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Endangered Species

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Lucía Soler is a biologist of the Universidad Nacional del Sur (Bahía Blanca, Argentina) and at the present time is President of HUELLAS. She is the general coordinator of the project "Carnivore Conservation in the Northeast of Argentina". The proposal have specific aims: to develop an education and ecological program for the carnivore conservation. Since September of 2004 two maned wolf are been radio-monitored in wildlife.



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Problems and Recommendations for the Conservation of the Maned Wolf in Argentina

Results from the *First Workshop of Chrysocyon brachyurus in Argentina and surrounding countries: conservation in situ and ex situ*



September 12,13, and 14, 2002
Mburucuyá, Corrientes, Argentina

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Abstract

Chrysocyon brachyurus is an endemic canid of South America. Is an "at low risk / near threatened" (international) and "endangered" (national) species. However, the information availability for the maned wolf is not enough for encourage an action plan for the conservation. The most significant and historic threats proposed to maned wolf are conflicts with humans, drastic reduction of habitat, kills by automobiles, and feral dogs (who pursue and kill maned wolf individuals, are a source of diseases, and compete for food). With the objectives to update the conservation problems and to contribute in an integrated and synchronized action plan for the maned wolf, was developed a Workshop for Conservation of Maned wolf in Argentina.

Resumen

Chrysocyon brachyurus es un canido endémico de Sudamérica. Internacionalmente ha sido categorizado Cercano a la Amenaza y en Argentina como en Peligro de Extinción; sin embargo la información disponible sobre la especie es insuficiente para desarrollar un plan de acción para su conservación. Las más significativas e históricas amenazas propuestas para el Aguara guazú son: los conflictos con los humanos, drástica reducción del hábitat, muerte por atropellamiento en rutas y los perros salvajes (persiguen y matan individuos de la especie, son fuente de enfermedades y compiten por el alimento en vida silvestre). Con el objetivo de revisar los problemas para la conservación y contribuir a un integrado y sincronizado plan de acción para el Aguara guazú, fue desarrollado un Taller para la Conservación del Aguara guazú en Argentina.

Introduction

Chrysocyon brachyurus, commonly known as *maned wolf*, *aguará guazú*, *lobo de crin*, or *borochi* is one of the 10 species of wild canids that inhabit South America (Ginsberg and Macdonald 1992). Its distribution area includes northeastern Brazil and Argentina, eastern Bolivia, southern Paraguay, and southeastern Peru (Cabrera 1957; Dietz 1985). Its existence in Uruguay is doubtful, and it is presumed to have been extirpated there. Maned wolves are found in low densities (Rodden et al. 2004) and thereby considered rare throughout the range (Ginsberg and Macdonald 1992; Rodden et al. 2004). The most significant threats to maned wolf populations are conflicts with humans (figure 1), including drastic reduction of habitat (especially due to conversion to agricultural and pasture land), and kills by automobiles. In addition, feral dogs pursue and kill maned wolves and can also be an important source of diseases and possibly compete with the wild canid for food (Ginsberg and Macdonald 1992; Rodden et al. 2004). In Argentina,

Figure 1. Maned wolf killed by rural people. It is a pregnant adult female. Photo by: Abel Fleita (HUELLAS)



the canid was studied between 1980 and 1990 by Marcelo Becaccesi (see 1985, 1987, 1988, 1990, 1992, 1992, 1993), however, important gaps in information about the distribution, ecology, biology, and behavior remain (Soler and Carenton 2001; Salvatori et al. 2003; Soler et al. 2004). Internationally, it has been categorized as near threatened (Rodden et al. 2004), and in Argentina endangered (Díaz and Ojeda 2000).

With the aim of renewing the state of knowledge about *C. brachyurus* in Argentina and surrounding countries, the "First Conservation Workshop of *Chrysocyon brachyurus* in Argentina and surrounding countries" took place September 12–14, 2002 in Mburucuyá, Corrientes, Argentina. It was sponsored by the National Park Administration, the Education and Culture Ministry of Corrientes, and the Honorable Chamber of Senators from Corrientes Province.

The goals of the meeting were (1) to debate the problems facing the development of field and captive projects), (2) to contribute in an integrated and synchronized way to an education program that will help manage projects and assure the conservation processes, (3) to evaluate the possibilities to generate interdisciplinary programs, and (4) to create a species working group at the international and national level.

There search and educational projects about *C. brachyurus* were presented and three working break-out groups were organized: Conservation in situ (CIS), Conservation ex situ (CES) and Political and Educational Management (P-EM). Each group debated real and potential problems for the species and developed recommendations.

Results

Fifty-nine people participated in the workshop, of which 24% were institutional members (governmental and nongovernmental organizations (GOs and NGOs). Park ranger–fauna and local teachers were in the same

proportion (17%); project leaders made up 10%; and the remainder was local people. In relation to the presentations (table 1), three were proposals in Argentina, one in Bolivia, one in Brazil, and one of international scale. The subjects of the presentations are shown in table 1. Sixty percent of the proposals involved wildlife, being 86% of the total institutional proposals. Forty-three percent had grants.

The CIS group developed a specific approach, using a problematic matrix (table 2). Each problem was classified according to the following criteria: *Urgency* and *Impacts* on the species and *Time Frame*. Within the *Urgency* criteria, the following scale was used: (1) few, (2) medium, and (3) big. *Impact* to the species was classified by whether the problem affected (1) individuals, (2) the species, or (3) populations. *Time*

Frame was divided into three possible situations depending on if the solution to the problem is of (1) short duration (months), (2) medium duration (1 to 5 years), or (3) long duration (more than 5 years). Each problem was evaluated based on the following considerations: economic resources, specific human resources, availability of local people to help with the project, and institutional support. Each problem was then ranked and assigned a corresponding priority value: 9 = maximum priority; 7–8 = medium priority, and 5–6 = low priority.

Conservation Group Ex Situ

Detected problems:

- (1) individual efforts
- (2) low reproduction and survival in captivity

Table 1: Projects presented during the *First Maned wolf Conservation Workshop for Argentina and surrounding countries*.

INSTITUCIÓN	AUTHOR/AUTHORS	TITLE OF PROJECT
Jardín Zoológico de la Ciudad de Buenos Aires, Argentina	Díaz, Marcela L.; Orozco, M. Marcela; Pino, M. de la Cruz; Rosso, M. Soledad; and Kina A. María	MANED WOLF CONSERVATION PROJECT
Istituto di Ecologia Applicata de Roma, Italia	Salvatori, Valeria	AREAS FOR THE CONSERVATION OF THE MANED WOLF (<i>Chrysocyon brachyurus</i>)
Centro de biología Genomita e Molecular da Pontificia Universidade Católica do Rio Grande do Sul, Brasil	Prates, Paulo Jr., Moreira, José Roberto and Sandro Bonatto	MITHOCONDRIAL DNA DIVERSITY, POPULATION HISTORY AND CONSERVATION OF <i>Chrysocyon brachyurus</i> .
Cátedra de fauna silvestre de la Facultad de Veterinaria de la Universidad de Rosario. Argentina	Steiman, Laura	PROBLEM OF THE MANED WOLF IN SANTA FE AND CHACO PROVINCES, REGIÓN OF THE LOW SUBMERIDIONALS.
Cátedra de Fisiopatología de la Reproducción y Obstetricia. UNNE, Corrientes. Argentina	Torres Jiménez, Gonzalo	STUDY OF THE REPRODUCTIVE PHISIOLOGY OF THE MANED WOLF <i>Chrysocyon brachyurus</i> (ILLIGER, 1811) IN CAPTIVITY BY DOSAGE OF SEXUAL FECAL ESTEROIDS.
Museo de Historia Noel Kempff Mercado. Bolivia	Chávez Calvimontes, Verónica	ECOLOGY OF THE MANED WOLF (<i>Chrysocyon brachyurus</i>), IN THE CAMP "LOS FIERROS" FROM NOEL KEMPPF MERCADO NATIONAL PARK - BOLIVIA.
HUELLAS – Asociación para el estudio y la conservación de la biodiversidad, Bahía Blanca. Argentina	Soler, Lucía; Pérez, Pascual; Cáceres, Cesar; Taboada, Adrián and Jean Marie Carenton	CONSERVATION OF THE CARNIVORES FROM ARGENTINEAN NORTHEAST BY THE PARTICIPATION OF LOCAL PEOPLE

- (3) low or non-participation of zoo directors in discussions about captive management problems
- (4) lack of concern and institutional responsibility for maned wolf conservation,
- (5) lack of current information about individuals in captivity (origin, genetic, later derivations, etc.)
- (6) nonexistence of standardization between zoos for management of health and nutrition; nonexistence of proper places for the disposal of rescued, confiscated, and accidentally injured animals
- (7) lack of an authority able to decide the destiny of rescued animals
- (8) lack of an action protocol for captured wild animals and another for uniform necropsy to facilitate efficient use of information from dead animals
- (9) lack of a management plan for the species at a national level

Recommendations:

For the short term we recommended

- (1) compilation of information from zoo animals and creation of a national register for *C. brachyurus* in Argentina (NRAG) (figure 2);
- (2) establishment of a uniform recording system and implementation of an action protocol for treatment of rescued, confiscated animals, etc., that determines the destiny of an

animal (freedom or captivity), and provides procedures to follow from the moment of acquisition;

- (3) formation of an *ex situ* working team to facilitate the exchange of information between institutions; and
- (4) providing the report from this workshop to the directors.

For the medium and long term we recommended

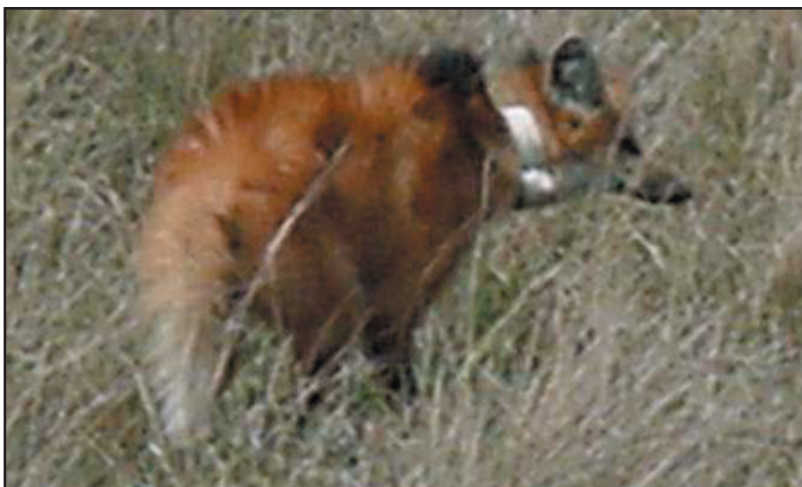
- (1) creating a facility to house confiscated and rescued maned wolves;
- (2) standardizing biological samples (collection, processing, and storage) and dispersal of the protocols to park rangers, fauna rangers, fauna inspectors, etc.;
- (3) collecting information from captive animals that are not registered in the NRAG;
- (4) developing an educational program *ex situ*;
- (5) promoting the collaboration and support of the Species Survival Plan (SSP); and
- (6) enabling people at a national level through the support of the World Conservation Union (IUCN) Canid Species Survival Commission (SSC).

Conservation Group *In Situ*

Detected Problems: (table 2)

The problems detected for the *in situ* conservation of the maned wolf were listed in a table and scored in order of urgency, impact, and temporal reach. This was done considering the local situations reported from the participants in various locations of the Corrientes, Chaco, Santa Fé, Santiago del Estero, and Entre Rios regions. Urgency was considered in terms of highly needed in order to either progress with other studies or stop the decline of the species; impact was considered in terms of effect on the species (both positive and negative);

Figure 2. Maned wolf (male) with radio-collars, captured in a rural area. At the moment, it is monitored by a HUELLAS biologist and collaborators. Photo by: Abel Fleita (HUELLAS)



PROBLEM	VARIABLES			TOTAL
	URGENCY	IMPACT	TEMPORAL REACH	
No information about the distribution in all scales			3	7
International Distribution	1	3		
National distribution	3	3	3	9
Local distribution	2	2	3	7
No information about the vulnerability of the species by local people	3	3	3	9
No information about the presence/absence in protected areas	1	2	1	4
No information about how the modification of the environment affects the species	3	1	1	4
Impact of artificial and prescribed fires, in times of breeding, etc.				
Density and distribution of human settlements associated with areas with important wild populations	3	1	3	7
No information about the impact of artificial barriers (crop for wood exploitation, for example)	3	2	3	8
No information regarding fragmentation as a problem for the species	3	3	3	9
Taming of animals by local people:				
As semidomesticated animals	1	1	2	4
As pets	3	1	3	7
Commercialization of animals for private collections, zoos, etc.	2	1	3	6
Negative image of the animal (because of predation or traditions). The results of traditions are: "The legend of 'el lobisón'"	3	3	3	9
Lack of information from investigations in captivity and wild. No information regarding the ecology and behavior	3	3	3	9
Legal situation: no information on the commercialization, transit, pertinence, hunting by local people, laws at different scales (international, national, and regional) inside and outside of protected areas	3	3	3	9
Predation mortality	3	2	3	8
Predation by wild dogs	3	1	3	8
Road kills or injuries resulting from high speed traffic	3	2	3	8

temporal reach was considered in terms of sustainability and long-term effect on the population. Each variable identified was given a score between 1 (low) and 3 (high) for the three effects considered, and the sum of the three scores was used to rank the variables in order to prioritize problems to be tackled. The table is reported below.

Recommendations:

(1) creation of a data bank with forms and procedures for the collection of

uniform data, involving academic institutions, natural resources, environmental, fauna and flora directions for each province and also of the nation, security forces, and nongovernmental conservation organizations. Use of the Biodiversity Information System (BIS) of the National Park Administration was suggested.

(2) promotion of ecological and behavioral studies of the species using radiotelemetry to assess

Table 2: Problem matrix from the Conservation Group *In Situ*.

- habitat fragmentation and human impacts
- (3) digitalization of the actual and the potential distribution, defining optimal environments
 - (4) creation of a directory of investigators and fauna observers
 - (5) promotion of sightseeing registers, from municipal centers, using teachers as compilers
 - (6) implementation of training for security forces regarding valid legal aspects in priority areas
 - (7) development of aggressive awareness campaigns using successful models that have already presented results (e.g., the European wolf)
 - (8) coordination of the interactions between national and provincial conservation agents in shared activities
 - (9) development of environmental educational programs about natural resources value, biodiversity, conservation, and local threats
 - (10) compilation of existent laws and distribution to security forces, municipalities, gendarmerie, police, firemen, etc.,
 - (11) involvement in curricula development by educational ministries from the areas where the species exists and education regarding the value of local natural resources
 - (12) continuation of workshops within distribution to develop a consensual action plan for the conservation of the species
 - (13) declaration of the maned wolf as a national monument to ensure its legal protection with a strong enforcement of the law
- (2) lack of interest by the public in general
 - (3) ignorance at all levels
 - (4) lack of communication between managers and management agencies
 - (5) lack of political decisiveness
 - (6) lack of economic and human resources
 - (7) lack of enforcement of existing laws
 - (8) lack of continuity in governmental management
- Recommendations:**
- (1) promotion and management of the incorporation of education for conservation in the official school curricula, as well as in presentations made by park rangers, fauna rangers, etc.
 - (2) requesting NGOs and GOs for brochures already available about the maned wolf
 - (3) dispersal and implementation of data about ecotourism
 - (4) promotion of talks and development of local radio programs
 - (5) development of an information network with links to other institutions, GOs and NGOs, institutional projects, and on the Internet
 - (6) management of economic resources in different agencies for educational projects
 - (7) unification of management legislation
 - (8) use of the incoming funds proceeds through ecotourism operators in provincial protected areas
 - (9) diffusion of laws by fauna and flora delegates
 - (10) arrangement of interjurisdictional and interinstitutional activities

Politics and Educational Management Group

Detected problems:

- (1) lack of cooperation and public involvement within the species range

Discussion

The results of the First Maned Wolf Conservation Workshop were fully accepted by participants and recommendations were developed to benefit the species as well as promote

educational studies and conservation of threatened species. The presence of different social levels of the community from Corrientes province was enriching, however their actual contribution was limited. We proposed that local people should continue to participate in future meetings if the coordinators can first present an initial overview of the workshop goals. A better mechanism to disseminate information and a greater willingness to compromise between polarized stakeholders are needed to avoid disjunctive efforts. We must promote and generate uniform research criteria using the priorities developed here. Formal and informal education should develop not only in rural schools but in teacher training centers and in university centers, to promote the knowledge of natural resources of the area. The direct involvement of institutions that create, control, and apply effective legislation should be emphasized throughout the range of the species. The maned wolf has been declared a national monument in two provinces of Argentina, and this has improved protection of the species. The role of zoos housing maned wolves should be revised immediately, since many individuals are wild caught and no clear objective exists for holding them, nor is their fate understood.

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Conservation Status of Coral Reef Fishes in the Florida Keys



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Abstract

This article identifies coral reef fishes that may deserve a high conservation priority in the Florida Keys. Expert observations between 1993 and 2004 from the REEF database ($n = 5,783$) identified 114 coral reef fishes that occur in the Florida Keys. Of these, four restricted-range coral reef fishes and a number of rare species based on incidence may deserve a high conservation priority in the Florida Keys. Large-bodied species with low abundance and small range size have been hypothesized to be associated with extinction-proneness, but there were few large-bodied species that meet these criteria in the Florida Keys. The Serranids, *Mycteroperca venenosa* and *Mycteroperca interstitialis* are exceptions. Most large coral reef fishes have high incidences and have large ranges that extend throughout the Western Atlantic.

Resumen

Este artículo identifica los peces del arrecife de coral que merecen un alto nivel de prioridad en los esfuerzos de conservación de los cayos de Florida. Con observaciones hechas por expertos entre los años del 1993 hasta 2004 en la base de datos REEF ($n=5,783$) se identificaron 114 peces de arrecife de coral que se hallan en los cayos de la Florida. De estos, cuatro peces de arrecife de coral con extensión limitada y un número de especies raras, debido al nivel de incidencia, puede que merezcan una alta prioridad de conservación en los cayos de la Florida. Se cree que especies grandes con poca abundancia y de poca extensión tienen una mayor propensidad de extinción, pero hay pocas especies grandes que tengan estos requisitos en los cayos de la Florida. Los serranidos, *Mycteroperca venenosa*, y *Mycteroperca interstitialis* son excepciones. La mayoría de los peces de coral tienen una alta incidencia y grandes extensiones que se distribuyen por todo el Atlántico occidental.

reefs located between the Florida Keys and bank reefs. The Florida reef tract contains over fifty species of corals comprising over eighty percent of all the coral reef species in the Tropical Western Atlantic and over two hundred species of fish.

Methods

Data on fish diversity from coral reefs sites were collected between 1993 and 2004 by the Reef Environmental Education Foundation (REEF) volunteer surveys using the roving diver technique (Schmitt & Sullivan 1996). The roving diver technique entails a diver swimming freely throughout a coral reef site (500 m²) for at least 30 minutes and recording every fish species the diver can positively identify. Between January 1, 1993 and December 10, 2004, expert REEF observers completed a total of 5,783 surveys using the roving diver technique, at 292 coral reef sites, for a total bottom time of 13,623 hours. All native fish recorded by "Experts" according to REEF criteria in the Florida Keys from 1993 to 2004 were included with "Novice" data excluded.

Natural History Characteristics

Natural history data on habitat preference, body size, range size, incidence, and sighting frequency were compiled for all fish species identified in the REEF database (REEF 2004). All fish were classified as species that use coral reef as their primary habitat (herein called coral reef fishes) or species that use other habitats (i.e., seagrass beds, sandy substrates, pelagic) as their primary habitat. Classifications of these coral reef fishes came from habitat descriptions in Lieske & Myers (1997),

Humann & Deloach (2002) and FishBase (2002). Only fish that use coral reefs as their primary habitat were used in this analysis. The total incidence of each species recorded by an expert observer within the Florida Keys between 1993 and 2004 (n = 5,783) was used as a measure of species incidence. Body sizes were collected for all species based on mean species length (Humann & Deloach 2002). Range size was quantified by incidence in nine biogeographic regions in the Western Atlantic following REEF classification: 1. Florida, 2. Bermuda, 3. East Coast of the United States, 4. Gulf of Mexico, 5. Northwest Caribbean, 6. Bahamas, Turks, and Caicos, 7. Greater Antilles, Virgin Islands, 8. Lesser Antilles, 9. Continental South America. Data on species distribution in nine biogeographic regions are from the Tropical Western Atlantic distributional database (REEF 2004) and other sources (Lieske & Myers 1997, Humann & Deloach 2002). These expert observers also collected sighting frequency was also collected for coral reef fishes in the Florida Keys. Sighting frequency is a measure of how often a species is observed during a specified time period. It indicates the percentage of times out of all surveys that the species gets recorded (REEF 2004). For this research, we divided sighting frequency for this research into three time periods: January 1, 1993 to June 1997, July 1997-June 2001, and July 2001- December 10, 2004.

Conservation Assessment

Our research undertakes three conservation assessments to identify coral reef fishes that may deserve a high conservation priority in the Florida

Table 1. Restricted-range coral reef fishes in the Florida Keys and total incidence from 1993 to 2004 and sighting frequency (SF%) for three time periods. Table courtesy of the author.

Common Name	Scientific Name	Incidence	Range	SF%	SF%	SF%
			Size	93-97	97-01	01-04
Broadsaddle Cardinalfish	<i>Apogon pillionatus</i>	2	4		0.01	
Downy Blenny	<i>Labrisomus kalisherae</i>	31	4		0.8	0.4
Leopard Goby	<i>Gobiosoma saucrum</i>	171	5	2	3.3	2.9
Wrasse Blenny	<i>Hemiemblemaria simulus</i>	564	5	9.3	7.7	11.1

Common Name	Scientific Name	Incidence	SF % 93-97	SF% 97-01	SF% 01-04
Orangesided Goby	<i>Gobiosoma dilepsis</i>	1	0.1		
Sharknose Goby	<i>Gobiosoma evelynae</i>	1	0.1		
Yellowtail Hamlet	<i>Hypoplectrus chlorurus</i>	2			0.1
Broadsaddle Cardinalfish	<i>Apogon pillionatus</i>	2		0.01	
Spotlight Goby	<i>Gobiosoma louisae</i>	2	0.1	0.05	
Ringed Blenny	<i>Starksia hassi</i>	3			0.1
Yellowbelly Hamlet	<i>Hypoplectrus aberrans</i>	3		0.05	0.1
Yellowline Goby	<i>Gobiosoma horsti</i>	3		0.1	
Diamond Blenny	<i>Malacoctenus boehlkei</i>	4		2.2	
Candy Bass	<i>Liopropoma carmabi</i>	6	0.1	0.05	0.1
Roughlip Cardinalfish	<i>Apogon robinsi</i>	7			0.2
Sawcheek Cardinalfish	<i>Apogon quadrisquamatus</i>	13	0.8		0.2
Pale Cardinalfish	<i>Apogon planifrons</i>	22	1.4	0.05	0.3
Peppermint Goby	<i>Coryphopterus lipernes</i>	27	0.9	0.2	0.4
Downy Blenny	<i>Labrisomus kalisherae</i>	31		0.8	0.4
Tusked Goby	<i>Risor ruber</i>	35		0.9	0.5
Cherubfish	<i>Centropyge argi</i>	52	0.6	0.6	1
Roughhead Triplefin	<i>Enneanectes boehlkei</i>	67		1.4	1.2
Rusty Goby	<i>Priolepis hipoliti</i>	93	0.8	0.5	2.3
Sponge Cardinalfish	<i>Phaeoptyx xenus</i>	95	0.1	0.6	1.9
Queen Triggerfish	<i>Balistes vetula</i>	98	1.6	4	0.4

Table 2. Rare coral reef fishes based on incidence from coral reef sites in the Florida Keys and sighting frequency (SF%) for three time periods. Table courtesy of the author.

Keys. First, we selected restricted-range species in order to identify ones that may deserve a high priority for conservation at an international level. Second, we ranked all coral reef fishes recorded from 1993 to 2004 by incidence to identify rare species in the Florida Keys. Third, we selected the first quartile of coral reef fishes with large body sizes and ranked them by incidence and range size to identify species that have natural history characteristics associated with extinction-prone species (Gaston 1994).

Results

Using the roving dive technique, observers recorded 114 coral reef fishes in 25 families in the Florida Keys. Range size can be used to rank the coral reef fishes, in order to identify species in the Florida Keys that might be of global conservation importance. (Table 1). Few restricted-range species occur in the Florida Keys with most coral reef fishes

occurring in six or more biogeographic regions and only four species occurring in five or fewer regions. Two species, *Apogon pillionatus*, and *Labrisomus kalisherae* appear to have restricted-ranges and have a low incidence in the Florida Keys and may be of particular conservation importance. The Gobiid *Gobiosoma saucrum* and the Labrisomid *Hemiemblemaria simulus* appear to have permanent populations in the Keys and relatively low incidence. There is minimal data to assess trends in the two species with the smallest range, but *Gobiosoma saucrum* and *Hemiemblemaria simulus* do not appear to be declining based on sighting frequency.

There were 21 coral reef fishes identified as rare based on the coral reef fishes with an incidence of 100 or less (Table 2). Five species were recorded only once or twice, and 11 species were recorded ten times or less. The list of rare species is primarily composed of species

in the Goby (7 species), Cardinalfish (5 species) and Blenny (3 species) families. The sighting frequency for species recorded ten times or less is too low to make an assessment of the trends in species' populations. Most species with an incidence of 10 or more appear stable, with the exception of *Apogon planifrons* and *Balistes vetula*, which appear to be decreasing in sighting frequency within the Florida Keys.

The largest coral reef fishes based on body size were ranked by incidence and range size to identify species that have natural history characteristics associated with extinction prone species (Table 3). Most of these species are in the Parrotfish (5 species) and Grouper (4 species) families. Most large coral reef fishes have high incidences and have large ranges that extend throughout the Western Atlantic. *Balistes vetula* again appears to be the most endangered

species on the list due to low incidence, relatively restricted range, and a decline in sighting frequency. Two species of Serranids, *Mycteroperca venenosa* and *Mycteroperca interstitialis*, have a low incidence, however, their sighting frequency suggests that their numbers have been increasing in the Florida Keys. For large coral reef fishes recorded less than 1,000 times, all appear to be relatively stable or increasing in number based on sighting frequency, with the possible exception of *Balistes vetula* and *Cantherhines macrocerus*, which appear to be declining. There are six species (*Lactophrys bicaudalis*, *Lutjanus mahogoni*, *Aulostomus maculatus*, *Scarus vetula*, *Halishoeres radiatus*, and *Pomacanthus arcuatus*) with an incidence greater than 1,000 that appear to be declining based on sighting frequency. However, a majority of large coral reef fishes do not appear to have natural

Table 3. The first quartile of coral reef fishes by large body size with data on incidence, range size, and sighting frequency (SF%) for three time periods. Table courtesy of the author.

Common Name	Scientific Name	Incidence	Range	SF %	SF%	SF%
				94-97	97-01	01-04
Queen Triggerfish	<i>Balistes vetula</i>	98	7	1.6	4	0.4
Tiger Grouper	<i>Mycteroperca tigris</i>	183	8	1.4	4	3
Yellowfin Grouper	<i>Mycteroperca venenosa</i>	241	8	0.8	3.9	5
Whitespotted Filefish	<i>Cantherhines macrocerus</i>	263	9	6.2	5.1	4.3
Yellowmouth Grouper	<i>Mycteroperca interstitialis</i>	401	9	1.2	7.7	7.7
Goldentail Moray	<i>Gymnothorax miliaris</i>	510	8	9.9	9.8	8.2
Nassau Grouper	<i>Epinephelus striatus</i>	795	7	10.6	18.3	12.1
Dog Snapper	<i>Lutjanus jocu</i>	1026	9	12.7	17	19.4
Spotted Trunkfish	<i>Lactophrys bicaudalis</i>	1069	8	27.9	21.6	15.3
Rainbow Parrotfish	<i>Scarus guacamaia</i>	1643	8	22.6	34.5	26.7
Blue Angelfish	<i>Holacanthus bermudensis</i>	1751	9	32.4	30.4	30.9
Mahogany Snapper	<i>Lutjanus mahogoni</i>	2457	8	54.3	51.7	36.5
Princess Parrotfish	<i>Scarus taeniopterus</i>	2468	8	47.5	40.2	43.8
French Angelfish	<i>Pomacanthus paru</i>	2595	9	51.1	50.9	41.3
Trumpetfish	<i>Aulostomus maculatus</i>	2652	8	68.3	53.1	38.7
Redtail Parrotfish	<i>Sparisoma chrysopterygum</i>	2821	8	35.2	57.2	47.7
Queen Angelfish	<i>Holacanthus ciliaris</i>	2946	9	51.2	52.6	50.9
Queen Parrotfish	<i>Scarus vetula</i>	3047	8	69.7	58.9	48
Schoolmaster	<i>Lutjanus apodus</i>	3401	8	64.6	71	52.3
Doctorfish	<i>Acanthurus chirurgus</i>	3442	9	58.3	63	59
Puddingwife	<i>Halishoeres radiatus</i>	3701	9	72.5	75	57.6
Gray Angelfish	<i>Pomacanthus arcuatus</i>	3720	9	77	70.6	59.8
Spanish Hogfish	<i>Bodianus rufus</i>	4245	9	74.2	76.8	72.7
Hogfish	<i>Lachnolaimus maximus</i>	4333	9	64.1	80	75.6
Ocean Surgeonfish	<i>Acanthurus bahianus</i>	4881	9	86	89.5	82.9
Stoplight Parrotfish	<i>Sparisoma viride</i>	5057	8	87.2	93.9	85.6

history characteristics associated with extinction prone species because of high incidence and large range sizes.

Discussion

There are no endemic coral reef fishes in the Florida Keys and only four restricted-range species, which would support Callum et al. (2002) findings that coral reef tracts in the Florida Keys deserve a relatively low priority for conservation at a global spatial scale. Nonetheless, these restricted-range coral reef fishes should be closely monitored throughout the Florida Keys in the future. *Apogon pillionatus* is nocturnal and generally recorded on coral reefs below 20 m, which may be the reason that it has a low incidence based on REEF surveys (Humann & Deloach 2002). *Labrisomus kalisherae* is usually found among fire coral branches and usually found near continental coasts where it can be common (Humann & Deloach 2002, Brice Semmens pers.com.). Both *Gobiosoma saucrum* and *Hemiemblemaria simulus* are range restricted and relatively rare but appear to have stable populations based on sighting frequency. *Gobiosoma saucrum* perches on boulder corals and *Hemiemblemaria simulus* resides in holes in the coral reef where it waits for small prey, however, more research is needed on their distribution and habitat preference to identify their regional conservation importance (Humann & Deloach 2002).

Our research identifies a number of species that should be considered for national- or state-level conservation priorities. In particular, detailed population data for the coral reef fishes from Table 2 are needed to identify species with permanent breeding populations in the Keys and not simply vagrants, misidentifications, or species that only appear rare because of the survey method. First, a number of species with an incidence of one or two may simply be vagrants that do not have permanent populations within the

Florida Keys and should not be included on threatened or endangered species lists in the United States. Second, it may also be the case that some species with an incidence of one could be misidentifications given the fact that error is possible when over 100,000 fish were identified to species. This is especially true for Blennids (*Starksia*), Gobiids (*Gobiosoma*) and Serranids (*Hyoplectrus*), all of which can appear very similar. Third, there are a number of species such as *Starksia hassi*, *Risor ruber*, *Priolepis hipoliti*, and *Labrisomus kalisherae* that are very cryptic and difficult to identify in the field. Furthermore, *Apogon pillionatus*, *Liopropoma carmabi*, and *Centropyge argi* generally are most common in deep reefs and may appear rare in REEF surveys that are usually not undertaken deeper than 30 meters (Humann & Deloach 2002, REEF 2004). Finally, caution should be used when assessing the rarity of the five nocturnal Cardinalfish that may not have been seen during predominately diurnal surveys.

Official national- and state-level conservation priorities for terrestrial ecosystems have focused on identifying species that may have small population sizes, declining population trends, and species whose habitat has been fragmented or disappeared (Hoekstra et al. 2002). Our study identifies species that have small population sizes, however, population trends of these species appear relatively stable, with the exception of *Apogon planifrons* and *Balistes vetula*, which appear to be decreasing in sighting frequency throughout the Florida Keys. Detailed searches for these specific species would reveal whether or not they are as rare as our data suggests. Large-bodied species with low abundance and small range size have been hypothesized to be associated with extinction-prone species (Gaston 1994, Brown 1995). There were surprisingly few large-

bodied species that meet these criteria in the coral reefs of the Florida Keys. The Serranids *Mycteroperca venenosa* and *Mycteroperca interstitialis* had the lowest incidence of all large-bodied species of coral reef fishes, and should be considered a species of concern within the United States and Florida. However, their numbers appear to be increasing based on sighting frequency. Most species have incidences of over 300 and this suggests that they may be relatively abundant throughout the Florida Keys.

In conclusion, coral reef species identified as restricted-range should be further researched to determine if their populations are declining. Further data is needed on rare species, particularly the easy to identify *Balistes vetula*, which appears to be declining in the Florida Keys. Most large bodied coral reef fishes appear to be stable in the Florida Keys but game fish like the Serranids need to be closely monitored, as do the species that have shown a generally declining trend, such as *Cantherhines macrocerus*, *Lactophrys bicaudalis*, *Lutjanus mahogoni*, *Aulostomus maculatus*, *Scarus vetula*, *Halishoeres radiatus*, and *Pomacanthus arcuatus*. The REEF database can provide high-resolution data on the distribution and abundance of species in the Florida Keys and their database in Western Atlantic and other regions such as Pacific has been rapidly growing. Currently REEF has undertaken over 60,000 surveys in over 30 countries (REEF 2004). This will provide an excellent dataset for undertaking conservation research in other regions and larger spatial scales.

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Endangered Species, Prescribed Fires, and Public Resistance in a Florida Scrub Community



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Abstract

Endangered species management in pyrogenic communities is often complicated by the politics of prescribed fire use. Public resistance to fires had been instilled culturally through past fire suppression policies, in addition to a fear of property loss, though land managers have with increasing success been working to change perceptions and ease concerns. These politics are visible in Savannas Preserve State Park, on Florida's east coast, which is comprised of several natural communities that are adapted to fire and is home to various endangered animals and plants. These ecosystems, however, have not experienced significant burning in many years, and high fuel loads have built-up over time that could lead to catastrophic wildfires. As part of an endangered species management effort, this study presents the need as well as tools for educating residents near the park of the role of prescribed fires in protecting both their property and ecosystem communities.

Resumen

El manejo de especies en peligro de extinción en comunidades pirógenas se complica frecuentemente por las políticas del uso de fuegos prescritos. La resistencia popular a los fuegos había sido culturalmente infundida a través de las políticas contra fuego del pasado, además del miedo de pérdida de propiedad, a pesar de que los administradores han trabajado, cada vez con más éxito, en cambiar las percepciones y aliviar las preocupaciones. Estas políticas son visibles en el parque estatal de la Reserva Savanna en la costa este de Florida, que abarca varias comunidades naturales que están adaptadas al fuego y son el hábitat de varios animales y plantas en peligro de extinción. Sin embargo, estos ecosistemas no han tenido una quema significativa en muchos años, y altos niveles de combustible se han acumulado a través de los años lo que crea la posibilidad de fuegos catastróficos. Como parte del plan de manejo de especies en peligro, este estudio presenta la necesidad, junto con las herramientas, para educar a los residentes que viven cerca del parque acerca del papel que tienen los fuegos prescritos tanto en el ecosistema como en la protección de su propiedad.

Introduction

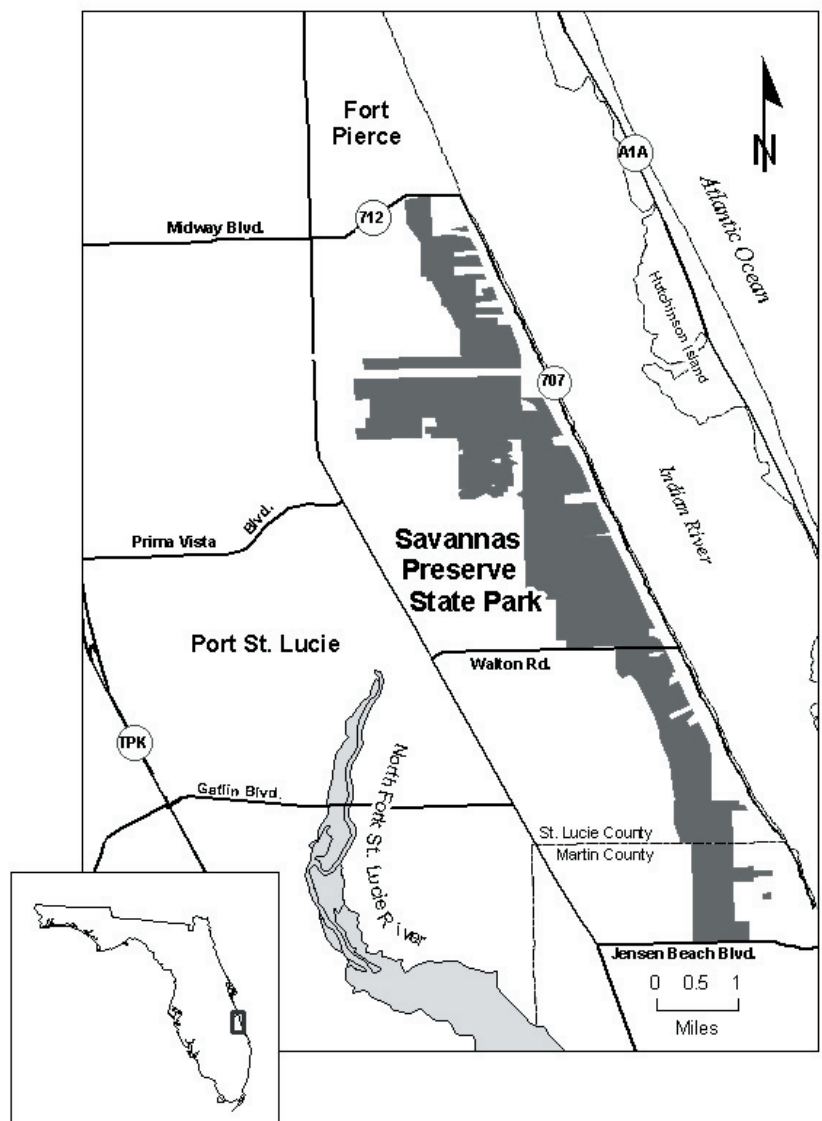
Public perceptions are very important to the successful implementation of prescribed fires for endangered species protection and habitat conservation. Public land managers often must perform a delicate balancing act, promoting the use of fire without alienating residents who might fear the fire and smoke hazards associated with natural or prescribed burns. Yet public resistance is also a legacy of fire suppression policies dating back to the early twentieth century and perpetuated through the 1960s (Pyne 1982, Buckner and Turrill 1990, Reice 2001). Symbolized most visibly by Smokey the Bear, created in the 1940s to remind the public, "Only you can prevent forest fires," the old suppression policies had successfully indoctrinated several generations of adults with the cultural understanding that fires in forests are unambiguously harmful (Buckner and Turrill 1999).

Earlier studies reflected a limited understanding of the ecological benefits of fire among the general public (e.g., Gardner et al. 1987), though more recent studies point to greater public understanding and acceptance of fire as a natural part of some ecosystems (Clute 2000). Attitudes among land managers and scientists were transformed in the 1960s and 1970s as they gained a better understanding of the role of fire in ecosystem processes, which translated into policy changes advocating prescribed fires as a land management tool. Increased environmental awareness in the 1970s and 1980s also led to gradually changing attitudes in the general public towards prescribed fire use. Yet the public remains ambivalent. State forest managers in the Southern US, for instance, report that public resistance remains one of the chief barriers to prescribed fires in the region (Haines et al. 2001), while studies in Florida suggest that in areas where fire

is a hazard, residents express support for prescribed fires in principle, though they also maintain wariness regarding their use (Jacobson et al. 2001, Monroe and Nelson 2004, Nelson et al. 2003).

Studies of public fire perceptions advise that expanded implementation of controlled burn policies requires locally targeted public educational programs, which hold a greater chance for success than sounding general alarms about fire danger associated with high fuel loads (Jacobson et al. 2001, Monroe and Nelson 2004). Savannas Preserve State Park, located on Florida's east coast (Fig. 1), is a case in which the successful navigation of fire politics is crucial to endangered species management. The

Fig. 1. Location of Savannas Preserve State Park.



preserve is comprised of several natural communities that are adapted to fire, requiring periodic burning for their maintenance. However, fire has mostly been suppressed in the park for many years, and this suppression threatens endangered species of wildlife and plants, as well as humans and their property. Lying at what has been called a “wildland/urban interface” (Pyne 2003), homes and other suburban infrastructure surrounding the preserve are dangerously close to high fuel loads. If and when catastrophic wildfires occur, these properties will be in great danger of being destroyed. This paper discusses the importance of fire to endangered species in the scrub ecosystem as well as strategies aimed at helping residents in this area to accept the practice of prescribed burning. These strategies include a more direct demonstration of the problem of fuel load build up around homes as well as educating property owners about the benefits to wildlife, particularly endangered species, from reintroducing fire in the scrub habitat.

Senescent Scrub Habitat and Fire Ecology

As its name implies, Savannas Preserve State Park is home to a mix of pyrogenic natural communities that includes mesic flatwoods (2,197 acres/889 ha), ephemeral basin marsh (1,592 acres/644 ha), scrubby flatwoods (156 acres/63 ha), and sand pine-oak scrub (446 acres/180.5 ha). Scrub within the Savannas Preserve displays the general characteristics described by Myers as “a xeromorphic shrub community dominated by a layer of evergreen, or nearly evergreen oaks (*Quercus geminata*, *Q. myrtifolia*, *Q. inopina*, *Q. chapmanii*) or Florida rosemary (*Ceratiola ericoides*), or both, with or without a pine overstory” (Myers 1990: 154-5). Soils tend to be nutrient-poor as they are derived mainly from quartz sand and contain practically no organic matter (Myers 1990). Some natural communities in Savannas, such as the sand pine-oak scrub and basin marsh, are identified as critically imperiled (FNAI 1990, FDEP 2003, Engeman et al. 2004).

The “pyrogenic” quality of scrub ecosystems means that the characteristic species of plants and animals have developed evolutionary adaptations to fire (Wright and Bailey 1982, Herron and Kirk 1999). Despite the importance of fire, scrub is not easy to ignite, and tends to burn only under severe conditions, making it an effective barrier to the spread of fires (Myers 1990). As a result, scrub habitat tends to have fairly long fire cycles. For instance, along Lake Wales Ridge, where most previous scrub fire ecology studies have been performed, fire cycles repeat every 20 to 30 years (Myers 1990). However, scrub in coastal regions tends to grow faster, and consequently needs fire more frequently. In Savannas Preserve, where the scrub habitat lies on the Atlantic Coastal Ridge of Florida, the difference in growth rates probably translates into a fire cycle of about

Fig. 2. Florida Scub-jay at Savannas Preserve State Park. Photo by Ernie Cowan.



every 15 to 20 years. Areas that have not burned periodically will eventually become an overgrown canopy with a pronounced layer of litter and debris, magnifying the likelihood of an intense crown fire in dry forests (Alverson et al. 1994, Myers 1990, Reice 2001). In the absence of fire, fire-dependent species will eventually disappear as the plant community moves into a later successional stage that is not suitable to the organisms (Wright and Bailey 1982, Buckner and Turrill 1999, Bolen and Robinson 2003).

Lack of fire threatens endangered plant and animal species in the Savannas Preserve. Thirteen of the endemic plant species that occur in Florida scrub habitat (in Savannas and elsewhere) are federally listed as endangered or threatened (Myers 1990). Additionally, 22 endemic species are listed by the State of Florida's enabling legislation, including scrub holly (*Ilex opaca* var. *arenicola*), silk bay (*Persea humilis*), garberia (*Garberia heterophylla*), palafoxia (*Palafoxia feayi*), and the wild olive (*Osmanthus megacarpa*) (Myers 1990). Animal species

found in the Preserve and federally listed as threatened include the Florida Scrub-jay (*Aphelocoma coerulescens coerulescens*, Fig. 2), the Eastern indigo snake (*Drymarchon corais couperi*), and the sand skink (*Neoseps reynoldsi*) (USFWS 1999), while the Florida mouse (*Podomys floridanus*) and gopher tortoise (*Gopherus polyphemus*, Fig. 3) are state-listed as species of special concern. Though many of these animals can also survive in other communities, others such as the Florida Scrub-jay, can only survive in scrub.

Maintaining the structure and successional stage of the scrub vegetation is important for its resident wildlife, making fire an important element in species conservation; keeping the shrub layer below a critical height, for instance, prevents Florida Scrub-jays from abandoning sites (Meyers 1990). Additionally, Meyers points out that habitat is eliminated for the Florida mouse, gopher tortoise, scrub lizard (*Sceloporus woodi*), sand skink, and various birds if a pine canopy develops, shading the scrub oak and open sandy



Fig. 3. Gopher Tortoise. Photo by Jon Moore.

patch understory (Myers 1990). Active habitat management, particularly prescribed burning, is recommended to benefit populations of protected species by maintaining their habitats in the optimal stage of succession (Diemer 1992, Moler 1992, Layne 1992, Woolfenden and Fitzpatrick 1996).

Environmental Law and Prescribed Fires

Very few prescribed burns have been attempted in Savannas Preserve State Park despite the importance of fires in pyrogenic communities, and even though Federal and State laws recognize and support the necessity of using prescribed fires as an endangered species management tool. The Endangered Species Act (ESA) mandates such programs aimed at the conservation of endangered and threatened species of plants and animals, including the habitats in which they are found (USFWS 2004). The Florida Natural Areas Inventory (FNAI) lists scrub communities as globally and state endangered (FNAI 1990, FDEP 2003) largely due to the presence of protected species like the Eastern indigo snake, Florida Scrub-jay, the fragrant prickly apple (*Harrisia fragrans*), and the four-petal pawpaw (*Asimina tetramera*).

Florida's Wildlife Code (Chapter 39, Florida Administrative Code) provides additional levels of protection to state-listed endangered or threatened species and wildlife species of special concern in Florida. Wildlife protection on Florida's parklands is placed under the jurisdiction of the Florida Park Service. Additionally, the Florida Prescribed Burning Act (Florida Statute 590.125, formerly FS 590.026) mandates the use of prescribed burning for the management of public lands as essential to maintaining the specific resource values for which such lands were acquired. Not only does the Act "authorize and promote the continued

use of prescribed burning for ecological, silvicultural, wildlife management, and range management purposes" (Division of Forestry 1997, 4), it goes even further to state that "significant loss of the state's biological diversity will occur if fire is excluded from fire-dependent systems" (Division of Forestry 1997, 3).

While legislative authorization for burning is clear, accounting for citizen concerns is also viewed as vital, and as a result prescribed burning action must abide by rules set by the Division of Forestry. The major provisions of Florida's prescribed burning regulations (FS 590.125) state that all prescribed fires must

1. [b]e authorized or permitted by the local DOF [Division of Forestry] office, or its designated agent, before the fire is ignited. The permit must be in writing if the burn area is within an area of severe drought emergency (FS 590.081) ... A written prescription must be prepared before a burning authorization is received from the DOF [and] a certified prescribed burn manager must be on site with a copy of the written prescription from ignition of the burn to its completion.
2. [h]ave adequate fire breaks around the planned burn area, and sufficient personnel and firefighting equipment for controlling the fire must be on site.
3. [r]emain within the boundary of the authorized area.
4. [h]ave someone present at the burn site until the fire is extinguished (which is defined as no spreading flame).
5. [h]ave the specific consent of the landowner or his or her designee." (Long 1999, 3).

A prescribed burning authorization is

issued once the DOF determines “that air quality and fire danger are favorable for safe burning. The DOF can cancel authorizations of those conditions change” (Long 1999, 3).

Despite the mandate and these regulations, the use of fire in Savannas Preserve has been severely curtailed for decades, partly due to public resistance stemming from a general fear of fire, and potential smoke management problems for residential areas, schools, and hospitals in close proximity to the preserve (FDEP 2003: 20). Park managers advocate a gradual increase in prescribed fires as homeowners grow more tolerant through experience (FDEP 2003: 22); however, by 2003-2004 only three small scrub burns totaling 11 hectares have been performed after mechanical treatment (horizontal restratification) of the high fuel loads

(Fig. 4). These burns were very carefully conducted and did not generate any adverse comments from the neighboring property owners. In addition to these fires, Savannas Preserve staff conducted prescribed burns in 94.2 hectares of pine flatwoods communities during the same period.

There have been wildfires in Savannas Preserve, which have enhanced public anxieties regarding fire use. The most recent occurred in March 2004 and burned 85 hectares. Unfortunately, however, this fire was confined to pine flatwoods communities and did not burn scrub habitat where it was needed most (Wood 2004). The most recent wildfire in scrub habitat occurred in 1987 and burned 45 hectares in the east-central and northern areas of the park. That fire became very large due to wind gusts of over 40 miles an hour,

Fig. 4 A prescribed burn in horizontally restratified (=mechanically treated) scrub at Savannas Preserve State Park in 2004. Photo by Ernie Cowan.



an extended dry period in the area, and an over-accumulation of flammable materials as the scrub had not been burned in over 25 years, according to neighboring residents. Thirty-nine structures near the preserve had to be defended from the towering flames as a result (Van Murphy 1988).

Beyond public wariness due to such obvious danger to property, an additional and significant reason for the slow implementation of prescribed fires specifically in the scrub areas of the preserve is long-term right-of-way (ROW) negotiations between the Park Service and the Florida East Coast (FEC) Railroad whose tracks border the entire Savannas scrub-dominated eastern boundary. The FEC-owned land along the tracks provides the most feasible access of public land managers to the scrub areas. The legal conundrum has resulted in continuing fire suppression for over 20 years in the scrub because the land occupied by that habitat could not be accessed legally; the Florida Park Service needed to execute a ROW easement agreement with the FEC in order to access the scrublands along the railway to conduct management practices including prescribed fires and mechanical treatments. In May 2003, the liability issues that prevented an agreement were finally resolved, allowing access by Park Service staff to conduct management actions. Public access to the ROW is still prohibited for safety reasons, and Park Service law enforcement officers assist the FEC with patrol duties.

Convincing a Skeptical Public

The removal of the ROW obstacle, along with an increasing public understanding of fire, provides a hopeful signal regarding the future of prescribed burning in Savannas. The next step is to engage the local public in further dialog regarding the importance of prescribed fires for endangered species management. Monroe and

Nelson's 2004 study suggests that fire education for residents must go beyond general warnings of the danger of high fuel load accumulation to also provide more pointed messages about the importance of fire in promoting closely held values, such as conservation of wildlife and endangered species. Likewise, Jacobson et al. (2001) advise that education efforts must be directed to local forest issues and address local understandings, rather than rely solely upon generalized fire education, such as in the form of pamphlets (see also Monroe and Nelson 2004). Following such recommendations, convincing the still-ambivalent public will require educational efforts in at least two areas: (1) a locally focused demonstration of the immediate danger to property due to the absence of fire for long periods, and (2) educating local residents about the necessity of fire for protecting endangered species in the preserve.

Regarding the first issue, homes, sheds, garages, vehicles, and other flammable suburban infrastructure lie in close proximity to the senescent scrub with the railroad track ROW serving only as a narrow firebreak between the eastern border of Savannas and these adjacent homes. In the event of an intense wildfire, the weak firebreak would be ineffective in keeping high flames from jumping across the tracks. Further complicating the problem, many of the landowners bordering Savannas Preserve have overgrown fuel loads in their own backyards (see table 1), which could quickly ignite their property and homes, contributing to the potential severity of damage.

To help convince residents living at the edge of Savannas Preserve of the need for prescribed fires, we collected in-field measurements between scrub high fuel loads in the park and surrounding homes and other flammable infrastructure using a global positioning system (GPS) unit, a laser

optical range finder, and measuring tapes. Our goal was to determine actual distances between flammable property and accumulated fuel loads. As part of this effort, we examined twenty-one data stations along the Florida East Coast Railroad ROW covering a distance of 8.5 kilometers. We collected GPS coordinates at each station, and at each station, measured the distances

between the high fuel loads (FDEP, unpubl. data) in the preserve and the flammable neighboring homes and other infrastructure, including measurements of the width of the railroad track ROW (table 1). The measurements demonstrate the close proximity of these suburban homes and infrastructure to the overwhelmingly high fuel loads in Savannas Preserve's scrub, exposing

Table 1. Distances from Savannas Preserve State Park scrub high fuel loads to residential homes and other infrastructure.

*Note: the fact that the brush obscured a laser range finder reading attests to fuel thickness within the private parcel.

STATION	NORTH	WEST	DISTANCE TO NEAREST FUEL LOADS
1	27° 16.076'	080° 14.767'	No overgrown fuel loads.
2	27° 18.678'	080° 15.783'	No overgrown fuel loads.
3	27° 18.941'	080° 15.910'	Garage: 20m; Home: 28m
4	27° 18.942'	080° 15.911'	Wooden Boat: 35m; Home: 117m
5	27° 19.319'	080° 16.104'	No overgrown fuel loads.
6	27° 19.301'	080° 16.084'	Trees: 19m; Heavy equip: 39m; Home: too far within heavy brush to measure accurately*
7	27° 19.467'	080° 16.164'	Garage: 25m; Home: 76m
8	27° 19.471'	080° 16.164'	Wooden fence: 23m; Home: 29m
9	27° 19.734'	080° 16.272'	Wooden fence: 19m
10	27° 19.896'	080° 16.350'	Dense fuel: 45m
11	27° 19.998'	080° 16.399'	No overgrown fuel loads.
12	27° 20.003'	080° 16.404'	Fuel; 99m
13	27° 20.150'	080° 16.457'	Fuel: Approx. 50m
14	27° 20.439'	080° 16.653'	Porch: 24m; Home: 34m
15	27° 20.670'	080° 16.802'	Fence: 20.6m; Boat: 22.4; Shed.: 40m Home: 175m
16	27° 20.913'	080° 16.921'	Fuel: 17.4m
17	27° 21.252'	080° 17.078'	Dense fuel: 16.2m
18	27° 21.414'	080° 17.154'	Fence: 18.6m
19	27° 21.619'	080° 17.250'	Fence: 51m; Garage: 177m
20	27° 21.931'	080° 17.395'	Fuel: 15.6m
21	27° 22.115'	080° 17.477'	15.6m; Home: 77m; Van: 58m

them to risk of damage or destruction in the event of an uncontrolled wildfire such as the one that occurred in March 2004. Had this fire occurred in the senescent scrub habitat where fuel loads are high, the fire may not have been suppressible. Our intent is to take this collected data to residents in public meetings and in individual consultations to demonstrate the seriousness of the fire danger situation.

The second educational task is to convince property owners that prescribed burning will help protect endangered species. Monroe and Nelson (2004) suggest that wildlife protection is a major concern among surveyed residents and that prescribed fire education programs need to emphasize the positive wildlife impacts of burning. Jacobson et al. (2001) suggest that Florida residents in fire hazard areas have a fairly sophisticated understanding of fire issues, but mistakenly tend to perceive that prescribed fires are damaging to wildlife. The study recommends that fire education programs should seek "to counter common beliefs that fire usually results in high animal mortality, animal injury, and excessive habitat destruction" (Jacobson et al. 2001: 935) by providing evidence of positive wildlife outcomes from prescribed burning.

Toward this education effort, the park staff must emphasize, for instance, that it has safely performed three prescribed fires in Savannas Preserve scrub communities, and that during the most recent survey of Florida Scrub-jays, it was noted that individual birds were already using the newly restored areas (E. Cowan, Florida Park Service, unpubl. data). Such targeted educational efforts can also help to counter negative media portrayals of forest fires that reinforce and promote public fears and encourage fire suppression (see Jacobson et al. 2001). For instance, one

news story about the March 2004 fire in the preserve, titled "Fire Rages Through Savannas" (Wood 2004), promoted the perception of fire as a wild threat to surrounding properties, while omitting the benefits of fire to plant and animal communities in the area, and the role fires play in reducing fuel loads. Monroe and Nelson (2004) note, however, that surveyed residents tended to trust expert opinion in relation to what they perceive as unreliable and sensationalist media accounts. Thus, a targeted, localized educational approach can help to spread a more positive message about the benefits of prescribed fires.

Conclusions

While many areas in Florida experience significant wildfire activity, a more broadly memorable example of the harm caused by suppressing fire is Yellowstone National Park and the catastrophic wildfires of 1988 (Turner et al. 2003). If fire had not been suppressed for so many years, many smaller fires would have occurred naturally, thereby reducing the high fuel loads, and the density of trees. Due to the previous suppression policies that kept fire from occurring naturally, in 1988 the fuel loads were so immense that devastating wildfires destroyed 400,235 hectares (989,000 acres) of forest, and countless infrastructure (Reice 2001). While catastrophic in impact, the Yellowstone fires in fact had many positive impacts, clearing litter from the ground and exposing the soils to sunlight again, which allowed many rare floral components to recolonize and reproduce naturally. The fires recreated the normal mosaic landscape of burned and unburned stands, and allowed some tree species to germinate for the first time in decades. The most significant problem in Yellowstone was not the catastrophic fires, but the old suppression policy, and erroneous public perceptions, which created the fire conditions that led to catastrophe

(Reice 2001). The same problem occurs in Savannas and on public lands nationwide.

To face this challenge, the Florida Park Service in Savannas Preserve must make public education a primary concern when it comes to using prescribed fires to conserve endangered species, along with protecting public and private property. By providing the public with compelling evidence of the dangers of excess fuel loads near their homes, and of the importance of prescribed burning to endangered animals and plants, park managers may increasingly convince homeowners to accept the idea of allowing burns near their backyards. To implement an education program and get information to local residents, the Florida Park Service will be holding public meetings and conduct door-to-door consultations to explain the dangers associated with high fuel loads along with the need for prescribed fires to benefit endangered species conservation. Toward this end, the Florida Park Service and the Harriet L. Wilkes Honors College of Florida Atlantic University are united in a "Parknership" program aimed at educating students and the general public of the importance of ecosystem restoration and preservation. It remains to be seen whether or not this education process will alter the local politics of fire suppression; however, the future of endangered species in the area may depend on it.

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Reproductive Success, Territory Size, and Predation Pressures of the Florida Scrub-jay (*Aphelocoma coerulescens*) at Savannas Preserve State Park



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Abstract

The Florida Scrub-jay is found only in the fire-dependent xeric oak communities of Florida. The number of scrub-jays statewide has been in steady decline over the past century due to the habitat loss resulting from urban development and the aging of xeric oak scrub caused by fire suppression policies. This study looks at the effect that aging of the scrub has on a population of scrub-jays at the Savannas Preserve State Park in Port St. Lucie, Florida. The population of scrub-jays at Savannas has been in decline over the past eight years. This study revealed that they are occupying territories that are much smaller than the normal optimal size and are having minimal reproductive success. In addition, the birds are subjected to predation pressures from natural predators present at higher than normal densities and by other predators brought into their habitat by encroaching urban development. The implementation of an aggressive prescribed fire program to restore their habitat is crucial to the long-term survival of this population of Florida Scrub-jays.

Resumen

El chara pecho rayado se encuentra solamente en comunidades de encinar arbustivo xerófilo y fuego-dependientes. El número de charas pecho rayado a nivel estatal había estado disminuyendo consistentemente en el último siglo debido a pérdida de hábitat al desarrollo urbano y el envejecimiento del encinar arbustivo xerófito debido a la política de supresión de fuegos. Este estudio analiza el efecto que el envejecimiento de la comunidad de encinar arbustivo tiene en la población de charas pecho rayado en el parque estatal de la Reserva Savanna en Port St. Lucie, Florida. La población de charas pecho rayado ha estado disminuyendo en los últimos ocho años. Este estudio reveló que están ocupando territorios mucho más pequeños que el tamaño óptimo normal y están teniendo un éxito reproductivo mínimo. Además, los pájaros son víctimas de depredadores naturales que se encuentran en altas densidades y otros depredadores introducidos por la expansión del área urbana. La implementación de un programa agresivo de fuegos prescritos para restaurar el hábitat es crucial para la supervivencia a largo plazo de esta población de charas pecho rayado de Florida.

Introduction

The Florida Scrub-jay (*Aphelocoma coerulescens*) is the only avian species that is restricted entirely to Florida (Woolfenden and Fitzpatrick 1996a, 1996b). They live only in xeric oak scrub communities (Woolfenden and Fitzpatrick 1984, 1996a), and individuals rarely disperse more than a few kilometers, with most recruits to the breeding ranks settling within two territories from their natal site (Woolfenden and Fitzpatrick 1984). This sedentary behavior and site tenacity make the Florida Scrub-jay vulnerable to changes within the scrub community, such as a decline in the amount of suitable habitat.

Xeric oak scrub communities are pyrogenic, so their flora and fauna have developed adaptations to fire. Natural fires generally occur at intervals of 8 to 20 years, depending on chance ignition and accumulation of fuel (Meyers 1990).

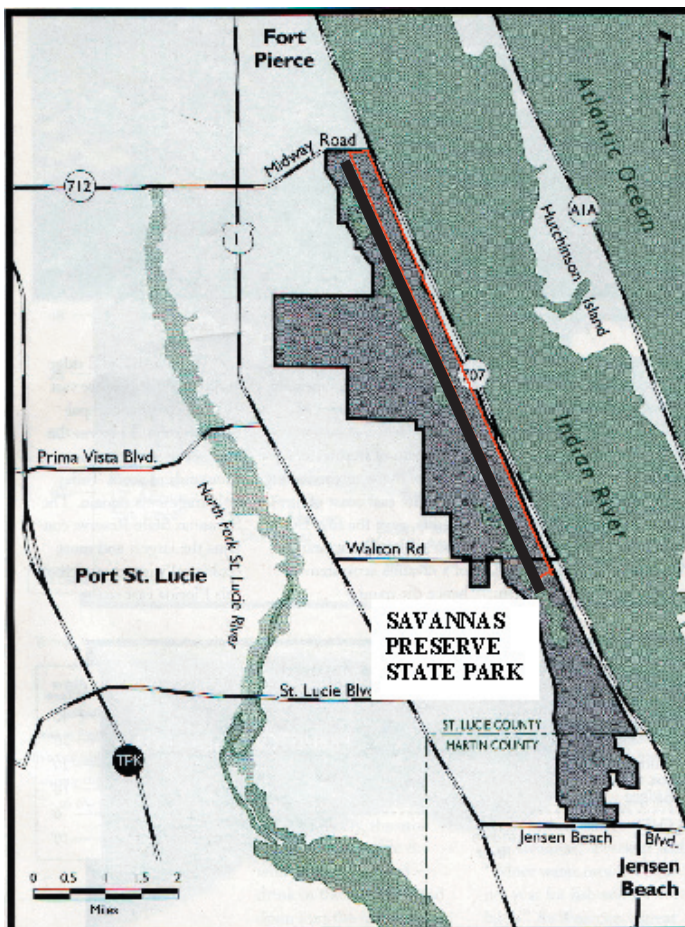
Scrub communities are dominated by evergreen oaks with an occasional overstory of sand pines. The understory is characteristically open, with large expanses of white sand interspersed with the oaks and saw palmetto. Major destruction of scrub has occurred in the 20th century with the clearing for citrus groves, housing developments, golf courses, and agricultural pasturelands. Since the 1950s, fire suppression policies have led to a further rapid decline. Currently, it is estimated that only about 10% of the scrub that was present 150 years ago remains (Meyers 1990). An estimated 40–60% of the species found in scrub communities are endemic, and the majority of these floral and faunal components have declined in numbers during recent decades (Meyers 1990, Christman and Judd 1990, Fitzpatrick et al. 1991, Humphrey 1992, Moler 1992, Deyrup and Franz 1994, Rodgers et al. 1996).

The Florida Scrub-jay (hereafter, Scrub-jay) is one of these species and has become a keystone species in the attempt to save what is left of the scrub habitat throughout Florida. The estimated number of Scrub-jays statewide has declined by more than 50% over the last 100 years (Cox 1987). Current population estimates are between 9,000–11,000 individuals. Under the Wildlife Code of the State of Florida (Chapter 39 FAC) the Scrub-jay was listed as a threatened species by the Florida Game and Freshwater Fish Commission in 1975, and the U.S. Fish and Wildlife Service likewise followed with a federal threatened designation in 1987 under the Endangered Species Act of 1973.

The Savannas Preserve State Park (hereafter referred to as Savannas) contains about

2,429 ha of protected habitat. The Scrub-jays inhabiting the Savannas have long been isolated from the larger populations of Scrub-jays found in

Figure 1. Study Site at Savannas Preserve State Park. Boundaries of 2001–2002 Florida Scrub-jay study site are filled in black. Savannas Preserve State Park is located in Martin and St. Lucie County, Florida. Study site is located entirely within St. Lucie County.



central Florida and Ocala National Forest and Merritt Island to the north. This Savannas metapopulation has been identified as a research priority by the Florida Department of Environment Protection's Land Acquisition and Management Advisory Council (FDEP 1999), which described it as "highly vulnerable, but with a high potential for improvement..." suggesting that habitat restoration and proper management were crucial to the long-term prospects for this metapopulation.

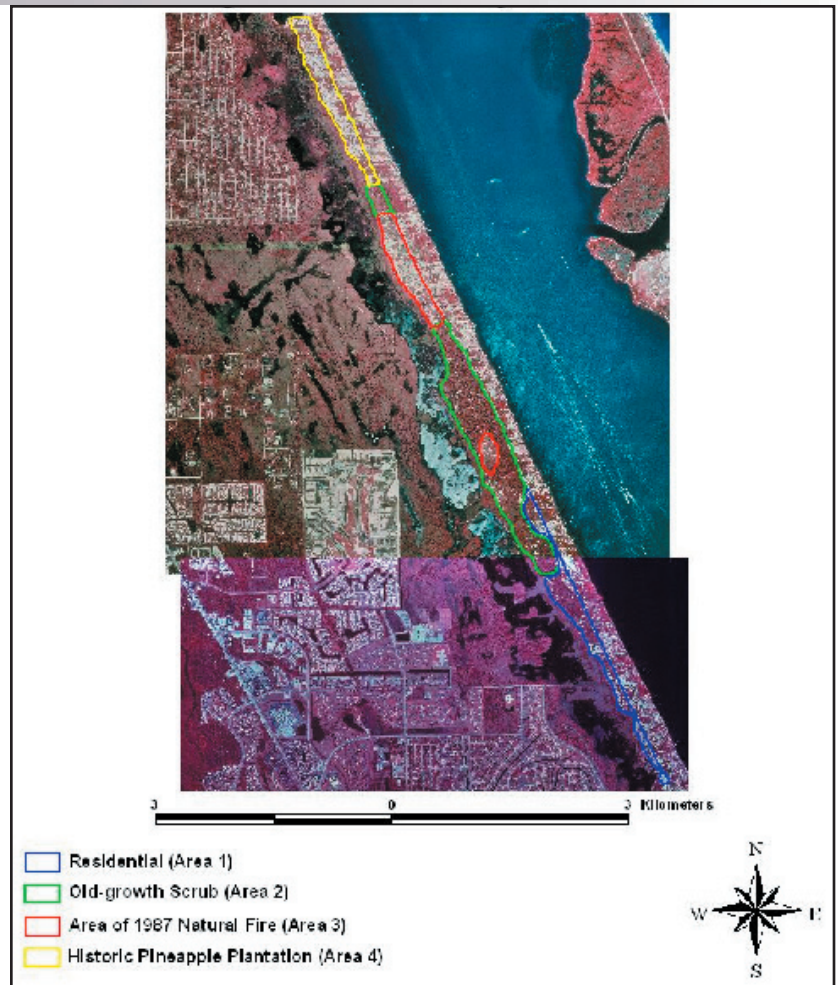
The objectives of this research project were to (1) continue the annual census of Scrub-jays at Savannas, (2) delineate territory sizes and boundaries, (3) quantify reproductive success, (4) compare predator pressures experienced by Scrub-jays in the different habitat areas, and (5) develop ecosystem management plans to ensure the future success of the population at Savannas.

Methods

Study Areas

The study site in Savannas Preserve State Park is located in St. Lucie County, Florida (figure 1), and is approximately 11.6 km long, 2.6 km in width at its widest point, and 0.7 km wide at the narrowest point. The park is bounded by roadways to the north and south, basin marsh wetlands to the west, and the Florida East Coast Railroad Right-of-Way (ROW) and suburban infrastructure to the east.

I divided the study site into four distinct habitat regions, based on the age of the scrub and the level or type of anthropogenic impact on the scrub. These regions were (south to north): Area 1 (about 34 ha) characterized by moderate human activity or close proximity to residential developments, Area 2 (about 122 ha) old growth or "senescent" scrub, Area 3 (about 36 ha) an area where a natural fire had occurred in the Savannas in 1987, and Area 4 (about 20 ha) historic agricultural



influences from pineapple plantations during the period from 1895 to 1920 (see review in FDEP 2004, figure 2).

Population Census

The Florida Park Service has conducted an annual census of the Scrub-jays at Savannas since 1996. Thirty-seven census stations based on habitat suitability were previously established within the study site in 1998 (figure 3), and all censusing protocols followed the techniques developed by Henry Smith, Wildlife Biologist, District 5 (H. T. Smith unpubl. data, Fitzpatrick et al. 1991, USFWS 2002). Scrub-jays were censused at the onset of breeding season (late February–early March; Fitzpatrick et al. 1991, USFWS 2002), when defense of the territory by members of the family group was beginning to heighten. All members of the family group participate in territorial

Figure 2. Distinct Habitat Regions of Study Site. The 2001-2002 study site is divided into four distinct areas based on the level of anthropogenic impact on the scrub by outside influences, and the age of scrub.



Figure 3. Scrub-jay Census Stations. Thirty-seven census stations at Savannas Preserve State Park used for the annual scrub-jay count since 1998.

defense (Woolfenden and Fitzpatrick 1984). A call tape (recording) of Scrub-jay vocalizations was broadcast to attract individual birds to a census station located within the territory (Fitzpatrick et. al. 1991, USFWS 2002). The recording was played at 1-minute intervals in each of the cardinal compass directions. Playback was repeated three times until all members of the family group had assembled to investigate the perceived “intruder” into their territory. This technique allowed for a true count of all the individuals within each family group, and of the total population of Scrub-jays within the entire study area (Fitzpatrick et. al. 1991, USFWS 2002).

Territory Size

Because of manpower constraints, the 1996–2000 annual census of the Scrub-jays by the Florida Park Service had not included measurements of territorial boundaries or estimates of territory size. During this study, territory sizes were determined. Boundaries were established and mapped using Global Positioning System (GPS) equipment (Garmin e-Trex™ Model G12). Ingress issues, topographic features, vegetative cover types and density, and priority to the prevention of human disturbance to birds during critical portions of the breeding cycle limited absolute territory size mapping with portable GPS equipment to six occupied territories. Coordinates were taken in the field and a data point was recorded for each location at which an individual from the family group was observed. I analyzed these data points were analyzed using Arc-View Version 3.2a (ESRI 1998) software, and maps were prepared showing the boundaries and area in of the individual family territories.

Reproductive Success

The reproductive success of Scrub-jays was quantified using the previously published criteria of Woolfenden and Fitzpatrick (1984). I calculated the average number of fledglings produced per pair for samples of pairs. During the breeding season (March–August), I observed the daily activity of the birds within a family territory to establish nest locations. Once the nest location was confirmed, the nest pair was observed throughout the season from a blind, using a 20–60X spotting scope and 7–15X binoculars. Once I established that the nest was viable (by daily observation of continuous incubation activity), the nest was visually inspected with a mirror pole to determine the clutch size and status.

Reproductive success was calculated

as the ratio of the number of fledglings produced by the number of nests observed (see above Woolfenden and Fitzpatrick 1984: page 220). An additional population census was conducted in mid-October, approximately 90 days after the end of breeding season, to identify any birds fledged from nests that may have been missed during observation periods from blinds (Fitzpatrick et. al. 1991, USFWS 2002). These juveniles were identified by their brown heads, shown during the first six months after fledging (Woolfenden and Fitzpatrick 1984, 1996a, 1996b).

Predators

Predators were identified in each of the study areas by using tracking stations, by visual observation, and by evidence remaining at predated nest sites.

A tracking station consisted of a one-meter diameter area of completely unvegetated sand, smoothed with a brush (figure 4). A visual attractant was placed in the center of the smoothed circle. The visual attractant imitated a mock prey species and consisted of a cotton ball body, with eyes, a flexible tail and feathered wings, glued to a red wooden dowel that resembled legs (figure 5). An olfactory attractant (fox urine) was sprayed onto the cotton body. A tracking station was placed in each territory occupied by a family group, remote from the nest site, and at three additional sites chosen at random in Area 4. Stations were set up in the evening before dusk and checked the next morning. Tracks of any mammalian visitors were identified to the species level. Field observations were verified using a field guide of animal tracks (Murie 1954). In addition, when depredated nests were discovered, a careful inspection of the nest microhabitat and surrounding grounds was conducted to identify tracks and spoor of the predator species (figure 6).

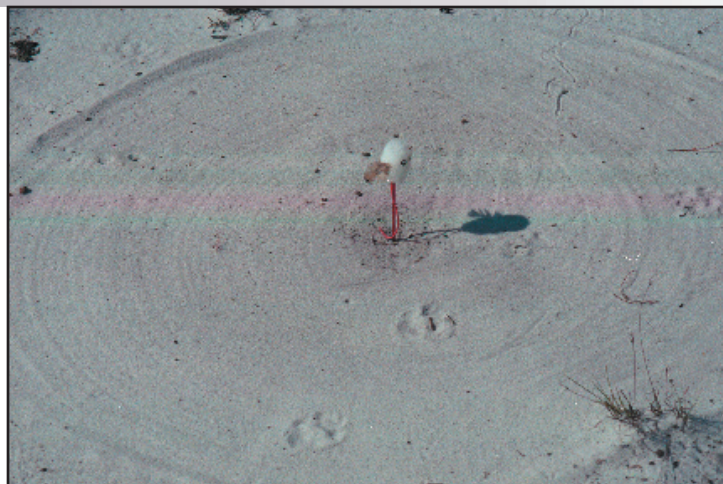


Figure 4. Typical Predator Tracking Station. Shown in this photo are the tracks of a bobcat, recorded at the predator tracking station in territory T12 in 2001.

Statistical Analysis

Statistical tests followed Zar (1999) and were considered significant at $\alpha < 0.05$, unless otherwise specified. Chi-square tests were used to compare predator presence or absence among the distinct habitat regions of the study area and the changes in family size. All statistical tests were conducted using SPSS Statistical Analysis 11.0 for Windows (1998).

Results

Population Census

The number of birds observed during the annual censuses remained relatively stable from 1996–1999. However, the numbers steadily declined thereafter, from 41 individuals in 1999 to 28 individuals in 2003 (figure 7). This is a decline of 33% over the eight-year



Figure 5. Predator Tracking Station Visual Attractant. Note feathers on ground next to attractant in this photo. These were removed by a predator during a visit to this station.



Figure 6. Predator Identified by Nest Predation Evidence. Shown are raccoon tracks discovered under the nest tree, after the 2001 nest in Territory T18 was depredated.

span and 22% over the three years of this study.

Territory Size and Family Size

Six territories were occupied by Scrub-jay families during both years of this study. Territory sizes during the study ranged from 3.7 to 6.3 ha and were not homogeneous in shape or boundaries (figure 8). Of the six territories, two (T2, 3.9 ha; and T6, 4.2 ha) were in

Area 1, the portion of the study area with moderate human activity or close proximity to residential developments. The four other territories (T12, 6.3 ha; T18, 4.2 ha; T20, 4.9 ha; and T23, 3.7 ha)

were in Area 3, the study area burned by a wildfire in 1987. Territories averaged 4.5 ha (Table 1).

Reproductive Success

During the two-year study period, a total of 10 nests were observed within the six territories, from the time of initial discovery (construction) until either the chicks fledged, the nest failed, or it was abandoned by the breeding pair (table 2). Only one pair (nesting in T2) fledged a chick.

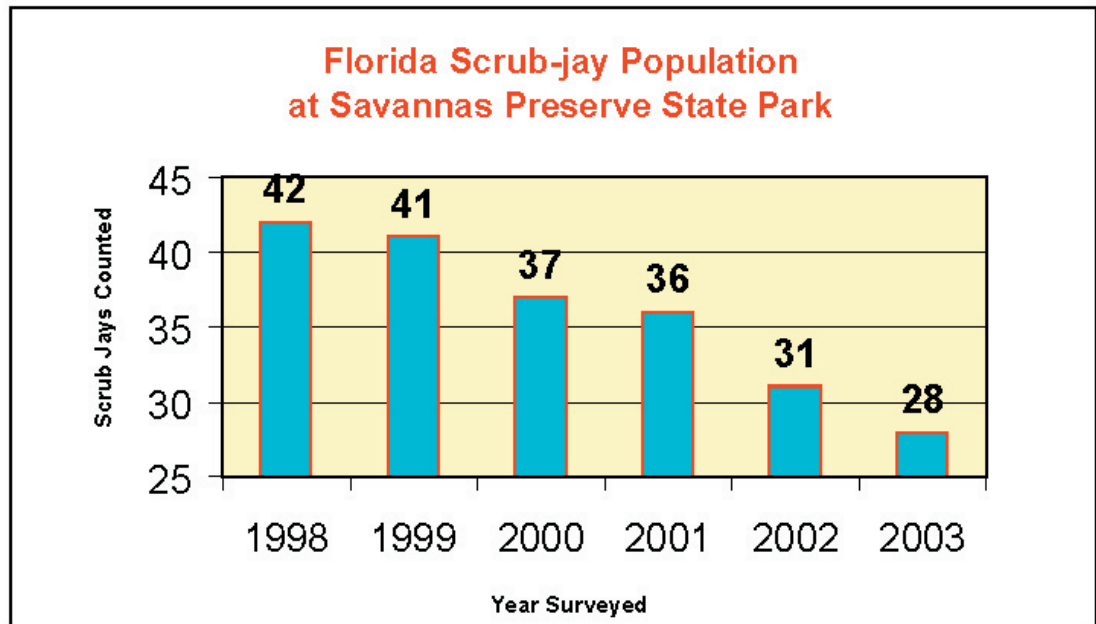
Of the 10 nests I observed, four failed as the result of predation. Three failed for unknown reasons. One failed when the breeding female died or was killed during nesting (T6), and one was abandoned after the deposition of a single egg (T23). This pair (in T23) renested that year (2002).

In Area 1, one chick was fledged successfully in four nest attempts. Area 3 produced no fledglings in six nesting attempts. Thus, only one pair produced a surviving chick during the two-year study period. Its reproductive success was 0.50.

Predators

During the two-year study period, tracks of six known predators of Scrub-jays, their young, or eggs were

Figure 7. Census Survey Results. Numbers of scrub-jays counted at Savannas Preserve State Park during annual census for the years 1998-2003.



observed and identified at the nine stations. Raccoons (*Procyon lotor*) and foxes (*Vulpes* spp.) were found in all of the areas. Armadillos (*Dasypos novemcinctus*) were present in Areas 1 and 4. Feral cat (*Felis catus*) and dog (*Canus familiaris*) tracks were found in Area 1, and a bobcat (*Lynx rufus*) track was found in Area 3 (Table 3). Raccoons were present in significantly higher frequency in Areas 1 and 4 as compared to Area 3 ($X^2 = 16.4$, $p < 0.001$, $df = 2$). Feral cats were present with significantly higher frequency in Area 1 as compared to Areas 3 and 4 ($X^2 = 19.1$, $p < 0.001$, $df = 2$). Dogs were also present with significantly higher frequency in Area 1 as compared to Areas 3 and 4, where they were not recorded ($X^2 = 12.5$, $p < 0.01$, $df = 2$). The frequency of occurrences for foxes ($X^2 = 3.2$, $p < 1.0$, $df = 2$), bobcats ($X^2 = 1.0$, $p < 1$, $df = 2$) and armadillos ($X^2 = 3.8$, $p < 0.2$, $df = 2$) were not significantly different in the three areas.

Discussion

Habitat Requirements

Florida Scrub-jays are most abundant in open, oak-dominated scrub communities, which are dependent on periodic fire to maintain viability. In fire-suppressed scrub, a dense, tall understory with an encroaching canopy of sand pines develops, creating a low-quality habitat for Scrub-jays that cannot support a stable population (Fitzpatrick et al. 1994, Woolfenden and Fitzpatrick 1996a, 1996b). For Scrub-jay habitat, a fire frequency of about 10 to 20 years is optimal (Fitzpatrick et al. 1991). A greater fire frequency will consistently maintain the scrub oak species below acorn-bearing height and may slowly favor the spread of palmettos at the expense of oaks; at a lower frequency, pine forests with a tall dense understory of oaks will prevail (Meyers 1990). Such habitats are of limited value, and likely entirely unsuitable to Scrub-jays. Likewise, in aged, overgrown scrub, the

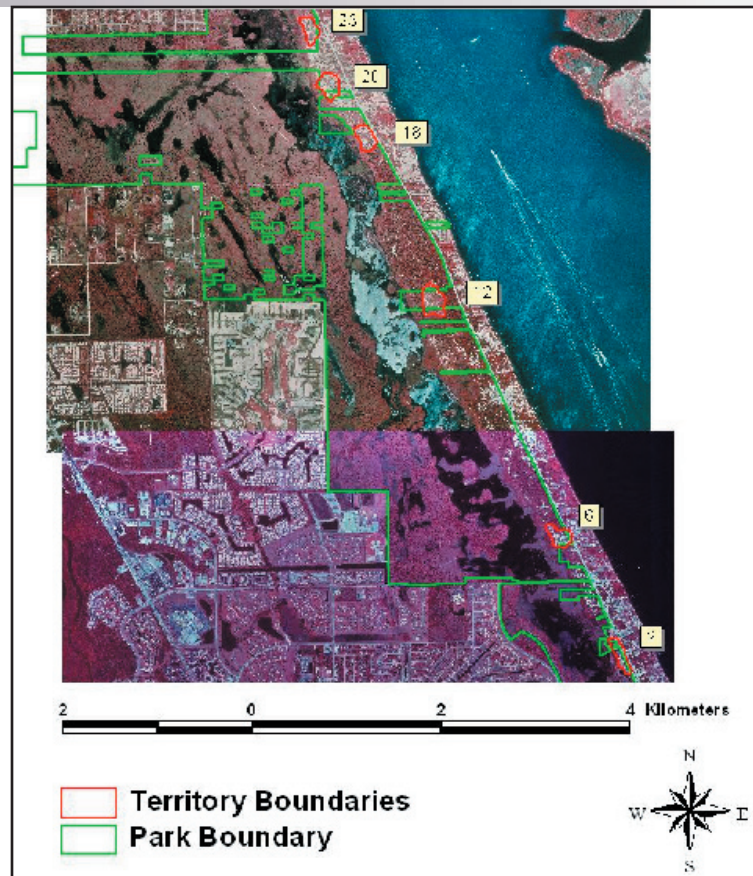


Figure 4. Territory Location Map. Location of six territories that were occupied for both years (2001-2002) of this study.

detection of ground predators is more difficult, which may increase predation rates on Scrub-jays, their nests, and young (Woolfenden and Fitzpatrick 1984, 1996a, 1996b).

In optimal Scrub-jay habitat, the majority of oaks are between 1 and 3 m tall; these oaks are interspersed with numerous patches of exposed sand (Woolfenden and Fitzpatrick 1984, 1996a, 1996b). Scrub-jays need this sandy substrate to “cache” (bury) and recover the six to eight thousand acorns each bird stores per year (DeGange, et al. 1989). Furthermore, Scrub-jays spend the majority of their foraging time on the ground and will avoid areas of heavy leaf litter or herbaceous cover that is typical of aging scrub. Frequent fires help to burn off this litter layer, restore the areas of open sand, and open the canopy and understory.

The most recent, large-scale natural fire in the Savannas area occurred almost 18 years ago, and the Scrub-jay

Family Group Size and Territory Size

Year	Area 1				Area 3							
	T2 # of birds	Territory Area	T6 # of birds	Territory Area	T12 # of birds	Territory Area	T18 # of birds	Territory Area	T21 # of birds	Territory Area	T23 # of birds	Territory Area
2001	4	3.87 ha	5	4.16 ha	4	6.29 ha	3	4.24 ha	5	4.82 ha	2	3.70 ha
2002	5		4		3		5		3		2	

Table 1. Family Group Size and Territory Size. These six territories were the only territories occupied during both years (2001 and 2002) of the study at Savannas Preserve State Park.

population has declined more rapidly as the scrub has aged and become more dense. The largest decline (22%) occurred between 2001 and 2003, or 14 to 16 years since the last fire, and it will continue in the absence of fire. Florida Scrub-jays will not persist in scrub that is prohibited from burning normally (Fitzpatrick et al. 1994).

Territory Size

Florida Scrub-jays live in family groups, varying in size from a single mated pair up to large family groups of eight or more individuals (Woolfenden and Fitzpatrick 1984, 1996a, 1996b). These family groups live in large, all-purpose territories throughout their lives. An average size of 5.4 ha is the “best available estimate” for the minimum sustainable territory size for the Scrub-jay within contiguous, optimal habitat (Fitzpatrick et al. 1991).

Territory sizes in the Savannas population during the study ranged from 3.7 ha to 6.3 ha (table 1). Of the six territories, only one was larger than the minimum sustainable territory size

described by Fitzpatrick et al. (1991). The Scrub-jays of Savannas are occupying territories that are smaller than what should be optimal, or perhaps even adequate, to sustain them.

The Scrub-jays at Savannas have filled the available suitable habitat and have no room to expand. The average density of territories per 40 ha in scrub communities that have reached the upper limit of optimal age is 2.9 (Fitzpatrick et al. 1991). Even in excellent scrub, densities rarely exceed 5.0/40 ha, and densities of about 2.0/40 ha should be considered the minimum for stable populations. The area of the 1987 wildfire was only 36.4 ha and should only be able to sustain 2.6 quality territories; however, there are 4 occupied territories. These family groups are struggling to do more with less in terms of territory size and available resources. As more usable scrub is made available through aggressive resource management or as a result of naturally occurring wildfires, the average territory size should increase.

Table 2. Observed Nest Locations and Fledglings Produced. Location of the 10 nests observed from initial discovery (construction) until either the chicks fledged, nest failed, or it was abandoned. N/A = no nest found. In 2002, T-23 renested after an initial failure.

Observed Nest Locations

Year	Area 1				Area 3									
	Territory T2		Territory T6		Territory T18		Territory T20		Territory T21		Territory T22		Territory T23	
	Nest	# Chicks Fledged	Nest	# Chicks Fledged	Nest	# Chicks Fledged	Nest	# Chicks Fledged	Nest	# Chicks Fledged	Nest	# Chicks Fledged	Nest	# Chicks Fledged
2001	Yes	1	Yes	0	Yes	0	Yes	0	N/A	N/A	Yes	0	N/A	N/A
2002	Yes	0	Yes	0	N/A	N/A	N/A	N/A	Yes	0	N/A	N/A	Yes (2)	0

Mammalian Predators Recorded at Savannas Preserve State Park

Tracking Station Location	Raccoon (<i>Procyon lotor</i>)	Feral Cat (<i>Felis cattus</i>)	Dog (<i>Canis familiaris</i>)	Fox (<i>Vulpes spp.</i>)	Bobcat (<i>Lynx rufus</i>)	Armadillo (<i>Dasypus novemcinctus</i>)
Area 1	Y (14/27)	Y (6/27)	Y (4/27)	Y (3/27)	N	Y (1/27)
Area 3	Y (6/54)	N	N	Y (1/54)	Y (1/54)	N
Area 4	Y (10/27)	N	N	Y (2/27)	N	Y (3/27)

Reproductive Success

Typically, Scrub-jays build their nests in dense oak shrubs, usually at the edge of a thicket bordering an open space or bare ground. This allows them a clear view of predators approaching the nest (Woolfenden and Fitzpatrick 1984, 1996a, 1996b). Nest failure is almost always the result of predation. The incidence of predation increases as the scrub ages, with re-nesting after a failure common, especially early in the breeding season (Woolfenden and Fitzpatrick 1984, 1996a, 1996b). Average production of young is about two fledglings per pair per year (Woolfenden and Fitzpatrick 1984, 1996a, 1996b).

During the years 2001 and 2002, from the 10 nests observed at the Savannas only one chick was successfully fledged and survived through its first year. Nearly half of the failed nest attempts at Savannas were the result of predation. Unfortunately for the Savannas, this production rate was dismal and requires remediation to ensure a viable population.

Quite simply, the Scrub-jays at Savannas are having little reproductive success, probably because they are in small territories in declining quality scrub habitat. This results in higher competition for scarce breeding and foraging resources. In suboptimal scrub, females must leave the nest more often to feed themselves and their dependent young. This regularly exposes the eggs and nestlings to the elements of weather and a greater chance of predation. As the Savannas scrub continues to age, the

reproductive success of this population will continue to decline and, unless conditions change, extirpation will most likely occur.

Predators

In the Savannas scrub, there are birds occupying varied habitat regions. Within these varied habitats, Scrub-jays are exposed to different assemblages of predators, at varying frequencies.

In Areas 1 and 4, there were significantly more visits (24) to the tracking stations by raccoons, compared to visits in Area 3 (6 visits). Areas 1 and 4 are located at the southern and northern boundaries, respectively, of the Savannas study site. Both are located immediately west of residential development, with only the Florida East Coast Railroad ROW serving as the boundary between them.

The densities of raccoons in Savannas in close proximity to residential development are likely considerably higher than normal. The numbers of recorded observations of raccoons in Areas 1 and 4 support this assumption. There is no doubt that raccoons are heavily depredating Scrub-jay nests at Savannas. Two of the three confirmed predation events by raccoons occurred in Area 1 (T2 and T6).

Suburban areas are subjected to a high degree of habitat alteration, and fewer species inhabit them than natural environments. However, for those species that do inhabit these suburban environments, increased availability and concentration of food, den sites,

Table 3. Mammalian Predator Occurrence. Occurrence of six known mammalian scrub-jay predators documented at the twelve predator tracking stations in Savannas Preserve State Park for the years 2001-2002. Numbers in parenthesis indicate number of times tracks were recorded per total tracking attempts at each station.

and other refuges can create dense populations (Dickman 1987, Dickman and Doncaster 1987, Riley et al. 1998). Urban raccoon populations can reach extremely high densities. Trapping at Hugh Taylor Birch State Park, an urban park, in Ft. Lauderdale, Florida, revealed one of the highest densities of raccoons ever recorded in North America (Smith and Engeman 2002). Raccoons in Florida have become an example of an abundant native vertebrate that impacts the conservation of endangered species such as nesting marine turtles (Garrott et al. 1993).

Two other mammalian predators, feral cats and dogs, were observed to have significantly more recorded visits to the tracking stations in Area 1 than either Area 3 or Area 4. In areas like Savannas, where the Scrub-jays are in close proximity to suburban habitats, house cats are important predators of many bird species as well as herpetofauna (FDEP, unpublished data). The added stresses of these common feral residents of urbanized areas, combined with the predators that are commonly found in natural habitats, negatively impact the success of breeding Scrub-jays.

Ambush attacks by predators account for nearly all captures of adult Scrub-jays (Woolfenden and Fitzpatrick 1984, 1996a, 1996b). The increased density of understory growth at Savannas, typical of old scrub, increases the likelihood that a successful ambush will occur. This increased density also makes it more likely that predators of nest contents (eggs and chicks) will be more successful.

Future Research and Management

Savannas Preserve State Park contains a varied set of rich and unique natural communities, including mesic flatwoods, basin marsh, wet prairie, marsh lake, sand pine scrub, and scrubby flatwoods. A common element of these natural communities (with the exception

of marsh lakes) is that they require periodic fire for proper management, especially the scrub and scrubby flatwoods. However, Savannas Preserve State Park is surrounded by suburban development. This interface includes schools, hospitals, and residences: a political and public perception environment that is unfriendly to the use of prescribed fires (Marti 2004). The consequence of this close proximity to urbanization is that fire has been excluded from the Savannas scrub for far too long. Under these conditions, scrub habitat will succeed to a xeric hardwood-forest dominated landscape (Wright and Bailey 1982, Myers 1990). With Scrub-jays and other pyrogenic species in decline, it is imperative that an aggressive prescribed fire plan be implemented for the scrub communities in Savannas. Likewise, on a global perspective, many species of wildlife are fire adapted and would disappear without a fire regime (Wright and Bailey 1982; Bolen and Robinson 2003). This is especially true for species adapted to the xeric oak scrub, sand pine scrub, and scrubby flatwood communities of Florida and Savannas Preserve State Park. In an effort to reduce the fire hazard associated with burning overgrown scrub high-density fuel loads, the Florida Park Service is working with the Florida Division of Forestry to timber the sand pines associated with the old successional stage scrub. This will help to re-stratify and reduce the heavy fuel loads associated with these large old-growth pines. After the timbering is completed, burning these scrub communities is necessary to finish the process of restoring them to an early successional stage. Habitat restoration and proper management are crucial to the long-term prospects of the Florida Scrub-jay (Stith 1999) and the many other endemic scrub species in the Savannas scrub.

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News From Zoos

Lemur Species Discovered by Omaha's Henry Doorly Zoo Researcher

If the discovery of any new species is considered rare, then the discovery of two new species of primates is extraordinary. Dr. Edward Louis of Omaha's Henry Doorly Zoo discovered two new species of lemurs that will be officially published in the December 2005 *International Journal of Primatology*. Lemurs are rare prosimians found only in Madagascar. Their decline has been exacerbated by the loss of approximately 27 million acres of forest cover in the last 20 years. About 70 species of lemurs have been identified to date. During the course of this project, Louis and his team of researchers took DNA samples from over 1,800 lemurs in the wild.

As with other primates, the discovery of a new species is very rare. In order to be considered an official new species, observations must be reviewed and confirmed by other scientists. This has led to the discovery of five new species of lemurs during Dr. Louis' six years of research in Madagascar; the other three species are awaiting confirmation. The Mitsinjo Sportive Lemur lives in the dry forests of the west coast and is named after that region of Madagascar. The Seal's Sportive Lemur, or *Lepilemur seali*, lives in the east coast rainforest. This species is named in honor of the late Ulysses S. Seal III, who served as chairman of the Conservation Breeding Specialist Group (CBSG) of the World Union for the Conservation of Nature (IUCN) from 1979 to 2003.



North Carolina Aquariums Join Federal Conservation Education Plan

The North Carolina Aquarium's three locations were collectively recognized by President Bush as the "United States' 18th Coastal Ecosystem Learning Center by Coastal America" on January 13, 2005. This honorable designation follows a recent trend of increased federal awareness of coastal ecosystem status after the September release of the U.S. Commission on Ocean Policy report. The North Carolina aquariums were specifically recommended for this program in President Bush's Ocean Action Plan, which was announced in December 2004. Coastal America aims to provide a collaborative network between government organizations and marine facilities, a goal resulting in the creation of the Coastal Ecosystem Learning Centers in 1996. Coastal Ecosystem Learning Centers pledge to work in partnership with federal agencies in order to educate and involve the public in protecting our nation's ecosystems.

Benefits from the partnerships with federal agencies include unique access to expert speakers, exhibit information, educational publications, teaching materials, field trip sites, and scientific data from

around the country. The North Carolina Aquariums will also have access to an EPA vessel and confiscated materials from the U.S. Fish and Wildlife Service. The National Marine Fisheries Service will provide the aquariums with a turtle excluder, a device required on ocean shrimp trawls. These items will serve to educate the public about the conservation issues facing coastal ecosystems.

Newport Aquarium Plays Key Role in Sea Turtle's Trans-Atlantic Journey

All seven species of sea turtles are now on the IUCN Red List of Threatened Species as either endangered or critically endangered. Sea turtle numbers continue to decline because they are vulnerable to commercial fishing, boating, habitat degradation, pollution, and poaching. The Newport Aquarium in Kentucky has a history of supporting sea turtles through various rescue and rehabilitation centers. In the last few months they've witnessed some astounding feats by sea turtles that were rehabilitated at the Aquarium and returned to the open waters of the Atlantic. Fisher, a 150-pound

loggerhead turtle, was released into the Atlantic Ocean in July of last year after being tagged by a satellite transmitter. The transmitter was glued to the turtle's shell and is expected to return data for approximately one year after his release. Fisher's progress while making his journey across the Atlantic is monitored by scientists and can be seen online at www.seaturtle.org.

Having traveled about 4,000 miles since his release, Fisher was about 600 miles from Cape Verde off the west coast of Africa in mid-January. He typically travels between 4-5 mph; about twice as fast as loggerhead turtles were previously thought to swim. In the first month at sea, Fisher traveled an astounding 900 miles. With the data collected using the satellite transmitter, scientists hope to gain valuable knowledge regarding the remarkable journeys made by sea turtles.

Elephants in Zoos: Preparing for the 21st Century

Directors of 78 American Zoo and Aquarium Association (AZA) accredited zoos that care for elephants recently endorsed an aggressive new vision that focuses on ensuring elephants are part of the world's future. This vision resulted from a meeting that focused on elephant care, management, facilities, research, and conservation. One of the strongest messages from the meeting was an agreement to provide increased support for elephant research and conservation programs.

In the wild, African elephant populations have declined more than 75% in the last 20 years, while Asian elephants have been highly endangered for most of the last century. Zoos maintain populations of

elephants that contribute to conservation in numerous ways, including public education, scientific research, professional training, technology transfer, political action, and direct involvement in field conservation. Although last year AZA-accredited zoos initiated or supported a total of 86 elephant-related conservation and associated research and educational projects, there are still opportunities to do more.

"Much has been learned about elephants in the wild and some of that research is directly applicable to directing the care of elephants in our zoos," said AZA President and Birmingham Zoo Director William R. Foster, DVM. "In turn, zoo studies have created important breakthroughs in technologies such as elephant communication and satellite tracking techniques that are being used to aid conservation efforts in range countries. We want to foster additional collaborations that will bring benefits to elephants in our care and in the wild."

Condors Take Flight in Oregon Zoo's Conservation Facility

The Oregon Zoo is "flying high" in their quest to restore wild condors to their native habitat in the Pacific Northwest. The California condor once ranged throughout the Pacific Northwest, displaying a magnificent wingspan of over nine feet and diving at incredible speeds of 80–100 mph. The last wild condors in Oregon were seen in 1904, and in 1987 there were only 17 left anywhere in the wild. Biologists decided to place the remaining condors into a captive breeding program in an attempt to save the species. In November 2003, the Oregon Zoo joined the San Diego Wild Animal Park, the Los Angeles Zoo, and the World Center for Birds of Prey to create the nation's fourth condor breeding program. The California Condor Recovery Program, coordinated by the U.S. Fish and Wildlife Service, is now one of the most successful endangered species recovery efforts in existence.

The year-old breeding program is a private project of the Oregon Zoo Foundation. The 50-acre Condor Creek Conservation Facility is located on 8,000 acres of public land in the Clackamas River drainage near Estacada, Oregon. Breeding condors is a spacious endeavor, with each pair requiring a minimum flight cage measuring 20 x 40 feet. Thirteen condors currently share this facility, which consists of 30-foot tall pens spread over one acre of land. Since these birds will eventually be released into the wild, the location and design of the condor pens allow for minimum human contact so that the condors don't associate or bond with their caretakers. Scientists are able to observe the birds regularly through one-way glass and closed-circuit computer monitors.

The Condor Creek Conservation Facility will eventually house 16 pairs of condors that may produce up to 32 young a year. This goal will be achieved through managed breeding and a technique called "double clutching." Condors reproduce only after age six in the wild, yielding one egg every other year. To increase their level of fecundity, when an egg is produced it is removed from the nest and placed in an incubator. Often the breeding pair reproduces again the same year, therefore producing a second clutch.

Aside from the ecological significance of the condor's recovery, the California condor was once beheld as a cultural icon of the Wasco people. Living along the Columbia River, the Wasco considered the condor a "helper" and it appears in many native myths as "Thunderbird." Lewis and Clark are also widely noted for their critical observations of this "beautiful buzzard of the Columbia."

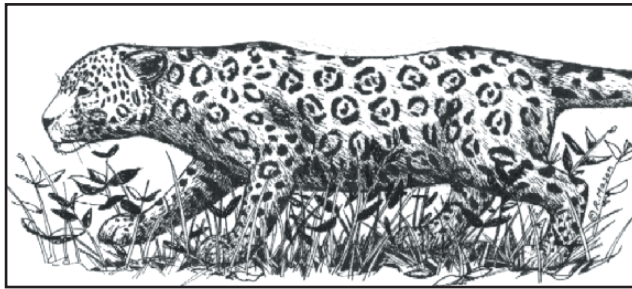
To date, the recovery program has overseen the release of approximately 111 birds in Arizona, California, and northern Baja California, making up nearly half of the total population of 219 California condors in captivity and the wild.

*Submitted by Amanda Strandquist
American Zoo and Aquarium Association,
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Photo of Fisher the Sea Turtle, by Pam Lyons, Newport Aquarium"

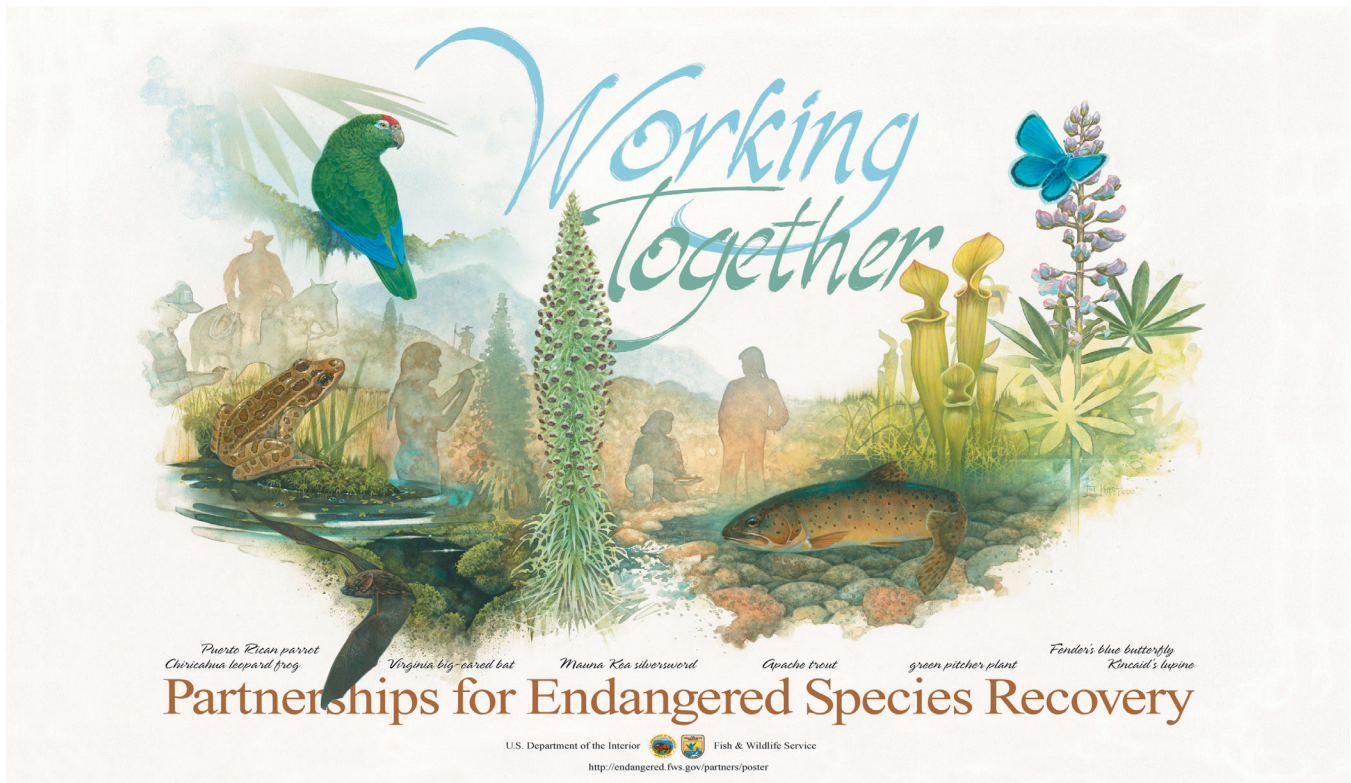


FOCUS ON NATURE™ by Rochelle Mason



Fresh tracks with large, rounded footpads reveal the presence of a big cat. The mud also shows imprints of cloven hooves, possibly from a peccary. Up ahead, along the bank of this rich Amazonian river, a male **JAGUAR** (*Panthera onca*) lurks in the dense understory. He uses stealth and the power of his large, 8-foot-long, 260-pound body to catch this porcine prey in a single bound. After his meal, he relaxes in damp foliage as the moon casts soft light upon the jungle floor. During the day the well-camouflaged feline rests on a fallen tree while the temperature and humidity rise. This particular cat has a home range of 10-15 miles in diameter, depending on food availability. Over the past century jaguar populations have moved from the US/Mexican border area into their present strongholds within Central and South America. *Artwork and text by Rochelle Mason. Copyright 2003*
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Endangered Species Act 30th Anniversary Commemorative Poster



Provided by the U.S. Fish and Wildlife Service. Artwork by Tim Knepp illustrating endangered species in our country and the partners who work to recover them.

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Notes

Notes

Instructions to Authors

The Endangered Species UPDATE is committed to advancing science, policy, and interdisciplinary issues related to species conservation, with an emphasis on rare and declining species. The UPDATE is a forum for information exchange on species conservation, and includes a reprint of the U.S. Fish and Wildlife Service's Endangered Species Technical Bulletin, along with complementary articles relaying conservation efforts from outside the federal program.

The UPDATE welcomes articles related to species protection in a wide range of areas including, but not limited to:

- Research and management of rare and declining species;
- Theoretical approaches;
- Strategies for habitat protection and reserve design;
- Policy analyses and approaches to species conservation;
- Interdisciplinary issues;
- Emerging issues (e.g., wildlife disease ecology).

In addition, book reviews, editorial comments, and announcements of current events and publications are welcome.

Subscribers to the UPDATE are very knowledgeable about endangered species issues. The readership includes a broad range of professionals in both scientific and policy fields including corporations, zoos, and botanical gardens, university and private researchers. Articles should be written in a style that is readily understood but geared to a knowledgeable audience.

Acceptable Manuscripts

The Endangered Species UPDATE accepts several kinds of manuscripts:

1. Feature Article — on research, management activities and policy analyses for endangered species, theoretical approaches to species conservation, habitat protection, and interdisciplinary and emerging issues. Manuscripts should be approximately 3000 words (8 to 10 double spaced typed pages).

2. Opinion Article — concise and focused argument on a specific conservation issue; may be more speculative and less documented than a feature article. These are approximately 450-500 words (About 2 double spaced typed pages).

3. Technical Notes/Reports from the Field — ongoing research, application of conservation biology techniques, species conservation projects, etc., at the local, state, or national level. These are approximately 750 words (3 double spaced typed pages).

4. Species at Risk — profiles of rare and declining species, including the following information: taxonomy, distribution, physical characteristics, natural/life history, conservation status, and economic importance. These profiles are approximately 750-1500 words (3 to 6 double spaced typed pages).

5. Book Reviews — reviews should include such information as relevant context and audience, and analysis of content. Reviews are approximately 750-1250 words (3 to 5 double spaced typed pages). Please contact the editor before writing a book review.

6. Bulletin Board — submissions of news items that can be placed on the back page. These items can include meeting notices, book announcements, or legislative news, for example.

Manuscript Submissions and Specifications

Submit the manuscript to:

Editor, Endangered Species UPDATE
School of Natural Resources and Environment
University of Michigan
440 Church Street
Ann Arbor, MI 48109-1041

To submit your manuscript electronically, e-mail the manuscript as a Word file or rich formatted text (.rft) attachment to: esupdate@umich.edu.

Manuscripts should be typed, double-spaced, with ragged right margins to reduce the number of end of line hyphens. Print must be in upper- and lower-case letters and of typewriter quality. Metric measurements must be given unless English measurements are more appropriate, in which case metric equivalents must be given in parentheses. Statistical terms and other measures should conform to the Council of Biology Editors Style Manual. All pages should be numbered. Manuscripts must be in English.

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Citations, Tables, Illustrations, and Photographs

Literature citations in the text should be as follows: (Buckley and Buckley 1980b; Pacey 1983). For abbreviations and details consult the Editor and recent issues of the Endangered Species UPDATE.

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Author credit instructions for each author of the article should accompany the manuscript.

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- | | | | |
|----|--|----|---|
| 3 | Problems and Recommendations for the Conservation of the Maned Wolf in Argentina
Lucia Soler | 3 | Problemas y recomendaciones para la conservación del Aguará-guazú en Argentina
Lucia Soler |
| 10 | Conservation Status of Coral Reef Fishes in the Florida Keys
Thomas W. Gillespie & Anais Smith | 10 | Nivel de conservación Los Peces del arrecife de coral en los Cayos de Florida
Thomas W. Gillespie & Anais Smith |
| 18 | Endangered Species, Prescribed Fires, and Public Resistance in a Florida Scrub Community
Diana Marti, William O'Brien, Henry T. Smith, Jon A. Moore & Stephanie Fitchett | 18 | Especies en peligro, fuegos prescritos y resistencia publica en una comunidad
Diana Marti, William O'Brien, Henry T. Smith, Jon A. Moore & Stephanie Fitchett |
| 29 | Reproductive Success, Territory Size, and Predation Pressures of the Florida Scrub-jay (<i>Aphelocoma coerulescens</i>) at Savannas Preserve State Park
Ernest M. Cowan | 29 | Éxito reproductivo, tamaño de territorio y presiones de predacion del chara pecho rayado <i>Aphelocoma coerulescens</i> en el parque estatal de la Reserva Savanna
Ernest M. Cowan |