LONGEVITIES OF Diamesa mendotae MUTTKOWSKI, A HIBERNAL EMERGING SPECIES OF CHIRONOMIDAE

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INTRODUCTION

Species of the Subfamily Diamesinae are among the most cold-adapted Chironomidae in the Holarctic Region (Ferrington, 2000; Hansen & Cook, 1976; Hågvar & Østbye, 1973). Adults of Diamesa mendotae Muttkowski (Diptera: Chironomidae) commonly emerge during winter from groundwater-dominated streams in Minnesota and are non-feeding. Adults are active on snow, mate and fly at ambient air temperatures below 0ºC. Adults have the capacity to suppress their freezing point to less than -20°C (Carrillo et al., in preparation) indicating significant physiological mechanisms to prevent freezing. Another species of Diamesa from a Himalayan glacier is also very cold-adapted, being active to -16°C, and was shown to be long-lived, with females surviving more than one month (Kohshima, 1984). However, little is known about the length of the adult portion of the life cycle of any winter-emerging Diamesinae in North America.

Figure 1: Collection of winter emerging Chironomidae adults

METHODS

Adults of D. mendotae (n=729) were collected on eleven different days during December, January, February and March from five different ground-water dominated streams in eastern Minnesota and western Wisconsin. Water temperatures of the streams are strongly mediated by groundwater inputs and none froze completely during winters. Adults were collected from snow banks adjacent to the streams up to a distance of three meters from open water (Figure 1). Air temperatures were always below freezing when specimens were collected and during several days prior to the day of collection. Specimens were located on snow banks, then scooped individually into one-dram vials with a small amount of snow and maintained at 6ºC until dying. No food sources were provided to adults but the water from melted snow prevented dehydration as individuals aged. Specimens were maintained in controlled temperature chambers in the dark at 6°C, but were removed from the chamber and checked daily until all specimens died.

Most specimens remained upright, actively flying, climbing or walking until about 1-2 days before death, when their activities became uncoordinated and often resulted in individuals lying upside down on the water surface in the test vial. Death was determined by (1) lack of movement by the insect when test vials were disturbed and (2) specimens were then checked under 12X magnification for lack of muscle or gut movements.

RESULTS

Figure 2 shows the numbers of males and females dying during each 24 hour period post-collection. A peak in male deaths occurred at day 15 post-collection. By contrast the peak of female deaths occurred at day 22 post-collection.

The pattern of cohort survivorship, plotted for all collections combined (Figure 3), is sigmoidal, with most individuals dying between day 10 and day 30 post-collection, however individuals survived forty or more days. Maximum longevity of males was 48 days post-collection and for females was 54 days post-collection.

Age-specific survivorship and age specific mortality of males and females roughly coincided to 16 days post-collection (Figures 4 & 5). After this date females shower lower age specific mortality than males.

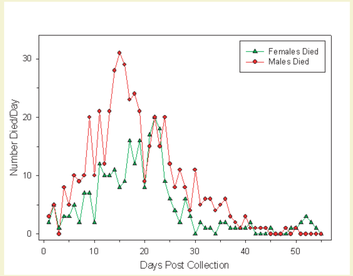


Figure 3: Percentage of cohort surviving per day (= cohort survivorship curves).

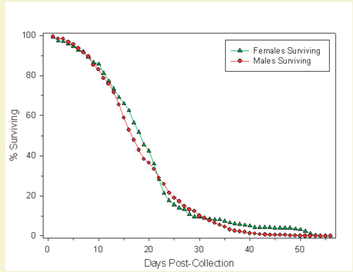


Figure 2: Numbers of adults dying per day. (= daily mortality rates).

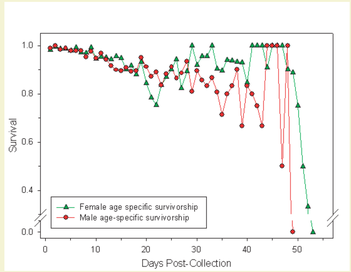


Figure 4: Age-specific survivorship.

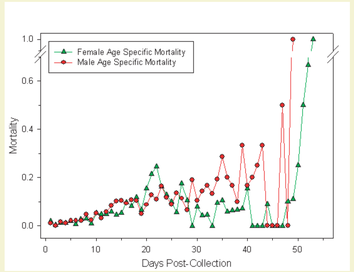


Figure 5: Age-specific mortality.

RESULTS (Continued)

Average life expectancy of males and females showed dramatic differences after approximately 20 days post-collection (Figure 6). The life expectancy of females with ages of 20 or more days post-collection showed a peak at 29 days and gradually declined to 43 days post-collection before declining at a greater rate for females older than 44 days.

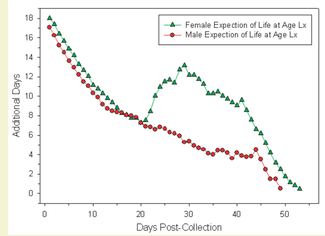
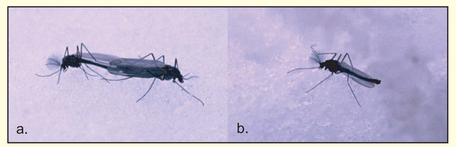


Figure 6: Average life expectancy at a given age (age = Lx).

CONCLUSIONS

- Adults of Diamesa mendotae are long-lived when held at constant temperature of 6°C, with average longevities 18.6 days.
- Maximum longevities are 48 and 54 days for males and females, respectively.
- Age-specific longevities of males and females differ slightly, with female age specific mortality being slightly lower, especially after 21 days post-collection.
- Average life expectancies of males and females are very similar until approximately 20 days post-collection. After that time the average life expectancies of males continue to decline, but increases dramatically for females until reaching a peak at 30 days post-collection.
- The relatively long adult survivorship of winter emerging individuals likely confers increased probability of successfully mating for both males and females, and for ovipositing in females.
- Adults may live for extended periods during winter in small protected areas near streams that are groundwater dominated even in high latitudes where colder thermal regimes predominate.



Diamesa mendotae on snow a) in copula and b) male.

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