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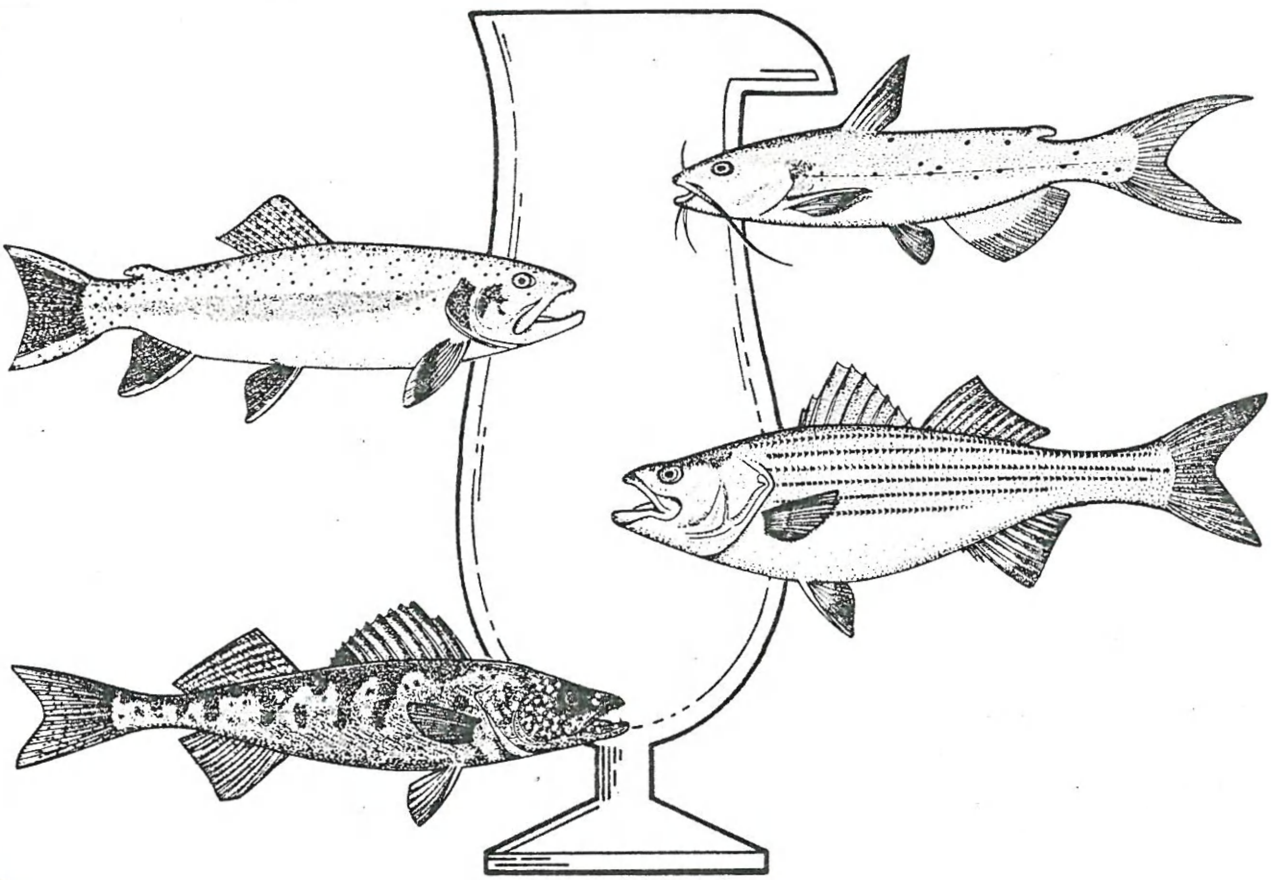
Progressive Fish-Culturist



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Environmentally Controlled Sea Water Systems for Maintaining Large Marine Finfish

Experimental fish culture facilities at the Florida Department of Natural Resources (FDNR) Bureau of Marine Research (BMR) were recently expanded to allow concurrent replicate studies of large marine finfish. Three of nine duplicate environmentally controlled systems were completed in 1982.

Three criteria were established prior to design and construction of facilities: 1) the largest possible tanks and water volume within a wet lab 24.4 × 18.3 × 3.0 m (80 × 60 × 10 ft), 2) duplicate systems to allow statistical comparison of concurrent environmental regimes and 3) complete control and monitoring of environmental parameters.

Rectangular tanks are favored over other configurations because they provide the most efficient use of floor space and can be stacked to utilize vertical space. Each system incorporates two fiberglas tanks with a total water volume of 20,000 L (5284 gal), recirculating artificial salt water and biological filtration located within an environmentally controlled room (Fig. 1). This method maintains exceptional water quality with minimal disease problems and has been used successfully at the BMR to maintain and spawn pompano, *Trachinotus carolinus* (Hoff et al. 1972) and red drum, *Sciaenops ocellata* (Roberts et al. 1978). Current research in these new systems involves conditioning and spawning of gag, *Mycteroperca microlepis* and snook, *Centropomus undecimalis*.

The single large holding tank, 4.3 × 3.0 × 1.2 m (14 × 10 × 4 ft), with a capacity of 13,000 L (3435 gal) is constructed and reinforced entirely of hand-laid fiberglas. All corners are rounded and airlifts at vertical corners (Fig. 2) eliminate debris accumulation and maintain water flow. A single 7.6 cm (3 in.) boat thru hull fitting mounted flush with the bottom and at one end of the holding tank serves as a drain and is connected to an outside standpipe to control water depth. The drain fitting accepts a 7.6 cm (3 in.) PVC standpipe which allows surface overflow and directs pelagic eggs onto a collecting screen placed under the outflow.

Water from the holding tank is directed into a settling tank (Fig. 3) modified from Parker (1979). This settling tank has a capacity of 510 L (135 gal) and directs water flow over a series of baffles which effectively eliminate most large particulate from the water column before collecting and clogging the biological filter. Debris separated in the settling tank is

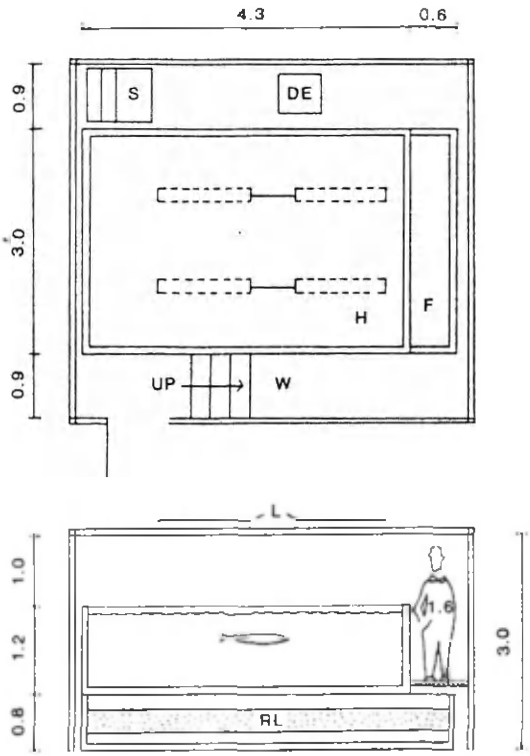

Fig. 1. Top and side view of environmental room showing dimensions (m) and placement of holding (H), filter (F), and settling (S) tanks, and diatomaceous earth (DE) filter, rock lime (RL), wooden walkway (W), and fluorescent fixtures (L).

periodically flushed through a drain in the lowest point of the triangular tank.

Water is directed from the settling tank into the lower biological filter tank. The filter tank, 4.9 × 3.0 × 0.8 m (16 × 10 × 2.6 ft), supports the holding tank and is accessible through a 3.0 × 0.6 m (10 × 2 ft) area at one end of the tank. Wooden walkways, built over the filter tank, extend along each side of the holding tank. Broodstock are captured with the aid of a 3.0 × 1.2 m (10 × 4 ft) seine. A false bottom in the filter tank built with bricks, fluorescent light fixture egg crate lens material, and fiberglas window screen supports 30–46 cm (12–18 in) of 0.9 cm (3/8 in) lime rock which provides substrate for nitrifying bacteria and pH buffering control. A 1 H.P. pump, coupled to a network of 3.8 cm (1½ in)

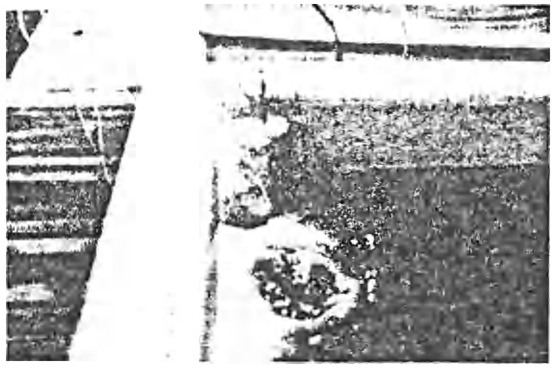

Fig. 2. Airlifts at vertical corners of holding tanks reduce debris in corners and direct water around tank.

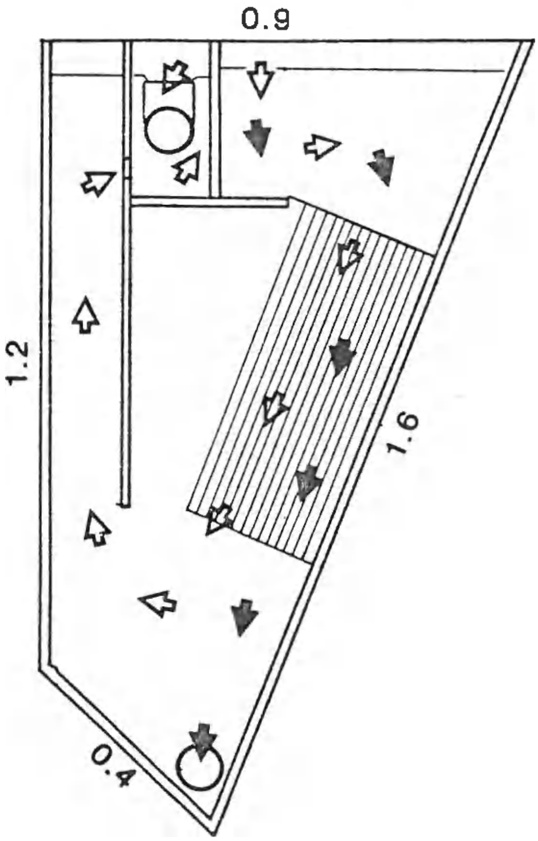

Fig. 3. Side view of settling tank with dimensions (m). Water (open arrows) and particulates (dark arrows) flow as indicated; particulates settle to the lowest point and are discharged at the bottom while clarified water overflows through an outlet at the surface.

PVC wellpoints under the false bottom, draws water from a central point on the bottom of the filter tank and reduces channeling effects due to tank shape. Water volume in the filter tank, minus the volume of lime rock is 6,350 L (1678 gal).

A diatomaceous earth filter (D.E.), connected to the 1 H.P. pump with valves, provides additional particulate filtration when necessary. Flow rate is 265 L/minute (70 gal/minute) without D.E. filtration and provides 18 water changes within a 24 hour period. Each system has separate fresh water and salt water supply lines. Artificial salt water is pumped from two 4,163 L (1100 gal) mixing tanks located within the wet lab.

Each system is completely enclosed in a 5.3 × 4.9 × 3.0 m (17 × 16 × 10 ft) room constructed from 7.6 cm (3 in) rigid foam between 0.2 cm (⅛ in) fiberglass sheets providing an R-23.1 insulation rating. Individual wall panels, 3.0 × 1.2 m (10 × 4 ft), joined by fiberglass and resin, provide wall units with adjacent rooms sharing a common wall. Access to each room is through a single insulated door. Roof panels, made from 10.2 cm (4 in) rigid foam between 0.2 cm (⅛ in) fiberglass, contain two 3.0 × 0.3 m (10 × 1 ft) sealed plexiglas windows that protect 16 fluorescent light fixtures. The fixtures, located outside the room, are wired in parallel and can be operated singly to control light intensity. A single white incandescent light with dimming capacity is used to eliminate abrupt light cycle changes and simulates sunrise and sunset. A single red incandescent light provides minimal lighting for observation of fish during hours of darkness.

Water temperature in each system is controlled through teflon immersion coils located in each settling tank. One 2.4 m (8 ft) coil, connected to the existing building brine air conditioning system, provides 7.0 C (45 F) cooling when activated; a second 1.2 m (4 ft) coil, connected to the building boiler system, provides 82.0 C (212 F) water for heating when activated. Cooling or heating is accomplished through electrically operated on/off solenoid valves on each exchanger. Rate of temperature change is controlled by regulating flow of brine or hot water by manual ball valves.

All environmental parameters, water temperature within 0.1 C (0.2 F), water level, fluorescent photoperiod and incandescent sunrise and sunset are controlled and monitored by computer. Experimental regime schedules are stored on computer disk and actual conditions are monitored and compared continuously with expected values. Deviations in environmental parameters beyond specified tolerances or malfunction of equipment or monitoring devices trigger a computer alarm system that informs personnel by telephone at their office or home. An emergency generator insures continued computer operation and environmental control in the event of power failure.

Three two-tank recirculating systems have been operative since August 1982. Water quality, clarity and pH depend on number of fish in the system, their total body weight and feeding schedules but have remained exceptional from that date while maintaining different numbers of gag and red drum broodstock through several different environmental regimes. Water circulation is not restricted by rectangular tank design and broodstock have adapted well to tank shape. Environmental rooms, immersion coils, lighting and computer installation were completed in December 1982. Preliminary conditioning regimes and spawning attempts with gag have indicated satisfactory operation of all fish culture facilities.

Acknowledgments

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