tebrates, and fruit (Orejuela 1980, Remsen et al. 1993). The Rufous Motmot consumes arthropods, other invertebrates including crabs, small vertebrates including fish, lizards and birds, as well as fruit (Remsen et al. 1993). Frogs have been reported as a dietary component of the Rufous, Broad-billed (*Electron platyrhynchum*) and Torquoise-browed motmots (Remsen et al. 1993), and Blue-crowned Motmots in captivity (C. Rowsom, pers. comm.).

The effect of poison dart frog toxins on various potential predators has received relatively little attention. Brodie and Tumbarello (1977) tested the response of garter snakes (*Thamnophis sirtalis*) to *D. auratus* offered as prey. Snakes readily mouthed, or in some cases consumed the frogs but all exhibited head shaking, mouth opening, convulsions, and loss of equilibrium. Only one snake actually died and that was after consuming its third frog. These snakes do not possess color vision and might not be influenced by the aposematic coloration to the extent that an organism with color vision would be (Brodie and Tumbarello 1977).

While motmots in general may be warned by aposematic coloration, the Rufous Motmot at least is capable of handling and consuming this particular species of poison dart frog. *Dendrobates auratus* reaches densities of 1 individual/180 m^2 in one locality at La Suerte known to be frequented by Rufous Motmots (B. Graves, pers. comm.) One pair was observed on the ground rummaging through leaf litter where they would undoubtedly encounter *D. auratus* (B. Graves, pers. comm.). The level of toxins in the frogs of this area, how the motmots physiologically handle the toxins, and the frequency with which they consume *D. auratus* remain unknown.

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Evidence Of Egg Ejection In Mountain Bluebirds

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ABSTRACT.—When the last two eggs of Mountain Bluebird (*Sialia currucoides*) clutches were replaced with another bluebird egg and one House Sparrow (*Passer domesticus*) egg, 20% (3/15) of the sparrow eggs were removed within 24 hr. None of the surrogate bluebird eggs was removed. This is the first recorded instance of interspecific egg ejection in a bluebird species, and hole-nesters in general. *Received 2 Nov. 1998, accepted 18 Feb. 1999.*

Of the approximately 140 biological hosts of the Brown-headed Cowbird (*Molothrus ater*), fewer than 7% have been classified as rejectors (Friedmann and Kiff 1985, Ortega 1998). Rejectors typically remove cowbird eggs from the nest within 24 hr of introduction (Rothstein 1982). Ejection is accomplished either by grasping the cowbird egg between the mandibles or by puncturing the egg with the beak and then lifting the egg out of the nest (Sealy 1996). Acceptors, by contrast, do not remove cowbird eggs and in most cases provision the cowbird nestling(s) (see Petit 1991, Sealy 1996).

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Unlike the Shiny Cowbird (*M. bonarensis*), the Brown-headed Cowbird infrequently parasitizes hole-nesters (Ortega 1998; but see Petit 1991). Bluebirds (*Sialia* spp.) are parasitized infrequently by Brown-headed Cowbirds (Friedmann and Kiff 1985). Cowbird eggs have been found in 0.2–2.6% of Eastern Bluebird (*S. sialia*) nests, but there are only 4 records of parasitism on Mountain Bluebirds (*S. currucoides*) and none for the Western Bluebird (*S. mexicanus*; Friedmann and Kiff 1985). These low frequencies of parasitism may be due to aggression by adult bluebirds towards female cowbirds (Gowaty and Wagner 1988). Furthermore, the cowbird parasitizes smaller hosts than itself (Friedmann et al. 1977), thus female cowbirds may be too large to squeeze through bluebird cavity entrances (Friedmann et al. 1977, Pribil and Picman 1997).

Given such low frequencies of parasitism by Brown-headed Cowbirds on hole-nesters in general (Friedmann and Kiff 1985), apparently there has been little selection pressure favoring the evolution of rejection behavior (Davies and Brooke 1989). In fact, there is only one published record of interspecific egg ejection in hole nesting species (Moksnes et al. 1990). Here I present data that indicate that Mountain Bluebirds apparently cannot distinguish between conspecific eggs, whereas they can recognize interspecific eggs as different from their own, and that these eggs are sometimes removed from the nest.

METHODS

I collected the data between May and July, in 1995 and 1996, on a population of Mountain Bluebirds nesting in boxes near Virden, Manitoba (49° 51′ N, 100° 55′ W). Nest-boxes were visited every 2–3 days during nest-building and daily during laying. Eggs were measured and weighed within 24 hr of laying, and numbered on the blunt end using a non-toxic felt marker. Once the clutch was complete, the penultimate and ultimate eggs were removed for 24 and 48 hr, respectively. To minimize the risk of abandonment, some of these clutches received one bluebird egg from failed clutches and one House Sparrow (*Passer domesticus*) egg. The presence or absence of these replacement eggs was then recorded 24 and 48 hours later when the original eggs were returned to their clutches.

Because House Sparrow eggs are very similar to Brown-headed Cowbird eggs (see Lowther 1993, Lowther and Cink 1992), I expected bluebirds to respond to a sparrow egg the same way they would respond to a cowbird egg (see also Rothstein 1977).

RESULTS

Fifteen nests received a bluebird egg and a sparrow egg, and none of these nests was abandoned. None of the replacement bluebird eggs was removed from the nest within 48 hr. By contrast, 3/15 (20%) of the sparrow eggs were removed from the nest, all within 24 hr of introduction. In 2 of the 3 ejections, the sparrow egg was removed from the nest-box, whereas in the third instance the undamaged egg ended up on the rim of the nest. For both years combined, 12 bluebird eggs were known to have been cracked or dented during measuring. Of these, one was found on the rim of the nest cup the following day, 7 were gone the following day, and 4 remained in the nest.

DISCUSSION

The results of this study indicate that Mountain Bluebirds are capable of egg ejection. Mountain Bluebirds possess several traits that Rothstein (1975) identified as pre-adaptations for the evolution of ejection behavior. For instance, Rothstein (1975) suggested that the evolution of ejection behavior would be facilitated if the hosts' eggs differed from those of the cowbird in at least two respects: base color, maculation, and size. Mountain Bluebird eggs differ from sparrow and cowbird eggs in color and maculation (see Lowther 1993, Lowther and Cink 1992, Power and Lombardo 1996). Mountain Bluebirds can remove their damaged eggs from the nest; their eggs are similar in size to those of the cowbird. Thus it can be assumed that bluebirds would be capable of removing cowbird eggs from their nests.

Given that Mountain Bluebirds are sympatric with Brown-headed Cowbirds (see Lowther 1993, Power and Lombardo 1996), and that their eggs are sufficiently different to facilitate recognition and ejection of a cowbird egg, a rejection rate of only 20% would appear to be low. However, the low rate of ejection I observed is likely an underestimate of the frequency of ejection behavior in Mountain Bluebirds. For example, Rothstein (1982) observed that American Robins (*Turdus migratorius*) are less likely to eject cowbird eggs that are introduced into the nest after laying. As I introduced sparrow eggs at clutch completion, it is thus possible that bluebirds were less likely to eject them. Furthermore, the ejected sparrow eggs were removed within 24 hr of placement in bluebird nests. Such a quick response is typical of most rejector species (Sealy 1996) and suggests at least a moderate level of intolerance (sensu Rothstein 1982) to cowbird parasitism in Mountain Bluebirds.

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