

NOTE

Alcedoffula alcyonae Carriker (Phthiraptera: Ischnocera: Philopteridae) infesting belted kingfisher, *Megaceryle alcyon* (Linnaeus) (Aves: Coraciiformes, Alcedinidae), in Manitoba, Canada

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Abstract

Forty-one belted kingfishers, *Megaceryle alcyon* (Linnaeus) (Aves: Coraciiformes: Alcedinidae), from Manitoba, Canada were examined for ectoparasites in 1995–2020. One species of chewing louse, *Alcedoffula alcyonae* Carriker (Phthiraptera: Ischnocera: Philopteridae), infested 48.8% of hosts. The mean intensity of infestation was 17.1, and mean abundance was 8.5 lice per bird. Distribution of infestation was highly aggregated. Although female lice outnumbered males, the sex ratio was not significantly different from 1.0. The ratio of nymphs to females was 2.6. An unidentified species of feather mite of the genus *Proterothrix* Gaud (Acari: Astigmatina: Proctophylloida) infested three of 35 hosts (8.6%). No mites were found in the quills of primary feathers from 19 birds, and no nasal mites were collected from 32.

The belted kingfisher, *Megaceryle alcyon* (Linnaeus) (Coraciiformes: Alcedinidae), is distributed widely in North America and is the only coraciiform bird in Canada (Kelly *et al.* 2009). It is one of about 117 species of kingfishers worldwide (Catanache *et al.* 2019) and a member of the least diverse subfamily, Cerylinae (Moyle 2006). It breeds throughout the forested regions of Canada, including Manitoba, especially along waterways and lakes where food (fish, crayfish, invertebrates) is abundant and where there are suitable banks in which to excavate burrows for nesting (Godfrey 1986). Belted kingfishers are not particularly common in Manitoba (Holland and Taylor 2003), but many people might recognise their familiar call and perhaps even recall their appearance on the Canadian five-dollar bill in the Birds of Canada Series that ran from 1986 to 2002.

A number of studies have investigated internal parasites of belted kingfishers (*e.g.*, Zelif 1941; Preble and Harwood 1944; Anderson 1959; Boyd 1966; Boyd and Fry 1971; Scott 1984; Muzzall *et al.* 2011; Bronson *et al.* 2014), but records for ectoparasites are largely taxonomic or anecdotal and generally lacking in significant ecological context (*e.g.*, Peters 1936; Stirrett 1952; Judd 1953; Whitehead 1954; Carriker 1959; Keirans 1967; Boyd and Fry 1971; Emerson 1972; Pence and Gray 1996; Galloway *et al.* 2014). As part of a long-term study on ectoparasites infesting wildlife in Manitoba, an opportunity arose to examine a sample of 41 belted kingfishers. The objectives are to provide an assessment of infestation parameters for the one species of chewing louse that infests kingfishers in the province, *Alcedoffula alcyonae* Carriker (Phthiraptera: Ischnocera: Philopteridae), and to determine other ectosymbionts infesting this host.

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Kingfishers were obtained from wildlife hospitals (Wildlife Haven, Île-des-Chênes, and Prairie Wildlife Rehabilitation Centre, Winnipeg and St. Adolphe, Manitoba, Canada), from Manitoba Sustainable Development, and from Oak Hammock Marsh Interpretive Centre (near Stonewall, Manitoba). All birds had been euthanised or died from their injuries and were frozen individually in plastic bags for at least 48 hours to kill all ectoparasites. Birds were lightly thawed and then washed twice in warm, soapy water, then once in warm water to collect lice as described by Mironov and Galloway (2002). This method removes virtually all the chewing lice, except most of the eggs (Clayton and Drown 2001; Galloway, personal observation). Lice were collected onto a 90- μ screen and then preserved in 70% or 95% ethanol. Specimens were sorted using a stereomicroscope, counted, and enumerated according to sex and stage of development (adult versus nymph). Representative specimens were prepared onto microscope slides as per Richards (1964). Vouchers were deposited in the J.B. Wallis/R.E. Roughley Museum of Entomology (Department of Entomology, University of Manitoba, Winnipeg, Manitoba). After birds had been washed, the nasal passages were flushed through each nostril and out through the mouth with a solution of warm soapy water, using a 12-mL Monojet® 412 curved-tip plastic orthodontic syringe to collect nasal mites. Primary and secondary feathers were removed from the wings of 19 birds and were examined under a stereomicroscope for quill mites.

The following infestation parameters were calculated using Quantitative Parasitology (QPweb, Version 1.0.14; Reiczigel *et al.* 2019): prevalence (proportion of birds infested; Sterne's method for 95% confidence limits), mean intensity, and mean abundance (mean number per infested bird and mean number per sampled bird, respectively; Bootstrap BCa with 2000 bootstrap replications for 95% confidence limits for both). Measures of aggregation of infestation, including the variance–mean ratio, Poulin's Index of Discrepancy (D ; Poulin 1993), and the negative binomial exponent, k , were also calculated using QPweb.

From 1995 to 2020, 41 birds were examined, 27 of which were from Winnipeg. Two birds came from each of Gimli and Selkirk, and one bird came from each of Falcon Beach, Glenlea, Minnedosa, Spruce Siding, and Whiteshell. Five birds came from unknown locations in Manitoba. At least one to four kingfishers were obtained in every year of the survey, except 1997, 2007 and 2019, when none was examined. Kingfishers in Manitoba are migratory, and birds were examined during all months they are typically present in Manitoba, with the number of birds examined in each month as follows: May – 2; June – 2; July – 6; August – 7; September – 17; October – 4. No dates of collection were available for three birds.

The only chewing louse species found to be infesting belted kingfishers was *A. alcyonae*. It was found on 20 of the 41 birds examined, or 48.8% (95% confidence interval = 34.0–64.1) of the birds. Of the 342 lice collected, 59 were males, 80 were females, and 203 were nymphs (with a ratio of 2.6 nymphs to each female). Although females outnumbered males, the sex ratio was not significantly different from 1.0 ($\chi^2 = 3.173$, $P = 0.08$, $df = 1$). The number of lice on each infested bird ranged from 1 to 70. Mean intensity of infestation was 17.1 (95% confidence interval = 10.40–29.10), and mean abundance was 8.3 (95% confidence interval = 4.46–15.10). Distribution of infestation was highly aggregated: variance/mean = 30.7, $D = 0.763$ (95% confidence interval = 0.690–0.849), $k = 0.184$ (not significantly different from k for negative binomial, $P = 0.654$, based on χ^2).

No nasal mites were collected from any of 32 birds examined in this study (Knee and Galloway 2017). The only feather mite collected was an undescribed species of *Proterothrix* (Acari: Astigmatina: Proctophylloidae) (Galloway *et al.* 2014), which infested three of 35 birds (8.6%). No quill mites were found in the primary feathers removed from 19 birds.

Alcedoffula Clay & Meinertzhagen is a relatively small genus of chewing lice that includes 19 described species, all of which are specific ectoparasites of kingfishers (Price *et al.* 2003). To the author's knowledge, the present study is the first quantitative analysis of chewing lice infesting belted kingfishers. There are studies in which small numbers of other species of kingfishers have been examined for chewing lice. For example, Roda and Isidro de Farias (1999) reported one louse,

a *Quadriceps* Clay & Meinertzhagen sp. (Phthiraptera: Ischnocera: Philopteridae), from one green kingfisher, *Chloroceryle americana* Kaup, in Brazil, but lice in this genus typically infest charadriiform birds (this specimen is likely a straggler or a contaminant). Clayton *et al.* (1992) examined one each of two *Chloroceryle* species of kingfishers from Peru, Amazon kingfisher (*C. amazona* (Latham)) and green kingfisher, the former of which was infested by four females of an *Alcedoffula* sp. Gustafsson *et al.* (2019) examined one specimen of black-capped kingfisher, *Halcyon pileata* (Boddaert) from China, but found no lice. Najer *et al.* (2014) collected five specimens of *Alcedoecus annulatus* Ansari (Phthiraptera: Ischnocera: Philopteridae) from one of three white-throated kingfishers, *Halcyon smyrnensis* (Linnaeus), in southern Vietnam. When Saxena *et al.* (2007) examined 30 white-throated kingfishers in India, they recorded 40% to be infested with a species of *Meropoecus* Eichler (Phthiraptera: Ischnocera: Philopteridae), a genus typically infesting bee-eaters, *Merops* Linnaeus spp. (Coraciiformes: Meropidae). This genus of louse has not otherwise been recorded from this host (Price *et al.* 2003; perhaps a misidentification). Saxena *et al.* (2007) reported a mean intensity of 17.75, similar to infestation parameters in the present study. Intensity of infestation reported in the present study is higher than in either Roda and Isidro Farias (1999) or Najer *et al.* (2014), perhaps because numbers of host specimens examined in their studies are very small, but differences in efficiency of collecting methods may have also contributed to the differences found in infestation intensity.

No conclusions about seasonal patterns in infestation can be reached because of the small numbers of kingfishers obtained for study in each month. Greatest numbers were available for study in August and September (65.7% of birds for which collection dates were available), likely because of the greater proportion of migrating juveniles in the population. No attempt was made to age birds in this study.

Because the belted kingfisher is widely distributed in North America and is closely associated with aquatic systems (Baron *et al.* 1997), it has become an important indicator for environmental contaminants, including heavy metals, PCBs, and pesticides, acquired through its predominately piscivorous feeding habits (Moore *et al.* 1999; Blocksom *et al.* 2010; Flanagan Pritz *et al.* 2014; Jackson *et al.* 2016). This species seems to be less affected than other piscivorous species of birds by some contaminants in aquatic systems because of the small size of their prey (Jackson *et al.* 2016). Human activities that affect water quality and food availability, cover, and nesting habitat can impact populations of belted kingfisher (Kelly *et al.* 2009). The conservation status of belted kingfisher at this time is of Least Concern (BirdLife International 2016), but any major decline in belted kingfisher populations in the future may also affect populations of the monoxenic chewing louse, *A. alcyonae*.

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