Aqua Info
AQUACULTURE NOTES

AIN 23.2014

High-pressure Water Application to Control the Vase Tunicate and Increase Mussel Productivity

Background

Culturing of the blue mussel has been made more difficult with the introduction of aquatic invasive species. Since the establishment of the industry in the early 1980s, four exotic tunicates have been detected in Prince Edward Island (PEI) waters. Tunicates have established populations and are considered a pest to the mussel aquaculture industry. These aquatic nuisance species are the main fouling community on mussel socks and gear and are the cause of decreased mussel productivity through competition for food and space with cultured mussels. The vase tunicate, *Ciona intestinalis*, is currently the most problematic species to infest mussel farms (Fig. 1). Much effort has been invested in mitigating the effect of *C. intestinalis* over the last several years.

Figure 1. High-pressure water application to control vase tunicate fouling on mussel crop.

The use of a high-pressure water (typically 400-600 psi) application to reduce tunicate fouling on mussel socks has become a common practice and has proven to be very effective. However, because of the fecundity of the vase tunicate, mussel farmers are having difficulty keeping ahead of newly recruited tunicates on the mussel socks following a treatment. The objectives of this project were to determine the optimal time to start treating mussel crop and the frequency of re-treatments required to keep the crop free of tunicate fouling.

Methods

Mussel seed was socked at an average density of 750 mussels per metre in the fall 2007. A total of 680 socks, 2.5 m in length, were used for this study. Forty socks for each of the 17 high-pressure water treatments (see Table 1) were deployed 40 cm apart on two mussel long-lines (20 socks on each line) in St. Mary's Bay. Socks were inspected bi-monthly, ensuring they remained buoyant and separated from the bottom substrate to prevent starfish predation. High-pressure water treatment was applied within 2 weeks after tunicate recruitment was first observed on the mussel socks (July 11th) and every three weeks thereafter to a maximum of five treatments per sock. At each sampling (November 2008 and May 2009) eight socks from each treatment group were selected from each of the two

Prince Edward Island CANADA
Fisheries, Aquaculture and Rural Development

Table 1. High-pressure water treatment schedule

Treatment Date	Treatment Group																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Jul 11	X	X	X	X	X												
Aug 5		X	X	X	X	X	X	X	X							X	
Aug 27			X	X	X		X	X	X	X	X	X					
Sep 16				X	X			X	X		X	X	X	X		X	
Oct 9					X				X			X		X	X		

long-lines. In addition, at each treatment date in 2008 three untreated control socks were sampled to assess *C. intestinalis* population development and mussel productivity. Samples were processed immediately after collection to separate the sock section into (1) mussels and (2) *C. intestinalis*. Dead mussels, silt, and socking material were discarded.

Results

In November 2008 the results showed a trend of increasing mussel abundance with increased treatment application. It became apparent that if the mussel crop was not treated until mid-August for the first time a high quantity of mussel fall-off was observed (Fig. 2). Mussel socks that were treated three to five times during the field season, starting from early July, had almost 3X as many mussels as those that were untreated. *Ciona intestinalis* fouling, by weight, decreased with each additional high-pressure water treatment application. Mussel socks treated only once or twice early

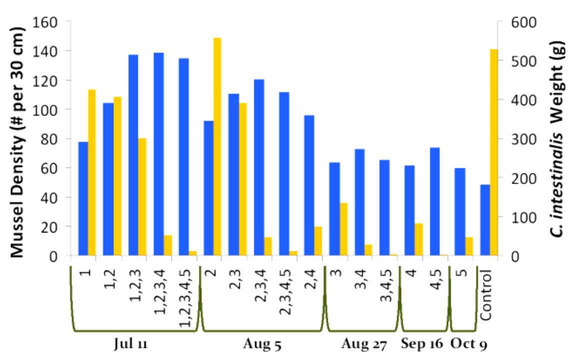

Figure 2 Mussel density (blue) and *Ciona* weight (orange) for each of the 17 different treatment groups.

in the treatment schedule had as much as 50X more tunicate fouling than socks treated four to five times. For example, socks treated only once, on July 11th, had on average 426 g of tunicate fouling compared to socks treated an additional 4 times, fouled with 10.2 g of tunicates (Fig. 3). In addition, socks treated once or twice early in the treatment schedule had an equivalent amount of tunicate fouling compared to the untreated (control) socks. Mussel density in untreated socks decreased significantly from the time of the first high-pressure water treatment to the last. At the time of the first and second treatment applications mussel stocking density in the untreated socks was above 160 mussels per 30 cm. Untreated socks sampled on the third treatment date had, on average, 60 mussels per 30 cm, representing a decrease to approximately 1/3 of what they were three weeks previous.

Figure 3. Mussel socks treated 4 times, starting on July 11th (left) vs untreated control socks (right).

It is speculated that a critical threshold point was reached which reduced the ability of mussels to strongly attach to the socking material, resulting in mussel loss (Fig. 4), in addition to tunicate fall-off. Stocking density remained relatively constant at 60 mussels per 30 cm for the remainder of the treatment trial.

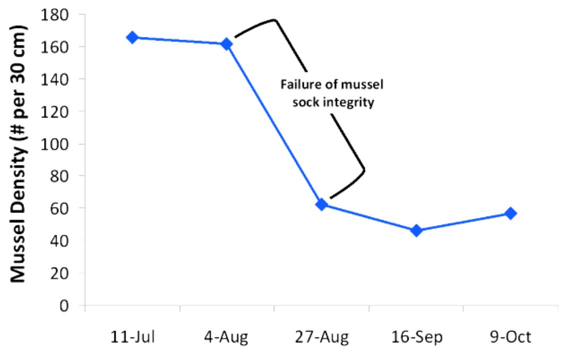

Figure 4. Mussel density reduction over time when no treatment is applied.

Ciona weight on untreated socks was very low at the time of the first treatment, however, by the time of the second treatment the weight of *Ciona* had increased substantially to 1.2 kg per 30 cm of sock. The weight of *C. intestinalis* fouling stressed the mussel sock and fall-off of both mussels and tunicates resulted. *Ciona* was approximately 40-45 mm in length when this resulted (Fig. 5).

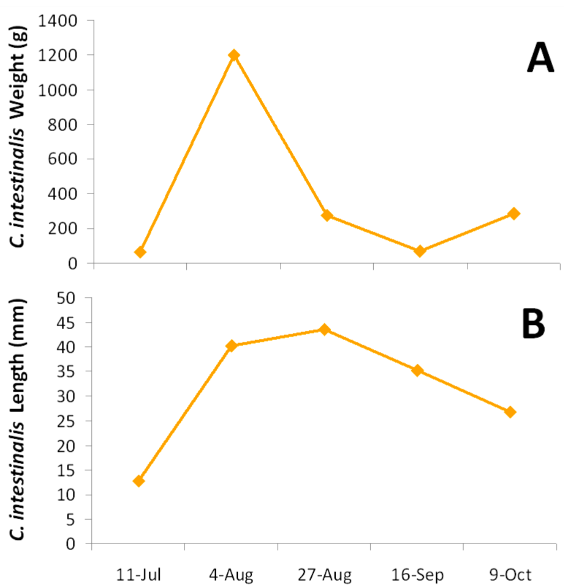

Figure 5. *Ciona* weight (A) and average length (B) on a 30 cm mussel sock section (untreated).

Overwinter mortality (> 95%) of *Ciona* was observed between November 2008 and April 2009. This mortality event appears to happen annually when *Ciona* populations multiply at an unsustainable rate. We currently can only speculate that this mortality event is caused by depleted food resources, cold winter temperatures or possibly a combination of both. The weight of *Ciona* on mussel socks in all treatment groups is reduced to almost 0 during the overwinter period (Fig. 6).

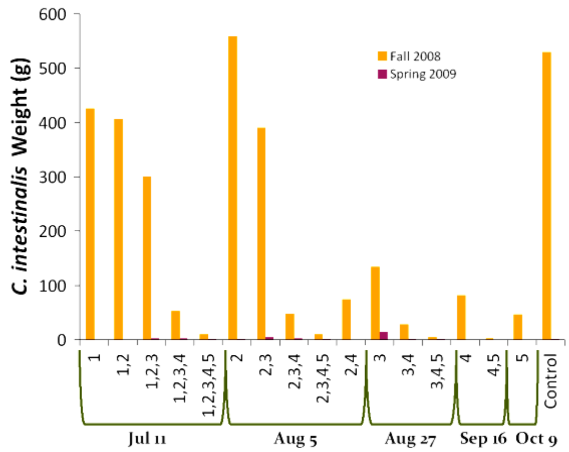

Figure 6. Comparison of *Ciona* weight on mussel socks in November 2008 vs May 2009.

Data from the November 2008 sampling showed there was no added gain in mussel yield by treating more that 3 times; however, the May 2009 sampling showed an increase in mussel weight of approximately 0.5 kg per 30 cm of sock with a 4th treatment (30% gain compared to 3 treatments, Fig. 7). Presumably, this is a result of less tunicate fouling on the socks in the fall of the year.

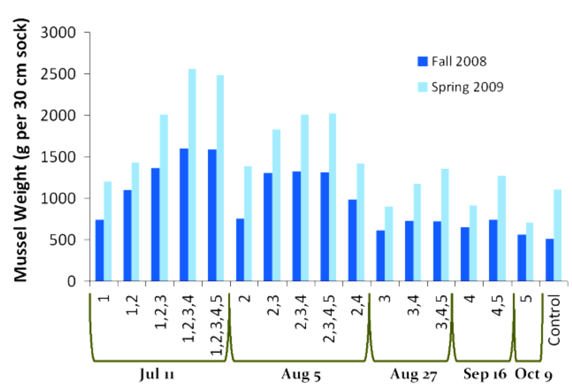

Figure 7. Comparison of mussel weight on socks in November 2008 vs May 2009.

Conclusions and Recommendations

The high-pressure water treatment systems used by the majority of industry in *Ciona* infested areas have proven to be quite effective in reducing the level of *Ciona* fouling. This study suggests that mussel socks should be treated for the first time when *Ciona* is still very small (< 20 mm) and that treatments should be reapplied at a rate that prevents the majority of *Ciona* fouling from being greater than 30 mm in length (3 week intervals in this case). The following are recommendations of this project for commercial mussel operators in the management of *Ciona intestinalis* on mussel socks:

- Routinely monitor mussel socks, at a minimum of two week intervals, for the presence and amount of *C. intestinalis* fouling.
- Begin treating in early-mid July after *Ciona* has been detected on mussel socks. Treatments should be applied before *Ciona* reaches 20 mm in length. Earlier treatments may be required if mussel socks have a significant amount of tunicate fouling after the winter period. High winter tunicate mortality is not an annual occurance. Presumably, the tunicate population is prevented from reaching an unsustainable level that will result in winter mortality because of effective farm management with the high-pressure spray systems.
- Treat multiple times through the season – as deemed necessary by reappearance of *Ciona* recruitment on mussel socks

It should be noted that this treatment trial was also conducted in Murray River and Georgetown, but the results did not exhibit the same trends. In Georgetown, some of the socks that weren't treated were similar to socks that were treated multiple times. This site had an abundant population of rock crabs which may have contributed in reducing the tunicate fouling. In addition, the water temperature was colder at this site, which resulted in *Ciona* recruitment starting later in the summer and growth after recruitment was slower compared to the other two sites. In Murray River, there was heavier recruitment of the clubbed tunicate, *Styela clava*, and also a set of starfish and second set of mussels, which may have limited recruitment of *Ciona* on socks.

This information sheet was made possible by the following partners:

- University of Prince Edward Island (AVC)
- PEI Department of Fisheries, Aquaculture and Rural Development
- PEI Aquaculture Alliance
- Atlantic Innovation Fund
- PEI Shrimp Corporation
- Department of Fisheries and Oceans

For further information contact:

Aaron Ramsay
PEI Fisheries, Aquaculture and Rural Development
Aquaculture Division
P.O. Box 1180
Montague, PEI
C0A 1R0
(902) 838-0827
apramsay@gov.pe.ca

Prince Edward Island AQUACULTURE ALLIANCE

Fisheries and Oceans Canada