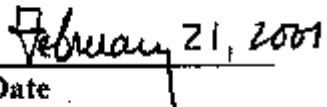


**MANAGEMENT PLAN**  
**FLATWOODS SALAMANDER**

*Ambystoma cingulatum*

February 21, 2001

  
\_\_\_\_\_  
Approved

  
\_\_\_\_\_  
Date

Florida Fish and Wildlife Conservation Commission  
620 South Meridian Street  
Tallahassee, Florida 32399-1600

# MANAGEMENT PLAN FLATWOODS SALAMANDER

February 21, 2001

## EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) proposes to add the flatwoods salamander, *Ambystoma cingulatum*, to the Species of Special Concern list with a prohibition of direct take except through permit authorized by the executive director or his delegate. Rule 68A-1.004, Florida Administrative Code (F.A.C.), defines “direct take” as “intentionally pursuing, hunting, capturing, killing, or destroying fish or wildlife or the nests, eggs, homes, or dens of fish or wildlife.” Since the proposed rule imposes fewer restrictions on land use than the federal listing of the flatwoods salamander as a threatened species (U.S. Fish and Wildlife Service [USFWS] 1999), and since the state permit required for direct take is a no cost permit, FWC does not anticipate any economic impacts to any affected parties as a result of management plan implementation. If the rule is not implemented, the potential exists for the flatwoods salamander to become increasingly imperiled.

Previous FWC listing actions invoked criticism from both the conservation and development communities for the lack of a clear statement of required management necessary to conserve and protect the species. This management plan presents (1) an assessment of the threats believed to be responsible for the flatwoods salamander’s apparent status as a Species of Special Concern, (2) an identification of the conservation goal and objective targeted by the management plan, and (3) the recommended conservation actions, FWC regulations, and incentives whose implementation would help attain that goal and objective. The plan also outlines a monitoring plan to assess flatwoods salamander status, an implementation strategy for the management plan, and areas for future research.

The FWC conservation goal of restoring the flatwoods salamander to a level where the species does not meet the state criteria for listing as a Species of Special Concern would necessitate maintenance in perpetuity of at least 129 self-sustaining populations of flatwoods salamanders in Florida, each of which is verified by the presence of larvae at least once every 5 years. Strategies to achieve this conservation objective include (1) maintenance of the 38 known self-sustaining Florida populations where they currently occur, (2) locating additional extant populations, and (3) establishment of additional flatwoods salamander populations within the historic range of the species in Florida where habitat conditions are favorable but salamanders appear to have been extirpated.

This management plan fulfills the requirements of Rule 68A-27.0012, F.A.C. (Appendix 1) which went into effect June 29, 1999. The listing process for flatwoods salamander was triggered by FWC acceptance of a valid petition for listing action (Appendix 3) following its federal listing as Threatened by the USFWS (1999). The FWC assessed flatwoods salamander biological status in a Final Biological Status Report (Appendix 4). Based upon that report, in March 2000, the FWC determined that listing of the flatwoods salamander as a candidate for Species of Special Concern

designation was warranted and directed FWC staff to develop a species management plan for consideration during the March 29-30, 2001 FWC meeting.

Public comments and outside review were formally solicited and incorporated at several junctures during the listing process for flatwoods salamander. In addition to scientific peer review ("Expert Reviewer Contacts," Appendix 12), the following public comment periods were noticed in the Florida Administrative Weekly:

- (1) October 22 - December 6, 1999 to solicit information on the biological status of the flatwoods salamander to be considered during the development of the Final Biological Status Report,
- (2) May 12 - June 26, 2000 to solicit information on the conservation needs of the flatwoods salamander and any economic and social factors that should be considered in its management,
- (3) October 13 - November 28, 2000 to solicit public comment on the Draft Management Plan, including any information regarding the anticipated regulatory economic and social impacts of management plan implementation.

In addition, public comments were presented at the FWC meeting of March 29-31, 2000, when FWC reported its findings regarding the flatwoods salamander's biological status. The March 29-30, 2001 FWC meeting provides additional opportunity for public comment relative to the proposed listing action.

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## **SPECIES MANAGEMENT PLAN**

### **INTRODUCTION**

The flatwoods salamander (*Ambystoma cingulatum*) is a small-headed stocky salamander with a total adult length of about 5 inches which breeds in seasonally inundated isolated wetlands within pine flatwoods in the Southeastern Coastal Plain. Its historic range is from Alabama to South Carolina, including the Florida Panhandle and the Florida Peninsula as far south as Marion County. Recent surveys conducted within the historic range of the flatwoods salamander revealed apparent population declines due to decreases in population numbers, area of occupancy, extent of occurrence, and quality of habitat.

In 1999, the USFWS (1999) listed the flatwoods salamander as federally threatened, prompting the FWC to develop a petition (Appendix 3) to list it as threatened in Florida pursuant to Rule 68A-27.0012, Florida Administrative Code (F.A.C.) (Appendix 1). The FWC directed staff to assess flatwoods salamander biological status in a Final Biological Status Report (Appendix 4). Based upon that report, in March 2000, the FWC determined that listing of the flatwoods salamander as a candidate for Species of Special Concern designation was warranted and directed FWC staff to develop a species management plan for consideration during the March 29-30, 2001 FWC meeting. This management plan fulfills the requirements of Rule 68A-27.0012. Public comments and outside scientific review were solicited and incorporated at several junctures during this process.

The flatwoods salamander management plan includes (1) an assessment of the threats believed to be responsible for the flatwoods salamander's apparent status as a Species of Special Concern, (2) an identification of the conservation goal and objective targeted by the management plan, (3) the recommended conservation actions and FWC regulations and incentives whose implementation would help attain that goal and objective, (4) a monitoring plan to assess flatwoods salamander status, (5) an implementation strategy for the management plan, and (6) suggested areas for future research. The recommended conservation action section includes a "toolbox" of management practices to assist in the elimination or reduction of potential threats to flatwoods salamanders on public and private lands. Depending upon the specific conditions and history of a given site, landowners may find 1 or more of these conservation actions appropriate for the voluntary enhancement of the flatwoods salamanders on their lands.

### **DEFINITIONS**

The following glossary defines scientific terms as they pertain to flatwoods salamander assessment, conservation, and research described in this management plan.

<b>Population</b>	A group of individuals of the same species that occurs in a defined area at the same time and regularly interact or interbreed. Unless otherwise defined, for flatwoods salamanders, a population is defined as a group of individuals that regularly shares 1 or more breeding sites (ponds) separated by less than 2 miles. Animals at breeding sites farther apart are considered to be from separate populations.
<b>Florida Population</b>	All individuals of the species within the state of Florida.
<b>Range-wide Population</b>	All individuals of the species throughout the entire extent of its area of occurrence. For flatwoods salamanders, the range-wide population includes individuals found in Florida, Georgia, South Carolina, and Alabama.
<b>Metapopulation</b>	The aggregate of all neighboring populations that are close enough to allow occasional gene flow between them. Interactions should occur at least once per generation.
<b>Robust Population</b>	A group of interacting or interbreeding individuals that is believed to have a greater than average chance of long-term viability. For flatwoods salamanders, robust populations are those that use 3 or more breeding ponds and thus have a high likelihood of successfully breeding each year.
<b>Viable Population</b>	A stable, self-sustaining population with a high probability (e.g., more than 95%) of surviving for a long-term period (e.g., 100 years).
<b>Long-term</b>	An extended period of time relative to the life span of individuals in a population. Length is based on commonly used viability procedures and practicality, but is typically at least 100 years.
<b>Area of Occupancy</b>	The geographic area inhabited by all individuals in a population. Typically, the area of suitable habitat in which individuals are known to occur.
<b>Extent of Occurrence</b>	The geographic area encompassing all locations of individuals of a species, including intervening areas of unoccupied habitat. Synonymous with range.
<b>Known Population</b>	Population where larvae have been verified within the past 5 years.

## THREAT ASSESSMENT

FWC staff undertook an assessment of the underlying cause(s) of apparent population declines in flatwoods salamanders as a necessary precursor to the design and implementation of effective conservation measures. First, FWC staff identified the population parameters which put the species at risk. The criteria used to distinguish species as Endangered, Threatened, or Special Concern are listed in the definitions in Rule 68A-1.004 (F.A.C.) (Appendix 2). The Final Biological Status Report (Appendix 4) specified 3 criteria underlying the proposed designation of the flatwoods salamander as a Species of Special Concern.

1. **Population reduction.**—There is a suspected reduction of at least 20% (as compared to 50% for Threatened) over the last 10 years based on (a) possible decline in occurrence of breeding sites of 64.5% during previous 50-year period, (b) inferred 60-80% loss of original pine flatwoods habitat, and (c) likely decline in habitat availability or quality of at least 20% in the last 10 years.
2. **Extent of occurrence, area of occupancy.**—The flatwoods salamander's extent of occurrence is unclear, but may be less than 7,700 square miles (which still exceeds the 2,000 square miles threshold for listing as Threatened). Its area of occupancy is estimated to be less than 770 square miles (but more than the 200 square miles threshold for Threatened) based on surveys, and (a) its populations are severely fragmented, with 52 isolated populations known range-wide, including 38 populations known from 12 counties in Florida (Palis 1997b, Means 1998, USFWS 1999); (b) although extensive surveys are badly needed, at present extant populations are not known from 4 historically occupied counties in Northeast Florida (Bradford, Alachua, Marion, Duval) nor from Escambia and Gulf counties in the Panhandle, and several historic sites in Calhoun and Jackson counties in the Panhandle are believed to no longer support populations; and (c) continuing declines in habitat availability and quality will likely continue to reduce the area of occupancy, the number of occupied locations, and the number of mature individuals throughout the current range.
3. **Population size and trend.**—The total range-wide population of flatwoods salamanders is estimated to number fewer than 10,000 mature individuals (but more than the 2,500 threshold for Threatened). In addition, it is reasonable to estimate that continuing declines in habitat availability and quality will produce a continuing population decline of at least 10% within 10 years (as opposed to 20% over 5 years for Threatened).

The second assessment step involved an examination of threat factors potentially giving rise to the apparent population declines in flatwoods salamanders. The following threat factors have been

proposed by 1 or more researchers although specific data demonstrating cause and effect for flatwoods salamander declines due to these threats are generally lacking, and further research is warranted.

1. **Loss and degradation of pine flatwoods and savanna habitat due to development for silviculture**, especially through the following practices.
  - a. **Ditching and bedding**, which (1) alter the hydrology, dropping the ground water table and possibly increasing the period of time salamanders must remain in burrows, especially in the dry season, probably reducing overall activity including feeding; (2) may present physical barriers to salamander movement and reproduction; (3) reduce the hydroperiod of the breeding site, thereby limiting the number of successful metamorphs; (4) destroy burrows and underground structure; (5) cause direct mortality to highly vulnerable fossorial salamanders (Ashton and Ashton 1988; Ashton 1992, pers. commun.; Means et al. 1996; Palis 1997b, pers. commun.; Semlitsch pers. commun.; Jensen pers. commun.; LaClaire pers. commun.)
  - b. **Mechanical damage to soil from heavy machinery**, including roller chopping, in both breeding ponds and terrestrial ranges, which destroys burrow complexes, alters soil structure, reduces native groundcover, opens habitat for invasion by weedy plant species, possibly alters the hydrology, and causes direct mortality to highly vulnerable fossorial salamanders (Ashton pers. commun., Jensen pers. commun.)
  - c. **Firebreaks**, which are often tied in to wetlands, and which provide similar impacts as bedding, reducing the hydroperiod and presenting untenable sites for egg deposition (Printiss and Hipes 2000)
  - d. **Fire suppression and reliance on winter burns**, which increase the dominance of woody plants at the expense of the heliophilic groundcover, grasses, and forbs; woody plants shade herbaceous layer, reduce available soil moisture, decrease hydroperiod and hasten successional filling of the pond, shortening its lifetime as a useful breeding site; reduction of peat buildup is prevented, increasing water acidity and thus impacting development of eggs and larvae; also, migrating salamanders may be vulnerable to winter burns (Palis 1997b, Jensen pers. commun., Ashton pers. commun.)
  - e. **High stand density**, which reduces sunlight, increases leaf litter, and eventually eliminates native groundcover species which may be important for providing microhabitat and supporting a prey base for salamanders (Means et al. 1996)
  - f. **Application of herbicides and pesticides**, which may cause direct mortality, or reduce prey populations and groundcover (Ashton 1992, Palis 1993, Palis and Walker 1993, Palis 1997b)
  - g. **Fertilization of pine plantations**, which can cause algal blooms that produce anoxic conditions in breeding ponds (Palis 1993, Palis and Walker 1993, Palis 1997b)



## CONSERVATION GOALS AND OBJECTIVES

### Conservation Goal for Flatwoods Salamander

Given knowledge of current population status and the threats underlying apparent population decline, it should be possible to set a scientifically defensible, reasonable, and explicit conservation goal for flatwoods salamanders in Florida. However, until more extensive surveys are conducted throughout the range (both known and potential range) of the flatwoods salamander so that comprehensive reliable information is available on its range-wide status, the FWC must necessarily proceed with caution in stating its goals and objectives. **The most ambitious or optimistic conservation goal, and the one toward which this management plan is primarily aimed, is to secure a stable (or increasing) Florida population of the flatwoods salamander at levels above the threshold defining a Species of Special Concern.** If that goal were met, the FWC could determine that removing the flatwoods salamander from the Species of Special Concern list was warranted.

On the other hand, if surveys fail to document any additional occupied or suitable habitat, the FWC may be forced to reassess and select a less optimistic goal of maintaining the Florida populations of the flatwoods salamander at its current levels as a Species of Special Concern. The absolute minimum conservation goal would be to ensure that the flatwoods salamander's status does not decline to the extent that it fulfills the criteria defining a Threatened species.

### Conservation Objective for Flatwoods Salamander

To further focus conservation efforts, and to facilitate assessment of progress toward the conservation goal, a single, highly measurable objective was derived for the flatwoods salamander. Restoration of flatwoods salamander populations to a level where the species does not meet state criteria for listing as a Species of Special Concern would necessitate **maintenance, in perpetuity, of at least 129 self-sustaining populations of flatwoods salamanders in Florida, each of which is verified by the presence of larvae at least once every 5 years.**

This objective addresses multiple criteria for attainment of the conservation goal and makes use of the most easily observed life stage of the flatwoods salamander, the larvae. Although much remains to be learned about flatwoods salamander population dynamics, the successive presence of larvae is sufficient to identify a persistent population. The subjective 5-year monitoring interval is less demanding than an annual interval, and should accommodate natural fluctuations in reproductive success. Extant populations are relatively unambiguous units of concern that can easily be counted to determine success in achieving the objective.

The numerical component of this objective is based upon assumptions regarding the distance individual salamanders move to and from breeding sites, the resulting acreage of habitat used by the average population, and how many of such populations Florida would need to sustain in order to meet its area of occupancy requirement to exceed Species of Special Concern status. More and better data that modify these assumptions will in turn enable the FWC to fine-tune this conservation objective (i.e., revise the target number of populations up or down). Assuming that the other states where flatwoods salamanders are or were found (Georgia, South Carolina, Alabama) implement similar conservation efforts for their populations, Florida's goal of at least 129 healthy, self-sustaining populations would constitute 73% of the 177 populations postulated to be needed range-wide in order to satisfy the 770-square-mile area of occupancy criterion associated with the listing as Species of Special Concern. Should the assumption of other states' efforts be unmet, Florida's targets would be modified accordingly.

This is a daunting but perhaps not unreachable objective. Florida is presently known to have 38 geographically disjunct populations in 12 counties (Appendix 7), including some that are obviously robust, using multiple ponds as breeding sites, as well as others that are based solely on the capture or observation of a single individual. Twenty-two of these populations, including the 3 largest, are located on 9 parcels of publicly owned land in 8 counties; the remainder are on private land (Appendix 8). Recent surveys (Palis 1997b) failed to find flatwoods salamanders on at least 30 sites where they had been recorded historically (defined by Palis as pre-1990), although these surveys were not necessarily exhaustive. Twelve of these historic sites were in 6 counties (Alachua, Bradford, Duval, Escambia, Gulf, and Marion) where no extant populations are known. In addition, cursory surveys (Palis 1993) identified at least 9 additional public lands in 7 counties where increased survey efforts may locate additional, but as yet unknown, populations. Although no historic sites are known from there, Ashton (pers. commun.) suggests that Hamilton County may still have sites with high potential for flatwoods salamanders, albeit many fewer than indicated in 1969 aerial photos.

### **Derivation of the Conservation Objective**

FWC staff arrived at the proposed conservation objective after careful consideration of the Species of Special Concern listing criteria. To be considered a Species of Special Concern, a species needs to meet only 1 of the 5 alternative criteria, listed as (a) through (e) in Appendix 2. However, to exceed the threshold for designation as a Species of Special Concern, it would have to be ascertained that the flatwoods salamander met or exceeded all of the criteria. The scientific basis for setting the conservation objective at the level of at least 129 known populations in Florida derives from a mathematical application of the criteria to existing data on flatwoods salamander habitat and life history.

As discussed in the Final Biological Status Report (Appendix 4), population data are generally lacking for the flatwoods salamander. Much of the status assessment was inferred from habitat trend

data, the key assumption being that the flatwoods salamander population in Florida has likely undergone a reduction in population numbers and distribution commensurate with the documented decline in available, suitable habitat. Since detection and census of adult flatwoods salamanders is nearly impossible on a state-wide scale, the most direct method of determining population status, and detecting changes in population status, is to monitor numbers of known populations. Appendix 9 presents a complete discussion of the scientific basis for the conservation objective and its feasibility with respect to each of the 5 listing criteria. The main points can be summarized as follows:

1. **A population reduction of less than 20% either over the last 10 years or projected within the next 10 years is inferred from the trend in flatwoods salamander habitat conversion and degradation.** To assess population status and trend directly, data on the number of known, persistent populations will have to be collected over a sufficient time interval.
2. **Due to its dependence on isolated wetlands in a landscape that has already been fragmented, it is apparent that the flatwoods salamander's distribution range-wide is highly discontinuous, and could be defined as "severely fragmented." Also, it is to be expected that amphibian population numbers fluctuate dramatically from year to year due to differences in amount and duration of precipitation.** Against this background of natural fluctuations, one could define a robust population as one known to be using 3 or more breeding sites, hence potentially having a reduced likelihood that extreme fluctuations will cause local extinction.
3. **The flatwoods salamander's extent of occurrence already appears to span well over 7,700 square miles range-wide (i.e., including other states as well as Florida).** This area would equal a square about 88 miles on the side, or about 13% of Florida's total area of 58,560 square miles. The Florida range maps given in Ashton (1992) and in Petranka (1998) show a suspected gap in distribution between Panhandle and Northeast Florida populations, but the implied total geographic range on each of those maps would still exceed 7,700 square miles.
4. **At an average of 4.36 square miles per population (231 divided by 53), the minimum target area of occupancy of 770 square miles would contain 177 flatwoods salamander populations range-wide (i.e., including other states as well as Florida).** The 770 square mile area would equal a square about 28 miles on the side, or about 1.3% of Florida's total area. The amount of habitat actually used by a flatwoods salamander population includes the breeding pond or ponds and the associated surrounding flatwoods. Ashton (1992) reported on individuals that traveled up to 1 mile from their breeding pond. Assuming that such movements occur in most flatwoods salamander populations (Appendix 11), a population's minimum habitat requirements could be defined as that area around the pond extending 1 mile from the wetland edge. Therefore, a population using only 1 breeding pond would need a minimum of

3.14 square miles (the area of a circle  $A = \pi r^2$  with radius  $r = 1$  mile), but one could postulate that a population using 2 ponds would need less than double the amount needed for 1 pond, perhaps 5 square miles; 3 ponds - 7 square miles, and so on. Using these conventions (Moler pers. commun.), the total area of occupancy for the 53 known populations range-wide is 231 square miles, resulting in an average of 4.36 square miles per population (231 divided by 53). Using the postulated average area occupied by a population as a "unit" of area of occupancy, a minimum of 124 additional populations (covering 539 square miles) need to be found or restored range-wide. Florida has about 73% of the known populations (38; Appendix 7), so to achieve its share of the target area of occupancy, Florida should have a total of 129 known populations ( $0.73 \times 177$ ).

5. **The Final Biological Status Report suggested that the sum of all populations range-wide is between 2,500 and 10,000 mature individuals, and it seems reasonable that if an additional 124 self-sustaining populations were found or created one could safely assume the total population consisted of more than 10,000 mature individuals.** The 3 largest populations known (all in Florida: 1 using 21 ponds on Eglin Air Force Base [AFB], 2 using 10 ponds each on Apalachicola National Forest [NF]) probably contain at least 1,000 mature individuals each, although supporting data are lacking at present. If the target threshold of 10,000 individuals were distributed evenly among the 177 populations postulated (53 known + 124 new) above, the average population would contain 56 mature salamanders, which may be reasonable based on known numbers of adults in other populations that have been sampled. The long-term investment of equipment and personnel necessary to actually census the number of adults would make this prohibitively expensive to pursue at more than a handful of populations. Therefore, rather than counting individuals, FWC staff believe it is more reasonable to assume that each self-sustaining population supports at least 56 adults, and to use the count of self-sustaining populations to infer that the target of 10,000 mature salamanders is met.
6. **Current information estimates of population size and distribution suggest that the flatwoods salamander does not meet the criterion for a very small population nor is it acutely restricted.** Current estimates place the population size at above 1,000 mature individuals, with an area of occupancy greater than 40 square miles and the number of locations greater than 5.
7. **Available data are not sufficient to permit estimation or modeling of the probability of extinction of flatwoods salamanders in the wild.** Population demography, habitat association, and other studies would be necessary to yield appropriate data for population modeling, but such studies would be prohibitively expensive and take away from more direct conservation actions. Accordingly, FWC staff believe it is prudent to accept that this criterion

cannot be addressed at this time, and rely instead on counts of self-sustaining populations as an empirical measure of status.

### **Strategies to Achieve the Conservation Objective**

As previously stated, restoration of flatwoods salamander populations to a level where the species does not meet state criteria for listing as a Species of Special Concern would necessitate maintenance, in perpetuity, of at least 129 self-sustaining populations of flatwoods salamanders in Florida, each of which is verified by the presence of larvae at least once every 5 years. Extensive and intensive efforts will be required to (1) survey known and potential flatwoods salamander populations on both public and private lands, (2) implement management actions to enhance their long-term viability, (3) establish a long-term monitoring schedule for periodic range-wide status assessment, and (4) conduct needed research to further enhance our ability to conserve this species. Completion of these tasks cannot be accomplished by the FWC alone, but will require partnerships with public and private land managers.

FWC staff identified 3 key strategies required to achieve the conservation objective. These strategies, listed in priority order of implementation, are as follows:

1. **Maintain the 38 self-sustaining populations where they currently occur.**
  - a. Establish a Memorandum of Agreement (MOA) with the USFWS regarding the role of each agency in coordinating and monitoring work on existing populations on federal, state, local government, and private lands.
  - b. Conduct systematic surveys of each population to map extent of occurrence and number of breeding ponds used by that population.
    - i. The FWC will implement or oversee surveys on sites where it is the lead according to the MOA to the extent possible given budget and logistical constraints.
    - ii. The FWC will maintain a database of survey results.
  - c. Develop and implement a plan to maintain each population.
    - i. Prepare a threat assessment for each identified population, identifying needs and opportunities for habitat management or restoration (see Recommended Conservation Actions below).
    - ii. FWC will implement or oversee implementation of plans on sites where it is the lead according to the MOA to the extent possible given budget and logistical constraints.
  - d. Establish and implement a long-term monitoring plan for each population to confirm persistence.

2. **Locate additional extant populations.**
  - a. Establish a MOA with the USFWS regarding the role of each agency in coordinating flatwoods salamander surveys on federal, state, local government, and private lands where landowners willingly grant access to their property.
  - b. Identify and rank, according to likelihood of occupancy, potential sites where flatwoods salamanders might occur.
  - c. Conduct systematic surveys to confirm status on sites of potential occurrence, with highest emphasis on sites where occurrence is most likely.
  - d. Manage sites where occupancy is confirmed according to Strategy 1.
  
3. **Establish flatwoods salamanders (at the number of sites necessary to achieve the population objective) within the historic range of the species where habitat conditions are favorable but salamanders appear to have been extirpated.**
  - a. Identify suitable candidate recipient sites, in conjunction with the surveys called for under Strategy 2.
  - b. Conduct research at sites currently occupied by populations to identify likely macro- and micro-habitat features necessary for the species to thrive.
  - c. Conduct research to identify best options for translocating salamanders for stocking, including identification of best candidate donor sites (using information gathered under Strategy 1).
  - d. Evaluate candidate sites according to findings from research under Strategy 3b.
  - e. Establish clear numerical objectives by which to evaluate the success of each re-establishment attempt.
  - f. Conduct experimental translocations in an adaptive management context, with thorough monitoring relative to the objectives established under Strategy 3e.
  - g. Manage sites where establishment is successful under Strategy 1.

Although FWC staff consider Strategy 3, re-establishment of flatwoods salamanders within the historic range, to be a critical component of conservation objective achievement, it should be undertaken with caution. Dodd and Seigel (1991) determined that most relocation, repatriation, and translocation (RRT) projects involving amphibians and reptiles have not proven successful. They warn against undertaking an RRT project unless (1) causes of the species' decline are known and have been eliminated; (2) the species' biological (habitat, demographic, and biophysical) constraints are fully understood; (3) consideration has been given to population genetics, including minimum viable population size, and social structure; and (4) there will be commitment to the long-term monitoring of marked individuals to establish the success or failure of the project.

## **RECOMMENDED CONSERVATION ACTIONS**

## Proposed FWC Regulations

The federal listing package for the flatwoods salamander (USFWS 1999) provided guidance on the types of actions that would be considered prohibitions and exceptions (Appendix 5, see also Appendix 6). These federal prohibitions obviate the need to propose many state-level regulations. The FWC considers the following 2 rules sufficient to protect flatwoods salamanders while conservation efforts are underway to secure the species in Florida by (1) providing a legal basis, at the state level, for prosecuting deliberate take of individuals and populations consistent with Florida Statute 372.0725 (killing or wounding of any species designated as Endangered, Threatened, or Species of Special Concern), (2) regulating scientific collecting and research impacts, and (3) discouraging overt commerce.

1. **Listing of the flatwoods salamander, *Ambystoma cingulatum*, as Species of Special Concern.** This rule is the expected outcome of the current listing process.
2. **Prohibition of direct take of the flatwoods salamander, *Ambystoma cingulatum*, except through permit authorized by the executive director or his delegate.** This rule continues the prohibition of direct take automatically imposed in March 2000 when the FWC accepted the flatwoods salamander as a candidate species for listing. It will allow the FWC to maintain oversight on the research and management of the species, and give the FWC dual authority with the USFWS to review any actions that would result in the planned killing or collection of flatwoods salamanders.

## Management Actions

Accomplishment of the conservation objective requires wetland and upland flatwoods habitat of sufficient quality, connectivity, and availability to assure long-term survival and adequate distribution of the flatwoods salamander. There may be a variety of ways to attain this desired future condition in different parts of the species' range, depending on the particular history of the land in question and the tools at the disposal of the land manager. The following recommended management actions should be considered part of a land manager's "toolbox" for the maintenance or enhancement of Florida's statewide flatwoods salamander population. Recommended actions can be grouped into 6 categories: (1) inventory of extant populations across the Florida range, (2) maintenance of habitat quality where extant populations are verified, (3) restoration of habitat quality where historic populations no longer occur, (4) maintenance or restoration of landscape-level features, (5) re-establishment or establishment of flatwoods salamander breeding sites and populations, and (6) reduction of the impact of other potential threats.

Implementation of these actions should help secure the long-term survival of the flatwoods salamander in Florida, and result in a stable or increasing Florida population. A sufficient number of healthy, self-sustaining populations (ones using 3 or more breeding sites each) would be maintained or established to exceed the threshold criteria for Species of Special Concern.

1. **Inventory all appropriate habitat to verify known populations and identify previously unknown populations of flatwoods salamanders throughout the species' Florida range.**
  - a. Implement surveys and repeat surveys in appropriate potential habitat across North Florida, including counties where not previously recorded.
  - b. Establish geographically based conservation units to help guide survey and management efforts; a proposed scheme with 5 such units is presented in Appendix 10.
  - c. Prioritize populations on public lands for implementation of management actions.
  - d. Prioritize populations on private lands where landowners willingly allow access for implementation of management actions.
  
2. **Maintain pine flatwoods and savanna habitat where the species currently occurs through application of forestry techniques that are compatible with flatwoods salamander conservation.**
  - a. Apply the forestry practice guidelines as outlined in federal listing package (USFWS 1999, Appendix 4).
  - b. Maintain the integrity of the native groundcover and the soil through the application of fire and minimal use of soil disturbing techniques near known breeding ponds. As stands of off-site species such as slash pine (although slash or loblolly pine may be appropriate on-site species in some areas) mature, they should be thinned by burning or tree removal to provide an increasingly open condition needed to permit an herbaceous understory. Thinning and harvest should avoid activities that significantly disturb soil layers and subsurface hydrology, or cause soil compaction. After harvest of off-site species, replace with native, expected overstory species, which may be thinned by burning or tree removal as the stands mature.
  - c. Apply growing season fire in preference to winter burning for maintenance of native groundcover and hardwood reduction. However, the application of fire in any season, given appropriate moisture regime, is preferable to not burning.
  - d. Avoid poisoning of salamanders and their habitat by using only herbicides and other chemicals labeled for use in and around wetlands and that have a low toxicity for fish and wildlife. Foliar spraying, broadcast application, and banded treatments of herbicides, which pose a greater risk than hack-and-squirt and spot-grid applications of being absorbed through the skin of amphibians, should not be used within 1 mile of known breeding ponds between October and April, or when the soil is saturated.
  - e. Promote fire in wetlands by avoiding disturbance of the wetland-upland ecotone.

3. **Restore pine flatwoods and savanna habitat, including native groundcover and wetland breeding sites, through habitat restoration, especially through use of growing-season burns (May - September), in areas where flatwoods salamanders used to occur but do not now.**

- a. Restore the integrity of the native groundcover and the soil through the application of fire and minimal use of soil disturbing techniques. Apply growing season fire in preference to winter burning to restore and maintain native groundcover and reduce hardwood encroachment. However, the application of fire in any season, given appropriate moisture regime, is preferable to not burning. When the existing seedbed and the use of fire and other techniques are insufficient to restore native groundcover in disturbed areas, seeds or other stock from local areas and similar soil types should be used to hasten restoration.
- b. Burn through wetlands during the lightning season when they are dry or nearly dry, to promote a graminaceous ecotone, better larval habitat, and reduce acidity from the increasing buildup of peat. Although growing season burns are essential to maintain the natural character of the breeding ponds, initial and occasional winter burning may be required to reduce fuel loads in some areas. Effective restoration may also require the limited use of herbicides (labeled for use in wetlands) or machinery to knock down invading woody shrubs in a manner that will not disrupt the soil structure.
- c. Plant the native, expected species of pine in preference to off-site slash pine or other species at each site. Maintenance of the groundcover and soil is probably more important to salamanders than the identity of the overstory tree species, but it is important that the dominant canopy species be able to carry the fire essential to the habitat's long-term maintenance.
- d. Restore the natural hydrology to disturbed wetlands by removing berms, filling drainage ditches, and eliminating extensive drainage and ditching within 1 square mile of potential, but presently not used, breeding sites. No such restoration should be attempted for active breeding ponds that are successful but "unnatural" (i.e., the wetland has an appropriate hydroperiod due to the presence of ditches and dikes), as long as they continue to be used by flatwoods salamanders.

4. **Maintain or restore the landscape-level features that encourage natural metapopulation processes and genetic diversity and increase the likelihood of long-term survival of flatwoods salamander populations.**

- a. Maintain or restore the integrity of natural vegetation and associated habitats in terrestrial buffer zones to protect breeding sites (ephemeral isolated wetlands).
- b. Protect the integrity of ecological connectivity (i.e., stepping stone ponds with corridors of natural vegetation) among wetlands with a diverse array of hydroperiods in the landscape.

- c. Protect ephemeral isolated wetlands of all sizes important for amphibian reproduction. Persistence of wetlands as small as 0.1 ha or less are critical to long-term survival of flatwoods salamanders and other species.
  - d. Re-establish historic connections among known flatwoods salamander areas with corridors of appropriate habitat to facilitate gene exchange among populations.
5. **Re-establish or establish additional flatwoods salamander breeding sites and populations throughout its Florida range.**
- a. Re-establish extirpated populations in restored, formerly occupied sites, using animals from closest population on that side of Apalachicola River.
  - b. Establish new populations in suitable habitat within the extent of occurrence, but where extant populations are not presently known, using animals from closest population on that side of Apalachicola River.
6. **Reduce the impact of other potential threats to flatwoods salamanders.**
- a. Enforce regulations prohibiting trash dumping in or near breeding sites.
  - b. Do not allow damaging off-road vehicle use in or near breeding sites.
  - c. Reduce road mortality by providing drift fences or similar structures to guide migrating salamanders through appropriate under-road passages to and from breeding ponds.
  - d. Explore measures to minimize impact of crayfish harvest on flatwoods salamanders at known breeding sites.
  - e. Do not introduce predatory fish into temporary wetlands.

### **Proposed Incentives for Management Actions on Private Lands**

FWC staff investigated potential, existing incentives to promote the voluntary enhancement of flatwoods salamanders populations on private lands.

1. **Seek opportunities to obtain funds and other incentives to help private landowners conserve known or potential flatwoods salamander populations.** The Florida Forestry Stewardship Program or Stewardship Incentive Program (SIP) (Duryea et al. 1992) provides cost-sharing for development of a management plan, soil and water protection and improvement, wildlife habitat enhancement, and other forest management activities. Another program that offers cost-sharing for implementation of Best Management Practices, including enhancement of wildlife habitat, is the Environmental Quality Incentives Program (EQIP) (Olmstead et al. 1997).
2. **Explore adoption of a wildlife stewardship-type program involving flatwoods salamanders.** Such a program could be modeled after Georgia's Forestry for Wildlife

Partnership Program (FWP) (Georgia Department of Natural Resources 1998), which provides public recognition for those corporate forest landowners whose activities promote wildlife conservation, and habitat and species diversity on their lands. This program builds on the Sustainable Forestry Initiative (SFI) established by the American Forest and Paper Association (AF&PA 2000a, 2000b).

3. **Investigate opportunities available to private landowners with flatwoods salamanders to participate in federal incentive programs.** As part of the proposed process to develop a MOA with the USFWS regarding management of salamanders on federal land, the FWC will investigate the availability of federal funds that might be used as incentives for conservation of the species on private lands.
4. **Determine what federal requirements would need to be met to enter into a statewide Habitat Conservation Plan (HCP) for flatwoods salamanders.** Under such a plan, the state would maintain a specified population level of flatwoods salamanders in exchange for the delegation authority to issue permits for take resulting from land use practices.

### **Monitoring Plan**

The success of management actions undertaken for flatwoods salamander conservation can be measured through the periodic monitoring of extant salamander populations, as determined by the location and persistence of active breeding ponds. Due to the relative inconspicuousness of the flatwoods salamander, evaluation of its current status depends on repeated labor-intensive seasonal surveys. Two different types of surveys are used to assess presence of this species: (1) dipnetting for larvae, which are boldly striped and easily recognized, and (2) the capture-mark-recapture of adults, typically using drift fences and traps. Larval dipnetting is less time-consuming and involves less equipment, and is therefore the method better suited for broad scale assessment of flatwoods salamander presence. Use of drift fences is not suited for extensive surveys to determine presence at many different sites, and so is not recommended as a major component of this monitoring plan. However, drift fences and mark-recapture techniques are important research tools to address questions of population size and demography, timing of migration, migration distances, and habitat use.

Successful flatwoods salamander reproduction is greatly influenced by localized weather trends, particularly precipitation. Annual differences in amount or timing of rainfall may determine whether a given pond is used. Some sites that serve as breeding sites 1 year may not have larvae the next (Palis 1993); by the same token, failure to find larvae 1 season is not sufficient evidence to exclude a given pond from the suite of potentially important flatwoods salamander reproductive sites. Therefore, long-term monitoring of the reproductive success at each known breeding pond, as measured by the presence or absence of larvae, is the critical feature of this monitoring plan. The objective of the monitoring plan is to confirm the presence of larvae at least once every 5 years for each population.

The monitoring protocol proposes that 5 consecutive years of sampling without verified larval presence in at least 1 of a population's breeding ponds are required before a population is "written off." A population with verified presence of flatwoods salamanders needs to be monitored a minimum of once every 5 years, more often if changes in land use or other factors raise concerns about salamander persistence at that site. Demonstration that multiple proximal breeding ponds are being used indicates a population with an increased potential for long-term survival; that population might be able to persist even if 1 or more ponds become unsuitable.

Palis and Walker (1993) attempted to develop a standardized dipnetting sampling procedure, based on the number of dipnet sweeps expended before obtaining the first larva, as an index to categorize ponds by relative numbers of larvae. Although their results were not conclusive, it would be useful if breeding ponds eventually could be so ranked. Due to inherent difficulties (e.g., dense vegetation, high water, variations in dipnetting skill) sometimes associated with larval dipnetting, it has been suggested (D. Stevenson pers. commun.) that this technique be supplemented with the use of aquatic funnel trapping (using aluminum funnel traps without bait) and night visits to breeding sites (using flashlight to look for larvae stratifying in the water column) to increase the chances to verify larval presence.

The following variables will be monitored and assessed to detect change in flatwoods salamander population status.

1. **Number of known populations in Florida.** A known population is one where larvae have been verified within the past 5 years. This is the primary variable for assessing the status of the flatwoods salamander.
2. **Number of Florida counties with extant populations.** This is a coarse measure of status. Flatwoods salamanders are historically (pre-1990) known from 17 counties; currently they are known from only 12 counties.
3. **Number of known populations outside of Florida.** Periodic collaboration with other states using similar monitoring efforts for flatwoods salamanders could provide information indicating a change in the species' range-wide status.

If monitoring reveals that the following thresholds have been reached, FWC staff will recommend reassessment of population status.

1. **Verification of 129 or more Florida populations (occupying an area of about 562 square miles), with reproduction verified by the presence of larvae at least once in 5 years .** This would exceed the criteria for Species of Special Concern designation, given the assumption that an average population occupies about 4.36 square miles.

2. **Verification of only 33 or fewer known or potential Florida populations.** This would trigger a re-evaluation of the species' status for possible reclassification to Threatened status (0.73 x 46 populations occupying 200 square miles or less).
3. **Verification of at least 10,000 mature individuals range-wide, or at least 7,300 in Florida** which exceeds the criteria for Species of Special Concern.
4. **Verification of 1,825 or fewer mature individuals**, which may indicate Threatened status (0.73 x 2,500).
5. **Verification of change in status (increase or decrease) in other states.**

### Areas for Future Research

There are many facets of flatwoods salamander life history and ecology that remain poorly understood or are as yet unknown. Active pursuit of research on the following topics, and on others as they arise, is critical to our understanding of this species, and the results will help guide and refine recommended management actions.

1. **Salamander Movement and Upland Habitat Use.** Very few data exist on the movement of individual flatwoods salamanders (Appendix 11). This information is critical to demonstrating upland as well as pond use, designation of population size and boundaries (i.e., area of occupancy), determination of potential for gene exchange, and understanding metapopulation processes. As additional movement data are obtained, recommendations for habitat definition and protection may change.
2. **Systematics.** Molecular data support taxonomic splitting of *Ambystoma cingulatum* into 2 well-defined taxa east and west of the Apalachicola River (Pauly et al. 2000). Should further study validate such splitting, conservation actions and listing designations should accommodate all resulting taxa.
3. **Delineation of Microhabitat and Other Aspects Prior to Reintroduction Attempts.** If an insufficient number of extant populations are found to exist in Florida to meet the target conservation objective, attempts will be made to re-establish extirpated populations and/or establish new populations of flatwoods salamander. However, the species' biological (habitat, demographic and biophysical) constraints should be fully understood prior to the initiation of such efforts. Studies that delineate the microhabitat needs of the flatwoods salamander (e.g., soil characteristics, pH, temperature and moisture regimes, herbaceous structure and

component species, prey species abundance and distribution) will enable biologists to identify suitable unoccupied sites or restore potential sites.

4. **Population Size and Demography.** The monitoring plan emphasizes the use of larval dipnetting; however, the number of larvae encountered in a pond gives no indication of how many adults entered the depression to breed (Palis 1997a). Encircling breeding sites with a continuous drift fence and using mark-recapture techniques can provide information on the size of the adult breeding population. This type of study also yields information regarding the timing of migration, migration distances, habitat use, and factors that stimulate breeding. Studies should continue on a long-term basis (e.g., Palis 1997a, Palis and Aresco 2000) throughout the species' range to reveal year-to-year fluctuations. These studies would also provide data on actual reproductive success by censusing emerging metamorphs. These data may be used to derive population viability models for flatwoods salamanders.

## ANTICIPATED ECONOMIC AND SOCIAL IMPACTS

The assessment of anticipated economic and social impacts of management plan implementation derives from a consideration of the rules proposed therein and from issues raised during the public comment periods. The rule proposed for FWC action is the addition of the flatwoods salamander to the state Species of Special Concern list with a prohibition on direct take except as authorized by the FWC executive director or his delegate. Eight written comments were received during the flatwoods salamander management plan public comment period concluding November 28, 2000. Technical and scientific comments were considered during plan revision and finalization. Economic and social issues are summarized and addressed below.

### Potentially Affected Parties

Private landowners, public land managers, scientific researchers, and citizens of the state of Florida are the potentially affected parties.

### Economic Impacts

***Estimated cost to FWC of implementing proposed rule.***—The proposed rule will necessitate commitment of staff time to review permit applications for executive director consideration and approval. Up to one-half of the full time equivalent of a Biological Scientist III would be required annually to complete this work.

***Estimated cost to potentially affected parties of implementing and of not implementing the proposed rule.***—Since the proposed rule imposes fewer restrictions on land use than the federal listing of flatwoods salamander as a threatened species (USFWS 1999), and since the state permit required for direct take is a no cost permit, FWC does not anticipate any economic impacts to any affected parties as a result of management plan implementation. If the management plan is not implemented, the potential exists for the flatwoods salamander to become increasingly imperiled. This eventuality could necessitate future imposition of additional, potentially costly, conservation measures.

***Summary of public comments.***—

***Issue 1:*** Financial incentives must be provided in order for the management plan to be successfully implemented on private lands.

The majority of known flatwoods salamander populations are found on public lands, and the recommended management actions outlined in the FWC management plan are primarily intended as a guide to public lands managers. The FWC supports, in concept, the development of financial incentives for private landowners who voluntarily provide access to their lands for survey and monitoring activities and who manage their properties in such a way as to promote the perpetuation of flatwoods salamander populations. Private landowners participating in the conservation of flatwoods salamanders may be eligible to receive compensation under the auspices of at least 2 established programs: (1) the Florida Forestry Stewardship Program or Stewardship Incentive Program (SIP) (Duryea et al. 1992), which provides cost-sharing for development of a management plan, soil and water protection and improvement, wildlife habitat enhancement, and other forest management activities; and (2) the Environmental Quality Incentives Program (EQIP) (Olmstead et al. 1997), which offers cost-sharing for implementation of Best Management Practices, including enhancement of wildlife habitat.

***Issue 2:*** If county governments incorporate the recommended management actions into their comprehensive plans, possibly making them even more restrictive, the resultant economic impacts on private landowners could be very severe.

The FWC based the recommended management actions presented in this plan upon the best available science. These recommendations are intended to alleviate current range-wide threats to flatwoods salamander sufficiently to secure the population at a level which exceeds the threshold for Species of Special Concern designation and hence warrants removal from the state list. The FWC encourages but does not compel consideration of these recommendations by county governments or other agencies regulating private land use. County governments should solicit public comment and carefully assess the potential economic impacts to local landowners prior to adopting any mandatory land use regulations.

**Issue 3:** Imposition of this plan in addition to the federal listing restrictions will make it impossible to manage private lands economically.

The only compulsory regulation contained within the flatwoods salamander management plan is the proposed prohibition on direct take, which is far less restrictive than prohibitions currently in place under federal regulations. The FWC intends to pursue negotiations which may lead to the establishment of a statewide Habitat Conservation Plan (HCP) and subsequent issuance of incidental take permits for land management activities on private lands by the USFWS. It should be noted that not all affected parties endorse the development of an HCP for the conservation of flatwoods salamander. The FWC plans to coordinate its activities closely with the USFWS to ensure that an HCP would in fact confer positive progress toward the conservation of flatwoods salamanders.

### **Social Impacts**

None of the public comments specifically identified anticipated social impacts related to implementation of the management plan. The potential for social impacts was always paired with concern for the potential economic cost to private landowners. Nor did any of the public comments specifically identify anticipated social impacts which could result from not implementing the management plan. However, although difficult to quantify, there are uncompensated social costs associated with the decline or loss of a species. These include loss of biological diversity and dwindling genetic resources, loss of individual animals, and concomitant loss of the opportunity to encounter and study the species.

## **IMPLEMENTATION STRATEGY**

The wide array of conservation actions necessary to ensure the long-term survival of the flatwoods salamander requires prioritization. Accomplishment of the conservation objective requires the coordination and cooperation of multiple public and private land managers, each of whom works within various constraints. Proposed budgets, schedules, and tasks have to be feasible for there to be any hope of management action implementation.

### **Priority Actions**

FWC staff identified the following suite of conservation actions as high priority and requiring primary or significant participation by the FWC:

1. **Develop a Memorandum of Agreement with federal land managers.** The flatwoods salamander's federal status as Threatened compels the federal land management agencies on

whose lands it is known to occur (currently 19 of the 38 populations known in Florida occur on federal properties, Appendix 8) to evaluate the potential adverse impacts of their activities on the species. In addition, these federal agencies have funded previous and ongoing surveys to document occurrence of flatwoods salamanders at both known and newly discovered breeding sites. In the interest of monitoring the status of the flatwoods salamander statewide, the FWC would like to enter into a Memorandum of Agreement (MOA) with these federal land managers to keep apprised of their ongoing and planned management activities, to share information about the locations of salamander breeding sites and other localities, and to assist in the development and implementation of joint or complementary survey and monitoring plans.

2. **Coordinate initiation of conservation actions on wildlife management areas.** For all wildlife management areas throughout the flatwoods salamander's extent of occurrence in Florida, including but not limited to those that are known to harbor flatwoods salamanders, FWC staff will assess where potential flatwoods salamander habitat exists and, on those areas, will coordinate with the lead management authority and/or landowner to plan and implement survey, monitoring, management, and research activities to ensure the discovery and long-term survival of all extant populations.
3. **Explore the feasibility for cooperative agreements or conservation easements for long-term management for flatwoods salamanders on private lands.** The FWC will strive to develop positive relationships with private landowners, offering advice and, if available, other resources to support long-term efforts to survey, protect, and manage populations of flatwoods salamanders on their land. Whenever possible, it would be desirable to obtain cooperative agreements or conservation easements for long-term management for flatwoods salamanders on private lands.
4. **Maintain a comprehensive database.** FWC staff will maintain, in collaboration with Florida Natural Areas Inventory, a comprehensive database (Wildlife Occurrence Database or "Wildobs") and maps for flatwoods salamander breeding sites and population designations.
5. **Explore the potential for a Statewide Habitat Conservation Plan (HCP).** The FWC will collaborate with the USFWS to establish what population levels or other parameters of flatwoods salamander conservation in Florida would need to be met in order to set up a statewide Habitat Conservation Plan (HCP) that could serve as the basis for relaxation of federal flatwoods salamander take prohibitions in some situations.
6. **Collaborate with state wildlife agencies in Georgia, South Carolina, and Alabama.** FWC staff will collaborate with state wildlife agencies in Georgia, South Carolina, and Alabama to determine the current status of flatwoods salamanders and to encourage actions to survey, manage, and enhance their populations range-wide.

7. **Prepare a “how-to” pamphlet for land managers.** In coordination with other agencies, FWC staff will assist in the preparation of a “how-to” pamphlet on flatwoods salamander requirements and management for publication on the Internet and hard-copy distribution to applicable landowners and the interested public.
8. **Encourage research.** The FWC will encourage the implementation of research, as described in the section Areas for Future Research.

### **Budget**

The primary budget needs for implementation will be for personnel, equipment, and travel to conduct surveys, meet with public and private landowners, and initiate management actions and research. The full scope of the FWC’s commitment will depend partly upon the MOA with the USFWS and the respective role each agency will have in flatwoods salamander conservation. Specific budget needs for each year will be addressed in the FWC’s annual operational plan for this project.

### **Proposed 12-Month Implementation Schedule**

Given current FWC staffing and budget appropriations, the following represents a reasonable set of tasks to be completed between March 2001 and March 2002.

1. Implementation of proposed rules for the flatwoods salamander.
2. Development of a MOA with the USFWS to clarify each agency’s role in coordinating and monitoring work on existing populations on federal, state, local government, and private lands.
3. Coordination with Florida Natural Areas Inventory and other state and federal agencies to address implementation of the management plan, including available resources and timetables to implement habitat management and restoration, wetlands inventory, statewide surveys and resurveys of known and potential flatwoods salamander populations.
4. January - April 2002 initiation of surveys for larvae at known sites to assess status and standardize survey techniques.
5. Preparation of a threat assessment for all known sites for which FWC assumes management or coordination responsibility via the MOA process. The assessment would include descriptions and cost estimates for survey, monitoring, and management actions for each site.

## Scheduled Review and Revision of Species Management Plan

In order to ensure steady progress toward the conservation objective, FWC staff will regularly review and assess the assumptions and recommended actions outlined in the management plan in light of newly available data as follows: (1) survey data (including primarily dipnet surveys, perhaps some drift fence and road-cruise data) will be reviewed at the end of each field season (May-June) to revise the tally of known populations, and their distribution across counties and geographic regions; (2) reassessment of population status with respect to population status thresholds in the management plan could occur annually for extent of occurrence and area of occupancy, and every 3-5 years for perceived population trends; (3) accumulation of sufficient data to warrant petition for change in listing status is expected to take a minimum of 5 years so formal reassessment of Florida population status should be scheduled for year 5 to delete those populations with no verified presence in the preceding 5 years of monitoring and to add newly confirmed populations; (4) dramatic changes observed in species status (sudden decline due to environmental catastrophe, increase due to discovery of many previously unknown populations) could trigger immediate revision of management plan or petition for change in listing status.

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