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RESEARCH

Development and introduction of detection dogs in surveying for scats of small Indian mongoose as invasive alien species

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Abstract The small Indian mongoose was introduced to the island of Okinawa in 1910 to control rats and snakes, however, it poses a threat to many endemic species in the Yambaru forest region in Okinawa Island. An important concern in eradication is that, as much as possible, capture should be carried out without affecting native species. To protect endemic species in the Yambaru region of Okinawa Island, we trained and used detection dogs to search for mongoose scats that indicated that mongoose were present in the area. We confirmed the ability of the dogs to detect scats in positive and negative control tests in the Yambaru forest region after basic, obedience, and mongoose-scat-detection specific training. In 30 trials, the dogs found 60 of 65 scats samples. For the trained alert, the dogs carried out 59 trained alerts for the 60 scats found. In the positive and negative control tests, the dogs showed no reaction to 129 of 130 negative controls. We then surveyed the forest in the Yambaru region for mongoose scats using the detection dogs. In this study, the detection dogs found 79 scats in a survey of a 69.0-km area. We divided the survey area into 43 grids and calculated the rate of detection in each grid. The rate of detection of scats was higher in the southern part of the Yambaru region. These result showed that our mongoose scat detection dogs can be useful tools to assist in determining the presence of mongoose in the Yambaru region of Okinawa Island.

Introduction

The small Indian mongoose (*Herpestes javanicus*; mongoose) is a small diurnal, insectivorous carnivore not reported to have a complex society (Hays and Conant, 2003). The length of head and body is from 509–671 mm and they have short legs (Nellis, 1989). Mongoose population densities and space use vary significantly in different locations (Quinn and Whisson, 2005) from 0.5/ha in Fiji (Gorman, 1979) to 24.7/ha in Hawaii (Seaman, 1952). Few investigations of the range occupied by mongoose have been conducted; one found ranges as small as 1.1 ha (Nellis and Everard, 1983), and the other reported ranges of >100 ha (Keith et al., 1986). Some studies of reproductive activity

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in the mongoose described it occurring from spring to summer in Hawaii (Pearson and Baldwin, 1953) and Fiji (Gorman, 1976). At birth the dorsal surface is covered with light-gray hair and weight is approximately 21 g (Nellis, 1989). Maturity is reached by 1 year of age (Nellis and Everard, 1983). Their life span, under captive zoo conditions, can reach 7 years of age (Flower, 1931). Mongooses have a pair of anal pockets (Pocock, 1916). The secretions from the pocket contain short-chain (C6), odorous carboxylic acids that are used in marking behaviors and give a distinctive odor to the animal (Gorman, 1976).

The mongoose originally extended throughout southern Asia from Iraq through India and Burma to southern China (Honacki et al., 1982), and was introduced to Okinawa Island, Japan in 1910 to control rats and snakes (Kishida, 1931). This species was also introduced in the West Indies (Espeut, 1882; Hoagland et al., 1989) and to the Hawaiian Islands (Baldwin et al., 1952), and Mauritius (Roy, 2002) to eradicate field mice. Mongooses feed on birds, lizards, insects, and other vertebrates in Puerto Rico (Vilella, 1998) and the Hawaiian Islands (Oliver and Baldwin, 1953). On Amami Island, Japan, where they were released in 1979, mongooses also prey on insects, mammals, birds, lizards, and frogs, but show no evidence of predation on snakes (Watari et al., 2008; Yamada et al., 2000). In the northern forest region of Okinawa Island (Yambaru region), many endemic species (e.g., Okinawa rail [*Rallus okinawae*], Okinawa spiny rat [*Tokudaia muenninki*], and Jambar long-armed beetle [*Cheirotonus jambar*]) are exposed to attacks by mongooses. In addition, some reports have suggested that the mongoose is an important reservoir and vector of leptospirosis, a disease that is transmissible to humans (Everard et al., 1976, 1979; Nellis and Everard, 1983). Consequently, it is necessary to eradicate mongooses to conserve the endemic species on Okinawa Island, especially in the Yambaru region.

On the other islands where they were introduced, mongooses have threatened native species and attempts have been made to eradicate these carnivores. Only on Fajou Island, in the West Indies, eradication was successful by trapping throughout the island (Lorvelec et al., 2004). However, Fajou Island is 1 km^2 in area whereas the Yambaru region is about 300 km^2; therefore, it is difficult to adopt the method applied on the island. In Hawaii, a study on chemically controlling mongooses was conducted (Smith et al., 2000), but this method is also difficult to apply in the Yambaru region because many endemic species and >10,000 people live in this area. Therefore, no model for mongoose eradication in this region has been developed to date. An important concern in eradication is that capture should be carried out without affecting native species. As the number of the target species decreases, the efficacy of capture generally decreases, which is also a big obstacle in eradication; hence, it is essential to increase the efficiency of capture. Additionally, no reports are available on the nesting pattern of this species of mongoose. It is also important to confirm whether these animals are still present at the end of the eradication project in the Yambaru region. We tested the use of a particular survey method in an attempt to show its potential effectiveness of detection for the scat of mongoose that will enable capture in the Yamburu region.

Some studies have suggested that researchers seeking to detect carnivores consider the use of dogs to detect scats of specific carnivores, especially when high detectability and minimal bias are priorities (Long et al. 2007a,b; Smith et al., 2003; Wasser et al., 2004). Dogs can be used as tools in the detection of a target because of their superior sense of smell.

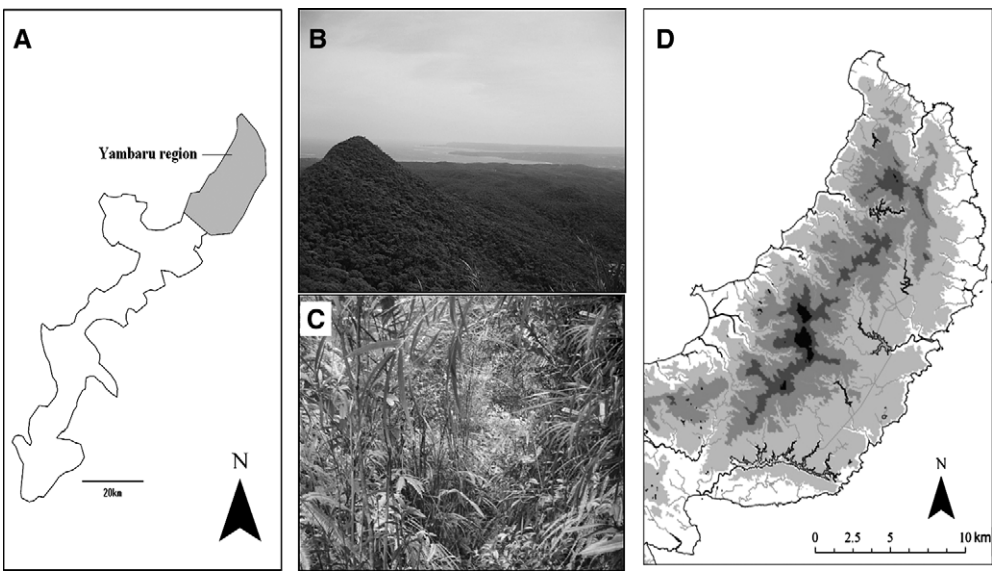

Figure 1 (*A*) Okinawa Island and the Yambaru region is shown. The Yambaru region is separated from other regions by a fence to prevent the invasion of mongooses from the southern region of Okinawa Island. (*B*) Landscape of a part of the Yambaru forest region. (*C*) A typical search route for mongoose scats. (*D*) Elevation above sea level in the Yambaru region: white, 0–100 m; light grey, 101–200 m; grey, 201–300 m; dark grey, 301–400 m; and black, >400 m.