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Wilson Bull., 104(2), 1992, pp. 342–345

The effectiveness of Helmeted Guineafowl in the control of the deer tick, the vector of Lyme disease.—Lyme disease, a parasitic infection of increasing concern in the United States, is caused by a spirochete (*Borrelia burgdorferi*) spread by the deer tick (*Ixodes dammini,* Acarina, Ixodidae; Lane et al. 1991). A variety of measures for controlling the deer tick has been suggested, such as pesticides, burning, host eradication, or removal (Mather et al. 1987, Schulze et al. 1987, Wilson et al. 1988), but no single method has been demonstrated to be effective over a wide variety of habitats. Use of certain pesticides (Stone 1979) and host eradication, especially of the white-tailed deer (*Odocoileus virginianus,* Wilson et al. 1988), are not practical near areas of heavy human use such as playgrounds, school yards, and suburban housing developments.

The Helmeted Guineafowl (*Numida meleagris*) has been used as a "folk" defense against ticks acting as vectors for Lyme disease on Shelter Island, New York, and on the islands of Martha's Vineyard and Nantucket, Massachusetts. In Africa, this species eats a wide variety of arthropods (Skead 1962, Angus and Wilson 1964, Grafton 1971, Mentis et al. 1975) and gleans ticks from warthogs (*Phacochoerus aethiopicus;* Maclean 1984). In the United States, Crowe (unpubl. data) found ticks in the stomachs of three Helmeted Guineafowl in Nantucket.

Accordingly, we tested whether guineafowl might be useful in reducing tick populations in a series of controlled exclosure and enclosure experiments during September–November 1990 when adult deer ticks quest for large mammalian hosts (Daniels et al. 1989). Our experiments were performed at suburban sites in Easthampton, Suffolk County, New York, where free-ranging guineafowl had been introduced one year earlier to control high tick numbers, and in Islip, Suffolk County, New York, where guineafowl had not been present for ten years and tick populations previously seemed elevated (C. D. Webster, pers. comm.).

Although the deer tick is commonest in woodland (Maupin et al. 1991), we chose lawns because most human activity occurs on lawns and because people on lawns appear less likely to take precautions against ticks than when entering habitats such as woodlands (D. Duffy, pers. obs.). Lawns are also structurally more homogenous than woodland or hedgerow, allowing a greater similarity of controls and cages. Finally, lawns appeared to be more or less uniformly used by foraging guineafowl, while our initial observations indicated greater small-scale variability in use of brush and woodland.

We placed ten exclosure cages at the Easthampton site at intervals of approximately 20 m along the edges of a 3.7 ha mowed meadow surrounded by hedgerow. Each exclosure was made of 10 cm mesh and was 1-m^3, with a mesh roof. A flock of 25–30 guineafowl fed freely over the meadow. To sample presence and numbers of ticks, we conducted one-min repeated drags of a 30 × 60 cm cloth over the ground within each exclosure at approximately one-week intervals from 15 October to 21 November 1990. Control samples were obtained in the same manner on the lawn immediately adjacent to each cage. Any ticks found were returned to the area sampled. We avoided sampling during rainy weather, on days following rain, or when ambient temperatures were below 10°C.

The Islip experimental landscape was lawn intermixed with second-growth woodland and unmaintained horticultural plantings. The enclosures were also placed on the edge of lawn immediately adjacent to denser vegetation around trees or shrubs. Four guineafowl were introduced into 2 × 2 m mesh cages on nine days between 22 October and 5 November 1990 (22, 24, 25, 31 October and 1–5 November). Cages were moved every day and birds were not put out during inclement weather or when the temperature was forecast to remain below 10°C. After removing the birds, we made three sequential one-minute sweeps using a 30 × 60 cm terry cloth on a one-m rope within each enclosure and then repeated the same procedure for two separate 2 × 2 m control patches immediately outside each enclosure, in the same habitat.

Following each one-min sweep, we recorded the presence and number of ticks and other arthropods on the drag. For analysis, we used the combined totals of the three counts for comparisons of frequency of occurrence between controls and experimental areas. In as much as we expected tick occurrence to be reduced in the presence of guineafowl, our tests were one-tailed (Sokal and Rohlf 1981).

The results of the exclosure experiment indicated a significantly higher probability of finding deer ticks within exclosures than outside ($G = 6.74$; $P = 0.01$). Ticks were present in eight of 50 samples of ten exclosures (7 samples had single ticks, 1 sample had 2) and in one of 50 controls. Similarly, the enclosure of guineafowl resulted in a reduced probability of encountering ticks within the four-m^2 cages, although the difference was not significant (Fisher Exact Probability Test, $P = 0.07$; no ticks were found in nine enclosures, while single ticks occurred in five of 18 outside controls). If the probabilities of the tests for enclosures and exclosures are combined as a test that the pattern of results could be due to chance alone (Sokal and Rohlf 1981), the resulting value ($-2\ \Sigma \ln P = 14.8$) is greater than the χ^2 value of 13.82 at $P = 0.001$, suggesting a highly significant difference in tick presence in response to guineafowl activity.

At the Islip site, guineafowl also substantially reduced the occurrence of leaphoppers (Fisher Exact Probability Test, $P = 0.0195$; leafhoppers were present in three of nine enclosures and in 14 of 18 controls) and beetles in enclosures (Fisher Exact Probability Test, $P = 0.021$; beetles were present in one of nine enclosures and in 10 of 18 controls).

Our experiments suggest that predation by guineafowl reduced numbers of adult deer ticks on lawns adjacent to dense foliage at two sites on Long Island. Adult deer ticks have a 50–100% probability of being infected with the Lyme disease spirochete (Lane et al. 1991), so the presence of free-ranging guineafowl may help reduce the probability of contracting Lyme Disease from adult ticks on lawns and lawn edges. In addition, guineafowl reduced the presence of other arthropods, suggesting they may help reduce the need for chemical insecticides.

Our experiments tested only whether guineafowl could reduce adult tick populations. It did not measure the density of birds needed for effective control of ticks. Other aspects also need to be investigated. For example, nymphal deer ticks present the greatest risk of transmitting Lyme disease to humans (Piesman et al. 1987), but they are smaller than adults and may not be captured as easily by guineafowl. Most deer ticks are found in woods or at the edges of woods (Maupin et al. 1991), habitats used by foraging guineafowl to a lesser extent than lawns (D. Duffy, pers. obs.). Are guineafowl effective predators of ticks in less open habitats?

Guineafowl are inexpensive compared to many pesticide treatments and present less potential for direct environmental damage. On the other hand, guineafowl have several drawbacks that may make them unsuitable in some situations. They are noisy and may be objectionable to human neighbors. Their droppings, while serving as a fertilizer, may be unpleasant if the lawn is used for human recreation. On the other hand, the droppings may discourage some human behaviors, such as sitting on the ground, that increase the risk of contracting Lyme Disease. Finally, the birds are sometimes vulnerable to predation by feral or free-ranging dogs (C. Brinkley, pers. obs.), so that a fenced yard may be needed to reduce flock mortality.

Guineafowl may be most appropriate as one means of controlling ticks in low-density housing areas and in public parks and school yards where their noise is unlikely to be a problem and where custodial care is available for the flock. Guineafowl alone should not be relied on for the complete control of deer ticks, but rather should be used as one of a suite of methods such as tick repellents, judicious use of acaricides, and habitat modification to reduce the risk of Lyme disease.

Acknowledgments.—We thank B. Joel and C. D. Webster for permission to conduct experiments on their land, Congressman G. Hochbrueckner and K. Bryant for their encouragement, L. Baylinson for assistance with logistics, T. M. Crowe for his personal observations and help with the literature, and H. Kale and D. Klem, Jr. for serving as referees. Funding for this study was provided by the Seatuck Foundation, Inc.

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Wilson Bull., 104(2), 1992, pp. 345–352

Song repertoires of the White-browed Blackbird.—The vocal behavior of the White-browed Blackbird (*Leistes superciliaris*), a locally common species in grassland and pastures of Argentina, Uruguay, Paraguay, Bolivia, southeastern Brazil, and Peru has been studied poorly. The taxonomic status of *L. superciliaris* is uncertain, as the bird appears to form a superspecies with the Red-breasted Blackbird (*L. militaris*; Short 1975). The latter replaces *L. superciliaris* northward, and they occupy open areas in the Amazon river region from Peru to the state of Para in northern Brazil (Meyer de Schauensee 1982). Like most other species in this genus, *L. superciliaris* is generally terrestrial, gregarious during the nonbreeding season, and sexually dimorphic in coloration. In the Argentine pampas, the breeding season lasts from September to February, and it is during this period that males sing. Here, I describe in detail the flight song (FS) and the perched song (PS) of *L. superciliaris* in the Argentine pampas. Also, I present evidence on the sharing of FS features among neighboring males.

Methods.—From September to December 1989, songs from 23 adults of *L. superciliaris* were recorded at the University of Luján Campus, Partido of Luján, northeast Buenos Aires Province, Argentina. Eight other neighboring males were recorded on 12 October 1990. Luján Campus is a typical agro-ecosystem with a dominant open herbaceous vegetation and several scattered introduced tree species (e.g., *Eucalyptus* sp.). Although birds were not banded, the chance of recording the same subject twice in the same day was negligible because simultaneous observation of several territorial neighbor males was possible. In addition, to avoid including the effect of possible song variation during the study period, I restricted the analysis of syllable sharing to those small neighborhoods where all males were recorded on the same day.

Recordings were made with a Uher 4000 Report-L at a speed of 9.5 cm/sec, using a directional hypercardioid Lec 970 LEEA microphone. Only best quality recordings were sonographed (total = 196 songs, ranging from 1 to 16 songs/individual) using a Kay Electric