

The recovery of the Cape Sable seaside sparrow through restoration of the everglades ecosystem.

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Abstract

The Cape Sable seaside sparrow (Ammodramus maritimus mirabilis) has been listed as federally endangered since 1967. Its small population size and unique ecology have perpetuated conservation concern. The ultimate factor in this sub-species' decline is the alteration of the everglades ecosystem. Range-wide surveys conducted since 1992 have documented 90 percent declines within some sub-populations leaving the sub-species vulnerable to extinction in the near future. Although the life history of the sparrow is typical of grassland birds, its demographic characteristics leave it highly vulnerable to even short-term alterations of fire and flood regimes. A multi-billion dollar restoration plan has been launched in an effort to return everglades' hydrology to a more natural state. However, even with this plan, the Cape Sable seaside sparrow is in danger of extinction. As shown for the plight of the Dusky seaside sparrow (Ammodramus maritimus nigrescens), a close and now extinct relative of the Cape Sable seaside sparrow, management actions must be swift to avert the extinction of short-lived, habitat specialists such as this sparrow.

Introduction

Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) population numbers have declined nearly 50 percent between 1992 and 1996 (Curnutt et al. 1998). This federally listed sub-species currently exists within the protected lands of Everglades National Park (ENP) and adjacent Big Cypress National Preserve. These two biological preserves (together nearly 8,500 km² in area) form one of the largest protected areas in North America, yet fail to function as a preserve for this and many other inhabitants (Mayer and Pimm 1998). Because large-scale hydrologic changes reflect patterns of population decline in the Cape Sable seaside sparrow, this bird is perceived to be the 'canary' in the 'coal mine' of the everglades. At present, the 20-year plan to restore original everglades hydrology promises recovery of the ecosystem. For short-lived species such as the sparrow; however, special attention must be paid to interim protection.

Historical perspective

Historically, the everglades were a 'river of grass' encompassing an estimated 28,205 km² of unbroken, freshwater prairie (Mayer and Pimm 1998). Extending from Lake Okeechobee in the north to Florida and Biscayne Bays in the south, water drained across the flat terrain as a 'sheet,' its peak averaging 64 km wide and 0.5 m in depth (Mayer and Pimm 1998). The heaviest flows (up to six km/hr) occurred during the wet-season (June to January).

South Florida was sparsely populated before the turn of the century (Tebeau 1968). High variation in water flow made south Florida an unpredictable place for most economic ventures, especially commercial farming (Mayer and Pimm 1998, Snyder and Davidson 1994). In 1850 the U.S. Congress passed the Swamp Lands Act which encouraged development in south Florida by 'reclaiming' flooded lands for agriculture (Light and Dineen 1994). This act, and another passed in 1948 (the Central and South Florida Project), set in motion a series of hydrology changes culminating in the construction of 2,200 km of canals and levees and over 40 pumps and spillways (Mayer and Pimm 1998). Lake Okeechobee was impounded in the 1930s, permanently altering the hydrologic link between the lake and the freshwater prairies to the south (Light and Dineen 1994).

These changes enabled south Florida to become one of the largest producers of winter vegetables and domestic sugarcane in North America (Snyder and Davidson 1994). Coupled with flood control, economic growth enabled the human population to reach four million by 1990 (Light and Dineen 1994). As early as the 1940s, officials recognized that this growth created additional demands on available water. Consequently, three Water Conservation Areas (WCAs) were included in flood control measures and established just north of ENP (Figure 1). These areas receive most of the run-off from Lake Okeechobee and the Everglades Agricultural Areas. They provide freshwater sources for agriculture, residential areas, and recreation. They also function as a 'filter' removing agricultural run-off (e.g., phosphorous) from water entering natural areas such as ENP (Light and Dineen 1994).

Between the WCAs and federal biological preserves, 67 percent of the original everglades ecosystem is protected from urban development. Although nearly half of that area is managed largely for biological resources, there is a limit to preservation efforts as only the lands, not the historical water flows, were protected. Since the re-plumbing of south Florida, water flows from the WCAs into the principle tributary of the lower everglades (Shark River Slough) via six spillways (Figure 1). Levees split the slough into eastern and western halves (Light and Dineen 1994). Western Shark River Slough receives most of the water, while the eastern slough (and other eastern tributaries such as Taylor Slough) receive little. The result is that prairies fringing western Shark River Slough are unnaturally wet for longer periods each year and the eastern prairies have desiccated (Nott *et al.* 1998). These prairies are home to the only six sub-populations of the Cape Sable seaside sparrows known (A-E, Figure 2).

The Cape Sable seaside sparrow, a small, drably colored bird, has never been common (Curnutt *et al.* 1998). First described in 1919 by Arthur Howell, this sub-

species was thought to exist only within the freshwater marshes that grew on Cape Sable early this century (Werner and Woolfenden 1983). A hurricane that made landfall over Cape Sable on September 2, 1935, forever changed the Cape's vegetation and landscape (Mayer and Pimm 1998, Curnutt *et al.* 1998). The sparrow was not found on Cape Sable after that event. In fact the species was believed extinct until L.A. Stimson's 1951 documentation of inland populations in freshwater prairies (Stimson 1956). Because most seaside sparrows live within tidal marshes, this discovery made the sub-species an ecological oddity (Post and Greenlaw 1994). As a likely consequence of the sparrow's phoenix-like identity and its unusual ecology, the U.S. Congress placed the Cape Sable seaside sparrow on the first endangered species list enacted in 1967 (Curnutt *et al.* 1998).

Current status

In 1981, ENP researchers conducted range-wide point counts of the Cape Sable seaside sparrow breeding population. Points were located one km apart and accessed via helicopter (Kushlan and Bass 1983). This survey yielded sparrow population estimates of over 6,000 individuals, with more than 2,000 located in each of two 'core' sub-populations (A and B) (Kushlan and Bass 1983). Similar estimates resulted from the next survey in 1992. In 1993, however, estimates dropped 90 percent from 2,500 to 400 individuals within sub-population A (Curnutt *et al.* 1998). Sub-populations C, D, and F each declined from over 400 individuals to fewer than 80 in the ensuing years (Curnutt *et al.* 1998). Annual surveys since 1993 have shown no reverse in these declines (Pimm and Bass 1999). Only the central sub-populations (B and E) contain relatively stable numbers from year to year.

To understand these declines, we have monitored nests and color-banded individuals from nine study plots (each 0.50 km²) within sub-populations A, B and E (Lockwood *et al.* 1999a,b). From six years of study, we know the following aspects of the sparrow's demography. The breeding season can last from late March to August depending on the onset of summer rains (Lockwood *et al.* 1997, Werner 1975). A pair can fledge at least three broods per breeding season with early broods more likely to fledge young than later broods (40 percent vs. 16 percent Mayfield success scores respectively). Sparrows prefer to nest in one m tall sparse sawgrass (*Cladium jamaicense*) stands mixed with bunchgrasses typical of seasonally dry areas (Lockwood *et al.* 1999b). Nests are built approximately 16 cm from the soil surface with a standard variation in height off the ground between 2 and 30 cm (Lockwood *et al.* 1999a, Werner 1975). Adults feed nestlings grasshoppers, spiders, dragonflies, and lepidoptera larvae, all locally abundant food sources (Lockwood *et al.* 1997). The principle threat to nests is predation, probably by water snakes or rats (Lockwood *et al.* 1997).

Adults are site fidelic, often returning to the same 200 m territory every year to breed (Lockwood *et al.* 1999a). When sparrows are not breeding they do not travel far. Using radio telemetry, Dean and Morrison (1998) recorded sporadic long distance movement over five km, but most tagged individuals stayed within one km of their nesting grounds. We have never re-sighted an individual banded in one sub-population within another (Lockwood *et al.* 1999a). Adult sparrows live a maximum of four years and just less than half of the adults in any given year will die (Lockwood *et al.* 1999a).

Hatch-year individuals exhibit low survival their first year out of the nest but they are more likely to move over longer distances (up to one km) (Lockwood *et al.* 1999a).

Although these demographic attributes are typical of most grassland birds, they become a unique liability in the context of current alterations in everglades water flow. In the western prairies of ENP, satellite images and ground-based hydrologic monitoring stations show several high water events between 1993 and 1996. In some years, water levels reached 50 cm above ground level (Nott *et al.* 1998). This exceeds the average nest height off ground by 34 cm and the highest nest ever recorded by 20 cm. These large water flows did not result from rainfall *per se*, but were due to released WCA water (Nott *et al.* 1998).

In the eastern prairies, altered hydrology has changed temporal fire patterns that, in turn, have impacted sparrow breeding habitat. Although periodic fires maintain freshwater prairies by preventing the encroachment of shrubs and hardwood trees (Kushlan and Bass 1983), comparisons between fire records and sparrow surveys demonstrate the following: 1) sparrows regularly occupy sights that have burned one year prior, and 2) historically occupied areas that burn every one or two years rarely hold sparrows today (Curnutt *et al.* 1998).

Since sparrows live a maximum of four years, short-term disruption of reproduction (such as fire or flood) can significantly effect population numbers (Lockwood *et al.* 1999a). In areas where adult sparrows cannot breed for two or three consecutive years, most adults die without replacing themselves in the population. This situation is exacerbated by the sparrow's limited clutch size. A pair of adult sparrows averages two young per nesting attempt. Theoretically, if all adults in an area successfully fledge one brood, population number will simply remain stable. (In practice, population numbers still decrease due to the low survivorship of juveniles.) Population increases are only possible when individuals successfully fledge two to four broods per breeding season (Lockwood *et al.* 1999a).

When short term disruptions occur over a wide geographic range, recovery is further hampered by the sparrow's limited dispersal over long distances. Low numbers will persist because immigration rarely occurs across sub-populations. There is little chance for the 'rescue effect' whereby individuals from a stable sub-population immigrate into a declining one.

A final concern is that high water and frequent fires are causing long-term changes in habitat structure (Nott *et al.* 1998, Lockwood *et al.* 1999a). Known to be a habitat specialist, this sub-species will not breed in prairies lacking specific structural cues (Lockwood *et al.* 1999b).

Restoration and future management

Restoring historical 'natural' water flows was a goal of a bill passed by the U.S. Congress in 1992 (Mayer 1999). The restoration plan aims to rectify environmental damage done by the 1948 Central and South Florida Project while maintaining adequate flood control and freshwater supplies for the local populous (Governor's Commission for a Sustainable Florida 1995). Though the plan is promising, the task is monumental. Current estimates place the completion of the restoration at 20 years (Mayer 1999). The

existent configuration of canals and levees simply provides no physical route to quickly redirect water flow from the over-flooded west to over-dry east (Pimm and Bass 1999).

Given the observed steep declines in Cape Sable seaside sparrow numbers over two or three years, there is no guarantee the sparrow can survive the 20 required to restore its breeding habitat. Consider the damage its close relative, the Dusky seaside sparrow (*Ammodramus maritimus nigrescens*), sustained between 1960 and 1980. The Dusky seaside sparrow was once found around Titusville, Florida. Like the Cape Sable seaside sparrow, the Dusky inhabited seasonally flooded marshes and existed in distinct geographic populations. Also like the Cape Sable seaside sparrow, the Dusky declined when hydrological changes left breeding grounds flooded or fire prone.

From an estimated 2,000 pairs on Merritt Island in the 1950s, DDT had already reduced populations 70 percent by 1957 (600 pairs) (Sykes 1980, Trost 1968). A bad situation was made worse when mosquito control impoundments flooded breeding habitat. The Dusky declined another 90 percent to 70 pairs by 1963 (Sykes 1980, Trost 1968). The threat was understood and the Dusky's habitat requirements documented (Trost 1968). Piecemeal studies to determine whether the birds would respond favorably to restoration of 'natural' hydrologic patterns satisfied endangered species legislation (Walters 1992) but left only one individual on Merritt Island by 1977 (Sykes 1980, Baker 1973, Sharp 1969).

The population of Dusky seaside sparrows located in the marshes along the St. John's river was estimated at 984 males in 1968 (Sharp 1970). Although it took two years to purchase U.S. National Wildlife refuge land here for the endangered bird, it took only one to gain a permit to build a highway through one densely populated colony (Walters 1992). Highways and development outside the refuge reduced the largest colony from 100 to 12 birds (Baker 1978). Inside the refuge, an open ditch drained Dusky habitat while six fires from neighboring farms burned over 4,000 acres. By 1977 fewer than a dozen birds of the 143 counted in 1970 were left on the refuge (Baker 1978). Despite urgent requests for fire lines as early as 1975, they were not completed (nor was the ditch plugged) until 1979. By that time, only nine males were left (Walters 1992). The last wild Dusky seaside sparrows were taken into captivity in 1980. The last individual, referred to as Orange for the legband he wore, died in captivity in 1987.

Conclusion

In many ways the current recovery prospects of the Cape Sable seaside sparrow mirror those of the Dusky from the early 1960s. Recovery seems feasible. The sparrow's demography and habitat requirements are known; the hydrologic changes that impact that habitat are understood. Unlike the Dusky, the Cape Sable seaside sparrow enjoys advantages such as higher population numbers, a range entirely within federally protected lands, and consensus on the need to restore the ecosystem on which it depends.

Nevertheless, these advantages do not guarantee success. With such obvious parallels between the management needs of the Dusky and those of the Cape Sable seaside sparrow it is incumbent upon managers to avoid the known pitfalls that lead to extinction. More than anything else, the story of the Dusky illustrates how critical the timing of management decisions are in dealing with short-lived habitat specialists. Each delay in decisions to purchase refuge land, construct fire lines, and seasonally drain

impoundments, carried the cost of a few more Dusky seaside sparrows. Though the restoration of the everglades ecosystem is a commendable and significant undertaking, it in no way alleviates the need for short-term, and often difficult, management actions. Without such actions, the Cape Sable seaside sparrow may become a martyr for the threatened ecosystem about which it once raised awareness.

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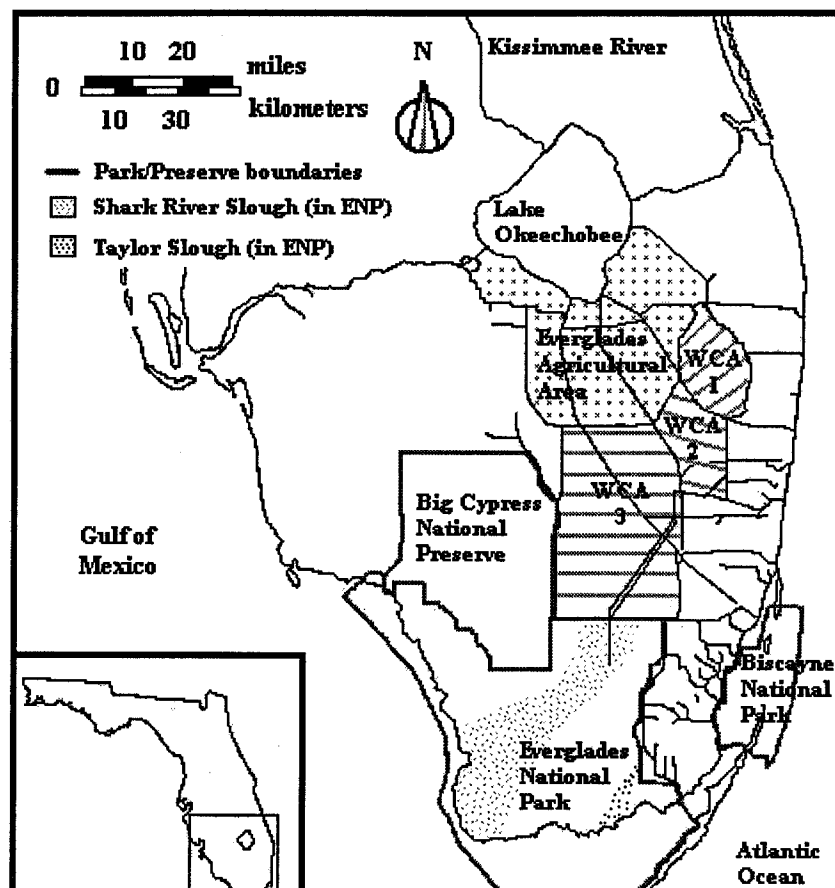


Figure 1. Map of the present Everglades watershed, including major canals, sloughs and political boundaries of parks and preserves (reproduced with permission from Mayer 1999).

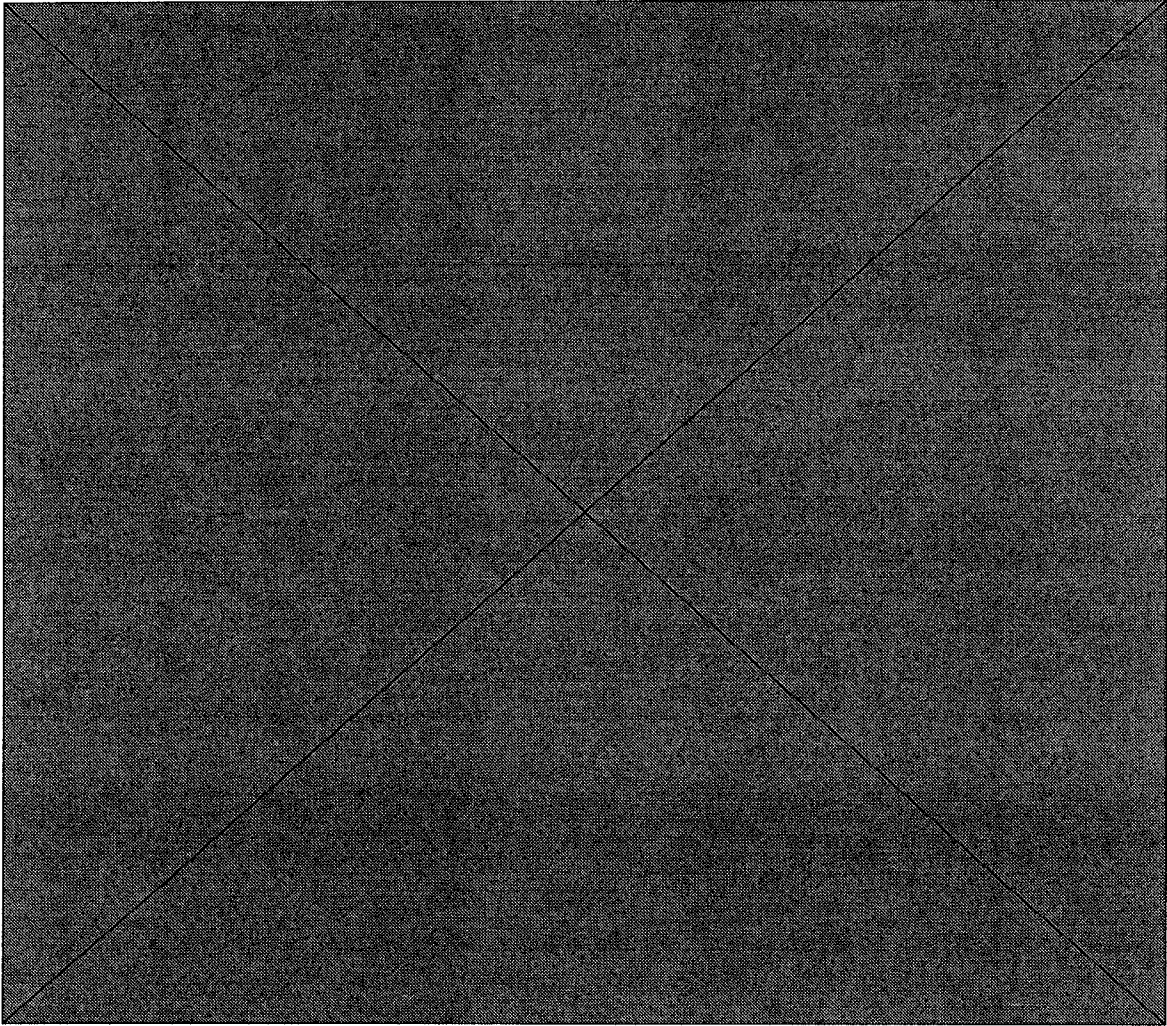


Figure 2. Location of Cape Sable seaside sparrow sub-populations within Everglades National Park and Big Cypress National Preserve.

