Monosex Tilapia Fry Production

ROY BUDDLE
6 Church Close, St. Erme, Truro, Cornwall
England

The high reproductive capacity of mature tilapias in a normal population leads to overcrowding and results in the production of small, stunted and commercially useless fish. The use of monosex culture is the management practice most widely used to prevent this happening. There are several ways of achieving this, each with its own advantages and disadvantages:

(i) A predominantly male population may be produced by growing fry to a sexable size and then selecting only males by examining the urogenital papillae. This method is labor intensive, time consuming, wasteful of the 50% female component and unreliable. It is still widely used in many parts of the world where serious alternatives do not exist.

(ii) The production of populations characterized by a high percentage of males can also be achieved by hybridization, for example *Oreochromis niloticus* x *O. aureus*. For a commercial production system this method relies heavily on management practices to maintain separate pure lines of the broodstock.

(iii) Sex-inversion of gonadally undifferentiated fry, by feeding androgen treated diets, will produce 95-100%

Production of all-male tilapia at the Gan Shmuel Fish Breeding Centre. ***Above:*** The spawning pond has been drained and the net is being lifted, separating broodstock from fry. ***Below:*** Broodstock are held in the net prior to their removal. Note the inflow of clean water. Photos by the author.

Above: Broodstock are checked for females incubating eggs. *Below:* Free swimming fry being removed from the mosquito net.

males. This method has received widespread attention in the scientific literature over the years, but has only recently been adopted as a realistic method for commercial mass production of monosex tilapia fry, for example, in Israel and Taiwan.

The Gan Shmuel Fish Breeding Centre, Hadera, Israel has, since 1982, developed a successful agrotechnique for the commercial mass-production of sex-inversed *Oreochromis* hybrids. A total of 2,500,000 and 4,000,000 sex-inversed fry were produced in 1982 and 1983, respectively.

Two broodstocks are used for fry production at Gan Shmuel: 3,000 *O. niloticus* x *O. aureus* hybrids, 400-800 g body weight, stocked in a ratio of two females to one male and 4,500 *O. mossambicus* (white mutants) x *O. niloticus* hybrids, 200-400 g body weight, stocked in a ratio of three females to one male. Both groups are stocked in earthen ponds, approximately one hectare in area, at the beginning of a spawning cycle. These spawning cycles last for 19-21 days which corresponds to the reproductive cycle of the tilapias. At the end of this period the ponds are drained and both the broodstock and fry are removed.

The broodstock are removed from the pond first before taking out the free-swimming fry: at Gan Shmuel a large, 30 m x 20 m, 30-mm mesh net is laid around the pond drain prior to the start of a spawning cycle, so that to remove the broodstock the net is simply lifted and the parent fish are then held ready for removal. As they are removed, the mouths of parent females are checked for incubating eggs. If any are present they are washed out and retained for later incubation in hatchery tanks. As many as 1,000,000 free-swimming fry of a size suitable for sex-inversion then remain in the pond and these are netted out using a mosquito net.

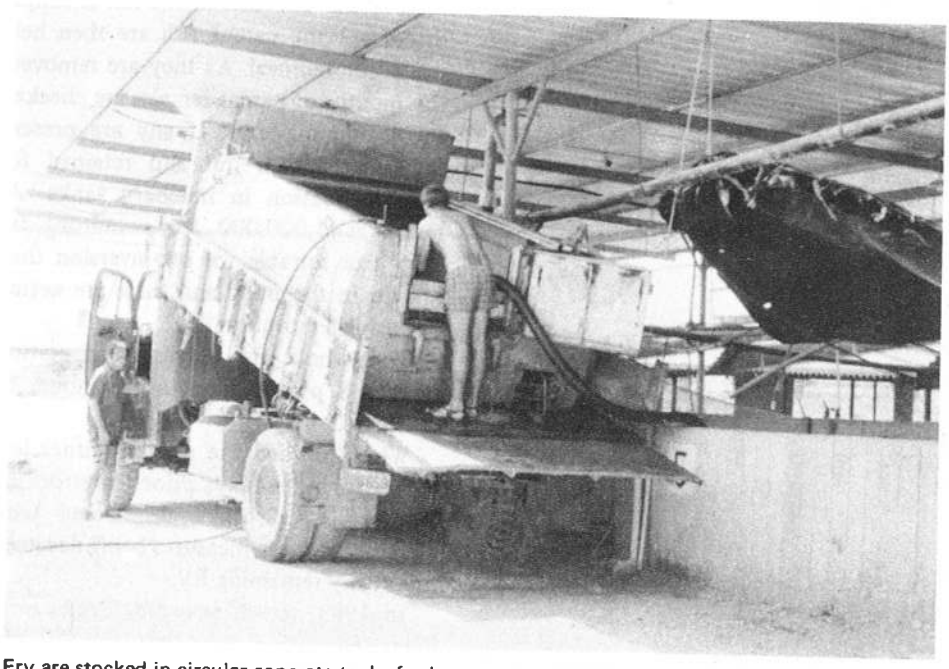
The whole fry harvesting operation takes 6-8 people four to five hours to complete.

When finished the pond is either left to dry for a few days prior to restocking with parent fish, or disinfected with 'Rotenone', both measures being designed to kill any remaining fry.

In 1983, eleven spawning cycles were harvested from the two broodstocks during a four-month period lasting from May to September.

Androgen Diet

Fry returned to the hatchery are removed from the transport tanker using a large siphon hose. This ensures that the delicate fry are stocked undamaged into their concrete tanks for androgen treatment. Between 200,000 and 600,000 fry are stocked for feeding treatment in



Fry are stocked in circular concrete tanks for hormone treatment. Note the siphon tube.

each of the tanks at a rate of 23-75,000 fish/m^3. Androgen-treated diets are prepared by an alcohol evaporation method, so that they contain 60 mg/kg of ethynyltestosterone in an eel starter or trout-mix base (40%-60% protein). Fry are maintained in a circulating stream of biologically filtered freshwater at a temperature of 23°C and fed 15-20% of their body weight per day for 25-28 days. The result is sex-inversion to fish populations characterized by greater than 95% males.

Food is made up in batches 3-4 days in advance and weekly sampling of fry enables recalculation of weekly feeding levels. During the treatment period, the growth of fry is slow because of the high densities and relatively low treatment temperatures maintained.

Ectoparasitic infections *(Gyrodactylus, Dactylogyrus* and *Trichodina)* can cause disease during the feeding treatment and these have to be carefully monitored and controlled with the use of effective prophylactic agents such as malachite green, formalin and 'Bromex'.

Upon completion of the sex-inversion treatment, fry are stocked in nursery ponds for a period of rapid growth prior to their stocking in production or overwintering ponds according to the time of the year. In both nursery and production ponds, fish are fed 18% protein commercial carp pellets, in addition to the natural food available in the ponds.

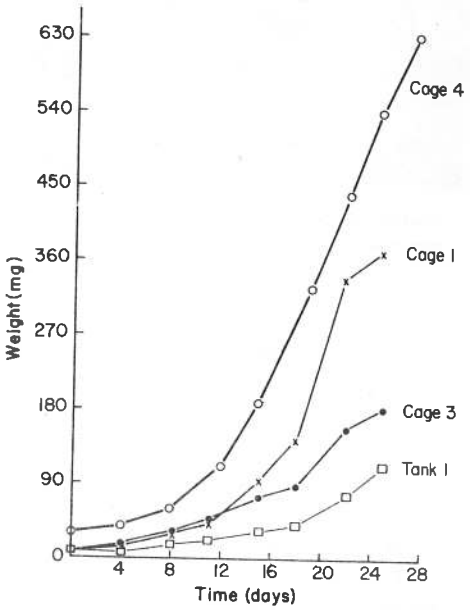
Constraints

One of the constraints to the more widespread use of a sex-inversion technique using androgens is the marketing of treated fish. Fears about eating hormone-treated fish may be alleviated following studies, conducted in Israel and the U.K., which indicate that subsequent androgen levels are comparable to those found in 'normal' or untreated fish. This is reasonable to expect considering the low hormone doses involved, the short duration of the feeding treatments and the time that elapses between the end of treatment and marketing. A more general restriction on the wider use of the sex-inversion technique is the use of expensive facilities, concrete tanks and the like, for the administration of androgen-treated diets.

Inexpensive Technique

To find a less expensive method, the author conducted research in 1983 to determine whether or not sex-inversion of *Oreochromis* fry could be achieved in cages placed in earthen ponds where naturally occurring food was available in addition to the androgen-treated diets. Previously, all androgen induced sex-inversion, including the commercial Gan Shmuel treatments, have been done in water where no such food was available, the hypothesis being that natural food would compete in the fishes diet so that sex-inversion to a high percentage of males would not occur.

Fry that were stocked in small cages, set in an earthen pond, were successfully sex-inversed to populations consisting of 96-99% males, following a 25-28 day treatment period. The graph shows that in addition, those fry fed androgen-treated diets, (cages 1 and 4), were substantially larger than those sex-inversed in 'clean' water (Tank 1). This additional growth is attributed to the extra, natural food available in the pond.



Growth of fry during androgen treatment. Tank 1 contained fish receiving the androgen diet in clean water; Cage 3 held untreated fish in an earthen pond; Cages 1 and 4 contained fish receiving the androgen diet in an earthen pond.

Fry stocked in cage 3 were not fed any supplemental diet but they still exhibited good growth.

These findings hold considerable potential for the further use and development of monosex tilapia fry production, using androgen sex-inversion.

The adoption of the pond sex-inversion technique as described above, would obviate the need for the expensive concrete tanks presently used for such treatment. If developed on a larger scale and combined with the Gan Shmuel fry collection methods, one can envisage less intensive monosex tilapia fry production systems. ●