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SCIENTIFIC NOTE

Temporal variation of adult sex ratio in the whirligig beetle *Dineutus nigrior* Roberts (Coleoptera: Gyrinidae)

An adult sex ratio (ASR) of 1 : 1 is generally predicted (Fisher 1930) but deviation from that ratio can occur in a range of taxa including insects (Wrensch and Ebbert 1993) (for beetles see for example Kirkendall 1993; Majerus and Majerus 2000; James *et al.* 2002). Skewed ASR can be due to a skewed sex ratio at birth/hatching for example due to male-killing or feminizing endosymbionts, meiotic drive, or adaptive sex allocation (Hardy 2002; Wrensch and Ebbert 1993). It could also result from a variety of factors after birth/hatching such as sex difference in age of maturation (Muralimohan and Srinivasa 2008), mortality (Donald 2007), or dispersal (Dale 2001). Temporal variation in ASR in a population can occur (Pettersson 2004). Adult sex ratio can influence several important ecological and evolutionary factors including population growth rate (Johnson 1994), effective population size (Hedrick 2000), and sexual selection pressures (Kvarnemo and Ahnesjö 1996).

Adult sex ratio has only rarely been quantified for whirligig beetle (Coleoptera: Gyrinidae) populations (see Fitzgerald 1987; Svensson 1998) and to our knowledge temporal variation in ASR in this taxon has not been addressed. Collections of the whirligig beetle *Dineutus nigrior* Roberts, 1895 from Swan Lake near Sudbury, Ontario, Canada (see Fairn *et al.* 2007 for lake characteristics) suggested a strongly female-biased ASR (~6 : 1) in spring and summer of 2004 and 2005 (Y. Alarie pers. obs.) although this was not empirically

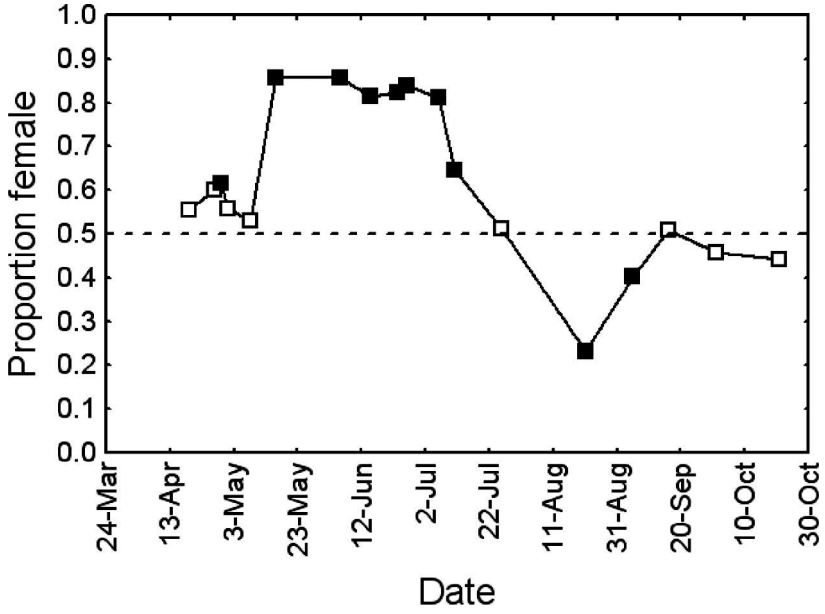

Fig. 1. Proportion of *Dineutus nigrior* specimens from Swan Lake that were females. April 19 (n = 36), April 27 (n = 20), April 29 (n = 115), May 1 (n = 111), May 8 (n = 301), May 16 (n = 98), June 5 (n = 84), June 16 (n = 139), June 23 (n = 85), June 26 (n = 196), July 7 (n = 84), July 11 (n = 79), July 25 (n = 84), August 21 (n = 95), September 4 (n = 159), September 16 (n = 61), October 1 (n = 48), October 21 (n = 43). Solid squares indicate significant difference from 1 : 1 ASR (Chi-square test, $P \leq 0.014$), open squares indicate no significant difference from 1 : 1 ASR.

verified. This is opposed to the approximately 1 : 1 ASR in a different population (Fitzgerald 1987).

In the present study we quantified ASR in the Swan Lake population of *D. nigrior* from April to October, 2006 to test the hypothesis that the population exhibits a female-biased ASR, and to determine if ASR changes over the active season. Eighteen samples of adult *D. nigrior* were collected using large nets to opportunistically sample beetles that were observed swimming on the water surface. The sex of each specimen was determined based on sex differences in protarsal morphology (Fairn *et al.* 2007).

When all specimens collected over the sampling period (n = 1,838) were considered, 62.7% were females and the ASR was significantly different from 1 : 1 (Chi-square = 118.15, $P < 0.001$). In early spring there was a small, generally non-significant, female bias. A strong female-bias similar to the one observed in 2004 and 2005 was evident in early to mid May and remained until early July. The proportion of specimens that were females began to decline in early July until a strong male-biased ASR became evident in late August. The ASR was not significantly different from 1 : 1 in the last three samples of the season (Fig. 1). Future work should endeavor to determine both the causes and consequences of ASR variation in this population. Temporal patterns in ASR should also be quantified in multiple populations of this species from a variety of environments over several years to allow the elucidation of broad patterns of ASR in the species.

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