Final Report

Feasibility of harvesting, holding and culturing *Donax spp.* for resource enhancement aquaculture

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Executive Summary

The project goals were to investigate the harvesting, holding and propagation of *Donax spp*. (Coquina clam) in the context of resource enhancement aquaculture following beach nourishment. Seven previously submitted in-depth quarterly reports with detailed statistical analyses are appended as addenda.

Objective A: Develop and document efficiency of various mass-harvesting techniques.

Hand-harvesting, mechanical hydraulic harvesting and electric sorting devices were developed and tested for mass harvesting *Donax spp*. Test conditions and techniques for harvesting were replicated to minimize variability and to insure that the differences in catches resulted from the various mesh sizes and/or depths used. Data was analyzed for statistical significance. Comparisons were made of the harvested catch volumes, average numbers of clams and bycatch volumes for the following parameters: square mesh sizes of 3-mm, 5-mm and 7-mm and harvest depths of 2-cm and 4-cm.

The most efficient harvesting of *Donax spp.* was accomplished with 3-millimeter square mesh screen at a depth of 2-centimeters.

Donax spp. clams were frequently observed to emerge en masse from the beach substrates immediately prior to large waves on flood tides. The clams rode the wave up the beach, which aided in locating them and allowed for greatest harvests. At high and low tides the *Donax spp*. were mostly found in largely unharvestable shelly areas.

Donax spp. appeared to congregate in the sandy valleys of the intertidal zone that run perpendicular to the beach and which provide harvests with less bycatch. Fishing piers also seemed to attract patches of *Donax spp*. Clams were often found and collected from around the pilings and several meters to either side of the piers. Dense populations of clams were also found beside intertidal pools.

Donax spp. clams were available throughout the year in varying amounts. During the winter only small amounts of harvestable clams were evident along Bogue Banks. Greatest aggregations for harvesting mass quantities were during the summer months.

Observations of the environmental parameters and behavior of *Donax spp*. was an important factor for locating and harvesting the clams.

Objective B: Compare and refine feasibility of two long-term holding methods.

Two devices were developed and tested for holding *Donax spp*.: a replica of the standard shellfish raceway and a redesigned version of a commercial shellfish upweller.

Raceways were made from 1-meter lengths of standard PVC rain gutter. Upwellers were made from 18-inch lengths of 4-inch diameter PVC pipe with platform bottoms fastened to one end. Water was supplied to the bottoms of the upweller cylinders by way of centrally-fitted 20-inch lengths of 1-inch diameter PVC pipe.

Test conditions and methods for holding clams were replicated to minimize variability and to insure that the differences found resulted from the intrinsic values of the holding methods. Data was analyzed for statistical significance. Comparisons were made of the growth and survivorship of clams in holding systems for the following parameters: holding method, water flow rates, clam density per unit, and raw versus filtered seawater.

The survival rate of *Donax spp.* held in the upweller method was much greater than the survival of clams held in the raceway method. The highest survival rate for clams in raceways, 81%, was lower than the lowest survival rate, 94%, for upwellers.

Upwellers were the best management practice for long-term holding *Donax spp*.

The final objective of the holding phase was a side-by-side comparison of water flow rates and clam densities per unit against two water qualities in upwellers. Higher clam densities had greater survival rates but not greater growth. Higher water flow rates had greater survival but not greater growth. Raw water units had greater survival and greater growth.

The most successful long-term holding of *Donax spp.* used upwellers with higher flow rates, higher densities and raw seawater.

Objective C: Test and improve techniques for aquaculture propagation of *Donax spp*.

Each spawning treatment successfully produced spawns of *Donax*; however the magnitude of the spawns varied widely among treatments and among replicates of the same treatment. Adding a mixture of live algae at 20^{o} C triggered the greatest spawn of 100,000 eggs. Other treatments such as hydrogen peroxide and raising the pH reliably produced spawns but not a large quantity of gametes.

Mass spawning tests produced a large amount of *Donax spp.* fertilized eggs.

Gonad maturity indices were conducted before and after each test to determine suitability for spawning tests. A subsample of mature *Donax spp*. was taken from a homogenous mixture and the gonads were dissected and indexed. This was done to insure that the clams had mature gonads before and after the tests. Test results support a hypothesis that *Donax spp.* clams may be trickle spawners rather than mass spawners.

Monthly gonad investigations were completed for the second year mirroring the first year's data and indicating consistent, accurate methodology. A pattern of biannual spawns was indicated as well as continuous but limited spawning throughout the year.

Donax spp. gonad index was illustrated to facilitate replication by future users.

Gonad analyses show that during the months of March and November nearly 100% of *Donax spp*. have mature gonads and possess the ability to spawn.

Ripest broodstock was collected for spawning prior to and during the months of March and November.