



# Rhode Island Naturalist

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## Observations on the colonization of the invasive tunicate *Didemnum* sp.

BY LINDA A. AUKER AND CANDACE A. OVIATT

An invasive tunicate (Figure 1), referred to presently as *Didemnum* sp. (the organism has not yet been identified to species), has been observed in Narragansett Bay since 2000, when it was found

at Coasters Harbor Island in Newport during a rapid assessment survey (Pederson et al. 2001). These tunicates, also called ascidians, have been observed at the University of Rhode Island (URI) Graduate School of Oceanography (GSO) dock since 2002, when Dr. Christopher Deacutis (URI) photographed the dock pilings and noticed *Didemnum* sp. colonizing the pilings above the low water line. *Didemnum* is considered a strong competitor with the ability to rapidly colonize a substrate (Coutts 2002), and it prefers hard substrate, like dock pilings, over soft sediment (Bullard et al. 2007).

The ecology of *Didemnum* sp. is poorly known, and the effects of its introduction to an ecosystem have not been studied in detail. There may be competition for space and food between *Didemnum* sp. and native species (Stachowicz 2004), especially the Blue Mussel (*Mytilus edulis*), a

primary food source for important species in Narragansett Bay, e.g., Tautog and Common Eider (Olla et al. 1974). The tunicate frequently overgrows adult mussels, often to the point where the ability of the mussel to open its valves is restricted (personal observation). As part of a larger study of *Didemnum* sp. distribution in Narragansett Bay, we conducted a six-month study at the GSO dock in 2005. We compared *Didemnum* percent cover and recruitment timing to that of *M. edulis*, and also to two other colonial tunicates present in the bay, *Botrylloides violaceus* and *Botryllus schlosseri*.

Dr. Robert Whitlatch of the University of Connecticut has used 100-cm<sup>2</sup> polyvinyl chloride (PVC) panels attached to PVC pipes suspended from floating docks to quantify recruitment of newly settled organisms at different sites in Long Island Sound (Whitlatch and Osman 2005). For our study in Narragansett Bay, the same types of panels were used, which were hung from the GSO dock ladder. Four of these panels—referred to as community panels—were used to examine changes in percent cover of *Didemnum* sp., *B. violaceus*, and *B. schlosseri* over a six-month period. Panels were photographed once per month from May to October in 2005. Photographs were then used to measure percent cover of each of the three colonial ascidians using an image analysis program, Scion Image. All other

organisms (i.e., *Mytilus edulis*) were identified and counted. The average rates of growth of each *Didemnum* sp., *B. violaceus*, and *B. schlosseri* on individual panels were calculated as cm<sup>2</sup>/day.

Identical panels to those used in the community assemblage study were suspended along with the community panels to measure recruitment. They were replaced once a week and analyzed under a dissecting microscope. All sessile animals were counted and identified using Bullard and Whitlatch (2004), and the counts were averaged by month.

### *Didemnum* sp. and *Mytilus edulis*

Recruitment of Blue Mussels at the GSO site peaked in June, but fell back to very low levels in July (Figure 2). *Didemnum* sp. began to recruit at this time and eventually abundances peaked in September. On the community panels, adult mussels were visible only in August, and occurred at relatively low levels (Figure 3). *Didemnum* was first visible in August, followed by substantial increase in September and a maximum in October.



Providing Ecosystem Science and Information

## A Message From the Editor

We missed getting out the Fall/Winter 2006 issue of *Rhode Island Naturalist*. To compensate, this issue is larger than usual (e.g., there are five research articles instead of our usual three). The focus of the issue is on invasive species, following what we did in the 2006–2007 Mark Gould lecture series and our March 2007 Annual Conference.

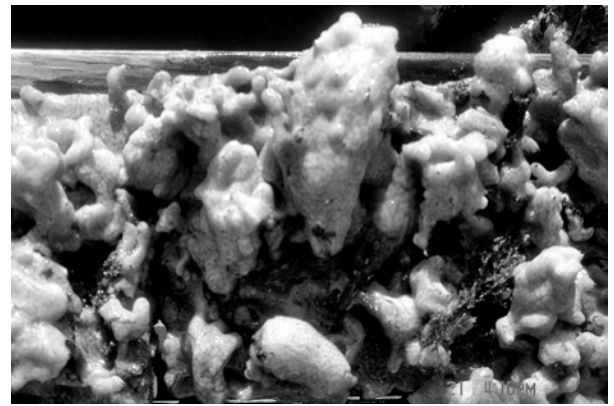
You will note that some of our continuing features are missing. There is no EIMS article, since the Survey no longer has a formal Ecological Inventory, Monitoring, and Stewardship Program or staff. Lisa Gould's "Invasives Beat," which she began in 2005, ended as such with Lisa's departure for North Carolina last year. "Notes from Field and Study," a column that Rick Enser revived from the old *Narragansett Naturalist* in our November 2003 issue, has fallen victim to Rick's retirement and departure for Vermont. We need the help of you—the members of the RI Natural History Survey and readers of *Rhode Island Naturalist*—to continue providing a quality publication. As Peter Paton's message on page 20 points out, the Survey has a remarkably dedicated and hard-working staff, but there are only three of them. Everyone else involved is a volunteer.

We need your contributions to future issues of *Rhode Island Naturalist*. We re-designed our format a few years ago for increased visibility and enhanced focus on scientific research. We now lead off with Scientific Reports, and are especially interested in your contributions there. This is the perfect time to dust off that half-finished note in the back of your desk drawer. We are also looking for your contributions in these other areas:

- Articles that would fit into either the "Notes from Field and Study" or "Invasives Beat" theme.
- Reviews of recent books related to natural history (plants, animals, habitats, geology, hydrology, soils, etc.);
- Articles on Rhode Island natural history collections;
- "Focus On" pieces featuring one of the RINHS member organizations;
- Any other information you think would be pertinent to the Rhode Island ecological/natural history community.

We publish two issues per year, in spring/summer and fall/winter. Copies of recent issues can be viewed or downloaded at our web page — <http://www.rinhs.org> (go to "Web Publications," then "RI Naturalist"). For a copy of our author's guidelines, contact me at [rkennedy@gso.uri.edu](mailto:rkennedy@gso.uri.edu) or the RINHS office at [info@rinhs.org](mailto:info@rinhs.org). Or, please contact me if you have any other questions about submitting an article.

Robert D. Kenney, editor

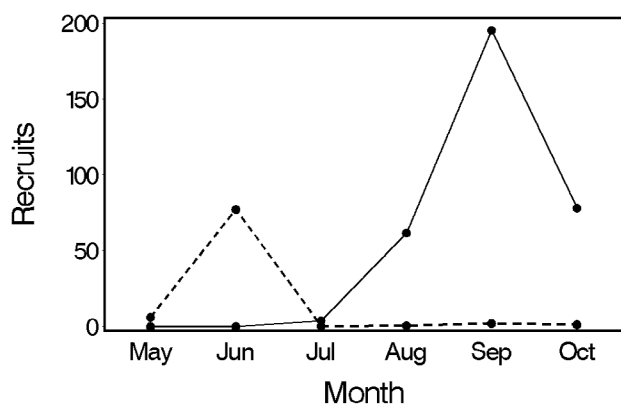


**Figure 1.** *Didemnum* sp. growing on a settlement panel hung from the URI GSO dock in 2005.

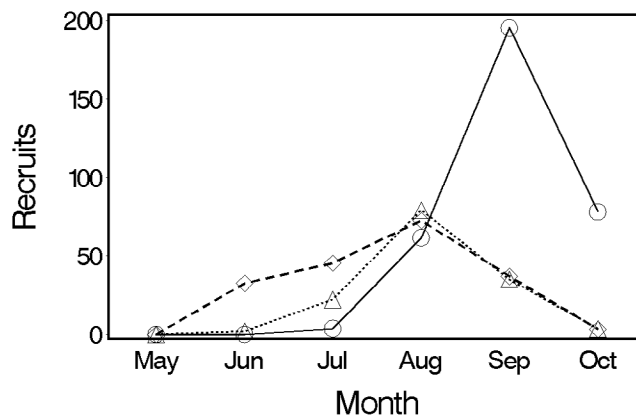
## *Didemnum* sp. and other colonial tunicates

*Didemnum* percent cover over the six-month period was compared to other colonial tunicates (*Botrylloides violaceus* and *Botryllus schlosseri*) on the community panels (Figure 4). *B. violaceus* was first present in June, and *B. schlosseri* appeared in July at slightly higher coverage. *Didemnum* sp. appeared in August, as the other two species decreased slightly, and became strongly dominant in September and October. *Didemnum* sp. appeared later in the season and had the highest growth rate ( $1.03 \pm 0.82$  cm<sup>2</sup>/day), compared to *B. violaceus* ( $0.06 \pm 0.58$  cm<sup>2</sup>/day) and *B. schlosseri* ( $0.00 \pm 0.70$  cm<sup>2</sup>/day) during each of their time present on the panels (3 months, 5 months, and 4 months, respectively); most or all of the growth by *Botrylloides* and *Botryllus* was offset by overgrowth of *Didemnum*. Comparing recruitment for the three colonial tunicates, *Botrylloides* and *Botryllus* showed peak recruitment rates one month earlier than *Didemnum*, in August, and in substantially lower numbers (Figure 5).

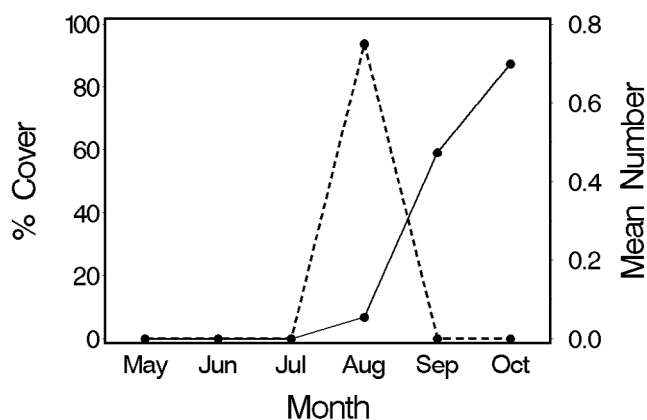
*Mytilus edulis* provides a secondary substrate for other species that grow attached to hard surfaces (Lindsey et al. 2006, Miyamoto and Noda 2004). Overgrowth of *M. edulis* by *Didemnum* sp. was observed on all panels, and it was clear that *Didemnum* used the mussel as a substrate. The decrease of adult mussels on the community panels was most likely due to overgrowth by the tunicate. However, recruitment panels also showed a significant decline in recruitment of Blue Mussels as *Didemnum* began to settle on panels. It warrants further study to determine if the decline of the mussel recruitment was due solely to *Didemnum* sp. recruitment increase, or if there were additional factors that may have affected *M. edulis* recruitment.



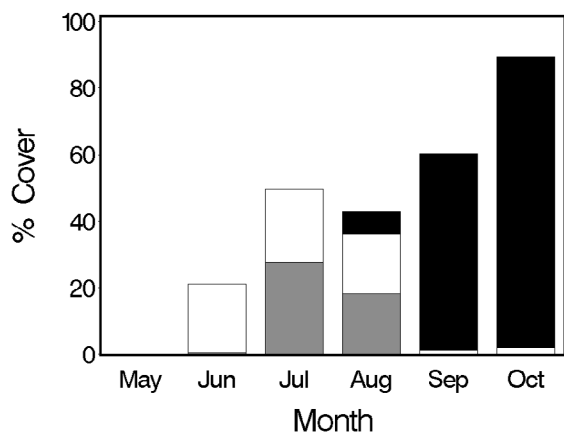
**Figure 2.** *Mytilus edulis* recruitment (dashed line, numbers of settled larvae per 100-cm<sup>2</sup> panel) peaks then declines earlier than *Didemnum* sp. recruitment (solid line).



**Figure 5.** The peak recruitment (numbers of settled larvae per 100-cm<sup>2</sup> panel) of *Didemnum* sp. (solid line and circles) at the GSO dock occurred a month later (and in greater abundance) than both *Botrylloides violaceus* (dashed line and diamonds) and *Botryllus schlosseri* (dotted line and triangles).



**Figure 3.** *Mytilus edulis* (dashed line, mean number of adults per 100-cm<sup>2</sup> panel) appeared during the month of August on the community panels and declined thereafter, as *Didemnum* sp. percent cover (solid line) increased. This decrease in visible mussels on the panels was most likely attributed to overgrowth by the tunicate.



**Figure 4.** *Didemnum* sp. (black bars) became the dominant colonial tunicate on the community panels during September and October (*Botrylloides violaceus* = white bars; *Botryllus schlosseri* = gray bars).

*Didemnum* sp. did not avoid competitors like *B. violaceus* and *B. schlosseri* and soon overtook them at the GSO dock. Competitive success depends on the types of species interacting rather than the size of the colonies (Nandakumar and Tanaka 1997), and smaller colonies of *Didemnum* were able to compete with larger colonies of other tunicates. *Didemnum* exhibits toxic properties and low pH, which may serve as further advantage to strong colonization (Bullard et al. 2007).

*Didemnum* took a longer period of time to establish itself as a dominant species in New England fouling communities than *B. violaceus*, though they were introduced at about the same time in the late 1970s (Dijkstra et al. 2007). During the past few years, however, increasingly warmer temperatures in Narragansett Bay may have allowed *Didemnum* sp. to spread more rapidly and compete more strongly with the other colonial tunicates (Stachowicz et al. 2002). It is clear that its recruitment peak was simultaneous with the temperature peak in Narragansett Bay during 2005 and the warmer summer of 2006 yielded more *Didemnum* recruits than the previous summer (L. Auker, unpublished data).

Since *Didemnum* sp. shows competitive advantage over other species, there is a danger of its potential to successfully invade other parts of the bay. If one species has a competitive advantage over each of the others, then

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eventually it takes over all the sites in a system (Durrett and Levin 1998). Bullard et al. (2007) concluded that this tunicate “may be of particular concern for shellfish, and thus the aquaculture industry, as colonies can completely overgrow the siphons of epifaunal and infaunal bivalves and lead to their death,” not to mention the threat of reducing viable fish habitat.

### Acknowledgements

Dr. Robert Whitlatch, University of Connecticut, provided equipment and his expertise. Dr. Jeremy Collie, URI GSO, and Dr. Christopher Deacutis, Narragansett Bay Estuary Program, contributed their advice and insight into this project. A draft of this manuscript was improved by the comments of Jennifer Dijkstra. The study was funded in part by a Rhode Island Natural History Survey Wald Grant.

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*Linda Auker completed her M.S. degree at the URI Graduate School of Oceanography, where she wrote her thesis on the distribution and ecology of Didemnum sp. in Narragansett Bay, and is now a Ph.D. student at the University of New Hampshire. Dr. Candace Oviatt, Linda's M.S. thesis advisor, is a Professor of Oceanography at the University of Rhode Island.*

