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Title: A Rapid Assessment of the Status of Introduced Mexican Red-bellied Squirrels at Biscayne National Park

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Abstract:

The Mexican red-bellied squirrel (*Sciurus aureogaster*) was introduced on Elliott Key (in what is now Biscayne National Park) in 1938. The introduced animals quickly established a

breeding population on the island and became a highly visible member of the mammalian fauna of Biscayne National Park. The impact of this exotic species on the native flora and fauna was never clearly delineated. Introduced populations of a number of other species of tree squirrel are known to cause numerous changes at the sites of their introductions. The population was believed to be lost following the devastation of Hurricane Andrew in 1992; however, the species survived and has been documented on numerous occasions in recent years. Given the potential for exotic species to negatively influence ecosystems, it is prudent to assess the status of this conspicuous member of Biscayne National Park to document the presence, distribution, and habitat use of the species. Herein, I propose an intensive rapid assessment of Mexican red-bellied squirrel distribution and abundance on Elliott Key, Adams Key, and Sand Key.

Key Words: Conservation, nonindigenous, non-native, exotics, mammals, mammalogy, habitat, extirpation, inventory, rapid assessment

PROJECT OVERVIEW:

A major threat to biological diversity is the intentional or accidental introduction of non-native species to novel ecosystems (Primack 2002). Such introductions can disrupt the function of their new communities through a number of mechanisms to include the spread of disease, competition, predation, reproductive performance, and induced habitat change (Simberloff et al. 1997). The ecological literature is replete with instances of these devastating consequences (Lever 1985).

The Mexican red-bellied squirrel (*Sciurus aureogaster*) is a medium bodied, diurnal squirrel native to southern Mexico (reviewed in Koprowski et al., In press). Four individuals were introduced to Elliott Key in 1938 and spread to occupy the entire island by the 1960's (Brown 1969, 1997a, 1997b, Brown and McGuire 1975, Van Gelder 1982). The species has been reported from two adjacent islands, Adams Key and Sand Key, apparently the result of natural dispersal (Layne 1997). Studies were initiated in the 1980's to assess the potential impacts of this common exotic species on the imperiled Sargent Palm, *Pseudophoenix sargentii* (Curry, Pers. Comm). In 1992, the zone of greatest damage due to winds and storm surge from Hurricane Andrew passed directly over Elliott Key resulting in massive loss of island forests (Ogden 1992, Davis et al. 1993). Many large mammal species appeared to survive the storm on the mainland (Ogden, 1992, Davis et al. 1993) but red-bellied squirrels were greatly reduced on Elliott, Adams, and Sand keys; recent sightings suggest that this exotic species survived the catastrophic hurricane on Elliott Key and has been increasing in number (Layne 1997, Curry, Pers. Comm.).

Present status on Sand and Adams Keys are not known. Without knowledge of status and distribution, management strategies on the islands cannot be developed that include this notorious seed predator. This project was undertaken in an effort to rectify this paucity of data on the status, distribution, and impact of introduced Mexican red-bellied squirrels on Elliott Key.

OBJECTIVES

The rapid assessment of the status of Mexican red-bellied squirrels will:

1. Document the status of the exotic squirrels on Sand and Adams keys during the post-Hurricane Andrew era.
2. Contribute inventory and monitoring data on the distribution and habitat use of the introduced Mexican red-bellied squirrels on Elliott Key in Biscayne National Park.

METHODS

Study area:

The principal study area for the intensive inventory of red-bellied squirrels will be the forests of Elliott Key, Biscayne National Park, Dade County, Florida. Surveys to assess status will be extended Adams Key and Sand Key where the species was reported to also exist prior to Hurricane Andrew in 1992 (Layne 1997).

Procedures:

Inventory. The relatively small size of Elliott Key and its forests enables the entire island to be searched on foot through the dense vegetation. The large leaf nests of red-bellied squirrels are conspicuous and most easily distinguishable from mammals on Elliott Key based upon size, structure, and height in tree (Brown and McGuire 1975). Trees containing leaf nests are temporarily marked with forestry flagging and locations documented with a GPS unit. Adams Key and Sand Key will also be visited to assess if the species persists.

Habitat Analysis. The species, DBH, height of tree, type of nest, height of nest, interdigitation of nest tree with other canopy trees, and quality of nest are determined. A 10-m radius circle around each nest tree is traversed to assess species diversity of trees, shrubs, and palms. A similar number of random trees is selected and the same suite of measures of habitat collected. Random and nest trees and plots are compared to assess features favored by Mexican red-bellied squirrels.

Habitat Use. Presence of squirrels at nest sites is verified by observation during the early morning or late evening when squirrels exit and enter nests (after Koprowski and Corse 2001). Standard transect methods (Eberhardt 1978) will be applied to obtain estimates of nest, crude

squirrel densities, and availability of habitat types. The localities of all nests and sightings will be determined by GPS and entered into a GIS overlay.

Radiotelemetric tracking of movements of squirrels will be accomplished by live trapping squirrels in wire mesh live traps baited with thick-hulled nuts. Captured animals will be transferred to a cloth handling cone (Koprowski 2002) and fitted with a 8-10 g radiocollar (Wildlife Materials International, Murphysboro, IL), a variety of physical data collected, and released at the capture site within 10 min of capture. Animals will be located through homing on signals; the habitat type and behavior of the focal animal will be recorded. Home range (MCP and AK) estimators will be calculated using Ranges 6 (Institute for Terrestrial Ecology, Wareham, UK). The percent of each home range in various habitat types will be determined and the frequency of overlap with known distributions of the endangered palms will be quantified.

Appropriate state, national park, and University of Arizona Institutional Animal Care and Use Committee permits for the live trapping operations will be obtained before intensive field work is initiated.

PROGRESS TO DATE

Personnel and Effort:

A graduate research assistant, Geoffrey Palmer, was recruited to complete his MS thesis on the red-bellied squirrels of Elliott Key. He has been resident at Biscayne National Park since 20 December 2005. He has spent >60 days in the field since his arrival and conducted more than 600 trap nights of live trapping under permit from the National Park Service and the State of Florida Fish and Wildlife Conservation Commission. In addition, a team of 6 researchers and volunteers from The University of Arizona assisted with an initial survey of approximately 60% of Elliott Key to locate squirrel dreys from 5 to 10 January 2006.

Status and Distribution:

Surveys of the entirety of Elliott Key were completed by March 2006 and resulted in the location of nests and the sighting of 8 squirrels. Interestingly, both color morphs known to be on Elliott Key prior to Hurricane Andrew in 1992 have been documented to persist on the island. One-hundred and twenty nine nests of red-bellied squirrels were discovered and their locations recorded. Mexican red-bellied squirrels appear to again be found on the length of Elliott Key as noted prior to Hurricane Andrew.

Nest and Sighting Locations for *Sciurus aureogaster* on Elliott Key, Biscayne NP, Florida



Habitat Analyses:

Data collection has been initiated on nest and random sites. One-hundred and six of the 129 known nest trees (82.2%) were assessed; nests are most commonly found in West Indies Mahogany trees (61.8%: *Swietenia mahagoni*) with a large number of other species used less commonly (Table 1).

Table 1. Nest trees used by Mexican red-bellied squirrels (*Sciurus aureogaster*) on Elliott Key, Dade Co., Biscayne National Park, Florida.

Tree Species	Percent Use
West Indies Mahogany - <i>Swietenia mahagoni</i> (SWMA)	61.8%
Wild Tamarind - <i>Lysiloma latisiliqua</i> (LYLA)	10.2%
Florida Poisonwood - <i>Metopium toxiferum</i> (METO)	4.2%
Buttonwood - <i>Conocarpus erectus</i> (COER)	3.4%
Pigeon Plum - <i>Coccoloba diversifoli</i> (CODI)	2.5%
Black Ironwood - <i>Krugiodendron ferreum</i> (KRFE)	2.5%
Mastic - <i>Mastichodendron foetidissimum</i> (MAFO)	1.7%
Other	17.8%

In addition, 90 habitat plots (10 m radius surrounding the nest tree) and random plots have been completed.

PROSPECTUS

During the upcoming year, we will complete the habitat analysis portion of the field data collection. This will document characteristics of nest trees and nest sites to identify habitat preferences for the red-bellied squirrels on Elliott Key. In addition, two additional phases of the project will be initiated: 1.) we will continue to attempt to trap and radiocollar individuals to assess space and habitat use by Mexican red-bellied squirrels on Elliott Key, and 2.) we will examine the locations of squirrel nests relative to the endangered Sargent's Palms found on Elliott Key in collaboration with the Fairchild Tropical Botanic Garden.

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