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Survey of the Ectoparasites of the Invasive Small Indian Mongoose (*Herpestes auropunctatus* [Carnivora: Herpestidae]) on St. John, U.S. Virgin Islands

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ABSTRACT

In March 2012, live trapping surveys were conducted for invasive small Indian mongoose (*Herpestes auropunctatus*) on St. John, U.S. Virgin Islands. Forty mongoose were sampled (31♂, 9♀) for ectoparasites, and cat fleas (*Ctenocephalides felis*) were discovered on 17 individuals. There was no difference in the number of ectoparasites per mongoose across age classifications (r = 0.109, P = 0.579). However, males had more cat fleas than females, even when mass was taken into account (males are generally heavier). Future behavioral studies may explain these sex differences. Although management suggestions from this research are limited, these data contribute to an understanding of ectoparasite distributions on these invasive mongoose in the Caribbean.

INTRODUCTION

The small Indian mongoose (*Herpestes auropunctatus*) is a 120-1000-gram carnivore, feeding opportunistically on all major vertebrate groups, invertebrates, and occasionally, plants (Lewis et al. 2011). Although uncertainty exists about the extent of its geographic range, this mongoose is believed to be native to the Middle East, India, and Myanmar (Veron et al. 2007). The uncertainty lies in its confusion with a sympatric mongoose, the Javan or small Asian mongoose (*H. javanicus*), for which *H. auropunctatus* had been treated as a conspecific. Indeed, nearly all literature published prior to 2007 assumed that the mongoose released onto Hawaiian and Caribbean islands was *H. javanicus*. However, Veron et al. (2007) confirmed with mtDNA analyses that *H. auropunctatus* and *H. javanicus* were two distinct species, and Bennett et al. (2011), definitively determined through mtDNA barcoding that mongoose currently inhabiting Hawaiian and Caribbean islands were *H. auropunctatus*.

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The small Indian mongoose was originally introduced in the late 1800s (likely the 1870s) to control the invasive black rat (*Rattus rattus*) population on St. John, St. Croix, and other nearby Caribbean islands (Nellis and Everard 1983; Horst et al. 2001). The primary diet of mongoose in this region is not the black rat but instead includes native species on the U.S. Virgin Islands (USVI) such as eggs of the brown pelican (*Pelicanus occidentalis)* and the green sea turtle (*Chelonia mydas*; Seaman and Randall 1962), and, more commonly, lizards, amphibians, ground-nesting birds, and invertebrates (Nellis 1989; Lewis et al. 2011).

Besides hawks (on some islands), the small Indian mongoose has no other natural predators in the USVI, and wildlife managers lack the time, effort, and funds to eradicate the species from the islands (Nellis and Everard 1983). However, as a method of managing for rare breeding birds or reptiles, localized, seasonal removal efforts can be fairly successful. For example, Coblentz and Coblentz (1985) estimated 86% of the mongoose populations were removed in five nights of trapping a number of bays and trails on St. John. However, immigrants and young dispersing mongoose quickly take the place of those lethally removed (Coblentz and Coblentz 1985). If removal efforts only temporarily decrease the mongoose population, what else might negatively impact this invasive species? We suggested that if mongoose on St. John, USVI, carried a heavy parasite load, this could negatively impact the health of the mongoose. Rust and Dryden (1997) report that high flea loadings can cause skin irritation, skin allergies, and anemia in affected individuals.

Past studies of mongoose on St. Croix and Puerto Rico found them to be carriers of cat fleas (*Ctenocephalides felis)*, ticks (*Ornithodoros puertoricensis*), and mange mites (*Notoedres cati*; Pimentel 1955; Garrett and Haramota 1967; Webb 1980; Corn et al. 1994; Corn et al. 2009). Nellis (1989) states that cat fleas are the most common ectoparasites in the mongoose's introduced range, and suggests that these fleas were not present in their native habitat in the late 1800s. However, Baldwin et al. (1952) cite a 1934 Hawaiian public health survey, suggesting cat fleas were so common on mongoose on Hawaiian Islands, this animal must be a natural host. With so little natural history research completed on this mongoose in its native range (Horst et al. 2001), absolute confirmation of the cat flea in the native range is not possible. Further, it is clear that flea density varies among locations. Counter to the Hawaiian surveys, Pimentel (1955) found just a single cat flea on 1/210 individuals examined in Puerto Rico. To date, although reported studies of mongoose ectoparasites exist for St. Croix (Webb 1980; Nellis and Everard 1983), Puerto Rico (Pimentel 1955), and Hawaii (e.g., Haas 1966; Garrett and Haramota 1967), we find no published findings of ectoparasites on St. John, USVI, nor their potential negative impact on the mongoose on this island. Further, some studies collected ectoparasites from museum specimens (e.g., Garrett and Haramota 1967), and the authors' goal was to conclusively determine presence on live individuals.

MATERIALS AND METHODS

To determine the parasite loads of mongoose on St. John, USVI, the authors live-trapped individuals from 8-10 March 2012 using 45 Tomahawk #202 traps (Tomahawk

Live Trap, Hazelhurst, Wisconsin, USA). Hiking trails in early and late successional habitats were selected, and were restricted to the south-central portion of the island. Sites were at or within 2 km of the Virgin Island Environmental Resource Station (VIERS; UTM Zone 20, 2026684 N, 317964 E).

Forty mongoose were captured and combed: 31 males, aged 5.5 – 46 months (AVG. age = 21.4 ± 2.8 [SE]), and 9 females, aged 5.5 – 26 months (AVG. age = 14.3 ± 2.5) via tooth wear (Pearson and Baldwin 1953). Using a flea comb, mongoose fur was brushed for approximately one minute, and ectoparasites were collected. Results, therefore, do not assume that all ectoparasites were collected from each individual; instead, equal brushing effort allowed for a relative comparison among individuals in this study.

Collected ectoparasites were stored in 70% ethanol, and transferred back to Radford University for identification. Authors identified the contents of each vial using keys and data from past studies (Webb 1980) and flea guides (Ewing and Fox 1943; De Campos Pereira 2012).

This study was approved by the Radford University Institutional Animal Care and Use Committee, protocol #F12-03, and permitted by the National Park Service, VIIS-2012-SCI-0001. Arthropod voucher specimens are housed in the Radford University, Biology Department's Natural History Collection.

RESULTS

Ectoparasites were discovered on 62.5% of 40 captured individuals (22♂, 3♀), but authors were only able to capture and preserve the ectoparasites from 18 of these 25 individuals. Such ectoparasite escapes are not uncommon, given the difficulty in sampling live mongoose under sometimes intense field conditions (Haas 1966). Seventeen of the 18 individuals from which ectoparasites were successfully collected harbored cat fleas (*Ctenocephalides felis*). A single tick of the genus *Amblyomma* also was documented on the 18th individual; an incomplete specimen prevented identification to the species level. However, this tick genus was detected on mongoose by Nellis (1989) from the West Indies (specific island not reported) and by Corn et al. (1994; *Amblyomma variegatum*) in Antigua, West Indies.

When examining all 40 individuals for which ectoparasite relative counts (number of ectoparasites per 1 minute of brushing) were available, there was no difference in the number of fleas per mongoose across age classifications (Pearson's product-moment correlation; r = 0.109, P = 0.579; SAS Institute 2009). However, Student's t-tests revealed that males had significantly more parasites (AVG number of parasites for ♂: 1.7 ± 0.4 [SE]) than females (AVG number of parasites for ♀: 0.4 ± 0.2; t = 2.65, df =19, P = 0.016). Even when mass was taken into account (AVG mass for ♂: 596 ± 18 g [SE], AVG mass for ♀: 514 ± 18 g), this gender difference remained in place (Student's t-test; t = 2.07, df = 16, P = 0.027).

DISCUSSION

The discovery of the cat flea was not surprising, given its documentation in multiple locations by multiple sources (e.g., Baldwin et al. 1952; Seaman 1963; Haas 1966;

Webb 1980). However, few reported actual ectoparasite loads, only taxon lists of ectoparasites discovered. Seaman (1963, as reported in Nellis and Everard 1983; AVG = 8.6), Haas (1966; March AVG for ♂: 4.7, AVG for ♀: 1.0), and Webb (1980; AVG = 2.7 fleas per mongoose) found similar parasite loads and trends in male vs. female parasite loads. However, with some authors failing to report the methods of parasite sampling (Webb 1980) and others only cursorily describing methods (Haas 1966), direct comparisons of parasite loads across studies may be of little scientific value. Therefore, this study was limited to relative comparisons.

This study's finding that males typically had more parasites than females is in agreement with the findings from these other locales, and this supports their theory that behavioral differences between sexes may impact ectoparasite loads (Haas 1966; Webb 1980). Although Webb (1980) and Haas (1966) suggested that size differences between sexes is a primary reason for unequal parasite load, the statistics from this study suggest that males had greater parasite loads regardless of mass differences. Webb (1980) further suggested that, on St. Croix, this sex difference might be influenced by males' greater home range size and higher activity level than females, especially during the breeding season. The authors suggest that future studies of these mongoose examine which differences in behavior (e.g., territory size, microhabitat use, or grooming mechanisms) most influence the presence and density of these parasites.

Webb (1980) did find a difference in ectoparasite density in comparison to age (juvenile females tended to have more ectoparasites than adults). Although the current study did not find such patterns, it's possible that the sample size (just 3 females carrying parasites, 2 of them juveniles) may not have been representative. Further, Webb was unaware of the development of an aging method for mongoose, which was employed in the current study (Pearson and Baldwin 1953); instead, he used weight as a predictor of age.

Similar to findings in Hawaii (Haas 1966) and St. Croix (Webb 1980), it appears that mongoose parasite loads on St. John are insufficient to detrimentally affect this invasive species. Unlike Rust and Dryden (1997), no individual captured showed obvious symptoms of excessive flea loads (skin irritation, allergies, missing fur patches) which could have been associated with health issues in the mongoose. However, direct observations of mongoose in traps and in hand were limited to approximately five minutes per individual. Currently, this relationship between the small Indian mongoose and its ectoparasites does not affect management for this species. However, these data contribute to an understanding of ectoparasite loads and distributions in the Caribbean.

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LITERATURE CITED

Baldwin, P. H., C. W. Schwartz, and E. R. Schwartz. 1952. Life History and Economic Status of the Mongoose in Hawaii. Journal of Mammalogy 33(3):335-356.

Bennett, C. E., B. S. Wilson, R. DeSalle, 2011. DNA Barcoding of an Invasive Mammal Species, the Small Indian Mongoose (*Herpestes javanicus*; E. Geoffroy Saint-Hillaire 1818) in the Caribbean and Hawaiian Islands. Mitochondrial DNA 22(1-2):12-18.

Coblentz, B. E., and B. A. Coblentz. 1985. Control of the Indian Mongoose *Herpestes auropunctatus* on St. John, US Virgin Islands. Biological Conservation 33:281-288.

Corn, J. L., D. M. Kavanaugh, T. E. Creekmore, and J. L. Robinson. 1994. Wildlife as Hosts for Ticks (Acari) in Antigua, West Indies. Journal of Medical Entomology (31)1:57-61.

Corn, J. L., P. Berger, and J. W. Mertins. 2009. Surveys for Ectoparasites on Wildlife Associated with *Amblyomma variegatum* (Acari: Ixodidae)-Infested Livestock in St. Croix, U.S. Virgin Islands. Journal of Medical Entomology 46(6):1483-1489.

De Campos Pereira, M. 2012. The Veterinary Parasitology Images Gallery, Arthropoda: Insecta and Acari. Retrieved from http://www.icb.usp.br/~marcelcp/. Date accessed: 18 November 2012.

Ewing, H., and I. Fox. 1943. The Fleas of North America: Classification, Identification, and Geographic Distribution of These Injurious and Disease-Spreading Insects. U.S. Dept. of Agriculture, Miscellaneous Publication No. 500.

Garrett, L. E. and F. H. Haramota. 1967. A Catalog of Hawaiian Acarina. Proceedings of the Hawaiian Entomological Society 19:381-414.

Haas, G. E. 1966. Cat Flea-Mongoose Relationships in Hawaii. Journal of Medical Entomology 2(4):321-326.

Horst, G. R., D. B. Hoagland, and C. W. Kilpatrick. 2001. The Mongoose in the West Indies: The Biogeography and Population Biology of an Introduced Species. Pp. 409-424, in Biogeography of the West Indies: Patterns and Perspectives. C. A. Woods and F. E. Sergile (eds.), Second Edition. CRC Press, Boca Raton, FL.

Lewis, D. S., R. van Veen, and B. S. Wilson. 2011. Conservation Implications of Small Indian Mongoose (*Herpestes auropunctatus*) Predation in a Hotspot within a Hotspot: The Hellshire Hills, Jamaica. Biological Invasions 13(1):25-33.

Nellis, D. W. 1989. *Herpestes auropunctatus*. Mammalian Species 342:1-6.

Nellis, D. W. and C. O. R. Everard. 1983. The Biology of the Mongoose in the Caribbean. Studies of the Fauna of Curacao and Other Caribbean Islands 64:1-162.

Pearson, O. P. and P. H. Baldwin. 1953. Reproduction and Age Structure of a Mongoose Population in Hawaii. Journal of Mammalogy 34(4):436-447.

Pimentel, D. 1955. Biology of the Indian Mongoose in Puerto Rico. Journal of Mammalogy 36(1):62-68.

Rust, M. K., and M. W. Dryden. 1997. The Biology, Ecology, and Management of the Cat Flea. Annual Review of Entomology 42(1):451-473.

SAS Institute. 2009. SAS 9.2 User's Guide, 2nd Edition. Retrieved from Accessed https://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#titlepage.htm. Date accessed: 29 April 2014.

Seaman, G. A. 1963. Quarterly Progress Report, Wildlife Resources Survey of the Virgin Islands. March. P-R Project V-4-R-13. Unpublished document prepared for U.S. Fish and Wildlife Service.

Seaman, G. A., and Randall, J. E. 1962. The Mongoose as a Predator in the Virgin Islands. Journal of Mammalogy 43(4):544-546.

Veron, G., Patou, M. L., Pothet, G., Simberloff, D., and A. P., Jennings. 2007. Systematic Status and Biogeography of the Javan and Small Indian Mongooses (Herpestidae, Carnivora). Zoologica Scripta 36(1): 1-10.

Webb, J. W. 1980. Parasites of Small Indian Mongoose on St. Croix, Virgin Islands. The Journal of Parasitology 66(1):176-178.