Population dynamics and natural history of the Sierra Madre Sparrow *Xenospiza baileyi* at La Cima, Mexico

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En la temporada de reproducción de 1999, estudiamos la demografía e historia natural del Gorrión Serrano *Xenospiza baileyi*, ave endémica de México y críticamente en peligro. Encontramos que alcanza una densidad poblacional alta (2.9 territorios por hectárea) y un éxito de anidación relativamente bajo (35.71%), e identificamos los riesgos principales para su sobrevivencia. El mayor peligro para la especie es la destrucción de hábitat, actualmente muy reducido.

Introduction

Sierra Madre Sparrow *Xenospiza baileyi* is a Mexican endemic currently placed in a monotypic genus[1]. The first specimen was collected in 1889 in northern Jalisco. Early in the 20th century it was found in two nearby localities in Durango and, disjunctly, in a small area straddling the border of Morelos and Distrito Federal. Since 1951 there have been no records of the northern populations[2] despite searching (J. Rojas Tomé pers. comm., S. N. G. Howell pers. comm.) and the species is currently considered Critically Endangered (D. C. Wege pers. comm.). It appears to be restricted to four populations south of Mexico City (L. Cabrera pers. comm.)

The main threat to this species is destruction of its habitat of bunchgrass meadows within pine woodland, most of which is now cultivated, and the remnants are principally threatened by burning and removal of grass, both to prepare land for cultivation and to stimulate new growth for grazing by sheep and cattle[2]. Our project aimed to produce basic population and natural history information for the Sierra Madre Sparrow during its 1999 breeding season (early March–early September).

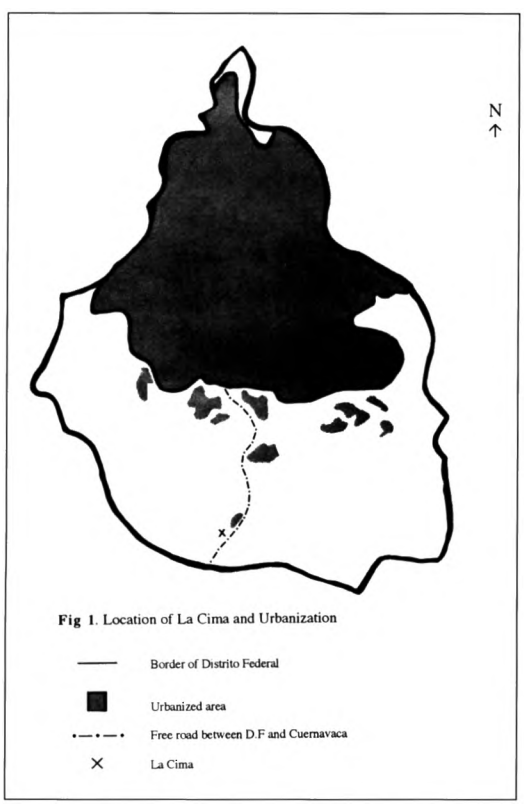

Figure 1. Map showing the location of La Cima with respect to Mexico City.

Study area

Our project was undertaken at La Cima in southern Distrito Federal, Mexico. This locality (19°05'N 99°12'W) is at km 42.5 of the free road between Mexico City and Cuernavaca (Fig. 1). The elevation is c.3,100 m, mean annual temperature is c.9°C and mean annual rainfall is 1,200 mm[3]. The meadow at La Cima measures 2 km^2, but includes cultivated fields of cereals, mainly oats, as well as relict patches of bunchgrass. Our study plot measured 12 ha, of which 7.6 ha is bunchgrass and 4.4 ha cultivated fields. La Cima is the site of a former train station (the Mexico–Cuernavaca train was discontinued in the early 1990s).

Methods

Fieldwork was generally conducted every second day during March to early September, except on 6–26 May, after AOI had been robbed at gunpoint. The fieldwork comprised colour-banding, territory mapping, nest monitoring and natural history observations. Aluminium colour bands, favoured by canary fanciers, of six colours were used: silver, canary-yellow, emerald-green, turquoise-blue, bright red and orange. Because this species is monomorphic, females were identified as such by their incubation patch and males by cloacal protuberance or, in two cases, by singing behaviour.

Fifty-two visits were made for territory mapping purposes, and the territories of males were

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Figures 3–4. Adult Sierra Madre Sparrow *Xenospiza baileyi* (Adán Oliveras de Ita)

Figure 5. Juvenile Sierra Madre Sparrow *Xenospiza baileyi* (Adán Oliveras de Ita)

Figure 6. Two nestling Sierra Madre Sparrows *Xenospiza baileyi* (Adán Oliveras de Ita)

plotted based on singing birds. A Kowa TSN-2 telescope, with a 20–60x zoom eyepiece, was used for observations and the position of each individual located on a 1:2000 scale map based on an aerial photograph[4]. This map shows isolated trees, trails, roads, field edges, train tracks and electric posts, thus making it easy to plot such positions. All observed birds were mapped and their activities indicated by map footnotes (i.e. whether they were singing, flying, feeding, carrying nesting material or food, whether other Sierra Madre Sparrows were singing simultaneously, whether song was made by perched or flying birds). Territorial males were considered to be those noted singing on more than two days, when observations were clustered around a central spot. Mapping was undertaken from 06h30 to 12h00 (occasionally later).

Because nest monitoring is considered the most direct measure of reproductive success[6], each nest was visited virtually every other day. Nest success was based on the percentage of nests from which at least one chick fledged (chicks remain in the nearby grass for c.12 days after leaving the nest, but data on survival are unavailable for this period). Precautions were taken to avoid affecting nesting success, e.g. by approaching a nest from different directions on consecutive visits, pretending to be searching for nests in areas where we knew them to be absent, never touching eggs or nests, and not placing marks next to nests. Compass readings and landmarks or, in some cases, rocks placed c.2 m away, were used to locate the nest.

Results

Sierra Madre Sparrow closely resembles Song Sparrow *Melospiza melodia*, which occurs in brushy habitat within 13 km north-west of La Cima (pers. obs.) but not at La Cima. Song Sparrow is larger with a longer, round-tipped tail (notched in *Xenospiza*), and lacks the bright yellow wing bend of Sierra Madre Sparrow[5]. The call note of Sierra Madre Sparrow is very similar to that of Song Sparrow, but the former's song is variable, sometimes closely resembling that of Savannah Sparrow *Passerculus sandwichensis*. Juvenile Sierra Madre Sparrows differ from adults in having a distinctly less well-marked yellow-buff supercilium, pale yellow-buff underparts and eye-ring, mustard yellow beak with dark grey culmen, slight cinnamon wash to lower belly, brown rather than black breast streaks, and no flank streaks (Figs. 3–5). Furthermore, juveniles lack the bright yellow wing bend (pale yellow in some) and are in fresh plumage when the adults are worn. Sierra Madre Sparrows were seen feeding on moths, flying ants, earthworms, caterpillars, grass seeds and sown oat seeds.

During 790 mist-net-hours, 53 adult and three juvenile *Xenospiza* were banded. Early in the fieldwork an additional six adults were banded at a locality 450 m to the west, two of which were later observed in the study plot. Thirteen nestlings were also banded.

Males were already singing territorially on 2 March (our first visit), but incubation patches were not noted before 29 April. In the study area, two other emberizids nest among the bunchgrass, Yellow-eyed Junco *Junco phaeonotus* and the Mexican endemic Striped Sparrow *Oriturus superciliosus*. Incubation patches were detected in these species on 10 and 11 April, at least 18 days earlier than in Sierra Madre Sparrow. The first sightings of Sierra Madre Sparrow carrying nest material were on 14–15 June, with one on the former date and three on the latter. The first sighting of food carrying was on 23 June and the first juvenile was observed on 7 July.

The territories of 19 males were mapped (Fig. 2). Most males had only one territory but one held two territories simultaneously, each with an active nest. No territorial males without colour bands were observed, suggesting that all those present in the study plot were captured. Males usually sing from tall grass stalks, rocks or in song flights, although they sometimes sing from the ground and one was observed vocalising atop an isolated pine tree c.13 m high. Individuals with territories near the edge of cultivated fields occasionally sang from the field (see Fig. 2). Because territories were entirely or mostly restricted to areas of bunchgrass, we con-

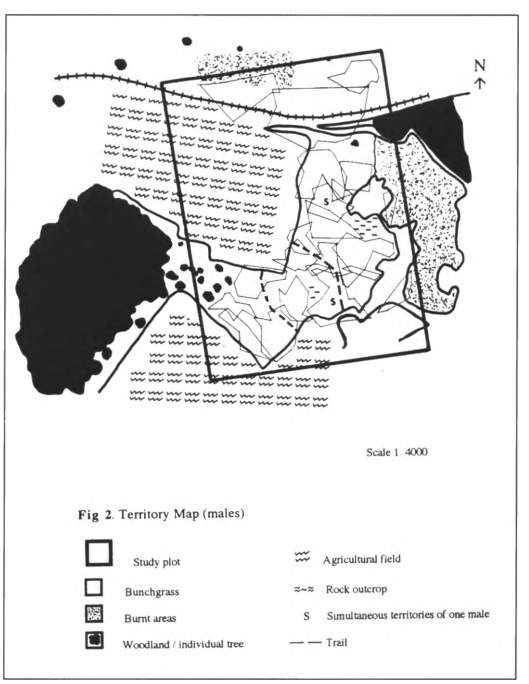

Figure 2. Study plot, showing the 20 territories of Sierra Madre Sparrow *Xenospiza baileyi*.

sider that the 22 territories occurred in 7.6 ha, yielding an estimate of 2.9 territories/ha.

Until the final day of mist-netting, unbanded adults were still being captured. Furthermore, two adults banded outside the study plot were subsequently observed within it. One sang in the same place on two consecutive days and was detected in other parts of the study plot, without singing, on six subsequent dates, and apparently failed to establish a territory at the study site. The other was noted in the study plot three times, always in different places and never singing. These observations suggest that there are a large number of individuals without territories (floaters) and/or that a large number of individuals, with territories elsewhere, occasionally entered the study plot.

Based on aerial photographs, the sum of the grassy areas at La Cima is 37 ha. On 4 May, 17.83 ha was burnt to produce new growth for livestock, reducing potential breeding habitat for Sierra Madre Sparrow at La Cima by 48%. If unburned, grassy areas at La Cima could support 97 territories, but due to the 1999 burning, only 50 were established, presumably because grass was too sparse in burnt areas. However, aerial photographs demonstrate that most of the study area had been burnt in 1997. Observations of territories and nests in these areas indicate that bunchgrass regenerates swiftly and can be used for breeding by Sierra Madre Sparrows within two years.

Eleven nests were located by observing adults carrying nest material or food, and three were discovered while walking, accidentally flushing the adult. Seven were found at the incubation stage and the other seven had chicks. The female alone is responsible for nest construction, which occupies 2–4 days. All nests had three eggs. Incubation occupied 15–16 days after the clutch was completed. Only the female incubated and brooded the nestlings, but both parents fed them. When bringing food, adults generally flew direct to the nest. However, in one pair the birds flew to a nearby spot and then walked 5–10 m to the nest. All flew directly away from the nest, usually making a soft, short twittering call. Nestlings left the nest 9–12 days after hatching.

Of those nests monitored, five (35.71%) were successful. One failed due to the female's death (see below), when only one of the three eggs had hatched. In another, one nestling disappeared and the other two died in the nest, perhaps also due to death of the female or abandonment. Another six failed due to chick predation, while only one failed due to egg predation. No case of predation was observed, but was inferred from eggs or chicks missing from nests. One failed nest was surrounded by trampled and torn grass, presumably the result of a dog *Canis familiaris* or coyote *C. latrans* predation, the only animals in the area large enough to cause such damage. Several likely predators were recorded: rattlesnakes *Sistrurus catenatus*, *Crotalus durissus* and *C. molussus*, a lizard *Barisia imbricata*, Sharp-shinned Hawk *Accipiter striatus*, Cooper's Hawk *A. cooperii*, American Kestrel *Falco sparverius*, Grey-breasted Jay *Aphelocoma ultramarina*, Steller's Jay *Cyanocitta stelleri*, cotton rat *Sigmodon leucotis*, rock squirrel *Spermophilus variegatus*, weasel *Mustela frenata*, striped skunk *Mephitis macroura*, and dogs belonging to shepherds. Some nests, nestlings and sitting females had Mallophaga lice, ticks (Dermanysidae, Mesostigmata) and flies (Hippoboscidae).

Autopsies were performed on two adult Sierra Madre Sparrows. One, foraging by a mist-net in an area where we had already captured and banded intensively, was flushed into the net. Upon handling, it was seen to be plumper than usual and weighed 14.5 g, 5% less than a healthy adult. Its belly skin was yellowish and appeared to be peeling and inflamed air sacs were visible on the belly and neck. It died in the hand. An autopsy revealed that it had a high degree of micotoxicosis and damage to several internal organs, including heart and liver. The second appeared normal on capture but also died in the hand. The autopsy again revealed a high degree of micotoxicosis and infection by mycoplasms, as well as damage to the heart and other organs.

Discussion

Nesting success of the Sierra Madre Sparrow at La Cima is low, but similar to other sparrows, e.g. Grasshopper Sparrows *Ammodramus savannarum* in Florida and Illinois[8]. Population density is higher than in some other grassland sparrows[7–9], and individuals feed both in grassy areas and cultivated fields. Therefore, the primary limiting factor is not demography, population density or food availability, but rather the small area of breeding habitat remaining in its former range. Further expansion of agricultural fields must be prevented. Only 37 ha of bunchgrass remain at La Cima, 18.5% of the habitat available before agriculture was practised. Many nearby areas, formerly covered by bunchgrass, have now totally or almost wholly been converted into agricultural fields.

The reason some grassy areas remain at La Cima probably relates to topography. Most remaining grassy areas are close to volcanic rock outcrops and/or on slopes difficult to operate a tractor on. However, rock extraction was observed in several parts of La Cima. This must be avoided; areas formerly protected by these outcrops from agricultural development could become accessible.

Shepherds who graze their sheep and cattle at La Cima request controlled burning of the grass by personnel from SEMARNAP (Mexican Ministry of the Environment). We have requested that SEMARNAP only burn below the canopy of trees (i.e. outside the meadows) because Sierra Madre

Sparrow does not nest in bunchgrass sheltered by tree canopies. The high quantities of micotoxins in the autopsied individuals suggest they had fed on contaminated grain. Oats planted at La Cima are used as forage for livestock and do not have the strict quality control of those used for human consumption. A workshop, teaching agriculturists how to store grain so that it does not become infected by micotoxins, is desirable. Genetic study of the remaining Sierra Madre Sparrow populations to evaluate their health is also needed. La Cima is unprotected, although the 'Corredor Chichinautzin —Zona de Protección para la Flora y Fauna' is only 10 km to the south. No bunchgrass meadows are contained within this protected area.

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