CONTROLLING BIOFOULING ON SHELLFISH AND GEAR

By Michael A. Rice*

Biofouling is a complex and costly problem in most shellfish aquaculture operations. Problem areas include fouling on gear such as cages, mesh bags, predator control netting that may impede proper water flow to the shellfish stock, resulting in reduced food supply, and ultimately, growth stunting of the shellfish stock. Estimates of the effect of not properly managing biofouling on shellfish aquaculture gear suggest that it can reduce growth rates in oysters in excess of 40%.

Any aquaculture gear or shellfish stock placed into marine environments rapidly becomes colonized by biofouling organisms. In very short order upon immersion, surfaces become primed for colonization by chemical adhesion or adsorption of proteins and other dissolved organic material (DOM) present in the water, and these chemically prepared surfaces allow for bacterial colonization within a few hours, followed by unicellular microalgae, protozoans, and fungi. These earliest colonizing organisms form a slimy surface referred to as a biofilm or microfouling. Finally macrofouling invertebrates such as barnacles, mussels, and ascidians begin to cover the surfaces along with macroalgae or seaweeds. Biofouling is a complex and costly problem in most shellfish aquaculture operations, often significantly cutting into profit margins.

The specific types and the intensity of biofouling in shellfish farms are very site-specific, depending on local environment, season and year-to-year climate variables. Problem areas include fouling on gear such as cages, mesh bags, predator control netting that may impede proper water flow to the shellfish stock, resulting in reduced food supply, and ultimately, growth stunting of the shellfish stock. Estimates of the effect of not properly managing biofouling on shellfish aquaculture gear suggest that it can reduce growth rates in oysters in excess of 40%.

The most common method to control biofouling around shellfish farms is by some form of mechanical cleaning, such as use of brushing, scraping, or use of powered water spraying [See: Hodson et al. 1997. Aquaculture 152:77-90]. However, a drawback to power washing of gear is in some coastal areas is that farm neighbors object to the noise generated by the machine. Often air/sun drying of gear can aid in the cleaning by killing and drying out some of the biofouling organisms, making their mechanical removal easier. Cleaning of shellfish or gear can be combined with dips into fresh water, high salinity brine, acetic acid (vinegar) or chlorine bleach for varying lengths of time to aid in killing the biofouling organisms as well [see: Carver et al. 2003. J. Shellfish Res. 22:621-631]. The use of some biocidal chemical coatings such as copper oxide and tributyl tin on gear has been used as a means to avoid more labor-intensive approaches, but this approach has been banned in many jurisdictions based upon demonstrated negative consequences on local habitats and additional regulatory concern for human health [See: Guardiola et al. 2012. Int. J. Molecular Sci. 13:1541-1560 for an excellent review].

A number of alternative methods have been developed, such as the use of grazing fish or sea ur-
chins in conjunction with shellfish farming, as a means to control biofouling, particularly macroalgae [See: Hasse 1974. Prog. Fish Culturist 36:160-162; Lodieros & Garcia 2004. Aquaculture 231:293-298]. Local knowledge of specific areas and past occurrences of the timing of previous biofouling episodes can be used to develop strategies for moving gear temporarily to other locations to avoid a future fouling event.

In more recent times the use of silicone or other smooth surface plastic coatings for gear to resist development of initial bacterial or algal biofilms, or allow for easy release of freshly set biofouling organisms, have been developed or are under development. Current research on biofouling prevention is focusing upon the surface properties of materials and their ability to attract or resist biofouling organisms. The four key properties of material surfaces affecting biofouling settlement include, the mechanical properties such as coefficient of

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Michael A. Rice, PhD, is a Professor of Fisheries, Animal and Veterinary Science at the University of Rhode Island. He has published extensively in the areas of physiological ecology of mollusks, shellfishery management, molluscan aquaculture, and aquaculture in international development. He has served as Chairperson of his department at the University of Rhode Island, and as an elected member of the Rhode Island House of Representatives. rice@uri.edu