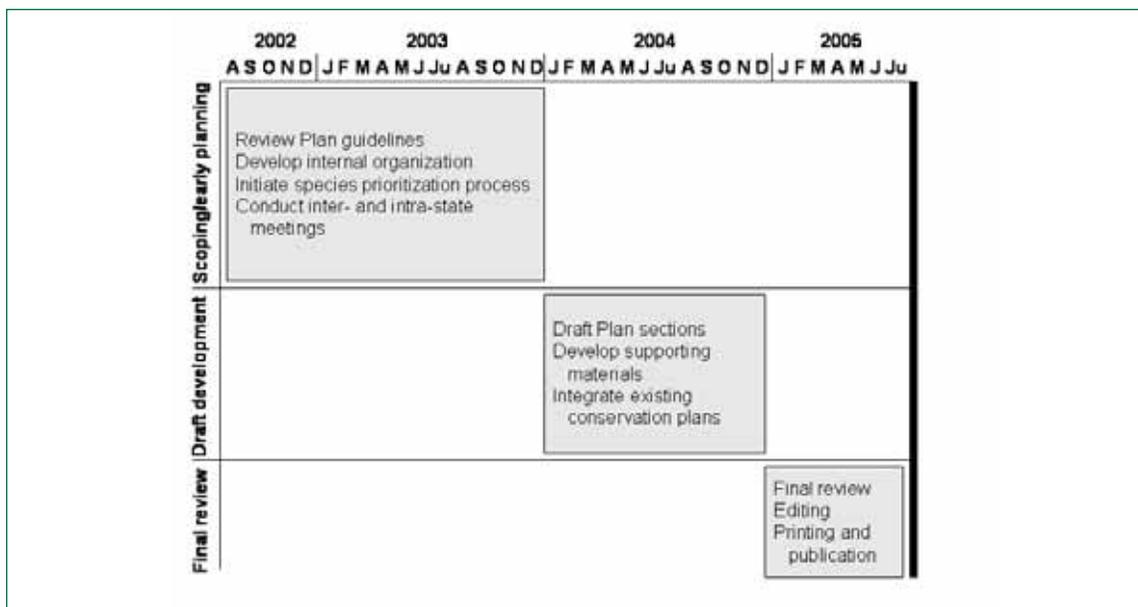


## CHAPTER 2. APPROACH

Planning for and protecting North Carolina’s fish and wildlife diversity is a multifaceted task that can only be accomplished through coordinated efforts by representatives of natural resource agencies, organizations, corporations, and private citizens. While staff within the Commission’s Division of Wildlife Management (DWM) and Division of Inland Fisheries (DIF) oversaw the development of the Plan, we sought out the expertise and feedback of many other agencies, organizations, and individuals. The successful implementation of the Plan depends on their input and support.

### General Process Timeline

The timeline below (Figure 2.1) identifies the three major phases of the Plan development process. We spent the first year and a half (Aug 2002 – Dec 2003) scoping and planning the process. This included the development of committees and a staff organizational structure, the review of conservation planning literature and guidelines, the design of processes necessary to fulfill the eight required elements, and the development of a format outline. The majority of 2004 was spent developing and expanding text, identifying supporting materials (i.e., maps, figures, tables), and assimilating existing conservation planning resources. This involved extensive assistance from biologists and staff among many organizations and agencies across the state. The final six months (Jan – July 2005) were spent finalizing edits, and preparing the Plan for completion.



**Figure 2.1.** Generalized timeline for Plan development; key events/processes identified within each phase.

### Organizational Structure

#### *Wildlife Action Plan Coordinator (Salinda Daley)*

Role: Coordinate the Plan development process; act as project manager; be a liaison to, and communicate the activities of, each internal committee; ensure involvement of all interested parties; help assemble final products and publications.

The following internal committees (made up of Commission staff) were developed to serve as resources for the Coordinator on particular aspects of the Plan development process:

### Steering Committee

Role: Oversee the Plan development process; provide guidance related to administrative and policy issues; give final approval of products and processes developed.

Members: Fred Harris (Assistant Deputy Director), David Cobb (Chief, DWM), Bob Curry (Chief, DIF), Shannon Deaton (Section Manager, DIF), Brad Gunn (Section Manager, DWM), Wib Owen (Section Manager, DWM), Ken Bridle (Nongame Wildlife Advisory Committee Representative), Tom Henson (Faunal Diversity Coordinator, DWM), and Scott Van Horn (Research and Surveys Coordinator, DIF)

Meeting frequency: The Coordinator met with the Steering Committee approximately every six weeks throughout the entire Plan development process.

### Technical Committee

Role: Provide guidance and support related to Plan details and content; assist in developing text and coordinating with external contacts and resources; assist in identifying supporting materials pertinent to the Plan; ensure the utility of the Plan as an on-the-ground planning and implementation resource.

Members: Scott Van Horn (Research and Surveys Coordinator, DIF), Tom Henson (Faunal Diversity Coordinator, DWM), Steve Fraley (Mountain Region Aquatic Nongame Biologist, DIF), Jeff Simmons (Mountain Region Aquatic Nongame Biologist, DIF), Ryan Heise (Central Region Aquatic Nongame Biologist, DIF), Rob Nichols (Central Region Aquatic Nongame Biologist, DIF), Angie Rodgers (Eastern Region Aquatic Nongame Biologist, DIF), Nolan Banish (Eastern Region Aquatic Nongame Biologist, DIF), Chris McGrath (Mountain Faunal Diversity Supervisor, DWM), Jeff Marcus (Piedmont Faunal Diversity Biologist, DWM), David Allen (Coastal Faunal Diversity Supervisor, DWM), Mark Johns (NC Partners in Flight Biologist, DWM), Sarah Cross (Herpetologist, DWM), Scott Anderson (Faunal Diversity Research Biologist, DWM & DIF)

Meeting frequency: The Coordinator met with the Technical Committee approximately every six weeks during the draft development phase of the process (as need be with the entire group, but more often as separate groups, aquatic and terrestrial).

### Outreach Committee

Role: Provide guidance related to public outreach opportunities, media publications, web site development, and final production and publication of the Plan.

Members: Kate Pipkin (Outreach Biologist, Division of Conservation Education- DCE), Jodie Best (Outreach Specialist, DCE), Russell Wong (Outreach Supervisor, DCE), Mark Dubowski (Special Publications Editor, DCE)

Meeting frequency: The Coordinator met with the Outreach Committee members as the need for their guidance was warranted (approximately once every three months).

### Partnerships and Public Involvement

External stakeholders were engaged in many ways throughout the Plan development process. Stakeholder involvement varied in nature, depending on the audience and their interests (Table 2.1). Early in our planning efforts, we identified four broad groups of stakeholders that we engaged, or will engage in the future, in different ways throughout the development, implementation, and review process:

#### Partners

This group of stakeholders includes other agencies and organizations who have a direct stake in Plan development and implementation, and with whom we directly collaborate and share data and resources (e.g., North Carolina Audubon, North Carolina Natural Heritage Program, The Nature Conservancy, university researchers). The standing Nongame Wildlife Advisory Committee to the Commission is a key representative group who will continue to play a vital feedback and coordination role in Plan implementation and review (*see more about the committee below*).

### User Groups

This group of stakeholders includes organizations that represent specific natural resource advocacy, education, and/or recreation groups. These groups, with whom we primarily consult and share information, are key to maintaining support for fish and wildlife conservation and funding, and to disseminating information to wider audiences across the state (e.g., North Carolina Wildlife Federation, North Carolina Herpetological Society).

### General Public

The general public was engaged in a number of different ways during development of the Plan. Primarily, our efforts were focused on enhancing education and understanding about the importance of conservation funding and the work that it makes possible, with the purpose of gaining and maintaining public support for continued conservation funding into the future. Through the general news media, the Commission magazine, the Plan web site, and the Commission Wildlife Advisory Hotline (see below for more details on these tools), the public was educated about the State Wildlife Grants program and about projects made possible through State Wildlife Grant funding, and was invited to participate in the Plan development process.

### Private Landowners

Private landowners are an integral part of fish and wildlife conservation in the state, a vital subset of the general public, and a key audience to target, especially during implementation activities. Within Chapter 4B we highlight opportunities to further engage private landowners in land and watershed conservation projects, with the purpose of strengthening and expanding conservation on private lands in the state. We support the recommendations generated through two stakeholder-driven private lands initiatives already underway in the state, the Working Lands Summit and the North Carolina Forestry Summits (sponsored through the One North Carolina Naturally Program, NC Department of Environment and Natural Resources).

**Table 2.1.** Stakeholder involvement activities and primary audience targets.

| Level of involvement | Type of activities   | Primary audience target |             |                |                    |
|----------------------|--|-------------------------|-------------|----------------|--------------------|
|                      |  | Partners                | User Groups | General Public | Private Landowners |
| Inform               | <ul style="list-style-type: none"> <li>• Meetings/presentations</li> <li>• Web site</li> <li>• Media</li> <li>• Email updates</li> </ul>                                     | X                       | X           | X              | X                  |
| Consult              | <ul style="list-style-type: none"> <li>• Meetings/presentations</li> <li>• Committees work groups</li> <li>• Web site</li> <li>• *Future human dimensions surveys</li> </ul> | X                       | X           | *X             | *X                 |
| Involve              | <ul style="list-style-type: none"> <li>• Committees/work groups</li> <li>• Review/feedback on draft text</li> </ul>  | X                       | X           | X              |                    |
| Collaborate          | <ul style="list-style-type: none"> <li>• Partnerships</li> <li>• Project coordination</li> <li>• Data sharing</li> </ul>   | X                       | X           |                |                    |

### Key Stakeholder Involvement Activities

The following section highlights some of the most important stakeholder involvement activities carried out during the Plan development process. Beyond these specific activities initiated to engage and involve external stakeholders, it is also important to note that, at the field level, coordination among agencies and organizations in North Carolina has been ongoing for many years. Commission biologists regularly coordinate with their counterparts in agencies such as the US Forest Service, National Park Service, US Fish & Wildlife Service, and the Natural Resources Conservation Service, among others. Implementation partnerships are growing out of these ongoing coordination efforts.

### Individual Meetings

Throughout the entire Plan development process, the Coordinator met with individual stakeholder groups. Early on, these meetings were primarily to inform groups about the Plan requirements and engage them in the development process. As the project grew, some meetings became more specialized in nature as more specific technical expertise or assistance was sought. During the Plan development process, the Coordinator held over 40 meetings with individual groups.

### Small-scale Group Meetings

Stakeholders were also engaged through small group meetings (<20 individuals) in order to facilitate dialogue and cooperation among groups with common interests. This included both intra- and inter-state efforts.

- **'Neighbor States' meeting:** In July 2003, we held a meeting of our neighboring states (Virginia, Tennessee, Georgia, South Carolina, Alabama) and our regional Federal Assistance coordinators, to discuss common issues and develop guidelines that would allow our individual Strategies to link across state boundaries. A key product of that meeting was the drafting of a format outline endorsed by all six states and the Federal Aid representatives. The outline was eventually combined with examples from two other states to become one of two Plan formatting examples endorsed by the US Fish & Wildlife Service and the International Association of Fish and Wildlife Agencies, and offered as a model to states nationwide.
- **'Partners' meeting:** In October 2003, the Coordinator organized a meeting of five key partners in North Carolina, each of whom were involved in specific conservation planning efforts in the state (Table 2.2). The purpose of the meeting was to share information about the objectives of each effort in order to identify common goals and strategies to highlight in the Plan. The information shared by attendees at that meeting ultimately resulted in better representation and synthesis of the strengths of each individual conservation effort within the Plan.

**Table 2.2.** Groups invited to participate in a small scale conservation planning meeting and their respective conservation planning efforts, October 2003.

| Agency/Organization   | Conservation planning effort   |
|---|--|
| NC Natural Heritage Program                                   | Ongoing species and habitat data collection, 'One NC Naturally' Program                  |
| NC Gap Analysis Program                                       | Statewide land cover, species distribution modeling, and stewardship data; NC GAP report |
| NC Division of Water Quality                                  | Basinwide Plans for the 17 river basins in North Carolina                                |
| NC Division of Marine Fisheries<br>(unable to attend meeting) | Coastal Habitat Protection Plan  |
| The Nature Conservancy  | Ecoregional Plans, Site Conservation Plans   |

As the text and format of the Plan developed, other small-scale meetings were organized on a variety of topics in order to initiate dialogue and brainstorming. Different stakeholders and partners were called to the table, depending on their interest and expertise. For example, discussions about land conservation strategies involved representatives from The Nature Conservancy and the NC Natural Heritage Program; private lands management meetings involved representatives from the US Fish & Wildlife Service, Natural Resources Conservation Service, the NC Division of Forest Resources, timber industry representatives, and the Southern Environmental Law Center.

Though considered, we opted not to hold a series of public meetings because of first-hand experience and concern expressed among Steering Committee members about the effectiveness of such meetings at actually engaging the public. Instead, we focused our attention on engaging and empowering stakeholder groups to spread the word to their constituencies and on partnering with other conservation initiatives in the state to reach as many people as possible. We recognize a need to do more to engage developer/homebuilder associations and local zoning and planning commissions; we hope that by partnering with other conservation efforts (e.g., the One North

Carolina *Naturally* Initiative, NC Department of Environment and Natural Resources; the Coastal Habitat Protection Plan, NC Division of Marine Fisheries) we will be more effective in our communications with these groups in the future.

### Taxa Committees

We used feedback from expert species authorities in the state to assist in prioritizing our species conservation targets (*this process is detailed in the next section, Species Prioritization Process*). Taxa group committees were initially convened during the spring and summer of 2003 to discuss the results of the species prioritization process. Members of the committees were subsequently involved (to varying degrees depending on their interest) in identifying species and habitat threats, survey, research and monitoring needs, and conservation recommendations. Throughout the Plan development process, we expanded our list of species and habitat authorities such that in the future, formal committee membership will likely grow in size and scope.

### Nongame Wildlife Advisory Committee

The Nongame Wildlife Advisory Committee (NWAC) is a standing committee of the Commission that provides guidance on matters of nongame fish and wildlife species and conservation issues. The NWAC is made up of 19 individuals representing state and federal agencies, universities, private industry, and land conservancies. A member of the NWAC served on the Steering Committee during the Plan development process. The Coordinator attended the quarterly meetings of the NWAC to keep them up to date on progress, and individuals on the committee were involved in specific aspects of Plan development as their technical expertise warranted. And as of November 2004, four additional NWAC members were on-hand to provide direct feedback on draft Plan text and were invited to subsequent Steering Committee meetings. The NWAC will continue to be a vital connection to external stakeholders across the state and their role in future revisions and editions of the Plan is expected to become more formalized and substantial.

### Media

A variety of media products were developed throughout the Plan development process to highlight the work that the State Wildlife Grants program makes possible and the importance of the Plan in implementing future work. Key examples are listed below (also see Appendix B for copies of select media examples):

- *FIRST AMONG equals* – article in *Wildlife in North Carolina* magazine, February 2004
- ‘Back Porch’ note in *Wildlife in North Carolina* magazine, August 2004
- 12 + articles in the news media across North Carolina, developed from Commission press releases
- Write-ups in the following newsletters/publications: NC Partners in Flight, NC Chapter of the American Fisheries Society, NC Chapter of The Wildlife Society, NC Conservation Network, NC Sea Grant *Coastwatch* magazine.
- Commission Wildlife Advisory Hotline announcements – the Commission sponsors an e-mail hotline that releases information on various topics to citizens who have signed up to receive such updates. Public comment and review of draft Plan text were solicited in this way, in addition to quarterly email updates.

### Stakeholder Input Meeting

On March 2, 2004 the Commission hosted a large-scale meeting in Raleigh to solicit stakeholder input from groups statewide. The meeting was attended by 53 individuals representing 48 different groups, including State and Federal agencies, conservation organizations, private industry, and academia. Our objectives were to: 1) educate stakeholders about the State Wildlife Grants Program and the Wildlife Action Plan, 2) gain a better understanding of the conservation concerns of stakeholders, and 3) learn how stakeholders would like to be involved in the Plan development and implementation process. Stakeholder feedback was solicited through breakout group discussions facilitated by staff of the Watershed Education for Communities and Local Officials office

(Cooperative Extension, NC State University). Stakeholder feedback helped us to verify the importance of issues we were pursuing in the Plan, generated additional issues and topics to consider, and even gave us the ability to identify issues that are important to conservation stakeholders in North Carolina but need to be addressed through avenues beyond the scope of the Plan. One of the most important findings of the meeting was the indication that stakeholders preferred to continue their involvement through smaller, more directed meetings and communications. This, in large part, directed our future approaches to stakeholder involvement. An Executive Summary of the feedback (including a list of attendees) can be found in Appendix C.

### Stakeholder Communication and Updates

As a result of our Stakeholder input meeting, we began regular communications and updates with stakeholder groups and partners through quarterly email updates, newsletter announcements, and participation in meetings and conferences. Invited presentations were given at the following meetings: US Fish & Wildlife Service Ecosystem Team meeting, Onslow Bight Conservation Initiative, joint meeting of the NC Chapter of The Wildlife Society and the NC Chapter of the American Fisheries Society. Other meetings the Coordinator participated in included annual meetings of NC Partners in Flight, the inaugural meeting of NC Partners in Amphibian and Reptile Conservation, One North Carolina Naturally initiative regional meetings, and the One North Carolina Naturally 2005 statewide conference.

### Web Site

In April 2004, we completed the design and development of a web site dedicated to providing visitors with up-to-date information about the Plan development process (to visit, go to [http://www.ncwildlife.org/fs\\_index\\_07\\_conservation.htm](http://www.ncwildlife.org/fs_index_07_conservation.htm), or look under the 'Wildlife Species and Conservation' topic from the Commission homepage, [www.ncwildlife.org](http://www.ncwildlife.org)). We also used the web site as a clearinghouse for information exchange by:

- Offering visitors the opportunity to sign up as expert resources related to specific species, habitats, or river basins
- Posting chapters of the Plan as they were drafted and soliciting interim external review and comment
- Posting the final draft document and soliciting final external review and comment

### Species Prioritization Process

The State Wildlife Grants program established funding for species not traditionally covered under most previous federal funding programs. To qualify for these funds, each state was mandated to develop a Plan with a focus on "species of greatest conservation concern" and "species with greatest conservation need." It was left to the states' discretion as to how they identified these species. Criteria to consider included species that are currently rare or designated as at-risk, those for which we have knowledge deficiencies and those that have not received adequate conservation attention in the past. To identify these priority species in North Carolina, in the fall of 2002 the Commission began developing an iterative prioritization process.

First, a number of different planning/prioritization efforts were reviewed in order to weigh the utility of using a pre-existing database/prioritization effort versus developing a new process. An independent review and prioritization process was developed based on the following requirements: a) we wanted to consider all species within a taxa (regardless of status or threat) at the start of the process, b) we wanted to collect information not previously measured in existing prioritization efforts (e.g., degree of knowledge about a species), and c) we wanted to develop a process that reflected the Commission's mission and goals.

Our goal was to develop a Species Review process that would serve as a tool to set conservation priorities across eight taxonomic groups in North Carolina: amphibians, birds, crayfish, freshwater fish, freshwater snails, freshwater mussels, mammals, and reptiles. The Commission focused the reviews on these eight groups based on jurisdictional and traditional programmatic boundaries, and

the need to initiate the process, recognizing that it could be expanded in the future. This focus does not mean that groups excluded from this process are not addressed within the Plan (see *Note*). Conservation plans, prioritization methodologies and species groups that were not considered for this first edition will be evaluated for inclusion in the Plan during future updates and revisions.

*Note:* Recognizing that the following groups fall outside the bounds of the aforementioned prioritization process, we have done our best, using existing information, to identify conservation priorities for each of these groups: marine mammals and fish; pelagic birds; insects; arachnids; terrestrial gastropods. We have incorporated species and habitat priorities and conservation recommendations for these groups into the Plan where possible. Marine species (including pelagic birds) are addressed in the Marine Systems section (Chapter 5C). Invertebrates are discussed in Appendix D.

First, we developed complete and accurate lists of species found in North Carolina for each group. Next, through recommendations of the Steering Committee, we developed committees of taxonomic authorities from which to solicit information on each of the eight animal groups (Table 2.3). Generally, the larger the taxa group, the larger the committee. For some groups (e.g., snails and crayfish) we found only one or two individuals who had the knowledge and expertise to conduct a review. It should be noted that our list of expert contacts has grown *considerably* since we first initiated the Species Review process. Though our initial committees were quite small in size, we would like to recognize all of the individuals who have since contributed their time and expertise to the development of our Plan (see Acknowledgements).

Next, we developed a list of criteria for which we sought information. We collected ideas from a variety of sources to arrive at our final list of criteria: protection status, Natural Heritage ranks, staff feedback, and other prioritization efforts (e.g., Hunter et al., 1993, Millsap et al., 1990). We strove for practicality, simplicity, and utility. We came up with 10 criteria we initially wished to consider (all criteria are defined in detail in Appendix E):

1. State protection status
2. NC Natural Heritage Program state rank (S1-S5)
3. Degree of exploitation/harvest
4. Past or current Commission funding
5. Past or current external funding
6. Feasibility measure
7. Knowledge of the species' population status
8. Population status (trend)
9. Knowledge of species' distribution in the state
10. Knowledge of limiting factors affecting the species

**Table 2.3.** Taxa committee members, 2002 - 2003.

| Species group           | Member   | Affiliation  |
|-------------------------|--|--|
| Amphibians and Reptiles | Chris McGrath<br>Alvin Braswell <sup>1</sup><br>Jeff Beane<br>John Sealy                               | NC Wildlife Resources Commission<br>NC Museum of Natural Sciences<br>NC Museum of Natural Sciences<br>Appalachian State University <sup>2</sup>  |
| Birds                   | Mark Johns<br>David Allen<br>John Gerwin<br>David Lee <sup>1</sup><br>Harry LeGrand                    | NC Wildlife Resources Commission<br>NC Wildlife Resources Commission<br>NC Museum of Natural Sciences<br>NC Museum of Natural Sciences<br>NC Natural Heritage Program  |
| Crayfish                | John Cooper<br>Aimee Fullerton   | NC Wildlife Resources Commission<br>past employee, NC Wildlife Resources Commission  |
| Freshwater Fish         | Scott Van Horn <sup>1</sup><br>Steve Fraley<br>David Yow<br>Wayne Starnes<br>Bryn Tracy<br>Fritz Rohde | NC Wildlife Resources Commission<br>NC Wildlife Resources Commission<br>NC Wildlife Resources Commission<br>NC Museum of Natural Sciences<br>NC Division of Water Quality<br>NC Division of Marine Fisheries |
| Freshwater Mussels      | Judy Ratcliffe<br>John Alderman<br>Art Bogan <sup>1</sup>  | NC Wildlife Resources Commission<br>Private consultant<br>NC Museum of Natural Sciences  |
| Freshwater Snails       | Brian Watson<br>Art Bogan <sup>1</sup>   | VA Department of Game and Inland Fish<br>NC Museum of Natural Sciences   |
| Mammals                 | Chris McGrath<br>Mary Kay Clark<br>David Webster   | NC Wildlife Resources Commission<br>NC Museum of Natural Sciences<br>University of North Carolina at Wilmington  |

In December 2002, we initiated the reviews with the taxa committee members, sending each a Word document with directions for completing the reviews and an Excel spreadsheet with the species list and criteria. We supplied the information for criteria 1 and 2; the reviewers were asked to fill in scores for the remaining eight criteria based on their professional expertise, and only for those species they felt qualified to comment on. As review data were received (over approximately 2 months, Jan – Feb 2003), they were compiled in Excel spreadsheets.

### Scoring the Reviews

It took considerable time to develop a scoring system appropriate to the criteria. We tested a number of different systems before arriving at one that seemed to work the best across all taxa, that gave appropriate weight to criteria, and that made best use of the information collected in the reviews. We grouped these criteria into two categories: “Concern” group data included those that gave some indication of the species’ current status/population concern; “Knowledge” group data included the three metrics of knowledge about a species (Table 2.4).

<sup>1</sup>Member did not provide initial data, but was involved in subsequent discussions.

<sup>2</sup>John Sealy is now with the Rockingham County Department of Public Health.

**Table 2.4.** Criteria and scores for prioritizing species, 2003.

|                   | Criteria                                   | Measure                  | Score | Range   |
|-------------------|--|--------------------------|-------|---|
| 'Concern' Group   | Protection Status*                         | Endangered or Threatened | 3     | 1 (lowest concern) – 6 (highest concern)<br><br>*Keep in mind, a species may not have a Protection status score |
|                   |  | Special Concern          | 2     |   |
|                   |  | Significantly Rare       | 1     |   |
|                   | Population Trend                           | Decreasing               | 3     |   |
|                   |  | Stable                   | 2     |   |
|                   |  | Increasing               | 1     |   |
| 'Knowledge' Group | Knowledge of Population Status             | High                     | 3     | 3 (low knowledge levels, i.e., knowledge deficiencies) – 9 (high knowledge levels)                              |
|                   |  | Medium                   | 2     |   |
|                   |  | Low                      | 1     |   |
|                   | Knowledge of Distribution                  | High                     | 3     |   |
|                   |  | Medium                   | 2     |   |
|                   |  | Low                      | 1     |   |
|                   | Knowledge of Factors Affecting the Species | High                     | 3     |   |
|                   |  | Medium                   | 2     |   |
|                   |  | Low                      | 1     |   |

Next, we scheduled meetings with each group of reviewers to examine the data and work towards identifying our priority species and conservation goals. At each meeting, we reviewed the lists to discuss priority species and actions that are critical to their conservation. Each list identified a different sort of need—species scoring high on the ‘Concern’ list likely had immediate population concerns, and may be associated with imperiled habitats in need of protection, restoration, and/or management. Species scoring low on the ‘Knowledge’ list indicated a need for survey, monitoring, and or research attention in order to improve our overall understanding of them, or to fill a particular knowledge gap.

Each committee reviewed the scored data and generally considered species that fell within the following ranges as priority species:

- Those with a ‘Concern’ score  $\geq 3$  (indicating that, at the very least, the species was considered declining, and at most, Endangered), **and/or**
- Those with a ‘Knowledge’ score of  $\leq 5$  (indicating low knowledge levels, or knowledge deficiencies, as summed across the three knowledge metrics).

*Note:* Critical review of the scored data by knowledgeable authorities was essential to this process. This being our first attempt, it would have been rash to assume that scoring process alone could provide the most accurate assessment of prioritization status for each and every species. We anticipate many improvements to the process during future iterations.

The following changes were made as a result of discussions during taxa committee meetings:

- **Birds** – when reviewing the scored data, species at the extreme periphery of their range in the state, accidentals, and/or sporadic migrants were not considered priority species.
- **Freshwater fish** – when reviewing the scored data, species that do not currently exist in the state, species at the extreme periphery of their range in North Carolina and non-native species without direct conservation concerns/impacts (e.g., goldfish) were not considered priority species.

- **Freshwater snails** – the species review data could not be used to prioritize snails species because we know so very little about the taxa as a whole. We used protection status, National Heritage Program ranks, and expert opinion to determine priority snail species.

During May – August of 2003, we compiled the information collected at each of the taxa committee meetings. Some committees (e.g., fish) were reconvened multiple times in order to clarify and finalize priority species listings. As a final consideration, each taxa list was sent back to members of the committees in order that they be afforded the chance to provide final feedback and suggest potential additions or deletions to the list, accompanied by reasoning. Changes to the lists were made when at least two independent reviewers had the same suggestion (except in the cases where there was only one reviewer). (See Table 2.5 for summary statistics).

**Table 2.5.** Priority species summary statistics, by group.

| Group              | Total # of species considered | # of priority species | # of priority species with State and/or Federal protection status <sup>3</sup> | # of priority species tracked by NC Natural Heritage Program |
|--------------------|-------------------------------|-----------------------|--|--|
| Birds              | 260                           | 92                    | 22   | 63   |
| Amphibians         | 80                            | 41                    | 17   | 28   |
| Reptiles           | 79                            | 43                    | 20   | 29   |
| Mammals            | 80                            | 38                    | 16   | 27   |
| Freshwater fish    | 231                           | 83                    | 44   | 60   |
| Freshwater mussels | 56                            | 40                    | 34   | 48   |
| Crayfish           | 41                            | 21                    | 8  | 18   |
| Freshwater snails  | 62                            | 10                    | 7  | 9  |
| <b>Total</b>       | <b>889</b>                    | <b>371</b>            | <b>168</b>   | <b>276</b>   |

*Future species prioritization efforts:* Our current priority species lists were built on the process outlined above and based on the extent of current information. In future editions of the Plan, as we make improvements to the prioritization process and as new information becomes available, these lists will be subject to modification.

Priority species are listed, by taxa, in the following tables (Tables 2.6-2.13). Extirpated and/or experimental species (and species with questionable status<sup>3</sup>) are identified in Table 2.14.

<sup>3</sup>Endangered, Threatened, or Special Concern

**Table 2.6.** Bird species prioritized for conservation in North Carolina. *Breeding population focus, unless otherwise noted. Pelagic bird priorities are addressed separately within Chapter 5C (Marine Systems).*

| Common Name                          | Scientific Name                   | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | NC PIF Priority Species | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                |
|--------------------------------------|-----------------------------------|--|---|-------------------------|---------------------------------------|-------------------------------------|--|
| Cooper's Hawk                        | <i>Accipiter cooperii</i>         | SC   | S3S4B, S4N, G5  | X                       | X                                     | X                                   |  |
| Sharp-shinned Hawk                   | <i>Accipiter striatus</i>         | SR   | S2B, S4N, G5  | X                       |                                       | X                                   |  |
| Northern Saw-whet Owl                | <i>Aegolius acadicus</i>          | T  | S2B, S2N, G5T?  | X                       | X                                     |                                     | S. Appalachian population                          |
| Bachman's Sparrow                    | <i>Aimophila aestivalis</i>       | SC   | S3B, S2N, G3  | X                       | X                                     |                                     |  |
| Saltmarsh Sharp-tailed Sparrow       | <i>Ammodramus caudacutus</i>      |  | SUB, S4N, G4  | X                       |                                       | X                                   |  |
| Henslow's Sparrow                    | <i>Ammodramus henslowii</i>       | SR   | S2B, S1N, G4  | X                       | X                                     | X                                   |  |
| Nelson's Sharp-tailed Sparrow        | <i>Ammodramus nelsoni</i>         |  |   | X                       |                                       | X                                   | Winter   |
| Grasshopper Sparrow                  | <i>Ammodramus savannarum</i>      |  | S3B, S1N, G5  | X                       | X                                     |                                     |  |
| Anhinga                              | <i>Anhinga anhinga</i>            | SR   | S2B, SZN, G5  |                         | X                                     |                                     |  |
| Short-eared Owl                      | <i>Asio flammeus</i>              |  | SUB, S3N, G5  | X                       |                                       | X                                   | Winter   |
| American Bittern                     | <i>Botaurus lentiginosus</i>      | SR   | S1B, S3N, G4  | X                       | X                                     | X                                   | Winter   |
| Sanderling                           | <i>Calidris alba</i>              |  |   | X                       | X                                     |                                     | Winter & migration                                 |
| Red Knot                             | <i>Calidris canutus</i>           |  |   | X                       | X                                     |                                     | Winter & migration                                 |
| Chuck-will's-widow                   | <i>Caprimulgus carolinensis</i>   |  |   | X                       | X                                     |                                     |  |
| Whip-poor-will                       | <i>Caprimulgus vociferus</i>      |  |   | X                       | X                                     |                                     |  |
| Pine Siskin                          | <i>Carduelis pinus</i>            |  | SZB, S4N, G5  | X                       |                                       | X                                   | Mtn. breeding populations                          |
| Brown Creeper                        | <i>Certhia americana</i>          | SC   | S3B, S5N, G5  | X                       | X                                     |                                     | Mtn. breeding populations                          |
| Chimney Swift                        | <i>Chaetura pelagica</i>          |  |   | X                       | X                                     |                                     |  |
| Piping Plover                        | <i>Charadrius melodus</i>         | T (T)                                      | S2B, S2N, G3  | X                       | X                                     |                                     | Winter and breeding                                |
| Wilson's Plover                      | <i>Charadrius wilsonia</i>        | SR   | S3B, SZN, G5  | X                       | X                                     |                                     |  |
| Lark Sparrow                         | <i>Chondestes grammacus</i>       | SR   | S1B, SZN, G5  | X                       | X                                     |                                     |  |
| Common Nighthawk                     | <i>Chordeiles minor</i>           |  |   |                         | X                                     |                                     |  |
| Northern Harrier                     | <i>Circus cyaneus</i>             | SR   | S1B, S4N, G5  | X                       | X                                     |                                     | Winter, rare breeder                               |
| Sedge Wren                           | <i>Cistothorus platensis</i>      |  |   | X                       |                                       | X                                   | Winter   |
| Yellow-billed Cuckoo                 | <i>Coccyzus americanus</i>        |  |   |                         | X                                     |                                     |  |
| Black-billed Cuckoo                  | <i>Coccyzus erythrophthalmus</i>  | SR   | S2B, SZN, G5  | X                       | X                                     | X                                   | Mtn. breeding populations                          |
| Northern Flicker                     | <i>Colaptes auratus</i>           |  |   | X                       | X                                     |                                     |  |
| Northern Bobwhite                    | <i>Colinus virginianus</i>        |  |   | X                       | X                                     |                                     |  |
| Eastern Wood-pewee                   | <i>Contopus virens</i>            |  |   | X                       | X                                     |                                     |  |
| Yellow Rail                          | <i>Coturnicops noveboracensis</i> | SR   | S2N, G4   | X                       | X                                     | X                                   | Winter   |
| Cerulean Warbler                     | <i>Dendroica cerulea</i>          | SR   | S2B, SZN, G4  | X                       | X                                     |                                     |  |
| Prairie Warbler                      | <i>Dendroica discolor</i>         |  |   | X                       | X                                     |                                     |  |
| Magnolia Warbler                     | <i>Dendroica magnolia</i>         | SR   | S1B, SZN, G5  | X                       |                                       | X                                   |  |
| Chestnut-sided Warbler               | <i>Dendroica pensylvanica</i>     |  |   | X                       | X                                     |                                     |  |
| Wayne's Black-throated Green Warbler | <i>Dendroica virens waynei</i>    | SR   | S3B, SZN, G5  | X                       |                                       |                                     | Disjunct subspecies; small isolated pops. at coast |
| Bobolink                             | <i>Dolichonyx oryzivorus</i>      |  | SUB, SZN, G5  | X                       | X                                     | X                                   | Erratic breeder, mainly migrant                    |

Note: See Table Key on page 27

**Table 2.6** (continued). Bird species prioritized for conservation in North Carolina. *Breeding population focus, unless otherwise noted. Pelagic bird priorities are addressed separately within Chapter 5C (Marine Systems).*

| Common Name                | Scientific Name                   | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup>                      | NC PIF Priority Species | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                                  |
|----------------------------|-----------------------------------|--|--|-------------------------|---------------------------------------|-------------------------------------|--|
| Little Blue Heron          | <i>Egretta caerulea</i>           | SC   | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Snowy Egret                | <i>Egretta thula</i>              | SC   | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Tricolored Heron           | <i>Egretta tricolor</i>           | SC   | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Swallow-tailed Kite        | <i>Elanoides forficatus</i>       |  |  |                         |                                       | X                                   | Possible breeder   |
| Alder Flycatcher           | <i>Empidonax alnorum</i>          | SR   | S <sub>2</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Willow Flycatcher          | <i>Empidonax traillii</i>         |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               | X                       |                                       | X                                   |  |
| Horned Lark                | <i>Eremophila alpestris</i>       |  |  | X                       | X                                     | X                                   | Mtn. breeding populations  |
| Peregrine Falcon           | <i>Falco peregrinus</i>           | E  | S <sub>1</sub> B, S <sub>2</sub> N, G <sub>4</sub>                               | X                       | X                                     |                                     | Mtn. breeding populations  |
| American Kestrel           | <i>Falco sparverius</i>           |  | S <sub>3</sub> B, S <sub>5</sub> N, G <sub>5</sub>                               | X                       |                                       |                                     | Breeding status in decline over last few decades                     |
| Common Moorhen             | <i>Gallinula chloropus</i>        |  |  |                         |                                       | X                                   |  |
| American Oystercatcher     | <i>Haematopus palliatus</i>       |  | S <sub>3</sub> B, S <sub>4</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Bald Eagle                 | <i>Haliaeetus leucocephalus</i>   | T (T)                                      | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>4</sub>                               | X                       | X                                     |                                     | Year round   |
| Worm-eating Warbler        | <i>Helmitheros vermivorus</i>     |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>5</sub> T?                            | X                       |                                       |                                     | Coastal pops. isolated and small; habitat very limited and declining |
| Black-necked Stilt         | <i>Himantopus mexicanus</i>       | SR   | S <sub>2</sub> B, G <sub>5</sub>   |                         | X                                     |                                     |  |
| Wood Thrush                | <i>Hylocichla mustelina</i>       |  |  | X                       | X                                     |                                     |  |
| Orchard Oriole             | <i>Icterus spurius</i>            |  |  | X                       | X                                     |                                     |  |
| Mississippi Kite           | <i>Ictinia mississippiensis</i>   | SR   | S <sub>2</sub> B, G <sub>5</sub>   | X                       |                                       | X                                   |  |
| Least Bittern              | <i>Ixobrychus exilis</i>          |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               | X                       | X                                     | X                                   |  |
| Loggerhead Shrike          | <i>Lanius ludovicianus</i>        | SC   | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>4</sub> T <sub>4</sub>                | X                       | X                                     |                                     |  |
| Black Rail                 | <i>Laterallus jamaicensis</i>     | SR   | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>4</sub>                               | X                       | X                                     | X                                   |  |
| Swainson's Warbler         | <i>Limnithlypis swainsonii</i>    |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>4</sub>                               | X                       | X                                     |                                     |  |
| Red Crossbill              | <i>Loxia curvirostra</i>          | SC   | S <sub>3</sub> B, S <sub>3</sub> N, G <sub>5</sub> T?                            | X                       | X                                     | X                                   | S. Appalachian population  |
| Red-headed Woodpecker      | <i>Melanerpes erythrocephalus</i> |  |  | X                       | X                                     |                                     | Winter & migration   |
| Wood Stork                 | <i>Mycteria americana</i>         | E (E)                                      | S <sub>1</sub> N, G <sub>4</sub>   |                         | X                                     |                                     | Post breeders  |
| Yellow-crowned Night-heron | <i>Nyctanassa violacea</i>        |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               | X                       |                                       | X                                   |  |
| Kentucky Warbler           | <i>Oporornis formosus</i>         |  |  | X                       | X                                     |                                     |  |
| Savannah Sparrow           | <i>Passerculus sandwichensis</i>  | SR   | S <sub>1</sub> B, S <sub>5</sub> N, G <sub>5</sub> T <sub>3</sub> T <sub>4</sub> | X                       | X                                     |                                     | Mtn. breeding populations  |
| Eastern Painted Bunting    | <i>Passerina ciris</i>            | SR   | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>4</sub>                               | X                       | X                                     |                                     |  |
| Brown Pelican              | <i>Pelecanus occidentalis</i>     | SR   | S <sub>3</sub> B, S <sub>4</sub> N, G <sub>4</sub>                               | X                       |                                       |                                     | Limited nesting sites in NC  |
| Rose-breasted Grosbeak     | <i>Pheucticus ludovicianus</i>    |  | S <sub>3</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               |                         |                                       |                                     | Noticeable declines in breeders (mountains)                          |
| Red-cockaded Woodpecker    | <i>Picoides borealis</i>          | E (E)                                      | S <sub>2</sub> , G <sub>3</sub>  | X                       | X                                     |                                     |  |
| Hairy Woodpecker           | <i>Picoides villosus</i>          |  |  |                         |                                       | X                                   |  |
| Glossy Ibis                | <i>Plegadis falcinellus</i>       | SC   | S <sub>2</sub> B, S <sub>2</sub> N, G <sub>5</sub>                               | X                       | X                                     |                                     |  |
| Black-capped Chickadee     | <i>Poecile atricapilla</i>        | SC   | S <sub>3</sub> , G <sub>5</sub> T?   | X                       | X                                     |                                     | S. Appalachian population  |

Note: See Table Key on page 27

**Table 2.6** (continued). Bird species prioritized for conservation in North Carolina. *Breeding population focus, unless otherwise noted. Pelagic bird priorities are addressed separately within Chapter 5C (Marine Systems).*

| Common Name              | Scientific Name              | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | NC PIF Priority Species | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                  |
|--------------------------|------------------------------|--|---|-------------------------|---------------------------------------|-------------------------------------|--|
| Vesper Sparrow           | <i>Pooecetes gramineus</i>   | SR   | S2B, S2N, G5  | X                       | X                                     | X                                   | Mtn. breeding populations                            |
| Sora                     | <i>Porzana carolina</i>      |  |   | X                       |                                       | X                                   | Winter   |
| King Rail                | <i>Rallus elegans</i>        |  | S3B, S3N, G4G5  | X                       | X                                     | X                                   | Year round   |
| Virginia Rail            | <i>Rallus limicola</i>       |  |   | X                       |                                       | X                                   | Winter   |
| Black Skimmer            | <i>Rynchops niger</i>        | SC   | S3B, S3N, G5  | X                       | X                                     |                                     |  |
| American Woodcock        | <i>Scolopax minor</i>        |  |   | X                       | X                                     |                                     |  |
| Brown-headed Nuthatch    | <i>Sitta pusilla</i>         |  |   | X                       | X                                     |                                     |  |
| Yellow-bellied Sapsucker | <i>Sphyrapicus varius</i>    | SC   | S2B, S5N, G5T?  | X                       | X                                     |                                     | Mtn. breeding populations                            |
| Dickcissel               | <i>Spiza americana</i>       |  | S2B, SZN, G5  | X                       | X                                     | X                                   |  |
| Field Sparrow            | <i>Spizella pusilla</i>      |  |   | X                       | X                                     |                                     |  |
| Least Tern               | <i>Sterna antillarum</i>     | SC   | S3B, SZN, G4  | X                       | X                                     |                                     |  |
| Caspian Tern             | <i>Sterna caspia</i>         | SR   | S1B, S2N, G5  |                         | X                                     |                                     | Winter, uncommon breeder                             |
| Common Tern              | <i>Sterna hirundo</i>        | SC   | S3B, SZN, G5  | X                       | X                                     |                                     |  |
| Gull-billed Tern         | <i>Sterna nilotica</i>       | T  | S3B, SZN, G5  | X                       | X                                     |                                     |  |
| Eastern Meadowlark       | <i>Sturnella magna</i>       |  |   | X                       | X                                     |                                     |  |
| Eastern Kingbird         | <i>Tyrannus tyrannus</i>     |  |   | X                       | X                                     |                                     |  |
| Barn Owl                 | <i>Tyto alba</i>             |  | S3B, S3N, G5  | X                       | X                                     |                                     |  |
| Golden-winged Warbler    | <i>Vermivora chrysoptera</i> | SR   | S3B, SZN, G4  | X                       | X                                     |                                     |  |
| Blue-winged Warbler      | <i>Vermivora pinus</i>       | SR   | S2B, SZN, G5  | X                       | X                                     | X                                   |  |
| Canada Warbler           | <i>Wilsonia canadensis</i>   |  |   | X                       | X                                     |                                     |  |
| Hooded Warbler           | <i>Wilsonia citrina</i>      |  |   | X                       |                                       |                                     | PIF high priority; breeding habitat becoming limited |

Note: See Table Key on page 27

**Table 2.7.** Mammal species prioritized for conservation in North Carolina.

| Common Name                       | Scientific Name                            | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup> |
|-----------------------------------|--|--|---|---------------------------------------|-------------------------------------|-------------------------------------|
| Star-nosed Mole                   | <i>Condylura cristata pop. 1</i>           | SC   | S2, G5T2Q   |                                       | X                                   | Coastal population                  |
| Rafinesque's Big-eared Bat        | <i>Corynorhinus rafinesquii</i>            | T  | S3, G3G4  | X                                     |                                     |                                     |
| Virginia Big-eared Bat            | <i>Corynorhinus townsendii virginianus</i> | E (E)                                      | S1, G4T2  | X                                     |                                     |                                     |
| Least Shrew                       | <i>Cryptotis parva</i>                     |  |   |                                       | X                                   | Species complex?                    |
| Carolina Northern Flying Squirrel | <i>Glaucomys sabrinus coloratus</i>        | E (E)                                      | S2, G5T1  | X                                     |                                     |                                     |
| Silver-haired Bat                 | <i>Lasionycteris noctivagans</i>           | SR   |   |                                       | X                                   |                                     |
| Hoary Bat                         | <i>Lasiurus cinereus</i>                   | SR   |   |                                       |                                     |                                     |
| Northern Yellow Bat               | <i>Lasiurus intermedius</i>                | SR   | SU, G4G5  |                                       | X                                   |                                     |
| Seminole Bat                      | <i>Lasiurus seminolus</i>                  |  | S3B, SZN, G5  |                                       | X                                   |                                     |
| Southern Rock Vole                | <i>Microtus chrotorrhinus carolinensis</i> | SC   | S3, G4T3  | X                                     |                                     |                                     |
| Meadow Vole                       | <i>Microtus pennsylvanicus</i>             |  |   |                                       | X                                   | Species complex?                    |
| Long-tailed Weasel                | <i>Mustela frenata</i>                     |  | S3S4, G5  |                                       | X                                   |                                     |
| Least Weasel                      | <i>Mustela nivalis</i>                     | SR   | S2, G5  | X                                     | X                                   |                                     |
| Southeastern Bat                  | <i>Myotis austroriparius</i>               | SC   | S2?, G3G4   | X                                     | X                                   |                                     |
| Gray Bat                          | <i>Myotis grisescens</i>                   | E (E)                                      | SA, G3  | X                                     |                                     |                                     |
| Small-footed Bat                  | <i>Myotis leibii</i>                       | SC   | SUB, S2N, G3  | X                                     | X                                   |                                     |
| Northern Long-eared Bat           | <i>Myotis septentrionalis</i>              | SC   | SUB, S3N, G4  | X                                     |                                     |                                     |
| Indiana Bat                       | <i>Myotis sodalis</i>                      | E (E)                                      | SUB, SZN, G2  | X                                     |                                     |                                     |
| Woodland Jumping Mouse            | <i>Napaeozapus insignis</i>                |  |   |                                       | X                                   |                                     |
| Eastern Woodrat                   | <i>Neotoma floridana</i>                   | T (CP pop), SC (M pop)                     | CP: S1, G5T5<br>M: S3, G5T4Q                                | X                                     |                                     |                                     |
| Allegheny Woodrat                 | <i>Neotoma magister</i>                    | SC   | S2, G3G4  | X                                     |                                     |                                     |
| Hairy-tailed Mole                 | <i>Parascalops breweri</i>                 |  |   |                                       | X                                   |                                     |
| Cotton Mouse                      | <i>Peromyscus gossypinus</i>               |  |   |                                       | X                                   |                                     |
| White-footed Mouse                | <i>Peromyscus leucopus easti</i>           | SC   | S2, G5T1  | X                                     |                                     | Coastal subspecies                  |
| Old-field Mouse                   | <i>Peromyscus polionotus</i>               | SR   | S1, G5  |                                       | X                                   |                                     |
| Eastern Mole                      | <i>Scalopus aquaticus</i>                  |  |   |                                       | X                                   | Species complex?                    |
| Eastern Fox Squirrel              | <i>Sciurus niger</i>                       | SR   | S3, G5  | X                                     |                                     |                                     |
| Masked Shrew                      | <i>Sorex cinereus</i>                      |  |   |                                       | X                                   | Species complex?                    |
| Rock Shrew                        | <i>Sorex dispar</i>                        | SC   | S2, G4  |                                       | X                                   |                                     |
| Smoky Shrew                       | <i>Sorex fumeus</i>                        |  |   |                                       | X                                   |                                     |
| Southern Pygmy Shrew              | <i>Sorex hoyi winnemana</i>                |  | S3, G5T4  |                                       | X                                   |                                     |
| Water Shrew                       | <i>Sorex palustris</i>                     | SC   | S2, G5T3  |                                       | X                                   |                                     |
| Eastern Spotted Skunk             | <i>Spilogale putorius</i>                  |  | S3, G5  |                                       | X                                   |                                     |
| Appalachian Cottontail            | <i>Sylvilagus obscurus</i>                 | SR   | S3, G4  |                                       | X                                   |                                     |
| Marsh Rabbit                      | <i>Sylvilagus palustris</i>                |  |   |                                       | X                                   |                                     |
| Southern Bog Lemming              | <i>Synaptomys cooperi helaletes</i>        | SR   | S2, G5T3  | X                                     |                                     | Coastal subspecies                  |
| Manatee                           | <i>Trichechus manatus</i>                  | E (E)                                      | S1N, G2   | X                                     | X                                   |                                     |
| Meadow Jumping Mouse              | <i>Zapus hudsonius</i>                     |  | S3, G5  |                                       | X                                   |                                     |

Note: See Table Key on page 27

**Table 2.8.** Amphibian species prioritized for conservation in North Carolina.

| Common Name                    | Scientific Name                                   | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup>   | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>   |
|--------------------------------|---|--|---|---------------------------------------|-------------------------------------|---|
| Mabee's Salamander             | <i>Ambystoma mabeei</i>                           | SR   | S <sub>3</sub> , G <sub>4</sub>                               | X                                     |                                     |   |
| Spotted Salamander             | <i>Ambystoma maculatum</i>                        |  |   | X                                     |                                     |   |
| Marbled Salamander             | <i>Ambystoma opacum</i>                           |  |   | X                                     |                                     |   |
| Mole Salamander                | <i>Ambystoma talpoideum</i>                       | SC   | S <sub>2</sub> , G <sub>5</sub>                               | X                                     |                                     |   |
| Eastern Tiger Salamander       | <i>Ambystoma tigrinum tigrinum</i>                | T  | S <sub>2</sub> , G <sub>5</sub>                               | X                                     |                                     |   |
| Green Salamander               | <i>Aneides aeneus</i>                             | E  | S <sub>2</sub> , G <sub>3</sub> G <sub>4</sub>                | X                                     |                                     |   |
| Oak Toad                       | <i>Bufo quercicus</i>                             | SR   | S <sub>3</sub> , G <sub>5</sub>                               |                                       |                                     |   |
| Eastern Hellbender             | <i>Cryptobranchus alleganiensis alleganiensis</i> | SC   | S <sub>3</sub> , G <sub>3</sub> G <sub>4</sub>                | X                                     |                                     |   |
| Seepage Salamander             | <i>Desmognathus aeneus</i>                        | SR   | S <sub>3</sub> , G <sub>3</sub> G <sub>4</sub>                | X                                     |                                     |   |
| Southern Dusky Salamander      | <i>Desmognathus auriculatus</i>                   |  |   |                                       | X                                   |   |
| Shovel-nosed Salamander        | <i>Desmognathus marmoratus</i>                    |  |   |                                       |                                     | Specific habitat association (high quality streams)                                 |
| Pigmy Salamander               | <i>Desmognathus wrighti</i>                       | SR   | S <sub>3</sub> , G <sub>3</sub> G <sub>4</sub>                | X                                     |                                     |   |
| Three-lined Salamander         | <i>Eurycea guttolineata</i>                       |  |   |                                       |                                     | Limited knowledge; key breeding sites being lost to development                     |
| Junaluska Salamander           | <i>Eurycea junaluska</i>                          | T  | S <sub>2</sub> , G <sub>3</sub>                               | X                                     |                                     |   |
| Longtail Salamander            | <i>Eurycea l. longicauda</i>                      | SC   | S <sub>1</sub> S <sub>2</sub> , G <sub>5</sub> T <sub>5</sub> | X                                     | X                                   |   |
| Dwarf Salamander               | <i>Eurycea quadridigitata</i>                     | SC   | S <sub>2</sub> , G <sub>5</sub> T <sub>2</sub> Q              | X                                     |                                     |   |
| Sandhills Salamander           | <i>Eurycea sp. 1</i>                              |  | S <sub>3</sub> ?, G <sub>3</sub> ?Q                           |                                       |                                     | Undescribed species, very limited range   |
| Four-toed Salamander           | <i>Hemidactylium scutatum</i>                     | SC   | S <sub>3</sub> , G <sub>5</sub>                               | X                                     | X                                   |   |
| Pine Barrens Treefrog          | <i>Hyla andersonii</i>                            |  | S <sub>3</sub> S <sub>4</sub> , G <sub>4</sub>                | X                                     |                                     |   |
| Barking Treefrog               | <i>Hyla gratiosa</i>                              |  |   | X                                     |                                     |   |
| Northern Gray Treefrog         | <i>Hyla versicolor</i>                            | SR   | SU, G <sub>5</sub>  |                                       | X                                   |   |
| Neuse River Waterdog           | <i>Necturus lewisi</i>                            | SC   | S <sub>3</sub> , G <sub>3</sub>                               | X                                     |                                     |   |
| Common Mudpuppy                | <i>Necturus maculosus</i>                         | SC   | SH, G <sub>5</sub>  | X                                     | X                                   |   |
| Tellico Salamander             | <i>Plethodon aureolus</i>                         | SR   | S <sub>2</sub> , G <sub>2</sub> G <sub>3</sub> Q              |                                       | X                                   |   |
| Chattahoochee Slimy Salamander | <i>Plethodon chattahoochee</i>                    |  |   |                                       |                                     | Need to know more about their distribution within NC and be able to better identify |
| Northern Slimy Salamander      | <i>Plethodon glutinosus sensustricto</i>          |  |   |                                       | X                                   |   |
| Southern Ravine Salamander     | <i>Plethodon richmondi</i>                        |  | S <sub>3</sub> , G <sub>5</sub>                               |                                       | X                                   |   |
| Southern Zigzag Salamander     | <i>Plethodon ventralis</i>                        | SC   | S <sub>1</sub> , G <sub>4</sub>                               | X                                     | X                                   |   |
| Wehrle's Salamander            | <i>Plethodon wehrlei</i>                          | T  | S <sub>1</sub> , G <sub>5</sub>                               | X                                     | X                                   |   |
| Weller's Salamander            | <i>Plethodon welleri</i>                          | SC   | S <sub>2</sub> , G <sub>3</sub>                               | X                                     | X                                   |   |
| Crevice Salamander             | <i>Plethodon longicrus</i>                        | SC   | S <sub>1</sub> , G <sub>4</sub> T <sub>1</sub> Q              | X                                     |                                     |   |

Note: See Table Key on page 27

**Table 2.8** (continued). Amphibian species prioritized for conservation in North Carolina.

| Common Name                  | Scientific Name                    | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup> |
|------------------------------|------------------------------------|--|---|---------------------------------------|-------------------------------------|-------------------------------------|
| Mountain Chorus Frog         | <i>Pseudacris brachyphona</i>      | SC   | S1, G5  | X                                     | X                                   |                                     |
| Brimley's Chorus Frog        | <i>Pseudacris brimleyi</i>         |  | S3S4, G5  | X                                     | X                                   |                                     |
| Striped Southern Chorus Frog | <i>Pseudacris nigrita nigrita</i>  |  |   | X                                     |                                     |                                     |
| Ornate Chorus Frog           | <i>Pseudacris ornata</i>           | SR   | S3, G5  | X                                     |                                     |                                     |
| Carolina Gopher Frog         | <i>Rana capito</i>                 | T  | S2, G3  | X                                     |                                     |                                     |
| River Frog                   | <i>Rana heckscheri</i>             | SC   | SH, G5  | X                                     | X                                   |                                     |
| Eastern Spadefoot            | <i>Scaphiopus holbrookii</i>       |  |   | X                                     |                                     |                                     |
| Eastern Lesser Siren         | <i>Siren intermedia intermedia</i> |  |   | X                                     | X                                   |                                     |
| Greater Siren                | <i>Siren lacertina</i>             |  |   |                                       | X                                   |                                     |
| Many-lined Salamander        | <i>Stereochilus marginatus</i>     |  |   |                                       | X                                   |                                     |

**Table 2.9.** Reptile species prioritized for conservation in North Carolina.

| Common Name                        | Scientific Name                           | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>           |
|------------------------------------|---|--|---|---------------------------------------|-------------------------------------|---|
| American Alligator                 | <i>Alligator mississippiensis</i>         | T (T)                                      | S3, G5  | X                                     |                                     |   |
| Gulf Coast Spiny Softshell         | <i>Apalone spinifera aspera</i>           |  | S3, G5T5  |                                       | X                                   |   |
| Eastern Spiny Softshell            | <i>Apalone spinifera spinifera</i>        | SC   | S1, G5T5  |                                       | X                                   |   |
| Loggerhead Sea Turtle              | <i>Caretta caretta</i>                    | T (T)                                      | S3B, S3N, G3  | X                                     |                                     |   |
| Northern Scarle snake              | <i>Cemophora coccinea copei</i>           |  |   | X                                     | X                                   |   |
| Green Sea Turtle                   | <i>Chelonia mydas</i>                     | T (T)                                      | S1B, SZN, G3  | X                                     |                                     |   |
| Spotted Turtle                     | <i>Clemmys guttata</i>                    |  | S3, G5  |                                       |                                     | Concerns over habitat loss and road mortality |
| Bog Turtle                         | <i>Clemmys muhlenbergii</i>               | T (T)                                      | S2, G3  | X                                     |                                     |   |
| Eastern Diamond-backed Rattlesnake | <i>Crotalus adamanteus</i>                | E  | S1, G4  | X                                     |                                     |   |
| Timber Rattlesnake                 | <i>Crotalus horridus</i>                  | SC   | S3, G4  | X                                     |                                     |   |
| Eastern Chicken Turtle             | <i>Deirochelys reticularia</i>            | SR   | S3, G5  | X                                     | X                                   |   |
| Leatherback Sea Turtle             | <i>Dermochelys coriacea</i>               | E (E)                                      | SAB, SZN, G3  | X                                     |                                     |   |
| Corn Snake                         | <i>Elaphe guttata guttata</i>             |  |   | X                                     |                                     |   |
| Hawksbill Sea Turtle               | <i>Eretmochelys imbricata imbricata</i>   | E (E)                                      | SZN, G3   | X                                     |                                     |   |
| Coal Skink                         | <i>Eumeces anthracinus</i>                |  | S3, G5  |                                       | X                                   |   |
| Broad-headed Skink                 | <i>Eumeces laticeps</i>                   |  |   |                                       | X                                   |   |
| Eastern Mudsnake                   | <i>Farancia abacura abacura</i>           |  |   |                                       | X                                   |   |
| Common Rainbow Snake               | <i>Farancia erytrogramma erytrogramma</i> |  |   |                                       | X                                   |   |
| Eastern Hog-nosed Snake            | <i>Heterodon platirhinos</i>              |  |   |                                       | X                                   |   |
| Southern Hog-nosed Snake           | <i>Heterodon simus</i>                    | SC   | S2, G2  | X                                     | X                                   |   |

Note: See Table Key on page 27

**Table 2.9** (continued). Reptile species prioritized for conservation in North Carolina.

| Common Name                  | Scientific Name                                | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                |
|------------------------------|--|--|---|---------------------------------------|-------------------------------------|--|
| Striped Mud Turtle           | <i>Kinosternon bairii</i>                      |  | S3?, G5   |                                       | X                                   |  |
| Mole Kingsnake               | <i>Lampropeltis calligaster rhombomaculata</i> |  |   |                                       | X                                   |  |
| Eastern Kingsnake            | <i>Lampropeltis getula getula</i>              |  |   |                                       | X                                   |  |
| Outer Banks Kingsnake        | <i>Lampropeltis getula sticticeps</i>          | SC   | S2, G5T2Q   | X                                     |                                     |  |
| Scarlet Kingsnake            | <i>Lampropeltis triangulum elapsoides</i>      |  | S3, G5T5  |                                       | X                                   |  |
| Kemp's Ridley Sea Turtle     | <i>Lepidochelys kempii</i>                     | E (E)                                      | SAB, SZN, G1  | X                                     |                                     |  |
| Diamond-backed Terrapin      | <i>Malaclemys terrapin</i>                     | SC   | S3, G4T4  | X                                     |                                     |  |
| Eastern Coachwhip            | <i>Masticophis flagellum</i>                   | SR   | S3, G5  | X                                     | X                                   |  |
| Eastern Coral Snake          | <i>Micrurus fulvius</i>                        | E  | S1, G5  | X                                     | X                                   |  |
| Carolina Watersnake          | <i>Nerodia sipedon williamengelsi</i>          | SC   | S3, G5T3  | X                                     |                                     |  |
| Smooth Greensnake            | <i>Opheodrys vernalis</i>                      | SC   | SH, G5  |                                       | X                                   |  |
| Eastern Slender Glass Lizard | <i>Ophisaurus attenuatus longicaudus</i>       |  | S3, G5  | X                                     | X                                   |  |
| Mimic Glass Lizard           | <i>Ophisaurus mimicus</i>                      | SC   | S2, G3  | X                                     | X                                   |  |
| Northern Pine Snake          | <i>Pituophis melanoleucus melanoleucus</i>     | SC   | S3, G4T4  | X                                     |                                     |  |
| Glossy Crayfish Snake        | <i>Regina rigida</i>                           | SR   | S2S3, G5  |                                       |                                     | Incomplete data indicates knowledge deficits; rare |
| Pine Woods Littersnake       | <i>Rhadinaea flavilata</i>                     |  | S3, G4  |                                       | X                                   |  |
| Black Swamp Snake            | <i>Seminatrix pygaea</i>                       | SR   |   | X                                     | X                                   |  |
| Pygmy Rattlesnake            | <i>Sistrurus miliarius</i>                     | SC   | S3, G5  | X                                     |                                     |  |
| Loggerhead Musk Turtle       | <i>Sternotherus minor</i>                      | SC   | S1, G5  |                                       | X                                   |  |
| Southeastern Crowned Snake   | <i>Tantilla coronata</i>                       |  |   | X                                     | X                                   |  |
| Eastern Box Turtle           | <i>Terrapene carolina</i>                      |  |   |                                       |                                     | Concerns over habitat loss and road mortality      |
| Common Ribbonsnake           | <i>Thamnophis sauritus sauritus</i>            |  |   |                                       | X                                   |  |
| Eastern Smooth Earthsnake    | <i>Virginia valeriae valeriae</i>              |  |   |                                       | X                                   |  |

Note: See Table Key on page 27

**Table 2.10.** Freshwater fish species prioritized for conservation in North Carolina.

| Common Name                   | Scientific Name                            | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>               |
|-------------------------------|--|--|---|---------------------------------------|-------------------------------------|---|
| Shortnose Sturgeon            | <i>Acipenser brevirostrum</i>              | E (E)                                      | S1, G3  | X                                     |                                     |   |
| Atlantic Sturgeon             | <i>Acipenser oxyrinchus</i>                | SC   | S3, G3  | X                                     | X                                   |   |
| Roanoke Bass                  | <i>Ambloplites cavifrons</i>               | SR   | S3, G3  | X                                     |                                     |   |
| Snail Bullhead                | <i>Ameiurus brunneus</i>                   |  | S3, G4  |                                       | X                                   |   |
| River Carpsucker              | <i>Carpiodes carpio</i>                    | SC   | SH, G5  | X                                     | X                                   |   |
| Quillback                     | <i>Carpiodes cyprinus</i>                  |  |   | X                                     | X                                   |   |
| Highfin Carpsucker            | <i>Carpiodes velifer</i>                   | SC   | S2, G4G5  | X                                     |                                     |   |
| LittleTennessee Rosyside Dace | <i>Clinostomus funduloides</i> ssp.        | SC   | S2, G5T3Q   | X                                     |                                     | Otherwise known as "Smoky dace"                   |
| Blue Ridge Sculpin            | <i>Cottus caeruleomentum</i>               | SR   | S1, G4  | X                                     |                                     |   |
| Spotfin Chub                  | <i>Cyprinella monacha</i>                  | T (T)                                      | S1, G2  | X                                     |                                     |   |
| Thinlip Chub                  | <i>Cyprinella</i> sp. (cf. <i>zanema</i> ) | SC   | S2, G4T2Q   | X                                     |                                     |   |
| Carolina Pygmy Sunfish        | <i>Elassoma boehlkei</i>                   | T  | S1, G2  | X                                     |                                     |   |
| Everglades Pygmy Sunfish      | <i>Elassoma evergladei</i>                 |  |   |                                       | X                                   |   |
| Banded Pygmy Sunfish          | <i>Elassoma zonatum</i>                    |  |   |                                       | X                                   |   |
| Blackbanded Sunfish           | <i>Enneacanthus chaetodon</i>              |  | S3, G4  | X                                     | X                                   |   |
| Banded Sunfish                | <i>Enneacanthus obesus</i>                 |  |   | X                                     | X                                   |   |
| Blotched Chub                 | <i>Erimystax insignis</i>                  | SR   | S2, G3G4  | X                                     |                                     |   |
| Lake Chubsucker               | <i>Erimyzon sucetta</i>                    |  |   |                                       | X                                   |   |
| Sharphead Darter              | <i>Etheostoma acuticeps</i>                | T  | S1, G3  | X                                     |                                     |   |
| Carolina Darter               | <i>Etheostoma collis</i>                   | SC   | S2, G3T3Q   | X                                     |                                     |   |
| Turquoise Darter              | <i>Etheostoma inscriptum</i>               | SC   | S1, G4  | X                                     |                                     |   |
| Blueside Darter               | <i>Etheostoma jessiae</i>                  | SC   | SH, G4Q   | X                                     | X                                   | Extirpated?                                       |
| Kanawha Darter                | <i>Etheostoma kanawhae</i>                 | SR   | S2, S3, G4  | X                                     |                                     |   |
| Pinewoods Darter              | <i>Etheostoma mariae</i>                   | SC   | S3, G3  | X                                     |                                     |   |
| Johnny Darter                 | <i>Etheostoma nigrum</i>                   |  |   | X                                     |                                     |   |
| Waccamaw Darter               | <i>Etheostoma perlongum</i>                | T  | S2, G1Q   | X                                     |                                     |   |
| Riverweed Darter              | <i>Etheostoma podostemone</i>              | SC   | S2, G4  | X                                     |                                     |   |
| Glassy Darter                 | <i>Etheostoma vitreum</i>                  |  |   | X                                     |                                     |   |
| Wounded Darter                | <i>Etheostoma vulneratum</i>               | SC   | S2, G3  | X                                     | X                                   |   |
| Tonguetied Minnow             | <i>Exoglossum laurae</i>                   | SR   | S2, G4  | X                                     | X                                   |   |
| Cutlips Minnow                | <i>Exoglossum maxillangua</i>              | E  | S1, G5  | X                                     |                                     |   |
| Banded Killifish              | <i>Fundulus diaphanus</i>                  |  |   |                                       | X                                   |   |
| Lake Phelps Killifish         | <i>Fundulus</i> cf. <i>diaphanus</i>       | SR   | S1, GUQ   | X                                     |                                     | Formerly considered part of <i>F. waccamensis</i> |
| Lined Topminnow               | <i>Fundulus lineolatus</i>                 |  |   | X                                     | X                                   |   |
| Waccamaw Killifish            | <i>Fundulus waccamensis</i>                | SC   | S1, G1QT1   | X                                     |                                     |   |
| Least Killifish               | <i>Heterandria formosa</i>                 | SC   | S1, G5  | X                                     | X                                   |   |
| Rosyface Chub                 | <i>Hybopsis rubifrons</i>                  | T  | S1, G4  | X                                     |                                     |   |
| Roanoke Hog Sucker            | <i>Hyptelium roanokense</i>                | SR   | S3, G4T2Q   | X                                     |                                     |   |
| Mountain Brook Lamprey        | <i>Ichthyomyzon greeleyi</i>               |  |   |                                       | X                                   |   |
| Smallmouth Buffalo            | <i>Ictiobus bubalus</i>                    |  |   |                                       | X                                   |   |
| Brook Silverside              | <i>Labidesthes sicculus</i>                |  |   |                                       | X                                   |   |
| Least Brook Lamprey           | <i>Lampetra aepyptera</i>                  | T  | S2, G5T3Q   | X                                     | X                                   |   |

Note: See Table Key on page 27

**Table 2.10** (continued). Freshwater fish species prioritized for conservation in North Carolina.

| Common Name            | Scientific Name                 | NC Status <sup>1</sup> | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                                    |
|------------------------|---------------------------------|------------------------|---|---------------------------------------|-------------------------------------|--|
| American Brook Lamprey | <i>Lampetra appendix</i>        | T                      | S1, G4  | X                                     | X                                   |  |
| Dollar Sunfish         | <i>Lepomis marginatus</i>       |                        |   |                                       | X                                   |  |
| Spotted Sunfish        | <i>Lepomis punctatus</i>        |                        | S3, G5  |                                       | X                                   |  |
| Bluefin Killifish      | <i>Lucania goodei</i>           | SC                     | S1, G5  | X                                     |                                     |  |
| Striped Shiner         | <i>Luxilus chrysocephalus</i>   | T                      | S1, G5  |                                       |                                     | Range restrictions, phylogenetic differences in NC populations?        |
| Pinewoods Shiner       | <i>Lythrurus matutinus</i>      | SR                     | S3, G3  | X                                     |                                     |  |
| Waccamaw Silverside    | <i>Menidia extensa</i>          | T (T)                  | S1, G1  | X                                     |                                     |  |
| Notchlip Redhorse      | <i>Moxostoma collapsum</i>      |                        |   | X                                     |                                     |  |
| Shorthead Redhorse     | <i>Moxostoma macrolepidotum</i> |                        |   | X                                     |                                     |  |
| V-lip Redhorse         | <i>Moxostoma pappillosum</i>    |                        |   | X                                     |                                     |  |
| Robust Redhorse        | <i>Moxostoma robustum</i>       | SC                     | S1, G1  | X                                     |                                     |  |
| Sicklefin Redhorse     | <i>Moxostoma spp 1</i>          | SR                     | S1S2, G2G3Q   | X                                     |                                     |  |
| Carolina redhorse      | <i>Moxostoma spp 2</i>          | SR                     | S1S2, S1G2Q   | X                                     | X                                   |  |
| Comely Shiner          | <i>Notropis amoenus</i>         |                        |   |                                       | X                                   |  |
| Bridle Shiner          | <i>Notropis bifrenatus</i>      | SC                     | S1, G5  | X                                     | X                                   |  |
| Ironcolor Shiner       | <i>Notropis chalybaeus</i>      |                        |   | X                                     | X                                   |  |
| Yellowfin Shiner       | <i>Notropis lutipinnis</i>      | SC                     | S3, G4Q   | X                                     |                                     |  |
| Taillight Shiner       | <i>Notropis maculatus</i>       |                        | S2, G5  | X                                     | X                                   |  |
| Cape Fear Shiner       | <i>Notropis mekistocholas</i>   | E (E)                  | S1, G1  | X                                     |                                     |  |
| Silver Shiner          | <i>Notropis photogenis</i>      |                        |   |                                       | X                                   |  |
| Rosyface Shiner        | <i>Notropis rubellus</i>        |                        |   |                                       | X                                   |  |
| Mimic Shiner           | <i>Notropis volucellus</i>      |                        | S3, G5  |                                       | X                                   |  |
| Mountain Madtom        | <i>Noturus eleutherus</i>       | SC                     | SH, G4  | X                                     | X                                   | Extirpated?  |
| Stonecat               | <i>Noturus flavus</i>           | E                      | S1, G5  | X                                     | X                                   |  |
| Carolina Madtom        | <i>Noturus furiosus</i>         | SC                     | S2, G3T2Q   | X                                     | X                                   |  |
| Orangefin Madtom       | <i>Noturus gilberti</i>         | E                      | S1, G2  | X                                     | X                                   |  |
| Broadtail Madtom       | <i>Noturus n. sp.</i>           | SC                     | S1,G2   | X                                     |                                     |  |
| Tangerine Darter       | <i>Percina aurantiaca</i>       |                        | S3, G4  |                                       | X                                   |  |
| Blotchside Darter      | <i>Percina burtoni</i>          | E                      | S1, G2  | X                                     | X                                   |  |
| Logperch               | <i>Percina caprodes</i>         | T                      | S1, G5  | X                                     | X                                   |  |
| Longhead Darter        | <i>Percina macrocephala</i>     | SC                     | SX, G3  | X                                     | X                                   | Extirpated?  |
| Blackbanded Darter     | <i>Percina nigrofasciata</i>    | SR                     | S1, G5  | X                                     | X                                   |  |
| Sharpnose Darter       | <i>Percina oxyrhynchus</i>      | SC                     | S1, G4  | X                                     | X                                   |  |
| Olive Darter           | <i>Percina squamata</i>         | SC                     | S2, G3  | X                                     |                                     |  |
| Sea Lamprey            | <i>Petromyzon marinus</i>       |                        |   | X                                     | X                                   |  |
| Kanawha Minnow         | <i>Phenacobius teretulus</i>    | SC                     | S2S3, G3G4  | X                                     |                                     |  |
| Bluntnose Minnow       | <i>Pimephales notatus</i>       |                        |   |                                       | X                                   |  |
| Sailfin Molly          | <i>Poecilia latipinna</i>       | SR                     | S2?, G5   |                                       | X                                   | 2001 data; as of 2004, NCNHP no longer lists estuarine/marine species. |
| Brook Trout            | <i>Salvelinus fontinalis</i>    |                        |   | X                                     |                                     |  |
| Bigeye Jumprock        | <i>Scartomyzon ariommus</i>     | T                      | S2, G4  | X                                     |                                     |  |
| Sandhills Chub         | <i>Semotilus lumbee</i>         | SC                     | S3, G3  | X                                     |                                     |  |
| Rustyside Sucker       | <i>Thoburnia hamiltoni</i>      | E                      | S1, G3  | X                                     |                                     |  |

Note: See Table Key on page 27

**Table 2.11.** Freshwater mussel species prioritized for conservation in North Carolina.

| Common Name             | Scientific Name                    | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup> |
|-------------------------|------------------------------------|--|---|---------------------------------------|-------------------------------------|-------------------------------------|
| Dwarf Wedgemussel       | <i>Alasmidonta heterodon</i>       | E (E)                                      | S1, G1G2  | X                                     |                                     |                                     |
| Appalachian Elktoe      | <i>Alasmidonta raveneliana</i>     | E (E)                                      | S1, G1  | X                                     |                                     |                                     |
| Carolina Elktoe         | <i>Alasmidonta robusta</i>         | SR   | S1, G1  | X                                     |                                     |                                     |
| Triangle Floater        | <i>Alasmidonta undulata</i>        | T  | S2, G4  | X                                     |                                     |                                     |
| Brook Floater           | <i>Alasmidonta varicosa</i>        | E  | S1, G3  | X                                     |                                     |                                     |
| Slippershell Mussel     | <i>Alasmidonta viridis</i>         | E  | S1, G4G5  | X                                     |                                     |                                     |
| Barrel Floater          | <i>Anodonta couperiana</i>         | E  | SH, G4  | X                                     |                                     |                                     |
| Alewife Floater         | <i>Anodonta implicata</i>          | T  | S1, G5  | X                                     |                                     |                                     |
| Purple Wartyback        | <i>Cyclonaias tuberculata</i>      | E  | S1, G5  | X                                     |                                     |                                     |
| Box Spike               | <i>Elliptio cystellaeformis</i>    |  | SU, G4Q   | X                                     |                                     |                                     |
| Carolina Slabshell      | <i>Elliptio congaraea</i>          |  | S3, G4  | X                                     |                                     |                                     |
| Spike                   | <i>Elliptio dilatata</i>           | SC   | S1, G5  | X                                     |                                     |                                     |
| Pod Lance               | <i>Elliptio folliculata</i>        | SC   | S1, G2G3Q   | X                                     |                                     |                                     |
| Variable Spike          | <i>Elliptio icterina</i>           |  |   | X                                     |                                     |                                     |
| Yellow Lance            | <i>Elliptio lanceolata</i>         | E  | S1, G2G3  | X                                     |                                     |                                     |
| Cape Fear Spike         | <i>Elliptio marsupiobesa</i>       | SC   | SU, G3Q   | X                                     |                                     |                                     |
| Roanoke Slabshell       | <i>Elliptio roanokensis</i>        | T  | S1, G2G3  | X                                     |                                     |                                     |
| Tar River Spiny mussel  | <i>Elliptio steinstansana</i>      | E (E)                                      | S1, G1  | X                                     |                                     |                                     |
| Waccamaw Spike          | <i>Elliptio waccamawensis</i>      | E  | S1, G2Q   | X                                     |                                     |                                     |
| Tennessee Pigtoe        | <i>Fusconaia barnesiana</i>        | E  | S1, G2G3  | X                                     |                                     |                                     |
| Atlantic Pigtoe         | <i>Fusconaia masoni</i>            | E  | S1, G2  | X                                     |                                     |                                     |
| Longsolid               | <i>Fusconaia subrotunda</i>        | SR   | S1, G3  | X                                     |                                     |                                     |
| Yellow Lampmussel       | <i>Lampsilis cariosa</i>           | E  | S1, G3G4  | X                                     |                                     |                                     |
| Wavyrayed Lampmussel    | <i>Lampsilis fasciola</i>          | SC   | S1, G4  | X                                     |                                     |                                     |
| Waccamaw Fatmucket      | <i>Lampsilis fullerkeri</i>        | T  | S1, G1Q   | X                                     |                                     |                                     |
| Carolina Fatmucket      | <i>Lampsilis radiata conspicua</i> | T  | S1?, G5T2Q  | X                                     |                                     |                                     |
| Eastern Lampmussel      | <i>Lampsilis radiata radiata</i>   | T  | S1S2, G5T5  | X                                     |                                     |                                     |
| Carolina Heelsplitter   | <i>Lasmigona decorata</i>          | E (E)                                      | S1, G1  | X                                     |                                     |                                     |
| Tennessee Heelsplitter  | <i>Lasmigona holstonia</i>         | E  | S1, G3  | X                                     |                                     |                                     |
| Green Floater           | <i>Lasmigona subviridis</i>        | E  | S1, G3  | X                                     |                                     |                                     |
| Tidewater Mucket        | <i>Leptodea ochracea</i>           | T  | S1, G4  | X                                     |                                     |                                     |
| Eastern Pondmussel      | <i>Ligumia nasuta</i>              | T  | S1, G4G5  | X                                     |                                     |                                     |
| Littlewing Pearlymussel | <i>Pegias fabula</i>               | E (E)                                      | S1, G1  | X                                     |                                     |                                     |
| James Spiny mussel      | <i>Pleurobema collina</i>          | SR (E)                                     | S1, G1  | X                                     |                                     |                                     |
| Tennessee Clubshell     | <i>Pleurobema oviforme</i>         | E  | S1?, G3   | X                                     |                                     |                                     |
| Creeper (Squawfoot)     | <i>Strophitus undulatus</i>        | T  | S2S3, G5  | X                                     |                                     |                                     |
| Savannah Lilliput       | <i>Toxolasma pullus</i>            | E  | S1, G2  | X                                     |                                     |                                     |
| Notched Rainbow         | <i>Villosa constricta</i>          | SC   | S3, G3  | X                                     |                                     |                                     |
| Eastern Creekshell      | <i>Villosa delumbris</i>           | SR   | S3, G4  | X                                     |                                     |                                     |
| Rainbow                 | <i>Villosa iris</i>                | SC   | S1, G5  | X                                     |                                     |                                     |
| Cumberland Bean         | <i>Villosa trabalis</i>            | SR (E)                                     | S1, G1  | X                                     |                                     |                                     |
| Mountain Creekshell     | <i>Villosa vanuxemensis</i>        | T  | S1, G4  | X                                     |                                     |                                     |
| Carolina Creekshell     | <i>Villosa vaughaniana</i>         | E  | S2, G2  | X                                     |                                     |                                     |

Note: See Table Key on page 27

**Table 2.12.** Freshwater crayfish species prioritized for conservation in North Carolina.

| Common Name                           | Scientific Name                | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Population Trend Concern <sup>3</sup> | Knowledge Deficiencies <sup>4</sup> | Additional Information <sup>5</sup>                                   |
|---------------------------------------|--------------------------------|--|---|---------------------------------------|-------------------------------------|---|
| Spinytail Crayfish                    | <i>Cambarus acanthura</i>      | SR   | S1, G4  |                                       | X                                   |   |
| Greensboro Burrowing Crayfish         | <i>Cambarus catagius</i>       | SC   | S2, G3  | X                                     |                                     |   |
| Oconee Stream Crayfish                | <i>Cambarus chaugaensis</i>    | SC   | S2, G2  | X                                     | X                                   |   |
| Carolina Ladle Crayfish               | <i>Cambarus davidi</i>         | SR   | S2S3, G2G3  |                                       |                                     |   |
| Little Tennessee River Crayfish       | <i>Cambarus georgiae</i>       | SC   | S2S3, G1  | X                                     | X                                   |   |
| Hiwassee Crayfish                     | <i>Cambarus hiwasseeensis</i>  |  | S3S4, G3G4  |                                       | X                                   |   |
| Sandhills Spiny Crayfish              | <i>Cambarus hystricosus</i>    | SR   | S2, G2  |                                       |                                     |   |
| Broad River Stream Crayfish           | <i>Cambarus lenati</i>         | SR   | S2, G1G2  | X                                     | X                                   |   |
| Knotty Burrowing Crayfish             | <i>Cambarus nodosus</i>        | SR   | S2, G4  |                                       | X                                   |   |
| Hiwassee Headwaters Crayfish          | <i>Cambarus parrishi</i>       | SC   | S2S3, G1  | X                                     | X                                   |   |
| French Broad River Crayfish           | <i>Cambarus reburus</i>        | SR   | S2S3, G3G4  |                                       | X                                   |   |
| Broad River Spiny Crayfish            | <i>Cambarus spicatus</i>       | SC   | S2, G3  | X                                     | X                                   |   |
| Tuckasegee Stream Crayfish            | <i>Cambarus tuckasegee</i>     | SR   | S1, G1  |                                       | X                                   |   |
| North Carolina Spiny Crayfish         | <i>Orconectes carolinensis</i> | SC   | S4, G3  | X                                     | X                                   |   |
| No common name until status finalized | <i>Orconectes sp. 1</i>        | SR   | S2?, G?   |                                       | X                                   |   |
| Chowanoke Crayfish                    | <i>Orconectes virginiensis</i> | SC   | S3, G3  | X                                     | X                                   |   |
| Edisto Crayfish                       | <i>Procambarus ancylus</i>     |  | S3, G4G5  |                                       |                                     | Distribution very uncertain, mostly because of taxonomic difficulties |
| Santee Crayfish                       | <i>Procambarus blandingii</i>  |  | S3S4, G4  |                                       |                                     | Distribution very uncertain, mostly because of taxonomic difficulties |
| Waccamaw Crayfish                     | <i>Procambarus braswelli</i>   | SC   | S2S3, G2G3  | X                                     | X                                   |   |
| Tar River Crayfish                    | <i>Procambarus medialis</i>    |  | S2, G3  |                                       | X                                   |   |
| Croatan Crayfish                      | <i>Procambarus plumimanus</i>  | SR   | S3, G4  | X                                     |                                     |   |

Note: See Table Key on page 27

**Table 2.13.** Freshwater snail species prioritized for conservation in North Carolina. *The Species Review process was not an effective tool for prioritizing snails species because we know so very little about the taxa as a whole that the criteria could not be assessed. We relied on listing status, the Natural Heritage program ranks, and expert opinion to determine priority snail species.*

| Common Name           | Scientific Name                | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> | Additional Information <sup>5</sup>    |
|-----------------------|--------------------------------|--|---|--|
| Waccamaw Snail        | <i>Amnicola</i> sp.            | SC   | S1, G?  |  |
| Waccamaw Siltsnail    | <i>Cincinnatia</i> sp.         | SC   | S1, G?  |  |
| Christy's Elimia      | <i>Elimia christyi</i>         | E  | S1, G1  | Previously know by <i>E. interputa</i> |
| Blackwater Ancyloid   | <i>Ferrissia hendersoni</i>    | SC   | S1, G5  |  |
| Greenfield Rams-horn  | <i>Helisoma eucosmium</i>      | E  | S1, G1Q   |  |
| Seep Mudalia          | <i>Leptoxis dilatata</i>       | T  | S1, G2?   |  |
| Smooth Mudalia        | <i>Leptoxis virigata</i>       | SR   | SU, G2  |  |
| Magnificent Rams-horn | <i>Planorbella magnifica</i>   | E  | S1, G1  |  |
| Panhandle Pebblesnail | <i>Somatogyryus virginicus</i> | SR   | S1?, G1G2   |  |
| Rotund Mysterysnail   | <i>Viviparus intertextus</i>   | SR   | S2?, G3G4   |  |

**Table 2.14.** Extirpated species, experimental populations, and/or species with questionable distributions in North Carolina. *For those reasons, the species were not included in the priority listings by habitat or river basin (Chapters 5A and 5B).*

| Group                  | Common Name                        | Scientific Name                   | NC Status <sup>1</sup><br>(Federal Status) | Natural Heritage Program State and Global Rank <sup>2</sup> |
|------------------------|------------------------------------|-----------------------------------|--|---|
| <b>Birds</b>           | Ivory-billed Woodpecker            | <i>Campephilus principalis</i>    | (E)  | SX, GH  |
|                        | Carolina Parakeet                  | <i>Conuropsis carolinensis</i>    |  | SX, GX  |
|                        | Passenger Pigeon                   | <i>Ectopistes migratorius</i>     |  | SX, GX  |
| <b>Mammals</b>         | American Bison                     | <i>Bos bison</i>                  |  | SX, G4  |
|                        | Gray Wolf                          | <i>Canis lupus</i>                |  | SX, G4  |
|                        | Red Wolf (experimental population) | <i>Canis rufus</i>                | SR (E- XN)                                 | S1, G1  |
|                        | Elk (experimental population)      | <i>Cervus canadensis</i>          | SC   | S1, G5  |
|                        | North American Porcupine           | <i>Erethizon dorsatum</i>         |  | SX, G5  |
|                        | Snowshoe Hare                      | <i>Lepus americanus</i>           |  | SX, G5  |
|                        | Fisher                             | <i>Martes pennanti</i>            |  | SX, G5  |
|                        | Eastern Cougar                     | <i>Puma concolor cougar</i>       | E (E)                                      | SH, G5TH  |
| <b>Mussels</b>         | Oyster Mussel                      | <i>Epioblasma capsaeformis</i>    | EX (E)                                     | SX, G1  |
|                        | Cumberland Moccasinshell           | <i>Medionidus conradicus</i>      | EX   | SX, G3G4  |
|                        | Kidneyshell                        | <i>Ptychobranthus fasciolaris</i> | EX   | SX, G4G5  |
|                        | Pimpleback                         | <i>Quadrula pustulosa</i>         | EX   | SX, G5  |
|                        | Purple Lilliput                    | <i>Toxolasma lividus</i>          | EX   | SX, G2  |
|                        | Pistolgrip                         | <i>Tritogonia verrucosa</i>       | EX   | SH, G4  |
| <b>Freshwater fish</b> | Lake Sturgeon                      | <i>Acipenser fulvescens</i>       | SC   | SX, G3G4  |
|                        | Longear Sunfish                    | <i>Lepomis megalotis</i>          | EX   | SX, G5  |

Note: See Table Key on page 27

## Table Footnotes

1 NC Status – Endangered (E); Threatened (T); Special Concern (SC); Significantly Rare (SR), Extirpated (EX). E, T, and SC status species are given legal protection status by the NC Wildlife Resources Commission.

SR status is defined as any species which has not been listed by the NC Wildlife Resources Commission as Endangered, Threatened, or Special Concerns species, but which exists in the state in small numbers and has been determined by the NC Natural Heritage Program to need monitoring. Extirpated species are no longer believed to occur in the state. Federal status is indicated in parentheses.

2 A measure of rarity and threat status, used here as a metric of population abundance (rankings and information below taken from LeGrand and Hall 2001, then updated with LeGrand et al., 2004):

### State rank

- S1** (1–5 extant populations): Critically imperiled in North Carolina because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from North Carolina.
- S2** (6–20): Imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from North Carolina.
- S3** (21–100): Rare or uncommon in North Carolina.
- S4** (100–1000): Apparently secure in North Carolina, with many occurrences
- S5** (1000+): Demonstrably secure in North Carolina and essentially ineradicable under present conditions.
- SA** (1–?): Accidental or casual; one to several records for North Carolina, but the state is outside the normal range of the species.
- SH** (0?): Of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years, and suspected to still be extant.
- SR** (--): Reported from North Carolina, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.
- SX** (0): Apparently extirpated from North Carolina.
- SU** (--): Possibly in peril in North Carolina but status uncertain; need more information
- S?** (--): Unranked, or rank uncertain
- \_B** (1–?): Rank of breeding population in the state. Used for migratory species only.
- \_N** (1–?): Rank of non-breeding population in the state. Used for migratory species only.
- \_Z** (1–?): Population is not of significance conservation concern

### Global rank - applies to the status of a species throughout its range, and based on data on the species' status range wide.

- G1** (1–5 extant populations): Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction.
- G2** (6–20): Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range.
- G3** (21–100): Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range.
- G4** (100–1000): Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5** (1000+): Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GH** (0?): Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.
- GX** (0): Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered.
- GU** (--): Possibly in peril range-wide, but status uncertain; need more information
- G?** (--): Unranked, or rank uncertain
- G\_Q** (--): Questionable taxonomic assignment.
- T\_** (--): The rank of a subspecies or variety.

3 Species Review data indicated population trend concerns ranging from, at minimum, a perceived population decline, to Endangered status.

4 Species Review data indicated knowledge level deficiencies as summed across three metrics: knowledge of population status (P), knowledge of distribution (D), knowledge of limiting factors affecting the species (F).

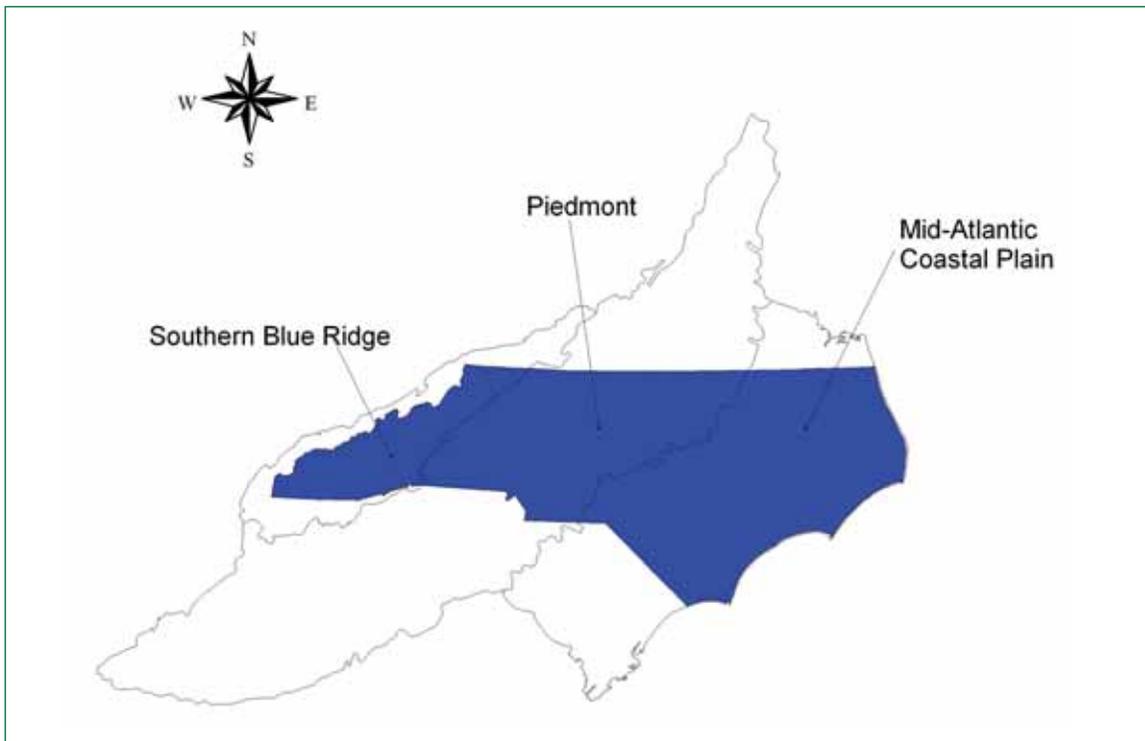
5 Additional information, including population focus, pending status recommendations, and/or reasons for inclusion of species added during the final review phase of the prioritization process (meaning those that did not have an 'X' in the 'Population' or 'Knowledge' columns).

CP = Coastal Plain populations ; P= Piedmont populations ; M= Mountain populations (Southern Blue Ridge)

## Habitats and River Basins

Employing a fine-filter/coarse-filter approach, we felt it appropriate to not only develop a set of species priorities, but to ensure that habitat-scale conservation priorities were an integral part of our Plan (indeed, we use habitat-scale approaches more often than species-specific approaches in order to accomplish conservation at a landscape level). So once we identified our set of priority species, we asked experts from each taxonomic committee to supply habitat association or river basin distribution information for each species on the list. Designations were identified in the following manner:

A NC Natural Heritage Program report (2001), developed from the *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990), was used as the basis for terrestrial habitat designations. Through Technical Committee feedback, designations were modified to improve the scale and specificity of particular habitats with respect to the conservation needs addressed in the Plan. This resulted in a total of 23 habitat types. A crosswalk was developed between these designations and the 1992 NC Gap Analysis Program (NC GAP) land cover classification in order to standardize habitat labels for mapping purposes (Appendix F). Habitats were linked to ecoregions using designations based on Bailey (1995) (Figure 2.2, Table 2.15). Appendix G indicates habitat associations for priority terrestrial species by taxonomic group. (See Chapter 5A for more on this topic).



**Figure 2.2.** Ecoregional designations according to Bailey (1995) (data source: NC GAP).

**Table 2.15.** Terrestrial habitat, river basin, and coastal habitat designations.

|   |   | Ecoregion                  |          |                     |
|---|---|----------------------------|----------|---------------------|
|   |   | Mid-Atlantic Coastal Plain | Piedmont | Southern Blue Ridge |
| Terrestrial habitats                    | Beach/dune                                      | X                          |          |                     |
|   | Estuarine communities                           | X                          |          |                     |
|   | Maritime forest/shrub                           | X                          |          |                     |
|   | Tidal swamp forest and wetlands                 | X                          |          |                     |
|   | Nonalluvial mineral wetlands                    |                            | X        |                     |
|   | Small wetland communities                       | X                          | X        |                     |
|   | Wet pine savanna                                | X                          |          |                     |
|   | Pocosin   | X                          |          |                     |
|   | Dry longleaf pine forest <sup>4</sup>           | X                          | *        |                     |
|   | Lakes and reservoirs                            | X                          | X        |                     |
|   | Riverine aquatic communities                    | X                          | X        | X                   |
|   | Floodplain forest                               | X                          | X        | X                   |
|   | Early successional                              | X                          | X        | X                   |
|   | Oak forest (& mixed hardwoods/pine)             | X                          | X        | X                   |
|   | Dry coniferous woodlands                        | X                          | X        | X                   |
|   | Mesic forest                                    | X                          | X        |                     |
|   | Low elevation cliffs/rock outcrops <sup>4</sup> |                            | *        | X                   |
|   | High elevation rock outcrops                    |                            |          | X                   |
|   | Caves and mines                                 |                            |          | X                   |
|   | Bogs and associated wetlands <sup>4</sup>       |                            | *        | X                   |
| Cove forest                             |   |                            | X        |                     |
| Northern hardwoods                      |   |                            | X        |                     |
| Spruce-fir forest                       |   |                            | X        |                     |
| River basins                            | White Oak                                       | Catawba                    |          |                     |
|   | Lumber  | Broad                      |          |                     |
|   | Chowan  | Savannah                   |          |                     |
|   | Pasquotank                                      | New                        |          |                     |
|   | Tar-Pamlico                                     | Watauga                    |          |                     |
|   | Neuse   | French Broad               |          |                     |
|   | Cape Fear                                       | Little Tennessee           |          |                     |
|   | Roanoke   | Hiwassee                   |          |                     |
|   | Yadkin-PeeDee                                   |                            |          |                     |
| Coastal (estuarine and marine) habitats | Water column                                    |                            |          |                     |
|   | Shell bottom                                    |                            |          |                     |
|   | Submerged aquatic vegetation                    |                            |          |                     |
|   | Wetlands  |                            |          |                     |
|   | Soft bottom                                     |                            |          |                     |
|   | Ocean hard bottom                               |                            |          |                     |

<sup>4</sup>Some habitats are found at the periphery of or in scattered locations within a second ecoregion not designated in the table above. To reduce redundancy, we have simply made note of these instances within the text of the primary habitat section and we have indicated that recommendations therein would apply to the habitat, wherever it is found. A (\*) indicates additional ecoregion(s) where the habitat can be found.

River basins served as the organizing theme for aquatic species (Table 2.15). Designations are based on the NC Division of Water Quality boundaries. Basin distributions were identified for all priority aquatic species. Appendix H indicates river basin distributions for priority aquatic species by taxonomic group. (See more about this in Chapter 5B).

Estuarine and marine habitat designations (referred to in detail within Chapter 5C), are based on the habitats included in the Coastal Habitat Protection Plan (Street et al., 2004) (Table 2.15).

## References

- Bailey, R. G. 1995. Descriptions of the ecoregions of the United States. Report #1391. U.S. Department of Agriculture, Forest Service.
- Hunter, W. C., M. F. Carter, D. N. Pashley, and K. Barker. 1993. The Partners in Flight species prioritization scheme. Pages 109–171 *in* Status and management of neotropical migratory birds. U.S. Forest Service General Technical Report, RM 229.
- LeGrand, H. E. and S. P. Hall. 2001. 2001 Natural Heritage Program List of the Rare Animal Species of North Carolina. N.C. Department of Environment and Natural Resources, Natural Heritage Program, Raleigh, NC.
- LeGrand, H. E., S. E. McRae, S. P. Hall, and J. T. Finnegan. 2004. Natural Heritage Program list of the rare animal species of North Carolina. N.C. Department of Environment and Natural Resources, Natural Heritage Program, Raleigh, NC.
- Millsap, B. A., J. A. Gore, D. E. Runde, and S. I. Cerulean. 1990. Setting priorities for the conservation of fish and wildlife species in Florida. *Wildlife Monographs* 54:1–57.
- N.C. Natural Heritage Program (NCNHP). 2001. Descriptions of the biological themes of North Carolina, 2nd edition. N.C. Department of Environment and Natural Resources, Raleigh, NC.
- Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. N.C. Department of Environment and Natural Resources, Natural Heritage Program, Raleigh, NC.
- Street, M. W., A. S. Deaton, W. S. Chappell, and P. D. Mooreside. 2004. Coastal habitat protection plan. N.C. Department of Environment and Natural Resources, Division of Marine Fisheries, Morehead City, NC.