AN INVESTIGATION INTO HEADLESS MILLIPEDES ON TUCKERNUCK ISLAND, MASSACHUSETTS

Andrew Mckenna-Foster[1], Cheryl Beaton[1], and Lawrence Millman[2]
[1] Maria Mitchell Association, 4 Vestal St. Nantucket, MA 02554
[2] P.O. Box 381582, Cambridge, MA 02238

ABSTRACT

The American millipede *N. americanus/annularis* complex is common on Tuckernuck Island, Massachusetts. Each summer numerous headless millipede bodies are found partly alive on the trails and roads of Tuckernuck; the cause of these decapitations remains unknown. We traveled to the island three times between June and October 2009 to measure headless millipedes and attempt to catch a decapitation on digital video We did not see any evidence of millipede predation In 97 minutes of video but we did record birds foraging on the roads for 6.7% of the video time. We present measurement data for injured and headless millipedes found during 2009 and note the occurrence of parasitic Myriophora flies harassing millipedes. Our data do not explain how or why millipedes are found headless on the island but present several possibilities for future work as well as important baseline observations to aid future investigators.

INTRODUCTION

During our visits to Tuckernuck in the last four years, we have seen large numbers of headless American millipedes (*Narceus americanus/annularis* complex). There has been recent confusion about the separation of *N. americanus* and *N. annularis*; therefore, Shelley *et al.* (2006) suggest using "*N. americanus/annularis* complex". Tuckernuck is on the eastern most edge of the *N. americanus/annularis* complex range and residents and other researchers have frequently noted finding millipedes that are dead or still partially alive but missing their head and the first 7-9 segments (Fig. 1). We have heard from Tuckernuck residents that the oldest observations of headless millipedes date to the 1940's.

Headless millipedes are found elsewhere in the world but few are studied (Larsen *et al.* 2009; Eisner 2003; Forgie Shaun *et al.* 2002). To our knowledge, the phenomenon on Tuckernuck has never been fully investigated. This is a popular mystery and there is a debate over the decapitating culprit. Many believe a rodent eats the head, some vote for a bird. In upstate New York, the well renowned and very clever Thomas Eisner experimented with predation behavior of various rodents and shrews on millipedes but could not prove any rodents were beheading the millipedes (Eisner 2003). Most recently, researchers in the Amazon jungle found a dung beetle (*Deltochilum valgum*) that hunts living millipedes and, many times, decapitates them (Larsen *et al.* 2009). One of us has been studying the *Narceus* species on Tuckernuck since 2004; both its existence in such a seemingly inappropriate habitat and the decapitations. Our objective in this study was to

collect morphological data on headless millipedes and attempt to capture the predator on digital video.

METHODS

Headless Millipede Morphology

We collected headless millipede bodies from dirt roads and paths on Tuckernuck during several trips in 2009. Most of our collections were along the road leading south from the Tuckernuck Field Station (TFS) driveway entrance (hereafter 'the road'). We counted the remaining intact segments (including the pre-anal ring) and measured the body length and the width at the middle of the body. A segment was not considered intact if it had been damaged at all on the anterior edges. We also collected and examined millipedes we captured in pitfall traps or found in other locations. Pitfall traps were set primarily for spiders and consisted of a small canning jar buried to its lip in the ground with a small amount of dirt in it.

Video Surveillance

We used a Sony DCR-SR200 Digital Handycam mounted on a tripod to monitor the TFS driveway as well as the road. We set the camera up in shrubs on the side of the driveway or the road and left it to record for at least half an hour. Before and after recording we checked the visible area for headless and complete millipedes. Any headless millipedes were removed. The video footage was then copied on to DVDs using a Sony DVDirect VRD-MC5 DVD burner.

RESULTS AND DISCUSSION

Headless Millipede Morphology

We collected 14 headless millipedes on the morning of 13 June 2009 and two on the morning on 17 July 2009 (Table 1 and Fig 1). Only one of these millipedes was not moving when we found it. All the rest were either walking or their legs were still moving. Thirteen of the millipedes were on the road and the other three were from the TFS driveway. During the morning of 13 June, we saw one live millipede on the road and three live millipedes on the driveway. Averages are reported with standard error. The average number of intact segments was 49 ± 0.72. The average body length was 73 ± 1.8 mm and the average width was 7.6 ± 0.21 mm. We have observed living millipedes with between 52 and 57 total segments.

Table 1. Collection data and measurements for headless millipedes collected on Tuckernuck Island.

Date	Location	Intact Segments	Length (mm)	Width @ middle (mm)	Condition
13June	TFS Driveway	45	63	8	Moving
13June	TFS Driveway	45	78	9	Moving
13June	TFS Driveway	51	79	8	Moving
13June	Road	52	78	8	Moving
13June	Road	48	57	6	Moving
13June	Road	50	77	7.5	Moving
13June	Road	55	77	7	Moving
13June	Road	47	69	8	Moving
13June	Road	47	70	7	Moving
13June	Road	47	75	8	Moving
13June	Road	49	74	8	Moving
13June	Road	47	68	7	Moving
13June	Road	45	63	6	Moving
13June	Road	51	80	7.5	Unmoving
17July	Road	51	75	8	Moving
17July	Road	51	83	8.5	Moving
Average		49	73	7.6	
Standard Error		0.73	1.8	0.21	

On 13 June we found an injured millipede along the road. It had two gashes behind its head (Fig 1). It was 75 mm long and contained 57 segments counting from the segment posterior to the plate that covers the head. The posterior gash was on the fourth segment posterior to the head and the anterior gash covered the plate covering the head. The gashes were 4.5 mm apart. The remaining segments were undamaged. We kept the millipede in a jar with grass. On 16 June only its legs were still moving, whereas on previous days its body had reacted to stimulus and at this point we placed the specimen in 75% ethanol.

Between 13 June and 14 June, we caught two living millipedes in a pitfall tap near the TFS. In an identical trap nearby we found a freshly dead millipede in two pieces and missing its head (Fig. 2). Based on the bodily damage we tentatively hypothesize that a deer stepped into the trap and crushed the trapped millipede. We cannot rule out the possibility that a rodent or some other nocturnal creature predated the millipede. In 2007, we placed a live millipede in a small container with a short tailed shrew (*Blarina brevicauda*) and left them over night. In the morning, the millipede was completely disarticulated and eaten (Fig. 2). This provides evidence that the defensive secretions produced by millipedes will not protect it against hungry rodents. We released the *Blarina* that morning, however, and did not monitor it for long term effects.

Figure 1. Top, 13 of the headless millipedes from 13 June. Middle and Bottom, the injured millipede.

Figure 2. Top, the remains of a millipede found dead in a pitfall trap in 2009, without its head. Bottom Left, preserved remains of a millipede devoured by a shrew. The white crystals are due to long term storage of the millipede in ethanol. Bottom Right, a Myriophora fly captured harassing a live millipede on Tuckernuck. The faint scale represents millimeters and the fly is about 2.5 mm.

Video Surveillance

We recorded 127 min of video from four recording times between 13 and 14 June. We recorded for a total of 52 minutes on the afternoon of the 13th along the TFS driveway and 45 minutes on the morning of the 14th the road facing south. We did not record at night. We eliminated five minutes of video from the start and end of each recording to account for the impact from the video operator. We analyzed a total of 97 minutes. We did not record any direct evidence of a decapitating culprit. An American robin (*Turdus migratorius*), at least one catbird (*Dumetelia carolinensis*), and several unidentified birds (due to distance from the camera) were recorded on the driveway. They were present on the road in nine separate instances for 6.7% (6 min 30 sec.) of the

total footage time. The robin and the unidentified birds seemed to forage along the roads, zig-zagging toward or away from the camera. One catbird flew onto the TFS driveway picked something up in its beak and flew off again. The object was unidentifiable.

No other live creatures were seen, aside from a slow moving, unidentified creature on the TFS driveway. This could have been a millipede or a large beetle. No headless millipedes were found on the road or driveway after recording. Recording at night would be useful in assessing how often rodents forage on the dirt roads and may provide evidence of rodent predation on millipedes.

Despite finding 14 millipedes on the road on 13 June, we saw no millipedes, alive or decapitated, on the road on 14 June. It had lightly rained the night before but it is unclear if this is the reason for their absence. In October, we saw no live millipedes. However, in previous years we have observed large numbers of active millipedes in September and October.

Other Observations

We observed Myriophora flies harassing two millipedes on 17 July. In both instances flies were landing on a millipede crossing a dirt path until the millipede writhed around and coiled and uncoiled its body before continuing across the path. We successfully captured three of the fly specimens and one of the millipedes. The millipede died in captivity several days later and its body was destroyed by maggots. It is unclear what species the maggots represent since the millipede was in a sealed container (with small air holes) with leaf litter and soil from Tuckernuck.

Myriophora flies (Fig. 2) have been shown to be commonly associated with millipedes but the literature is difficult to access and mostly in French (references in Brown 1992).

CONCLUSION

What causes millipede decapitations and the reasons behind this activity remain mysterious. Our data show that birds forage on the roads of Tuckernuck but we found no evidence that they prey on millipedes. We found no evidence of predation by small mammals either, though the remains of the millipede in the pitfall trap were more likely the result of mammal rather than bird predation.

As we learn more about the Myriophora flies, updates will be made available to the Nantucket Biodiversity Initiative. It is unlikely that these flies cause the decapitations but they cannot be ruled out.

This mystery is difficult to study, partly because Tuckernuck is isolated, but more importantly because the predation seems to take place sporadically and not necessarily at

a specific time of day. The problem requires several consecutive days of dedicated observation.

ACKNOWLEDGMENTS

This study was funded by a grant from the Nantucket Biodiversity Initiative. The Maria Mitchell Association provided lab space and access to a boat and the Tuckernuck Land Trust provided housing. Cheryl Creighton assisted us with field work and gave us important advice. We greatly appreciate the opportunity to work on Tuckernuck and thank the residents for their cooperation and support.

LITERATURE CITED

Brown, B.V. 1992. Generic revision of Phoridae of the Nearctic Region and phylogenetic classification of Phoridae, Sciadorceridae and Ironomyiidae (Diptera: Phoridea). *Memoirs of the Entomological Society of Canada*. **164:** 1-144.

Eisner T. 2003. *For the Love of Insects*. President and Fellows of Harvard College. United States of America. pg 256.

Forgie Shaun A. , Grebennikov Vasily V. , Scholtz Clarke H. (2002) Revision of *Sceliages* Westwood, a millipede-eating genus of southern African dung beetles (Coleoptera : Scarabaeidae). *Invertebrate Systematics* **16**, 931–955.

Larsen, T.H., A. Lopera, A. Forsyth, F. Genier. 2009. From coprophagy to predation: a dung beetle that kills millipedes. *Biology Letters*. Published online. 10.1098/rsbl.2008.0654

Shelley, R.M., C.T. McAllister, and M.F. Medrano. 2006. Distribution of the millipede genus *Narceus* Rafinesque, 1820 (Spirobolida: Spirobolidae): Occurrences in New England and west of the Mississippi River; A summary of the peripheral localities and first records from Connecticut, Delaware, Maine, and Minnesota. *Western North American Naturalist*. **66**(3): 374-389.