FINAL REPORT: FISHERY RESOURCE GRANT PROGRAM 2007-01

"FEASIBILITY OF CONVERTING CRAB SHEDDING TANKS TO EFFECTIVELY SET SINGLE OYSTER SEED FOR AQUACULTURE AND COMPARISON OF TECHNIQUE TO TRADITIONAL REMOTE SETTING PRACTICES"

EXECUTIVE SUMMARY

The goal of this project was to design and implement a simple, single oyster setting system. More intricate single seed setting systems are typically employed at commercial shellfish hatcheries. However, this project aimed to demonstrate a simplified single seed setting system using existing crab shedding systems making it possible for a wider spectrum of the seafood industry.

Crab shedding systems, as traditionally designed, can operate as an effective setting system. In order to create a 'downwelling' system (i.e. downward flow of seawater) setting rings are placed inside the crab shedding tanks and lightly filtered seawater is forced down through the setting ring. The majority of original PVC plumbing around the crab shedding system is retained—the drain and sprayer bars, for example. During this project it was necessary to lightly filter the incoming raw seawater, by implementing a crude filtration system—Jacuzzi sand filter (flow rate = 20 gpm) and a Lifegard standing single cartridge filter (20 micron). A standard sewer riser and ring was used to create a downweller. The riser was fitted with 130 micron Nitex screening, the ring secured to the bottom using stainless steel screws and the in-seam sealed using marine sealant fast cure 5200. Crushed oyster shell (microcultch) was soaked overnight prior to setting. Microcultch (approximately 400 micron) was spread evenly over the entirety of the Nitex screening.

A standard remote setting system was designed using a rectangular fiberglass tank, a 2.5 horsepower seawater pump and 2" schedule 40 PVC pipe used to deliver raw seawater. A 3.0 horsepower regenerative air blower was used to evenly distribute air throughout the tank. A continuous grid system of airlines was created using 1¼" schedule 40 PVC pipe with ⅜" holes drilled in the bottom of the pipe that covered the majority of the bottom of the tank. Washed and graded shell was bagged into one-half bushel bags and placed into the tank on top of the PVC airlines. The rectangular fiberglass tank held 400, one-half bushel shell bags. Incoming raw seawater was filtered using a 50 micron bag and the tank filled until all shell bags were completely covered.

Approximately 10 million triploid larvae were placed into each system—the remote setting tank and the single seed downwelling system. Setting was conducted in middle June 2007. Product from the remote set system (spat-on-shell) was field deployed in early July 2007, roughly 2 weeks after initial stocking with triploid larvae. Remote set rate was reasonably successful—approximately 17% with an average of 14 spat per shell. Product from the downwelling system was field deployed in late July 2007, approximately five weeks after initial stocking with triploid larvae. Downwelling set rate was also reasonably successful—approximately 32% with 3.2 million seed deployed into the floating upweller.

Downwelling product was tended according to typical intensive aquaculture practices—splitting, sizing, and cleaning—at appropriate intervals to maximize growth and survival. Remote set product was planted and monitored, but otherwise not handled, until harvest. Downwelling product was harvested within 2½ years; however, limited mortality (~20%) was observed and most obviously was due to siltation and fouling. Remote set product was harvested within 3½ years; however, significant mortality (~50%) was observed most obviously due to predation.

MATERIALS

This project aimed to utilize materials that were readily available to the seafood industry or could be sourced locally.

Single seed setting system:

- Jacuzzi sand filter (minimum 20 gallon per minute flow rate)
- Lifegard single cartridge filter (20 micron)
- (1) Traditional crab shedding tank
- (2) 24” sewer risers and rings
- (6) 6” x ⅜” galvanized carriage bolts
- (12) nuts
- (12) washers
- ½” stainless steel screws
- 130 micron Nitex mesh (36” diameter)
- Marine Sealant 5200 (Fast Cure)
- (2) 30” x ¾” PVC SCH 40
- Unscented petroleum jelly
- (1) Liter 400 micron cultch
- Triploid eyed larvae
- Mixed Shellfish Diet algae paste (Reed Mariculture)

Remote setting system:

- (1) 30’ x 8’ x 3’ fiberglass tank (‘tomato gondola’) or comparable tank
- 1¼” PVC SCH 40
- 2” PVC SCH 40
- (1) 3 HP regenerative air blower
- (5) 50 micron filter bag
- ½ bushel shell bags (aged, clean oyster shell)
- Triploid eyed larvae

METHODS

Single seed setting system:

1. Thoroughly wash, scrub and rinse crab shedding tank using soap and warm water. If necessary, repair any holes using Gluvit or fiberglass but be sure to let the repair completely cure. Fill repaired tank with seawater and let it soak for several days to leach any impurities. Repeat as necessary.
2. Rinse empty Jacuzzi sand filter and fill approximately ¾ full with fine sand (20#).

3. Rinse Lifegard cartridge filter housing and soak the 20 micron cartridge filter in seawater for one day.
   [This project assumes that seawater is previously plumbed into facility from the use of crab shedding tanks.]
4. It is necessary to have a ¾” PVC SCH 40 trunk line coming to the top and middle of the crab shedding tank.
5. Plumb a ¾” ball valve and then a ¾” tee at the end of the trunk line so the tee is approximately 22” off the bottom of the shedding tank.
6. Cut two 30” x ¾” PVC SCH 40 sections capping one end.
7. Drill approximately 12, ¼” holes on each 30” section and soft plumb into the ¾” tee. These ‘spray bars’ will distribute the filtered seawater to the downwellers and soft plumbing will allow for removal and periodic cleaning.
8. Drill 3, ⅜” holes in the ring for placement of the carriage bolts. Provide equal spacing between the holes to increase stability of the downweller.
9. Place a washer and nut on either side of the ring to allow for height adjustment using the carriage bolt.
10. Construct downweller screen by cutting the 130 micron Nitex mesh approximately 36” diameter.
11. Place cut Nitex in between the riser and ring; align the manufactured holes in the riser for stainless steel screws.
12. Screw in the ½” stainless steel screws in an opposite rotating pattern, concurrently pulling the Nitex screen taut as you place the screws.
13. Once all screws are in place and the Nitex screen is fairly taut (no ripples in the Nitex) then place a bead of Marine Sealant 5200 (Fast Cure) on the inside of the riser to seal the Nitex to the riser.
14. Cut a 7½” PVC SCH 40 to be used as a standpipe in the middle of the shedding tank.
15. Fill shedding tank with filtered seawater and place completed downweller in tank to soak overnight. Repeat as necessary.
16. After final drain of filtered seawater, thoroughly coat the inside riser ring and the bead of Marine Sealent with unscented petroleum jelly.
17. Fill shedding tank again with seawater and place downweller in tank. Use 500 mls of microcultch (400 micron) evenly spread across the entire Nitex mesh. Let system soak overnight.
18. Drain tank (leaving microcultch in downweller) and refill with filtered seawater.
19. Once tank is full, install spray bars and turn on filtered seawater to a very slow trickle.
20. Slowly add approximately 300,000-400,000 eyed larvae to the downweller. This may be accomplished by concentrating larvae in a small can or jar half-filled with filtered seawater and slowly pouring the larvae mixture into the downweller.
21. Allow downweller system to set for 48 hours. Add concentrated algae paste after 24 hours.
22. Gently spray the downweller system after 72 hours with filtered seawater to remove any uneaten algae and bacteria build-up. Repeat as necessary. Generally, seed can be removed from filtered seawater after 5-7 days (depending on ambient seawater temperature).

Remote setting system:

1. Purchase a ~3,000 gallon fiberglass tank with standard dimensions of 4’ height x 12’ diameter. Alternatively, procure a used tank (preferably fiberglass; do not use steel).
2. Construct a 4” drain at the edge (or corner) of the setting tank. Fiberglass an appropriately sized coupling so a stand pipe can be placed in the tank to retain seawater.
3. Procure clean and aged oyster shell (optimal aging is 2 years).
4. Containerize oyster shell and store shells.
5. Fully wash, rinse and cure any fiberglass tank using raw seawater. Ideally, the setting tank should be washed, rinsed and filled with raw seawater (overnight) several times before commissioning in oyster setting.
6. PVC airlines (typically 1¼” schedule 40) used to, as completely as possible, cover the bottom of the tank. Airlines should be constructed in sections for easy removal and cleaning.
7. Drill ⅜” holes at least 6” apart in the bottom of the PVC airlines, so as to evenly distribute air in the tank.
8. Place airlines securely in the bottom of the setting tank.
9. Place clean, aged, containerized (either mesh netting or cages) oyster shell on top of the PVC airlines in the tank.
10. Turn on air blower and allow air to blow out any shell particles or debris that may reside in the PVC airlines.
11. Turn on seawater pump. Let seawater pump run for several minutes to clear any debris or standing water in the line.
12. Attach a 50 micron filter bag to the incoming raw seawater line into the tank.
13. Place an appropriately sized stand pipe in the coupling in the corner (or edge) of the setting tank. Filtered seawater should now be filling the tank.
14. Allow tank to slowly fill with seawater. NOTE: the 50 micron filter bag will clog with sediment/debris and may have to be changed frequently.
15. Continue to fill the tank with filtered seawater until all shells are completely covered and air is gently and evenly mixing the seawater. Shut off seawater pump, remove 50 micron filter bag.
16. Allow filtered seawater to sit overnight with air gently bubbling.
17. The following day (around midday), acclimate eyed larvae to ambient air temperature. This may be best accomplished inside a building or outside in the sun.
18. Measure and record the temperature and salinity of the filtered seawater in the tank.
19. Allow eyed larvae to acclimate to air temperature (commensurate with temperature in the tank).
20. Fill a bucket with some of the filtered seawater from the tank and add the eyed larvae.
21. Gently agitate the eyed larvae in the bucket of filtered seawater.
22. Allow 10-15 minutes for eyed larvae to swim and exhibit setting cues (setting cues may include ‘stringing’ or ‘sticky’ behavior in the bucket).
23. Evenly spread the acclimated eyed larvae to the filtered seawater setting tank.
24. Allow 48-72 hours for the eyed larvae to attach to the shells.
25. After 2-3 days, turn on the seawater line (unfiltered).

26. After 5-7 days of attached spat and shells remaining in the tank, plant on oyster ground according to typical planting procedures.

RESULTS

Existing, traditional crab shedding tanks were successfully adapted to accommodate setting eyed larvae to produce single set oyster seed. Recycled 'tomato gondola's' were used to successfully set eyed oyster larvae to produce 'spat-on-shell' (SOS). See Table below.

SET DATE	PRODUCT	SET RATE	PLANT DATE	HARVEST DATE	YIELD (bushels)	EST. START-UP COST $ (per bushel)	EST. OPERATING COST $ (per bushel)	EST. MAINTENANCE COST $ (per bushel)
6/2007	SOS	17%	7/2007	11/2010	415	8.00	7.00	2.50
6/2007	SINGLES	32%	9/2007	9/2009	1,050	12.00	18.00	25.00

Table Definitions:

'Set Date' is the date that eyed larvae was added to the system.

'Product' is the type of final commercial product produced in the system.

'Set Rate' is the percent of product produced divided by the number of eyed larvae added to the system.

'Plant Date' is the date that the final commercial product was placed overboard.

'Harvest Date' is the date that the final commercial product was first harvested.

'Yield' is the volume of product harvested (in bushels) from the oyster ground.

'Est. Start-Up Cost $ (per bushel)' is the estimated cost ($/bushel) to purchase equipment, materials and larvae.

'Est. Operating Cost $ (per bushel)' is the estimated cost ($/bushel) to initiate the system, continue operation through setting and initial planting. NOTE: project did not heat or cool seawater in either system.

'Est. Maintenance Cost $ (per bushel)' is the estimated cost ($/bushel) to conduct routine and systematic aquaculture activities (e.g., splitting/grading single seed oysters in cages or checking spat on shell (SOS) for evidence of predation mortality).

Spat on shell exhibited a lower set rate, lower yield and lower overall cost per bushel (to produce, operate and maintain product). Conversely, singles exhibited a higher set rate, higher yield and higher overall cost per bushel (to produce, operate and maintain product). All harvested product was shucked and the meat yield (not shown in table) was significantly higher in singles production. SOS production meat yield averaged 6 pints/bushel compared to singles production meat yield averaged 8.5 pints/bushel.

DISCUSSION

The fundamental question that this project aimed to resolve was whether a commonly used (traditional) crab shedding tank may be converted to a downwelling (single setting oyster) system. Emphatically, the answer to that question is yes. With some existing infrastructure and equipment available (e.g., PVC plumbing, shedding tanks, building, seawater pump) this 'retro-fit' becomes rather economical. For example, the estimated start-up and operational cost to produce about 168 bushels of single seed for stocking into cages was approximately $5,040.00. This single seed cost compares favorably to the production of 200 bushels of SOS for approximately $3,000.00. The true difference between the two production methods is in the 'maintenance cost' which results in significantly higher cost in single seed production compared to SOS. The benefit of single seed production is the lower mortality and higher return (in terms of bushels harvested and meat yield) however, the higher maintenance cost can be 80% of the overall single seed production cost. In contrast, the production of SOS showed higher mortality and lower returns (again, in terms of bushels harvested and meat yield) yet the lower maintenance cost can be 25% of the overall SOS production cost.

Despite the subtle differences in start-up and operational costs to produce single seed and SOS, and the dramatic differences in maintenance cost, the two production systems can be part of a viable aquaculture production scheme. Although this project diverted the harvested product to shucking and packing operations, it is conceivable that the single seed production could have been diverted to more lucrative whole shell box market at a higher price per oyster. In addition, this project is just one experiment that had very simple parameters and if replicated at a different site with different operations, handling and markets those conclusions may be different. To be clear, the following are the conclusions of this specific project:

1) It is feasible to convert crab shedding tanks to a viable single oyster seed setting system.

2) The overall cost of production (start-up, operation, maintenance) for single seed is significantly higher compared to SOS, however, the increased harvest and meat yield of single seed production makes both aquaculture methods a viable part of any aquaculture operation.