

**PINELAND BREEDING-BIRD COMMUNITIES IN BICY AND EVER:
SPECIES COMPOSITION, POPULATION DENSITY, CAUSES OF DECLINES AND
EXTIRPATIONS, AND RECOMMENDATIONS FOR RESTORATION**

A proposal submitted to:

National Park Service
Southeast Regional Office
75 Spring Street S.W.
Atlanta, Georgia 30303

Prepared by:

Kenneth D. Meyer
Department of Wildlife and Range Sciences
University of Florida, Gainesville, Florida 32611

and

William B. Robertson, Jr.
South Florida Research Center
Everglades National Park, Homestead, Florida 33030

Starting date: 15 January 1993
Duration of study: 37 months (end 29 February 1996)
Requested funding: \$58,420 first year
(approximately \$175,000 total)

Submitted 28 November 1992

Superintendent, Big Cypress National Preserve Date: _____

Superintendent, Everglades National Park Date: _____

ABSTRACT

The rapid loss of pinelands from the southern Florida landscape and the extirpation of several endemic bird species from the remaining habitat on NPS lands is cause for great concern. This proposal describes an investigation of the pineland bird communities in Big Cypress National Preserve (BICY) and Everglades National Park (EVER) that will form the basis for restoration and long-term management of this rare avifauna.

The only vertebrates known to have disappeared from EVER are six pineland birds: Red-cockaded Woodpeckers, Eastern Bluebirds, Brown-headed Nuthatches, Southeastern American Kestrels, Hairy Woodpeckers, and Summer Tanagers. Kestrels, Hairy Woodpeckers, and Summer Tanagers are rare or absent in BICY; the other three species have declined and are assumed to be at risk. Causes and potential remedies have not been studied. In light of the growing threats to the ecological integrity of Florida's remaining uplands, the tenuous status of the extant avifauna on NPS lands, and the increasingly important role of these lands as habitat islands in southern Florida, we propose a cooperative study to determine the status and the potential for management of the pineland bird communities of BICY and EVER. The study will be unusual in examining ecological relationships of threatened uplands; it will be unique in addressing the extirpation of species in Florida's national parks. Benefits will include integration with ongoing studies of fire ecology, Red-cockaded Woodpeckers, and the effects of Hurricane Andrew on pinelands and associated hammocks. This research will focus on the management needs of the pineland avifauna before restoration and protection become prohibitively difficult and expensive.

The project's specific objectives are: to assess the current status of the pineland avifaunas of BICY and EVER; to form a baseline of avian distribution, abundance, and species richness (community structure) for future monitoring; to determine the ecological and behavioral correlates of species abundance and richness; to identify the principal causes of recent declines and extirpations; to evaluate the effects of Hurricane Andrew; to develop techniques for translocations and reintroductions; and to provide management recommendations aimed at restoration and long-term protection. The study will encompass three nesting seasons (1993-1995), and will have two co-directors and two seasonal technicians (one each per park). The first-year budget is \$58,420; the total cost is about 175,000.

Field work will consist of fixed-radius point-count surveys, behavioral observations, and measurements of vegetation on a total of six pineland study plots (four in BICY, two in EVER) that represent a wide range of conditions (e.g., age, fire and logging history, plant associations, physical structure). Recent and historic data on logging, fire, and hydrology of the study plots, and estimates of current distribution and status of pineland species north of BICY and EVER, will be taken from previous studies and reviews. The emphasis during the first year will be on establishing and surveying the plots and standardizing the vegetation and behavioral sampling methods. Surveys will be run in all three years; vegetation and behavioral data will be collected and reintroduction methods developed and tested mainly during the second and third years.

The survey data will permit assessment of current status and distribution, abundance, and richness in the different types of pine forest; statistical comparisons among the plots will reveal differences in community structure and specify the probability of occurrence for individual species. Behavioral and nesting success data will quantify differences in competition for food and nest sites on the various plots and identify factors that limit pineland endemics (the project could be expanded with external funding to include a graduate student to test behavioral hypotheses). Species abundance, richness, and nesting success will be analyzed with regard to vegetation features measured with point-sampling methods on the bird survey plots.

Vegetation correlates of high abundance, richness, and nesting success will be used to determine habitat suitability of potential reintroduction sites in BICY and EVER. Specific methods will be tested by translocating birds to occupied range within BICY and by introducing birds from outside to unoccupied range within the Preserve. These experiments will involve bluebirds, nuthatches, kestrels, and Hairy Woodpeckers.

The study's principal goal, restoring EVER's pineland avifauna, has become even more important as a result of the damage inflicted by Hurricane Andrew. Fortunately, most of the pinelands in BICY, with their variations in structure and bird communities, remain as an excellent source of comparative and predictive data for achieving this restoration.

It is reasonable to expect that the proposed study can develop the means to restore the deteriorating pineland bird community in BICY and EVER. The NPS, however, cannot manage its extant or restored pineland avifauna as if protective boundaries will assure longevity. If this and similarly rare communities are to survive in southern Florida's parks, the NPS will have to influence land-use practices and planning on a regional scale. The recommendations provided by the proposed study will serve as a model for ways in which the NPS can promote this process.

I. STATEMENT OF PROBLEM

Reference: Project statement number BICY-N-076, BICY Natural Resource Management Plan

The rapid loss of pinelands from the southern Florida landscape and the extirpation of several endemic bird species (i.e., those that breed only in native pine forest in this portion of their range) from the remaining habitat on NPS lands is cause for great concern. This proposal describes an investigation of the pineland bird communities in Big Cypress National Preserve (BICY) and Everglades National Park (EVER) that will form the basis for restoration and long-term management of this rare avifauna.

Despite their small area, slash pine forests (*Pinus elliottii* var. *densa*) are a major vegetation type in BICY and EVER (29,000 ha or 10% in BICY, 8,000 ha or <5% in EVER). Agricultural and residential development has all but wiped out the Miami Rock Ridge pine forest that once extended from Mahogany Hammock to the Miami River, except for the portion that is within EVER. Although not as drastic, the pine forest that is currently found west of Shark Slough, in BICY, has been reduced by the same forces to about 50% of its original extent. Both pinelands have been lumbered. In EVER, about 85% of the current stand was logged between about 1935 and 1947. In BICY, at least half the of the pine forest was logged from about 1955 to 1970. Thus, NPS lands in southern Florida include two pinelands of unique botanical character, which have been altered in extent and composition by development, logging, and human manipulations of the natural fire regime.

Naturally enough, research efforts in EVER and BICY have tended to concentrate on the critical wetlands, their hydrologic problems, and the resulting declines in wading birds. The relatively small NPS efforts in upland habitats have focused mainly on fire ecology and fire management while most upland wildlife has received only casual attention. Thus it may come as a surprise that avian diversity in NPS southern Florida pinelands has been slowly declining for decades. The process has continued to the point that, in EVER, about 25% of the pineland bird community has been lost and similar declines are now becoming evident in BICY. For all the concern about species in wetlands and transitional areas, the only vertebrates known to have disappeared from EVER are six pineland birds: Eastern Bluebird (*Sialia sialis*), Brown-headed Nuthatch (*Sitta pusilla*), Southeastern American Kestrel (*Falco sparverius paulus*), Red-cockaded Woodpecker (*Picoides borealis*), Hairy Woodpecker (*Picoides villosus*), and Summer Tanager (*Piranga rubra*) (Table 1). Kestrels, Hairy Woodpeckers, and Summer Tanagers are rare or absent in BICY; the other three species probably have declined since the early part of the century and are assumed to be at risk.

Although these declines and extirpations have been known and speculated about in general ways since the 1950s (Robertson 1955, Robertson and Kushlan 1974), causes and potential remedies have not been carefully studied. The most likely factors underlying the losses are logging, altered fire regimes, and isolation caused by the fragmentation and elimination of vast areas of adjacent pine forest. In light of the growing threats to the ecological integrity of Florida's remaining uplands, the tenuous status of the extant avifauna on NPS lands, and the increasingly important role of these lands as habitat islands in southern Florida, we propose a study to determine the status and the potential for management of the pineland bird communities in BICY and EVER.

SPECIES	EVER	BICY
American Kestrel	common breeder in 1920s; gone by 1940s.	gone by late 1970s; previous status unknown.
Hairy Woodpecker	fairly common to 1980; very rare by 1990.	uncommon breeder, late 1970s; very rare, 1990.
Red-cockaded Woodpecker	fairly common, 1920s; gone after logging, 1940s.	ca. 40 clans nest in old-growth pine, 1992; but declining at Lostman's
Brown-headed Nuthatch	common, 1920s; gone by 1950.	still fairly common in old-growth pine, 1992.
Eastern Bluebird	uncommon breeder, early 1950s; gone by mid-1960s.	still a fairly common breeder, 1992.
Summer Tanager	present in pinelands to ca. 1920s, not known if nested.	rare breeder still, 1992.

TABLE 1. Historic and current status of endemic pineland bird species in Everglades National Park (EVER) and Big Cypress National Preserve (BICY).

The benefits of the proposed research to the NPS include the project's potential for integration with ongoing studies in BICY and EVER, including long-term fire ecology research in both units, Red-cockaded Woodpecker research and monitoring in BICY, and studies addressing the effects of Hurricane Andrew on the pinelands and associated hardwood hammocks of EVER and southern BICY. Post-hurricane evaluations (report of EVER Fire Assessment Team, and D. Jansen, unpubl. data) have shown that the physical structure of the pine forests, and potentially the bird communities they support, changed dramatically due to the loss of about one-third of the trees, particularly large trees and those near edges. The impact of the hurricane on the extant bird communities of Long Pine Key (EVER) and Lostmans Pines (BICY) and its potential long-term effects on the status of this threatened avifauna are unknown. The proposed cooperative project between BICY and EVER will provide an ideal framework for examining these questions.

The proposed study will be unusual in that it will investigate ecological relationships of threatened upland habitats, which have received little attention in Florida; the study will be unique in addressing the problem of vertebrate extirpations on NPS lands in Florida. With its aim of examining the processes that shape one of the most interesting and vulnerable vertebrate communities in BICY and EVER, the study will contribute to efforts to understand and maintain the ecological integrity of southern Florida's threatened ecosystems. Finally, the proposed study will focus on the management needs of the pineland avifauna before restoration and protection become prohibitively difficult and expensive.

II. OBJECTIVES

The proposed study will:

- A. Assess the current status of the pineland avifaunas of BICY and EVER on study plots that vary in age, physical structure, extent of disturbance (e.g., logging, altered fire or water regimes), and degree of isolation.
- B. Form a baseline of avian distribution, abundance, and species richness (community structure) for future monitoring;
- C. Determine the ecological correlates of species abundance and richness and estimate relative nesting success among the study plots for the species of greatest concern (Table 1);
- D. Identify the principal causes of recent changes in the avifauna;
- E. Evaluate the effects of Hurricane Andrew;
- F. Develop techniques for translocations and reintroductions of pineland endemics where it is determined to be advisable and feasible; and
- G. Provide management recommendations aimed at restoration and long-term protection of the pineland bird community.

III. BACKGROUND

Several previous and ongoing studies of the southern Florida pinelands and their associated avifauna have illuminated the need for the proposed research or have helped shape the questions and design of this proposal. The proposed study and the ongoing projects listed below will be mutually supportive and beneficial.

Robertson and Curnutt (1990) summarized historic information (including Holt and Sutton 1928, Robertson 1955, Robertson and Kushlan 1974, Caprio 1982) and provided data from the first breeding bird survey in EVER, conducted in 1990. Their review and survey were the source of the information in Table 1. Breeding bird surveys are standardized point counts repeated annually at the same locations throughout the country (Bystrak 1981). They are designed as long-term indicators of changes in populations rather than as accurate measures of species abundance or richness. Breeding bird surveys that include mature pine habitats in the Raccoon Point area of BICY were begun in 1992 (D. Jansen, pers. comm.). Breeding bird survey data from both parks will assist us in siting the pineland study plots and interpreting results of our surveys in BICY's pine forests, which are highly interspersed with other types of vegetation.

Inventory and monitoring for Red-cockaded Woodpeckers in BICY was begun in 1983; results are presented in various NPS and Florida Game and Fresh Water Fish Commission unpublished reports (Patterson and Robertson 1981, D. Jansen). This work, along with habitat evaluations and color-banding of young for demographic studies, is ongoing in BICY (D. Jansen, unpubl. data). Range size and foraging activity of radio-tagged Red-cockaded Woodpeckers were studied by D. Jansen and K. Meyer in 1991 to examine the likely causes of a recent decline of red-cockadeds in the isolated pinelands of southern BICY. All of this work has contributed to a better understanding of Red-cockaded Woodpecker biology in BICY. D. Jansen's ongoing studies and the proposed research will provide complementary data on the ecology of the pineland avifauna.

J. Snyder and W. Platt began long-term pineland fire ecology studies in BICY and EVER, respectively, in 1992. We will establish some of our survey plots within the experimental burn units so that responses of the bird community to controlled fire might be at least tentatively measured during the proposed three-year project, with the option of periodic collection of longer-term data as future opportunities permit.

IV. METHODS

The study will encompass three nesting seasons, beginning 15 January 1993 and ending with submission of the final report on 29 February 1996. The field work will be conducted by W. B. Robertson, a project co-director (0.67 FTE), one BICY technician (0.33 FTE), and one EVER technician (0.33 FTE). The co-director will be based in BICY but will work in both parks, supervise both technicians, and be responsible for the day to day operations of the project. In addition to doing field work in EVER, W. B. Robertson will assist with the supervision of the EVER technician.

The field work will consist of surveys and behavioral observations of breeding birds and measurements of vegetation on a total of six pineland study plots (four in BICY, two in EVER). Recent and historic information on logging, fire, and hydrology for the six plots will be gathered from existing data. Estimates of current distribution and abundance of pineland bird species on privately owned lands north of BICY and EVER will be taken from existing survey data and previous studies of individual species.

The emphasis during the first year will be on establishing the plots and conducting the surveys. The second highest priority will be given to standardizing and refining the vegetation sampling methods. The remaining time during the first field season will be devoted to developing methods for locating nests, estimating nesting success, and observing behaviors that will allow testing of hypotheses regarding the effects of competition for nest sites and food on species richness and abundance. The plots established in year 1 will be reused in years 2 and 3. The vegetation sampling and behavioral observations will be conducted to their fullest extent during the second and third field seasons. Data on historic populations and present distribution and abundance on adjacent, private lands will be gathered before and after the field seasons during years 1 and 2. Some attempts at translocations may occur during year 2; most translocation and reintroduction methods will be tested during year 3.

The proposed research is described under the following seven headings (A-G), which correspond to the specific objectives listed in Section II.

A. Assessing current status.

The presence or absence of endemic pineland birds and estimates of population size relative to historic times will be derived from standardized counts conducted from April to June of 1993, 1994, and 1995 on each of the six plots. The lack of comparable historic data precludes a statistical comparison of past and present populations. The general hypothesis that we will address, however, is that at least five formerly breeding species in EVER and two in BICY have been extirpated in recent times, and most of the remaining pineland endemics have declined in number.

1. Locations and descriptions of study plots:

a. Raccoon Point (plots RPM and RPP), BICY. This area, which will have two plots, contains the most extensive stands of mature pine forest within the existing boundaries of BICY. The pinelands are interspersed with cypress domes and strands, dwarf cypress prairies, and hardwood hammocks. Red-cockaded Woodpeckers, Brown-headed Nuthatches, and Eastern Bluebirds are known to breed here. At least some portion of the study plots in Raccoon Point will include parts of the treatment plots to be used in J. Snyder's long-term study of pineland fire ecology. Access is good by truck and ATV via 11-mile road and various buggy trails.

b. Stairsteps Unit (SS), BICY. The pinelands north of Gum Slough and south of Loop Road are largely second growth stands interspersed with wet prairies and small hardwood hammocks. This area is among those in BICY most similar in age and physical structure to the second growth stands in Long Pine Key, EVER, but it is less isolated from adjacent pinelands. Red-cockaded Woodpeckers almost certainly do not nest here (D).

Jansen, pers. comm.), but the area has not been inventoried carefully enough to permit speculation on the status of the other endemics. Access is fair to good by ATV from Loop Road.

c. Addition Lands (AL), BICY. Although the acquisition process is not complete, NPS personnel have access to this area, which contains fairly extensive, low density stands of very large pines with poorly developed mid- and understories. Snag density appears to be low. The bird community has not been assessed except tentatively for Red-cockaded Woodpeckers, which appear to be rare or absent (D. Jansen, pers. comm.). This area will serve as a good comparison for the Raccoon Point pinelands, which, although similar in age, are distinctly different in structure, vegetation associations, and recent fire history. Our work on this plot will contribute vertebrate and vegetation data to upcoming resource inventories of the Addition Lands. This area is relatively far from BICY headquarters and access from I-75 is limited, at best. It may be necessary initially to enter via the Seminole Indian Reservation to the north. Once entered, however, the area is easily traversed by truck and ATV.

d. Long Pine Key, mature growth (LPK1), EVER. About 800 to 1,000 ha of mature pine forest remains in the northwest portion of Long Pine Key. This area was heavily damaged by Hurricane Andrew, which had disproportionately more impact on older, larger pine trees (report of EVER Fire Assessment Team). It is important that this plot be thoroughly surveyed and the damage assessed because of this area's potential for supporting species that may be more dependent on mature pinelands. Robertson's (1955) mapping censuses and Robertson and Curnutt's (1990) Breeding Bird Survey provide a means of comparing pre- and post-hurricane bird abundance and community structure. Access to the Long Pine Key area in general is excellent from the main park road and fire roads, although foot travel within this and the second growth plot described below will be difficult due to downed vegetation.

e. Long Pine Key, second growth (LPK2), EVER. Most of Long Pine Key was cut in the 1930s and 1940s (Robertson 1955). The present second growth forest appears to be relatively even-aged. Development of the mid- and understories and the density of snags vary across the area due to uneven patterns in the application of fire. Although second growth pines suffered less hurricane damage than mature trees, losses were still on the order of 20 to 30%, and hardwood hammocks within the pine forest were heavily damaged. Prior to the hurricane, the development of the overstory was such that this second growth forest could have had the potential, from a structural standpoint, to support the historic assemblage of pineland birds within 15 to 25 years. As with the plot of mature trees (LPK1), we will refer to historic and recent data to assess the effects of the hurricane on bird abundance and community structure. A principal goal of the proposed study will be to evaluate Long Pine Key's present potential for supporting the historic avifauna in light of the altered landscape of this isolated pineland.

2. Survey methods.

Methods for counting terrestrial birds fall under three main headings: mapping surveys, circular plots, and transects (Burnham et al. 1980, Verner 1985).

Mapping surveys provide the best estimates of absolute numbers for some species, but inconspicuous species may be drastically underestimated, and species with many

nonterritorial birds, species with large territories relative to plot size, and species that vocalize off their territories will be overestimated (Reynolds et al. 1980, Verner 1985). Nuthatches are a particularly good example of a species that is grossly underestimated in mapping surveys (R. Bennetts, MS thesis, pers. comm.).

Circular plot and transect counts can be based on visual and aural detections at either fixed or variable distances. Distance information can be used to develop an index of detectability for each species, thus permitting an estimate of absolute, rather than simply relative, abundance. Unfortunately, inaccuracies imposed by variations in vegetation and in observer's abilities to judge distances make these estimates of absolute numbers highly suspect (Verner 1985, Hutto et al. 1986). Of the two types of counts, circular plots are considered more accurate because stationary observers detect considerably more individuals than observers moving, even very slowly, along transects (Reynolds et al. 1980).

The fixed radius point-count (circular plot) method of Hutto et al. (1986) will be used to count birds on one plot in each of the five areas (RPP, SS, AL, LPK1, and LPK2). Unlike mapping surveys, this method produces a large number of truly independent samples that can be analyzed statistically, and it avoids most of the assumptions necessary for calculating abundance from mapping data.

At least 50 points will be established on each plot. The number of points per plot will be consistent to improve the accuracy of statistical comparisons among the five areas. The points will be staked and flagged, and marked on topographic maps or aerial photographs (location determined by GPS receiver, when necessary). A description of each plot will contain bearings and estimated distances between points. The points will be spaced so that it will be unlikely that the same individual birds will be detected at adjacent points. To minimize edge effects, points will be a minimum of 50 m from the interface of pine forest and other habitat types.

Each point will be censused only once per year, but counts in subsequent years will be made at the same sets of points. The counts will be made during the three hours following sunrise on rainless days evenly spaced over the period from mid-April to mid-June. On average, observers will conduct counts at six to eight points per morning.

Observers will spend exactly 10 minutes at each point and will record two kinds of data: the number of individuals of each species seen or heard within a 25 m radius of the point; and the number of each species detected beyond the 25 m radius but within pine forest. Birds originally detected outside the 25 m radius, but which move within 25 m during the 10 minute period, will be recorded as occurring within the fixed radius. The same will be true for birds flushed from within 25 m on the observer's arrival. Birds that are detected but remain unidentified during the 10 minutes can be pursued and identified before moving on to the next point. The number and species of birds detected at any distance while the observer walks between points (or while pursuing unidentified birds outside the 10 minute period) will be recorded under a third category.

Weather and water level data from existing sampling sites closest to the survey plots will be compiled for the survey period each year.

The results of the point-count surveys will permit us to characterize the present avifauna of each of the study plots, and the occurrence and relative abundance of species will be compared with our assessment of the region's historic pineland avifauna.

A mapping survey plot will be established in Raccoon Point (RPM) near the point-count plot (RPP) and concurrent surveys will be conducted during the first year to compare population estimates based on the two methods. The mapping surveys will use established methods (Anonymous 1970, Robbins (1970, Meyers and Odum 1981). A 16 ha plot (with irregular dimensions, due to the discontinuous nature of pineland habitat in Raccoon Point) will be gridded off in 50 m square blocks. The observer will begin within one hour of sunrise and stop at each marked intersection of the grid lines to map the locations of all singing males. It will be possible to cover about one-half of the plot per three-hour morning session. A total of at least 10 counts of the entire 16 ha plot will be completed.

Since mapping plots underestimate numbers of inconspicuous species, such as Nuthatches, we will combine the mapping surveys with playbacks of vocalizations of particular species (recorded in the region but not the immediate area) to increase the probability of detections (Falls 1981, Johnson et al. 1981). Playback techniques carry their own complications and risks (e.g., attracting birds from beyond the immediate territory), but they may effectively increase the number of species that can be included in the mapping survey's estimates of absolute numbers.

The best estimate of abundance and community composition based on the mapping surveys will be compared with the results from the adjacent point-count plot. If the results are similar, another mapping survey plot (LPKM) will be established in the second growth pine forest of Long Pine Key and conduct surveys on RPM and LPKM during the remaining two years of the study. This would provide a better estimate of absolute numbers, at least for some species, than the point-count plots. It also would create the opportunity for follow-up surveys, at very little cost, in subsequent years.

B. Forming a baseline of species distribution, abundance, and richness (community structure).

By determining the presence or absence of species in five point-count survey plots that represent the range of conditions for pinelands in BICY and EVER, we will be able to delineate the probable current distributions of pineland bird species within the parks.

The following procedure for evaluating the count data with regard to species abundance and richness is described in Hutto et al. (1986), with reference to Sokal and Rohlf (1981) and Verner (1985).

Since the birds observed will be moving into and out of detection range at unpredictable intervals, the effective area sampled will be unknown. This problem is common to all of the count methods, and it makes estimates of absolute numbers unreliable. While absolute counts would be useful for comparing BICY and EVER populations to those of other regions, all the goals of the proposed study can be addressed with the use of relative indices of abundance. Three such indices will be derived for each species: the mean number of birds detected per station, within 25 m, X 100; the frequency of occurrence per station, within

25 m; and the frequency of occurrence per station, within an unlimited radius. Differences in abundance between plots will be tested on a species-by-species basis by applying Mann-Whitney U-tests (for two-site comparisons) or Kruskal-Wallis one-way ANOVA (for multiple-site comparisons). The frequency of occurrence indices will be analyzed using Chi-square tests.

Differences in species richness (community structure) among the plots will be determined by using the log-linear model approach to analyzing three-way contingency tables (site x species x presence/absence). The test will be applied to both sets of frequency of occurrence indices (within and beyond 25 m). In short, this test will determine whether there is an effect of study plot on the avian community structure and the probability of occurrence of individual species.

C. Determining correlates of abundance, richness, and nesting success.

The study will determine the ecological and behavioral factors that influence pineland bird populations. Stepwise logistic regression will be used to test hypotheses regarding the relative importance of vegetation features in determining the abundance, richness, and nesting success of the endemic species. The bird population data will be derived from the point-count surveys and from observations of samples of nests on each of the five survey plots. A similar analysis will be used to test for correlations between frequencies of agonistic behaviors and abundance.

The vegetation will be measured and characterized at each of the survey points within the five point-count plots (RPP, SS, AL, LPK1, and LPK2) using the point-quarter method (Mueller-Dumbois and Ellenberg 1974), centered on the survey point. The vegetation variables will include overstory tree height, dbh of overstory trees, basal area, crown closure, density of snags, density of cavities (living trees and snags), recency and relative intensity of fire, extent of mid-story and understory development, and the relative proportions of cover types within the survey plot, determined from a GIS database. The BICY plots will have more variation in vegetation and thus will offer better opportunities for relating vegetation and population variables than will the EVER plots.

Specific sampling methods and sample sizes for quantifying behavior and determining nesting success will be determined during the first field season after workers have had the opportunity to locate and intensively observe nests on the survey plots. Behavioral observations will be focused on the remaining endemics in BICY to determine the role of competition for food and nest sites in limiting their populations and contributing to the extirpation of these species from EVER.

Most observations will be directed at observing Eastern Bluebirds and Brown-headed Nuthatches (both secondary cavity nesters) on their nesting territories (at least two nests per BICY plot). Observers will measure frequencies and outcomes of agonistic encounters with conspecifics and with selected species that appear most important. Likely competitors for food will include Pine Warblers (Dendroica pinus) and Great Crested Flycatchers (Myiarchus crinitus). Pine Warblers tend to be behaviorally dominant to other small passerines in mixed-species flocks when food is limiting (Morse 1974, 1989). Their dominance is particularly well documented in relation to Brown-headed Nuthatches (Morse 1967). Red-bellied Woodpeckers, Northern Flickers (Colaptes auratus), and Downy Woodpeckers (Picoides

pubescens) are the most likely competitors for cavities. Southern Flying Squirrels (Glaucomys volans) do not occur in BICY or EVER. The potential effects of nest parasitism, especially in EVER where Shiny Cowbirds (Molothrus bonariensis) are now present, will be evaluated. Although we do not suspect that predation is a factor in the declines, the study will consider ways in which documented nest predators may be having a disproportionately greater impact on endemics.

Competition may not be a strong limiting factor for BICY's population of Red-cockaded Woodpeckers (D. Jansen, unpubl. data and pers. comm.). Existing BICY data should provide a good indication of the potential sources and extent of competition for Red-cockaded Woodpecker cavities. This information will be useful in evaluating the suitability of Long Pine Key for eventual reintroduction of this species.

Behavioral and nesting success data will be taken from focal sampling observations (Altmann 1974) of at least six pairs per species per plot during each of study's last two years. Agonistic behaviors (frequency data) and nesting success (percent fledging at least one young) will be evaluated with regard to vegetation features (i.e., the influence of the plot) and community structure (i.e., the relative abundance of potential competitors).

The behavioral and nest observations have the potential to illuminate factors that may strongly influence community structure and, specifically, the populations of threatened endemics. This information is elusive, however, and the required observations are labor intensive. If this proposal is approved, the project should be expanded to incorporate a graduate assistant who would develop a MS research project that would address this topic. We have identified one prospective student, Ming Lee Prospero, who assisted on K. D. Meyer's study of Swallow-tailed Kites in BICY and is a likely candidate for admission to the University of Florida's graduate program. Ms. Prospero has expressed a strong interest in working on such a project. Support (graduate stipend and operating expenses) could be sought from the US Fish and Wildlife Service's Cooperative Education Program, as well as state and private sources.

D. Identifying likely causes of recent declines.

The most likely causes of the recent extirpations and declines of the pineland avifauna in BICY and EVER are logging, changes in the natural fire and water regimes, and isolation, which resulted from development of the Miami Rock Ridge and, to a smaller extent, the pinelands north of BICY. The proposed study will document the history of these changes in southern Florida and relate them, to the extent possible, to the timing and pattern of population changes in the pineland avifauna.

This review also will examine all available data from historic records and recent studies to document as best possible the past and present distributions of the pineland endemics in central and southern Florida. This will provide a description of the degree of isolation of BICY and EVER's populations and the potential for immigration from other populations. Sources will include Breeding Bird Survey data, Florida Breeding Bird Atlas data, S. Nesbitt's and K. Dryden's work with Red-cockaded Woodpeckers, J. Smallwood's studies of American Kestrels, records of Archbold Biological Station, and species lists for publicly managed lands.

E. Evaluating the effects of Hurricane Andrew.

As the proposed study was originally conceived (prior to Hurricane Andrew), its principal overall goal was to determine the advisability and feasibility of restoring the pineland avifauna in Long Pine Key, EVER. Part of the process we envisioned for arriving at these recommendations was a determination of the likely causes of the extirpations of six species in EVER. The hurricane has diminished the ability to determine the relative importance of the possible factors because we can no longer study the exact community that those factors produced. It is possible to roughly estimate the similarity of the present avifauna to that which existed before the hurricane, based on comparisons of our survey results with the single recent Breeding Bird Survey conducted in Long Pine Key (Robertson and Curnutt 1990). Breeding Bird Surveys, however, are designed to indicate long-term changes on a fairly coarse scale. The 1990 survey, unfortunately, does not provide sufficient data to adequately compare the pre- and post-hurricane pineland bird communities in EVER.

It is now more important and more challenging than ever to determine how EVER's historic pineland avifauna can be restored to the fullest extent possible. This remains as the principal goal in proposing this study, and the potential for success need not be reduced by the hurricane's effects. Fortunately, the nearby pinelands of BICY, with their convenient variations in structure and bird communities, remain as an uncommonly good source of comparative and predictive data for this appraisal. While it might be argued that natural successional processes should be allowed to reshape Long Pine Key's avifauna in the wake of Hurricane Andrew, such an argument would not take into account the valuable role of this island of rare habitat in maintaining the biodiversity of southern Florida.

F. Developing techniques for translocations and reintroductions.

Habitat characterizations of occupied survey plots in BICY will be used to evaluate the suitability of Long Pine Key for reintroductions of Red-cockaded Woodpeckers, Eastern Bluebirds, and Brown-headed Nuthatches. The suitability of BICY and EVER for reintroductions of Southeastern American Kestrels and Hairy Woodpeckers will be determined from recent studies of these species in south-central Florida (e.g., by J. Smallwood and J. Fitzpatrick). Southeastern American Kestrels and Red-cockaded Woodpeckers are state and federally listed as threatened and endangered, respectively. Any manipulations during this study (Kestrels) or recommendations for future translocations or reintroductions (Red-cockaded Woodpeckers) will be contingent on approval of a specific plan and granting of permits by state and federal agencies.

Some translocation and reintroduction techniques have been developed for American Kestrels and Red-cockaded Woodpeckers. The few written descriptions are in the form of reports. We are not aware of any specific attempts at reintroducing Hairy Woodpeckers, Eastern Bluebirds, or Brown-headed Nuthatches. Possible approaches to reintroducing these species include the use of artificial cavities (Copyon 1990) and soft release techniques, in which the birds are temporarily contained at the site in a large enclosure. Feeding will continue at the enclosure for some time after release.

First attempts at manipulations will be translocations of bluebirds and nuthatches, in which birds will be moved from one occupied area to another within BICY. The birds will be

color-banded and monitored as long as possible. The next step will be a trial reintroduction in which BICY family groups will be moved to suitable but vacant habitat elsewhere within the Preserve. Enclosures and artificial cavities will be used for the reintroductions.

If suitable and sufficiently extensive habitat can be located in BICY, and if approval is granted, attempts will be made to move a small number of wild Kestrels and Hairy Woodpeckers from south-central Florida into the Preserve using soft release and artificial cavity techniques. These birds will be temporarily radio-tagged to monitor their movements. J. Smallwood has agreed to assist in evaluations of habitat suitability and the specific design of the Kestrel reintroduction. Dr. Smallwood has studied Southeastern American Kestrels extensively in northern and central Florida over the last 12 years. His assessments of available habitat and feasibility will greatly improve the effectiveness of this portion of the study.

The management of Red-cockaded Woodpeckers in southern Florida should be addressed on a regional level in order to clarify goals and concerns (e.g., reintroduction sites, donor populations, genetic considerations). The NPS and the Florida Game and Fresh Water Fish Commission are in good positions to pursue cooperative leadership of this process. If viable populations of Red-cockaded Woodpeckers are to persist at the southern limit of the species' range, there is no doubt that BICY and EVER will play a central role by serving as the only substantial refugia in the region.

The possible reintroduction of Red-cockaded Woodpeckers to Long Pine Key, which was first suggested several years ago, should be considered within the broader regional context and, therefore, is largely beyond the scope of this proposal. Considerable effort, furthermore, is being invested throughout the Southeast in developing effective methods for translocations and reintroductions of this species. It is possible that BICY, during the course of the proposed study, might conduct translocations to bolster declining breeding groups as part of its ongoing studies of Red-cockaded Woodpeckers (D. Jansen, pers. comm.). The Preserve also may choose to test possible reintroduction methods by moving birds from threatened territories on private land into suitable, vacant habitat within BICY. This would be an important preliminary step in preparing for eventual reintroductions to Long Pine Key. The vegetation data collected as part of the proposed project will contribute to evaluations of habitat suitability for these trial reintroductions. Project personnel also will be available to assist as much as possible with banding, radio-tagging, and monitoring birds as part of this effort.

G. Recommending management practices aimed at restoration and long-term protection.

The proposed study will make three types of recommendations. The first will describe management practices for increasing and maintaining the extant populations of endemic pineland bird species. The second type will assess the advisability and recommend the best methods for reintroducing the extirpated species. Finally, the study will suggest ways in which the NPS can extend its influence beyond its boundaries to help assure the long-term viability of pine forest ecosystems in southern Florida.

The most useful management tools for improving conditions for endemic pineland birds, and thus the best means of restoring their populations to historic levels, probably will include prescribed fire, construction of artificial cavities, and addition of excluders to natural cavities (excluders limit access for birds over a certain size). Prescribed fire can control the development of the mid- and understories, thus modifying the available foraging and perching substrate in ways that favor targeted species. Prescribed fire also affects the availability of snags. Artificial cavities can be constructed where the availability of natural cavities to secondary cavity nesters is limited. Excluders can favor endemic species by limiting competition from larger species that usurp active cavities.

Recommendations for translocations and reintroductions will be based on assessments of habitat suitability, the results of trial manipulations, progress of other workers in developing techniques for similar species, the availability of birds, and, in the case of listed species, the approval of state and federal wildlife agencies.

We do not doubt that the proposed study will produce the necessary information and techniques to begin restoration of the pineland avifauna in BICY and EVER, but it is unrealistic to assume that this process alone will assure a future for this rare vertebrate community. The isolation of Long Pine Key represents an extreme on a continuum of decline for hydric slash pine forests in southern Florida. The pinelands of the Big Cypress Swamp region are experiencing a rate of decline that exceeds that undergone by the Miami Rock Ridge pinelands. Hydric pinelands are not afforded any protection under existing federal or state wetlands regulations. The relatively short hydroperiod of these forests makes them attractive sites for development. Since 1900, 85% of the pine forests on private land north of BICY and south of the Lake Wales Ridge have been destroyed; half of this loss occurred since 1973 (Southwest Florida Water Management District and UF Center for Wetlands and Water Resources data).

The Red-cockaded Woodpecker population in BICY may appear stable within the relatively narrow view of the available time frame, but the results of demographic and modeling studies suggest that this may be an unrealistic appraisal of their true status. Hurricane Andrew demonstrated in text-book fashion the vulnerability of small isolated populations, such as the sub-population of Red-cockaded Woodpeckers in BICY's Lostmans Pines and the assemblage of species in EVER's Long Pine Key.

It is reasonable to expect that the proposed study can develop the means to restore the deteriorating pineland bird community in BICY and EVER. The NPS, however, cannot manage its extant or restored pineland avifauna as if protective boundaries assure longevity. Unless the declining populations of pineland birds can be stabilized across the broader, southern Florida landscape, the long-term viability of the BICY and EVER populations cannot be assured. If this and similarly rare communities are to survive in the threatened ecosystems managed within southern Florida's parks, the NPS will have to expand its mission in ways that will influence land-use practices and planning on a regional scale. The recommendations provided by the proposed study will serve as a model for what the NPS can offer to promote this process.

V. PARK PARTICIPATION

Major support for the proposed study will be limited to temporary rental quarters for two technicians (one in BICY, one in EVER) from March through June, office space for the project director (BICY), three hand-held two-way radios, and storage space for an ATV on a small trailer (BICY). In addition to vehicle maintenance, requests for temporary assistance will include the short-term loan of a vehicle from resource management or research staff as unanticipated needs and equipment failures arise. The personnel and equipment associated with the proposed study would be available to the present staff in reciprocal arrangements. The project also would ask for temporary use of maps, aerial photos, and perhaps a GPS receiver for mapping survey plots, if they are available.

VI. OTHER SERVICE INVOLVEMENT

In addition to logistic needs, the director of the proposed project will occasionally seek consultation with research and resource management staff regarding wildlife and vegetation biology, fire management, weather and hydrology, and other topics. We would hope that many of these interactions will be mutually beneficial, and expect that opportunities for productive collaboration will arise. Some commitment of time by the research biologist in BICY will be required for project oversight and phase approval of the study. The research biologist and administrative staff in BICY will be involved in personnel selection and hiring.

VII. DELIVERABLES AND SCHEDULE

- A. Progress reports (5, at 6-month intervals)

Due:	31 August 1993	(6 months)
	28 February 1994	(12 ")
	31 August 1994	(18 ")
	28 February 1995	(24 ")
	31 August 1995	(30 ")

- B. Annual reports (3):

Due:	31 December 1993	(10.5 months)
	31 December 1994	(22.5 ")
	31 December 1995	(34.5 ")

- C. Final report
Due: 29 February 1996

- D. Oral reports (pre-study, annual, close-out),
presented at BICY Annual Research Colloquium

Due:	February 1993	(1 month)
	January - February 1994	(13 ")
	January - February 1995	(25 ")
	January - February 1996	(37 ")

- E. Park Science article on results of proposed study
Submitted by 31 December 1996

VIII. BUDGET

First year

Personnel:

Project director:	0.67 FTE GS-12	26,834
	Benefits (32%)	8,587
	Total cost	35,420

2 Technicians:	0.67 FTE GS-5	12,000
(Approx., 0.33 FTE ea.)	Benefits (15%)	2,000
	Total cost	<u>14,000</u>

EVER will provide 0.10 of W. B. Robertson's time.

TOTAL PERSONNEL COSTS: 49,420

Travel: None. Mileage costs are included in vehicle costs, below.

Equipment: 2 trucks (EVER will provide one vehicle), including gas and maintenance	6,000
1 ATV, with trailer	3,000

TOTAL COSTS, FIRST YEAR: 58,420

2nd and 3rd years

Personnel costs will be higher due to COLA allowances; equipment costs will be lower due to one-time cost for ATV. Total costs per year will approximate those of the first year.

TOTAL PROJECT COSTS, ALL THREE YEARS (Approx.) 175,000

IX. SUBCONTRACTS

None

X. LITERATURE CITED

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