Don’t bring me down: Abundance and distribution of a protozoan epibiont on a mysid in the San Francisco Estuary

Carolyn Belak (carolyn.belak@wildlife.ca.gov)

California Department of Fish and Wildlife, Stockton, California

Introduction

Mysids, also known as opossum shrimp, have long played an important role in the food web of the San Francisco Estuary and Delta[1]. Since its introduction in 1993, the species *Hyperacanthomysis longirostris* (Fig. 1) has taken over as the dominant mysid in the region, and has persisted as a food source for environmentally important fish populations[2,3]. Recently, a suctorian ciliated protozoan of the genus *Ophryodendron* was found living on the surface of many individuals, showing two types of life stages: tentaculate and vermiform (Fig. 2 &3)[4]. Here we describe the size and abundance of these epibionts and analyze their distribution along the mysid surface, taking into account the length and sex of the crustacean.

Figure 1. *Hyperacanthomysis longirostris,* 7mm.

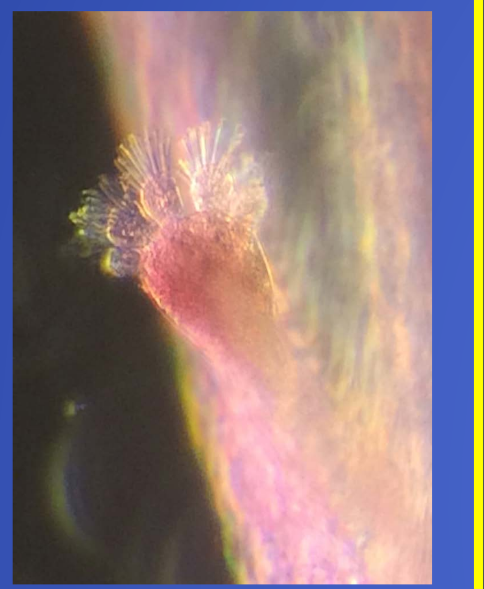

Figure 2. Tentaculate form of *Ophryodendron* sp., showing five visible anterior lobes.

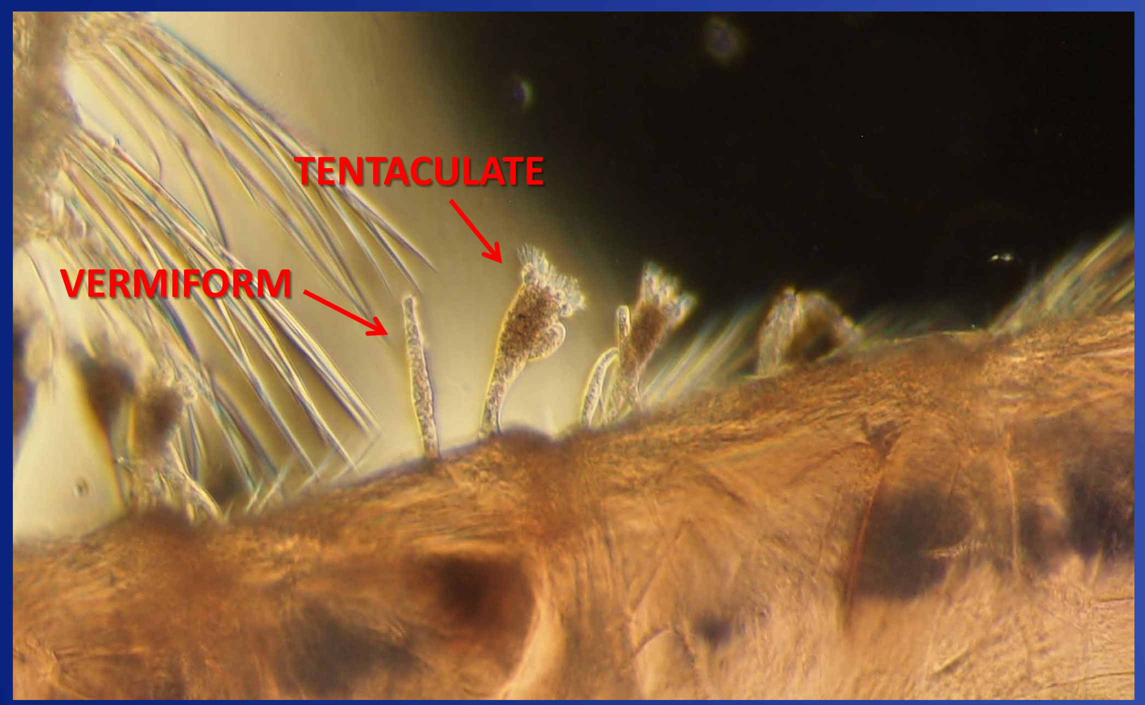

Figure 3. Two life stages of *Ophryodendron* sp.

Methods

Mysids utilized for distribution analysis were collected at one location in Suisun Bay (Fall Midwater Trawl [FMWT] Station 508), during the October 2016 survey (Fig. 5). Within the subsample processed, we discovered 89 out of 143 *H. longirostris* individuals were infested.

To document potential impacts on the mysid, we described the size and abundance of protozoan epibionts along each mysid’s surface, with respect to mysid length and developmental stage.

- Body location where ciliates were found were grouped into three general categories: sensory appendages, locomotive appendages, and body (carapace and abdomen)
- Developmental stage classified mysids in four groups: juvenile individuals (J), non-gravid females (NG), gravid females (G), and males (M)
- Mysid body length was defined as distance from apices of eye stalks to base of telson

Data on epibiont load based on mysid length was log-transformed to best conform to the assumption of normality before a simple linear regression was performed. We ran a one-way ANOVA to test the variance of epibiont load in relation to mysid developmental stage.

Results

In concordance with other members of their genus, we found that the ciliates remained host-specific[4] throughout our sample, and the number of epibionts per individual mysid significantly positively correlated with mysid length (R^2=0.24, $F_{1, 87}$=20.84, p=1.15x10^{-6}). Of 835 total ciliates found, 666 of these were tentaculate in form, while 169 were in the vermiform stage (Fig. 2 &3), showing that these epibionts are not only settling, but reproducing while living along the mysid surface.

- Tentaculate protozoans were located primarily anteriorly on the antennae and the base of the pereiopods, along the carapace and ventral abdominal surface, and heavily infested the thoracic exopodites (Fig 6 & 7).
- Vermiform individuals were more likely to occur on the eye stalks in addition to the antennae, and settled on both dorsal and ventral sides of the abdomen, the female marsupium, and the uropods and telson.

Table 1. Biometrical data (μm) of the two stages of *Ophryodendron* sp. found.

	Tentaculate		Vermiform	
	Mean	Standard deviation	Mean	Standard deviation
Body length	158.06	55.59	140.24	52.37
Basal diameter	49.73	11.61	27.25	10.17
Number of lobes	4.39	0.75	-	-

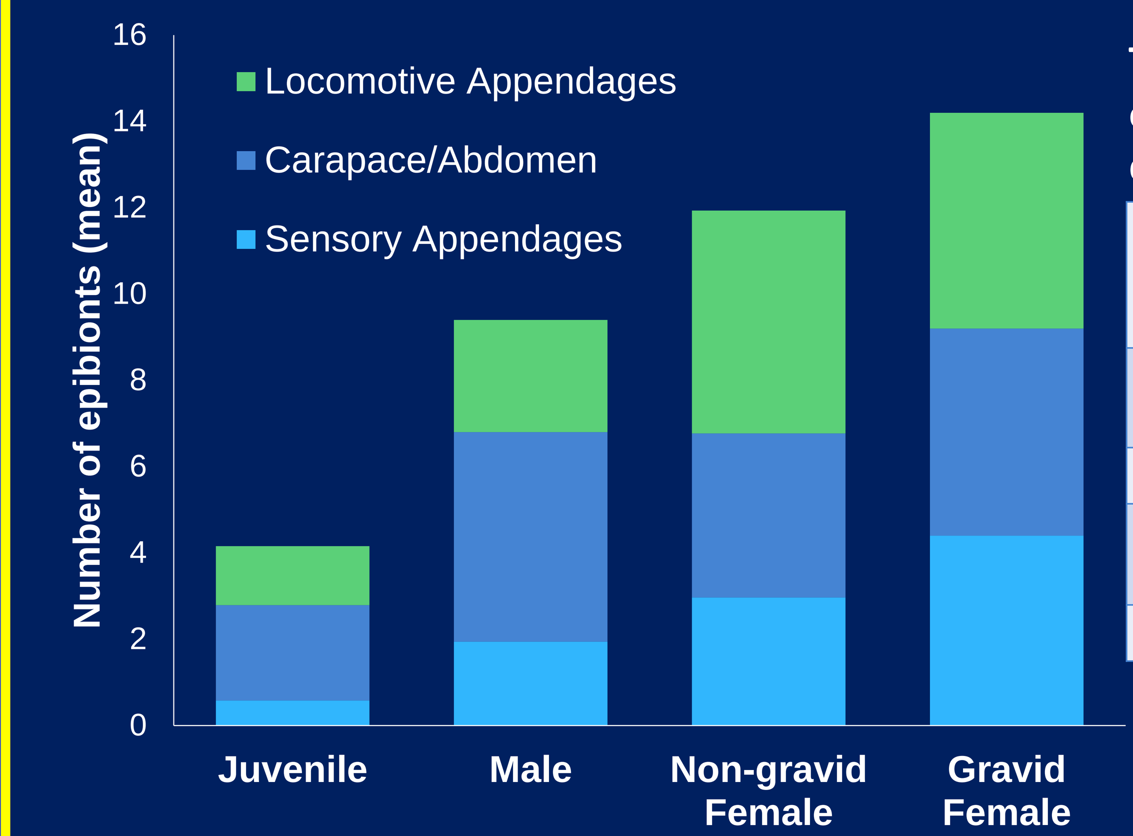

Figure 4. Mean number of total epibionts on the appendages and body of *H. longirostris*.

Table 2. Mysid body length of four *H. longirostris* developmental stages

Dev. Stage	Mean Length (mm)	SD
Juvenile	4.55	0.99
Male	7.16	0.72
Non-gravid Female	7.02	0.55
Gravid Female	7.46	0.17

- A significant difference was found in epibiont load between mysid developmental stages (Fig 4; ANOVA: $F_{3, 85}$=4.60, p=0.005). This reveals that stage, as well as mysid body length, plays a role in determining the number of epibionts hosted.

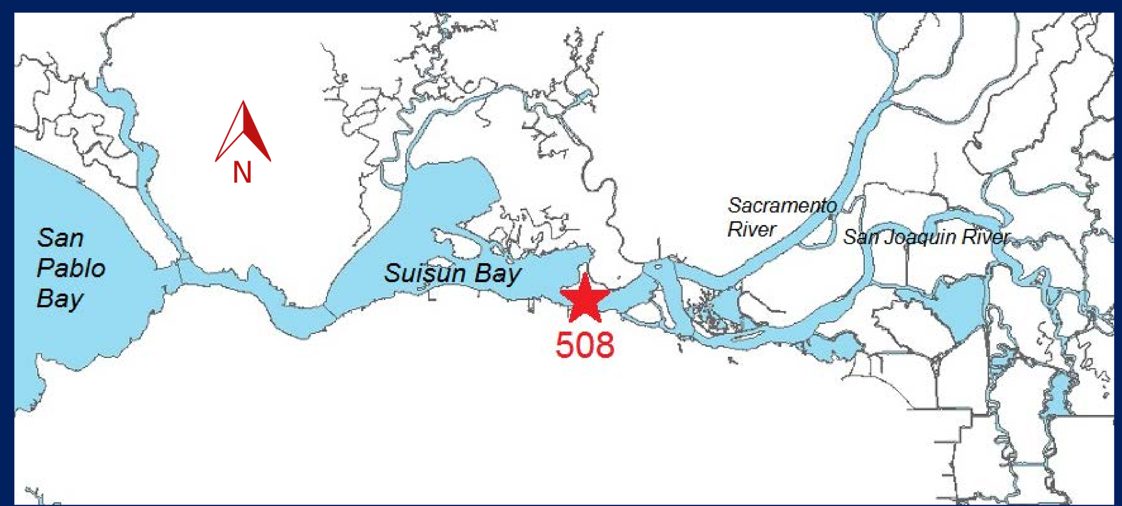

Figure 5. Location of FMWT Station 508, in relation to Suisun Bay. At time of sampling, surface water temperature was 13.7°C and salinity measured 9.4 psu.

Discussion

- Heavy infestation of thoracic exopodites across all developmental stages were found: These vital swimming appendages may be restricted if loaded down[5].
  - Affected mysids may show a difference in their physical response times, potentially reducing their fitness and increasing their susceptibility to predation.
- Higher epibiont load was found on mature individuals, rather than simply larger organisms: This may be due to reduced moulting, a more robust settlement structure, or increased accumulation time in adults[6].
  - The higher loads found on gravid females could selectively stress the breeding mysid population.
- An abundance flux of the epibiont population could vary with or influence the timing of mysid blooms and fish foraging behavior.

Figure 6. Infested ventral and dorsal abdomen of *H. longirostris.*

Figure 7. Infested eye of *H. longirostris.*

Future Work:

Previous studies around the world have documented epibiont-basibiont relationships of crustaceans and ciliated protozoans, most taking a theoretical, not empirical approach[6,7]. To gain more insight to these ecological interactions, the following is suggested:

- A broader sample size of abundance throughout the San Francisco Estuary
- Live experiments on infested mysid swimming and feeding behavior
- Extrapolation of epibiont population spatiotemporal data, coupled with mysid life cycle and young fish feeding maximums

Acknowledgements:

This study would not have been possible without the field crew and lab personnel who collected and processed zooplankton samples from the FMWT 2016 season. I would also like to thank CDFW Stockton office members for finding this subject fascinating, those outside of the agency who helped with identification, and the funding and support provided by the Interagency Ecological Program.

Citations:

1)Kimmerer, W.J. 2000. Analysis of an estuarine striped bass (Morone saxatilis) population: Influence of density-dependent mortality between metamorphosis and recruitment. Canadian Journal of Fisheries and Aquatic Science 57: 478–486. 2)Slater, S. B. 2008. Feeding Habits of Longfin Smelt in the Upper San Francisco Estuary. Presented at the 5th Biennial CALFED Science Conference 2008. October 22-24, 2008, Sacramento Convention Center, Sacramento, California. 3)Baxter, R., K. Hieb, and W.L. Mecum, 2005. Zooplankton and Mysid Abundance Trends. 4)Fernandez-Lebornas, G., Tato-Porto, M.L. and Sorbe, J.C., 1996. The morphology and life cycle of Ophryodendron mysidacii sp. nov. a marine suctorian epibiont on a mysid crustacean. Journal of Zoology 238: 97-112. 5)Cannon, G. H., and S. M. Manton. 1927. On the feeding mechanism of a mysid crustacean, Hemimysis lamornae. Transactions of the Royal Society of Edinburgh 55: 219-255. 6)Wahl, M. 1989. Marine epibiosis. I. Fouling and antifouling: some basic aspects. Marine Ecology Progress Series 58: 175-189. 7)Fernandez-Leborans, G., and M.L. Tato-Porto, 2000. A Review of the Species of Protozoan Epibionts on Crustaceans. II. Suctorian Ciliates. Crustaceana 73 (10): 1205-1237.