



# ROLE OF APPENDICULARIANS IN CLEANSING POLLUTION-RELATED BACTERIA FROM O'AHU COASTAL WATERS

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## Issue/Research Rationale

Appendicularians, very small (comma-sized) jelly-like organisms, feed on particles in the ocean by filtering water through a much larger (dime-sized) mucus "house." Prior to this study little was known about tropical appendicularians, which are members of the pelagic tunicate family. The word "tunicate" originates from Latin and describes the cellulous membrane that surrounds these animals like a tunic. This membrane allows some tunicates to filter water to obtain food. Appendicularians have a complex mucus filtering structure within their house that captures entering food particles.

Appendicularians occur in abundance in subtropical Hawaiian waters, filter water through their houses extremely fast, and have very high growth rates. While an appendicularian can live three to five days, it will immediately die after reproducing because its body explodes to release its cache of hundreds of eggs. Each newly fertilized embryo will have just enough energy to build a house and begin its feeding cycle.

Two issues were examined in this study: the role of appendicularians in cleansing pollution-related bacteria from O'ahu coastal waters (Māmalā Bay), and the role of these organisms in short-circuiting the food web with respect to higher trophic levels (Kāne'ohe Bay).

## 1999 - 2003 Sea Grant Funding

\$177,203 SG; \$98,500 match

## Hawai'i Discoveries/Contributions to Science

We investigated the ability of appendicularians to feed directly on the smallest size fraction of cells in the ocean, and the rate at which appendicularians were consumed by much larger predators who detect these small animals in their large houses.

Appendicularian populations in Māmalā Bay appear to increase during the late summer months and early autumn.

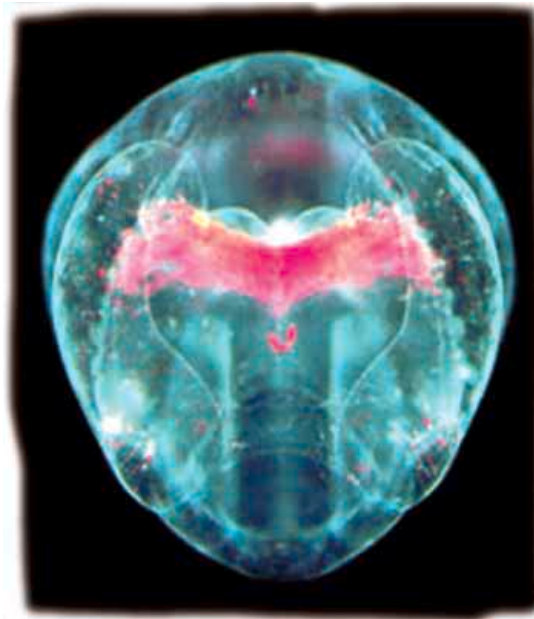


Photo courtesy Per Flood

Preliminary grazing rate experiments indicate that during periods of high abundance, appendicularians have the ability to consume the entire bacterial standing stock every day. We also measured the temporal and spatial variability of appendicularian impacts. To accomplish these goals, we determined the natural abundances and spatial and temporal variability of appendicularians in Kāne'ohe Bay, Hawai'i and assessed their rate capabilities with regard to the transfer of carbon (energy) through the food web.

## Research Impacts/Benefits

One of the most exciting results of our research in Kāne'ohe Bay was the discovery that appendicularians removed greater than 40 percent of the standing stock of extremely small cells from the water column daily, despite their low filtration efficiencies on this size fraction. This removal rate far exceeded that of co-occurring copepods (crustacean-like zooplankton) and suggested that appendicularians could also be a significant, direct link from small cells to higher-level consumers in this system, e.g., providing fish with a more direct link to bottom-of-the-food-chain organisms. In addition, we determined that appendicularians derive most of their nutrition from the slightly larger size fraction and did not appear to be better adapted to feeding efficiently on the smallest cells available, compared to their counterparts in richer temperate ecosystems. The impact of appendicularians on the transfer of energy through this system was both temporally and spatially variable, and depended on the season and the proximity to the mouth of the main shipping channel in Kāne'ohe Bay.

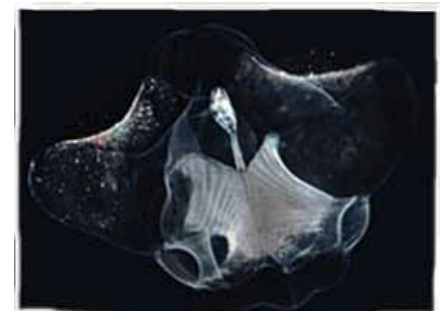


Photo courtesy Per Flood



Photo courtesy Alice Alldredge

## Publications and Presentations

Scheinberg, R.D. and M.R. Landry. In press. Clearance rates and efficiencies of *Oikopleura fusiformis* on the natural prey assemblage of a subtropical coastal ecosystem. *Response of marine ecosystems to global change: ecological impact of appendicularians*, G. Gorsky, Q. Bone, D. Deibel and M. Youngbluth, Eds. Gordon & Breach.

Scheinberg, R.D. and M.R. Landry. 2002. Grazing impact of appendicularians in the coastal subtropical Pacific. *American Geophysical Union Ocean Sciences Meeting*, Honolulu, HI, Feb. 2002, (oral presentation).

Scheinberg, R.D. and M.R. Landry. 2001. Grazing rates and prey size-selectivity of *Oikopleura fusiformis* on picoplankton in the coastal subtropical Pacific. *NATO/MAST Conference on the Ecology & Biology of Appendicularians*, Villefrance, France, Dec. 2001, (oral presentation).

Scheinberg, R.D., A. Calbet and M.R. Landry. 2001. A comparison of the grazing impact of appendicularians & small copepods. *American Society of Limnology & Oceanography Meeting*, Albuquerque, NM, Feb. 2001, (oral presentation).

Calbet, A., M.R. Landry, and R.D. Scheinberg. 2000. Microzooplankton grazing in a subtropical embayment. *Mar. Ecol. Prog. Ser.* 193:75-84.

Scheinberg, R.D., M.R. Landry, A. Calbet and S. Christensen. 2000. Dynamics & impacts of appendicularians in a subtropical embayment. *American Geophysical Union Ocean Sciences Meeting*, San Antonio, TX, Jan. 2000, (oral presentation).

## Students Educated

Rebecca D. Scheinberg, Ph.D. In progress.

Danielle Ruplinger, B.A. In progress.

## Outreach Highlights

Their research on appendicularians and general food web dynamics in the coastal waters of Hawai'i has inspired both Dr. Landry and his graduate student Ms. Scheinberg to develop a curriculum to teach graduate and undergraduate university students about the unique role of tropical organisms in the coastal ocean, with a specific focus on appendicularians.

Ms. Scheinberg has given guest lectures in both graduate and undergraduate oceanography courses on the subject, as well as to primary and secondary students in the community.

## Biography

Dr. Landry has been a member of the faculty at the University of Hawai'i (UH) since 1987 and has supervised thirteen graduate students within the last 10 years. His professional services include associate editor of *Limnology and Oceanography* (1996-present), senior editorial advisor of *Marine Ecology Progress Series* (1986 - 2003), chair and associate chair of the Department of Oceanography at UH Mānoa (1989-96), and membership in numerous oceanographic and scientific organizations.

Ms. Scheinberg has presented her Sea Grant-funded research at four national and international oceanography conferences and recently participated in an international workshop covering the ecology and biology of appendicularians. In addition to her research, she developed the biological oceanography portion of the undergraduate oceanography laboratory course at UH Mānoa, and has served as a guest lecturer on zooplankton feeding dynamics in both graduate and undergraduate oceanography courses.



Dr. Michael Landry, Professor of Oceanography at the University of Hawai'i at Mānoa, received his Ph.D. from the University of Washington in 1976. His research interests include food-web interactions involving micro- and mesozooplankton, population and community ecology of plankton, and physical-biological coupling.

Rebecca Scheinberg is a Ph.D. candidate in Biological Oceanography, Department of Oceanography, at the University of Hawai'i at Mānoa. Her Ph.D. dissertation focuses on zooplankton community dynamics in a subtropical embayment on the island of O'ahu, with an emphasis on the transfer of energy from microbes to higher trophic levels.

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