A Floating Powered Upweller System for Hard Clam Nursery

By
Gef Flimlin
NJ Sea Grant Marine Advisory Service
and
Kevin Brown
Harbor Branch Oceanographic Institution

The amount of time, energy and effort needed to raise seed clams coming from the hatchery to a field plantable size is considered the nursery phase. It is during this time that the shellfish culturist can expend considerable expense both in electric costs for pumping water to feed the tiny clams, and personnel time for cleaning the individual upwellers in a land based system. These parameters must be addressed to reduce the cost of production for the culturist.

The question then is how reduce these costs.

If one calculates the pumping needs for a land based upweller system, is would be evident that the higher water must be lifted, the larger the pump needed, the greater the costs of plumbing and its maintenance, and thus the greater the electric cost for moving that water. If the system is taken from the land and placed into the water, then the height that the water is lifted, or head, may be reduced to a fraction of the land based upweller, and the plumbing can be reduced significantly.

Within the past few years there have been several designs which have placed the upweller directly in the water. Designs from Maine and South Carolina were fashioned to use the power of the moving tide to supply the water and algae to the shellfish, but the constraint to these in some places is competing uses for the water area or lack of good tidal flow in some coastal estuaries. One design made the powered upweller into a floating dock in a marina but a large part of the space was needed for floatation instead of upweller space. Individual upwellers using air lift technology have also been introduced with a large plastic barrel being the container for the seed, but lifting the barrel out of the water for maintenance can be a problem.

The Harbor Branch Powered Upweller

The concept of placing the upweller system in the water can be a great advantage for reducing production costs. It also can give the culturist who doesn't have a complete hatchery/nursery system on the higher priced waterfront property, the ability to rent a boat slip and place the nursery system in it.

Harbor Branch Oceanographic Institution has been a leader in hard clam culture on the East Coast. Through community based training programs, they have been able to increase the size of the hard clam industry in Florida to a level never expected ten years ago.

Thus in order to supply the demand for seed, their hatchery needed to increase production and so their nursery had to keep up. This increase was the driving force behind the Floating Powered Upweller System. It is very simple in its design and operation.

The system is essentially a large floating box (20'L x 6'W x 2'D) made with 3/4" plywood bottom and 5/8" plywood sides with fiber glass lamination and gel coat. Wood or wood and resin are acceptable but the life span is considerably less. Four 2"x 4" planks serve as bottom support while some more are attached to the outside top of the box for rigidity. Foam Floats are placed between the bottom stringers at each corner with 4.5 cu. ft. at each corner near the pump and 3 cu. ft. at the opposite end. The box has 18 5" holes centered at 16 3/4 inches up on the long dimension, 9 to a side, to receive the 4" PVC couplings which are fiberglassed in to accept the individual upweller discharge pipes. The first hole is 12 3/4" from each end and there is 26 1/2" between each one, on center. The upweller silos themselves are constructed from halves of 55 gallon plastic barrels with screening material secured over the bottom open end to allow for water flow. They each fit over an individual piece of 4" PVC pipe fitted to the coupling in the side for discharge. Extra upweller silo units are made with varying size screen to increase water flow to the seed as they grow. The screen sizes used are 800 and 1000 micron Pecap screen from Tetco. All of the silos sit on a piece of 5" PVC pipe with an ell at one end to sturdy it. This keeps them off the bottom so that water can flow through.

On the end of the unit, the unit which supplies the water to the upweller box is located. Made mostly of 8" PVC pipe, it is constructed with a shaft running from top to bottom. At the top is a pulley which is attached the vertical shaft of a 1hp electric motor. This motor drives the shaft which has a machined 3 bladed aluminum propeller secured at the bottom, inside a section of pipe with 2¼" holes drilled in it . Once the motor is turned on, the water is propelled upwards through an 8" tee into the upweller box.

The motor is controlled by a reversing polarity switch which allows it to run the propeller in two directions. One will fill the box and, in reverse, it will drain the box. This allows for two very efficient operations to take place. When the box is filled with water, it will sink down in the water like a swamped boat. However, with the 18 holes in the sides, the natural buoyancy of the wood, the added floatation, and a 4" stand pipe near the end, the box can practically never sink. Ropes however are attached to cleats at each corner to assure that this won't happen and also help maintain its position in the floating dock or boat slip.

The operation works thus. Water that is pumped into the box must exit through the side ports with the individual upweller barrels containing seed attached to them. The true benefit here is that the distance that the water must be lifted by the pump (propeller) is only about a 2" head. The second aspect of the reversing switch is that when the polarity of the switch is reversed, the propeller turns in reverse and empties the box and upwellers. This allows for the operator to step into the box like getting into a boat, and using a water hose from the dock, all the upwellers and the box itself can be cleaned in short order. The polarity is again reversed and the box refills, sinks, and continues feeding the clam seed.

The entire system can be attached to floating dock for easiest access or hung on counter weighted lines from poles in a boat slip. To work properly, there needs to be about 4' of water under the box at low water to allow for sufficient supply and keep the pump unit out of the bottom.

What are the costs?

The upweller box can be purchased in Florida for approximately $1200 to $1400. The pumps can be purchased for about $1200. Silos are commercially available for $70 each. This would bring the cost of the system with two sets of silos to around $7000 plus shipping. If constructed privately the costs for the two sets of silos would be about $1200 or less, the pump may be built for about $800, and the upweller box would be less than $1000, all assuming no labor costs. Thus one could home build a system for about $3000.

The unit is stocked with seed which is sieved on 1000μ sieve and placed on 800μ upweller mesh. The first sieving after that is on 1200μ and placed on 1000μ mesh. Original stocking density is 600 to 300 seed/ml which would approximate 180,000 per silo. This stocking density may be too great for areas other than Florida, so an initial recommendation would be for 50 to 100K per silo in the North. Growers should adjust these figures for their area after some experimentation.

The time dedicated to cleaning each upweller would be about 5 hours per week, and so over a 12 week period would be close to 60 hours. If one figures a inclusive labor rate (fringe added) of $14/hr, total labor costs would be about $850.

The electric for the motor, using $.12/kilowatt hour would be another $250 for 12 weeks operation.

We will charge ourselves $40/ft for slip rental for the 12 weeks or $800.

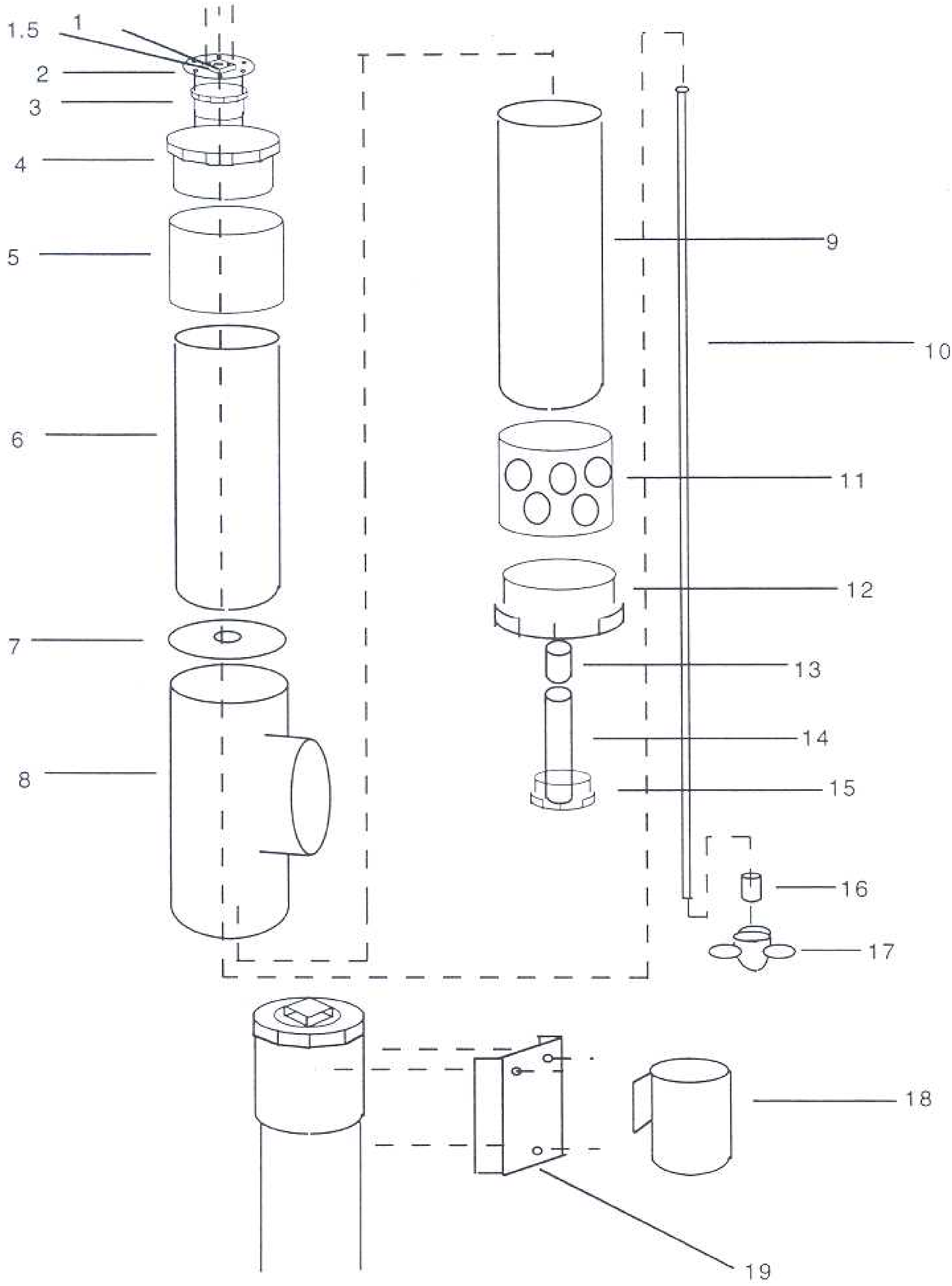
Now the seed cost. If we start with 1,000,000 1mm (1000μ) seed costing $3.00/1000, our initial stocking cost would be $3000. If we assume a 15% mortality in the 12 weeks, we would produce 850,000 10mm seed. If we purchased that size seed (10mm) it would cost (assuming $22/1000) about $18,700.

Therefore if the cost of construction, labor, electric, slip rental and small seed are added together, the total cost of producing 850,000 10mm seed using the powered upweller would be around $8000. This method would save over $10,000 in the first year and the cost of the upweller unit would be amortized in the first year.

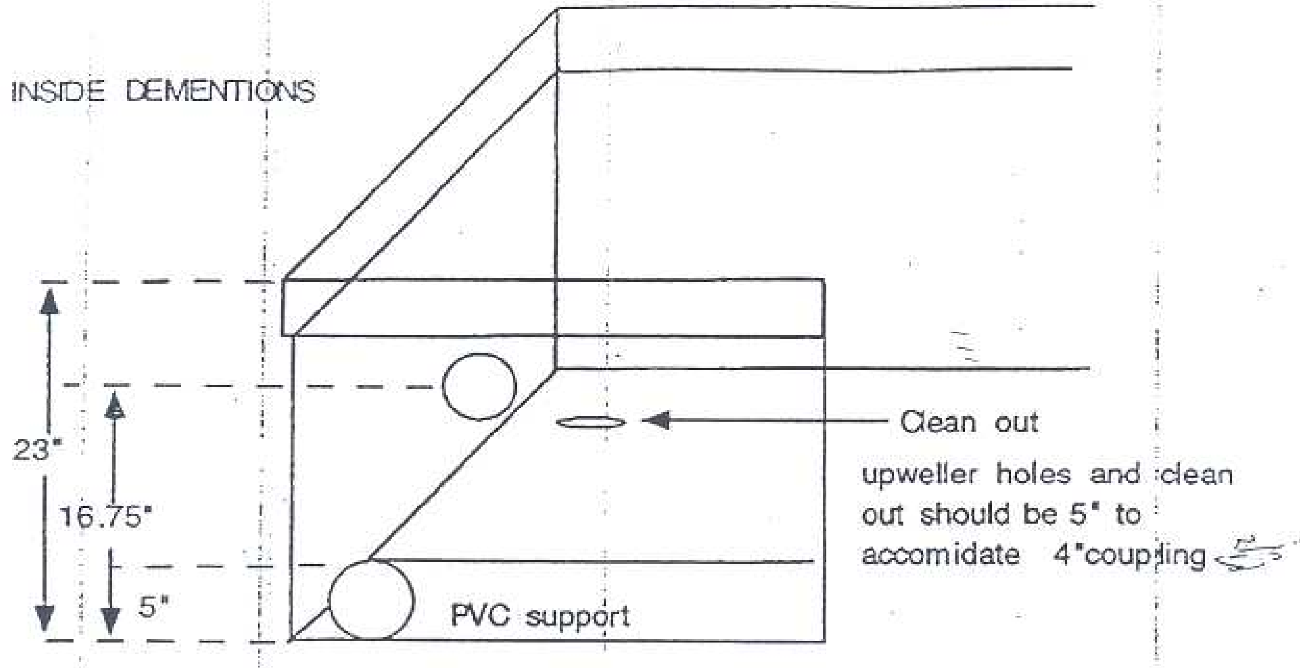
For argument's sake, let's suppose that the stocking density of 55,500 seed per silo was too great for the northern climate and the grower decided to use two full units instead of one. The cost of producing the same amount of seed as compared to purchasing the larger seed would still save $500 the first year, and over $7500 each successive year. In addition, the grower will have expanded flexibility in respect to planting the seed.

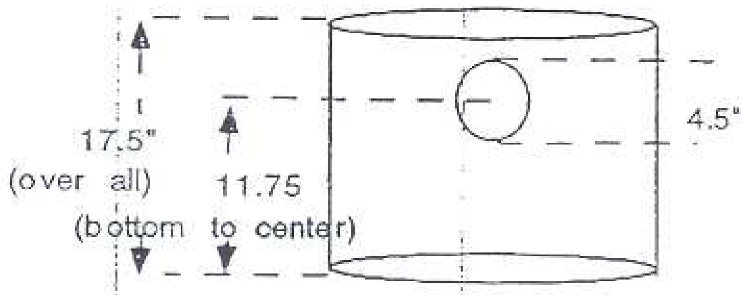
parts list

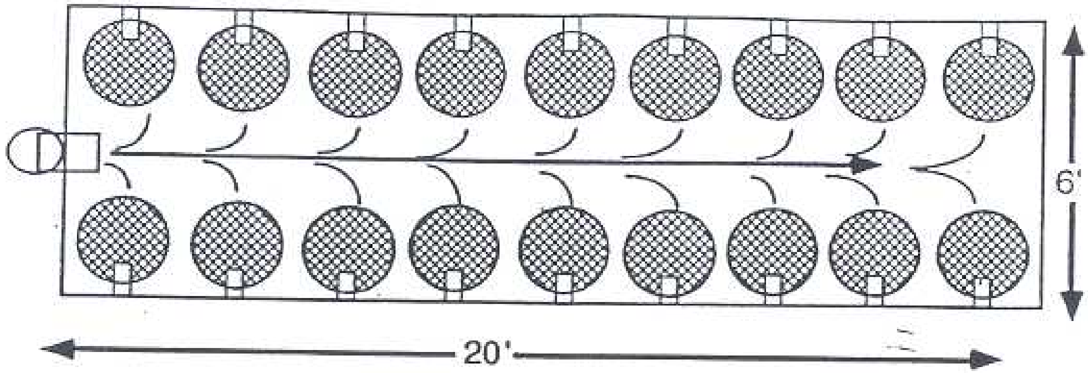
Part No.	Discription
1	1" self locking flang mount bearing
1.5	Rubber gasket
2	.25" aluminum plate 6" diameter
3	4"x2" reducing bushing
4	8"x4" reducing bushing
5	8" coupling
6	2' length 8" sch 40 PVC
7	8" PVC flow stop
8	8" P'VC - T
9	2' lengath sch 40 PVC
10	5.5' length aluminum round stock 1" diameter
11	Perferated 8" coupling
12	Modified 8"x4" reducing bushing (2" depth from stop)
13	UHMW polyethaline shaft guide
14	10" length 2" sch 80 PVC
15	Modified 4"x2" reducing bushing (2" stop removed)
16	1.5"x1" prop bushing
17	three blade 9x10 prop modified to fit in 8" pipe
18	1 horse farm duty motor
19	10" length 6" aluminum chanel

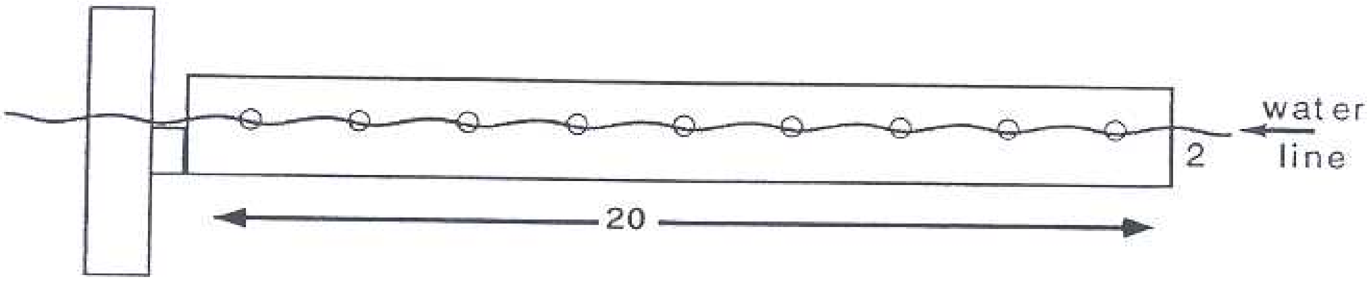

1.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

INSIDE DEMENTIONS






6'
20'


water
line
2
20