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RED HILLS SALAMANDER RECOVERY PLAN

RECOVERY PLAN FOR THE RED HILLS SALAMANDER

PHAEOGNATHUS HUBRICHTI HIGHTON

Prepared by

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For the

U.S. Fish and Wildlife Service

Atlanta, Georgia

Approved: _____
Regional Director, Southeast Region

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PART I. INTRODUCTION

General

Described by Highton in 1961, the Red Hills salamander, Phaeognathus hubrichti, is a plethodontid salamander whose range is confined to a small area of southern Alabama. A fairly large species (max. total length about 225 mm), it has nasolabial grooves, an elongate body, short limbs, and a prenhensile tail. Intercostal folds between adpressed limbs number more than 12; total costal groove count is 20 to 22, the usual number being 21. The color is rather uniform dark gray to dark brownish in life.

Phaeognathus hubrichti was officially designated a Threatened species under the provisions of the Endangered Species Act of 1973 on December 3, 1976 (Federal Register 41(234):53032-53034).

Present range

The Red Hills salamander is found in areas of suitable habitat within a small area of central southern Alabama (Fig. 1). The range includes portions of Monroe, Conecuh, Butler, Covington and Crenshaw Counties; is delimited by the Alabama and Conecuh rivers to the west and east, respectively; and is confined almost entirely to the Tallahatta and Hatchetigbee formations of the Red Hills, a physiographic subdivision of the Gulf Coastal Plain (Schwaner and Mount 1970; Jordan and Mount 1975; French and Mount 1978). For purposes of convenience in preparing this plan, the range is considered divisable into three components:

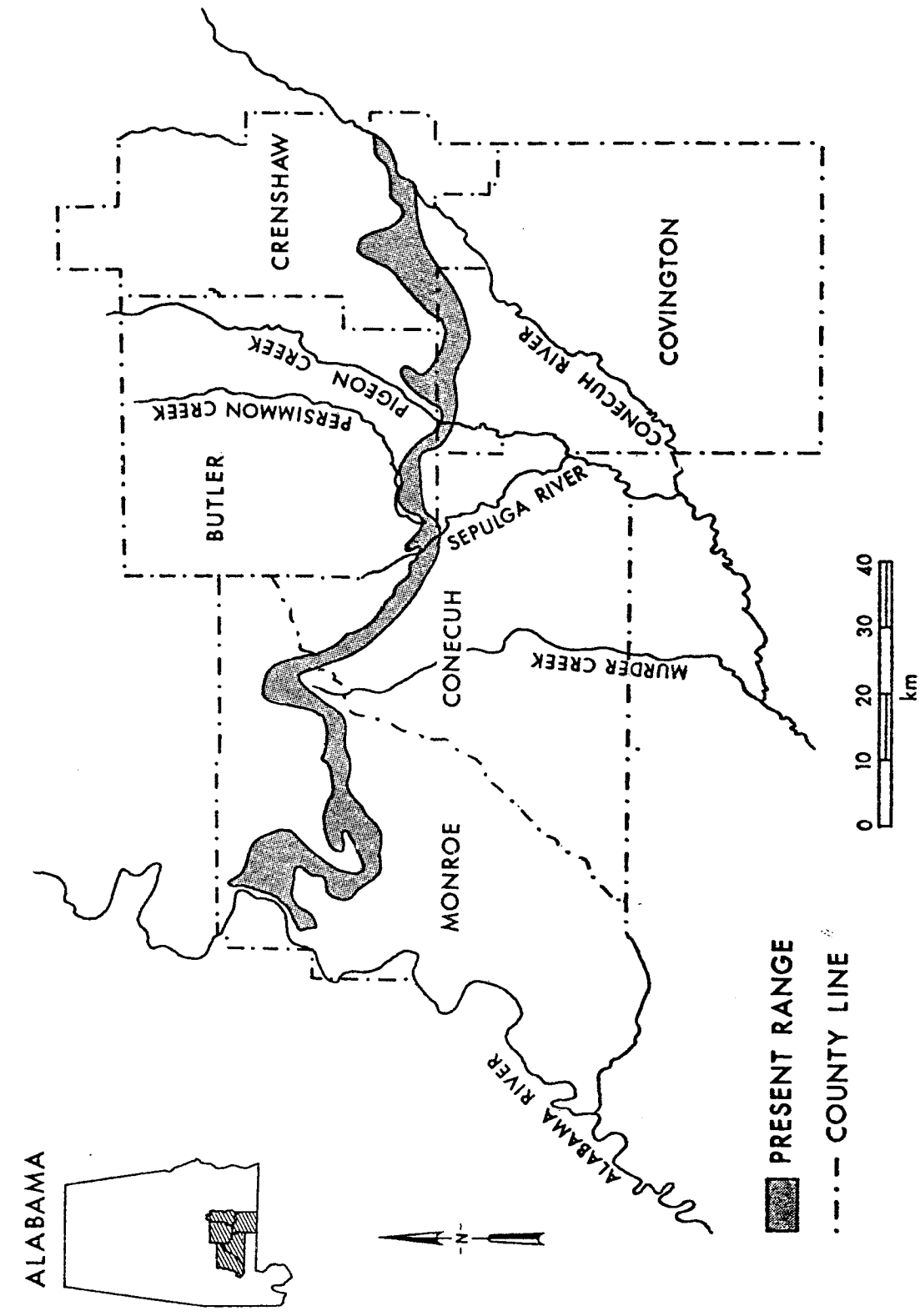

Fig. 1. Range of the Red Hills salamander.

(1) an eastern component, comprising that portion of the range east of Pigeon Creek; (2) a central component, comprising the portion lying between Pigeon Creek and the Conecuh-Monroe county boundary; and (3) a western component, that portion in Monroe County (see Fig. 1 for county boundaries and location of Pigeon Creek).

Former range

There is no evidence that the animal has occurred outside its present range within historic times, and there are no fossil records of prehistoric occurrence. Comparative data relating to temporal trends in population densities are unavailable, except for general observations included in subsequent sections of this report and the estimate by French (1976) that 1,485 ha of formerly suitable habitat, believed to have supported Phaeognathus, had been eliminated during the decade prior to his study.

Habitat requirements and size of management units

Phaeognathus is usually found on mesic ravine slopes and bluff-sides dominated by hardwood trees (Schwaner and Mount 1970; French and Mount 1978). Jordan (1975) stressed the importance of an outcropping or an underlying layer of siltstone, stating that the salamander's burrows, or branches of its burrows, invariably extend into cavities within this material. He postulated that siltstone is an important habitat constituent because of its tendency to retain moisture, enabling the salamander to survive droughty periods. A loamy, friable topsoil characterizes most sites where Phaeognathus occurs, and ground-dwelling arthropods are conspicuously abundant (Schwaner and Mount 1970).

Phaeognathus and their burrows are found in greatest abundance on relatively undisturbed sides of high bluffs and slopes of deep ravines along the northern edge of the Tallahatta formation. Such habitats tend to be associated with rivers and large creeks, and the major tributaries to the latter (French and Mount 1978). The area used by Jordan (1975) as his primary study area, however, was described as having a "large population" and was associated with northerly-facing slopes and embankments near a "small seepage stream." He indicated that his 6.5-acre study area was inhabited by an average of 42.6 individuals during a two and one-half year study period. Jordan's report is the only one known to contain such a quantitative statement of population density. Dr. Mount visited Jordan's study area during the study period, and formed the subjective impression that the density at that time was somewhat greater than densities observed at most other inhabited sites.

The best habitats for Phaeognathus, thus, may be described as extensive areas with moderately steep to steep, northerly-facing ravine slopes and bluffsides having (1) outcroppings or layers of siltstone, (2) a forest cover dominated by mature hardwood trees, (3) mesic moisture conditions, (4) rich forest-floor arthropod faunas, and (5) loamy, friable topsoils. Slopes and bluffsides facing in a southerly direction may be inhabited, provided that exposure to sun is minimal and moisture is adequate.

Marginally suitable habitats include some sites with relatively gentle relief but which are otherwise appropriate; wooded bluffsides having substantial erosion; wooded slopes along low, narrow "finger-like"

ridges; and some sites where much of the canopy has been removed by logging operations (see French and Mount 1978).

The ability of Phaeognathus to survive forestry operations depends on such factors as the extent of canopy removal, the directional aspect of the slope, and the extent of substrate disturbance (French and Mount 1978). Phaeognathus apparently cannot survive total removal of the canopy. Heavy selective cutting on south-facing slopes completely eliminates some populations (French and Mount 1978). On the other hand, limited selective cutting on north-facing slopes is substantially less detrimental and apparently permits most populations to survive (Jordan and Mount 1975; French and Mount 1978).

No attempt has been made to determine the minimum-sized unit of suitable habitat or management area needed to sustain a population of Phaeognathus indefinitely. In any considerations relative to this issue, it must be kept in mind that the quality of the habitat is affected by adjacent land use, especially as such use influences the moisture regime. For example, conversion of sites above and adjacent to inhabited slopes from hardwood forest or mixed forest to pine forest would be expected ultimately to produce higher rates of evapotranspiration and a concomitant reduction in soil moisture. If, at a given inhabited site, moisture was an important limiting factor, such a conversion of adjacent upland could result in extirpation of the population. The relatively dry slopes supporting "low population levels" in the "Potato Hills" region of Monroe County, southwest of Vredenburg, are perhaps exemplary in this respect (see French 1976). On the other hand, conversions of this nature may have little effect on Phaeognathus if year-round moisture is more than adequate.

Another consideration with respect to size (and number) of management units is provision for catastrophic events. There is no evidence that forest fires constitute a threat, but the possibility of degradation by a fire reducing food supply or otherwise causing damage should not be ruled out.

Thus, the minimum size of a management unit needed to insure suitability of a given area of habitat, and the nature of permitted land uses in such a unit, vary from one site to another and depend on several variables. Our present state of knowledge requires that such determinations be largely subjective and based on the opinions of those most familiar with the animal and its requirements.

The few data on population structure and dynamics relating to Phaeognathus are from Jordan's (1975) study of a single population in Crenshaw County. Additional studies on other populations would be desirable to determine whether the apparent low rate of reproductive success and correspondingly low number of juveniles he found in his population can be applied to the species as a whole. Also desirable would be information on vagility and dispersal rates and mechanisms. At present the only information we have on these subjects is based on speculation and inference.

Availability of suitable habitat

In 1975, habitat within the range remaining suitable (including marginally suitable) for Phaeognathus was estimated by Jordan and Mount as approximately 25,500 ha. In a more intensive investigation in 1976, amount of suitable habitat remaining was estimated at 22,200 ha (French

1976; French and Mount 1978). Of the latter amount, it was estimated that 1,245 ha had been detrimentally affected by forestry operations and that the populations thereon were small and irregularly distributed. It was also estimated that 1,485 ha, not included in the total, had been suitable and had probably supported Phaeognathus up until about 1966, but was no longer suitable (in 1976) because of forestry operations.

Substantial but undetermined amounts of apparently suitable habitat occur outside the range west of the Alabama River in the Red Hills and in smaller, scattered amounts east of the Conecuh River (French and Mount 1978 and pers. obs.). Extensive areas of habitat with many physical and vegetative characteristics similar to those that characterize habitats currently supporting Phaeognathus are common in portions of northern Alabama (ex. ravine slopes and bluffsides in parts of Bankhead National Forest) (pers. obs.). There have been no attempts, however, to establish Phaeognathus populations in any of these areas.

Reproduction

Reproduction remains a poorly known aspect of the natural history of Phaeognathus. Natural nests have never been found, despite intensive searching for them (Jordan 1975). The only recorded instance of oviposition was by a captive female in the Cincinnati Zoo. In this instance a small cluster of eggs was found suspended from the roof of a sheltering piece of bark in the container housing the animal. The eggs were infertile and did not develop (Brandon and Maruska, 1982).

Data on reproductive potential are limited to those obtained by counting yolked ova in a small number of females' reproductive tracts. A clutch size of from 4 to 9 eggs is indicated (Brandon 1965 and Mount,

pers. obs.). Jordan (1975) noted that of 79 Phaeognathus collected over a period of 6 years by him and by other investigators who published their findings, only 6 specimens were juveniles, leading him to speculate that reproductive success in the species was generally low. He suggested that the apparent wide spacial separation between individuals in some populations may lessen the frequency of courtship and mating and thus reduce the probability of reproductive success.

Limiting factors, known threats, and potential threats

A review of the findings of investigators who have studied the ecology of Phaeognathus strongly indicates that the animal is highly specialized, demanding in its habitat requirements, sensitive to habitat alterations, and low in vagility and reproduction potential (Brandon 1965; Schwaner and Mount 1970; Jordan 1975; Jordan and Mount 1975; French 1976; French and Mount 1978).

In scattered areas within the range where habitat conditions appear to be most nearly optimal visually to the experienced investigator, Phaeognathus can usually be found in roughly equivalent population densities, suggesting that such subtle factors as predation, food supply, environmental contamination by insecticides, and competition with other species are seldom limiting.

Predation on Phaeognathus is unknown. Predators occurring in the same habitats that might capture and eat Phaeognathus include shrews, several snake species (ex. Diadophis punctatus), and at least one other salamander, Pseudotriton ruber. The low reproductive potential for Phaeognathus and Jordan's (1975) failure to find any evidence of predation suggests that predation-rate is low.

Potential food in the form of a variety of arthropods is abundant in all forested habitats in the Red Hills. No evidence of mortality or habitat degradation resulting from application of chemicals has been reported.

Several other animals may compete with Phaeognathus for food. These include shrews and several species of amphibians that share the habitat. The abundance of insects and other food items in the habitats, however, would seem to discount competition for food as a limiting factor.

Overcollecting by herpetologists may have harmed one or more populations of Phaeognathus (Jordan and Mount 1975), but there is no evidence that overcollecting is currently a significant limiting factor.

Natural catastrophes within historic times are not known to have caused any substantial losses of Phaeognathus or of its habitat. However, French (1976) noted that steep bluffsides subject to continual "sloughing off," with concomitant talus accumulations along the lower slopes, support lower than expected population densities.

On the other hand, major habitat disturbances caused by man, such as clearing-up forest land, severe select-cutting for timber, mechanical site preparation, and conversion of hardwood forests to pine forests are detrimental and appear to constitute the most serious threats to the welfare of Phaeognathus (Schwaner and Mount 1970; Jordan 1975; Jordan and Mount 1975; French 1976; French and Mount 1978).

The most recent study of habitat availability was in 1976; a published version of the results of this study appeared in 1978 (see section entitled "Availability of suitable habitat," above). These

reports pointed out that much of the habitat remaining was owned or controlled by paper companies (ca. 44%) and that only a tiny amount (61 ha) was in public ownership. The latter report contained information on a publicly advertised policy of International Paper Company to the effect that reasonable protection of Phaeognathus habitat would be practiced on I.P.C. lands, which, at the time the policy was implemented, included about 12.6% of the total habitat remaining. The author visited I.P.C. lands once since that time and has been in contact with company representatives on several other occasions regarding this matter. The last such contact was approximately one year ago.

There has been no attempt on the part of any agency or individual to assess the status of Phaeognathus since French's survey in 1976. French stated at that time that "most timber companies are not 'marking out' the bluffs and steep slopes" and that the slopes and the areas above and below were being managed for saw timber on a long-rotation basis, using the select-cut method. The extent to which "timber companies" operating within the range of Phaeognathus are currently following such a practice is unknown.

PART II. RECOVERY

A. Recovery Objective

Objective: To remove the Red Hills salamander from Threatened status.

Ideally, it would seem that any recovery plan should have as its primary objective the development and implementation of a program that

would ultimately permit the delisting of the species in question. In the case of Phaeognathus, however, such a goal may not be attainable within the foreseeable future because of the animal's small range, limited available habitat, and other obvious considerations. A more realistic interim objective is the implementation of a program that would prevent deterioration of the species status as Threatened to the Endangered category. In as much as the population structure and dynamics of the species are very poorly known, the objective cannot be stated in terms of numbers of individuals. In terms of land area, maintenance of approximately 16,000 ha, total, of moderately good-to-optimal habitat seems to be a reasonable and attainable goal. The number, location, size, and configuration of tracts to be included within the total would depend heavily on current habitat conditions and land ownership within the range (see "Narrative"). As the current recovery tasks are implemented and more becomes known about the exact needs of the species, consideration can then be given to developing parameters for a delisting objective.

B. Step-down Outline

Prime Objective: To remove the Red Hills salamander from Threatened status.

1. Habitat re-assessment
   - 1.1 Categorize and map habitat
   - 1.2 Determine landownership
   - 1.3 Determine land use

2. Preserve and/or manage habitat
   - 2.1 Determine and implement most appropriate habitat protection measures
   - 2.2 Modify management practices as indicated by research

3. Population assessment and study
   - 3.1 Study and assess population structure and dynamics
   - 3.2 Study reproduction

4. Educate landowners

5. Monitor habitat and populations

C. Recovery Narrative

1. Habitat re-assessment

Re-assessment of the status of Phaeognathus and categorization of the suitable habitat remaining within the range should constitute the first phase of the recovery effort and be initiated as soon as possible. The precise nature of most of the other recommended actions would of necessity be based on the results of this phase. The re-assessment will be greatly facilitated by the availability of work maps, field notes, and other supplementary materials from French's 1976 survey, which are currently in Dr. Mount's possession.

1.1 Categorize and map habitat

Habitat classes should be established in the following manner: (a) "Optimal" habitat - areas characterized by numerous heavily forested, steep ($\geq 45°$) ravine slopes and bluffsides; forests healthy and mesophytic, dominated by mature or maturing hardwood trees; outcroppings and/or subsurface layers of siltstone readily detectable and extensive; topsoil loamy, friable, and usually moist; low tendency to erode; adjacent uplands (depending on how extensive) in land use(s) conducive to maintaining adequate moisture regimes on inhabited areas below; Phaeognathus or evidence of its occurrence, in the form of its characteristic burrows, very easy to detect (within 5-10 min or less) by experienced investigator(s); (b) Suitable but suboptimal habitat - areas typically somewhat deficient, but not completely lacking, in one or more of the above characteristics, but within which Phaeognathus or evidence thereof can usually be detected within 10-20 min of searching; (c) Marginally suitable habitat - areas severely deficient in one or more

of the above characteristics and within which detection of Phaeognathus is difficult, requiring up to 30 min or more of intensive searching or in the case of a recently degraded habitat, such categorization is intuitively obvious (ex. an inhabited, north-facing ravine slope recently subjected to select-cutting resulting in 75% canopy removal); and (d) Seemingly suitable, but apparently uninhabited habitat. It is possible that some rather extensive areas within the range will be found that are devoid of Phaeognathus, but which appear to meet the species' requirements. Such areas may have been subjected to land treatments or uses that eliminated the animal in times past and have since recovered their former supportive capacity. Such areas, if found, should be noted in the event that they are needed in the future for experiments on restocking, rate of dispersion, or other such aspects of the animal's natural history.

In categorizing habitats of Phaeognathus, the dynamic aspects of forest ecology must be kept in mind. It is to be anticipated, for example, that some habitats degraded by forestry operations could ultimately regain their former supportive potential. These habitats would ultimately be re-categorized in some later re-assessment to reflect the improvement.

The habitats should be mapped according to class on 7 ½-min quadrangles and the area within each category determined. Specific localities for Phaeognathus should be indicated on the maps, along with indications of sites investigated with negative results.

Finally, with respect to re-assessment and mapping, close attention should be given to small, isolated tracts of apparently suitable habitat, when such tracts are encountered. By determining the presence or absence

of Phaeognathus on such tracts, the apparent health of any populations found, and the history of each tract and its surroundings, data on minimum size of management units could be derived.

1.2 Determine land ownership

Land ownership should be determined by examining up-to-date records or publications in the tax assessors offices in the county seats of the respective counties. Whenever practicable, the name and address of any individual or corporation owning or controlling 50 ha or more of habitat should be recorded.

1.3 Determine land-use

A questionnaire should be developed and sent to each landowner in order that predictions can be made relative to the recovery and future welfare of Phaeognathus. The latter to be enclosed with the questionnaire should be worded so as to preclude the possibility of misinterpretation of the investigator's motives. Inclusion of map coordinates as well as subjective descriptions of the habitat would be desirable, (i.e., "the ravine slope running parallel to Hog Creek on the south side, and a 100 yd-wide strip paralleling and adjacent to the ravine's upper edge").

2. Preserve and/or manage habitat

Maintenance of habitat integrity is obviously vital to the survival of any species in nature. In the case of Phaeognathus, whose small range and habitat specificity border on the extreme, such maintenance should not be left to chance, especially when man's modern technology enables him to produce drastic and often catastrophic changes over large areas of the natural environment in a very short time-span. At present, as noted in

the introduction, only one large private landowner, holding about 12% of the total habitat remaining in 1976, has agreed publicly to avoid management practices incompatible with the existence of Phaeognathus, and only a tiny fraction of the animal's habitat is under public ownership. Although French (1976) stated that most "timber companies" were avoiding clear-cutting of the steep ravine slopes in the range of Phaeognathus, he also noted that in most cases severe select cutting was being practiced, with removal of up to 90% of the canopy. Such severe cutting can apparently result in extirpation of the salamanders from many habitats.

An ultimate objective of maintaining at least 16,000 ha in acceptable (classes a, b, and c) habitat, with about half that amount included in classes "a" and "b" seems to be reasonable and attainable. This assumes that all of the items under action "2" along with "action 4," in the step-down outline, are available for implementation as circumstances dictate.

2.1 Determine and implement most appropriate habitat protection measures

The various habitat protection options, e.g. cooperative agreements, purchase of easements, or land acquisition, must be evaluated to determine the most feasible and appropriate means for protecting the essential habitat identified in action 1.1.

Acquisition of refugia should be considered, particularly if the re-assessment (actions 1.1, 1.2, and 1.3) should reveal continuing deterioration in the amount and quality of habitat since the 1976 assessments. Tracts within which class "a" or classes "a" and "b" habitat is (are) abundantly represented, in comparison to others, should be sought. Location

within the range, land values, ease of protection, and benefits that would accrue to other "listed" or declining plant and wildlife species are important variables that must be considered. As nearly as can be determined, Phaeognathus habitat is currently being impacted most severely in the central and eastern components of the range. It is anticipated, therefore, that any need for refugia would be greatest in one or both of these components.

The dispersion of habitat within the range is extremely variable. The minimum size of areas required to preserve or compatibly manage given tracts of habitat is likewise variable, and depends on the specific nature of the tracts, surrounding land use, and access. Rural forested land within the range of Phaeognathus is usually priced from about $400-$700 per acre. The author's subjective impression is that refugia of 500-1000 acres (200-400 ha) would, in most cases, be of sufficient size to insure protection of the habitat and provide a reasonable measure of assurance that the resident Phaeognathus population could continue to exist, at least within the foreseeable future. The number of such refugia needed, ultimately, to insure perpetuation of the species would be substantially influenced by land-use dynamics within the animals' range.

In considering the concept of refugia for Phaeognathus, it is important to keep in mind that any areas set aside could be used for a variety of other purposes that would be popular with local residents. Hunting and fishing would be compatible, as would certain other forms of light recreational use. The extent and type of forestry operations permissible would depend on the characteristics of the refugia.

2.2 Modify management practices as indicated by research

Data obtained in actions 1 and 3 will be analyzed to determine

which land management practices (e.g. clear-cutting, selective-cutting, etc.) are compatible with the survival and recovery of the Red Hills salamander. This information will be utilized in the education of land-owners (action 4) and in the protection of habitat (action 2.1).

3. Population assessment and study

The need for additional information on population structure and dynamics is obvious. Only one population has been investigated in any detail (Jordan 1975), and the extent to which its parameters reflect those of the species is open to question.

3.1 Study and assess population structure and dynamics

At least two more populations should be investigated in detail, using techniques similar to those employed by Jordan, over a 3-year period. Objectives of such research should include a determination of the composition of the population with respect to sex-ratio and age-size class representation, rates of immigration and emigration, and dispersal mechanisms.

3.2 Study reproduction

Jordan (1975) speculated that the apparent low reproductive rate in the population he studied may have been due to the wide spacial separation of the constituent individuals. This speculation remains unsupported by available comparative data and should be investigated.

Concomitantly with some of the other actions, data on nesting should be sought. Attempts to develop captive-propagation techniques should be made, perhaps employing simulated microhabitats in the laboratory. Our current knowledge of all aspects of reproduction in Phaeognathus is extremely limited.

4. Educate landowners

MOU development in "action 2.1," should involve personal contacts as well as preparation and dissemination of a leaflet or brochure depicting the animal's range and habitat, along with other appropriate information. The education effort ("action 4") should also stress other benefits of protecting or compatibly managing Phaeognathus habitat and buffer zones to other components of the wildlife resource as well as benefits to the area's soil and water resources.

5. Monitor habitat and populations

Monitoring of the habitat and resident populations should be undertaken at 3-year intervals, if possible. Each monitoring effort would essentially constitute a 3-year re-assessment, and would involve up-dating the maps and re-categorization of habitat, if necessary. The results should include recommendations for corrective actions needed, if any problems should be revealed.

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PART III

IMPLEMENTATION

Priorities in column four of the following implementation schedule are assigned as follows:

1. Priority 1 - All actions that are absolutely essential to prevent extinction of the species.

2. Priority 2 - All actions necessary to maintain the species' current population status.

3. Priority 3 - All other actions necessary to provide for full recovery of the species.

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	FWS Program	Other	FY 1	FY 2	FY 3	
I 2	Categorize and map habitat	1.1	2	12 mos.	4	SE	Contract	15,000			
I 14	Determine land ownership	1.2	2	1 mo.	4	SE	Contract	800			
I 2	Determine land use	1.3	2	1 mo.	4	SE	Contract	800			
A 1,2,3, 6,7	Determine and implement most appropriate habitat protection measures	2.1	See Note	Unknown	4	SE	Contract ADGF*	See Note			Priority, effort, time required, and cost, dependent on results obtained in Task 1.1, 1.2, and 1.3 and to a lesser extent, 3.1 and 3.2
M 3	Modify management practices as indicated by research	2.2	See Note for Task 2.1	As needed	4	SE		Unknown			
R 1	Study and assess structure and dynamics of population	3.1	2	36 mos.	4	SE	Contract		6,000	6,000	Three-year study.
R 7	Study reproduction	3.2	3	12+ mos.	4	SE	Contract		1,200	1,200	Two-year study.
O 1	Educate landowners	4.	2	Indefinite	4	SE	ADGF		3,000	3,000	
I 1	Monitor habitat and populations	5.	2	Indefinite	4	SE	Contract				Recommended interval between monitorings: 3 yrs. maximum effort required for each: 0.1 scientist yr; cost for each: $5,500. Begin three years after completion of Task 1.3.

*ADGF - Alabama Division of Game and Fish

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES*

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

* (Column 1) - Primarily for use by the U.S. Fish and Wildlife Service.

APPENDIX

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