

SCIENTISTS CRYING “FOUL” SEA SQUIRTS ARE INVADING LONG ISLAND SOUND!

by Stephan Bullard, Robert B. Whitlatch, Sandra E. Shumway, and Richard W. Osman

"Our waters are being invaded by new species almost faster than we can identify them. Unfortunately we cannot predict which will cause harm, and which will not, so we must do what we can to prevent all new invaders. You never know when the next invader will cause serious problems, like this new species of *Didemnum*. Invaders such as *Didemnum* are not just a problem for conservation or protection of native species, but they also cause serious economic harm to industries such as shellfish aquaculture. This is one case where industry and conservation should really on the same side. The collaboration of scientists and aquaculturists in this important study will provide much needed and useful information. It is best for everyone if we can keep out dangerous invaders from our waters." –Dr. Dianna Padilla, SUNY Stony Brook

Sea grape, sea peach, sea pork, sea vase, golden star tunicate.....these are just a few of the sea squirts or ascidians that inhabit Long Island Sound's waters. The names sound pleasant enough, but they are frequently aliens – species that have come to our coast from foreign waters. Most of them are unwanted invaders, known to scientists as invasive species. They live in a variety of habitats and can be harmonious members of the bottom-dwelling assemblages of plants and animals, or can cause serious fouling problems.

Many people are familiar with the devastating impacts that the more notorious invasive species such as zebra mussels, gypsy moth, kudzu and snakeheads have had on terrestrial and freshwater environments. Few people other than resource managers and environmentalists are as aware of the terrible impacts invasive species have on the marine environment. For example, in the Mediterranean and southern California, the seaweed *Caulerpa taxifolia* has covered large areas of the seabed resulting in reduced fish and invertebrate populations. The ctenophore or comb jelly, *Mnemiopsis leidyi* (a jellyfish-like organism) has devoured plankton and food of fish and caused fisheries to collapse in the Black and Caspian Seas. Cannonball jellyfish (*Stomolophus meleagris*) have devastated larval fish populations in the Gulf of Mexico.

Unfortunately, invasions by sea squirts are becoming uncomfortably common. For instance, 14 species of sea squirts have invaded California in the last century, eight of these within the last 22 years. Similar rates of invasions occur in other areas of the world. Some of these sea squirts have major ecological or economic impacts

on the areas they invade. In Canada, huge masses of *Styela clava* and *Ciona intestinalis* have overgrown cultured mussels. These sea squirts compete with the mussels for food and space and are very costly and difficult to remove during mussel harvesting. Similar problems are being encountered here in Connecticut and elsewhere in New England.



photo: Sandra Shumway, UConn

A fouling community dominated by sea squirts growing on a rope. Sea squirts are one of the most common fouling animals in Long Island Sound. They are very common on docks, pilings, and jetties. This rope had been submerged for about one year in Groton, Connecticut.

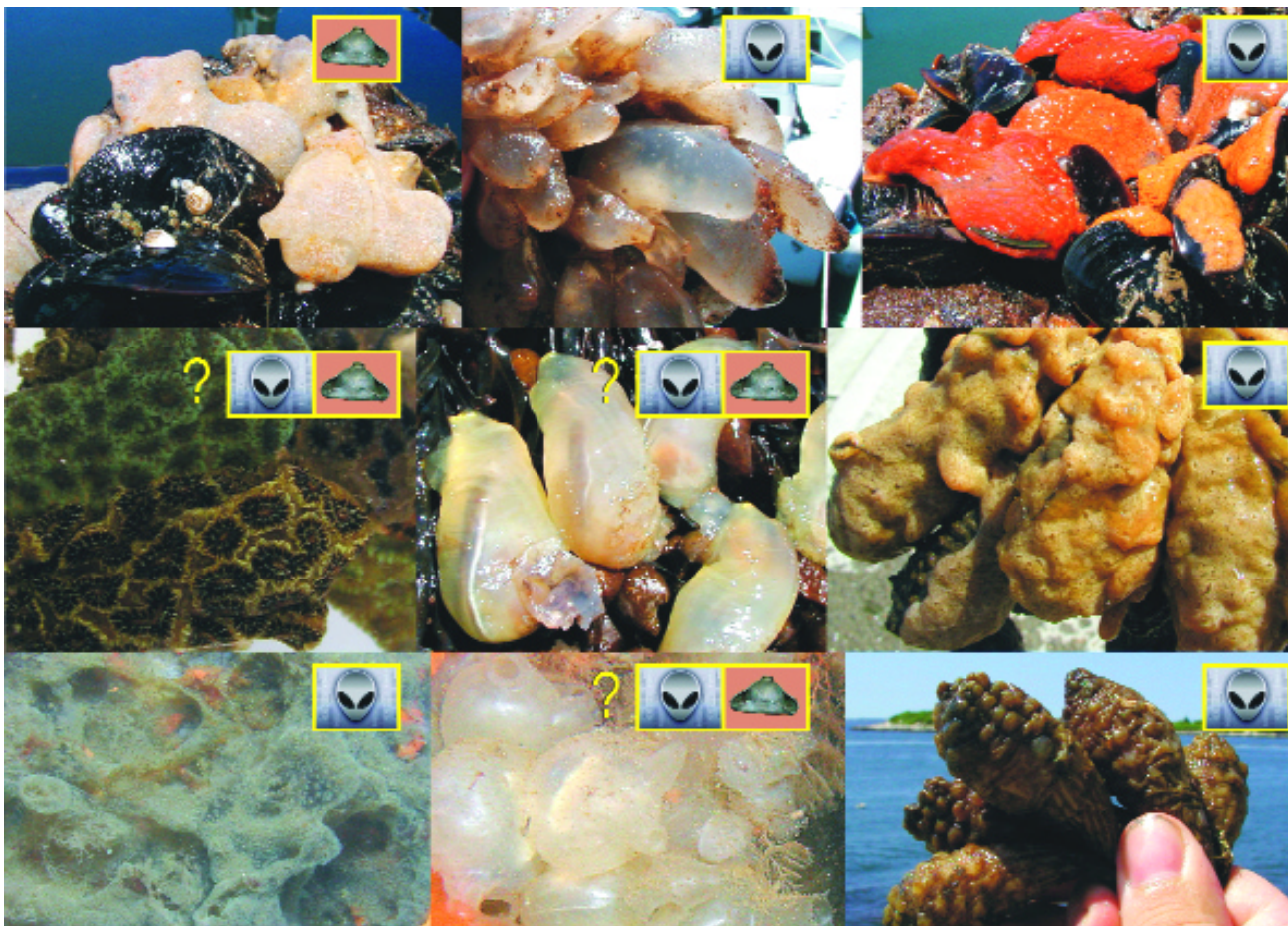
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How can such small and seemingly harmless creatures cause so much trouble?

When sea squirts invade a new area, they can quickly replace resident plants and animals. They are prolific and spread quickly by overgrowing and smothering other organisms. In addition some sea squirts contain powerful noxious chemicals or exude acids that help protect them from predators by making them unpalatable to some consumers such as cunners and spider crabs. Sea squirts can affect economically important species such as clams, mussels, scallops, oysters, and other shellfish by competing for food and space. They can also wreak havoc on aquaculture facilities by fouling nets, cages, pipes and other structures. Additionally, they can form dense mats on the underside of boats, which can slow them down and lead to increased fuel costs.

A few sea squirts are native to New England, but most have arrived here as the result of biological invasions, likely hitching rides on the bottoms of boats coming from distant ports in Europe, Asia and the southern hemisphere. Of the species most commonly found in Long Island Sound, only two are currently recognized as native, and some have been resident for so long that their status as native or invasive is debated. The rest are newcomers. Two of the more recent invaders, the bright orange to red colored colonial *Botrylloides violaceus*, and the green colored colonial *Diplosoma listerianum* arrived in the region about two decades ago. The white to pinkish/orange colored *Didemnum* sp. is the most recent arrival and reached the region about five years ago from either Asia or Europe. Since their arrival, all of these species have become very abundant in Long Island Sound.

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Common sea squirts from Long Island Sound. An alien head indicates an invasive species. A tri-corner hat indicates a native or well-established resident species. A question mark means we're not entirely sure. Top row, left to right: Sea pork *Aplidium constellatum*; *Ascidiella aspersa*; Compound tunicate *Botrylloides violaceus*. Middle row, left to right: Golden star tunicate *Botryllus schlosseri*; Sea vase *Ciona intestinalis*; Carpet tunicate *Didemnum* sp.; Bottom row, left to right: *Diplosoma listerianum*; Sea grape *Molgula manhattensis*; Asian stalked tunicate *Styela clava*.

Wrack Lines

Sea squirts invading LIS... continued

photo: Jeff Mercer, UConn



Stephan Bullard returning from a dive with *Didemnum* in hand. At sites near Groton, Connecticut, huge colonies of *Didemnum* cover many submerged rocks.

The most recent invader, *Didemnum*, doesn't have a common name, but has been referred to as "pancake batter" and "alien vomit" in recent press reports. As the name suggests, the animal resembles soggy scrambled eggs. We prefer the name **carpet tunicate**. It grows much like the creature from the movie "The Blob" and forms slimy mats that blanket just about everything in its path including huge areas of the seafloor. For example, on Georges Bank, the species covers 50-90% of the available space over a 27 square-mile area. At sites where *Didemnum* covers large areas of the seafloor, its mat-like structure may smother organisms in the sediments. This can reduce the food supply for bottom feeders and prevent the larvae and juveniles of many species from becoming established. It may also cover the resting crevices of fishes such as cunner and tautog and expose them to greater predation. Populations of *Didemnum* currently exist in the eastern end of Long Island Sound and the species will likely spread throughout the Sound in the near future. At one site near the Latimer Lighthouse (north of Fishers Island), *Didemnum* covers more than 50% of the bottom in an extensive area.

It's not just a local issue. *Didemnum* is generating a great deal of concern from scientists and coastal zone resource managers worldwide. Expanding populations have been reported from Western Canada, New Zealand, Europe, and both coasts of the United States. It currently ranges from Maine to Long Island on the east coast and from central California to British

Columbia on the west coast of the U.S. The carpet tunicate was first seen in the U.S. off the coast of Maine in 1988 and arrived in Connecticut in 2000.

Now, this species is a global problem. Unlike most other alien sea squirts which are typically restricted to living in shallow-water, protected harbors and bays and are only found attached to hard substrates (e.g. pilings, rocks, soda cans), the new invader has the ability to grow on gravel and cobble bottoms in much deeper waters. It commonly overgrows various sea squirts as well as algae, scallops, mussels and other shellfish which are particularly vulnerable because most are sessile and have no way to escape the encroaching *Didemnum* or other species that foul their shells and aquaculture cages, (see page 8) and under some circumstances colonies can completely overgrow and smother shellfish.



photo: Jeff Godfrey, UConn

The carpet tunicate *Didemnum* sp. blankets the bottom of Long Island Sound near Latimer Lighthouse. This site is about 100 feet deep and has a gravel bottom. When *Didemnum* forms thick mats like this it can smother organisms in the sediments, prevent larvae from settling, and reduce the number of hiding places for bottom-dwelling fishes and other animals.

Very little is known about the general biology of *Didemnum* sp. or the specific impacts that it has on shellfish and aquaculture. This summer, scientists from the University of Connecticut, the University of Hartford, the Smithsonian Institution and the University of South Florida are in the process of documenting its growth rates in different habitats, its effects on shellfish, aquaculture, and its ability to reproduce by fragmentation.

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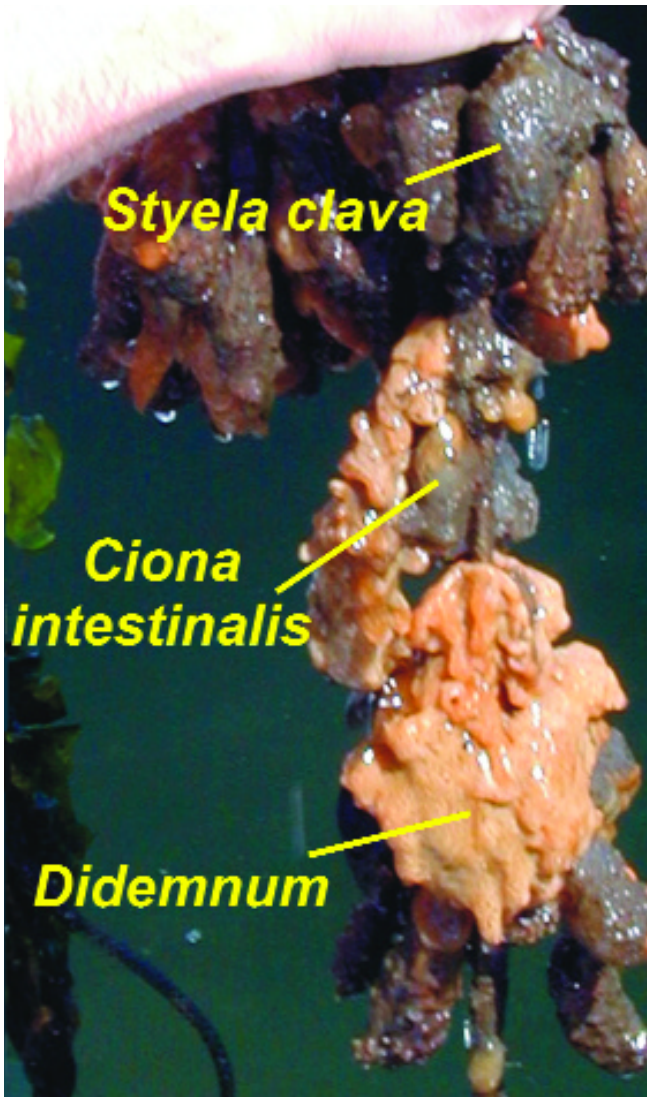


photo: Stephan Bullard

Didemnum on a rope, overgrowing other sea squirts.

AN ECOLOGICAL AND FINANCIAL MENACE

What can be done about invasive sea squirts?

At present, not much. The best means of control is prevention of introduction—keep them from invading in the first place. On average, one new species of sea squirt has invaded the east coast of the U.S. every five years. Most invasive sea squirts reach new areas on the hulls of ships or in ballast water. Commercial and recreational boaters can help prevent the spread of sea squirts by maintaining clean boat hulls. These animals are tiny and clever and often attach to hulls in places where anti-fouling compounds are not applied. Keeping boat hulls clean can greatly reduce the ability of invaders to spread.

With support from National Sea Grant’s Aquatic Nuisance Species research initiative, a collaborative study is underway between UConn scientists Bob Whitlatch and Sandy Shumway, Stephan Bullard (University of Hartford), Rick Osman (Smithsonian Environmental Research Center), economist Chuck Adams (University of South Florida/Florida Sea Grant), and Connecticut Sea Grant Extension Educators Tessa Getchis and Nancy Balcom. This team is studying the ecological and economic impacts the invaders have on shellfish aquaculture. In addition, they will be assessing how biological control methods may be used to reduce the impacts of ascidians in aquaculture operations. Studies are underway to assess the extent of threat to scallops, mussels, oysters and quahogs. For some animals, it may be a matter of too much fouling on their shells to allow them to function properly; for others it may be loss of habitat or smothering by the rapidly spreading and encroaching mats of *Didemnum*.

Sea squirts are eaten in some Asian and South American countries (see next page), but the taste for

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photo: Sandra Shumway, UConn

A sea squirt in action. A large *Ascidella aspersa* squirts water from its siphon.

JUST WHAT ARE ASCIDIANS?

Ascidians or “sea squirts” are a group of soft-bodied marine invertebrates that grow on hard surfaces such as rocks, eelgrass blades, shells of bivalve molluscs, docks, pilings, and boat hulls. They can grow either individually or in colonies. Solitary sea squirts typically look like small cylinders or round balls about the size of grapes. In fact, one common species is called “sea grape”. Colonial ascidians, on the other hand, grow in thick, slimy mats that can range from dime-sized to huge colonies as large as sheets of plywood.

Sea Squirts Invading...continued from previous page

these animals is highly acquired and few Americans enjoy eating them – one of us likens the pickled variety to sulphur-flavored sandpaper! In addition, many sea squirts are poisonous and, while this provides them with a built-in defense against predation, they cannot be utilized as a food source for humans.

You might not suspect it, but sea squirts are chordates which puts them in the same scientific grouping as vertebrates (the group that includes fishes, amphibians, reptiles, birds and mammals), i.e. sea squirts are really our marine cousins.

As adults, sea squirts are sessile. Sea squirts obtain their food by filtering small particles out of the water through siphons. Large sea squirts often spray water from their siphons when they are picked up, giving them their common name “sea squirts”.

Most invasions of non-native marine species are the result of human-related uses of the coastal zone. For example, the hulls of early sailing vessels are recognized as an important vector contributing to the spread of non-natives throughout the world. We are also beginning to understand better how alterations in coastal land use patterns and global climate change may actually be facilitating the invasions of some species. While sea squirts are but one group of marine invaders, they are becoming alarmingly abundant throughout many regions of the world and often pose a threat to native biodiversity and economically important shellfish. It is only through a better understanding of the biological and ecological aspects of the non-natives, that we can begin developing ways of controlling or reducing the impacts of them on our coastal waters.

“As an oyster farmer for the past 18 years, I can attest to the burden that these fouling organisms pose to those of us who work with cages, lines, buoys and gear in the waters of New England. In a matter of weeks a clean piece of gear can become totally occluded by sea squirts to the point where water flow is severely restricted, and growth of our target organisms is being stifled. A significant portion of my labor budget is devoted to controlling sea squirt infestation. The aquaculture industry up and down the East Coast would be grateful if any new control strategies could be developed to minimize or eliminate these pests.”

–Dr. Robert ‘Skid’ Rheault, Moonstone Oysters.

About the authors: Stephan Bullard is a faculty member at the University of Hartford. Robert B. Whitlatch and Sandy Shumway are faculty members in marine sciences at the University of Connecticut. Richard Osman is a researcher with the Smithsonian Environmental Research Center.

Squirts for dinner?

While few animals eat sea squirts, they are eaten and considered a delicacy in many Asian countries.

This photograph illustrates a Korean dish known as **Mideodok-chim** (steamed *Styela clava*). It is a stir fry of beef, clams, vegetables, and the clubbed sea squirt *Styela clava*.

*Like whiskey,
it's an acquired taste.*

Stephan Bullard prepared the meal pictured. He said the taste was "ok" but the thick, vinegary odor kept him from eating much. Kashmir pepper is a good choice for the red pepper powder.

Warning: this dish may not appeal to everyone!



photo: Stephan Bullard

RECIPE

Variation on Mideodok-chim

Ingredients

Roasted Rice 3 Tbsp.
 Styela: 4 oz (100g)
 Beef: 4 oz (100g)
 Clam meat: 4 oz (100g)
 Watercress: 4 oz (100g)
 Bean Sprouts: 4 oz (100g)
 1 medium onion
 1 green pepper
 Water: ½ cup
 Red pepper powder: ½ tsp.
 Paprika: 1 Tbsp.
 Salt: 1 tsp.
 2 green onions
 Garlic: 1 Tbsp. chopped
 Peanut oil*: 1 Tbsp.

**Be sure your guests don't have peanut allergy.*

Instructions

Prepare 3 Tbsp. roasted ground rice and mix with ½ tsp. red pepper powder, 2 tsp. paprika, ½ tsp. garlic powder

Stir fry beef and clams lightly

Steam onions, green pepper, bean sprouts, and watercress (½ stems, ½ leaves), garlic

Steam *Styela clava* separately.

Once steaming is complete, heat 1 tbsp of peanut oil* and stir fry all other ingredients (vegetables, meats, roasted rice mixture) together. Once heated, add green onions.

Serve over steamed rice.

Serves 4 or more, depending on squeamishness of the guests.