter	146	2	50
Black-Crowned Night-Heron	148	1	50
Mississippi Kite	141	1	51
Pallid Shiner	111	5	54
Bluebreast Darter	135	3	54
Weed Shiner	140	1	54
Regal Fritillary	96	10	56
Spectaclecase	117	2	56
Illinois Chorus Frog	78	24	58
Bigeye Chub	109	3	58
Spotted Turtle	108	2	61
Cerulean Warbler	110	0	61
Wilson's Phalarope	110	0	61
Bigeye Shiner	96	3	62
Eryngium Stem Borer	101	1	63
Indiana Crayfish	78	7	67
Bald Eagle	86	2	67
Common Moorhen	87	1	67
American Bittern	92	0	67
Mudpuppy	84	2	68
Bigclaw Crayfish	83	0	71
Forster's Tern	83	0	71
Redveined Prairie Leafhopper	83	0	71

Plains Hognose Snake	0	6	74
Golden Mouse	82	0	74
Longnose Sucker	82	0	74
Yellow Mud Turtle	0	5	76
Southeastern Myotis	80	0	76
Gray Bat	0	4	78
Sandhill Crane	74	3	78
Great Plains Ratsnake	0	3	81
Pugnose Shiner	75	1	81
Common Tern	76	0	81
Illinois Cave Amphipod	0	2	87
Snuffbox	0	2	87
Fat Pocketbook	0	2	87
Kidneyshell	0	2	87
Purple Liliput	0	2	87
Rainbow	0	2	87
Least Tern	0	1	94
Coachwhip	0	1	94
Flathead Snake	0	1	94
Kentucky Crayfish	0	1	94
Ottoe Skipper	0	1	94
Cobweb Skipper	0	1	94
Rabbitsfoot	0	1	94
Northern Long-Eared Bat	0	0	113
Clubshell	0	0	113
Eastern Ribbon Snake	0	0	113
Lined Snake	0	0	113
Mississippi Green Watersnake	0	0	113
Southern Watersnake	0	0	113
Slider	0	0	113
River Cooter	0	0	113
Smooth Softshell	0	0	113
Jefferson Salamander	0	0	113
Silvery Salamander	0	0	113
Spotted Dusky Salamander	0	0	113
Alligator Snapping Turtle	0	0	113
American Brook Lamprey	0	0	113
Least Brook Lamprey	0	0	113
Bird-Voiced Treefrog	0	0	113
Eastern Narrowmouth Toad	0	0	113

Four-Toed Salamander	0	0	113
Hellbender	0	0	113

Appendices

Appendix 1 SOI Report

Appendix 2 Conservation Guidance Template

Appendix 3 Mussel Documents

Appendix 4 Regal Fritillary Guidance Document

Appendix 5 Conservation Plan Template



@ORC

Issue # 64
January 3, 2017

People are IDNR's Most Utilized Information Source

By Bridget Henning, Illinois Natural History Survey

About a year ago, I sent out a survey through @ORC, issue #48, to gather information on the how IDNR staff got their information and what sources they use. Of the 257 people invited to take the survey, 88 people participated (34% response rate). There was participation across all ORC divisions. Most participants were field staff (43 participants) or program staff (32 participants). See Table 1.

Participants reported that staying informed was an important part of their work (figure 1). Overwhelmingly 73% of participants reported that new developments in their field of specialty were extremely important or very important to their division's work. interdisciplinary knowledge (from outside their field of specialty) was extremely important or very important to 56% of participants when it came to their day to day work. Nearly half, or 48%, of

participants believed that new developments in their field of specialty were extremely important or very important to their day to day work.

When participants were asked how frequently they acquire new information from various sources, on average, they reported obtaining information from colleagues on a weekly basis, more than any other source (Figure 2). Supervisors, review literature, primary literature, and reports were the next most frequently used sources of information, being used on average on a monthly basis. Manuals, webinars, workshops, and conferences were used least frequently, at once or twice a year. Participants also mentioned other sources of information including: professional societies, universities, cooperative extension, the Natural Heritage database, other government agencies, meetings, industry



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@ORC is a weekly publication by the IL Department of Natural Resources Office of Resource Conservation about exciting and wonderful things ORC staff are doing throughout Illinois.

Tammy Miller, Editor
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Division	Participants per division	% of survey respondents
INPC	9/11 (82%)	10%
Impact Assessment	6/9 (67%)	7%
Natural Heritage	14/30 (46%)	16%
Wildlife	16/48 (33%)	18%
Forestry	10/31 (32%)	11%
Fisheries	18/65 (28%)	20%
Private Lands	2/10 (20%)	2%
general ORC/other	13	15%
Total	88/257 (34%)	

Table 1. Survey participation across divisions

professionals, clients and customers, technical books, and internet resources (such as trusted websites, list serves, blogs, and online training classes).

Surprisingly, the frequency that various sources of information are used was not closely matched by information source preference. Participants had a range of preferred sources of scientific information: 18% preferred primary scientific literature, 16% preferred colleagues, 13% preferred workshops, 10% preferred reports, 7% preferred conferences, 6% preferred review literature, 2% preferred manuals, 1% preferred webinars, and 1% preferred personal experience. Perhaps not surprising, although supervisors were the second most frequent source of information, no one preferred them as a source of information.

On average, participants attributed about half of their knowledge and expertise to personal experience, but responses were across the board from all to no experiential knowledge. Surprisingly, experiential knowledge was not related to years spent working for IDNR. Despite the stated importance of new information and the frequency at which new information is acquired, participants reported having trouble obtaining new information.

In total, 80% of participants said they experience obstacles in acquiring new information: 47% had limited time for obtaining new information, 45% said travel restrictions were an obstacle, 24% said access, such as to scientific journals, was an issue, 9% explained that there was a lack of internal sharing of information within IDNR, and 8% were limited by technology issues, such as access to the internet. Additional obstacles (each identified by less than 3 participants) included lack of coordination with other agencies, limited value placed on science by IDNR, and too much information available to consume and synthesize.

Similarly, when specifically asked if they had access to primary scientific literature, 11% of participants said “Yes, it's readily accessible”, 20% said “Yes, but it is time consuming to access”, 43% said “I have access to some journals”, 14% said “No, I don't have access”, and 11% said “I don't know, I've never tried”.

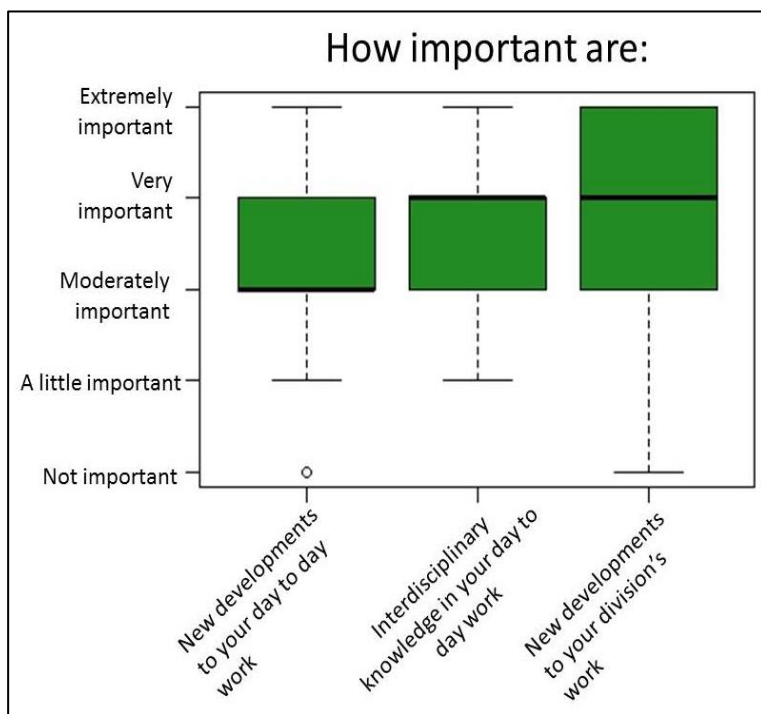


Figure 1. Graph depicts the median, interquartile range, nominal range, and outliers of responses to the three questions coded on a 1-5 scale

Although access to literature poses an obstacle to some participants, most were confident in their ability to comprehend scientific literature, as 92% of participants report understanding the full nuance or the main message of primary scientific literature.

Broader picture

IDNR is similar to other natural resource management organizations in terms of using information sources. Managers from California, Australia, and the United Kingdom also heavily rely on colleagues and experience for information^{1,2}. Commonly, scientific evidence is valued over all other information³, but there are limitations to its use. For example, most managers have access to scientific literature, but feel too time-constrained to use it^{1,2}. In addition, managers report that the complexity of resource management decisions typically extends beyond the realm of scientific literature³.

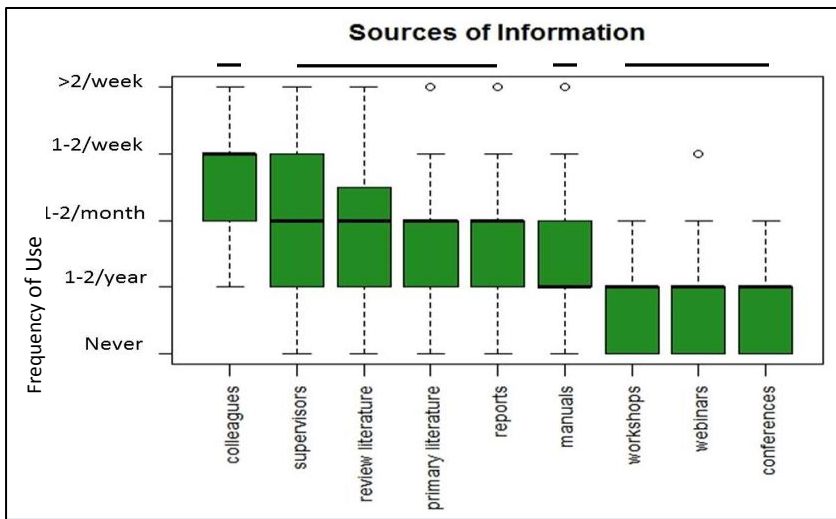


Figure 2. Survey Question: *In the past year, how often did you acquire new information in your field from the following sources?* Graph depicts the median, interquartile range, nominal range, and outliers of responses coded on a 1-5 scale. Bars at the top of the graph indicate significant differences between 4 groups of sources, as determined by a Welch's F-test and Games-Howell posthoc test.

Scientific literature vs Social networks

While most people agree that scientific information is important to the field of natural resource management, the most effective form and source of that information has been debated by researchers. Some researchers lament the limited use of scientific literature in natural resources decisions due to the demonstrated shortcomings of managers' perceptions and expert opinions⁴⁻⁶. However, scientific literature frequently does not provide information that practitioners find useful for their work^{1,7,8}. Perhaps more commonly, informal scientific information is more accessible and applicable to managers. For example, in California, 88% of natural resource managers report using their own research or monitoring to guide management, and this information is typically only shared with colleagues¹

Social learning and social networks are increasingly being acknowledged as important in natural resource management⁹. Indeed, IDNR's heavy use of colleagues as information sources clearly indicates the importance of IDNR's social network for information sharing. It has been demonstrated that social learning can play an important role in spreading scientific information and adoption of innovative practices¹⁰⁻¹², but the effectiveness of a social network is dependent on its structure and function¹³.

Examining the structure of the IDNR network could help us understand how it functions. Networks with many connections are cohesive but if disconnected from outside groups can become uniform echo-chambers, where innovative or critical ideas are absent. The introduction of new ideas may come from scientific literature, conferences, workshops, people themselves, or other groups.

Sub-groups within a network are important for maintaining a diversity of knowledge, for example, the different knowledge held within divisions or regions. However, sub-groups can also discourage collective action by creating "us vs them" mentality.

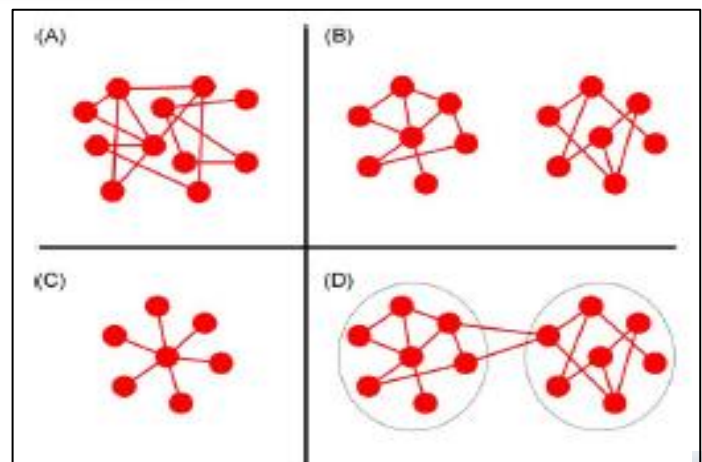


Figure 3. Simple network structures: A) Cohesive networks with no sub-groups may lose diversity of knowledge, B) Networks with two isolated subgroups can prevent collective action and sharing knowledge, C) Highly centralized networks are very dependent on the central person to spread information and facilitate action, D) Networks with subgroups and bridging ties maintains diversity and share knowledge.

Bridging connections between subgroups are necessary for sharing of knowledge and working together, and research has demonstrated that more bridging ties result in increased innovation and productivity¹⁴. Individuals may play central roles in the network, creating bridges between individuals or sub-groups. These central individuals may or may not be in management but play an huge role in spreading knowledge and facilitating group action.

Although it is difficult, if not impossible, to engineer a social network, understanding that IDNR already has a social network that it relies on for learning and sharing information can enable better appreciation and support for sharing information in this way. For example, creating opportunities for people to interact and share knowledge, such as annual meetings or working groups, strengthens connections and encourages new connections to sub-groups or outside groups. Increasing the strength and number of connections may increase innovation and productivity. It is also important to keep in mind that although social networks can be great for spreading information, it is necessary to inject them with a diversity of ideas, such as those that come from scientific literature and different groups of people.

Other comments

Survey participants had lots of comments and ideas related to the topics of learning and information sharing. Participants highlighted the importance of interdisciplinary knowledge and staying abreast of new developments. One participant even expressed concern about, “the future integrity and credibility of this agency” suffering if professional development is not promoted. Some participants commented on the importance of sharing information within and across divisions, especially in face to face workshops, meetings, and conferences. One participant said “it should be a priority to forward the final report and any future publications from every Illinois related (i.e. funded by the IDNR or was conducted in IL) research projects to the field biologist.” A few participants commented on the limited utility of literature, as it applies only to specific projects and “The reality of doing field work cannot be obtained from literature.” Participants also reiterated the significance of their time constraints and one suggested that if you are reading literature then “your objectives and duties that [sic] aren't getting done.” Numerous participants thought IDNR should obtain journal subscriptions or mentioned that they might have access to journals through the state but were unsure how to access them.

Note* After a little searching, I learned that the Illinois State Library provides state employees with multiple research databases, such as *Academic Search Complete*, and electronic access to many journals. See: <https://www.cyberdriveillinois.com/departments/library/databases/home.html>. But employees must first obtain a State library card for access: <http://www.cyberdriveillinois.com/departments/library/libcardapp.html>.

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IDNR Species Guidance Document template

Purpose

The primary purpose of a species guidance document is to provide various project developers/land managers with information on the species, how their actions may impact the species, and how they can minimize/mitigate/monitor those impacts. In addition, the documents should be useful for the general public, for identifying research needs for improving management, and as a first step towards recovery planning. We hope the documents will be comprehensive and inclusive of scientific and experiential knowledge of the species and its conservation. We would also like the documents to incorporate information on current conservation efforts, conservation opportunities and research needs. They will be posted on the IDNR website.

Content

Through discussions and working with IDNR and ITA applicants, specific guidance needs were identified and are contained in this template. The information within the document should build and justify the recommendations contained in the document. First the species natural history is described, then threats are described and related to the species life history needs, then avoidance, minimization and mitigation recommendations should be based on that understanding. The information including the management sections, such as threats, avoidance, minimization and mitigation, should be based on literature, if available.

The following template includes elements that should be covered. Each species will have different levels of detail and taxa specific elements. Ideally information will be species specific, but when it is not available, information on closely related species will be used as appropriate. The goal of the documents is to create common ground on species information for land managers, developers, biological consultants, and the general public. Because the audience will have varying levels of expertise it is important to avoid jargon, but provide references where more information can be located.

Format

The document must be provided to IDNR in Word document format so that they will be able to revise and update it as they see fit. Try to include pictures for species identification, habitat, and any other elements that will be easier to understand with a picture. Credit the photographer. Many photos can be found on Flickr for use under the creative common license:

<https://www.flickr.com/search/?license=2%2C3%2C4%2C5%2C6%2C9> . Indicate when evidence is available versus professional judgment is used. In-text citations can take away from the text and make it difficult to read for laypersons, but are important for documenting evidence, so use numeric in-text citations. Numeric citations can complicate things in the revision stage, unless references are stored in a bibliographic table, such as .bib or .xml from Endnote, Mendeley or another reference manager. Please, produce a bibliographic table such as .bib or .xml that will travel with the document for future revisions.

Review

The document should undergo stakeholder review to ensure all relevant information is included and to build understanding and agreement around the guidance. The first draft of the documents is intended to be a literature review and incorporate as much information as possible. Second and third drafts will incorporate experiential knowledge contributed by reviewers. Compile a list of reviewers with email addresses, including IDNR program, regional, and field biologists, other government agencies, academic researchers, land managers, and other interested stakeholders. Reviewers should be given adequate time

(~1 month) to review and provide comments on the first draft. Then revisions should be made to incorporate suggestions. The document should be sent out for a second round of review, so that people can see how revisions were made and given an opportunity to concur or request further changes. Acknowledge reviewers who provided feedback in the acknowledgement section of the document.

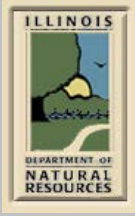
Below is a message that can be sent to reviewers with the document to introduce the purpose of the document. In addition, personalized invitations will elicit greater feedback.

IDNR is working with partners to produce documents that provide conservation guidance for listed species in Illinois. The primary purpose of the documents are to provide various project developers/land managers with information on the species, how their actions may impact the species, and how they can minimize/mitigate/monitor those impacts. In addition, the documents should be useful for the general public, for identifying research needs to direct various funds, and as a first step towards recovery planning. We hope the documents will be comprehensive and inclusive of scientific and experiential knowledge of the species and its conservation. We would also like to incorporate information on current conservation efforts, conservation opportunities and research needs. They will be posted on the IDNR website.

An initial literature review has been conducted and a guidance document has been drafted for comment. Your knowledge and experience will improve the documents and your input is needed! We would greatly appreciate your feedback on the content of the document.

Please, review the linked/attached draft species guidance documents for (species x) and provide feedback by (*provide deadline*). All comments, critiques, and suggestions are welcome and will be incorporated into the final version.

Feel free to circulate among interested parties who may wish to comment.



Common name

Genus species author

IL status:

US status:

Global rank:

From NatureServe or IUCN

Trend:

From IWAP or IUCN

Family:

Habitat:

Similar species:

What species look similar

Seasonal cycle:

Depict this as a pictograph showing months, survey periods, and relevant periods

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Survey period

Non-reproductive/absent/hibernating/aquatic

Reproductive period/present/terrestrial

Species information

Characteristics

Physical description of the species similar to description in a field guide with field cues. Include different life stages. Key identification traits should be bolded. It should include a photo or illustration.

Describe how the species is typically observed (i.e. in large flocks, heard calling). Link to a call recording, if appropriate.

What species might it be confused with and how can you tell them apart.

Habitat

This section should help readers understand key habitat features. Describe habitat characteristics including biotic and abiotic factors. Include description of less than ideal environments, such as a drainage ditch or flooded agriculture fields, where there have been occurrences. If known, habitat limitations should be indicated. Include different habitat requirements at different life stages.

If available, include a habitat map.

Taxonomy

For some species this will be as simple as naming the family and common names of the species. Also indicate ecologically relevant classification. For example, include tribe for mussels. Closely related species may be worth mentioning. Some species will be divided into subspecies and differentiation should be described, physically and geographically. If the species taxonomy is unresolved, describe its current state (See the Integrated Taxonomic Information System). Indicate which name is used by the Illinois Endangered Species Protection Board

Distribution

Describe and/or map species distribution on a global scale. If there are different winter and summer ranges this should be described. If known, describe what limits their range?

Describe and map state distribution. Information on state distribution should be shown by mapping records from the Natural Heritage database. Indicate recent (<10 years old) and older records. The point locations may need to be enlarged so as to conceal potentially sensitive information.

Status

What is the global status and trend?

What is the statewide listing status? Why was it listed (Check ESPB documents and meeting minutes)?

Discuss what is known about population sizes and trends.

Natural History

This section should include all information necessary for understanding how the species lives and may be impacted. The information should be detailed enough to understand how threats in the next section impact them. Include information on the timing of various life events and how are they triggered. Topics covered in this section may include, but are not limited to the following:

Movement

Does the species migrate or move between habitats? When? Why? Do they show site fidelity? Include spatial ecology- home range size, typical movement distances/timing, and densities.

Diet

What do they eat? Does diet vary by life stage?

Social lives

Are they social? Do they maintain territories?

Reproduction

What is their reproductive cycle and system? Indicate when and where reproductive activities take place.

Overwintering

When and how do they overwinter?

Interspecies interactions

Do they interact with other species? Hosts? Parasites? Predators?

Population dynamics

This section should help readers to understand what drives population growth or declines. Indicate species fecundity, recruitment, mortality, and longevity rates. Include population age and sex structure. What is the first age at reproduction? Have there been population viability studies? Sensitivity and elasticity analyses? What life stage drives population trends?

Conservation/Management

Threats

This section should help readers understand threats to the species as they relate to the species biology described in the previous section. Include a short overview paragraph identifying general threats to the species and relative importance. Then describe each threat in more detail. The goal is to explain threats, their relative importance, and their causes in enough detail that a reader will understand measures required to avoid, minimize and mitigate these threats, as described in the next section.

Indicate how the threats impact the species- Does it cause mortality or interfere with communication, feeding, reproduction, etc.? Be as specific as possible.

Include threat information relevant to development project impacts. It may be helpful to look at development project impacts in past IDNR Incidental Take Authorizations to understand impacts that should be considered. For example, describe if and how the species is susceptible to road mortality, erosion, sedimentation, noise pollution, soil compaction, structure collision, etc.

Consider the following threats, but each species will have different threats that need to be included:

Habitat loss

Habitat degradation

Habitat fragmentation

Climate change

Pollution- chemical, noise, light

Provide information on species sensitivity. Include toxicology research and research on what the species is known to perceive including noise, chemical, and light pollution. Are threshold levels known?

Predators

Diseases

Collisions with structures/vehicles

Regulations

This section will be similar for most species and should include the following:

In Illinois, it is illegal to “take” any threatened or endangered species, such as _____. “Take” is defined as “to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or attempt to engage in such conduct”, is prohibited by the Illinois Endangered Species Protection Act:

<http://ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1730&ChapterID=43>

The IDNR consultation section reviews proposed actions to assess potential impacts to listed species, using their online tool EcoCAT:

<http://dnr.illinois.gov/ecopublic/>

IDNR can authorize the taking of listed species that is incidental to otherwise lawful activities. To receive Incidental Take Authorization, one must prepare a conservation plan and notify the public of the impact. See:

<http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/IncidentalTakeAuthorization.aspx>

Research or handling of listed species may require IDNR permits, including a Scientific Collector Permit and an Endangered and Threatened Species Possession Permit, and additional site permits if research takes place on IDNR land or a dedicated Nature Preserve:

<http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/ResearchPermits.aspx>

Risks and impacts of research methods on the species’ survival must be weighed against the benefits to justify the activity.

Species conservation goals

Have goals been identified for the species? IWAP? State or federal recovery plans? Are there delisting triggers?

Conservation efforts

What has been done to conserve the species in IL? Describe recovery plans, research projects, etc. If there are regional plans related to the species, such as watershed protection plans or conservation opportunity area plans, identify them here.

Describe land protection efforts. For example, how many EORs are on INPC sites, other conservation lands (for example, use the CARL layer from Ducks Unlimited or iView), and non-conservation lands? Create a map of this info.

Are there stewardship, restoration, or propagation efforts being done to benefit the species? Also, include other agency programs, such as NRCS and EPA, that benefit the species even if species conservation is not the specific intent.

Survey Guidelines

Monitoring for trends

Describe surveys that are being conducted or should be conducted to monitor trends in population, abundance or distribution.

Surveys for presence and abundance

Describe survey methods that should be used to determine presence/absence and abundance. Indicate the confidence level of these methods; ideally, indicate how to achieve 75, 90, 95% confidence. Discuss how probability of detection is determined. Maybe create a table indicating uncertainty. For example:

	Low detection rate	Median detection rate	High detection rate
Number of surveys	0.17	0.28	0.39
5	61%	81%	92%
10	84%	96%	99%
15	94%	99%	100%

Monitoring for impacts

Describe methods that should be used to monitor impacts to populations, such as Incidental Take Authorization or habitat modification. Identify survey objectives, such as monitoring change in population size, survival, or recruitment. A before-after impact survey approach may be most appropriate.

Stewardship recommendations

This section should describe how to maintain or enhance habitat for this species. What structure or dietary needs can to be managed for and how? Are there host species that should be increased and how? Are there specific metrics, such as water quality, that can be targeted and how? Are there invasive species and predators that can be managed and how? If prescribed burning is recommended include date or weather restrictions.

If necessary, mechanical and chemical removal of vegetation should follow INPC stewardship guidelines:

(<http://www.dnr.illinois.gov/INPC/Pages/INPCManagementGuidelines.aspx>)

Include decontamination protocol to prevent spread of disease and invasive species, if appropriate.

Include section about informing adjacent landowners of conservation practices they can perform to support its survival, such as planting natural vegetation, nest site creation/protection, reducing pesticide use, conscientious driving, and confining pets.

Avoidance measures

Describe how impacts to the species can be avoided. Generally this is only possible by avoiding direct and indirect impact to the species occupied habitat. Include a biologically-based set back distance at which impacts may be avoided? For example, how far is the species or host known to travel, or is there a known flush distance. Avoid construction in flight corridors such as adjacent to shorelines or waterways.

Note: Timing is generally a minimization measure but under some circumstances it may be an avoidance measure, for example, a migratory bird that will readily use another area for breeding.

Minimization measures

Describe how impacts to the species can be minimized. Describe practices that reduces impact to the species. If possible, provide information on the effectiveness of these measures. If possible, include estimated costs of measures. Consider the following:

Timing

Identifying date or temperature restrictions for different types of activities in different locations, such as tree clearing, dewatering, or turbine curtailment to avoid times when the species is most sensitive, such as spawning or migration.

Compatible design

Development design should be compatible with continued use by the species. Design elements to consider include:

- a) Bore under habitat or build over it rather than building upon it.
- b) Maintain appropriate vegetation composition and structure, such as downed/dead trees, open areas, sparse vegetation, etc.
- c) Incorporate managed disturbance, such as mowing or burning when it will benefit the species.
- d) Maintain natural hydrology. Consider practices, such as using permeable surfaces, using retention basins, or increasing bridge/culvert openness to maintain connection and flow
- e) Maintain soil profile for fossorial species
- f) Reduced light, noise, and chemical pollution. Consider eliminating or reducing lighting, implementing pesticide restrictions, and treating run-off and effluent.
- g) Reduce roadway risk by providing barriers and passageways, reducing speed, or installing diversion poles
- h) Reduce collisions with reduced building lighting, bird safe glass, flashing lights on towers, and increasing cut-in speeds of turbines.

Construction practices

Construction practices should be sensitive to species needs and altered to reduce impact, if possible. It may be helpful to look into practices from past ITAs. Consider including the following practices if appropriate:

- i) Relocate animals found within the impact area
- j) Use animal exclusion fencing to prevent animals from entering the impact area
- k) Appropriate and stringent erosion control measures, including the use of natural fiber erosion control matting, revegetating with suitable native vegetation, and monitoring and repairing control measures during and after construction.
- l) Use appropriate techniques or tools, such as low psi tires, sheet piling, limit use of heavy machinery, or use floating barges in place of rock causeways.
- m) Locate staging areas away from sensitive habitat.
- n) Limit clearing of vegetation
- o) Debris and excess materials should be removed and properly disposed
- p) Personnel education and flag or fence areas that are not to be disturbed to alert construction personnel.

Mitigation and Conservation Opportunities

This section should provide suggestions of conservation actions that will benefit the species. If a recovery plan has been developed, include the identified actions. Consider including:

Protection

Describe protection options such as land acquisition and donation, INPC dedication, and other applicable conservation easements. If possible identify priority areas for protection. Direct them to the Prairie State Conservation Coalition website to locate potential partnering land trusts.

Stewardship

In this section identify stewardship needs that could be used for mitigation. If possible, estimate costs. Do not repeat the stewardship section from earlier, but refer to it for more details on specific practices. For example, mechanical removal of an invasive species on a public property.

Restoration/habitat creation

Give brief description of habitat creation and refer to other guides. If possible, include estimated costs

of various efforts. NRCS provides cost estimates for some conservation practices.

Coordination

Conservation may require coordinated action from multiple partners. Describe how coordination will conserve this species and which groups would be appropriate partners.

Research needs

Most of the research gaps should be identified in researching the previous sections and can then be compiled here in the form of questions. Although there may be basic research questions about the species, these research questions should target the needs of regulators and managers. Ask yourself “will the answer to this research question change how we do management/conservation for this species?” If the answer is “no” or “probably not”, this is not an appropriate research question for this document. Below each question identify how it could be addressed, e.g. GIS analysis, population modeling, telemetry.

Additional information

- a) Identify other sources of information on the species, such as INHS or NatureServe species profile pages.
- b) Identify documents providing habitat management advice.
- c) Link to relevant plans such as recovery plans, watershed protection plans, conservation opportunity area plans.
- d) Also identify spatial information that may be relevant to the species/habitat such as National Wetland Inventory (<http://www.fws.gov/wetlands/Data/Mapper.html>) or NRCS soil maps (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>).

References

In text citations can take away from the text and make them difficult to read for laypersons, but are important for documenting evidence, so use numeric references in-text with references included at the end.

Citation

Name. 2017. Conservations guidance for common name
(*scientific name*). Prepared for the Illinois
Department of Natural Resources, Division of
Natural Heritage.

Acknowledgements

Review and helpful comments were provided by:

Funding for this project was provided by:

Life History

Freshwater mussels are sessile organisms that spend their lives partly or entirely buried in the streambed (Figure 1). Mussels have a large muscular foot that anchors them in the substrate and can be used for locomotion. Mussels may move up or down in the substrate, or occasionally laterally across the streambed, depending on cues like water temperature or current velocity¹ (Figure 2). Some species will move readily, as much as 40 ft. in a week, while others move very little, unless dislodged during a high water event^{2,3}. Over 70% of a population may be buried or hidden beneath the substrate during much of the year⁴. Density and abundance of mussels vary substantially based on river and site⁵.

Habitat

Mussel species inhabit a variety of habitats from small headwater streams to large rivers, in substrates from coarse sand and gravel to silt, from riffles to runs to areas of low flow, with turbid to clear water.. Suitable habitat is often constrained by extreme high and low flow events⁶. During high flows, habitat instability due to shifting substrate is a critical limiting factor for mussels⁷. Mussels burrow in the streambed thus stable substrates help an individual stay anchored—unlike in less stable



Figure 1. A filtering, mostly buried freshwater mussel. Photo by A.P. Stodola.

habitats such as silt and shifting sand where mussels are more likely to be dislodged by fast flowing water. Areas that are protected from extreme flow by the shape of the river can serve as flow refuges⁶. Low flows also limit habitat suitability because areas may become dewatered or stagnant⁸. These areas have very low dissolved oxygen due to the low flow and warm temperatures. Stable substrates, like gravel with sand, in rivers with riffle-pool sequences are typically considered ideal mussel habitats¹. Large rivers are often considered more stable than small streams because large rivers have flow refuges that can buffer against high flow events and are also less susceptible to drought effects at low flows^{1,7,9}.

Feeding

Adult freshwater mussels feed by filtering microorganisms, such as algae and bacteria, from the surrounding water. They draw water into their shell via an incurrent (inhalant) aperture, move it across the surface of the gills by ciliary action, and expel the water via excurrent (exhalant) aperture¹⁰ (Figure 3). Newly metamorphosed juvenile mussels use cilia on their foot, gills, and mantles to feed¹¹ (Figure 4). Juveniles and adults may occupy different habitats and feed on different sized particles¹¹.



Figure 2. Lateral movement (see 'trail') by a freshwater mussel in low water. Photo by A.P. Stodola.

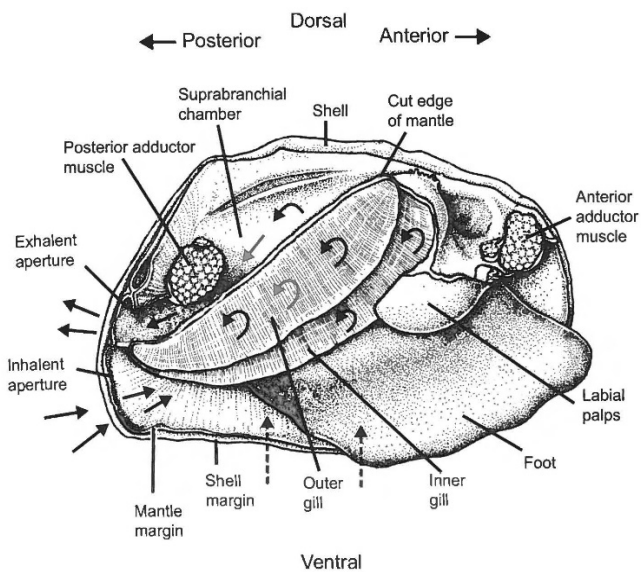


Figure 3. Internal anatomy of a freshwater mussel. Water flows into a mussel at the inhalant aperture, flows through the gills, and out through the exhalant aperture. Arrows show the direction of water flow¹. Image from Haag 2012, adapted from Williams et al. 2008.

Reproduction

Freshwater mussels have a unique life cycle (Figure 5). Males release sperm into the water column and the female draws them in to fertilize eggs. The fertilized eggs reside within the female's modified gill pouches and develop into larvae called glochidia. Some mussels hold onto their glochidia over winter, but others spawn and release glochidia in the same year¹². Different species release glochidia individually, in long strings, or in mucilaginous "packets"¹³. Glochidia may then be picked up by fish, which ingest free floating glochidia, become entangled in strings of glochidia, or are attracted to glochidia by female lures¹. The tiny glochidia will remain on the gills or fins of suitable host fish as they transform into juvenile mussels or be shed off of unsuitable host fish.

The glochidia of some mussel species can transform on a variety of fish species, whereas others transform on only a couple species. Host information for Illinois mussel species can be found in the Freshwater Mussel Host Database:

<http://wx.inhs.illinois.edu/collections/mollusk>

[/data/freshwater-mussel-host-database](#). The dispersal and settling location of juvenile mussels is dependent on host fish movement and water flow.

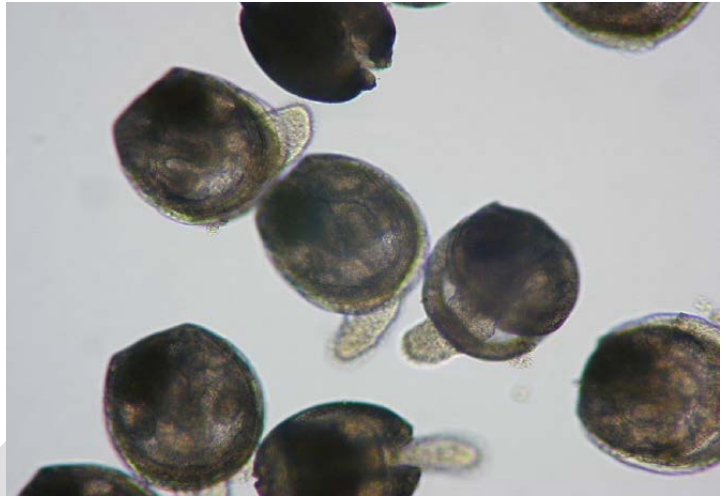


Figure 4. Newly metamorphosed juvenile mussels. Photo by M. C. Barnhart.

Mussels exhibit great variation in growth rates among populations due to differences in water chemistry, food availability, stream size, or latitude but growth gradually slows as individuals become older¹¹.

For species-specific life history information on most

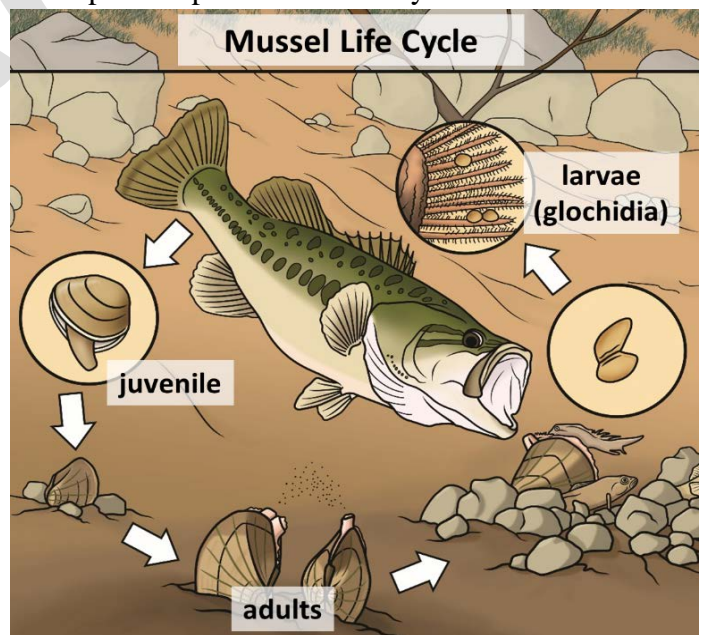


Figure 5. Freshwater mussel life cycle. Males release sperm into the open water that females take in to fertilize their eggs. Females release larvae, which are taken up by host fish. Larvae develop into juveniles while on the host fish, and eventually drop off to live the rest of their life in the substrate⁴³. Image by Cummings and Graf 2009.

mussel species in Illinois, see the companion table and species-specific guidance documents.

Conservation

North America is home to the world's richest freshwater mussel fauna (order Unionoida) with about 300 species¹⁴. However, 65% percent of those are considered imperiled¹⁴. Illinois is home to 82 species of mussels, over half of which are listed as threatened or endangered or are considered extinct. Mussel occupancy models estimate that on average mussel species in Illinois occur in 27-35% fewer reaches than they did historically, and the losses are even greater for listed species¹⁵. The specific causes of these declines are not well understood, but mussels are sensitive to many of the ways that humans alter aquatic environments¹.

Threats

Habitat loss, degradation, and fragmentation

Dams and channelization may result in critical habitat loss for many mussel species and their host fishes. Dams and other barriers alter the flow, temperature, and oxygen content of water, create areas of slackwater that are prone to siltation that may smother mussels, fail to provide nutritional inputs, and limit upstream or downstream movement of glochidia on host fishes^{16,17}. Ultimately, widespread river impoundment disrupts continuity of flowing water environments, which can limit host fish availability, movement, and mussel dispersal¹⁸.

Channelization removes habitat diversity including flow refuges—areas safe from scouring of the riverbed. Channelization may create conditions



Figure 6. Channelization of an Illinois stream. Photo by S.A. Douglass.

favorable for sediment transport, which can smother mussels or create unstable substrate, and is often accompanied by installation of construction materials for bank stabilization that do not provide suitable habitat (Figure 6). Other forms of altered flow resulting from changing land use, like urbanization, can cause extreme flow events. Increased high flow events cause scouring and destabilize banks, consequently dislodging or smothering mussels. Decreased flows may cause temporary dewatering, creating drought-like conditions.

Pollution

Both point and non-point source pollution are ongoing threats to mussels (Figure 7). Pollution includes the introduction of any matter into waters that changes the physical, chemical or biological condition of the water. Historic discharge of agricultural runoff, industrial waste, and raw sewage likely caused widespread population declines. Current risk from pollution exists in the form of urban or agricultural chemical runoff, water quality violations (e.g., industrial spills or livestock lagoon runoff), and wastewater effluent. The increase in pesticide use in the 1960s coincides with mussel declines and studies have shown chronic and sublethal effects of pesticides and surfactants on mussels¹. Juvenile mussels are particularly sensitive to unionized ammonia that may come from feed lots, wastewater, and fertilizer^{1,19,20}. Even treated wastewater may contain chemicals at concentrations that impact mussels. Endocrine disruptors from



Figure 7. Pollution in a small stream. Photo by S.A. Douglass.

human and agricultural pharmaceuticals are widespread in streams and rivers and have caused feminization of male mussels¹. Antidepressant in wastewater alters mussel movement and burrowing, which can impact successful host attraction and predation²¹.

Climate change

The impacts of climate change on mussels are unknown, but mussels in cool and headwater streams in Illinois were ranked highly vulnerable to climate change²². The ratings were driven by potential sensitivity to hydrological changes, such as low flow or temporary stream drying, and dependence on host fishes and their dispersal capabilities, which could be limited due to stream temperature changes or physical barriers. In addition, many mussel species are living close to their upper thermal limits and climate change is likely to have physiological and behavioral effects on these species²³.

Water demand

Another important emerging threat to mussels may be increased human water demand. Extraction of water from aquifers, streams, and rivers reduces the flow, potentially below ecological requirements of mussel species¹⁴. The threat from water demand may increase with climate change.

Exotic invasive species

Exotic mollusks may negatively affect mussels through competition for space and food. Asian clams (*Corbicula spp.*) are widespread in Illinois, but their impact on native mussels is not well understood¹⁴. Asian clams may negatively affect



Figure 8. Invasive Zebra Mussel *Dreissena polymorpha* clustered on the native mussel, White Heelsplitter *Lasmigona complanata*. Photo by S.A. Douglass.

mussels through ingesting broadcasted sperm, glochidia, and juveniles¹. Dense populations of Asian clams experience periodic massive die offs that can produce lethal levels of ammonia and low dissolved oxygen²⁴. Dense populations of Zebra mussels and Quagga mussels (*Dreissena spp.*) often cluster on native mussels and have reduced native mussel populations in some rivers in Illinois¹⁴ (Figure 8). Black Carp (*Mylopharyngodon piceus*), which feed on mussels, have also become established in Illinois and have the potential to impact native mussel populations¹⁴.

Predation

Several taxa such as muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*), otters (*Lontra canadensis*), wading birds, and several species of fishes prey on mussels, typically younger and thin-shelled species.

Diseases

Diseases of freshwater mussels are poorly understood. However, bacteria and viruses have been known to damage mussels in the freshwater pearl industry in China²⁵. Parasites, such as trematodes and mites, can be common and interfere with mussel reproduction; but infection rates are typically low and differ between species¹.

Physical impacts

In-stream construction, horses, ATVs, or livestock with unrestricted stream access may crush mussels.

Conservation efforts

Mussel research across the U.S. has provided information and direction for conservation efforts



Figure 9. Predation on Fragile Papershell *Leptodea fragilis*, a thin-shelled species, during drought conditions. Photo by S.A. Douglass.

(see <http://molluskconservation.org/index.html>). Priority actions for mussel conservation have been identified in the “National Strategy for the Conservation of Native Freshwater Mollusks”²³. In Illinois, recent research has improved our understanding of current and past distributions of mussel species across the state^{26,27}. Host fish for many mussel species have been identified and can be found in the Freshwater Mussel Host Database²⁸. Mussel propagation techniques continue to advance. The National Fish Habitat Partnership completed an assessment of stream and river habitat and determined the risk of habitat degradation of Illinois watersheds²⁹.

Mussels are being propagated and stocked in Illinois waterways to augment declining mussel populations.

Improvements have been made to mussel habitat in Illinois. Dams have been removed or modified to restore free flowing stream habitat in Illinois, and more removals have been planned by IDNR <https://www.dnr.illinois.gov/WaterResources/Pages/safetyAtDams.aspx>.

Water quality has improved since the Clean Water Act went into effect in 1972. In addition, new water quality criteria with a more restrictive unionized ammonia limit for wastewater treatment effluent has been developed by the Environmental Protection Agency to protect mussels²³. Various Illinois watershed groups have developed plans to restore rivers and stream.

Regulations

All mussels in Illinois are protected under the Aquatic life code: <http://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=1728&ChapterID=42>

In addition, many mussel species are protected by the U.S. Endangered Species Act and the Illinois Endangered Species Protection Act. It is illegal to “take” any threatened or endangered species. “Take” is defined as “to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or attempt to engage in such conduct”:

<http://ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1730&ChapterID=43> .

The IDNR consultation section reviews proposed actions to assess potential impacts to listed species, using their online tool EcoCAT: <http://dnr.illinois.gov/ecopublic/>

IDNR can authorize the taking of listed species that is incidental to otherwise lawful activities. To receive Incidental Take Authorization, one must prepare a conservation plan and notify the public of the impact. See: <http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/IncidentalTakeAuthorization.aspx>

Research or handling of listed species may require IDNR permits, including a Scientific Collector Permit and an Endangered and Threatened Species Possession Permit, and additional site permits if research takes place on IDNR land or a dedicated Nature Preserve: <http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/ResearchPermits.aspx>. Risks and impacts of research methods on the species’ survival must be weighed against the benefits to justify the activity. For example, protocols should include measures to avoid the destruction of habitat and the spread of disease and exotic species.

Survey Guidelines

To ensure mussel survival and minimize stress, surveys should occur when water temperatures are at least 50° F^{30,31}, and air temperatures are between 32 and 95° F³². Typically, this period is May 1 to October 1. In addition, it is recommended that surveys be conducted during base flow conditions because high water levels and velocity may limit the ability to conduct surveys.

Monitoring for population trends

A long-term monitoring program is needed to identify mussel population trends in Illinois²³. To determine population density and size, quantitative sampling of sampling units (e.g., quadrats or transects) is recommended. This can provide an estimate of population abundance³³. Qualitative, timed searches are efficient for monitoring species’

distribution, richness, and community composition³³. Sixteen person-hour searches identify about $\geq 70\%$ of species diversity; however, 10 person-hour searches also provided a reliable index of species richness³⁴.

Surveys for presence and density

Surveys to determine presence and density of a mussel species prior to potential impacts should follow the IDNR Illinois Mussel Survey Protocol for Impacted Areas.

Monitoring for impacts

Surveys to monitor changes from planned impacts, such as habitat restoration, mussel introductions, and Incidental Take Authorization, should assess changes in population size, survival, and recruitment^{33,35}. Monitoring should follow a before-after-control-impact design^{36,37}. Initial surveys should occur before impact, and then 2 years and 5 years post-impact. To detect a 50% change in density/population size, at least 30 cells or transects that cover the area of impact should be surveyed at each site. All mussels captured should be marked with an identifying number and replaced. Recaptures and age class should be recorded and reported to estimate survival and recruitment.

Management Guidelines

Protection

Rivers and streams that contain listed mussel species, adjacent reaches, and the surrounding riparian areas should be protected. Priorities for mussel conservation in Illinois have been identified by modeling mussel distributions^{15,38,39}. Figure 10 shows areas identified as stream conservation priorities for Illinois based on aquatic species modeling including 10 mussel species³⁸. Protection may consist of acquisition or conservation easement. Acquired property could be donated to a conservation agency or local conservation organization. Conservation easements may provide a level of protection without acquisition. Illinois Nature Preserves Commission permanently protects high quality natural areas and habitat for listed species on both private and public property in the Illinois Nature Preserve System. Conservation easements on agricultural land can

also protect habitat through retirement of farmed and previously converted wetlands. Conservation organizations that may be interested in partnering on conservation efforts can be identified through the Prairie State Conservation Coalition (<http://www.prairiestateconservation.org>).



Figure 11. Hatchery-reared individuals marked with a Hallprint tag (left) or glitter-tagged (right). Photo by Jessi DeMartini.

Habitat improvement

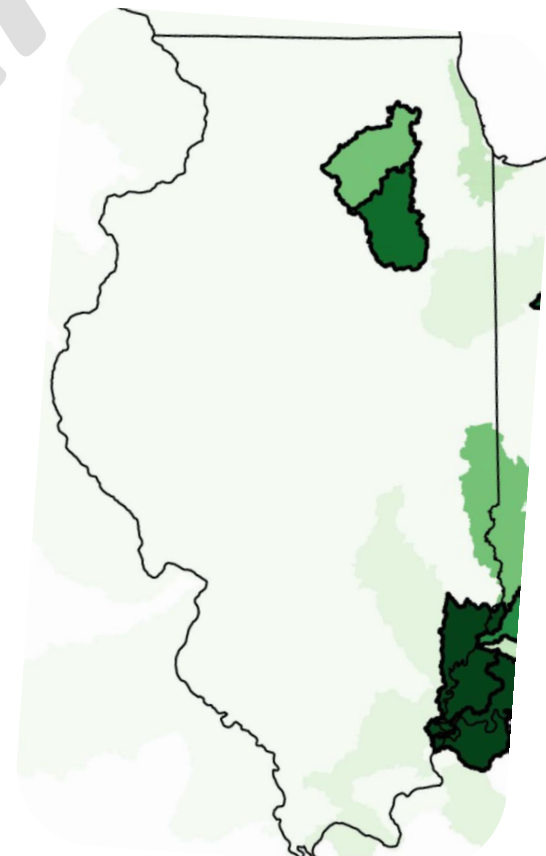


Figure 10 Illinois stream conservation priority areas³⁸.

Habitat conditions may be improved by removing unnecessary dams, replacing perched culverts, connecting rivers to their floodplains, or ensuring adequate flow in rivers through management of dams to mimic seasonal flow patterns.

Water quality may be improved through land management within the watershed. Watershed management plans, which identify actions needed to restore rivers and streams, are available for a number of rivers in Illinois:

<http://epa.illinois.gov/topics/water-quality/watershed-management/watershed-based-planning/index>.

The use of both urban and agriculture Best Management Practices (BMPs) should be increased to limit runoff and slow drainage water inputs to reduce high and low flows. Information is available on BMPs for urban areas

(<http://extension.illinois.edu/lcr/stormwater.cfm>) and agriculture areas

(<http://illinoisbmp.org/Practices/>), but appropriate practices will be site specific. In urban areas, rain gardens, pervious surfaces, green infrastructure, reduced fertilizer use, stormwater pollution prevention, and improved wastewater treatment plants may provide water quality improvements. In agriculture areas, conservation tillage, nutrient management, conservation buffers, livestock exclusions from streams, and proper management of animal feeding operations may provide water quality improvements.

Landowners should consider conservation easements to protect and restore floodplain lands and employ drainage water management systems, such as wide buffer strips and wetlands, to reduce excess runoff, particularly during spring high flows. The Natural Resource Conservation Service (NRCS) provides standards and estimated costs on BMPs in their Field Office Technical Guides.

Invasive species control

Prevent the spread of invasive aquatic species (for example, Zebra Mussel) by decontaminating watercraft and other equipment before transporting it between waterways. Remove all plant and animal

material, drain water, and thoroughly dry equipment.

Species population management

Hatchery-reared or translocated mussels may be available for population augmentation or reintroduction at historic locations. Establishing new populations at historic locations may provide benefit in terms of reducing the risk of extirpation¹⁴. In addition, there may be very low rates of natural colonization of unoccupied sites, indicating the need for reintroduction⁴⁰. However, there is limited information available identifying suitable brood stock or reintroduction locations⁴¹. Stocked mussels should be monitored to provide information on the suitability of the location for future conservation efforts (Figure 11). In addition, it is important to ensure that genetic variability is maintained in cultured stock and is appropriate for the release location. In mussel populations that are limited by abundance of host fish, stocking of host fish or improving fish habitat may provide benefit.

Coordination

Mussel conservation will require coordination of numerous groups to influence land use, point and non-point pollution, water drainage, physical habitat, and species management. Conservation benefits may result from coordinating the actions of landowners, conservation organizations, industries, municipalities, county level government, and state and federal agencies.

Avoidance & Minimization

Avoidance measures

Instream locations less than 0.1 mile from a listed species occurrence should not be directly impacted to ensure juvenile mussels or host fish carrying glochidia are not “taken”, unless a stream barrier exists that would prevent dispersal to the location in question¹⁸.

- Impacts that travel downstream, such as hydrologic alterations, sediment, or effluent, should be considered when delineating impacts.

- Project design should always consider boring under a stream or building structures that span the stream to avoid mussel habitat.

Minimization measures



STOP AQUATIC HITCHHIKERS!™

Be A Good Steward. Clean. Drain. Dry.

Spatial
and
temporal
effort
is
The

farther an impact occurs from a listed species population, the lower the chance of impact.

- Minimizing the project footprint may also reduce impacts.
- Avoid impacts during sensitive reproductive periods (e.g., April–July). Any releases of sediments into the water should avoid these periods because high concentrations of suspended sediments can interfere with host attraction, glochidia attachment, and metamorphosis¹.

Construction practices

Construction and maintenance practices and project design should be sensitive to impacts, mussels and their habitat including substrates, flow, and water quality.

- Educate personnel to ensure that they know the sensitive nature of the project and the areas not to be disturbed.
- Minimize alteration of hydrology during construction and maintain flow.
- Avoid in-stream use of explosives and heavy machinery.
- If a causeway is needed, use a floating barge causeway or install culverts in place of a solid rock causeway.
- Remove all debris and excess materials and properly dispose of it off site.
- Locate staging areas away from mussel habitat.

- Minimize increases in suspended sediment concentrations by using silt curtains and /or settling ponds ~~and monitor stream sediment levels throughout construction.~~
- Use standard erosion control practices in all terrestrial areas-
 - limit clearing of vegetation
 - use natural fiber erosion control matting
 - revegetate with suitable native vegetation
- Ensure invasive species are not spread on equipment. Check to identify whether invasive species are harboring on equipment. Clean and disinfect all equipment after each project and when moving waterbodies. See <http://stopaquatichitchhikers.org/> for further information.

Mussel translocation

If direct impacts cannot be avoided, mussels should be translocated from the project area to a suitable alternate location.

- All translocations require prior approval from IDNR and the owner of the relocation site.
- Translocation sites must provide suitable habitat for the species in both quality and quantity, as determined by IDNR (see IDNR **mussel survey protocol**).
- The translocation should not negatively impact the population at the translocated site, such as through introduction of pathogens, parasites, or distinct genetic stock⁴². To minimize such risks, translocation sites should be within the same stream reach.
- Survival and recruitment should be monitored at both the project area and translocation site (see survey guidelines section).

Research Needs

How viable are mussel populations in Illinois?

- Determine occupancy, survival, reproduction, and recruitment rates of mussel populations.
- Determine minimum density for reproductive success and the maximum distance for gene flow.

How much suitable habitat is available in Illinois and what are the habitat limitations?

- Determine oxygen, temperature, and contaminant tolerances of adults and juveniles and monitor environmental levels in Illinois rivers.
- Assess habitat conditions using survival rates of propagated mussels.
- Model climate change and water demand impacts on suitable habitat.
- Research increased ammonia input as human populations grow and put a strain on aging wastewater treatment plants.
- Identify suitable locations for population reintroduction.

Are host fish limiting mussel recruitment and dispersal?

- Determine host fish suitability, abundance, infection rates, and dispersal capabilities. Assess the benefits of increasing host fish abundance and enhancing host fish habitat.

What are the most effective survey methods for mussels?

- Investigate the detection rates of environmental DNA. Assess searcher efficiencies under different conditions and methods.

Additional Information

Freshwater mussel host database

<http://wwx.inhs.illinois.edu/collections/mollusk/data/freshwater-mussel-host-database>

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Table 1. EXAMPLE...to be continued.

Tribe	Species	Brood length	Glochidia release period	Host use	Host family	Host fish dispersal distance	Conglutinate type	Infection strategy	Hooked glochidia	Byssus	Life span (based on tribe) ¹
Margaritiferidae	<i>Margaritifera monodonta</i>	short-term		NA			white, branched, feather-like conglutinates	broadcast; mucus strands	hooks absent	NA	50
Amblemini	<i>Amblyma plicata</i>	short-term		generalist			fragile, white, leaf-shaped conglutinates	broadcast; mucus strands	hooks absent	Yes	25
Anodontini	<i>Alasmidonta marginata</i>	long-term		generalist	suckers		no conglutinates	broadcast; mucus strands	hooked	No	11
Anodontini	<i>Alasmidonta viridis</i>	long-term		generalist	darters and sculpins		no conglutinates	modified mantle margin ?	hooked	No	11
Anodontini	<i>Anodontoides ferussacianus</i>	long-term		generalist			no conglutinates	broadcast; mucus strands	hooked	No	11
Anodontini	<i>Arcidens confragosus</i>	long-term		generalist			no conglutinates	broadcast	hooked	NA	11
Anodontini	<i>Lasmigona complanata</i>	long-term		generalist			conglutinates of "composite C type"	broadcast	hooked	No	11
Anodontini	<i>Lasmigona compressa</i>	long-term		generalist			conglutinates of "composite C type"	broadcast	hooked	No	11
Anodontini	<i>Lasmigona costata</i>	long-term		generalist or non-parasitic use			conglutinates of "composite C type"	broadcast	hooked	No	11
Anodontini	<i>Lasmigona subviridis</i>										11
Anodontini	<i>Pyganodon grandis</i>	(both)		generalist			no conglutinates	broadcast; mucus strands	hooked	No	11
Anodontini	<i>Simpsonaias ambigua</i>	long-term		species specialist	mudpuppy		no conglutinates	broadcast; mucus strands	hooked	?	11
Anodontini	<i>Strophitus undulatus</i>	long-term		generalist			modified conglutinates	broadcast; mucus strands	hooked	Yes	11
Anodontini	<i>Utterbackia imbecillus</i>	long-term		generalist			loose masses	broadcast; mucus strands	hooked	Yes	11

Anodontini	<i>Utterbackia suborbiculata</i>	long-term		generalist			no conglutinates	broadcast; mucus strands	hooked	?	11
Lampsilini	<i>Actinonaias ligamentina</i>	long-term		generalist			white, leaf-shaped conglutinates	broadcast?	hooks absent	Yes	15

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ILLINOIS NATURAL
HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Black Sandshell

Ligumia recta (Lamarck, 1819)

IL status:
Threatened

US status:
None

Global rank:
Apparently Secure¹
Least concern¹



Trend:
Range expanding²

Family:
Unionidae

Habitat:
Medium to large rivers in riffles or areas with moderate current in firm sand or gravel and small cobble substrates.

Seasonal cycle:

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

 Non-reproductive
 Reproductive period

Species information

Characteristics

Black Sandshell exhibit a **dark brown to black outer shell layer**, but can range from dark green to brown or black. Young Black Sandshell can be greener, due to thicker green lines radiating from the umbo (or beak) (Figure 1). The outer shell is typically **smooth** and shiny. Black Sandshell are **elongate**, and adults can reach 7 inches in length³. The innermost layer of the shell, or nacre, can range in color from white to pink or purple near the beak cavity and hinge ligament, where the two halves are connected.

Distinguishing male and female characteristics in this species include a pointed posterior end in males and saber-shaped in females (Figure 2). The anterior end is rounded. The umbo (or beak), which is located on the hinge margin of the shell, is slightly inflated.

Habitat

Black Sandshell inhabit medium-sized to large rivers and, occasionally, smaller tributaries in riffles or areas with moderate current. They can be found in mixtures of sand, gravel and small cobble substrates³⁻⁵.

Distribution

Black Sandshell is widely distributed from eastern to central United States in the Great Lakes and Mississippi River drainages, and some Gulf Coast drainages^{1,5}. In Illinois, this species is present in the north, east central, and southern end of the state (Figure 3). At this time, their range appears to be increasing^{6,7}. Biologists recently discovered individuals repopulating the Upper Illinois River, most likely recruiting from the Kankakee River⁸.



Figure 1. Juvenile Black Sandshell appears greener than adults. Photo by S. Douglass.



Figure 2. Male (top) and female (bottom) adult Black Sandshell. Photo by S. Douglass.

Status

The global status of Black Sandshell is apparently secure and the IUCN Red List Category is species of least concern; however, it is considered secure or apparently secure in only three of the 30 states or provinces where it has occurred¹. Illinois listed Black Sandshell in 1999 and has remained State Threatened.

There are 119 occurrence records of Black Sandshell from 22 watersheds (HUC8) in Illinois, 96 of which have been observed since 2007 in 21 watersheds⁶. Surveys from 2007 estimate the population of Black Sandshells within pool 18 of the Mississippi, which contains two occurrence records, to be 200,000 individuals, but the uncertainty is great, with a 95% confidence interval of 0-600,000 individuals⁹. None of the Black Sandshells found were less than 5 years old, indicating limited reproductive success⁹. It is thought that historic populations were orders of magnitudes higher than at present⁹.

Natural History

Black Sandshell have a moderate to long life span of 8–30 years and reach sexual maturity early, around 1–3 years old^{10,11}. They have a moderate reproductive output and spawn in late summer. Female Black Sandshell are gravid from fall to the following early summer^{10,12}. As with most mussel species, glochidia mortality is very high and adult mortality is low, but there is little information available on population viability¹¹.

Black Sandshell exhibit fairly consistent growth rates across populations, with rapid growth the first 6-7 years¹⁰. The sexual dimorphic characteristic for females (saber-shaped) becomes apparent in their 3 year²¹. Adults do not readily bury or bury completely. Black Sandshell has been found at



Figure 4. A modified mantle margin (white papillae) on display. Photo by S. Douglass.

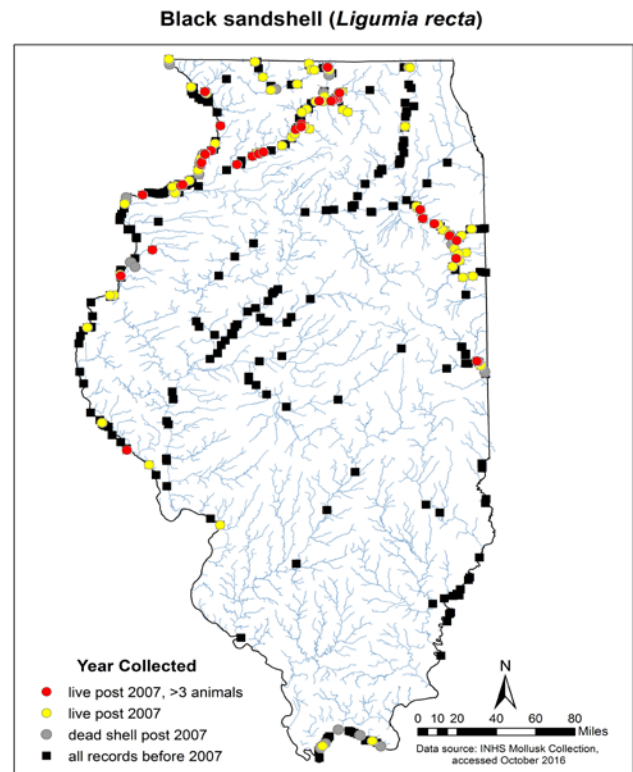


Figure 3. Distribution of Black Sandshell in Illinois⁷.

densities between 0.01 and 0.8 mussels/m²^{9,13}.

Black Sandshell are host specialists and primarily use Sauger (*Sander canadensis*) and Walleye (*Sander vitreus*) as hosts; although they may infest black basses (*Micropterus* spp.), crappie (*Pomoxis* spp.), Bluegill (*Lepomis macrochirus*) and a few small-bodied fishes as marginal hosts^{11,12,14}. Female Black Sandshell display large, white papillae while laying prostrate on the surface to attract hosts during spring and summer months (Figure 4). The ability of Black Sandshell to disperse, particularly upstream, is dependent on their host fishes. Walleye and Sauger are migratory species which may move 1.4 and 0.4 miles, respectively, during their spawning events¹⁴. Walleye and Sauger populations dramatically decreased historically due to barriers such as dams, but populations have rebounded because of active stocking across Illinois and their status as a sought-after sportfish (citation?).

Conservation/Management

Threats

Mussels are inordinately sensitive to the many ways that humans alter aquatic environments¹¹. In general mussels are threatened by habitat loss, degradation,

and fragmentation, pollution, climate change, altered hydrology, invasive species, predation, disease, and direct impacts (see Freshwater mussel guidance document). Dams and channelization result in habitat loss and fragmentation for Black Sandshell and their host fishes.

Species conservation goals

Currently, there is no recovery plan for Black Sandshell. The 2005 Illinois Wildlife Action Plan set a goal of delisting Black Sandshell¹⁵. Black Sandshell has been proposed as a candidate for delisting in 2017⁷.

Recent conservation efforts in Illinois

Improvements have been made to mussel habitat in Illinois. Eight dams have been removed or modified to restore free flowing stream habitat and twelve more removals have been planned by IDNR <https://www.dnr.illinois.gov/WaterResources/Pages/safetyAtDams.aspx>. The Vermilion Dam in Danville is slated to be removed, which has been a barrier to the upstream dispersal of Black Sandshell in that basin¹⁶. In addition, the Vermilion and Little Vermilion River Conservation Opportunity Area has developed an action plan to improve aquatic wildlife habitat quality¹⁷. Strategies for creating mussel habitat in the Upper Mississippi River are being explored by U.S. Army Corps of Engineers (USACE) and partners¹⁸.

Black Sandshell have been propagated and stocked by multiple agencies in states across its range¹⁹⁻²¹. In Illinois, an attempt to propagate and reintroduce Black Sandshell into the Illinois River was unsuccessful due to sedimentation of rearing cages and inability to locate gravid females¹⁹.

Host availability has likely increased through active stocking of Walleye/Sauger and may have contributed to the recovery of Black Sandshell in certain watersheds (e.g., Rock River).

Additional information

Please see the General Freshwater Mussel Information document for conservation management and mitigation guidelines. Find more Black Sandshell information at:

- explorer.natureserve.org and search for “*Ligumia recta*”.

- <http://www.inhs.illinois.edu/collections/mollusk/publications/guide/index/136>
- http://fm1.fieldmuseum.org/keystonature/mussels/black_sandshell.pdf

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Citation

Illinois Natural History Survey. 2017. Conservations guidance for Black Sandshell (*Ligumia recta*). Prepared for the Illinois Department of Natural Resources, Division of Natural Heritage.



ILLINOIS NATURAL
HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Clubshell

Pleurobema clava (Lamarck, 1819)

IL status:
Endangered

US status:
Endangered

Global rank:
Critically Endangered¹
Critically Imperiled¹

Trend:
Declining¹

Family:
Unionidae

Habitat:
Medium to large rivers in
mixed coarse sand,
gravel and cobble

Seasonal Cycle:

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

 Non-reproductive

 Reproductive period

Species information

Characteristics

The outer shell of Clubshell is yellowish-brown with prominent **broken green rays present near the umbo region** (Figure 1); older shells are dark brown or black. Adults can reach 3 inches in size. Clubshell are **triangular and slightly elongate** with a relatively thick shell. Additionally, they have a slightly compressed, smooth shell with an occasional crease or groove present on posterior lateral surface. The anterior end is rounded, whereas the posterior end is bluntly pointed. The umbo, or beak, is low, only slightly elevated above the hinge ligament, where the two halves are connected, and located nearer the anterior end. The beak has a few sharp ridges at the tip, but they wear away easily.



Figure 1. Adult Clubshell indicating anatomy. Photo by Kevin Cummings.

Habitat

Clubshell inhabit medium to large rivers in clean, stable coarse sand and gravel runs, or gravel and cobble and often on the downstream end of riffles. Stable substrates, like gravel with sand, in rivers with riffle-pool sequences are typically considered ideal mussel habitats².

Distribution

Clubshell were once widespread in the Ohio and Maumee River drainages but experienced a significant range-wide reduction during the last century (Figure 2). Today, the largest extant population of Clubshell is in the Allegheny River drainage of Pennsylvania. Other populations within the Ohio River drainage occur in Ohio, Pennsylvania, West Virginia, Kentucky, Indiana, and Illinois. In addition, Clubshell are extant in the Maumee River drainage in Ohio, Indiana, and Michigan^{3,4}.

Within Illinois, Clubshell were historically distributed throughout the Wabash River drainage in the North Fork, Middle Fork, and Salt Fork of the Vermilion River, the Embarras River and the Wabash River, as well as the Ohio River mainstem (Figure 3)⁵⁻⁸.

Clubshell were once considered extirpated from Illinois⁹. However, a fresh-dead shell was found in 1980 in the North Fork Vermilion River basin near Alvin⁶, and one live individual was found in 1998 in the Middle Branch of the North Fork¹⁰. Reintroduced populations are now found in the Salt and Middle Fork of the Vermilion River.

Status

Clubshell were listed as federally endangered in 1993. In Illinois, Clubshell were listed as endangered in 1989¹¹. The International Union for Conservation of Nature (IUCN) lists Clubshell as Critically Endangered and NatureServe lists it as Critically Imperiled. It is estimated that the global population has declined 70–90%¹. An inventory of Clubshell populations in 2008 identified 13 populations nation-wide, including the Middle Branch of the North Fork of the Vermilion River in Illinois¹². Eight of the populations show signs of recruitment¹², though not the Illinois population. There are six occurrence records of Clubshell in Illinois according to the Natural Heritage Database, five of which are reintroduced populations (Figure 3)¹³.

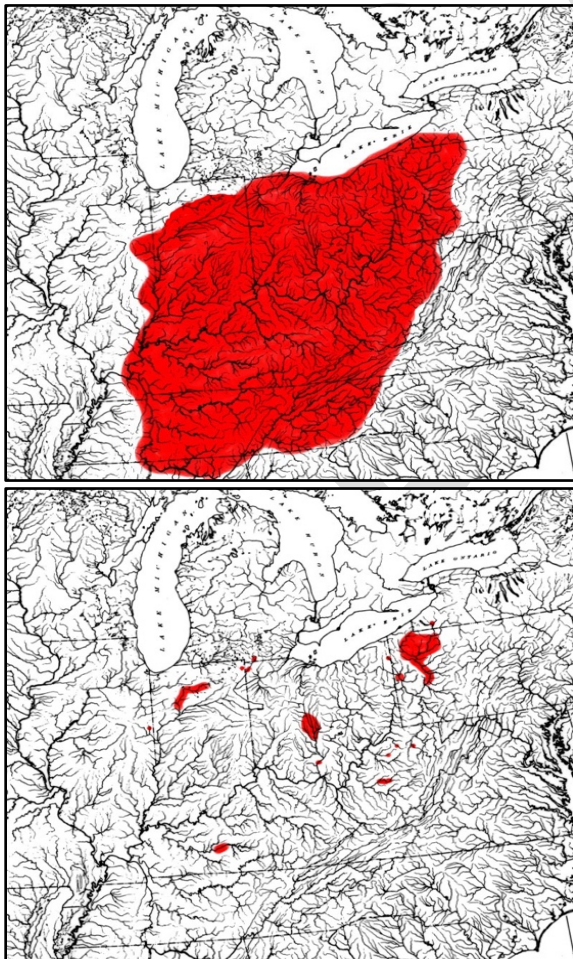


Figure 2. The approximate historic (top) versus current (bottom) distribution map for Clubshell³⁷.

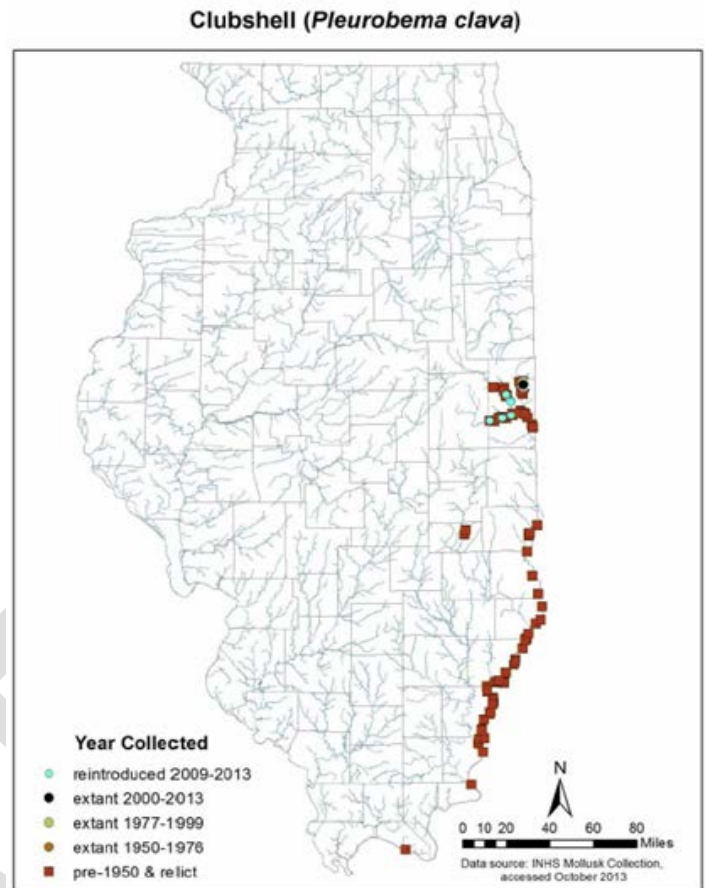


Figure 3. Distribution of Clubshell in Illinois³⁶.

Natural history

Clubshell are long lived, mature late in life, and have low reproductive output². Clubshell likely have life spans of 20-50 years and reach sexual maturity between 3 and 5 years^{14,15}. In most freshwater mussel species (including Clubshell), thousands of glochidia are produced by a single female, yet survival during the glochidial and 1st-year juvenile stage is exceptionally low with less than 0.1% surviving². In contrast, annual adult survival is estimated to be over 90%².

Clubshell exhibit great variation in growth rates among populations, but growth gradually slows as individuals become older¹⁶. Individuals 2.4 inches in length are generally between 4 and 12 years old, and 3.1 inch individuals may be 20 years old¹⁶. Density and abundance of Clubshell vary substantially based on river and site, but one study observed Clubshell at densities of 1.8 individuals per square foot¹⁷.

Clubshell spawn and release glochidia in the same year¹⁸. Males in the *Pleurobema* genus have been found to release sperm April – June¹⁴. Eggs were found in female Clubshells in May, and females

with fertilized eggs have been found in June and July in Pennsylvania^{18,19}. Female Clubshell have been found to release mucilaginous “packets” of glochidia²⁰. The most sensitive reproductive period for Clubshell is April–July.

Clubshell primarily uses cyprinids as hosts, successfully transforming on Central Stoneroller (*Camptostoma anomalum*), Striped Shiner (*Luxilus chrysocephalus*), Common Shiner (*Luxilus cornutus*), River Chub (*Nocomis micropogon*), Logperch (*Percina caprodes*), and Blackside Darter (*Percina maculata*)^{21,22}. These small-bodied fishes have home ranges between 35-140 feet and have limited migration^{23,24}; therefore, Clubshell may have restricted dispersal capabilities²⁵.

Conservation/Management

Threats

Mussels are inordinately sensitive to the many ways that humans alter aquatic environments². In general mussels are threatened by habitat loss, degradation, and fragmentation, pollution, climate change, altered hydrology, invasive species, predation, disease, and direct impacts (see Freshwater mussel guidance document).

Most of the Vermilion River basin, where Clubshell are found, was rated at high risk of habitat degradation by the National Fish Habitat Partnership due to large amounts of agricultural land use and high water use²⁶. A major source of aquatic pollution in the Vermilion River basin has been effluent from wastewater treatment plants in Urbana, Danville, Hoopeston, Paxton, Rantoul and other townships. Many wastewater treatment plants have improved their facilities to lessen these impact but degradation from effluent persists^{5,6,27,28}. The Vermilion River basin also has a history of coal, sand, and gravel mining throughout the basin, which may present pollution from runoff²⁹.

Another important emerging threat to mussels may be increased human water demand. The communities of Danville, Hoopeston, Oakwood, Paxton, and Urbana all withdraw water from the Vermilion River basin. Extraction of water from aquifers, streams, and rivers reduces flow, potentially below ecological requirements of mussel species³⁰. In the Vermilion Basin, the increasing demand for wastewater, which is normally discharged into waterways and maintains a

minimum flow during drought, is also a threat. The threat from water demand may increase with climate change.

Species conservation goals

A federal Clubshell Recovery Plan was developed in 1994 and updated in 2008^{12,31}. The current goal for down-listing Clubshell to threatened is to establish viable populations in 10 separate drainages across its range in the U.S. To achieve this goal will require:

- watershed conservation efforts
- protection and management of local populations
- research necessary for monitoring and recovery
- reintroduction to suitable locations
- public outreach

Recent conservation efforts in Illinois

Clubshells were translocated from the Allegheny River in Pennsylvania and to the Vermilion River basin (Wabash River drainage) in Illinois to increase viability in Illinois. Between 2012 and 2016, over 4,200 Clubshell were relocated to the Middle and Salt Fork Vermilion rivers³² (Figure 4). Ongoing research on survival and persistence of these populations has suggested high survival of individuals³².

Local watershed conservation efforts that will benefit Clubshell and other mussels include the Watershed Implementation Plan for the Upper Salt Fork of the Vermilion River and the Watershed Implementation Plan for Lake Vermilion and the North Fork Vermilion River^{33,34}. In addition, the Vermilion and Little Vermilion River Conservation Opportunity Area has developed an action plan to improve aquatic wildlife habitat quality³⁵.

Additional information

Please see the General Freshwater Mussel Information document for conservation management and mitigation guidelines. Find more Clubshell information at:

- explorer.natureserve.org and search for “*Pleurobema clava*”.
- <http://www.inhs.illinois.edu/collections/mollusk/publications/guide/index/56/>
- <https://www.fws.gov/midwest/endangered/clams/clubshell/index.html>

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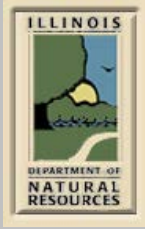
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Citation

INHS. 2017. Conservation guidance for Clubshell (*Pleurobema clava*). Report to Illinois Department of Natural Resources, Division of Natural Heritage.



Conservation Guidance for Regal Fritillary

Speyeria idalia (Drury, 1773)

IL status:
Threatened

US status:
In review

Global rank:
Vulnerable (Naturereserve)

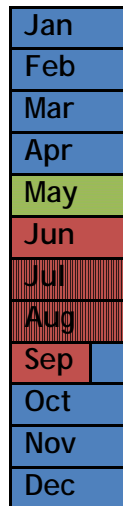
Trend:
Declining

Family:
Nymphalidae

Habitat:
Sand Prairie, Tallgrass
Prairie, Savanna

Similar species:
Monarch, Great Spangled
Fritillary, Aphrodite
Fritillary

Seasonal cycle:



- Larve dormant in leaf litter
- Larvae feeding on violets
- Adults
- Adult survey period
- Violet survey period

Species information

Characteristics

The Regal Fritillary is a relatively large showy butterfly similar in size to the Monarch (*Danaus plexippus*). They are similar in appearance to the Monarch but with **distinct white spots on the outer hindwing**. The Regal Fritillary has a graceful floating flight, and they are often stirred up from resting within tall grasses. Adult wingspan ranges from 2.7-4.2”¹. Males tend to be somewhat smaller than females with an overall lighter orange coloration and a row of orange (rather than white) spots on the base on the upper side of the hindwing and orange extending to near the tip of the forewing. Fresh females can have a salmon orange-red coloration which fades to orange with age.



Male Regal Fritillary on western wallflower (*Erysimum capitatum*) (top). Female Regal Fritillary on common milkweed (*Asclepias syriaca*) (center). Photos by Angella Moorehouse. Regal Fritillary caterpillar (bottom). Photo by Doug Taron.

Newly emerged caterpillars average 0.8” long and grow to 1.75” when fully developed². Early instar caterpillars are light tan with black spikes along the body, blending in with the dead leaf litter. Older instars are a reddish-orange color³.

The Regal Fritillary may be confused with other black and orange butterflies, such as the Monarch and other fritillaries. The Great Spangled Fritillary (*Speyeria cybele*) has an overall orange or buffy color. The Aphrodite Fritillary (*S. aphrodite*) is smaller and only found in northern part of the state. Both species lack the bold white spots on the underside of the hindwing⁴. There three other fritillary butterflies regularly found Illinois; Variegated Fritillary (*Euptoieta claudia*), Silver-bordered Fritillary (*Boloria selene*), and Meadow Fritillary (*B. bellona*). These fritillaries are all considerably smaller in size and lack the prominent white spotting seen on the Regal Fritillaries⁵.

Habitat

Within Illinois, Regal Fritillaries are most closely associated with sand prairies and open sand savannas, especially dry and dry-mesic sand habitats supporting sufficient populations of violets. They may also be found in black soil prairies. Regal Fritillaries are considered a prairie specialist that are dependent on unplowed remnant prairie^{6,7}, but they will also use degraded prairie, restorations, and violet plantings^{8,9}. Suitable Regal Fritillary habitat has four components: violets for larval feeding, nectar plants for adult feeding, tall grasses for adult resting, and leaf litter for larval overwinter cover.

Larvae will feed on many species of violets (excluding forest violets), but generally specialize on only one species of violet within a population or site¹⁰. Violets growing within the prairies that are utilized most frequently include: birdsfoot violet (*Viola pedata*), prairie violet (*V. pedatifida*), arrowleaf violet (*V. sagittata*), and Johnny-jump-up (*V. rafinesquii*). The primary larval food is Johnny-jump-up within central Illinois (Mason/ Cass/ Morgan counties); arrowleaf and possibly birdsfoot violet in north-central Illinois (Lee/ Whiteside counties); and birdfoot violet and Johnny-jump-up in northwest Illinois (western Whiteside/ Carroll/ Daviess counties) and the Kankakee Sands in northeast Illinois (Kankakee/ Iroquois counties)^{11,9}.

Johnny-jump-up patches at densities of 40 violets per m² support Regal Fritillary larvae in Morgan County¹², but 1.24 and 0.08 host violets per m² support breeding Regal Fritillaries in Pennsylvania¹³ and Kansas¹⁴, respectively. The difference may be related to the lower biomass of



Degraded dry sand prairie habitat at Sand Prairie Scrub Oak Nature Preserve, Mason County. Photo by Angella Moorehouse



Dry sand prairie habitat with birdsfoot violets (*Viola pedata*) at Hahnman Sand Prairie Nature Preserve, Whiteside County. Photo by Angella Moorehouse.

Johnny-jump-up compared to other violet species (*V. pedata*, *V. pedatifida*, and *V. sagittata*).

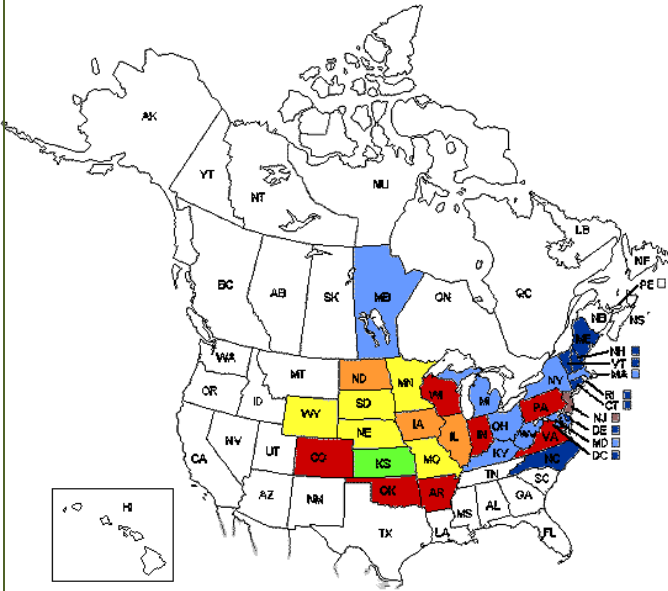
Adult Regal Fritillaries seek flowers with high nectar content, and most frequently nectar on milkweeds (*Asclepias* spp) and thistle (*Cirsium* spp., *Carduus nutans*). Other less frequently used nectar sources include: mountain mint (*Pycnanthemum* spp.), dogbane (*Apocynum* spp.), boneset (*Eupatorium* spp.), dogwood (*Cornus* spp.), golden aster (*Chrysopsis camporum*), western wallflower (*Erysimum capitatum*), prickly pear cactus (*Opuntia humifusa*), hoary vervain (*Verbena stricta*), goldenrods (*Solidago* spp.), wild bergamot (*Monarda fistulosa*), blazingstars (*Liatris* spp.), pale purple coneflower (*Echinacea pallida*), ironweed (*Vernonia* spp.) and red clover (*Trifolium pratense*).

Regal Fritillaries tend to avoid forest areas as well as areas devoid of prairie grasses needed for adult roosting. Breeding populations of Regal Fritillaries require large habitat areas of 125-250 acres or larger¹⁵⁻¹⁷.

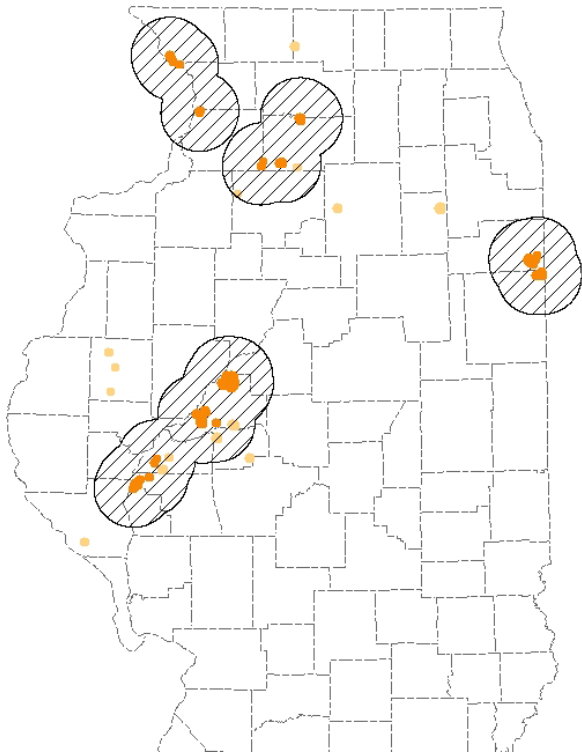
Distribution

The historic range of the Regal Fritillary extended from New England and the Mid-Atlantic states in the east to the eastern side of the Rocky Mountains in the west, from the prairies of southern Canada in the north to northern Oklahoma and Arkansas in the south. They are currently extirpated throughout much of the eastern states with a few small remnant populations in Pennsylvania and Virginia. The core range is now found in the tallgrass regions of eastern Kansas and Nebraska and western Missouri.

Within Illinois, there are, at most, 13 sites, that support potentially breeding populations of regal fritillaries¹¹. These sites are located in four general areas of the state: Upper Mississippi River Sands Area of Jo Daviess/Carroll/Whiteside counties; the Green River Lowlands of eastern Whiteside/Lee counties; Kankakee Sands of Kankakee/Iroquois counties; and the Illinois River Sands Area of Mason/Cass/Morgan counties. Records from outside these areas are considered transient



Global distribution of Regal Fritillary (NatureServe 2017).



Core Regal Fritillary breeding sites (orange), meta-population regions (hashed) and additional Regal Fritillary records (yellow) in Illinois¹¹.

individuals.

Taxonomy

Regal Fritillary belongs to the brushfooted butterfly family Nymphalidae. There may be of two subspecies of Regal Fritillary: a western race (*Speyeria idalia occidentalis*) and a very rare eastern race (*S.i. idalia*). Illinois classifies the Regal Fritillary at the species level *Speyeria idalia*.

Status

Regal Fritillary is considered vulnerable (G3) globally¹⁵. It is under review for federal listing under the Endangered Species Act. It is listed as state-endangered in New York, Ohio, Michigan, and Wisconsin, state-threatened in Illinois, and a species of concern in Pennsylvania, Iowa, Missouri and Minnesota. Populations within the eastern states collapsed between 1970-1990¹⁵, and there was a significant decline in the numbers of Regal Fritillaries reported across its range from 1991-2014¹⁸.

There are currently 30 occurrence records for Regal Fritillary in 19 counties¹¹. Of these 13 are considered confirmed or potential breeding sites because they have had a consistent populations or 10 or more adults seen annually and violet patches capable of supporting larval development.

However, 10 adults is a very low number and research has indicated a minimum of 100-200 individuals is necessary for a viable breeding population (Scott 1986). The other 17 occurrence records represent transient individuals or small populations located near known breeding areas.

Surveys from 2004-2007 revealed the largest number of individuals in Illinois were found in Mason and Cass counties in central Illinois⁸. Counts in some sand prairie during this time reported populations exceeding 600 individuals. However, since the mid-2000s the numbers of Regal Fritillaries reported in central Illinois has declined significantly, perhaps due to drought. The most recent reports from all of these areas total less than 100 individuals¹¹.

Species biology

Regal Fritillaries spend most of their life dormant as tiny caterpillars in leaf litter around host violets. They become active in mid to late May as they feed

on the tender new leaves of violets. Young caterpillars are unable to feed on older leaves, making the synchronization of activity with violet growth important¹⁹. The trigger which causes the caterpillars to cease hibernation and begin active feeding each spring is unknown, perhaps temperature or daylight. Caterpillars are thought to feed mostly at night and spend the day away from the host plants²⁰, but are also observed active during the daytime¹⁵. It is not known how successful young Regal Fritillaries are at locating a host plant, but the Oregon silverspot butterfly (*Speyeria zerene hippolyta*) caterpillars are unable to distinguish violet host plants at distances of 3cm²¹.

Around the end of May to early June the caterpillars form a chrysalis and enter a pupae stage which lasts 2.5 to 4 weeks¹⁹. The first males emerge from their chrysalis as adults in early to mid-June and persist only 1 month or so, until early-June to mid-July¹⁹. Females emerge 1-2 weeks later in mid-late June and survive up to 90 days, until late August or mid-September. In central Illinois, Regal Fritillaries have been seen flying from May 27 to September 20⁸.



Arrowleaf violet (*Viola sagittata*) at Green River State Fish and Wildlife Area, Lee County. Photo by Angella Moorehouse

After emergence, males typically remain near violet patches presumably awaiting the emergence of females²². Mating takes place shortly after the emergence of the females. Males die soon after, typically by the end of June to early July. After mating the females enter a summer diapause – a period of reduced activity. During this time females often rest in tall relatively dense patches of grass or shrubs within the prairie and feed only occasionally throughout the later part of July, August and into early September.

Most regal fritillaries spend their entire life cycle within a couple mile range²³, typically close to patches of violets where the females will lay their eggs towards the end of summer. Adult Regal Fritillaries have been observed at densities between 0.2 and 6 individuals per acre^{14,15}. They will travel to locate resources, such as nectar plants and violet patches, and are known to travel considerable distances (up to 50 miles), but are reluctant to travel into forested landscapes^{10,11,24}. Females are more likely to travel farther distances later in the summer, after diapause. They are more likely to travel away from small populations as opposed to sites with larger intact prairies which support viable breeding populations and these late season wandering females are generally not thought to contribute to the recolonization of new areas²⁵. Most recolonization occurs within close proximity to the existing breeding locations.

After diapause females lay eggs in the grass and leaf litter in the vicinity of violets, not directly on the violets^{26,27}. The diapause period is thought to reduce exposure of the caterpillar to desiccation during the heat of the summer and synchronizes caterpillar activity and violet growth in the spring^{28,29}.

Caterpillars emerge from their eggs in late September and consume the soft shells of their egg. They immediately enter hibernation within the leaf litter and do not emerge to feed until late spring (mid-late May) the following year²⁹. This litter provides winter cover for the young first instar caterpillars is assumed that the leaf litter is critical for overwintering survival. However, too much litter is may be detrimental to the growth of the violets and to the nectaring plants.

Population dynamics

Regal Fritillaries have a single generation per year, with each female laying 1000 to 2500 eggs in a season^{1,19,25,27,28}. Like most species of butterflies, the population of Regal Fritillary can fluctuate greatly from year to year. There is very little information on survival rates of each life stage, but much of the fluctuation is likely due to low overwinter survival of the larvae¹⁰. Regal Fritillaries typically exhibit metapopulation dynamics with local populations dying out frequently and overall persistence dependent upon recolonization from other nearby populations¹⁵. Observed sex ratios of Regal Fritillaries have varied from significantly more males in Illinois and Iowa^{8,22} to significantly more females in Nebraska and South Dakota³⁰, but the cause of these differences is unknown.

Conservation and Management

Species threats

The greatest threat to Regal Fritillary has likely been habitat loss and fragmentation. Invasive species and management of the remaining prairie remnants also pose a threat to Regal Fritillaries, as do pesticides and climate change.

Habitat loss and fragmentation

Over 99% of Illinois original prairie has been lost, mostly to agriculture and urban development in the last century. However, there have been eight Incidental Take Authorizations (ITAs) issued for Regal Fritillaries in Illinois, indicating an ongoing loss of habitat.

Much of the remaining Regal Fritillary habitat consists of small isolated patches. Isolated habitat patches inhibit the natural metapopulation dynamics, which depend on recolonization from nearby sub-populations, and lead to extirpation^{15,31}. In addition, isolated populations can suffer from loss of genetic variability and inbreeding, making the species more susceptible to population crashes^{10,32}.

Fragmentation is often accompanied with increased road density. Collision with traffic is thought to be a major cause of adult mortality¹⁰.

Invasive species

Much of the remaining prairie habitat is under threat of being overrun by invasive trees and shrubs, which decreases its suitability for Regal Fritillaries¹¹. Japanese beetles (*Popillia japonica*) have drastically increased in number in Illinois. When the populations of this non-native species are high the beetles cover common milkweed and thistle flowers preventing access by other pollinators seeking to feed on nectar.

Disturbance/management

Prairie remnants require management to prevent woody encroachment and establishment of invasive species. This management may take the form of prescribed fire, grazing, or manual removal, all of which threaten larvae in the leaf litter. Fire conducted from September through May can result in mortality of larvae in those areas burned^{30,33,34}. Mowing and grazing are common in much of the Regal Fritillary range but less so in Illinois.

Pesticides

Pesticides use, especially the use of insecticides on crop fields around Regal Fritillary habitat, likely has an impact. Neonicotinoids, which are highly toxic to insects at low doses, are now in widespread use³⁵. They can accumulate and persist in soils³⁵ and are taken up by wild plants in the proximity of agriculture areas³⁶.

Climate change

Regal Fritillary was rated as highly vulnerable to climate change in Illinois due to its narrow host plant requirements³⁷. Climate-induced shifts to the location of food resources both nectar (milkweeds and thistles) and larval (violets) may impact the species. Larval development is directly linked to temperature and therefore susceptible to climate change¹⁰.

Regulations

“Take” of listed species, defined as “to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or attempt to engage in such conduct”, is prohibited by the Illinois Endangered Species Protection Act: <http://ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1730&ChapterID=43>

The IDNR consultation section reviews proposed actions to assess potential impacts to listed species, using their online tool Ecocat:
<http://dnr.illinois.gov/ecopublic/>

IDNR can authorize the taking of listed species that is incidental to otherwise lawful activities. To receive Incidental Take Authorization, one must prepare a conservation plan and notify the public of the impact. See
<http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/IncidentalTakeAuthorization.aspx>

Research or handling of listed species may require IDNR permits, including a Scientific Collector Permit and an Endangered and Threatened Species Possession Permit, and additional site permits if research takes place on IDNR land or a dedicated Nature Preserve:
<http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/ResearchPermits.aspx>

Risks and impacts of research methods must be considered and weighed against the benefits. For example, vein traps, which have killed adult Regal Fritillaries, should not be used.

Conservation goals

Statewide a minimum of at least 3 of the 4 “breeding areas” (Illinois River Sands, Upper Mississippi Sand Area, Green River Lowlands, Kankakee Sands) should maintain an annual population of at least 200, if not close to 2000 individuals for a decade prior to delisting. The Kankakee Sand Macrosite has set a goal of maintaining three Regal Fritillary populations with at least 2000 individuals⁹.

Conservation efforts Conservation efforts for this species have included habitat protection, habitat creation and habitat management of sand prairies, as well as conservation breeding and reintroduction.

Most of the sand prairie and sand savanna breeding sites (11 out of 13; 85%) are either protected within the Illinois Nature Preserves System or are under ownership by government conservation agencies^{11,38}. The two unprotected areas are found within the southernmost portion of the range and steps are being taken to work with the private landowners to ensure long-term preservation and management of those sites.

In 1996 The Nature Conservancy and other partners initiated a large-scale high diversity restoration within the Kankakee Sand to restore the habitat connectivity for habitat restricted insects. Efforts include habitat restoration, violet reintroductions, habitat monitoring, and butterfly counts. In 2014, it was reported that the Regal Fritillary was the most abundant butterfly within the Kankakee Sands⁹.

The USDA’s Conservation Reserve Program (CRP) provides incentives for prairie plantings on agricultural land. When located near Regal Fritillary habitat they are visited frequently due to the abundance of disturbance adapted flowers, such as common milkweeds and thistles, tall grasses, and Johnny jump-ups, which readily colonize newly established CRP plantings.

Recent efforts to help the monarch population by promoting nectar-rich flowers, such as milkweeds, also provide benefit to the Regal Fritillary

Management of Regal Fritillary habitat has been conducted to maintain suitability. Efforts that increase light availability, such as tree thinning, invasive brush removal, and prescribed fire, have shown a positive impact in attracting butterflies independent of nectar source availability^{39,40}. Management, such as prescribed fire, tree thinning, and invasive control, increases the abundance of nectar flowers, which attract adult butterflies^{26,41-43}.

Efforts have also been made to monitor the status of Regal Fritillary. IDNR staff conducts presence/absence surveys on breeding sites in most years. More intensive surveys have also been conducted at some sites though less regularly^{8,11,44}. The Illinois Butterfly Monitoring Network engages citizen scientists in monitoring butterflies at over 100 sites across Illinois (bfly.org).

Methods for the captive rearing and reintroduction of this species are being developed at the Peggy Notebaert Museum in Chicago. Limited reintroductions have taken place and may benefit the species but long-term habitat needs must be better understood and appropriate management implemented. Reintroductions of Regal Fritillary have been attempted in Pennsylvania, Massachusetts, and Iowa with mixed results⁴⁵.

Survey Guidelines

Monitoring for trends

Regular monitoring of Regal Fritillary is needed to understand population trends. The Illinois Butterfly Monitoring Network coordinates the collection of relative abundance data from over 100 sites across Illinois by citizen scientists⁴⁶. However, the program does not specifically target Regal Fritillary and survey sites are concentrated in northeast Illinois. Survey efforts should be expanded to include Regal Fritillary breeding sites.

The Illinois Butterfly Monitoring Network uses fixed width transects, where all butterflies observed within 10m of a designated line are recorded^{47,48}. Survey transects should be established at Regal Fritillary breeding sites. The total length of transects established will depend on specific conditions of each site but should include a representative sampling of available habitat. Transect data should be collected a minimum of once a year during the peak active time mid-June – July, but preferably three times a year. Survey should be conducted between 10am and 4pm, and during favorable weather conditions (60-100°F, little or no wind, little or no cloud cover or precipitation).

These transect counts can provide relative abundance data when effort is adequately recorded, but have imperfect detection that varies with habitat, species, and surveyor^{49,50}. The detection probability for Regal Fritillary in Kansas was around 0.4-0.6 within 30m of the transect line³⁴. To account for imperfect detection, distance sampling targeting Regal Fritillary can be used⁵¹. Distance sampling is similar to transects but all individuals are recorded, not just those within 10m, and the distance of each butterfly from the transect line is also recorded⁴⁸. The probability of detection can then be calculated and transect counts can be adjusted to account for undetected individuals^{34,50}.

Surveys to determine presence and density

Distance sampling should be used to determine presence and density at sites of interest. Transect lines should be randomly placed in grassland areas at the site of interest at least 30m from edges. See table for transect length. Transect should be walked at least three times during the adult flight period

(typically June through mid-September) at least 1 week apart to ensure the flight period is observed. All Regal Fritillaries observed and their distance from the line should be recorded. Survey should be conducted between 10am and 4pm, and during favorable weather conditions (60-100°F, little or no wind, little or no cloud cover or precipitation). A density estimate can then be made that accounts for undetected individuals and can be extrapolated to the habitat area to estimate population at the site^{34,49,51}. If no Regal Fritillary are detected along transects, the site should also be scanned with binoculars³⁴.

Table indicating the degrees of certainty of presence or absence depending on the transect length and detection probability, assuming butterfly occurs at density of 1 individual per acre³⁴.

	Low detection rate	High detection rate
Total transect length	0.4	0.6
100m	44%	59%
300m	83%	93%
500m	95%	99%

Surveys to assess impacts

Surveys to assess impacts due to development or restoration activities should use before-after-control-impact survey design. Surveys should use the distance sampling method a minimum of three times per year between June and mid-September



Angella Moorehouse conducting butterfly survey. Photo by Brooke Bryant Myers over a period of two years.

In addition, host plant and nectar plant resources should be assessed before and after impacts. Forb species and percent cover should be recorded in vegetation monitoring plots randomly located across the site of interest. Plots should be surveyed twice per year, once in May-June and again in July-September to detect both host plant and nectar resources.

Stewardship recommendations

Sites that contain Regal Fritillary should be managed to maintain suitability by retaining and increasing violet patches, nectar plants and resting areas. All management activities should avoid impacts to violet patches from September to June. Management should focus on preventing woody encroachment and invasive species establishment. Management activities that may increase butterfly and violet populations may include prescribed fire, manual removal, pesticide application, or mowing^{14,52}. All management on Regal Fritillary sites should be accompanied by monitoring of Regal Fritillary and violet abundance to inform and adapt management actions (see survey guidelines section).

Severe disturbance by vehicles coupled with prescribed fire maintained populations of violet host plants better than traditional management, such as light soil disturbances, mowing and thatch removal, at one Regal Fritillary site (Latham et al. 2007).

Prescribed fire

Burning of an area from September through May will likely result in mortality of Regal Fritillary larvae present^{30,33}. Therefore it is essential that the majority of violet habitat be left unburned to avoid extirpating the species from a site. Prior to burning sites containing Regal Fritillary violet patches should be identified, and then maintained as unburned refugia²⁶.

The existing violet patches at these sites should be expanded to provide more habitat and increase the population³³. When the Regal Fritillary population is healthy and viable (at least 1000-2000 individuals estimated) and habitat is sufficient to support the population, rotational, prescribed fires may effectively manage the habitat⁵³. Burning no more than 20% of the breeding and foraging area is

recommended, and retaining unburned refugia is encouraged^{26,54}. Once numerous adults are seen utilizing the habitat and violets are present and thriving in previously burned area, another burn may be considered. While fall and early spring burns are known to be beneficial to some species of violets; late spring burns can seriously reduce birdsfoot violets (*Viola pedatafida*)⁵⁵.

Although untested, summer burns have the potential to reduce the risk of larvae mortality since the species would consist mostly of gravid females capable of flight⁵⁶. These burns would need to be conducted after the violets have produced seed and gone dormant. Burning a small portion of the regal fritillary habitat during mid-late summer (July-August) would likely be patchy and not completely remove the entire duff layer due to higher moisture levels in summer. Summer burning should be treated experimentally and the impact on the Regal Fritillary population, violet abundance, and leaf litter should be assessed.

Manual removal

Tree thinning in conjunction with prescribed fire, has been shown to increase the abundance of butterflies and bees⁵². Selective brush and tree cutting is encouraged, but trampling of violet patches should be avoided. Some shrubs, especially those which are less invasive (fragrant sumac, Carolina rose, leadplant, wild plum), should be allowed to remain as they can provide cover for adult females during summer diapause.

Pesticide use

Pesticides may be used to control invasive and woody plants from encroaching on violet patches, but chemicals used should not have adverse effects on violets or Regal Fritillary. Also, avoid unnecessary impacts to flowers providing nectar food.

Mowing

Mowing and haying of Regal Fritillary habitat should be done with a blade height of at least 3 inches between September 30 and June 1, but should be avoided during the summer, when adults are present¹⁷.

Off-site coordination

Discourage the use of prophylactic insecticides on adjacent agriculture land and promote the use of integrate pest management that use insecticides only when needed³⁵.

Avoidance measures

The best ways to avoid impacts to Regal Fritillary is to avoid impacting violet patches at breeding sites year round and to avoid working in areas with nectar plants and resting areas within one mile of known breeding sites June 1-September 30. However, Regal Fritillary can fly considerable distances and there may be potential to take an individual as far as 50 miles from a breeding site between June 1 and September 30.

Minimization measures

Spatial and temporal efforts

If disrupting habitat cannot be avoided, timing of activities may minimize impacts. Ground and litter disturbing activities within violet patches should occur between June 1 and September 30. The area to be impacted should be minimized.

Compatible design

Development designs should be compatible with continued Regal Fritillary occupation and survival by incorporating habitat need in the final project design. Violets patches of the appropriate species and genotype should be planted to replace the loss. Additional plantings should include preferred nectar flowers such as common milkweed and native thistles. Tall prairie grasses can be planted for the benefit of providing summer resting sites for the



Preferred habitat mix of dry sand prairie remnant and restored tallgrass resting area at Hahnman Sand Prairie Nature Preserve, Whiteside County. Photo by Angella Moorehouse

females. However, these tall grasses should be planted ideally on former croplands (where the composition of the soil profile has been compromised) and away from the violet patches as they grasses could easily outcompete the violets.

Maintenance of the site should include management of invasive and woody species, reduced pesticide use, restricted mowing height and timing, and reduced traffic speed and volume during summer flight months.

Construction practices

Construction and maintenance practices should be sensitive to impacts to Regal Fritillary and their habitat. Clearing of native vegetation should be limited. Staging areas should be located far from habitat areas. Limit the use of large machinery and require construction vehicles use slow speeds during the adult flight period. Erosion and sediment controls should be strictly implemented, monitored, and maintained for the duration of the project. Debris and excess materials should be removed and properly disposed. All project personnel should be informed of the sensitive nature of the project. Areas that are not to be disturbed should be flagged or fenced to alert construction personnel.

Mitigation and Conservation Opportunities

Mitigation opportunities include habitat protection, stewardship, and creation.

Protection

Unprotected Regal Fritillary breeding areas and the land surrounding breeding habitat should be the target of habitat protection. Protection may consist of acquisition or conservation easement. Acquired land may be donated to a conservation agency or local conservation organization. Conservation easements may provide a level of protection without acquisition. Illinois Nature Preserves Commission permanently protects high quality areas and habitat for listed species on both private and public lands in the Illinois Nature Preserve System. Conservation easements on agricultural land can also protect habitat through retirement of farmed and previously converted wetlands. Land trusts or conservation organizations may be interested in partnering on conservation efforts, specifically The Nature Conservancy (TNC) working in the Kankakee area,

TNC and Illinois Audubon Society working in the Green River area, the IDNR and the U.S. Fish and Wildlife Service in the Upper Mississippi area, and Prairie Land Conservancy and Friends of Sangamon Valley in central Illinois. For more information check the Prairie State Conservation Coalition website for land trusts.

Habitat stewardship

Beyond protection of Regal Fritillary habitat, there is considerable stewardship work that may be required to maintain habitat. Vegetation management may be required to prevent invasive species or encroachment by woody species. Habitat stewardship opportunities may exist on public property, various forest preserve/conservation districts, and private properties.

Restoration and habitat creation

Habitat restoration opportunities exist around all identified breeding areas. Regal Fritillary has been observed to readily colonize newly restored habitat⁹. Restoration efforts should aim to increase connectivity between breeding sites and to increase habitat area at breeding sites. Enlarging the habitat around the viable population will buffer against outside impacts on Regal Fritillary habitat.

Working with the agricultural community through SWCD, NRCS, and FSA to target incentives for the restoration of habitat adjacent to sand prairies known to host breeding regal fritillary could be one of the best ways to increase the amount of suitable habitat. While casual observations seem to suggest that early CRP plantings provide habitat to attract Regal Fritillary more research is needed to determine if these will continue to attract regal fritillaries and result in an expansion of breeding habitat over time.

Species population management

Research needs

How viable are Regal Fritillary populations in Illinois?

Assess population size of Regal Fritillaries at each of the 13 breeding locations.

What are the larval resources available to Regal Fritillary?

Within the 13 breeding locations of Regal Fritillaries identify the violet species being used as host plants. Assess the location, area, and density of violet patches present.

What is the most effective management for increasing host violets?

Assess the response of violets to prescribed fire in the dormant season, prescribed fire during the summer, mowing, and other ground disturbances.

What is effect of management on Regal Fritillary populations?

Assess the response of the Regal Fritillary population to summer burns. Evaluate the response of Regal Fritillary to the planting of various nectar food and grasses. Identify the most beneficial species, abundance, and placement of such plantings.

What is the importance of leaf litter?

Assess the impact of varying depths, density, and structure of leaf litter on violet and Regal Fritillary abundance.

What is limiting the connectivity of Regal Fritillary habitat?

Assess the movement and recolonization of new areas by regal fritillaries relative to the surrounding landscape cover and configuration.

Additional information

Xerces Society

<http://xerces.org/regal-fritillary/>

<http://xerces.org/pollinators-great-lakes-region/>

NatureServe Explorer

<http://explorer.natureserve.org/servlet/NatureServe?searchName=Speyeria+idalia>

USFS Technical conservation assessment

https://www.fs.usda.gov/Internet/FSE_DOCUMENT/S/stelprdb5206808.pdf

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- (Univ. MN), Chris Young, TNC Kankakee Sands and Nachusa staff, Upper Mississippi River Refuge (FWS) – Savanna District, Rich Henderson (WI DNR), Armund Bartz (WI DNR)

Citation and

- a) Illinois Nature Preserves Commission. 2017. Conservation Guidance for Regal Fritillary. Illinois Department of Natural Resources, Division of Natural Heritage.

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Illinois Department of Natural Resources
CONSERVATION PLAN
(Application for an Incidental Take Authorization)
Per 520 ILCS 10/5.5 and 17 Ill. Adm. Code 1080

150-day minimum required for public review, biological and legal analysis, and permitting

PROJECT APPLICANT:

PROJECT NAME:

COUNTY:

AMOUNT OF IMPACT AREA:

The incidental taking of endangered and threatened species shall be authorized by the Illinois Department of Natural Resources (IDNR) only if an applicant submits a conservation plan to the IDNR Incidental Take Coordinator that meets the following criteria:

1. A **description of the impact likely to result** from the proposed taking of the species that would be covered by the authorization, including but not limited to -

A) Identification of the **area to be affected** by the proposed action, include a legal description and a detailed description including street address, map(s), and GIS shapefile. Include an indication of ownership or control of affected property. Attach photos of the project area.

B) **Biological data** on the affected species including life history needs and habitat characteristics. Attach all pre-construction biological survey reports.

C) **Description of project activities** that will result in taking of an endangered or threatened species, including practices and equipment to be used, a timeline of proposed activities, and any permitting reviews, such as a USFWS biological opinion or USACE wetland review. Please consider all potential impacts such as noise, vibration, light, predator/prey alterations, habitat alterations, increased traffic, etc.

D) Explanation of the anticipated **adverse effects on listed species**;

- How will the proposed actions impact each of the species' life cycle stages?
- Describe potential impacts to individuals and the population. Include information on the species life history strategy (life span, age at first reproduction, fecundity, recruitment, survival) to indicate the most sensitive life history stages.
- Identify where there is uncertainty, place reasonable bounds around the uncertainty, and describe how the bounds were determined. For example, indicate if it is uncertain how many individuals will be taken, make a reasonable estimate with high and low bounds, and describe how those estimates were made.

2) Measures the applicant will take to **minimize and mitigate** that impact and the **funding** that will be available to undertake those measures, including, but not limited to -

A) Plans to **minimize the area affected** by the proposed action, the estimated **number of individuals** of each endangered or threatened species that will be taken, and the **amount of habitat** affected (please provide an estimate of area by habitat type for each species).

B) **Plans for management of the area** affected by the proposed action that will **enable continued use** of the area by endangered or threatened species by maintaining/re-establishing suitable habitat (for example, native species planting, invasive species control, use of other best management practices, restored hydrology, etc.).

C) Description of **all measures to be implemented to avoid, minimize, and mitigate** the effects of the proposed action on endangered or threatened species.

- Avoidance measures include working outside the species' habitat.
- Minimization measures include timing work when species is less sensitive, reducing the project footprint, or relocating species out of the impact area.
- Mitigation is additional beneficial actions that will be taken for the species such as needed research, conservation easements, propagation, habitat work, or recovery planning.
- It is the **applicant's responsibility to propose mitigation measures**. IDNR expects applicants to provide species conservation benefits 5.5 times larger than their adverse impact.

D) Plans for **monitoring** the effects of the proposed actions on endangered or threatened species, such as monitoring the species' survival rates, reproductive rates, and habitat before and after construction, include a plan for follow-up **reporting to IDNR**. Monitoring surveys should be targeted at reducing the uncertainty identified in Section 1.d.

E) **Adaptive management practices** that will be used to deal with changed or unforeseen circumstances that may affect the endangered or threatened species.

- Adaptive management is a way to make decisions in the face of uncertainty by monitoring the uncertain element over time and adjusting to the new information. Adaptive management requires identifying objectives and uncertainties, thinking through a range of potential outcomes, developing triggers that will lead to different actions being taken, and monitoring to detect those triggers.
- Consider environmental variables such as flooding, drought, and species dynamics as well as other catastrophes. Management practices should include contingencies and specific triggers. Note: Not foreseeing any changes does not qualify as an adaptive management plan.

F) **Verification that adequate funding exists** to support and implement all minimization and mitigation activities described in the conservation plan. This may be in the form of bonds, certificates of insurance, escrow accounts, or other financial instruments adequate to carry out all aspects of the conservation plan.

3) A description of **alternative actions** the applicant considered that would reduce take, and the reasons that each of those alternatives was not selected. A **"no-action" alternative** shall be included in this description of alternatives. Please describe the economic, social, and ecological tradeoffs of each action.

- Consideration of **alternative actions** is an important tool in conservation planning as it allows for thinking of other options and evaluating the potential outcomes in terms of all relevant objectives. However, to be useful it requires creativity in developing alternatives and systematic analysis in evaluating the alternatives.
- In evaluating alternatives, describe the economic, social, and ecological tradeoffs of each.

4) Data and information to indicate that the proposed taking **will not reduce the likelihood of the survival** of the endangered or threatened species in the wild within the State of Illinois, the biotic community of which the species is a part, or the habitat essential to the species existence in Illinois.

5) An **implementing agreement**, which shall include, but not be limited to (on a separate piece of paper containing signatures):

- A) Names and signatures of all participants in the execution of the conservation plan;
- B) The obligations and responsibilities of each of the identified participants with schedules and deadlines for completion of activities included in the conservation plan and a schedule for preparation of progress reports to be provided to the IDNR;
- C) Certification that each participant in the execution of the conservation plan has the legal authority to carry out their respective obligations and responsibilities under the conservation plan;
- D) Assurance of compliance with all other federal, State and local regulations pertinent to the proposed action and to execution of the conservation plan;
- E) **Copies of any final federal authorizations for a taking already issued to the applicant**, if any.

PLEASE SUBMIT TO: Incidental Take Authorization Coordinator, Illinois Department of Natural Resources, Division of Natural Heritage, One Natural Resources Way, Springfield, IL, 62702 OR DNR.ITAcoordinator@illinois.gov

July 2016