Florida Bog Frog

Management Guidelines for Species at Risk on Department of Defense Installations

NatureServe

Florida Natural Areas Inventory

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Front cover photo: Florida bog frog (*Rana okaloosae*) by David Printiss.

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FLORIDA BOG FROG

MANAGEMENT GUIDELINES FOR SPECIES AT RISK ON DEPARTMENT OF DEFENSE INSTALLATIONS

EGLIN AIR FORCE BASE
FLORIDA

Dale R. Jackson

September 2004

NatureServe
A Network Connecting Science With Conservation

FLORIDA Natural Areas INVENTORY

Acknowledgements

The previous work and cooperation of three biologists made completion of this document possible. David Bishop, Paul Moler, and David Printiss all assisted with field reconnaissance of Florida bog frog localities and shared their knowledge of the biology and conservation needs of the species. Bruce Hagedorn provided information about Eglin Air Force Base and its management programs that address the frog.

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

Executive Summary

The Florida bog frog, *Rana okaloosae*, is a small ranid frog endemic to three counties in western Florida. It is most closely related to the bronze (or green) frog, *Rana clamitans*, and is the smallest member of its genus in North America. The bog frog is restricted to a variety of seepage habitats, relatively stable streams and seeps that receive their water via percolation through adjacent, deep sandy uplands. The species was not discovered until 1982 and was formally described in 1985 (Moler 1985a). The few studies to date that have been conducted on it have been predominantly distributional surveys, although investigation of its ecology is underway (Bishop, 2004).

Despite surveys that have extended to several river drainages, the species remains known from only two, the Yellow and East Bay rivers, both of which empty into the Pensacola Bay system. Of approximately 57 known sites, all but five are located in roughly the western third of Eglin Air Force Base (AFB), Santa Rosa and Okaloosa counties, Florida. Two highly disjunct sites occur in the northeastern part of Eglin AFB, in Walton County, in Titi Creek, a tributary of the Yellow River via the Shoal River. The remaining three sites are on private lands on the north side of the Yellow River, across from Eglin AFB. In this document, sites are consolidated into Conservation Management Units (essentially individual tributary stream drainages or river floodplains) that are assigned to one of three drainages – Titi Creek, Yellow River, or East Bay River.

Conservation objectives for the Florida bog frog fall into two principal categories: 1) managing riparian and adjacent upland habitat on Eglin AFB to be optimal for the species, and 2) securing legal protection of private lands known to support the species so that they, too, can be managed appropriately. The state of Florida, through it Florida Forever program, has initiated steps to achieve the second goal, although there is no guarantee of success at this point.

Threats to the Florida bog frog stem primarily from factors that degrade or destroy its rather open, seepage microhabitats. Known and potential threats include fire suppression and habitat succession; erosion, siltation, and flooding (roads and borrow pits); impoundment; invasive non-native species (principally hogs and plants); pollution; impacts of military training and testing; silvicultural operations; habitat fragmentation; and potentially hybridization. This document elaborates upon each of these and discusses potential conservation measures to mitigate them.

1. SPECIES IDENTIFIERS

Scientific Name:	*Rana okaloosae*
Common Name:	Florida bog frog
Family:	Ranidae
Order:	Anura
Class:	Amphibia

2. SPECIES STATUS

Federal Status (Candidate):	No
State Status:	Species of Special Concern
Heritage Status Rank:	Global Rank: G2
	State Rank: S2

In addition, the Florida Committee on Rare and Endangered Plants and Animals lists the species as Rare (Moler, 1992).

3. RELATIONSHIP TO DOD

a. Installation Where Species Occurs

More than 90% of known Florida bog frog localities occur on Eglin Air Force Base (AFB), Florida (Fig. 1).

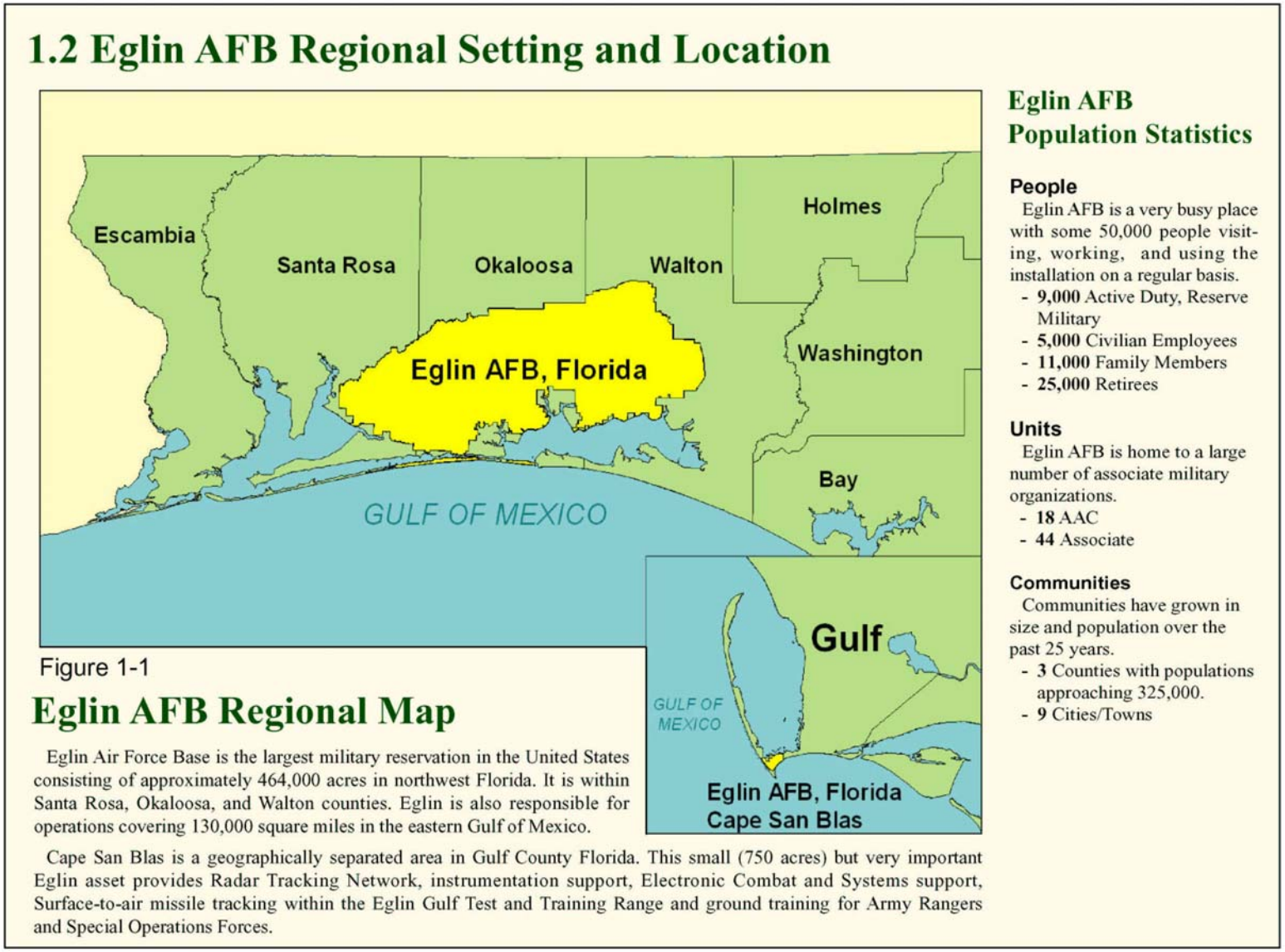

Figure 1. Eglin Air Force Base regional setting and location (from Eglin AFB Integrated Natural Resources Management Plan).

b. Existence of INRMP and Focus on Florida Bog Frog

Eglin AFB has an Integrated Natural Resources Management Plan (INRMP), last revised February 2002 (U.S. Air Force, 2002). Achievement of the plan's goals is under the direction of the base's Natural Resources Branch (NRB). General goals of the INRMP that are most pertinent to the Florida bog frog (or hereafter, simply the bog frog) are: conservation and rehabilitation of natural resources; fish and wildlife management and habitat enhancement; and wetland protection, enhancement, and restoration where necessary for support of wildlife.

The Eglin AFB INRMP includes the Bog frog as one of eight species considered to be Conservation Targets on the base. Desired future conditions for these targets were drawn from a report prepared by The Nature Conservancy (Sutter et al., 2001). The specific section of the INRMP outlining management direction for the species is attached as Appendix 1. Emphasis is placed on distributional surveys and studies of population ecology.

4. CONTACTS

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* Palis conducted studies of the gopher frog and flatwoods salamander on Eglin AFB from 1992-1994.

h. Additional Stakeholder Contacts and Interests

1. Conservation Partners

The following organizations may have or have already expressed an interest in conservation of the bog frog or its habitat. For each, the name and address of the most pertinent contact are provided.

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* DOF co-sponsored the 2002 Yellow River Ravines Florida Forever proposal (see section 6.c.2) and is recommended as potential manager of lands that are acquired through this program

Florida Fish and Wildlife Conservation Commission (FFWCC) *
attn: Paul E. Moler (see section 4.g.1)

* the FFWCC assists the Eglin AFB Natural Resources Branch (NRB) in the review and development of management plans and provides technical information and support of its fish and wildlife management program. Eglin has been part of the FFWCC's Type II Management Area Program for more than 20 years. As such, the FFWCC provides fish and wildlife law enforcement support from its Wildlife Officers.

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* The State of Florida has under consideration for protection the Yellow River Ravines Florida Forever Project (see section 6.c.2).

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* This partnership formed in 1996 to promote conservation of biodiversity within a one million-acre region of the East Gulf Coastal Plain Ecoregion. The partnership includes the U.S. Department of Defense, Florida Department of Environmental Protection, Florida Division of Forestry, International Paper, National Forests in Alabama, Nokuse Plantation, Northwest Florida Water Management District, and The Nature Conservancy.

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* TNC co-sponsored the 2002 Yellow River Ravines Florida Forever proposal (see section 6.c.2).

2. Landowners and Managers

Three occurrences of the bog frog are on private land north of Eglin AFB. Figure 1 depicts land ownership boundaries based on the 2002 Santa Rosa County plat book. The known frog sites occur along a power line right-of-way that crosses the three streams.

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* IP owns two of the three sites occurring on private lands and is cooperating with the state in securing protection of the land via the Florida Forever program (see section 6.c.2). IP has enrolled the lands with GCPEP (above).

The third privately owned site (Burnt Grocery Creek) has multiple owners (see section 6.c.2; IP owns much of the drainage below the known bog frog site). Conservation interest is unknown

but probably limited. The preferred option is to incorporate these parcels into the Yellow River Ravines Florida Forever Project (section 6.c.2).

5. SPECIES INFORMATION:

a. Species Description

Rana okaloosae is described in detail by Moler (1985a). Additional information and photographs are provided by Ashton and Ashton (1988; note photographic error below), Bartlett and Bartlett (1999), Conant and Collins (1991), Hipes *et al.* (2001), and Moler (1985b, 1992, 1993).

The Florida bog frog is a small, yellow-green to brown ranid frog that normally lacks spots (Fig. 2), although subtle spotting is present in some individuals. Body (snout-urostyle) length excluding the legs is 3.5 – 5.3 cm (1.5 to 2 inches), which makes this the smallest North American ranid frog. On each side of the back is a light dorsolateral ridge that starts behind the eye but which does not reach the groin. The skin of the upper surfaces bears numerous low tubercles that give the frog a somewhat warty rather than smooth appearance. Scattered light spots are on the lower jaw, lower sides, and outer abdomen, and the belly has dark worm-like markings. The tympanum (eardrum) is flat in both sexes, brown, and two-thirds of, to slightly larger than, the diameter of the eye. The upper lip is greenish yellow, the throat yellowish, and the eye coppery. Webbing between the toes of the hind feet is extremely reduced, with the pointed toes extending well beyond the webbing (at least three phalanges of fourth toe, and at least two phalanges of all others, free of web; Fig. 2). Males are slightly smaller than females in mean size, have somewhat swollen thumbs, proportionately larger tympana, and a pair of external vocal sacs (not internal as previously reported) that can be partially inflated by applying slight pressure to the abdomen (Bishop, 2004). The advertisement call is a series of 3-21 guttural chucks that slow noticeably toward the end of the series; single chucks are sometimes issued. The voice has relatively limited carrying power.

The tadpole is slender with an elongate tail. General coloration is olive brown, with numerous buff spots on the tail, and white spots on the belly. The last characteristic helps to distinguish this species from the often syntopic bronze frog, *R. clamitans*. Although many bronze frog tadpoles also have white spots on the belly, those of the bog frog tend to be better separated and on a darker (blacker) background; however, young tadpoles of the two species can be difficult to distinguish (D. Bishop, pers. comm.). Additional morphological characters are provided by Moler (1985a).

Photographs or illustrations of the bog frog may be found in Moler (1985a,b,1992, 1993), Stone (1986), Carmichael and Williams (1991), Conant and Collins (1991), Bartlett and Bartlett (1999), Hipes *et al.* (2001), and U.S. Air Force (2002). Ashton and Ashton (1988) provide color photographs of an egg mass and tadpole, although their depiction of a frog actually represents a species other than *R. okaloosae* (Moler , 1993). Moler (1985a, 1993) provides illustrations and photographs of the tadpole, detailed drawings of its oral disc, and audiospectrograms of the advertisement call.

Similar Species: All other ranid frogs within the southeastern U.S. are larger than 5 cm in body length except when very young. The bullfrog (*R. catesbeiana*), pig frog (*R. grylio*), and river frog (*R. heckscheri*) lack dorsolateral ridges. The bronze frog, which is common along Florida streams and co-occurs with *R. okaloosae*, is distinguished by the raised center on the tympanum of males. All four species have more extensively webbed hind feet, with toes extending little or not at all beyond the webbing (no more than two phalanges of fourth toe of bronze frog free of web).

Figure 2. Photographs of the Florida bog frog, *Rana okaloosae*. Top, adult; bottom, detail of hind foot showing reduced webbing. Photographs by David J. Printiss.

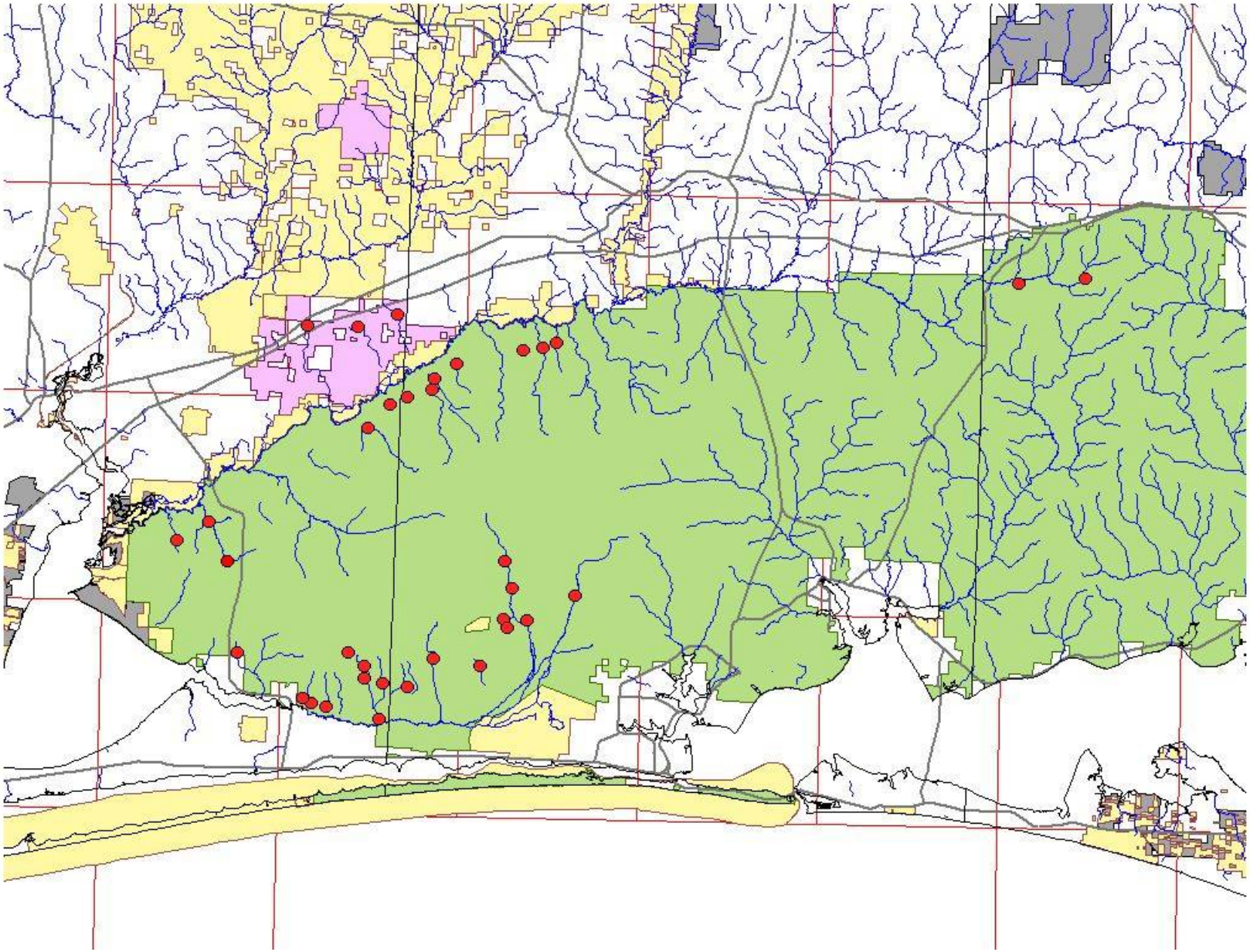
b. Distribution

In his surveys that led to the species' description, Moler (1985a) identified 15 localities for the bog frog; he had increased this to 23 by 1993 (Moler, 1993). Printiss (Printiss and Hipes, 1999), as part of a 1997-1998 survey for rare herpetofauna on Eglin AFB, discovered 12 additional occurrences and extended the frog's known distribution southward by 2.3 km. Enge (2002) added an additional site (upper Weaver Creek) during a 1998-1999 survey of seepage habitats in Okaloosa and Santa Rosa counties. Since 2001, Bishop (2004) has increased the total number of known locations to 57, although most of the additions are simply extensions of previously known sites (i.e., within the same tributaries); however, one represents a previously undocumented tributary (Prairie Creek) for the species. The increase in the number of known sites reflects heightened survey efforts and greater awareness of the species. As such, it is expected that additional sites will be discovered as surveys continue, although only the discovery of populations in previously undocumented drainages or streams would be especially notable. Bishop currently maintains a database to track the results (both positive and negative) of all bog frog surveys, which will continue during the 2004 activity season. Data for known localities, as recorded in the FNAI data base, are summarized in Appendix 2.

Current data indicate that the bog frog is endemic to a small, three-county area of western Florida (Fig. 3). Most known localities occur in contiguous southeastern Santa Rosa County and southwestern Okaloosa County, with two outliers approximately 30 km to the east in west-central Walton County. All localities lie within the Yellow and East Bay river drainages (both part of the Pensacola Bay hydrological basin). The eastern outlying sites are tributaries of Titi Creek and represent the only known occurrences within the Shoal River portion of the Yellow River drainage. For purposes of this document, all occurrences are hereafter assigned to one of three metapopulations – Yellow River, East Bay River, or Titi Creek. Elevations at known sites range from approximately 5 feet along the lower East Bay River floodplain, to more than 150 feet along upper Titi Creek. Despite the close proximity of tributaries of the Choctawhatchee and Blackwater river systems to known sites, the species has yet to be found in either drainage.

All but three localities occur on Eglin Air Force Base. The remaining three are situated on private land just north of the base (Fig. 3) in Santa Rosa County near the Okaloosa County line (see section 6.c.2, Regional Conservation Actions). The three non-DOD sites are the only ones known from the northern side of the Yellow River; the creeks in which they are situated lie directly across the river from other inhabited streams on Eglin AFB.

Fig. 3. Map of known localities (red dots) of the Florida bog frog, *Rana okaloosae*, as represented by element occurrence records in the Florida Natural Areas Inventory database. Additional recently identified sites in the same tributaries and general vicinities (Bishop, 2004) are not depicted separately. Green, Eglin Air Force Base; yellow, other public lands; pink, Yellow River Ravines Florida Forever project (see section 6.c.2); gray, other Florida Forever projects.



c. Habitat

The bog frog occupies a variety of microhabitats that share several features. Most sites are clear, shallow, non-stagnant, acidic (pH 4.1 - 5.5) seeps and seepage streams that arise via the percolation of water through the coarse soils of the surrounding sandy uplands (principally Lakeland-Troupe series: Moler, 1985a). In areas of lower relief, these seepages may overflow or broaden into boggy but still shallow, non-flowing areas that often support sphagnum moss (*Sphagnum* sp.), black titi (*Cliftonia monophylla*), and occasionally white cedar (*Chamaecyparis thyoides*). Printiss and Hipes (1999) characterized the vegetational layers at bog frog sites as follows: canopy sparse, with swamp tupelo (*Nyssa biflora*), Atlantic white cedar, and slash pine (*Pinus elliottii*); sub-canopy sparse to moderately dense, dominated by small canopy trees and large titi; shrub layer sparse, dominated by titi and St. Johns wort (*Hypericum* spp.); and herb layer lush, diverse, dominated by pitcherplants (*Sarracenia* spp.), sundews (*Drosera* spp.), graminoids (grass-like plants), and often large mats of sphagnum. The generally moderate to high levels of insolation (sunlight penetration) at many bog frog sites is at least in part an effect of periodic fires limiting or retarding hardwood encroachment , especially in the subcanopy and shrub layers (see section 6. Species Conservation Issues for management implications of this). At the non-DOD sites, it is at least in part a consequence of the maintenance of a broad power line right-of-way (ROW), although frogs at one site (Garnier Creek) occur just north of the ROW in a dense stand of white cedar with a sparse subcanopy and shrub layer and sphagnaceous herb layer. A fairly dense canopy is also present at Enge's (2002) upper Weaver Creek site. Even though Bishop (pers. comm.) has found the species in some fully shaded areas, his impression is that frogs are more abundant (and possibly larger) in sunnier sites.

Although surveys to date suggest that the conditions described above represent the primary habitat signatures for the bog frog, it should not be assumed, without extensive additional effort, that the species can not occupy other microhabitats. However, present knowledge suggests it to be unlikely that the frog can maintain viable populations in habitats in which seepage does not play a role.

Depending upon the distribution of appropriate microhabitat, frogs may occur from the headwaters of streams downstream to their confluence with larger streams or river floodplains. Frogs are known from isolated seepages as well as from seepage areas that occur along the upland edges of floodplains (Moler, 1985a; Printiss and Hipes, 1999; Bishop, 2004).

Although alteration of stream habitats appears often to be detrimental to bog frogs, it does not necessarily extirpate (though it may fragment) local populations. At least one site lies immediately below a small impoundment (Roberts Pond), and three sites are in cleared power line rights-of-way. Nonetheless, the species seems to disappear from or decline in impounded sections of streams, probably as a result of loss of the very shallow rivulet microhabitat that normally occurs along the margins of small seepage streams (see section 6.b.3).

Potentially suitable habitat can be identified by use of topographic maps and aerial photographs as viewed in ArcView. However, ground-truthing is necessary to determine whether microhabitat conditions at identified sites are appropriate for the species. Habitat that appears to be suitable for bog frogs is moderately common on Eglin AFB (roughly 150 km of streams and

floodplain edge as cursorily determined from 1:100,000 topographic map). Its availability, therefore, is not considered limiting to the species' long-term viability as long as it can be retained and managed (section 6.b) appropriately.

d. Life History

The bog frog is a resident of seepage habitats year-round, although its inactivity during cold weather makes it nearly impossible to find during the winter (except for tadpoles). Based on male calling activity and observations of eggs, the breeding season extends from March to September (Bishop, 2004; Moler, 1992). Males typically call from shallow water surrounded by sphagnum (Moler, 1992, 1993). Oviposition (and development) sites are characterized as small, shallow, non-stagnant seepage rivulets (Moler, 1985a; Printiss and Hipes, 1999). From <100 to several hundred eggs are laid in a thin gelatinous mass on the surface of the water; eggs may or may not be attached to vegetation or debris (Ashton and Ashton, 1988: see photograph; Bartlett and Bartlett, 1999; Bishop, 2004). Eggs can be observed in gravid females by shining a light through the abdominal region (Bishop, 2004). Tadpoles apparently overwinter and transform into tiny frogs (< 2.5 cm) the following spring or summer (Moler, 1985a).

Bishop (2004) is currently investigating the mating system and communication of the bog frog. Results will be published in his Ph.D. dissertation. His early studies have revealed that the calling sites selected by males are often the same sites at which females deposit their egg masses. Males produce three types of calls, including single chucks in addition to the serial chucks of the advertisement call; females occasionally make chucking calls as well. Males may father zero, one, or several clutches within a breeding season. By calling several nights, males improve their opportunities for reproductive success. Males respond to taped playbacks of calls but do so less on rainy nights. Bishop's dissertation will present analyses of male spacing patterns and the roles of various calls.

Because of their kinship and co-occurrence in many sites, it is not surprising that the bog frog and bronze frog (*R. clamitans*) have been reported to hybridize (Moler, 1992, 1993; Bishop, 2004). Hybridization is common between many congeneric frogs, however, and rarely seems to present any threats to species integrity, nor is there any strong reason to suspect it will be to the bog frog (P. Moler, pers. comm.); the two species presumably have cohabited for thousands of years. Still, it would be of interest to determine the abundance, microdistribution, and fertility of the reputed hybrids.

Bishop (2004) is also examining home range and movements along linear stream corridors. Frogs (mostly males) are captured, toe-clipped, and released, and positions of subsequent recaptures are recorded. Although probably exceptional, one frog did move a short distance overland from a stream to a cypress dome. Nonetheless, genetic exchange among frogs occupying different tributary streams is more likely to occur as a result of movements along common floodplains between the lower ends of the streams. The potential contribution to dispersal and gene exchange of in-stream movements of tadpoles is unknown and in need of study.

Population structure, abundance, carrying capacity, and survival rates have not yet been determined for the bog frog. Bishop's dissertation will present data for three field seasons at one study site, but longer term research and monitoring will be needed to determine such parameters and their variability. As an interim measure, it is suggested that a minimum viable (local) population for the species is indicated at a site by the presence of multiple calling males and documented presence of either one or more adult females or at least one dozen tadpoles (need not all be on the same date) in each of at least two years during a five-year period.

Little is known of predation on the bog frog. Bishop (2003) documented predation on tadpoles by the southern (banded) water snake (*Nerodia fasciata*), which is also likely to prey on juvenile and adult bog frogs. The cottonmouth (*Agkistrodon piscivorus*) is common within the bog frog's habitat and represents another potential predator (P. Moler, pers. comm.). Feral hogs potentially consume frogs, which are possibly vulnerable when inactive in winter retreats, although data on this aspect of life history are unknown.

e. Populations

Species conservation efforts generally focus on maintaining or increasing the size of populations, or at least limiting their rates of decline. Because of the recency of discovery of the bog frog, and the primary necessity of determining the species' distribution, there are as yet no rangewide data on its population size or population trends. About 90% of known sites occur on Eglin AFB, and it is likely that the base supports a comparable or even higher percentage of the species' total population.

Population data are very difficult to obtain for a relatively cryptic species such as the bog frog. Such methods as calling surveys and the capture, mark, and release of frogs (April-September) are necessary. Additional surveys for numbers of egg masses and tadpoles are helpful but may be of little use in quantifying population sizes because of incompleteness. Extensive survey effort would be required to begin to obtain such data rangewide. David Bishop's studies are focusing on obtaining such information in one relatively small stretch of a single inhabited stream. Even when his data are available, it will be difficult to gauge how representative they may be of populations in other sites, even nearby ones. Any attempt to address carrying capacity for this species is premature at present.

Defining a population for the bog frog is also difficult. Bishop (pers. comm.) does not yet feel able to do so after several years of study. It is not known how many adult frogs are necessary for a local population to remain viable (minimum viable population size, or mvp). Whereas a population consisting of hundreds of individuals might be considered robust, some sites undoubtedly are persisting with far fewer individuals, though the lower limit is unknown. For management purposes, it is logical to consider all frogs within a single tributary stream system, or along a continuous floodplain edge, as representing a local population or conservation unit (herein termed Conservation Management Unit, or CMU; see section 6.a.1, Conservation Objectives), although this should not be confused with defining them as a population in the sense of population genetics. CMUs within relatively discrete drainages or watersheds can then be

grouped as “metapopulations,” the conservation of which is now considered to be critical to the preservation of biodiversity. Metapopulations for the bog frog are designated in section 6.a.

Fortunately, in the case of the bog frog, good population data are probably not needed to manage and conserve the species. Rather, its conservation can be effected by a program that includes 1) monitoring all sites annually to biennially to assure that bog frogs are present, showing signs of reproduction/recruitment, and not exhibiting obvious declines or unusual mortality, and 2) managing habitat and threats at all sites appropriately (below).

To date, no known bog frog populations are known to have been extirpated, although some are known to have declined or been fragmented as a result of flooding of seepage habitats (see section 6.b.3). Therefore, this management document does not address restoration of populations at historical locations.

f. Survey Methodology

The most efficient method of surveying for the presence of bog frogs is the use of nocturnal auditory surveys during the activity season. Frogs call predominantly from May through August, and sporadically as early as March (D. Bishop, pers. comm.) and as late as September. Appropriate habitat (seepage streams and seepages along floodplains) is identified from topographic maps in conjunction with field reconnaissance. Males will call in response to taped playback of calls. In contrast to most frogs, calling activity is reduced during and for several days following heavy rains (Bishop, 2004). If bog frogs are present and active, they often can be heard calling within 2-3 minutes (Printiss and Hipes, 1999). Nonetheless, because of the sporadic nature of calling, a site should be visited for at least one half hour on five different nights before assuming that bog frogs are probably absent. Whether a night is appropriate for auditory surveys can be determined by first visiting a site(s) at which bog frogs are known; if none are calling, surveying other potential sites should be deferred (Printiss and Hipes, 1999). The surveyor should record number of calls (and estimated number of individuals) heard in a given time period in addition to noting pertinent non-biological data (e.g., time, air temperature, and precipitation).

Species presence can also be determined by dipnetting to capture tadpoles, although young tadpoles especially can be confused with those of the bronze frog (see section 5.a), which occurs microsympatrically with the bog frog. Although more labor-intensive and not providing data on adult population size (i.e., estimated number of calling males), this method does provide positive confirmation of successful breeding if larvae are found.

Frogs can also be captured by hand or with a dipnet, although their cryptic pattern and behavior may limit success. The placement of drift fences in conjunction with funnel traps in appropriate habitat can also document the presence of bog frogs (Enge, 2002), although the relative efficiency of this technique is low. Nonetheless, it can be a useful tool if part of a more general herpetological survey.

6. SPECIES CONSERVATION:

a. Conservation Strategy and Objectives

Because the bog frog occupies such a limited global range, conservation must focus on protecting as much habitat as possible (elaborated below) for the species. The species should remain viable as long as its present distribution is retained; i.e., no restocking or population enhancement is needed under present circumstances. However, habitat management activities are needed to increase local population sizes and availability of optimal habitat.

1. Underlying Conservation Strategy

An absolute minimal goal for the species' conservation must be the protection of a series of populations representing each of the three metapopulations (East Bay River, Yellow River, and Titi Creek) recognized herein. This is necessary to ensure conservation of any currently existing genetic variability (as yet unstudied) and to prevent random, naturally occurring factors from precipitating demographic collapse. Although not studied in bog frogs or closely related species, conservation theory predicts that species that have been extirpated from much of their range and/or declined substantially in population size (with concomitant loss of genetic diversity), or which naturally have very small ranges or population sizes, may experience the accumulation of deleterious alleles that ultimately result in severe population declines and eventual extinction. In order for such species to survive or recover in the future, all the genetic diversity across the total range of the species must be conserved in order to provide the species with adaptive abilities should future environments change (Culotta, 1995; Lande, 1988,1995; Lynch *et al.* 1995). Based on potential genetic differences, as well as simply the extra buffer that spatial dispersion offers against stochastic events, all three metapopulations of the bog frog are, therefore, considered necessary for the survival of the species and recovery from any future declines.

Watersheds are used as a basis for this conservation strategy, as they are natural units of the landscape, and because if there is important genetic heterogeneity in bog frogs, it is likely to follow watershed boundaries (overland movements between drainages are virtually non-existent so far as known).

2. Conservation Objectives

Two major categories of action are key to achieving success for the above strategy. Of paramount importance is managing bog frog habitat on Eglin AFB in an ecologically sound manner in order to achieve optimal conditions for the species. With more than 90% of the known range lying within the boundaries of Eglin AFB, the ultimate fate of the species rests with the Department of Defense. Every effort should be made to protect and manage all seepage stream and floodplain habitats, in conjunction with adjacent uplands, that are known to or which might support the species. Because most of these habitats are not directly used for DOD mission activities (but see section 6.b.6), this is a

feasible goal that could be accomplished with sufficient commitment and dedication of resources.

Of secondary importance, every effort should be made to protect all three stream systems known to support the frog on private (non-DOD) lands, as these presently are the only sites known from north of the Yellow River (but see section 7.b.1 regarding need for additional surveys). This will require acquisition or less-than-fee simple protection of land followed by ecologically sound management. Section 6.c.2 addresses current efforts to achieve this objective.

To assist managers in setting priorities for these actions, known localities for the species have been consolidated into Conservation Management Units (CMU; Table 1). Generally, a CMU represents a river floodplain or a stream system that flows into a floodplain. A CMU includes all bog frog localities within such a system, as well as other habitat that might support the species but which may not yet have been surveyed. Based on this classification, conservation priorities for all CMUs are assigned as Very High (1), High (2), Medium (3), or Low (4) (Table 1). Priorities are assigned principally on the basis of 1) size of available habitat (rough estimate of km of stream/floodplain length) as a surrogate for estimated bog frog population size, 2) contribution to geographic representation (e.g., drainage and disjunction), or 3) data indicating a reliable, sizable population. Protection should focus on entire stream systems (i.e., the CMUs), not just known bog frog sites. Table 2 summarizes priority assignments for all CMUs (Eglin AFB and off-site) by major drainage.

Protection (including appropriate habitat management) of all Very High priority CMUs (rank 1) is critical to meeting the overlying objective of conserving all three metapopulations of the Florida bog frog. This category encompasses 12 CMUs: four streams and the floodplain within the East Bay River system, five creeks and the floodplain within the Yellow River system, and the entire upper Titi Creek system. Protection of High priority CMUs (rank 2) is likewise considered integral to maintaining metapopulation dynamics and long-term viability, as these sites likely are very important reservoirs for the species as well as potentially provide additional genetic diversity. This category encompasses one additional stream in the East Bay River system, and six in the Yellow River system. Future distributional surveys (see section 7.b.1) may identify other CMUs that should subsequently be assigned to one of these two categories.

In conjunction with protecting the identified CMUs, management should also focus on maintaining continuity of appropriate riparian habitat (see section 5.c) among them to prevent habitat fragmentation and isolation of local populations (see section 6.b.8). The latter are considered by conservationists to be among the gravest threats faced today by many species (Culotta, 1995; Lande, 1988,1995; Lynch *et al.*, 1995). Section 6.c.1 addresses current DOD actions focusing on this objective. In this regard, it is important to protect the floodplains of lower Titi Creek and the Shoal River, as these serve as the only wetland connection between the potentially disjunct upper Titi Creek CMU and the Yellow River proper.

Table 1. Conservation Management Units (FNAI occurrence numbers from Appendix 2) and Conservation Priorities for the Florida bog frog.
Priorities (1, very high; 2, high, 3, medium; 4, low) are assigned principally on the basis of 1) size of available habitat as a surrogate for estimated population size, 2) contribution to geographic representation (e.g., drainage and disjunction), or 3) data indicating a reliable, sizable population. Protection should focus on entire stream systems, not just known bog frog sites.

Drainage/CMU	Conservation Priority
East Bay River	
Dean Creek (7)	1
East Bay River floodplain and Swamp (22, 23, 24, 25, 27)	1
Horse Branch (20)	3
Live Oak Creek and Swamp (17, 19, 26, 32, 33)	1
Panther Creek (25, 29, 30, 31)	1
Prairie Creek (34)	2
Turtle Creek (18)	1
unnamed creek east of Panther Creek (28)	3
Titi Creek	
upper Titi Creek (15, 16)	1
Yellow River	
North Side – private (Yellow River Ravines Florida Forever project)	
Burnt Grocery Creek (14)	2
Garnier Creek (13)	1
Julian Mill Creek (12)	2
South Side – Eglin AFB	
Camp Creek (21)	2
Carroll Creek (11)	2
Crane Branch (5)	2
Hicks Creek (8)	2
Malone Creek (1)	1
Milligan Creek (3)	1
unnamed seepage creek, west of Milligan Creek (4)	2
unnamed creek east of Malone Creek (10)	3
unnamed creek east of Metts Creek (2)	4
Weaver Creek (9, 35)	1
Wolf Creek (6)	1
Yellow River floodplain (mouths of 5, 6, 8, 9, probably many other sites)	1

Table 2. Summary of recommended conservation priorities by drainage and Conservation Management Unit, based on Table 1.

	East Bay River	*Titi Creek*	*Yellow River*
Very High (1)	floodplain and Swamp Dean Creek Live Oak Creek and Swamp Panther Creek Turtle Creek	upper Titi Creek (all)	floodplain Garnier Creek[a] Malone Creek Milligan Creek Weaver Creek Wolf Creek
High (2)	Prairie Creek		Burnt Grocery Creek[a] Camp Creek Carroll Creek Crane Branch Hicks Creek Julian Mill Creek[a]
Medium (3)	Horse Branch unnamed creek E of Panther Creek		unnamed creek E of Crane Branch unnamed creek E of Malone Creek
Low (4)			unnamed creek E of Metts Creek

[a] stream located on private lands north of Eglin AFB

b. Threats and Management Solutions

Because the Bog frog is unknown to most people and has little economic value, known threats to the species principally revolve around degradation of its environment. Printiss and Hipes (1999) and Enge (2002) reviewed the most obvious of such threats. In this section, an attempt is made to list known and potential threats in perceived level of importance, from most widespread or serious to least, although this order should not be considered sacrosanct, and future data might suggest its modification. Each threat category is followed by one or more management options or solutions.

Threats and management options and solutions differ little between occurrences of the bog frog on DOD and non-DOD (private) lands. They are, therefore, treated together in this section, with annotations specifically addressing any differences as appropriate. The scope and time frame of this project did not allow in-depth analysis of threats and management needs at all known bog frog localities. Nonetheless, site-specific threats and recommended management actions are included in Appendix 2 as they were noted during field examination of known occurrences. A

partial list of sites exhibiting various threats or in need of management attention is also included below (Table 3 at end of this section) for each of several categories of threat.

Priorities for habitat management activities should follow the CMU priorities presented in Table 2. Management actions should not be limited to known bog frog sites but rather extended throughout entire CMUs as needed. Some threats are most likely to occur at known bog frog sites (e.g., erosion at road crossings), whereas others (e.g., extensive woody encroachment) may occur within parts of CMUs that have not been surveyed due to difficulty of access.

1. Fire Suppression and Habitat Succession

Threats:
Fire plays a role in the maintenance of bog frog habitat. During dry periods, fires that naturally burn the uplands above seepage habitats would have swept downslope into shrub bog habitats. This would have eliminated or retarded the growth of shrubs and trees, which tend to invade these habitats in the absence of fire (Means and Moler, 1979). The reduction of insolation as a result of increased shading appears to reduce or eliminate local populations of such species as bog frogs and pitcherplants, which require at least some sunny areas. Increased density of woody species may also reduce soil moisture as well as the amount of shallow rivulet habitat preferred by the bog frog. In streams where the riparian vegetation consists predominantly of mature hardwood species, bog frogs typically occur only at disturbed (sunnier) sites such as at power line right-of-way crossings (Moler, 1992 and pers. comm.). Their absence from densely shaded sites is attested to by the results of auditory surveys (P. Moler, pers. observ.; D. Printiss, pers. observ.). Because of the recency of discovery of the species and the need to focus field work on basic distributional surveys rather than monitoring, data documenting local population extirpation related to woody encroachment and excessive shading are not available. Such extirpation probably occurs on a time-scale that equals or exceeds the time since the species discovery (ca. 20 years).

Although quantitative data on historic vs. current availability of suitable bog frog microhabitat are unavailable, present conditions suggest a long-term downward trend as a result of replacement of massive historic fires (often during drought) by more recent patterns of fire exclusion and controlled prescribed fires. The relictual presence of heliophilic plants (e.g., pitcherplants, *Sarracenia* spp.) in overgrown, shaded habitats along several bog frog streams attests to a pattern of woody plant encroachment that has continued to occur in recent decades.

Management Options and Solutions:
Where appropriate, management should attempt to maintain a relatively open shrub bog community (see Means and Moler, 1979). Although data for bog frogs are insufficient to permit quantification, a minimum of 20% of ground surface receiving some direct sunlight seems reasonable. This should secondarily benefit other rare species (e.g., panhandle lily [*Lilium iridollae*], sweet pitcherplant [*Sarracenia rubra*], and pine barrens treefrog [*Hyla andersonii*]) that thrive in this habitat. Prescribed fire is the principal tool to achieve this, and it is currently used extensively (and laudably) at Eglin AFB. Many of

the sites observed during 2004 nonetheless suffered from woody plant encroachment, and it was clear that recent fires rarely burned into the riparian zone. Fire managers should be encouraged to take such steps as they deem appropriate to achieving a more open riparian understory. The following paragraph offers possible tools for their consideration.

Although there may be increased risk associated with burning during dry periods, this would facilitate habitat maintenance and improvement for the frog. Fire managers could perhaps take advantage of directional winds to burn downslope into riparian zones when conditions permit. Growing season burns are generally preferable in associated upland habitats and can be expected to produce hotter fires that have increased chances of burning into riparian vegetation. If high fuel loads in adjacent uplands prohibit hot, growing season or wind-driven fires, managers might consider burning a "black line" upslope (along or above the upper edge of the riparian-upland ecotone) during less threatening conditions (P. Moler, communication, in Printiss and Hipes, 1999); the riparian zone would later be burned while fuels remained low within the black line. This should decrease the risk (of catastrophic or undesired fire in uplands) from igniting hot fires aimed at burning the riparian zone. In extreme cases, it may be appropriate (though labor intensive) to cut larger woody species along the riparian edge, then follow this with a burn after the slash has dried; burning a black line above the burn zone may again help to decrease risk to upland communities.

In summary, existing management at Eglin AFB should continue its present use of prescribed fires but attempt to increase their coverage, frequency, intensity, and effectiveness (by pushing them into riparian zones). In some instances (where fire will not carry or where smoke may be a problem for the Eglin mission), the use of mechanized equipment may be considered as a potential replacement for fire, though great care must be used to avoid undue soil and groundcover disturbance. Non-Eglin lands will require extensive remedial actions to restore fire-maintained communities; these may include harvesting of timber followed by reforestation with longleaf pine, mechanical cutting of shrubs, introduction of prescribed fire, and possibly the judicious use of herbicides (but only after thorough testing for effects on non-target species). Table 2 identifies priorities by CMU for such actions, although on-the-ground field inspection will be necessary to identify specific sites in greatest management need.

2. Erosion, Siltation, and Flooding (Roads and Borrow Pits)

Threats:
Roads that cross or run along the edges of seepage streams have several potentially negative effects on bog frog habitat. Among these are siltation and flooding. With 1930 km of streams on base (U.S. Air Force, 2002), it is not surprising that many of Eglin's unpaved range roads cut directly across one or more streams, including most of those inhabited by bog frogs. Base-wide, 286 known erosion sites on Eglin account for an estimated 90,000 tons of annual soil loss (U.S. Air Force, 2002). Especially in the steeper terrains of the Yellow River drainages, tons of soil and water rush downhill along or on roads directly into known bog frog sites during heavy rains. Eglin has attempted to stem the tide of runoff at some sites by paving stretches of road and constructing water

diversion channels. Results appear to be mixed. While the road crossings themselves are less likely to be washed out, large erosional gullies have formed on both sides of some roads, and deltas of sediment provide clear testimony to the continuing erosional deposition that accompanies precipitation. Flooding is naturally rare in the stable seepage stream ecosystem; in addition to unnatural and sudden increases in depth, it is also accompanied by pronounced changes in current velocity and water temperature. It is uncertain how such events (even though temporary) may affect bog frogs. Because eggs are laid and tadpoles develop in very shallow rivulets, it is likely that such flooding is deleterious if not disastrous to reproduction (Printiss and Hipes, 1999).

The construction of borrow pits from which clay is extracted for roadfill on Eglin AFB has likewise contributed to siltation and flooding at some sites. The walls of at least one pit have collapsed, with the result that tons of sediments entered and virtually blocked a seepage stream (Camp Creek, FNAI occurrence 21) known to support bog frogs. Frogs no longer occur in the impounded area but have been heard above it.

It should be noted that in at least some sites that have been heavily impacted by siltation, bog frog populations seem to be maintaining themselves (at least at present). Nonetheless, continued siltation of these sites might eventually make them unsuitable, perhaps by filling in the shallow rivulet microhabitat or favoring the development of a single, deep channel that replaces the broader, shallow one.

Management Options and Solutions:
Maintaining naturally vegetated slopes and uplands above riparian habitats used by bog frogs is the key to preventing erosion and siltation. Ideally, from an ecological perspective, roads contributing to soil erosion in seepage habitats should be closed; those considered important for traffic movement should be rerouted farther upslope. Where this is not practical, immediate actions should be taken to revegetate barren road shoulders and to fill and revegetate erosional gullies. Construction of additional water diversion turnouts may be helpful, but these must be monitored to assure that they themselves do not become erosional channels. Paving of road crossings may be helpful in reducing siltation, but only if adjacent road shoulder areas are well vegetated. Sites in need of erosion control actions are identified in Appendix 2; Eglin AFB reportedly has plans to re-route at least one road that crosses a small seepage stream (Appendix 2: FNAI occurrence 4; P. Moler, pers. comm.).

International Paper, the Florida Department of Transportation, and GCPEP, have initiated an effort to reduce runoff and siltation from the large gully on Julian Mill Creek (non-DOD land). In addition to the emplacement of hay bales, the project has begun to revegetate the slopes. This effort (and similar efforts elsewhere as needed) should continue. Special attention should be given in such projects to using species that occur naturally in local shrub bog habitats. If hay bales or potted plants are used, they should be certified as weed-free, as well as inspected to be sure that they are free of fire ants.

Borrow pits located immediately upslope of any seepage habitat should be closed. Grading or reconstruction may be necessary to assure that such pits do not become

holding ponds that may rupture during large storms. Major revegetation efforts, using native vegetation as much as possible, should be undertaken and include the reestablishment of a grassy groundcover in addition to shrub and canopy layers. The construction of a series of contoured catch basins below borrow pits also seems to be an effective means of rehabilitation (Enge, 2002). The closure and/or management of borrow pits within the range of the bog frog could be conducted as an extension of, and using knowledge gained from, similar restoration work that has been undertaken on Eglin AFB on behalf of the Okaloosa darter during the last 10 years.

3. Impoundment

Threats:
Impoundment of seepage streams may be deliberate or unintentional. It is common practice in western Florida for landowners to build small dams to impound portions of small seepage streams to provide recreation (especially fishing for stocked game fish) as well as a water supply. The resulting flooding typically eliminates or at least fragments local populations of animals, such as the bog frog, that require streamside microhabitats. Not only does impoundment flood the shallow riffle habitat preferred by adults bog frogs, but it also eliminates the freely moving, cooler, and more highly oxygenated waters that are probably required by the tadpoles.

On Eglin AFB, the negative effects of impoundment on bog frogs can be seen at Roberts Pond (a tributary of Live Oak Creek; FNAI occurrence 17), where bog frogs persist immediately below the dam. Similar damage may have occurred at Indigo Pond on Indigo Branch in the Titi Creek drainage (near FNAI occurrence 16). The collapse of a road crossing culvert has had a similar effect on Weaver Creek (FNAI occurrence 9), which Moler formerly considered to be the best known for the bog frog. Beaver dams, often created at artificial road crossings by plugging culverts, have likewise flooded bog frog habitat at several sites on Eglin (e.g., FNAI occurrences 4, 5, and 7), as did sediments from a collapsed borrow pit on Camp Creek (FNAI occurrence 21; previous section). In these cases, bog frogs now occur only above or below the impounded area. Nonetheless, it is premature to state that the relationship between bog frogs and beavers is entirely negative; it may be that in some instances beavers have created habitat for the frog (this requires study).

Although construction of additional impoundments can be prevented on Eglin AFB, there are few or no legal restrictions to assure that this will not occur on unprotected private lands, where three bog frog streams occur. This underscores the importance of bringing these private lands into public ownership or at least securing less-than-fee simple provisions to prevent impoundment (see section 6.c.2).

Finally, the potential threat to the bog frog and other seepage stream inhabitants from proposed impoundment of the Yellow River upstream of Eglin AFB should be noted. Although no known bog frog sites would be flooded, any drop in basal water levels within this system below the dam might affect seepage streams downstream, perhaps by increasing their head-cutting action (J. Herod, pers. comm.; J. Bachant Brown, pers.

comm.) or reducing the extent of shallow streamside rivulets.

Management Options and Solutions:
Under no circumstances should new impoundments be constructed along any stream inhabited by the bog frog. Unintentional impoundment, created by the blockage of culverts by debris or by beaver activity, as well as the collapse of culverts, can be reduced (though perhaps not eliminated) by installing large, cement box culverts rather than smaller, tubular metal culverts beneath roads that are deemed essential to retain for traffic movement. Beaver dams blocking streams recognized as being important to bog frogs can be physically removed, with trapping of beavers in areas of repeated blockages.

The Natural Resources Branch at Eglin AFB should carefully examine and monitor all proposals related to the damming of the Yellow River upstream. It would be especially pertinent to model potential effects this action might have on the base's seepage streams, both hydrologically and environmentally.

4. Invasive Non-Native Species

Several non-native species degrade bog frog habitat both on Eglin AFB and private lands. All of these require active control measures. Feral hogs directly damage the substrate and immediate microhabitat required by the frog, while a number of plants that grow aggressively in riparian zones have the potential to increase shading and thereby reduce the level of insolation (sunshine penetration) that typifies bog frog habitat. Fire ants, although present on the base and sometimes found within or near its wetlands, probably represent little threat to the frog, as water serves either as a habitat or refuge for all of the frog's life stages.

a. Hogs

Threats:
The seepage habitat of the Bog frog is especially vulnerable to disturbance by wild hogs. Printiss (pers. comm.) and Means (pers. comm.) both noted substantial hog damage to Eglin's seepage stream systems during herpetological studies in the 1990s. Eglin's INRMP summarizes the threat from hogs on the base as follows. "The wild hog or feral pig has been prioritized as the most problematic invasive non-native animal species that threatens natural ecosystems on Eglin. Wild hogs compete with native wildlife for food and alter natural habitats that are critical for both plants and animals. Wild hogs prey on many forms of native wildlife. The rooting of wild hogs in sensitive natural areas, such as seepage slopes and steephead ravines, has damaged and destroyed many rare and sensitive plants" (U.S. Air Force, 2002).

Management Options and Solutions:
Eglin's Natural Resources Branch (NRB) is responsible for addressing the threat to native ecosystems from wild hogs on the base. To provide greater flexibility for the control of feral hogs, Eglin AFB removed the "game species" status for hogs prior to the 1999-2000 hunting season. Nonetheless, despite there no longer being any size or bag limit for

harvesting hogs, the overall population has continued to increase, especially in areas where hunting is prohibited (on Eglin's "closed areas"). As stated in the INRMP, "wild hogs are extremely prolific. To achieve a declining population trend requires the removal of more than half the hog population on an annual basis." The NRB monitors the impacts of feral hogs on base (U.S. Air Force, 2002) and in October 2003 initiated a cooperative program with the U.S. Department of Agriculture that has already removed more than 200 hogs, principally from the closed areas. Although recent hog damage was not extensive at bog frog sites observed during early 2004 field examination, this can change quickly, and an aggressive approach to the control of hogs is appropriate.

b. Invasive Non-Native Plants

Threats:
Invasive plants are generally not abundant in bog frog habitat but do pose a potential threat of decreasing insolation (increasing shading) in the relatively open shrub bog habitats required by the species. The chief threat in riparian habitats in western Florida is Chinese tallow tree (*Sapium sebiferum*), a rapidly growing tree that easily establishes itself in sunny locations and which can develop into dense thickets. The species is ranked in Category I (highest management concern, known to alter native habitats) by the Florida Exotic Pest Plant Council (EPPC), a non-profit organization made up of public agencies, scientists, researchers, land managers, environmental organizations, and private citizens. Chinese tallow trees have been documented on approximately 200 acres and 20 known sites on Eglin property. The species has been introduced to Eglin property by past landscaping practices, illegal dumping of landscape debris, and seed dispersal by birds from adjacent privately owned property (U.S. Air Force, 2002). A second woody species also with the potential to degrade bog frog habitats is Chinese privet (*Ligustrum sinensis*; EPPC Category I).

Shading can also develop in such habitats beneath large tangles of Japanese climbing fern (*Lygodium japonicum*; EPPC Category I: see below), a rapidly growing vine that can cover and smother understory and mid-story plants. The species is spread by wind-blown spores and is difficult to control. Approximately 10 acres at five sites have been documented on Eglin property.

Other species that might present threats to bog frog habitats include the trees Chinaberry (*Melia azedarach*) and mimosa (*Albizia julibrissin*), air-potato (*Dioscorea bulbifera*, a rapidly growing vine that can cover trees and shrubs), and torpedo grass (*Panicum repens*). Cogon grass (*Imperata cylindrica*) may invade the adjacent uplands and power line rights-of-way. All are ranked in Category I by the EPPC.

Management Options and Solutions:
Every effort should be made to eliminate any infestation of invasive exotic plant species growing in bog frog habitat. Guidelines for removal and control of a given species can be obtained from the Florida Exotic Pest Plant Council (http://www.fleppc.org), the Florida Department of Environmental Protection's Bureau of Invasive Plant Management, and the University of Florida's Center for Aquatic and Invasive Plants. All

herbicides should be used with extreme caution in and around aquatic habitats, especially those that support rare amphibians. If plants are to be removed physically, extreme care should be taken to avoid impacts that might cause siltation or damage the soft substrate and delicate vegetation in such habitats.

Since 1999, approximately 155 acres of Chinese tallow tree on Eglin AFB have been treated with Garlon 4 and JLB Oil Plus adjuvant and are on a retreatment schedule. The remaining untreated acreage is to be placed on a treatment schedule as funds become available. When areas are treated for Chinese tallow, all other invasive non-native woody species are treated as they are encountered. All known Japanese climbing fern sites have been treated with herbicide and are being monitored. (U.S. Air Force, 2002).

5. Pollution

Threats:
Surface water quality of streams inhabited by the bog frog on Eglin AFB is considered intermediate or high (U.S. Air Force, 2002: fig. 3-9). Nonetheless, and although their effects on bog frog populations are unknown, pollutants do enter at least some of the streams inhabited by the species. Two of the three streams occurring on private land (Burnt Grocery, Julian Mill creeks) have their headwaters just below US-90 and pass beneath I-10; both likely receive petrochemical runoff as a result. The threat is likely most severe in Julian Mill Creek, where a very large gully has eroded below the interstate and enters the creek. Most of the streams supporting frogs on Eglin AFB are crossed by range roads and are therefore subject to introduction of some petrochemical pollutants. Potential input is probably greater in streams along the south side of the Yellow River, where steeper terrain leads to rapid channeling of runoff either via erosive gullies or directly along the roads themselves. Live Oak Creek crosses a major test range and may possibly be subject to the introduction of pollutants as a result.

A second form of pollution is the introduction of herbicides. Gulf Power uses herbicides to reduce or eliminate shrubs and trees along the power line right-of-way that cuts across the three privately owned bog frog streams; a 2004 application is currently planned. Eglin AFB cooperates with Gulf Power in allowing similar herbicide applications to rights-of-way on the base (although precautions are taken), where at least two cross known bog frog streams (Dean Creek and Live Oak Creek). No data address the effect of herbicide use on the bog frog.

Livestock (horses?) were observed grazing upslope from the Burnt Grocery Creek site. Although they did not have access to the stream and were separated from it by abundant vegetation, it is possible that livestock waste might have some, though probably minimal, effect on the stream's water quality.

Management Options and Solutions:
Efforts to eliminate or control erosion (see section 6.a.2) are also key to preventing pollutants, such as petrochemicals from vehicles, from entering bog frog streams via runoff. Water quality should be monitored at sites where erosion is substantial, or below

points that cross military test ranges, to determine whether corrective actions are needed.

Any herbicide to be used in or near bog frog habitat should be reviewed for potential effects on non-target organisms. Effects on amphibians, including their larval stages, should be examined. Laboratory studies to test potential effects specifically on bog frogs and their tadpoles should be conducted. Bog frog populations inhabiting streams that are subject to the introduction of herbicides should be closely monitored before and after local application of herbicides. Although Eglin AFB policy restricts the use of herbicides to uplands, and herbicides in use are believed to break down quickly in the soil, it would nonetheless be appropriate to monitor seepage streams as a precaution to assure that no leaching of herbicides is occurring.

If proven safe, the use of herbicides may be preferable to the physical clearing of vegetation, which likely would disturb groundcover vegetation and soils and lead to erosion, siltation, and introduction of petrochemicals. However, until research provides such information, the use of herbicides in bog frog habitat should be viewed with extreme caution. Mowing (bush-hogging) may present a safer alternative if done carefully; mowing in winter is less likely to disturb frogs, although it should be avoided when soils are soggy to reduce the risk of soil and groundcover degradation.

Elimination of livestock from slopes above bog frog streams may not be necessary but nonetheless would be a wise precaution. Any erosional features draining from slopes occupied by livestock should be filled and revegetated.

6. Impacts of Military Training and Testing

Threats:
Because of the bog frog's restriction to seepage habitats, direct impacts of Eglin's military training and testing missions appear to be limited. Most such activities take place in the base's upland habitats. Nonetheless, the construction and placement of roads and other facilities upslope from or through bog frog habitats has led to habitat degradation through factors listed above (e.g., erosion, siltation, pollution). A significant portion of one very high priority CMU, Live Oak Creek, crosses a major military test range. Because of restricted access, it is not known whether frogs occur there or whether military activities have impacted the habitat.

Management Options and Solutions:
Avoidance of bog frog habitats for infrastructural development and military missions and training should remain a primary focus of bog frog conservation efforts on Eglin AFB. It is imperative to preclude to the greatest extent possible the movement of vehicles and troops through sensitive seepage habitats, as they are so easily disturbed. This requires more of a continuation of current Eglin policies than any real change, as existing protective measures based on cultural and wetlands issues are already in place. The base's current operational plan acknowledges the importance of seepage habitats, which should support bog frog conservation and recovery. The ignition of fires in Eglin's wildlands as a result of military activities is a positive factor in terms of maintaining bog

frog habitat and, from an ecological perspective, need not be restricted or controlled.

Surveys of the portion of upper Live Oak Creek that crosses the test range should be conducted as feasible. These should assess the potential presence of bog frogs as well as habitat conditions and threats. It is especially important to assure that downstream portions of Live Oak Creek are not degraded by pollution or siltation that might result from test range activities (including vehicular movements).

7. Silvicultural Operations

Threats:
Replacement of the native upland longleaf pine forest ecosystem by intensively managed sand pine plantations has many consequences for rare as well as common species. Although directly leading to the decline or extirpation of native upland species, secondary effects on downslope (wetland) species is possible. The foremost threat to bog frog habitat is the exclusion of fire from such plantations, with the consequences elaborated above (section 6.b.1). The loss of native groundcover may affect the rate of percolation of rainfall, the slow release of which is the driving force that regulates seepage streams such as that required by the bog frog. Silvicultural operations also increase the potential for siltation of seepage streams as the result of ground disturbance during harvest operations. In some instances, insecticides and herbicides may be introduced. Invasive plants are also more prone to establishment in disturbed environments.

Management options and solutions:
Preferred management is eventual replacement of sand pine plantations with fire-maintained natural communities dominated by longleaf pine and native grasses. Sand pine should be harvested (by careful clear-cutting) with special attention given to minimizing soil disturbance, especially near the riparian-upland ecotone. Restoration will require massive revegetation with native upland species.

8. Habitat Fragmentation

Threats:
Habitat fragmentation is a major conservation threat to most species, as human degradation and destruction of natural landcovers have isolated individuals and local populations that once maintained gene flow across relatively continuous ranges. At present, this would seem to be a minor threat to the bog frog; it is included here as a potential threat that sound ecological management can prevent from becoming important. No data are available concerning the viability of small, isolated populations of bog frogs, but it is inherently logical that continuity with a larger source pool of frogs can only be beneficial in reducing the chances of local extirpations, as well as in allowing repopulation of habitats that might have lost bog frogs for some reason. Although patterns of movements of bog frogs among various occupied tributaries are unknown, the most parsimonious hypothesis is that such movements, which may occur only infrequently, are along stream corridors and via common floodplains at the lower ends of

tributaries, rather than across upland ridges situated between tributaries (Bishop [2004] did record one individual movement upslope, but this is likely rare). It is worth noting that excessive woody encroachment along seepage streams can potentially act as a mechanism that isolates localized frog populations even along the same tributary.

Management Options and Solutions:
Management should focus on maintaining natural riparian habitat (as described in section 5.c) along the entire lengths of tributaries, from sites of known occurrences of bog frogs downstream to their confluence with riverine floodplains. As discussed above (section 6.a.1), allowing (or encouraging) fires to burn into riparian zones, by burning under appropriate weather conditions, can reduce the opportunity for woody vegetation to isolate frogs inhabiting different sections of the same tributary. Floodplain riparian zones should be maintained intact and free of high-intensity timber harvesting.

9. Hybridization

As mentioned elsewhere (section 5.d), genetic swamping or alteration through hybridization with the bronze frog is not presently deemed to be a threat to the bog frog, despite reports of hybridization in the wild (D. Bishop, pers. comm..; P. Moler, pers. comm.). The topic is included within this list of threats only as a precaution that merits monitoring and study (see section 7.b.2).

10. Other Potential Threats

Since the 1970s, unusual declines of amphibians, especially frogs, have been reported worldwide (Alford and Richards, 1999). These have prompted hundreds of studies in search of causative agents (e.g., Lanoo, in press), as well as dedicated organizations such as the Declining Amphibian Populations Task Force (DAPTF) and U.S. Geological Survey Amphibian Research and Monitoring Initiative (ARMI). Several symposia and their resulting proceedings have shed light on the subject, while also raising questions and suggesting directions for future research. Some of the factors believed to be partially responsible for such declines are noted below. Nothing is known about the relevance of these to the bog frog (which is not known to be declining), but they merit long-term consideration in any amphibian conservation program and, therefore, are included here.

a. Disease and Parasites

Threats:
An association between amphibian declines and pathogens and/or parasites is now widely accepted. One suspected causative agent of global concern is chytrid fungus, which is known to be associated with many declining populations of frogs, especially species that breed in streams (Bonaccorso *et al.*, 2003, and references therein). However, chytrid fungus is also present in some seemingly healthy populations (Hopkins and Channing, 2003), so conclusions are not yet definitive. Bacterial and viral infections also pose potential threats. At least some populations of anurans (frogs and toads) are thought to have disappeared as a result of bacterial infection (Carey, 1993; Davis and Gregory,

2003).

A variety of trematodes (flukes) and nematodes (roundworms) are known from frogs, but rarely are their effects on host populations understood. In general, it is known that parasites may affect the growth and survival of individual hosts, and it is suspected that they may be able to regulate host population sizes (Kehr and Hamann, 2003, and references therein). Johnson *et al.* (1999, 2001) identified a parasitic fluke as the probable cause of malformation (e.g., excess limbs) in some species of North American frogs; such anomalies likely reduce the survivorship and fitness of individuals.

Management Options and Solutions:
Although control or treatment of pathogens and parasites may be difficult within infected local populations, it is important to prevent the spread of such agents among populations. Recommendations for anyone working within aquatic habitats that support breeding populations of amphibians are to disinfect appropriate clothing (e.g., boots, waders, shoes) and equipment (e.g., dipnets, seines, funnel traps) whenever moving between sites. A 10% solution of bleach has been suggested as adequate.

Monitoring is also important. Any signs of mortality, disease, or abnormal individuals should be recorded. If three or more such individual frogs or toads are observed at a local site, they should be preserved in 70% ethyl alcohol with their bellies slit to facilitate preservation. Specimens can later be provided to appropriate researchers for examination.

b. Physical/Climatological Environmental Factors

Threats:
Tremendous concern and attention are being directed globally toward changes in the physical and climatological environments that may be resulting from human disturbances to the environment. These issues are far too complex to treat in this document. Among the factors of concern are climatological change (including global warming and precipitation patterns), acid precipitation, and increased levels of ultraviolet radiation.

One potential long-term change that may affect the bog frog's distribution is the increase in sea level that is expected to accompany global warming (as a result of the melting of polar ice caps and glaciers). Because the bog frog inhabits low-elevation streams (with some sites along the lower East Bay River being little more than 5 feet above sea level), habitat may be lost as the lower portions of streams are flooded with saline water.

Management Options and Solutions:
Global environmental and climatological issues occur at a scale far beyond that for which management can be directed toward the bog frog alone. Rather, all persons, agencies, and organizations should support national and global efforts to ameliorate the potential threats posed by the factors noted above.

Table 3. Partial list of known bog frog sites in need of management attention.
Listed by FNAI occurrence number (Appendix 2) within CMU priority categories (Tables 1, 2). * = non-DOD sites. Sites shown in bold are considered in high need of attention. This listing should not be considered definitive; additions and modifications should be made in the future as indicated by detailed field assessments.

CMU Priority Management Recommendation	**Notes**	**1**	**2**	**3**	**4**
reduce woody invasion of riparian zone (burn if possible)	nearly all sites in need	**1**, 3, **7**, 9, 18, 19, **22**, **24**, **25**, 27, 29, 30	4, 5, 6, 11, 12*, 21	10, 28	2
road closure or rerouting		27	**4**		
erosion/road crossing evaluation and management		1, **3**, 15, 16, 17, 18, 19, 25, 26, 27, 31	5, 6, 8, 11, 12*, 13*, 14*, 21	10, 20, 28	2
borrow pit closure, repair, or restoration		**31, 33**	**12***, **21**		
beaver dam removal		**7**	**4**, **5**		
culvert clearing, repair, or replacement		**7**, **9**			
impoundment removal, restoration:		15, 17			
hogs: eradicate wherever sign is noted; include sites		17	**4**		
invasive plants	no critical sites noted; eradicate wherever discovered				
power lines: monitor streams for residual herbicide and unusual mortality following application		7, 9, 32	12*, 13*, 14*		
monitor military impacts		upstream of 17, 19, 26, 32, 33			
restore plantation to native upland pine community			12*, 13*, 14*		

c. Conservation Actions: Adaptive Management and Monitoring

1. DOD Conservation Actions

The Eglin AFB NRB has proactively designated the bog frog as a conservation target in its INRMP. As such, it has initiated actions toward the species' conservation, as well as outlined potential future actions (Appendix 1). The effectiveness of future management (and quantity of resources) directed toward the bog frog on Eglin AFB can be enhanced by a continued or increased level of cooperation with potential conservation partners (see section 4.h.1).

Included within its current and recent efforts directed toward the species are support of research into the ecology and distribution of the species, most specifically through Virginia Polytechnic Institute and State University (Bishop, 2004) and the Florida Natural Areas Inventory (Printiss and Hipes, 1999). Continued studies of these types will prove invaluable in conserving the species and its habitat.

Section 6.b of this document provides management recommendations to alleviate or limit known and potential threats to bog frogs on the base. One difficulty in managing the species on Eglin is the occurrence of several populations in areas of restricted access along the East Bay River. Special arrangements should be made to identify opportunities for periods of access to these areas that will be sufficient to inventory and monitor local populations and to identify management needs, as well as to conduct management activities.

Eglin AFB maintains an active program of prescribed burning in its uplands, with particular emphasis on maintaining or restoring habitat for the red-cockaded woodpecker. The current goal is to burn 70,000 acres per year. Greater emphasis at present is on increasing the frequency of fires, with less emphasis on seasonality (burns are conducted from December through June). A program to increase the coverage and frequency of fires on Eglin is compatible with bog frog conservation, with increased emphasis on burning into wetlands and riparian zones (as opposed to exclusion of fire from such areas, historically a common practice in Florida).

Eglin already has an active program addressing erosion control and the management of range roads (U.S. Air Force, 2002: 82-83; attached as Appendix 3). Stream sections that are receiving the most sediment receive the highest priority for action. However, streams with significant conservation targets (such as the bog frog) are eligible for more immediate action than those that have lower biodiversity value. At present, this program is driven primarily by conservation of the Okaloosa darter, the range of which is completely non-overlapping with the bog frog. Expansion of this program into the range of the bog frog would be highly appropriate.

Eglin has instituted management activities to address the threat from invasive non-native species (U.S. Air Force, 2002:109). As elaborated in section 6.b.4.b, management

activities most important to the bog frog are removal of hogs and elimination of Chinese tallow tree and Japanese climbing fern.

As part of its resource management program, the Eglin Natural Resources Branch (NRB) has established a large series of terrestrial and aquatic stations (monitoring plots) to determine the response of conservation targets (including the bog frog) to management actions. These include a number of tributaries that support the bog frog (U.S. Air Force, 2002: fig. 4-5).

Also, following a precedent on some military and government lands, Eglin AFB designated 15 areas as having special significance to conservation. These "Special Natural Areas (SNA's)," which are intended to represent and protect the best examples of major plant communities and habitat types within the Eglin Reservation, will be protected from most forest management activities (excluding restoration), some types of public access, and certain mission activities. They will also serve as reference sites for long-term ecological research and monitoring to assess impacts from various forms of management and mission activities as part of Eglin's adaptive management program. The SNAs include substantial stretches of two important bog frog streams, Weaver Creek (Yellow River) and Live Oak Creek (East Bay River) (U.S. Air Force, 2002: fig. 4-7).

2. Regional Conservation Actions (non-DOD lands)

Only three of the known occurrences of the bog frog are situated outside of Eglin AFB. These are in three adjacent tributaries flowing into the north side of the Yellow River (Eglin is on the south) near the community of Floridale. From east to west, the streams are Julian Mill Creek, Garnier Creek, and Burnt Grocery Creek. All three rise in the vicinity of the I-10/US-90 transportation corridor, where it passes between Eglin AFB and Blackwater River State Forest. The land encompassing the three streams has been proposed more than once for acquisition under the state's land acquisition programs.

In 1989, the Florida Natural Areas Inventory proposed protecting the bog frog sites through the state's Conservation and Recreation Lands program as part of a Blackwater-Eglin Connector project. Later renamed the Yellow River Ravines, the proposal was eventually approved and added to the state's Preservation 2000 project list from 1993-1996; it was removed in 1997 with the understanding that a state agency had it on its internal P-2000 list. In May 2002, The Nature Conservancy and the Florida Division of Forestry jointly submitted a modified Yellow River Ravines proposal (The Nature Conservancy and the Florida Division of Forestry, 2002) to the Florida Forever program. This proposal, which included all three bog frog streams, was approved by the Acquisition and Restoration Council (ARC) in June 2002 for re-addition to the state project list as a Group A/Full Fee Priority project. In refining the project's boundaries to include only willing sellers, the state removed one section of land that supported the bog frog site on upper Burnt Grocery Creek (but frogs might occur downstream on lands still within the project). The project, as depicted in the program's 2003 five-year plan (Florida Department of Environmental Protection 2003; see Appendix 4), includes 16,652 acres in 41 parcels held by five owners, with an estimated tax assessed value of $12,227,546. More than 90% of the project is owned by International Paper.

Negotiations to secure these lands are underway, with assistance from The Nature Conservancy; if successful, acquisition could occur as soon as late 2004 or early 2005. (Note: the Florida Department of Environmental Protection's Division of State Lands maintains an internet web site for the Florida Forever Program. This site contains a complete version of the five-year plan, which includes the Yellow River Ravines project on pp. 444-446).

If successful in acquiring the project, the state intends to assign its management to the Florida Division of Forestry (DOF) within the Department of Agriculture and Consumer Services. The land would then become part of Blackwater River State Forest (at 189,600 acres, already one of Florida's largest state forests). Blackwater Forestry Center personnel would carry out management activities and coordinate public access and use, as well as seek input and assistance from other agencies (e.g., FFWCC) and interested parties (e.g., GCPEP). The stated goals of DOF for managing such lands are "to restore, maintain and protect in perpetuity all native ecosystems; to integrate compatible human use; and to insure long-term viability of populations and species considered rare" (Florida Department of Environmental Protection, 2003). Such an ecosystem approach is highly compatible with bog frog conservation. The project also provides a key link in the protection of a continuous corridor of public land from Eglin AFB through Blackwater River State Forest and the adjacent Conecuh National Forest in Alabama.

The Yellow River Ravines project is crossed by a roughly east-west utility corridor that will require monitoring for unauthorized use (e.g., off-road vehicles) and introduction of invasive exotic species (e.g., Chinese tallow). The sites from which bog frogs are known within the Yellow River Ravines were discovered at the points at which the corridor crosses each of the three creeks, although it is expected that the occurrences extend along each stream.

The uplands within the Yellow River Ravines predominantly supported a sandhill natural community at one time, but intensive silviculture has severely degraded the resources. Initial management costs necessary to restore and manage this system as a state forest are, therefore, expected to be high. Groundcover restoration as well as reforestation in longleaf pine will be necessary. Costs should eventually decline to a moderate level as management emphasis shifts to habitat maintenance.

Both Julian Mill and Burnt Grocery creeks flow beneath Interstate 10 through concrete box culverts. Design flaws appear to have altered stream characteristics and induced sedimentation at these crossings. Pollutant-laden runoff and eroded sediments enter the streams from the highway during rain events, with consequent increases in turbidity as well as potential toxins to aquatic life. Preservation of these two stream ecosystems may require retrofitting of the highway crossings and drainage structures. If not acquired for conservation, water resources within the Yellow River Ravines project face potential threats from stream impoundment, sedimentation from improper silvicultural practices and road development and maintenance, and pollution and eutrophication from the use of

fertilizers and pesticides as well as septic tank discharge should development occur (The Nature Conservancy and the Florida Division of Forestry, 2002).

The Yellow River Ravines project excludes the section of land (sec 20, T2N, R26W) through which upper Burnt Grocery Creek passes, including the site of the known bog frog occurrence. In conjunction with preparation of this Management Guidance Document, the author identified four parcels of undeveloped land totaling 383.6 ac that should be considered for addition to the project. This was called to the attention of the Florida Forever program/DEP Division of State Lands, the Florida Division of Forestry, and The Nature Conservancy. Appendix 5 provides a map and parcel information.

d. Measuring Effectiveness of Conservation Actions

Conservation actions will be considered successful when the following criteria have been met.

1. Non-DOD Lands

a) Thorough distributional surveys for the bog frog have been completed in all potential habitats off-base (see section 7.b.1). Should the species be found in previously unknown locations, a plan will be delineated to assure that this habitat is managed and protected accordingly, and actions will be undertaken to instigate this plan. Failure to document the frog during each of three visits under appropriate climatic and seasonal conditions will be considered adequate sampling effort to support its probable absence from a site.

b) The State of Florida or a conservation partner has acquired or permanently protected by via less-than-fee simple measures private lands that encompass at least 90% of the mainstems of Burnt Grocery, Garnier, and Julian Mill creeks. This criterion could be fulfilled by securing the Yellow River Ravines Florida Forever project as well as additional lands recommended in section 6.c.2.
1) Perpetual management of these lands is assigned to a natural resource agency or organization, and a land management plan that focuses on the maintenance and restoration of natural habitats considered appropriate for bog frogs is written, approved, and instigated.
2) Measures have been put in place that permanently limit erosion, siltation, and pollution of these three streams, and culverts of sufficient size are in place that allow waters of Burnt Grocery and Julian Mill creeks to pass unimpeded beneath highways.

2. DOD Lands

a) Thorough distributional surveys for the bog frog have been completed in all potential habitats on Eglin AFB (see section 7.b.1). Should the species be found in previously unknown locations, the sites will be assigned to a CMU and ranked by priority (see section 6.a.2). Failure to document the frog during each of three visits under appropriate climatic and seasonal conditions will be considered adequate sampling effort to support its probable absence from a site.

b) All CMUs for the bog frog have been field-evaluated for existing and potential threats, both at known bog frog sites as well as at a sample of additional sites throughout the system (these could be pre-determined randomly, then visited; number of sites may range from three to 10 depending on system size). Data will be incorporated into Table 3. Efforts to accomplish this task will focus on CMUs in Priority order (1-2-3).

c) Sufficient and appropriate management actions, as outlined in section 6.b, have been undertaken so as to ameliorate identified and potential threats to bog frog habitat in all Priority 1 and 2 CMUs, with emphasis on sites known to be inhabited by the species (including any identified subsequent to the preparation of this document). Actions may include, but not be restricted to, the following:
1) reduce excessively dense, woody vegetation in the riparian zone and adjacent ecotone and uplands, most often by fire but by other means if fire is precluded, yielding at least 10% penetration (preferably closer to 20%) of sunlight to ground/water surface of stream floodplain or seepage area;
2) eliminate sources of unnatural erosion, siltation, and pollution, eliminate risk from collapse of borrow pits;
3) eliminate or maintain impoundments so as to prevent further damage (including dam collapse);
4) eliminate or reduce hog levels to minimize disturbance to riparian zones;
5) eliminate invasive exotic plants; and
6) restore uplands adjacent to streams inhabited by bog frogs back to appropriate, fire-maintained upland natural communities, particularly longleaf pine-dominated sandhills (may require sand pine removal).

3. Bog Frog Populations

Bog frog populations at all known sites within High (1) and Very High (2) CMUs are determined to be viable, and none show signs of local extirpation. Local populations (at individual sites) will be considered viable if, during any five-year time frame, they exhibit both of the following characteristics:

a) multiple calling males heard on one or more nights during breeding season in at least three of five consecutive years; and
b) at least one adult female or at least one dozen tadpoles observed in at least three of five consecutive years

e. Impacts to Other Imperiled Species

1. Other state or federally listed species that may benefit from management actions discussed in this document

Control of erosion and potential pollution in the streams inhabited by bog frogs will likewise help to limit the amount of silt and pollutants that enters the Yellow/Shoal, and East Bay rivers. This should be beneficial for other listed aquatic species that inhabit these rivers. In particular,

the Yellow River is known to be inhabited by the Gulf sturgeon (*Acipenser oxyrinchus desotoi*: US Threatened , T; Florida Species of Special Concern, SSC), bluenose shiner (*Pteronotropis welaka*: FL SSC), and at least formerly, by the Gulf moccasinshell (*Medionidus penicillatus*: US Endangered, E). The alligator snapping turtle (*Macrochelys temminckii*: FL SSC) and American alligator (*Alligator mississippiensis*: FL SSC) inhabit both rivers. It should be noted that the bog frog's distribution is not presently known to overlap that of the Okaloosa darter (*Etheostoma okaloosae*: US and FL E), which is endemic to Choctawhatchee Bay drainages.

Regular burning of the uplands and slopes down and into streamside vegetation should be beneficial to other species that utilize these habitats. Seepage slope species include Baltzell's sedge (*Carex baltzelii*: FL T), spoon-leaved sundew (*Drosera intermedia*: FL T), panhandle lily (*Lilium iridollae*: FL E), white-top pitcherplant (*Sarracenia leucophylla*: FL E), sweet pitcherplant (*Sarracenia rubra*: FL T), Harper's yellow-eyed grass (*Xyris scabrifolia*: FL T), and pine barrens treefrog (*Hyla andersonii*: FL SSC). Upland species include hairy wild indigo (*Baptisia calycosa* var *villosa*: FL T), flatwoods salamander (*Ambystoma cingulatum*: US T, FL SSC), gopher frog (*Rana capito*: FL SSC), gopher tortoise (*Gopherus polyphemus*: FL SSC), eastern indigo snake (*Drymarchon couperi*: US T, FL T), Florida pine snake (*Pituophis melanoleucus mugitus*, FL SSC), and red-cockaded woodpecker (*Picoides borealis*: US E, FL SSC).

2. Other state or federally listed species that may be negatively impacted from management actions discussed in this document

It is unlikely that the proposed management actions will have deleterious effects on any listed species. Potential loss of some dense cover potentially used by the locally small population of black bears would likely be offset by other benefits to their resource base.

7. SPECIES RESEARCH

a. Current Research Programs

David Bishop, a graduate student at Virginia Polytechnic Institute and State University, is conducting ecological and behavioral studies of the bog frog for his Ph.D. Much of the life history information included within this document stems from his interim results (Bishop, 2004). Bishop plans to complete field work in August 2004, with submission of his dissertation scheduled for 2005. In conjunction with Dr. James Austin (Cornell University), Bishop is also attempting to confirm, through DNA analysis, the true nature of putative bog frog-bronze frog hybrids, preliminarily recognized as such based on calls and morphology. Upon completion of these studies, it would be appropriate to review this document to determine whether any modifications are needed.

b. Further Research Needs

Future research should focus on 1) expanding and refining knowledge of the bog frog's distribution, both across its range and within known sites; and 2) increasing understanding of the species' biology, its ecological requirements, and its responses to habitat management.

1. Distributional Surveys

Field work to delineate the distribution and extent of precise occurrences of the bog frog should continue. Off of Eglin AFB, surveys should be undertaken in the Blackwater River drainage. Although these may prove to be unproductive, the possible existence of undiscovered populations of the bog frog in this drainage can not be ruled out. The floodplains of the lower Yellow and Blackwater rivers lie within 8 km of each other, and both rivers empty into Blackwater Bay. Headwater tributaries of the two drainages come within roughly 2 km of each other in the vicinity of the known non-Eglin occurrences of the frog, although the drainages are separated by Interstate 10. Enge (2002) used drift fences and funnel traps to survey seepage streams in the Blackwater River drainage for one year, but this technique is less definitive for determining presence or absence of bog frogs than auditory surveys.

Further surveys on Eglin AFB, as well as a few offsite, have the potential to discover additional occurrences in tributaries not yet known to support the species. Special emphasis should be directed toward the eastern end of the range, particularly upper Titi Creek (the northern side especially), as well as Alaqua Creek and other tributaries of Choctawhatchee Bay. Printiss (Printiss and Hipes, 1999) failed to locate any additional occurrences in those regions, and it may be that the known sites in upper Titi Creek (which Printiss surveyed extensively) are truly disjunct from those located elsewhere. It is possible that the failure of researchers to identify additional populations in at least some of Eglin's creeks may reflect insufficient exploration of segments that are far from road crossings. Only after extensive additional and repeated survey work should it be assumed that stream systems currently not known to harbor bog frogs truly lack them throughout. Many such streams lie within the Yellow River drainage; a partial list of those that should be the subject of further investigation includes the following creeks, listed from west to east (i.e., ascending upstream) within drainage segment: Yellow River – Moore, Boiling, Bear, Metts, Middle, Turkey Gobbler, and Carr Spring Branch on the south (Eglin) side, and Canoe, Trawick, and Wilkinson on the north (private) side; Shoal River – Gopher, Turkey Hen, and Pearl; and Titi Creek – Silver, Honey, Blue Spring, Big Fork, and Gum. Nonetheless, Printiss (pers. comm.) surveyed numerous sites within most of these drainages without success.

It should also be emphasized that nearly all known occurrences represent only very small sections of streams where access was facilitated by road or power line crossings. Determination of the distributional limits and precise occurrences of bog frogs within all occupied wetland systems is desirable but would require extensive effort. For now, management must assume that frogs may potentially occur within appropriate habitat anywhere within an occupied system.

2. Ecological Studies

Even after the completion of Bishop's studies, additional data will be needed on age of maturity, population size, structure, and turnover at a variety of sites and in different years. Determining minimum numbers of individuals necessary for a local population to remain viable would be of great interest although difficult to ascertain. Further studies of movements, both of frogs and tadpoles, would provide valuable data about the species' potential for dispersal.

Degree of competition with the bronze frog should be examined, as should hybrid viability between the two species. The occurrence and abundance of hybrids (i.e., frequency within local populations) should be monitored to determine whether they are of ecological significance. Local populations where hybridization is suspected should be examined periodically (e.g., 3-year intervals) to determine the frequency of hybrids. This may necessitate the establishment and use of genetic markers, as attempting to assess this from auditory surveys is unlikely to produce adequate results.

It will be important to monitor the response of bog frogs to the various threats and management actions outlined in this report. The responses of frog populations to siltation, hogs, beavers, fire exclusion, pollution, use of herbicides, and other factors affecting microhabitat and water quality should be determined, as should responses to management efforts that improve negative conditions. It would be especially valuable to compare data on frogs (and tadpoles) before and following planned management actions. Local populations of the bog frog occurring in heavily silted sites should be monitored to determine whether continued siltation eventually makes the habitat unsuitable, or whether frogs continue to maintain viable populations.

8. INFORMATION MANAGEMENT

Several agencies and organizations, all listed in section 4, are managing information related to this species, and there is no reason why this should not continue. Because it has the responsibility for managing bog frog habitats on the Eglin reservation, it will be most effective for the Eglin Natural Resources Branch to maintain an in-house system to monitor and track such activities and their effects on the frogs' populations. Toward this end, D. Bishop and J. Mathers created an Access database of historical and presently known localities for the bog frog and other frog species; it was last updated in August 2003 and requires additional quality control, verification, and editing (D. Bishop, pers. comm., 2004). An electronic copy can be provided to appropriate agencies.

The Florida Natural Areas Inventory maintains a conservation database that includes mapped occurrences and supporting data (element occurrence records) for the bog frog. This can be expected to continue as a regular part of FNAI's mission. The database utilizes an ArcView-based GIS platform in conjunction with a data management system known as Biotics, developed for and overseen by NatureServe. FNAI, in conjunction with NatureServe, also maintains summary information about the species; these data can help to guide federal (USFWS) and state agencies (FWC) in making decisions regarding the species' status.

9. FEASIBILITY

a. Legal Authority

1. DOD

Legal authority for DOD conservation actions at Eglin AFB is provided under a ruling approved September 15, 1960, and commonly referred to as the "Sikes Act." The stated purpose of the act is "to promote effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations."

2. Non-DOD

The State of Florida has the legal authority to acquire and manage lands for conservation purposes through its Florida Forever Program. For specific details about this program, please see its Internet web site: http://www.dep.state.fl.us/lands/.

b. Time frame

Three (to a maximum of five) years (i.e., by the year 2008) should be sufficient to achieve most of the management recommendations in this document. This relatively short time frame is possible because 1) most of the necessary management programs (prescribed fire, erosion control, road maintenance, invasive species control) are already in place at Eglin AFB as a result of years of natural resource planning activity, and 2) the State of Florida and its private conservation partners have already initiated steps to secure protection of the majority of privately owned bog frog sites. However, implementation within this time frame may require more resources than currently are devoted to these programs.

It is recognized that moving fires into riparian zones along streams is difficult and depends upon favorable climatic conditions (e.g., drought). Thus, any time frame for this activity is extremely tentative. Nonetheless, this should be attempted with every major burn, with special emphasis during dry years. Ideally, substantial success at at least half of known sites will have been achieved within one decade.

A longer time frame, perhaps 10 years, is also necessary to conduct meaningful ecological studies. Monitoring programs to measure the effectiveness of habitat management on bog frog populations have no finite time frame but should become a regular part of each managing agency's programmatic activities.

c. Costs

1. DOD lands

Determining the cost of instigating specific management recommendations for the bog frog on Eglin AFB is not currently possible, as nearly all of the principal management actions (e.g., fire, erosion control, invasive species control) will involve reallocation of resources within existing management programs. Certainly, increases in funding to focus portions of these projects specifically on bog frog habitat would be desirable, as would the dedication of a NRB staff position (estimated $50,000 annually, including support) to rare amphibians (e.g., bog frog, gopher frog, pine barrens tree frog, flatwoods salamander, tiger salamander, and others).

2. Non-DOD lands

Estimated tax assessed value of the 16,652-acre Yellow River Ravines (YRR) project (see section 6.c.2) was $12,227,546 in 2002 (Florida Department of Environmental Protection, 2003). Actual offering price may vary from this. 2003 tax assessed value of the four parcels recommended in this document for addition to the project totaled $49,800, but it is probable that actual purchase price would substantially exceed this.

Should acquisition by the state be successful, interim management costs are estimated at $1,049,000 (salaries $164,000; expenses $375,000; operating capital outlay $510,000) (Florida Department of Environmental Protection, 2003; no time frame given).

3. Regional partners

The Florida Natural Areas Inventory can maintain basic element occurrence and supplementary data within its existing programs, although any additional dedicated funding (up to $5,000 annually) would allow it to focus specifically on bog frogs, which otherwise might be precluded by other priorities. Field survey work (by any organization or agency) to search for additional localities or to confirm continued existence of frogs at known sites would require specific funding related to the level of effort required. It is estimated that $15,000 to $25,000 per year would be appropriate.

d. Potential Funding Sources for Management Implementation

This section addresses potential funding sources to implement management prescriptions recommended in this document. Sources for DOD and non-DOD lands are considered separately in sections 1 and 2. Regional partners (section 3) may be able to assist in both instances.

1. DOD

Although the DOD Legacy Program has provided invaluable support in the past for natural resource work on Eglin, current guidelines do not favor projects focusing on single species or single installations. Nevertheless, even under such limitations, it may be possible to develop fundable proposals that revolve around a suite of rare amphibians that occur on multiple installations.

Many of the management actions espoused in this document are already encompassed by existing programs under the direction of or in conjunction with Eglin's Natural Resources Branch (NRB). However, several such programs are driven principally by a focus on listed species – e.g., upland pine management and prescribed fire for the red-cockaded woodpecker, and erosion control for the Okaloosa darter. Re-directing or expanding such programs to include Florida bog frog habitat should be feasible without a major increase in funding, although some increase in resources would undoubtedly be beneficial.

The NRB may be able to identify additional federal, state, or private programs that assist with stewardship actions on public lands. The U.S. Fish and Wildlife Service and Florida Natural Areas Inventory contacts for this project will direct such knowledge to NRB staff as they learn of them in the future.

The NRB's recent use of volunteers, universities, and conservation organizations to assist with amphibian surveys and studies is highly commendable and should be continued. In addition to the data provided, such programs provide an important means of educating and involving the public in species conservation as well as Eglin's role in protecting natural resources.

2. State of Florida

Funds for state acquisition of the Yellow River Ravines project would be provided through the state's Florida Forever Program. The Nature Conservancy may assist with negotiations and acquisition but is not expected to contribute any permanent funds. If the project is acquired, it is anticipated that management funding would come from the state's Conservation and Recreation Lands (CARL) trust fund.

3. Regional partners.

As stated above (section 9.c.3), the Florida Natural Areas Inventory will continue to maintain databases that include geographic records of occurrences and pertinent sources about the bog frog. Part of FNAI's basic database functions is funded through the state's Florida Forever Program; however, funding is insufficient to focus adequate attention on all of Florida's rare species, including the bog frog.

Like Eglin AFB, GCPEP recognizes the bog frog as one of its conservation targets. GCPEP staff therefore assist partners that have this species on their properties. However, no specific funds are dedicated toward the bog frog.

The Nature Conservancy is currently assisting with negotiations to protect IP lands within the Yellow River Ravines Florida Forever project. Whether TNC would maintain any role in the tract's long-term management is undetermined.

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Appendix 1. Eglin AFB Integrated Natural Resource Management Plan section addressing the Florida bog frog.

intended to provide trends of population recovery following the hurricane. As the only unlisted subspecies of Gulf Coast beach mouse, it is thought that documentation of population trends are the only way to prevent listing of the subspecies and to understand the short- and long-term impacts of hurricane impacts on this population. When transects were initially established, no information was available to estimate population variance and calculate needed sample size. A recent review of this monitoring effort evaluated population trends used power analysis to discern the optimum sampling size needed to achieve desired statistical power for future sampling.

POPULATION STATUS AND TREND

The beach mouse tracks showed a statistically significant increase (< 0.0001) from 1996-2000, increasing 4-fold in tracks count frequency since Hurricane Opal. Reductions in sampling effort will likely occur to optimize sampling efficiency with future surveys following a subset of original sampling transects. To optimize efficiency but retain statistical power, future sampling will likely reduce effort to 5 transects, sampled bimonthly.

Bog Frog

GENERAL DESCRIPTION

The bog frog (Rana okaloosae) is one of the most poorly understood species targets at Eglin. Its dorsum is yellowish green to yellowish brown, unspotted; the upper lip is greenish yellow and it has light dorsolateral ridges stop short of groin; very little webbing between toes (on the longest toe, at least 3 phalanges extend beyond the webbing). The Bog Frog is small generally 3.5-4.4 cm snout-vent length (to 4.9 cm); larva is olive brown, with numerous buff spots on the tail and numerous white spots on the venter (Conant and Collins 1991; Moler 1992, 1993).

First discovered in 1982, only general information is available describing its current distribution and habitat needs. It is primarily found in early successional shrub bog communities; in or near shallow, nonstagnant, acid (pH 4.1-5.5) seeps and along shallow, boggy overflows of larger seepage streams that drain extensive sandy uplands, frequently in association with lush beds of sphagnum moss. They are often associated with black titi and Atlantic white cedar. In areas where streamside vegetation is more mature hardwood forest, occurs typically only in disturbed sites, such as utility right-of-way crossings (Moler 1992). Eggs are laid in thin masses at the water surface in pools in adult habitat. Males typically call from shallow water surrounded by sphagnum (Moler 1993). Calling has been heard from mid-April to mid-September; lays eggs probably from April through August; larvae apparently overwinter prior to metamorphosis (Moler 1985, 1992).

Bog Frog

MANAGEMENT DIRECTION

Objectives for management of this species are as follows: 1) Survey known and potential breeding locations of Florida bog frogs to determine current distribution, population size, and turnover, and 2) mark individual Florida bog frogs to begin collecting information on growth, survival, and dispersal.

Initial methods have involved volunteers revisiting all known sites and suitable habitat within the Yellow and East River basins to gather general baseline information. Intensive sampling will begin in the summer of 2001 under the Virginia Tech research program.

We will use information previously collected by Florida Natural Areas Inventory (FNAI) and maps of the base to select study sites. For this species, we will assess population status by measuring the following parameters: number of breeding sites active per year, number of adults per site, and larval density at each site. Where possible, by working with marked individuals, we will also measure growth rate and survival rate, and the frequency, distance, and direction of dispersal events. Species methods will include:

* Survey sites identified by FNAI for calling adults from May-August. Survey additional sites in similar habitat ("shallow, non-stagnant acid (pH 4.1-5.5) seeps and along shallow, boggy overflows . . . [associated with small clear streams that] drain extensive uplands of deep, excessively drained, sandy soils of the Lakeland-Troup series" (Moler 1985)) for calling adults from May-August.
* Use quantified sweep net surveys or leaf litter bags to capture tadpoles year round. Tadpoles can be distinguished from R. clamitans by white spots on the ventral surface of okaloosae (Moler 1993).
* Capture adults using hand-captures, partially submerged funnel traps, and/or dipnets at 2-5 known sites. Measure and mark individuals, probably using PIT tags. Recaptures will allow us to determine growth rates, occupancy of breeding areas in other seasons, and possibly to detect dispersal.

A complete listing of the goals and objectives pertaining to threatened and endangered species can be found in Appendix D.

The bog frog is one of the most poorly understood species targets at Eglin.

Appendix 2. Florida bog frog (*Rana okaloosae*) site data.

Drainage: E, East Bay River; T, Titi Creek; Y, Yellow River. *Conservation Management Unit (CMU):* some sites at lower ends of creeks are assigned to associated floodplain as well as creek. *2004 field check date:* date in parentheses = viewed from distance; U, access denied. *Threats:* B, beaver dam (flooding); C, culvert problem (collapsed, plugged, insufficient); E, substantial erosion; H, hogs; I, impoundment (flooded former habitat); L, power line management (chemical or mechanical clearing); P, borrow pit; R, road (erosion, pollution); S, uplands in sand pine plantation; W, woody encroachment. *Management needs:* B, beaver dam removal; C, culvert clearing, repair, or replacement; F, fire (uplands into riparian zone); H, hog extirpation; I, long-term, very slow and careful drainage, removal of dam, revegetation; L, evaluate and monitor power line management; P, borrow pit closure, repair, revegetation; R, evaluate road crossing for erosion control needs, manage accordingly; U, upland habitat restoration to fire-maintained native forest; X, re-route or close road. Site-specific lists of threats and management needs are not necessarily comprehensive.

FNAI occurrence number	*Site Identifier*	*Drainage*	*Conservation Management Unit (CMU)*	*2004 Field Check Date*	*Bog Frog Last Confirmed **	*Threats (partial)*	*Management Needs (partial)*
1	Malone Creek	Y	Malone Creek	3-3-04	1998	R W	F R
2 (may delete)	unnamed creek, east of Metts Creek, west of Malone Creek	Y	unnamed creek west of Malone Creek	3-3-04	1983	R W	F R
3	Milligan Creek	Y	Milligan Creek	3-3-04	1998	E R W	F R
4	unnamed creek, east of Crane Branch, west of Milligan Creek	Y	unnamed seepage creek, west of Milligan Creek	3-3-04	2003	B E H R W	B F H X
5	Crane Branch	Y	Crane Branch; Yellow River floodplain	3-3-04	1998	B R W	B F R
6	Wolf Creek	Y	Wolf Creek; Yellow River floodplain	3-3-04	1998	R W	F R
7	West Head Dean Creek	E	Dean Creek	1-7-04	1998	B C L W	C F L
8	Hicks Creek	Y	Hicks Creek; Yellow River floodplain	3-3-04	1998	R W	F R

9	Weaver Creek	Y	Weaver Creek; Yellow River floodplain	3-3-04	2000?	C L	C L
10	unnamed creek, east of Malone Creek, west of Middle Creek	Y	unnamed creek, east of Malone Creek	3-3-04	1998	R W	F R
11	Carroll Creek	Y	Carroll Creek	3-3-04	1983	R W	F R
12	Julian Mill Creek[a]	Y	Julian Mill Creek	3-3-04	>1983	E L P R S	F L P R U
13	Garnier Creek[a]	Y	Garnier Creek	3-3-04	1999	L S	L R U
14	Burnt Grocery Creek[a]	Y	Burnt Grocery Creek	3-3-04	>1983	L R W	F L R U
15	Wildcat Branch	T	upper Titi Creek	3-3-04	1985	I R	I R
16	Upper Titi tributary, between Indigo and Cawthon branches	T	upper Titi Creek	3-3-04	2002	R	R
17	Roberts Pond Creek	E	Live Oak Creek and Swamp	1-7-04	1998	H I R	H I R
18	Turtle Creek	E	Turtle Creek	1-7-04	2001	R W	F R
19	Live Oak Creek	E	Live Oak Creek and Swamp	1-7-04	1998	R W	F R
20	Horse Branch	E	Horse Branch	1-7-04	1998	R	R
21	Camp Creek	Y	Camp Creek	3-3-04	1998	E P R W	F P R
22	East Bay River floodplain, 0.9 km E CR 87	E	East Bay River and Swamp	1-9-04	1998	W	F
23	East Bay River floodplain, 1.2 km E CR 87	E	East Bay River and Swamp	1-9-04	1998	W	F
24	seep in East Bay River floodplain, 2.4 km E CR 87	E	East Bay River and Swamp	1-9-04	1998	W	F
25	lower Panther Creek	E	Panther Creek; East Bay River and Swamp	1-9-04	1998	R W	F R
26	Live Oak Creek Swamp east	E	Live Oak Creek and Swamp	(1-7-04)	1998	R	R

27	seep along East Bay Swamp, west of Prairie Creek	E	East Bay River and Swamp	1-9-04	1998	R W	F X
28	tributary of East Bay Swamp, east of Panther Creek	E	unnamed creek east of Panther Creek	1-9-04	1998	R W	F R
29	seep on middle Panther Creek	E	Panther Creek	1-9-04	1998	W	F
30	Panther Creek	E	Panther Creek	1-9-04	1998	W	F
31	upper Panther Creek	E	Panther Creek	U	1998	P R	P R
32	Live Oak Creek Swamp west	E	Live Oak Creek and Swamp	(1-7-04)	1998	L	L
33	Live Oak Creek	E	Live Oak Creek	(1-9-04)	1998	P	P
34	Prairie Creek	E	Prairie Creek	1-9-04	2003	-	-
35	Weaver Creek tributary	Y	Weaver Creek	not examined	1999	-	-
add new sites here in future							

[a] stream located on private lands north of Eglin AFB

Appendix 3. Eglin AFB Integrated Natural Resource Management Plan section addressing erosion control and road management.

Table 4-10

FOREST MANAGEMENT WORK PLAN 2002-2006*	
FOREST SALES	**ACRES PER YR**
Natural Sand Pine Removal	**1600**
Emphasis placed on areas that can support new RCW cluster sites	
Work T&E priority areas that will create immediate RCW habitat	
Plan removal areas to improve RCW habitat and facilitate movement of RCW toward Eglin's boundary	
To be planted with Longleaf pine	
25 year completion at annual removal rate	
Sand Pine Plantation Removal	**500**
Emphasis placed on future RCW habitat improvement/biodiversity management	
To be planted with Longleaf pine	
15 year completion at annual work rate	
Stunted Slash Pine Plantation Removal	**800**
Emphasis placed on future RCW habitat improvement/biodiversity management	
To be planted with longleaf pine	
25 year completion at annual removal rate	
Slash Pine Plantation Thinning/Conversion	**325**
Emphasis placed on future RCW habitat improvement/biodiversity management	
Objective will be conversion to longleaf pine	
Thinning operations will create holes within plantation that will be planted with longleaf pine	
Longleaf Pine thinning inside RCW 350 MEA	**100**
Thinning to improve critical RCW habitat within the MEA	
Longleaf Pine thinning outside RCW 350 MEA	**1000**
Create/emprove RCW habitat between the 350 and 450 MEA boundaries	
Stimulate ground cover	
Begin creation of an unevenaged stand structure	
Improve RCW forage and nesting capabilities	
Improve habitat outside the 450 MEA to begin moving RCW closer to Eglin boundaries	
Sand Pine Seed Tree	**200**
Commercial Forestry operation	
Only accomplished in areas planned for long-term sand pine management	
Commercial Firewood Sales	**100**
Emphases placed on areas that oak removal will improve RCW habitat	

REFORESTATION	ACRES PER YEAR
Plant Containerized/Bare root longleaf Pine seedlings	**3200**
Average seedlings per acres will vary from 100 to 600 per acre based upon area to be planted	
converted plantations will average 450 for containerized and 600 for bare root seedlings	
containerized longleaf planted by hand	
bare root longleaf seedlings planted by hand or machine based on site conditions	
longleaf seedlings planted by contour of area on a variable spacing of 5 to 20 feet	
planting pattern is design to create natural appearance, not rows	
number of seedlings planted in sand pine removal areas will depend on amount of natural longleaf remaining	
holes and opening will be planted in natural areas to begin creating unevenaged stand structure	
no seedings planted under existing longleaf pine	
natural regeneration utilized to complete unevenaged stand structure	
Average planting 1,600,000 longleaf pine seedlings	
Contract for longleaf pine cone collection on Eglin will be accomplished when adequate cones are available	
Longleaf pine seed will be purchased (if Eglin seed is not sufficient for needs) within 50 miles of the reservation	
Site Preparation	**2,500**
Both Mechanical and Chemical site preparation will be used. Objective will be to reduce ground cover impacts	
Chemical operations will be favored due to reduced ground-cover impacts	
Mechanical site preparation using roller-drum choppers will be utilized on 500 acres	
clumps and individual trees to remain on site	
single chopping operations will be favored to help protect ground cover	
double chopping opeations will be utilized only where needed to achieve required site preparation	
Chemical site preparation using Velpar herbicide will be utilized on 2000 acres	
clumps and individual trees to remain on site	
2 lbs AI per acre	
buffers created where potential exist for chemical to move off site - special care near roads	
No site preparation will be conducted on 700 acres that will be fuelwooded. The operation provided sufficient preparation	
No mechanical site preparation will be conducted on areas that have never receive site preparation. (Plantations only)	
Native Grasses Restoration	
Develop a seed collection and establishment protocol	
Develop a seed collection partnership outside of Eglin	
Create series of seed collection orchards at 10 sites across the reservation	
6 upland sites; 4 wetland sites	
From a baseline of 400 lbs, increase natural seed harvest by 20 percent each year for 5 years	
Establish native grasses on restoration sites (sand pine removal areas)	
70 percent of seed utilized on restoration areas (sand pine removal)	
30 perecent for orchard development	

FOREST MANAGEMENT WORK PLAN 2002-2006 (Continued)	
TIMBER STAND IMPROVEMENT	**ACRES PER YEAR**
Mechanical TSI (brush ax/chain saw)	750
control sand pine encroachment in artificially planted longleaf pine stands	
Chemical TSI (Velpar)	750
release of natural longleaf pine regeneration from competing oaks	
control of oak competition in artificially planted longleaf pine stands	
control of oaks within RCW cluster sites	
2 lbs AI per acre	

EROSION CONTROL	SITES PER YEAR
Darter Watershed Rehabilitation	25
Program completion by 2004 (New Construction)	
Remove culverts creating impoundments wherever practical	
Establish low-water crossing where practical	
Utilize Natural Resources Conservation Service for contracting/operations/inspection	
Use native grasses	
Non-Darter Watershed Rehabilitation	16
Program completion by 2018 (New Construction) on 206 sites and 65 Claypits	
Sites pritorized by individual watershed	
Utilize Natural Resources Conservation Service for contracting/operations/inspection	
Use native grasses	
Watershed Rehabilitation Maintenance	110
Perform as needed additional earthwork (seeding, mowing, fertilization, stabilization)	
Use native grasses	
Utilize Natural Resources Conservation Service for contracting/operations/inspection	
Maintain site integrity through vehicle exclusion and vigorous vegetation establishment	

ROAD MANAGEMENT
Road maintenance
Maintenance done on an "as required" basis
Road maintenance will be for silvicultural assess only
Best Management Practices will be followed
No major road construction is anticipated

maintained attribution for each road segment and stream crossing containing road conditions, culvert and bridge inventory, and management priorities. FY 2001 saw the completion of the Eglin Range Road Maintenance Handbook. This guide will assist road maintenance crews with effective and affordable best management practices on Eglin's road system. The same team will continue to coordinate on a future road closure program. The NRB will continue to work closely with the 46th TW and 96th CEG to select roads to be permanently closed, seasonally closed, those open to public recreation, those closed to the public, and those that will be used for special purposes, like fire breaks and utility maintenance corridors.

The work plans in Section 4.3.3 present forest activities that will accomplish objectives, which support Principal Goals I, II and III. Acre figures are annual amounts for each activity.

Table 4-13 also shows the labor, cost and income for the forest program,

list of INRMP Goals and Objectives can be found in Appendix D.

I.B.2 Complete operational planning actions and coordinate with Range Configuration Control Committee (RC3) on activities required to achieve desired cover types and sight-lines required by Test Wing Integrated Product Teams, after coordination and approval by TW and when all environmental consultations, permits, and assessments are completed.

II.A.3 Identify and prioritize for treatment, RCW clusters that are adjacent to test ranges, deficient in foraging habitat, and located in areas where future tree removal may be necessary. Encourage population growth in suitable habitats not adjacent to test areas, starting inside the 450 RCW Cluster area and moving outside this area over the next 25 years. Treatments will include all or some of the following forest activities:

- Timber Stand Improvement
  - `Herbicide Application
  - `Mechanical Removal of Sand Pine and Oak
- Sand Pine and Slash Pine Removal (timber sale)
- Site Preparation
- Planting Containerized Longleaf Pine Seedlings

II.B.2 Identify, map and preserve the unique, remnant old-growth longleaf pine communities and associated flora and fauna that meet Special Natural Area criteria by 2003.

II.C.2 By the end of FY02, determine the acreage and locations targeted for forest restoration activities over the next 5-10 years.

II.C.4 By June 2002, determine rates of conversion for Tier II to I and III to II and establish annual conversion objectives.

III.E.1. Reduce process cost by 10% within the next 5 years (2002-2006).

III.E.2. Apply time accounting products, processes and activities to INRMP goals, objectives and strategies in order to accurately capture program costs.

Borrow Pit restoration

III.E.3. Align operational performance indicators with INRMP goals, and objectives.

Erosion Control Program

The NRB has significantly reduced sediment erosion into freshwater streams over the past 7 years. This was accomplished through aggressive delineation of road-management needs and guidelines, restoration of known erosion sites, and research into native grasses.

In 1998-2000 the NRB repaired 120 erosion sites, covering 204 acres. These sites were rehabilitated and sediment reduced by 23,520 tons. Over 550 volunteer hours of work were performed planting native vegetation on erosion sites. These accomplishments resulted in the 2001 Environmental Achievement Award from the International Erosion Control Association (IECA).

The future management direction and priorities for erosion control on Eglin AFB will continue in the same direction as in past years. Our partnership with the Natural Resources Conservation Service will continue. This federal agency has supported our erosion control program in an outstanding manner. Installation and designs for erosion control projects have been exceptional, effective, and very affordable. See Forest Management Work Plan 2002-2006, for the number of planned sites per year for future erosion control projects. Sites will be prioritized on stream sections that are receiving the most sediment to those receiving the least, however, streams with significant Conservation Targets may be prioritized above those that have little biodiversity value.

Road Management

A progressive partnership between the 46th Test Wing, the 96th Civil Engineer Group, and the NRB has resulted in improved road management over the past few years. During 2000, over 42 miles of existing unpaved roadway was reconstructed with Best Management Practices. A GIS database


Native grass seeding on erosion site.

Appendix 4. Copy of Yellow River Ravines project account and map from Florida Forever Five Year Plan, 2003. (Florida Department of Environmental Protection, 2003).
Note: some parcels within the depicted assessment boundary are not included in the project.

Yellow River Ravines

Santa Rosa and Okaloosa County

Group A
Full Fee

Purpose for State Acquisition
This project would protect a high quality example of an imperiled natural community and threatened and endangered plant and animal species. Combined with the 183,000 acres of the Blackwater River State Forest, it will form a continuous corridor of public land from the Eglin Air Force Base through the Conecuh State Forest in Alabama. Acquisition of the project would meet Florida Forever goals of restoring natural habitat and ensuring biodiversity by restoring prescribed fire to areas that would benefit from it, and of increasing natural resource-based recreation by providing areas for camping, picnicking, nature appreciation, hiking and horseback riding. Acquisition of the Yellow River Ravines has also been endorsed by representatives of the U.S. Navy's Pensacola Naval Air Station. Navy officers said at the June 6, 2002 meeting of the Acquisition and Restoration Council that preserving undeveloped land around their satellite airfields enhances military training by preventing encroachment on military reservations.

Manager
Division of Forestry (DOF), Florida Department of Agriculture and Consumer Services (DACS)

General Description
This 16,652-acre project consists of two parcels of land, one on the Yellow River about nine miles east of Milton, and the other being an "infill" parcel in the existing Blackwater River State Forest. The main parcel stretches from the Blackwater River State Forest south to the Yellow River. This project includes a mix of floodplain swamp and floodplain forest, sandhill, mesic flatwoods, wet prairie, dome swamp and seepage stream. About 1,061 acres would protect natural floodplain functions. Much of the floodplain in this project is second-growth forest. The project includes approximately 2,501 acres of functional wetlands and approximately 10,033 acres of land that would provide protection to the surface waters of the state. About 70 percent of the project was originally sandhill, but has been disturbed in the past by being used for silviculture.

FNAI Elements	
Panhandle lily	*G2T3/S3*
Hairy wild indigo	*G2S2*
Sweet pitcherplant	
3 elements known from project	

Public Use
The DOF will promote recreation and environmental education in the natural environment. It is anticipated that interpretive and user services recreation facilities will be developed and the use of low-impact rustic facilities will be stressed.

Acquisition Planning and Status
The Yellow River Ravines project was added to the Florida Forever project list at the June 6, 2002 meeting of the Acquisition and Restoration Council (ARC). This project has 16,652 acres in 41 parcels held by five owners. The essential parcels are those held by International Paper Co.

Coordination
There are no acquisition partners or alternative funding sources identified at this time.

Management Policy Statement
The primary land management goal for the Division of Forestry is to restore, maintain and protect in perpetuity all native ecosystems; to integrate compatible human use; and to insure long-term viability of populations and species considered rare. This ecosystem approach will guide the Division of Forestry's management activities on this project.

Placed on list	**2002**
Project Area (acres)	**16,652**
Acres Acquired	**0**
At a Cost of	**0**
Acres Remaining	**16,652**
With Estimated (tax assessed) Value of	**$12,227,546**

444

Management Prospectus

Qualifications for State Designation

The majority of the acreage of this project consists of what appears to be disturbed sandhill, which has been converted to planted pines of various ages. This acreage has been estimated at 70% of the project, or 9,190 acres. Floodplain swamp represents the second largest land type, and occupies about 2,360 acres. There are lesser acreages of mesic flatwoods, baygalls, seepage streams, wet prairies, and dome swamps. The project's size and diversity makes it desirable for use and management as a state forest. Management by the Division of Forestry as a state forest is contingent upon acquiring fee simple title to the property.

Manager

The Florida Division of Forestry (DOF) of the Department of Agriculture and Consumer Services (DACS) is recommended to be the managing agency.

Conditions affecting intensity of management

Much of the project's plantable areas has been disturbed, and will require restoration efforts. There are approximately 1,200 acres of active timber sales or areas previously harvested that have not been site prepared and planted. Over the next couple of years, these acres will be harvested and will not be replanted by the current landowner. This acreage will require some level of restoration activity. There is at least one linear facility that bisects the parcel, which will be an area of management concern for monitoring unauthorized uses and introduction of invasive exotic species. Additionally, water resource development projects, water supply development projects, stormwater management projects and any linear facilities are considered incompatible with this ecosystem and with the resource values of this project. The activities of Eglin Air Force base may restrict prescribed burning in this area. The level of management intensity and related management costs is expected to be initially high to obtain the necessary information and resources to restore and manage this system as a State Forest. Once this information is obtained and the resources are available, long-term management costs are expected to be moderate to maintain this area as a State Forest, as the Division of Forestry currently manages approximately 189,600 acres in this area.

Timetable for implementing management, and provisions for security and protection of infrastructure

Once the project area is acquired and assigned to the Division of Forestry, public access will be provided for low intensity outdoor recreation activities. The Division of Forestry proposes to manage the site as a part of Blackwater River State Forest, and the Blackwater Forestry Center personnel will carry out management activities and coordinate public access and use. The Division of Forestry will cooperate with and seek the assistance of other state agencies, local government entities and interested parties as appropriate.

Revenue-generating potential

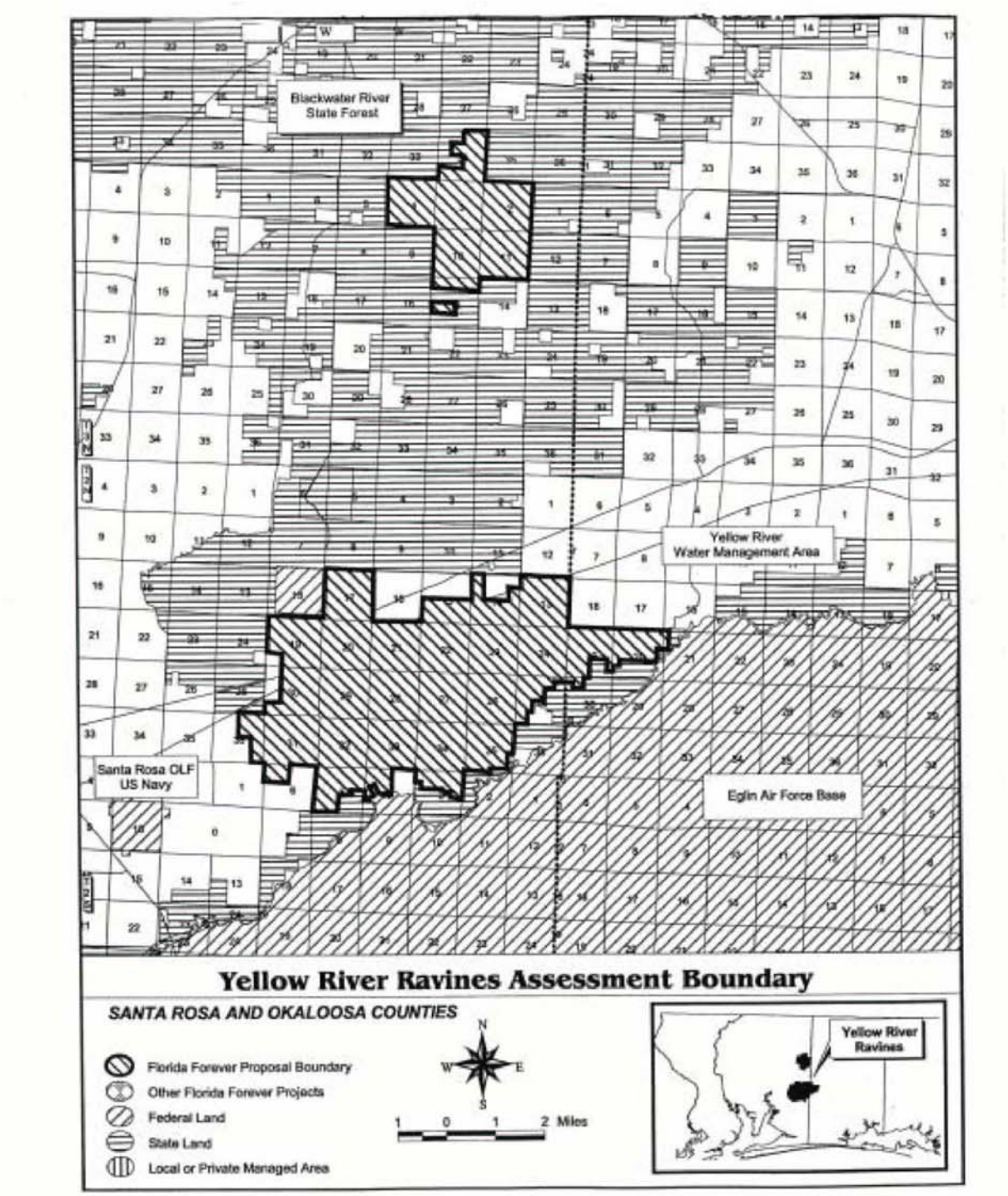
Timber sales will be conducted as needed to improve or maintain desirable ecosystem conditions. These sales will primarily take place in upland pine stands and will provide a variable source of revenue dependent upon a variety of factors. Due to the existing condition of the timber resource on the property, revenue generating potential of this project is expected to be medium.

Management costs and sources of revenue

It is anticipated that management funding will come from the CARL trust fund. Budget needs for interim management are estimated as follows:

SALARY (5 FTE)	**$164,000**
EXPENSE	**$375,000**
OPERATING CAPITAL OUTLAY	
$510,000	
TOTAL	**$1,049,000**

Yellow River Ravines - Group A/Full Fee

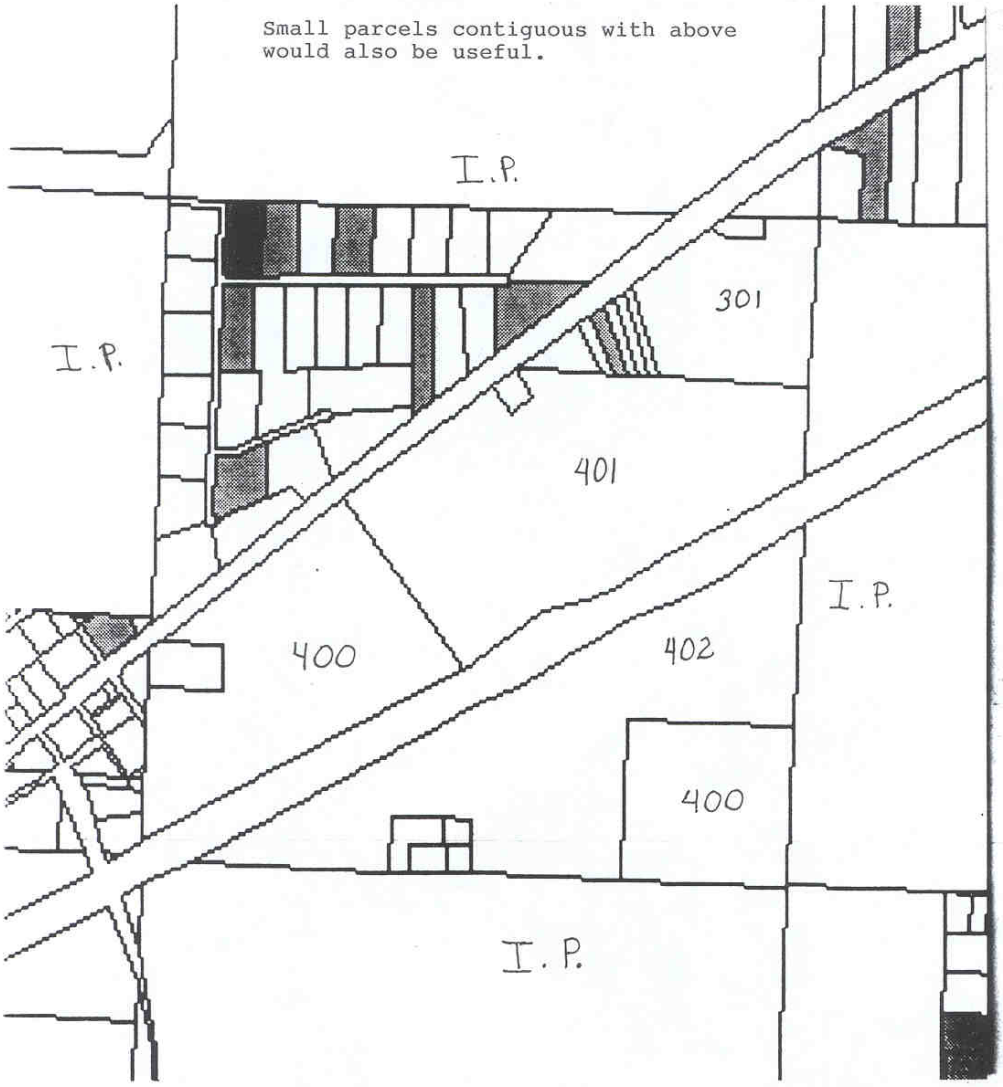


Appendix 5. Map and parcel information depicting lands for consideration for addition to the Florida Forever Yellow River Ravines project. These lands contain most of upper Burnt Grocery Creek. Generated from Santa Rosa County Property Appraiser web site, March 2004.

Section 20 T2N R26W, Santa Rosa County, Florida, that should be considered for addition to Yellow River Ravines Florida Forever Project. Specific parcels to include (and which contain most of upper Burnt Grocery Creek) include:

301 Stokes
400 Stokes - particularly the eastern tract
401 Goff
402 Hobbie

Small parcels contiguous with above would also be useful.



Gregory S. Brown, CFA
Santa Rosa County
Property Appraiser
6495 Caroline Street
Milton, Florida 32570
(850) 983-1880 Voice
(850) 623-1284 Fax
info@srcpa.org

Print Labels

PARCEL NUMBER	OWNER NAME	ADDRESS	HOMESTEAD	
20-2N-26-0000-00100-0000	BYROM WILLIAM H & FRANCES R		N	
20-2N-26-0000-00100-0000 M	HANNA HAYWOOD & JULIA B		N	Acres
20-2N-26-0000-00100-0010 M	ESTES JAMES T & SYNOVUS TRUST		N	
20-2N-26-0000-00100-0020 M	MARNUL JOYCELYN		N	
20-2N-26-0000-00200-0000 M	WILLIAMS H L		N	
20-2N-26-0000-00301-0000	STOKES JOSEPH G		N	35.81 ac.
20-2N-26-0000-00303-0000	DUGAN JUDITH A	10849 HWY 90	N	
20-2N-26-0000-00304-0000	VYVX INC D/B/A/	12539 HWY 90	N	
20-2N-26-0000-00305-0000	SANBORN MICHAEL WILLIAM JR		N	
20-2N-26-0000-00306-0000	THOMPSON ROGER		N	
20-2N-26-0000-00307-0000	THOMAS BOBBY G & KELLIE	10875 HWY 90 E	N	
20-2N-26-0000-00308-0000	ARNE GLEN E & TRACY D	10871 HWY 90 E	N	
20-2N-26-0000-00309-0000	SANBORN MICHAEL WILLIAM JR	10865 HWY 90	N	
20-2N-26-0000-00400-0000	STOKES JOSEPH G L		N	116.41 ac.
20-2N-26-0000-00401-0000	GOFF BOBBY C		N	114.8 ac.
20-2N-26-0000-00402-0000	HOBBIE ERNESTINE S TRUSTEE		N	116.6 ac.
20-2N-26-0000-00500-0000	REEVES WAYNE EUGENE &	10815 HWY 90	Y	
20-2N-26-0000-00700-0000	MILLER DONALD A & TONYA R	BLUE BARNES RD	N	
20-2N-26-0000-00801-0000	HARIELSON LUCILLE & JAMES T		N	
20-2N-26-0000-00900-0000	BARNES L J JR & BARBARA	10780 BLUE BARNES RD	Y	
20-2N-26-0000-00901-0000	BARNES STEPHEN LEWIS	10794 BLUE BARNES RD	Y	
20-2N-26-0385-00000-0000	BLACK WATER RIVER		N	
20-2N-26-0385-00000-0010	BENTON ALICE &	6540 WAYLON DR	Y	
20-2N-26-0385-00000-0020	BELCAS JAMES P & JUANITA F		N	
20-2N-26-0385-00000-0030	BROSSETT MARVIN L & RITA A	10686 HATCHER ST	Y	
20-2N-26-0385-00000-0040	DEUTSCHE BANK	10712 HATCHER ST	N	
20-2N-26-0385-00000-0050	ENFINGER DOUGLAS W	10742 HATCHER ST	Y	
20-2N-26-0385-00000-0060	HALL RICHARD SHANE		N	
20-2N-26-0385-00000-0070	OLWICK HAROLD J & DIANE M	10780 HATCHER ST	N	
20-2N-26-0385-00000-0080	CORRIGAN CHRISTOPHER S	10806 HATCHER ST	Y	
20-2N-26-0385-00000-0090	WILSON J C & SUE & GARY		N	
20-2N-26-0385-00000-0100	CORY GLEN & BARBARA	10807 HATCHER ST	Y	
20-2N-26-0385-00000-0110	KELLEY JOSEPH E	10793 HATCHER ST	Y	
20-2N-26-0385-00000-0120	BAILES WILLIAM J & LINDA D		N	
20-2N-26-0385-00000-0130	FANNIN DAVID M & BARRON OPAL J	10755 HATCHER ST	N	
20-2N-26-0385-00000-0140	CREGGER ROBERT A & SHERRY	10743 HATCHER ST	N	
20-2N-26-0385-00000-0150	HOURIHAN KIM KAROL	10723 HATCHER ST	Y	
20-2N-26-0385-00000-0160	STOKES CURTIS E & NANCY L		N	
20-2N-26-0385-00000-0170	STOKES NANCY L & CURTIS E	10683 HATCHER ST	Y	
20-2N-26-0385-00000-0190	CARPENTER MAGGIE L	6524 WAYLON DR	Y	
20-2N-26-0385-00000-0200	HARRIS BENJAMIN J	6472 WAYLON DR	Y	
20-2N-26-0385-00000-0210	NEWBY JOHN J JR & CRYSTAL LEE	10676 SUN UP CT	Y	
20-2N-26-0385-00000-0220	JONES WILLIAM C JR & LISA A	10706 SUN UP CT	Y	
20-2N-26-0385-00000-0230	JONES STEVE C & TERESA A	10707 SUN UP CT	Y	

Appendix 6. Draft document reviewers and affiliations.

Review does not necessarily imply concurrence with all statements in document.

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