July 2006

Hull Fouling's a Drag on Boats and Local Ecosystems

Nancy C. Balcom
nancy.balcom@uconn.edu

Hull Fouling's a Drag on Boats and Local Ecosystems

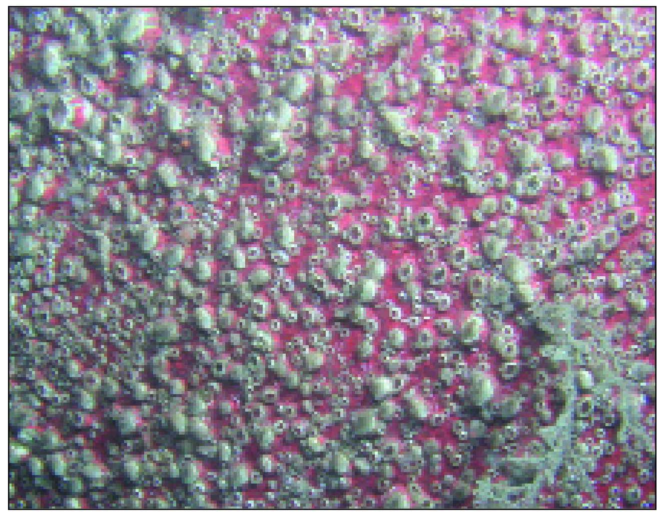
Nancy C. Balcom

At last, it's time. The gear is stowed, the course charted, and the lines released. Backing away from the Floridian dock that has been your home away from home for five months, you head your boat towards the Intracoastal Waterway and north to New England. Did you do everything necessary to prepare for the journey?

Mental checklist: PFDs... flares... radio.... fuel... food... MSD... weather report... electronics.... clean hull... ***CLEAN HULL?***

Why on earth would cleaning the boat hull be on a "to do" list of preparations before making a long journey? The answer: fouling organisms. As every boat owner knows, that gleaming, slick hull surface on a new boat in the showroom does not stay that way once the boat is put into the water, particularly salt water. Over time, a slimy "biofilm" of bacteria and microscopic algae adheres to the boat hull, paving the way for the attachment of other organisms, including barnacles, seaweeds, bivalves, bryozoans, sponges, sea squirts, polychaete worms, and sea anemones. In the absence of regular maintenance, the boat hull becomes increasingly fouled, carrying its own marine microcosm along. The "drag" or friction that results from this entourage slows sailboats and causes power boats to use more fuel, which at today's fuel prices can turn a brief boating jaunt into a pricey proposition. Heavy fouling can diminish the maneuverability of a boat as well. Leaving a fouling community attached to a boat hull for too long can damage the paint and lead to overall deterioration of the boat.

Another major concern, and the focus of this article, is the attached organisms themselves. Think about a boat docked for months in Florida or the Caribbean somewhere, accumulating fouling organisms, which is then brought to a marina in Mystic, Connecticut and again moored for months. That boat hull can serve as a vector or pathway for inadvertently introducing non-native marine species into Long Island Sound waters. Could this happen? Absolutely! According to the U.S. Coast Guard, thousands of privately-owned sailboats and power boats transit along the eastern seaboard, making annual year-round sojourns between Florida and New England. The potential is there for this vector



Hull fouling organisms such as these barnacles can cover a very large surface area, slowing speed and increasing the cost of fuel.

to be significant, but little was known about the role these vessels actually play in invasive species transport until now.

Sea Grant-funded researchers Robert Whitlatch (University of Connecticut) and Richard Osman (Smithsonian Environmental Research Center) have spent the past two years assessing the role of hull fouling on privately-owned vessels as a transport vector for non-native species. The research team surveyed boats and marinas for fouling organisms before they left their 'winter' ports in Florida in early May and at several traditional stopover ports in North Carolina, Connecticut and Rhode Island as the boats moved northward to their 'summer' ports. "In addition to surveying the

continued on next page

continued from previous page

hulls, taking digital images, and collecting samples of the organisms, we gathered information on the history and method of hull maintenance, the ports visited, and the routes taken north from each of the boat owners who volunteered to help us with our survey," said Whitlatch. "The response from the marina operators and boat owners we approached was extremely positive. Although some had never heard of invasive species, they were all very interested in what we were doing."

That interest is not surprising, given the effect that fouling organisms can have on a boater's wallet. It has been estimated that in tropical waters, the amount of fouling on a boat increases by about 10% for every five months it spends moored and uncleaned. While many of the organisms making the south to north transit may not survive the trip, some inevitably will, finding conditions suitable for survival and successful establishment. These newly-introduced organisms can compete with native species for space and other resources, threaten the viability of important fisheries or aquaculture operations, or introduce a devastating disease or harmful algae to the region.

This method of species transport is hardly new. Introductions of non-native aquatic invasive species are occurring all over the world, and have been for centuries. Recent efforts are focusing on ways to interrupt or block the pathways of these introductions, to reduce the rate and number of new occurrences.

The New England region is particularly vulnerable to the introduction of exotic marine species. Cape Cod divides the region into two generalized thermal regimes, with the colder Boreal "province" to the north and the warmer Virginia "province" to the south. Because of this, many species are at the limits of their distributional ranges and are very susceptible to being replaced by newly-introduced species. The Northeast region is also subject to a lot of commercial ship and recreational boat traffic, thus there are a lot of boat hulls traversing these waters.

One way to slow the rate of hull fouling is the use of antifouling paints on boat and ship hulls, but it does not prevent attachment altogether. For example, even when these paints are used, marine organisms can cover about half of the submerged surface of a boat moored in tropical waters within two years of being painted. Most antifouling paints contain elemental copper, cuprous oxide, or tinoxide compounds which kill marine organisms trying to attach to the painted surface. By design, these paints are toxic to marine life and their use is regulated. According to Elke Sutt, who developed the

Robert B. Whitlatch (squatting) and members of his research team double-check equipment on a dock before examining it, and boats at the marina, for fouling organisms.

Clean Marina Program for the Connecticut Department of Environmental Protection, the use of antifouling paints formulated with any tin compound as a biocide has been banned in the U.S. on vessels less than 25 meters long (unless they are aluminum) since 1988. However, antifouling paint containing tin can be used on the outboard motor or lower drive unit of these vessels, as long as it meets EPA standards. There is currently no ban on the use of copper-based antifouling paints. Other antifouling products, like Teflon®, silicone, wax, and polyurethane, have limited negative environmental effects, and their use by boaters is increasing.

In addition to using antifouling paints, how and how often a boat hull is cleaned can also play a role in reducing the possibility of viable introductions of non-native species. For example, when a boat is hauled out for hull maintenance, how and where are the organisms disposed of that are scraped off the hull? Keeping them away from the water will prevent any viable organism from possibly establishing. What about the timing and location of in-water hull cleaning? This goes back to the earlier mental checklist: clean organisms off the hull *before* leaving port.

So, how big a problem is hull fouling? We certainly hear a lot about ballast water as a significant vector for aquatic invasions. How does hull fouling compare to ballast water? Certain areas of a vessel such as the dry dock strips on the keel, the seawater intakes, and the anchor wells act as havens where organisms can attach.

continued on next page

Hull Fouling...continued from previous page

Studies from the North Sea indicate that hull fouling species sampled from commercial vessels contained a higher percentage of non-native species than ballast water and ballast water tank sediments collected from those same vessels. The percentage of non-native species likely attributed to ship fouling (40-60%) is equal to or greater than the other two major modes of species introductions–mariculture and ballast water. Researchers conclude that 69% of the recorded marine species introduced into New Zealand waters were transported there on vessel hulls. An estimated 70% of the non-native coastal marine species living in Hawaii likely arrived clinging to ship hulls as well.

It's not just the commercial ships, either. Smaller, privately-owned boats are also an important vector of non-native species transport. Several devastating introductions—the Japanese seaweed, *Undaria pinnatifida,* and the fanworm, *Sabella spallazanii*)—to Australian, New Zealand, and Tasmanian waters have occurred via privately-owned vessels.

Coastal marinas are designed to be havens, protecting the vessels within from adverse weather conditions and strong currents. The chances that an organism may be flushed into or out of a marina may be reduced as a result. Researchers suggest that this also makes marinas ideal incubation sites for fouling species. The floating docks, pilings, and mooring buoys provide a large surface upon which organisms can grow, as well as refuge from predators. Recreational boats also remain moored in marinas for longer periods of time, making them susceptible to settling invertebrate larvae and algal spores. Whitlatch and Osman's data show that the recruitment rates of fouling organisms in enclosed Connecticut embayments are much greater than the rates for adjacent coastal waters.

As part of the hull fouling-as-a-vector study, and with the permission of the boat owners and marina operators, Whitlatch, Osman, and members of their research team made dives to survey and photograph the boat hulls. They recorded the percentage of fouling cover on the hulls, keels, rudders, propeller shafts, and propellers. They collected voucher specimens using an underwater suction sampler to confirm the identifications made from the digital images. In all, the hulls of more than 100 vessels ranging in size from 34'-155', and the pilings and floating docks of 15 marinas were sampled. About a quarter of the boats examined were sailboats; the remainder were power boats.

"Frequent Foulers"

The survey data are still being analyzed, however, preliminary results suggest that the species fouling hulls generally correlated with the fouling fauna found in the 'winter' port. Barnacles, bryozoans, and polychaete worms were the most frequently identified; ascidians or sea squirts, sponges and bivalves were less common.

As one might expect, the degree of hull fouling cover ranged from zero to heavily-fouled. No correlation was found between the amount of fouling and vessel size, or where the vessel was moored at the time. Sailboat hulls had a slightly higher number of fouling species on them than power boats. On the majority of vessels examined, the amount of fouling 'coverage' ranged from less than 10% of the below-water surfaces to more than 80% of the below-water surfaces. Rudders,

continued on next page

Boaters beware–
It's not just a problem for marine waters!

Boaters and anglers using freshwater lakes and ponds can also serve as a vector of aquatic invasive species introductions. Bait bucket water or live wells should be drained away from the lake and live bait should never be released into a water body unless it was originally caught there. Dispose of unused live bait in the trash or share it with another angler. Do not empty live or bait buckets into the lake itself as larval organisms may be present, invisible to the naked eye.

As of 1 October 2003, it became **illegal in Connecticut** to transport vegetation on boat vessels or trailers. Violators face a fine up to $100 per plant and a mandatory court appearance. This regulation was passed to help protect Connecticut lakes from the problems caused by invasive aquatic weeds. Eurasian water milfoil, fanwort, and hydrilla damage local aquatic ecosystems, diminish recreational activities such as swimming, boating and fishing, and can adversely affect the value of lakeside properties. Lake associations, local communities, and state resource managers spend a lot of time and money working to reduce or eliminate the effects of these weeds annually through approved herbicide applications, mechanical harvesting, hand-pulling or hydroraking, or drawn-downs of local dams.

continued on next page

Hull fouling... continued from previous page

propellers, and propeller shafts typically had the greatest amount of fouling, while hull surfaces and keels had the lightest amount of fouling.

"While our findings to date indicate that many of the hulls are very well-maintained by owners or operators, it should be recognized only a small number of organisms attached to a hull are needed to create new populations as the vessel moves along the coastline," noted Whitlatch.

Most of the vessel operators follow a regular schedule of hull maintenance that includes yearly or bi-yearly renewal of the bottom antifouling paints and periodic inspections of the hull to assess the degree of fouling. Most rely on copper-based antifouling paints, and some use brushes or coarse cloth to periodically remove fouling organisms from the hulls of their boats.

CTSG Extension is collaborating with Whitlatch's project team and other Sea Grant programs in the Northeast to develop educational and outreach materials for transient boaters that describe both the role hull fouling can play as a vector of non-native species introductions and the various hull maintenance and hull-cleaning techniques that boaters, marina operators and boat yards can utilize to reduce or minimize the potential for inadvertent introductions. These materials will be made available to the target transient boaters with the help of cooperating marinas, boater chat rooms, boating magazines, and the Clean Boater and Clean Marina programs that operate in many coastal states. (In Connecticut, these programs are managed by the Connecticut Department of Environmental Protection Boating Division in Old Lyme.)

In the near future, look for posters asking… "Traveling the intracostal waterway? You may not be the only thing your boat is carrying along for the ride…" or stating "Fouling organisms are not only a *DRAG*, they can also *INVADE* new waters…" Connecticut Sea Grant will be bringing them soon to a marina near you.

"We are very keen to continue this project and find additional vessel operators/owners who are interested in participating in our survey work," said Whitlatch. "Given the number of privately-owned vessels that regularly move along the eastern seaboard, the more information we can obtain can only increase our understanding of the role of these vessels as potential vectors of the movement of aquatic non-native species."

Nancy C. Balcom is Connecticut Sea Grant's Extension Leader.

See inside back cover for more great ANS resources.

Comprehensive ANS Management Comes to Connecticut

For the past two years, the drafting of a comprehensive aquatic nuisance species management plan for the State of Connecticut has been underway. The plan development effort is led by Connecticut Sea Grant's Nancy Balcom and Connecticut DEP's William Hyatt and Nancy Murray, with the assistance of Patricia Bresnahan of the Connecticut Institute of Water Resources. A grant from the National Sea Grant College Program provided support for the project. More than 50 individuals representing lake associations, water and power companies, research institutions, nurseries and water garden suppliers, pet retailers, and resource management agencies have been meeting to frame the plan to address management, research, and educational objectives.

Public meetings on the draft plan were held in late June and early July, 2005. Following preliminary review by members of the federal Aquatic Nuisance Species Task Force (ANSTF), it has been sent to state agencies for review, and hopefully, approval. Upon acceptance at the agency level, the plan will be sent to Governor Rell for consideration. Acceptance of this plan by key state agencies and the Governor will not only elevate the issue of aquatic nuisance species statewide, but it will also provide a framework to address the problem in a coordinated, comprehensive fashion. Further, the state plan can be submitted to the ANSTF for formal review. Acceptance of the plan at the federal level will make Connecticut eligible to apply for federal funds to help implement the plan.

For more information, contact Nancy Balcom via email at nancy.balcom@uconn.edu or telephone (860) 405-9127.