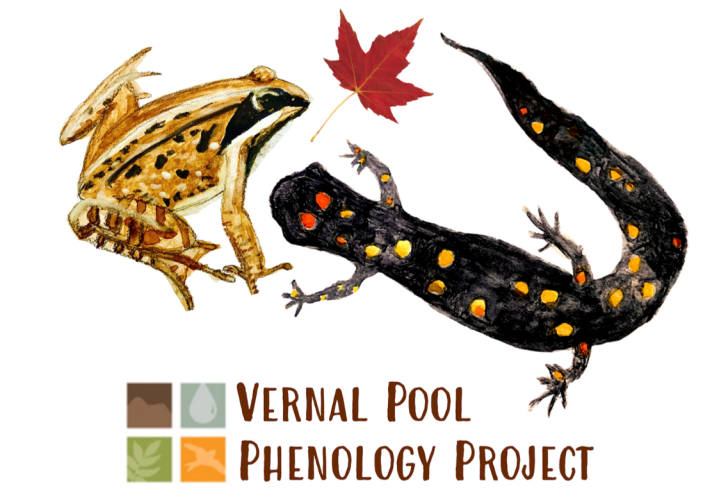


An example of predator-prey role reversal in wood frog embryos (*Lithobates sylvaticus*) and midge larvae (Diptera: Chironomidae)



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Discovery of novel frog-midge interaction

In April 2022, during a routine egg mass survey, we observed two wood frog egg masses in a vernal pool at the University of New Hampshire's East Foss Farm in Durham, New Hampshire (Fig. 4).

Both egg masses were infested with non-biting midge larvae (Diptera: Chironomidae), commonly known as bloodworms (Fig 2).

Although wood frogs and midge larvae are common inhabitants of vernal pools, and it isn't uncommon for wood frogs to consume chironomid larvae, an association of this sort between the two species had not been previously reported⁸.

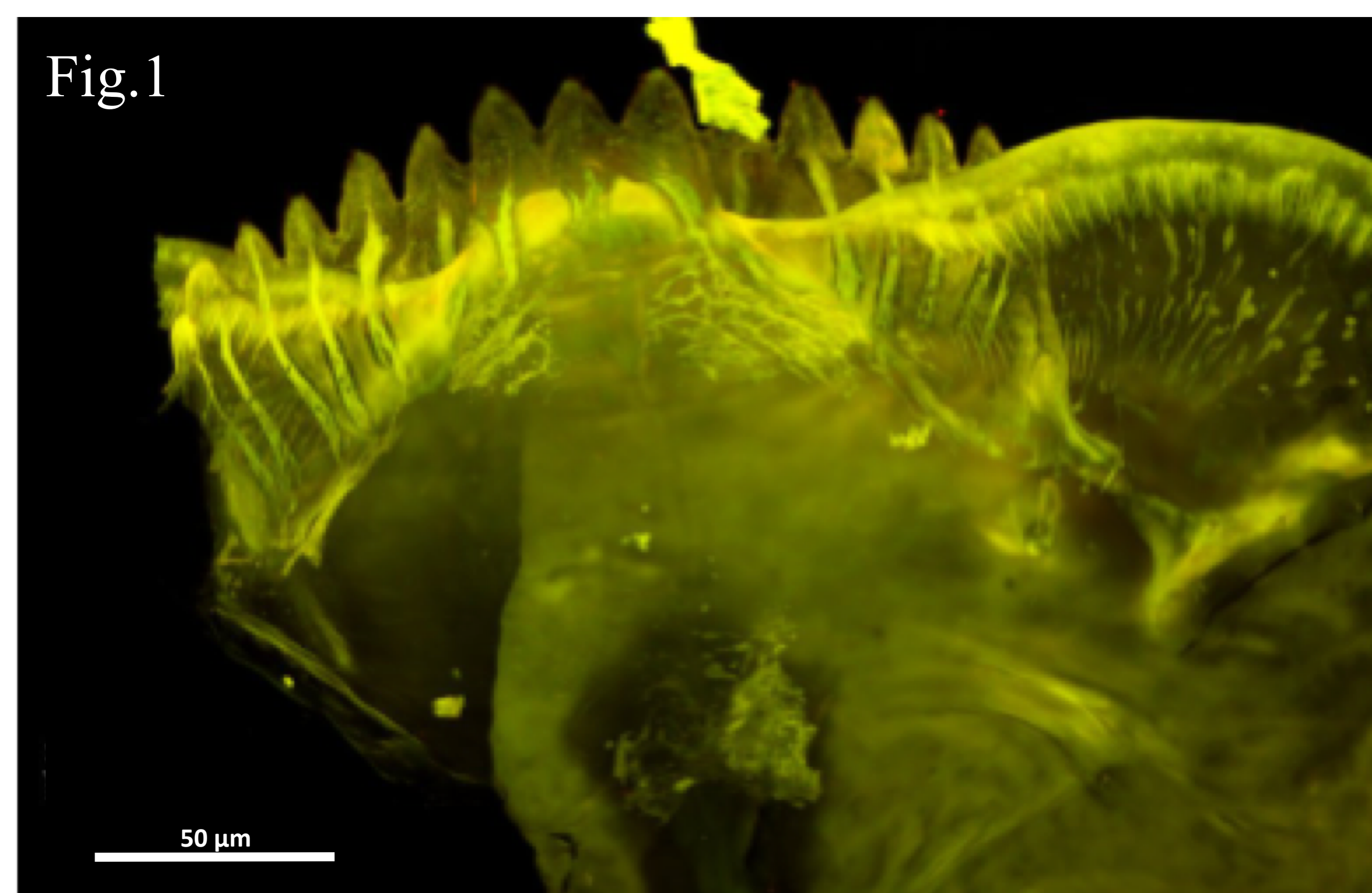


Figure 1. Confocal micrograph of chironomid mouthparts used for identification.

Observation & identification of midge larvae

We transported one wood frog egg mass infested with midge larvae (Fig. 2) to the laboratory for examination with a Huvitz stereomicroscope.

We observed midge larvae tunneling through the egg mass, pupating, and feeding on a frog embryo (Fig. 3A, Fig. 3B, and video).

Using an Olympus CX 41 compound microscope and confocal laser scanning microscopy (CLSM)¹, we viewed the midge at 40x magnification and identified it as *Tribelos atrum* (Diptera: Chironomidae) based on diagnostic traits of the larval mouthparts^{2,3} (Fig. 1).

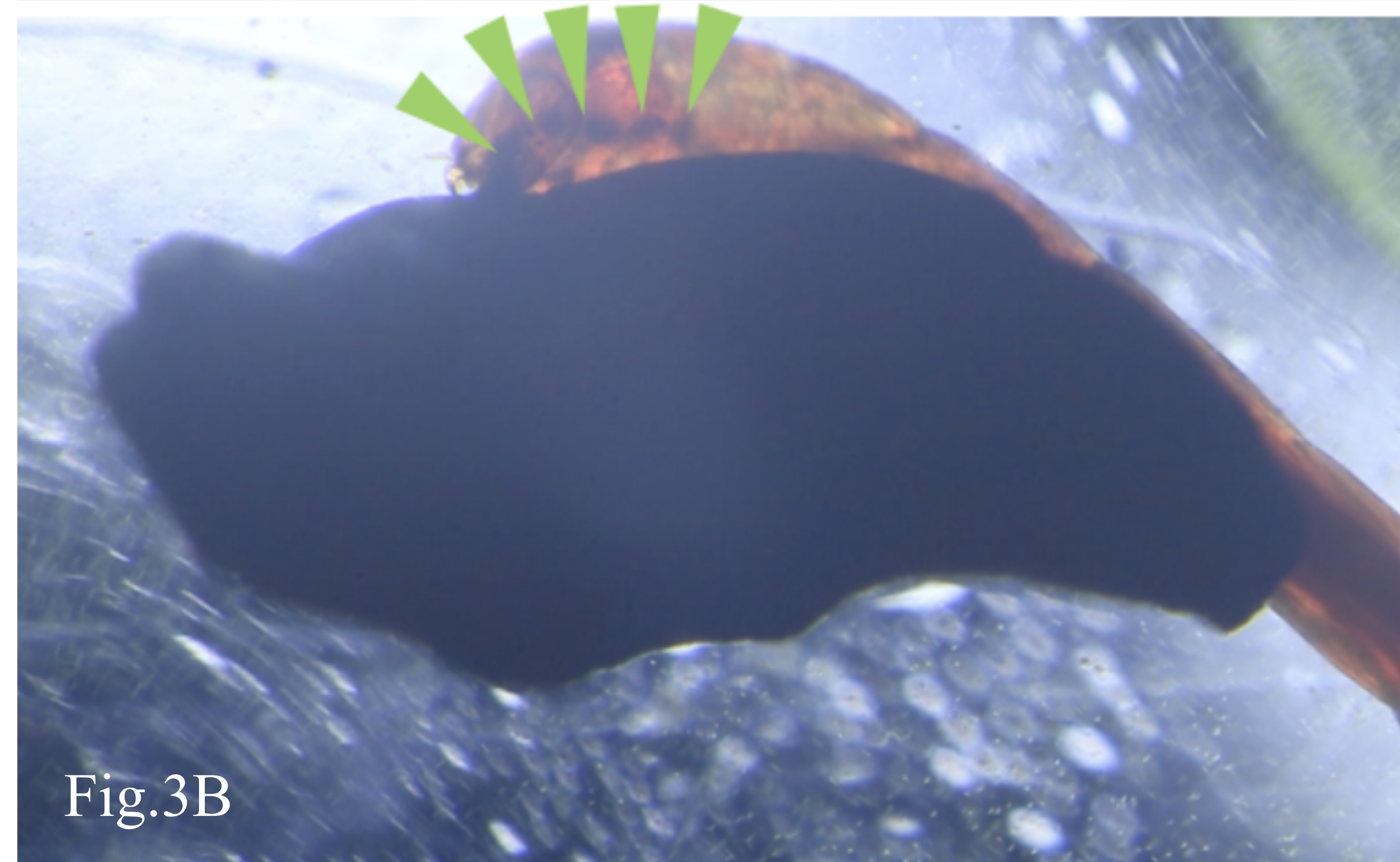
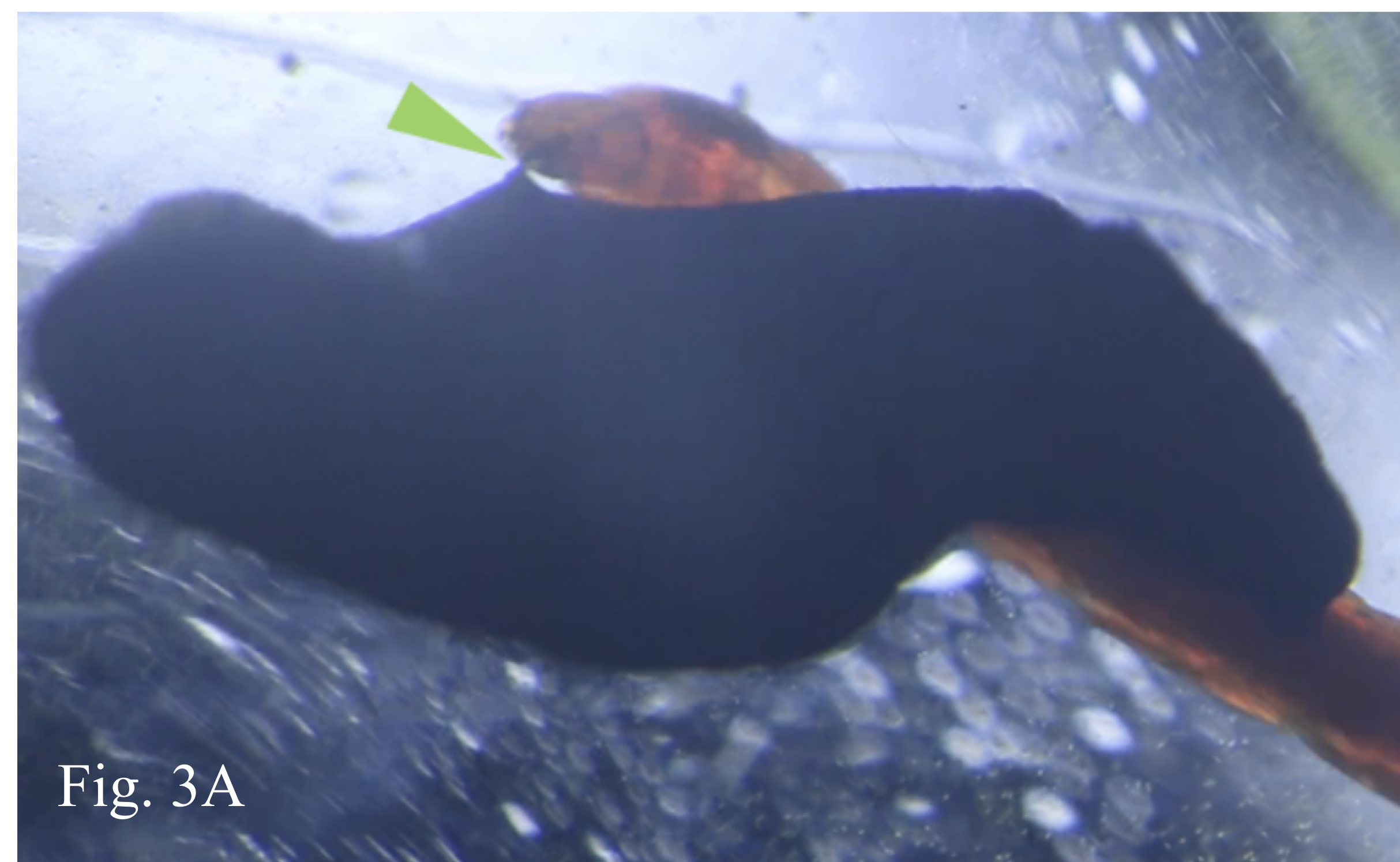
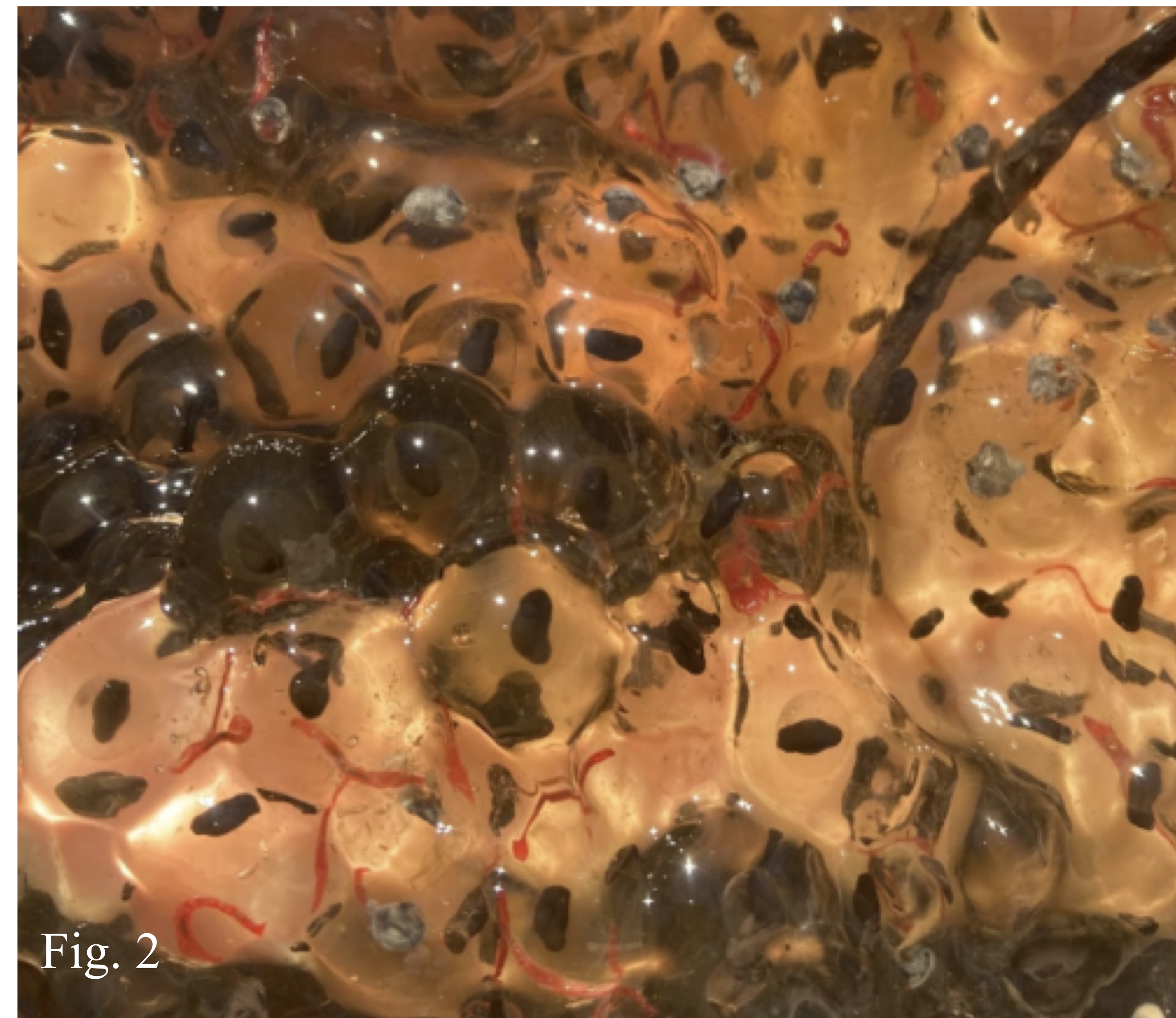


Figure 2. Wood frog egg mass infested with midge larvae.

Figure 3A. Green arrow points to midge larva biting wood frog embryo.

Figure 3B. Green arrows point to wood frog tissue in the digestive tract of the midge larva.

An example of predator-prey role reversal?

Larvae of non-biting midges (Diptera: Chironomidae) are common inhabitants of vernal pools. They typically burrow in mud to feed on organic debris⁴ and pupate⁵. Wood frog egg masses may also serve as a substrate appropriate for burrowing.

Climate-driven changes in the hydrology of vernal pools⁶ and the phenology of their inhabitants may increase the frequency of contact between mud-burrowing midges and wood frog egg masses, while concomitant increases in the local density of the two species is predicted to result in altered feeding relationships, including, potential cases of predator-prey role reversals⁷.

Because wood frog larvae have been shown to feed on chironomid larvae⁸, we suggest that such a predator-prey reversal has occurred in our vernal pool. Whether this reversal is widespread and overlooked, rare and localized, or a sign of changes to come, the phenomenon requires more investigation.



Figure 4. Vernal pool in East Foss Farm, Durham, NH, where midge-infested wood frog eggs were observed.

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