BALANCING RECREATIONAL BOATING, INVASIVE SPECIES PREVENTION, AND WATER QUALITY PROTECTION

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Keywords: recreational boats, invasive species, water quality, hull transport, antifouling paint

INTRODUCTION

California's boating industry contributes $16 billion per year to the state's economy (CSU, Sacramento Foundation 2002). Impacts from invasive species introductions and from toxic antifouling bottom paints continue to affect California's ecosystem. The University of California Cooperative Extension- Sea Grant Extension Program in San Diego has been working on cost-effective programs for boaters to prevent hull transport of aquatic invasive species (AIS) and to protect water quality by reducing the use of toxic antifoulants.

BACKGROUND

Antifouling paints are under regulatory scrutiny in California due to elevated levels of dissolved copper in crowded boat basins. Total Maximum Daily Load programs to regulate copper from antifouling paints are complete or are underway in a few, southern California coastal areas. The California State Water Resources Control Board will require 76% reduction of copper discharges from antifouling paints in Shelter Island Yacht Basin of San Diego Bay by 2022 (CRWQCB, SDR 2004). Other parts of San Diego Bay have been listed on the California SWRCB 303(d) list of impaired water bodies for dissolved copper (CSWRCB 2006) and actions in other southern California boat basins suggest copper antifouling paints may soon be restricted elsewhere in the region (CRWQCB, LAR 2005; USEPA 2002). State and national action may further restrict copper-based antifouling paints. California Department of Pesticide Regulation and United States Environmental Protection Agency (USEPA) (Singhasemanon 2005) are reevaluating antifouling paints and USEPA is considering lowering the standard for dissolved copper in saltwater from 3.1 µg/l to 1.9 µg/l (USEPA 2003). Some scientists and regulators fear that antifouling paint restrictions may increase the risk that aquatic invasive species (AIS) will be carried on vessel hulls.

The entire California coast has experienced invasions by species not native to the state or to the area of the coast where they have been discovered. Invasive species threaten biological diversity and ecological integrity worldwide. They can permanently reduce biodiversity by preying on, parasitizing, out-competing, causing or carrying diseases, or altering habitats of native species. (Convention on Biological Diversity 2005) Some AIS cause or carry human diseases or foster other species that do (Brancato and MacLellan 1999). Hull-borne invasive species can cause severe economic and ecological damage. Some can damage shorelines, man-made marine structures, equipment, and vessels,

requiring costly repair or replacement. For example, the Atlantic shipworm (*Teredo navalis*) introduced by hull fouling, caused between $2 billion and $20 billion worth of damage to maritime facilities in San Francisco Bay in the early 20th century. (Cohen 2004)

WATER QUALITY AND INVASIVE SPECIES

The potential statewide ban of copper-based antifouling paints in California may exacerbate invasions as the toxicity of vessel hulls declines and water quality improves in coastal ports and harbors. On the other hand, native species may be more resistant to invasions if water quality improves. Although antifouling paints contribute to fouling control, recent studies indicate that hull fouling is still an important vector for invasive species. (Rainer 1995; Coutts 1999; Hewitt et al. 1999; Hewitt and Campbell 2001) In part this is because toxic antifouling paints simply slow fouling growth; they do not prevent it from becoming established on vessel hulls. Periodic, mechanical, hull cleaning is needed even when antifouling paints are present (Johnson and Miller 2002). Additionally, despite the biocidal action of antifouling paints, some species have evolved resistance to copper-based antifouling paints (Hall 1981). Resistance to heavy metals is a potentially important trait for introduced marine organisms, facilitating their successful invasion into disturbed natural communities (Piola and Johnston 2005).

RECOMMENDATIONS

The Hazard Analysis and Critical Control Point (HACCP) approach is becoming the standard for aquatic invasive species management. HACCP principles include identifying critical control points (CCPs), establishing controls for each CCP and establishing CCP monitoring requirements (AIS-HACCP 2004).

The CCPs are the points where removing fouling growth from hulls and underwater running gear and where using antifouling paints will be most effective in preventing or controlling invasive species transport. Focusing efforts on these CCPs helps to reduce costs and avoid unnecessary inconvenience. This approach begins by identifying vessels and situations that pose a higher risk of transporting and introducing hull-borne invasive species, taking into account those that pose a higher risk of contributing to elevated metal levels from antifouling paints in boat basins. Boat owners, marina managers, resource managers, scientists and others can help to develop this information. They can use it to decide how and when to deploy antifoulants, hull cleaning and other practices, to design research to improve practices, and to design long-term solutions.

The HACCP approach has been considered in developing the following recommendations for preventing the hull transport of AIS while protecting water quality. These practices are enhancements of existing, hull-husbandry practices and thus should be reasonably easy to adopt:

- Clean the hull before leaving the home harbor to travel to a distant region, island or to an event with boats from other areas.
- Boat owners, who have left their home region or visited a major port, should clean hulls before traveling to a new destination or returning home.

- Upon arrival from a distant region or major port, heavily fouled boats should be hauled for hull cleaning.
- Removed material should be contained and disposed to prevent release to local ecosystems.

Some additional recommendations take into account boater trip distances. Boats that do not travel long distances are less likely to encounter potentially invasive species. Thus, the most reduction in pollution with a low risk of AIS transport could be achieved if such boats used nontoxic hull coatings with companion strategies, such as slip liners or frequent, in-water hull cleaning. Boats that travel long distances are most likely to acquire and transport invasive species. These boats may be better candidates for copper-based or less toxic antifoulants, as opposed to nontoxic hull coatings. Because they are relatively few in number and spend more time at sea, they would discharge relatively less toxicant to confined, marina waters.

By following the recommendations based on their own situations that may pose risks of transporting AIS or contributing to water quality degradation, boaters can adapt the HACCP approach and take matters into their own hands to protect water quality and prevent the hull transport of invasive species.

The University of California Cooperative Extension-Sea Grant Extension Program of San Diego County continues to conduct outreach programs on these recommendations for the boating communities of California and Baja California.

LITERATURE CITED

Aquatic Invasive Species- Hazard Analysis and Critical Control Point Training Curriculum. 2004. J. Gunderson and R. Kinnunen, eds. http://www.deq.state.mi.us/documents/deq-ogl-AIS-HACCP_manual.pdf Accessed February 2, 2007.

Brancato, M.S. and D. MacLellan. 1999. Impacts of Invasive Species Introduced through the Shipping Industry (abstract). Oceans 1999 MTS/IEEE. Riding the Crest into the 21st Century. Volume 2: 676. September 13-16, 1999. Seattle, WA. ISBN: 0-7803-5628-4.

California State University, Sacramento Foundation. 2002. California Boating Facilities Needs Assessment. Volume V: Boating Economic Assessment and Demand Projections. California Department of Boating and Waterways, Sacramento, CA.

California Regional Water Quality Control Board, Los Angeles Region. 2005. Draft Total Maximum Daily Load for Toxic Pollutants in Marina del Rey Harbor**.** http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/marina_del_rey/toxics/05_0803/MdR%20Toxics%20Staff%20Report.pdf Accessed February 2, 2007.

California Regional Water Quality Control Board, San Diego Region. 2004. Total Maximum Daily Load for Dissolved Copper in Shelter Island Yacht Basin, San Diego Bay, Public Review Draft revised October 14, 2004. http://www.waterboards.ca.gov/sandiego/tmdls/tmdl_files/shelter%20island/SIYB

%20TMDL%20Tech%20Rept%2010-14-04%20rev1.pdf Accessed February 6, 2006.
California State Water Resources Control Board. 2006. Approval of Proposed 2006 CWA Section 303(d) List of Water Quality Limited Segments. http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/final/r9_final303dlist.pdf Accessed February 2, 2007.
Cohen, Andrew N. 2004. Invasions in the Sea. *Park Science* 22 (Fall): 37-41.
Convention on Biological Diversity. 2005. Invasive Alien Species Introduction. http://www.biodiv.org/programmes/cross-cutting/alien/default.aspx Accessed February 16, 2007.
Coutts, A.D.M. 1999. Hull fouling as a modern vector for marine biological invasions: investigation of merchant vessels visiting northern Tasmania. Unpublished Masters Thesis, Australian Maritime College, Launceston, Tasmania, Australia. 283 pp.
Hall, A. 1981. Copper accumulation in copper-tolerant and non-tolerant populations of the marine fouling alga, *Ectocarpus siliculosus* (Dillwyn) Lyngbye. *Botanica Marina* 24:223–228.
Hewitt, C.L., M.L. Campbell, R.E. Thresher, and R.B. Martin, eds. 1999. Marine biological invasions of Port Phillip Bay, Victoria. Centre for Research on Introduced Marine Pests, Technical Report 20, 344pp. Commonwealth Scientific and Industrial Research Organization (CSIRO). Hobart, Australia.
Hewitt, C.L. and M.L. Campbell. 2001. The Australian distribution of the introduced sphaeromatid isopod *Paracerceis sculpta* (Homes 1904). *Crustaceana* 78: 925-936.
Johnson, L.T. and J.A. Miller. 2002. *What You Need to Know About Nontoxic Antifouling Strategies for Boats*. California Sea Grant College Program Report No. T-049.
Piola, R.F. and E.L. Johnston. 2005. Differential tolerance to metals among populations of the introduced bryozoan *Bugula neritina. Marine Biology* (Published Online, November 2005).
Rainer, S.F. 1995. Potential for the introduction and translocation of exotic species by hull fouling: A preliminary assessment. Commonwealth Scientific and Industrial Research Organization (CSIRO) Centre for Research on Introduced Marine Pests. Technical Report 1. Hobart, Australia.
Singhasemanon, N. 2005. Minutes of Copper Antifouling Paint Sub-Workgroup Meeting of July 14, 2005. Minutes dated August 10, 2005. 5 p.
United States Environmental Protection Agency. 2002. Region 9: Total Maximum Daily Loads (TMDLs) for Toxic Pollutants, San Diego Creek and Newport Bay. http://www.waterboards.ca.gov/santaana/html/tmdl_toxics.html Accessed February 2, 2007.
United States Environmental Protection Agency. 2003. Draft Updated Aquatic Life Copper Criteria Fact Sheet. http://www.epa.gov/waterscience/criteria/copper/draftupdatefs.htm Accessed February 2, 2007.

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