**Comparative Breeding Strategy of Ornamental fish, Sword Tail *(Xiphophoru shelleri*) & Sawdust Molly (*Poecilia sphenops*) under Captive condition**

Abstract:

An experiment was conducted over a period of 4 to 6 weeks (February to April 2023) in glass aquariums and tanks within the laboratory of the Forestry and Fisheries Department to study the comparative breeding techniques of two ornamental fish species: Swordtail (Xiphophorus hellerii) and Sawdust Molly (Poecilia sphenops). Breeding pairs were introduced at ratios of 2:1 for Swordtail and 2:3 for Sawdust Molly. Successful breeding of Swordtail was recorded in March 2023, with the observation of 8 live fry in the aquarium. These fry were subsequently transferred to a separate tank equipped with a bubble diffuser to facilitate respiration and were fed crushed feed suitable for their size. The first mortality of a pregnant Swordtail was observed in April 2023. Upon dissection, 38 undeveloped fry were recovered. Breeding in Sawdust Molly was observed later in April 2023, yielding a total of 14 **.**

**Keywords:** Ornamental fishes, Dissection, Fry,Capitive breeding ,breeding technique,

Introduction:

An aquarium is a recreational display that houses ornamental fish and other aquatic life, appreciated for their aesthetic value. The term *aquarium* was coined by English naturalist Philip Henry Gosse, combining the Latin word *aqua* (meaning "water") with the suffix *-arium*, indicating a place associated with a specific function (Khanna, S.S., 2011). Aquariums can be constructed from various materials such as glass, concrete, wood, fiberglass, and acrylic sheets, with the choice depending on factors like location, cost, and durability (Ngucku, B.B., 2014). Aquarium tank construction is a practical skill that can be acquired with just a few days of hands-on experience (Mahapatra, B.K., 2014).

Ornamental fish species, popularly known as aquarium fish, play a vital role in the aquarium trade (Laha and Das, 2007). In India, around 90% of the ornamental fish trade involves freshwater species, of which 98% are cultured and 2% captured from the wild. The remaining 10% includes marine species, where 98% are wild-caught and only 2% are cultured (Mahapatra and Lakra, 2014). Most Indian breeders focus on exotic ornamental species, with relatively little emphasis on breeding indigenous, marine, or brackish water fish.

Goldfish (*Carassius auratus*) remains the most favored species among hobbyists, dominating the Indian ornamental fish sector. In total, approximately 150 varieties of ornamental fish are exploited commercially, including both freshwater and marine species (V.S. Murty, 1996). Given its rich diversity of indigenous fish with ornamental features, India holds immense potential to expand its ornamental fish trade and generate significant foreign exchange. West Bengal, in particular, has emerged as a leader in this sector (Mahapatra and Lakra, 2014).

Among livebearing ornamental fishes, mollies (*Poecilia sphenops*) are especially popular. Known as the common or short-finned molly, *P. sphenops* is native to freshwater streams and coastal brackish and marine waters from Mexico to Colombia. Wild mollies are typically dull and silvery in color. However, through hybridization and selective breeding, numerous colorful varieties have been developed. Mollies can produce fertile hybrids with several other *Poecilia* species, including the sailfin molly. Male mollies often exhibit mild aggression in aquarium settings and require a varied diet that includes high-quality flake food and vegetables (Divya D., 2018).Swordtails (*Xiphophorus hellerii*) are another widely recognized ornamental species, known for their distinct tail extensions. They are one of the most commercially important freshwater tropical fish after goldfish due to their aesthetic appeal, dietary flexibility, and reproductive efficiency. Swordtails are reported to reach sexual maturity at a total length of 25–30 mm or at 10–12 weeks of age (Milton and Arthington, 1983; Dawes, 1991). Most ornamental varieties of swordtails and platys have arisen through hybridization of *X. hellerii*, *X. maculatus*, and *X. variatus*. Feeding is a critical aspect of ornamental fish care. Key factors when selecting feed include particle size and nutritional composition. In this study, two primary feeds were used: **Optimum Feed** and **Freeze-Dried Tubifex Worms**.**Optimum Feed** is a commercially available pellet feed that includes fish meal, corn protein meal, soybean meal, cassava pellets, fish oil, lecithin, symbiotics, vitamins and minerals, astaxanthin, food coloring, and antioxidants. Its nutritional composition is as follows:

* Crude Protein: 28% (min)
* Crude Fat: 3% (min)
* Crude Fiber: 4% (max)
* Moisture: 10% (max)

**Freeze-Dried Tubifex Worms**, a popular live feed alternative, are rich in crude protein and fatty acids, making them highly nutritious and cost-effective (Yanar et al., 2003; Görelşahin et al., 2018; Debnath et al., 2022). Their composition includes:

* Crude Protein: 52% (min)
* Crude Fat: 12% (min)
* Crude Fiber: 2% (max)
* Ash: 12% (max)
* Moisture: 5% (max)

Swordtails, being omnivorous, consume both live and artificial feeds (James and Sampath, 2003). Their optimal diet includes higher protein (60–65%), moderate lipid (8–9%), and lower fiber (4–5%) content (Sharma, 2020), which supports their rapid growth and reproductive health.

**MATERIALS AND METHOD**: An experiment was conducted over a period of 4 to 6 weeks (February to April 2023) in glass aquariums and tanks within the laboratory of the Forestry and Fisheries Department

Aquarium fish are broadly classified into two categories based on their reproductive strategies: egg layers and livebearers. Egg layers deposit eggs in the aquarium environment, whereas livebearers give birth to fully formed, free-swimming young. Among the most popular livebearers in the aquarium trade are mollies (*Poecilia sphenops*), valued for their prolific breeding and ease of care (Divya D., 2018).

Swordtail fish (*Xiphophorus hellerii*), another widely favored livebearer, reach sexual maturity at a total length of 25–30 mm (1.0–1.2 inches) or at 10–12 weeks of age (Milton and Arthington, 1983; Dawes, 1991). For effective breeding, a sex ratio of 2 females to 1 male (2F:1M) or 4 females to 1 male (4F:1M) is typically recommended to reduce male aggression and maximize reproductive success.

During copulation, sperm is transferred into the female and fertilizes the eggs. Remarkably, swordtail females have the ability to store viable sperm in the oviduct walls for extended periods. This adaptation allows a single mating event to result in five to nine consecutive broods over a span of up to two years (Siddiky and Mondal, 2016). It is essential to select healthy breeding pairs—typically one robust male and one or more healthy females—to ensure successful reproduction and the production of viable offspring.

**Aquarium Formula** =

|  |
| --- |
| L×W×D = cubic feet  Cubic feet× 7.47= Gallons.  1.42×1.50×0.98×7.47= 15.59 equal to **59 litres**(Water).  (1 Gallon = 3.785 litres.)  Where, L= length (1.42 ft), W= width (0.98 ft), D= depth (1.50 ft). |



Where, Wt = mean final weight, WI = mean initial weight and T = total experimental days.

Brood survival rate 100%

Male female ratio = 4:6

**Identification of sex in swordtail molly**

For breeding the most important thing you kept in mind is differentiation in male and female swordtail and knows its characteristic.



Gravid spot

Figure1: Mature female swordtail molly Figure 2: Mature male swordtail molly

Male molly fish tend to be much smaller than female mollies, have a specialized anal fin called a gonopodium. Males have larger fins and are more torpedos shaped than females. For reproductive purposes female mollies have bulkier proportions than males. She will have a bulging and dark spot appearance in belly region while she is pregnant. Her anal fins are triangular and she has shorter fins. (Durgude Archana, 2020).

**Embryonic Development**

According to **(**Milton and Arthington 1983), reports of embryonic development vary from 26 to 63 days (Table). They demonstrated that temperature is the major factor in the rate of development while photoperiod plays a minor role. The gestation time of a molly is approximately 40 to 70 days.

|  |  |  |
| --- | --- | --- |
| **Embryonic Stages (Days)** | **Duration(Days)** | **Description** |
| Early Development  Early-eyed Embryo  Late-eyed Embryo  Mature Embryo | 1-12  13-16  22-24  25-26 | 12 Embryo less than 1.5 mm, seen as a pale strip on the surface of the ovum  Some retinal pigment, no body pigments  Distinct neck strap of receding extra embryonic membranes  Neck strap absent, preparturition stage with fully developed fins |

**Table 1: Classification of embryo stages during Embryonic Development**

(Milton and Arthington (1983) the number of fry a female fish can give birth to numbers of fry depending up the sizes of the fishes. A large pregnant fish can give birth up to 100 fry, whereas a small pregnant fish can give birth up 65- 80 fry (Divya, 2018). Changes in the type and quality of feed, feeding rate, ammonia and dissolved oxygen levels, disease, and age of broodstock are all factors that can affect fry production. The average swordtail fish lifespan is around three to five years.

**RESULT AND DISCUSSION:**

The breeding cycle in mollies usually remains for approximately 3 to 6 weeks (20 to 40 days). Before the fry are born a dark triangle shaped patch around the anal vent known as ‘gravid spot’ showed the gravid condition of fish which becomes larger and darker as it matures as was also observed in the present study (Swain *et al*., 2010). The gestation period for gravid female molly fish is between 28-35 days and their fry can swim after birth A matured female molly fish can produce around 20-60 fry/broodstock .Their movement tends to become slow and they start hiding under the plants of an aquarium. After 35-45 days, the fry hatch. Once a female is fully formed it can produce up to 30-70 young ones per female, though you may not get them all to survive (Ayyapan, 2018). The young ones need to be separated from the adults or they will get eaten. One option is to put pregnant mollies in a breeder’s box before they give birth, the young ones are free to leave the box through small holes but the adults stay trapped. Mollies take 12-16 weeks to mature.

The fish was brought from market from 27th February 2023 after completing the fabrication process where the ratio of the female and male taken was 3:1. The successful breeding of swordtail molly was observed in 23March 2023, where a total of 8 fries was found in the aquarium. The fry was < 0.5 cm in length. After the fry were found they were put in a separate tank with only bubble diffuser, to allow them to breathe easily. Fry was provided with crushed feeds, so it is easy for them to intake in their mouth.The 1st mortality of pregnant fish was observed on 10 April2023. A total of 38 undeveloped fry were found when it was dissected.

A similar study was done by Siddiky and Mondal (2016) for 3 to 4 weeks in a glass aquarium and tanks to study on Breeding technique of goldfish (Carassius auratus), molly (Poecilia sphenops), guppy (Poecilia reticulata), (Sudha, 2012).

Similar studies were done by Naik (2020) on three different species of molly, Black, White and Sailfin Poecilia species originating from Central and North- Eastern South America, required for the experiments were obtained from ornamental fish traders of Ratnagiri and Mumbai during the months from April 2016 to March 2017. Another experiment was conducted for 3 to 4 weeks in glass aquarium tanks to study the Breeding technique of molly (Poecilia sphenops) by Divya (2018). Molly starts breeding at the age of 4 months. The sex ratio was taken slightly differently in jars of three sets that are 1 female 2 male, 1 female, and 2 males and 2 females with one male. The molly can produce fertile hybrids with many Poecilia species, most importantly the sailfin molly. The male mollies generally tent to be mildly aggressive. I take mixer of molly fish species (gold dust molly, platinum molly, and common molly) in my aquarium and 12 numbers of species. 4 are male and 6are female species. My molly fish average length is 4- 5 cm.

**Discussion**

In live-bearing species like *Poecilia sphenops* (commonly known as mollies), the young are born fully formed and free-swimming. At birth, fry typically sink to the bottom of the tank and remain inactive briefly. To protect them from predation, especially by adult fish, floating breeding units equipped with a slotted grid are often used. These units allow the newborn fry to fall through the grid to a separate compartment, minimizing the risk of being eaten by the adults (Divya D., 2018).

Maintaining clean water conditions is essential for fry survival. A dosage of one teaspoon of salt per gallon is often recommended to prevent infections and improve fry health. In the early stages, fry should be fed highly digestible and nutrient-rich foods such as specialized fry flake food, finely chopped lettuce, the soft inner portion of cucumbers, and small portions of boiled egg yolk. These feed types support rapid growth and development in the initial weeks post-birth (Divya D., 201

**Aquarium Formula** =

|  |
| --- |
| L×W×D = cubic feet  Cubic feet× 7.47= Gallons.  1.42×1.50×0.98×7.47= 15.59 equal to **59 litres**(Water).  (1 Gallon = 3.785 litres.)  Where, L= length (1.42 ft), W= width (0.98 ft), D= depth (1.50 ft). |



Where, Wt = mean final weight, WI = mean initial weight and T = total experimental days.

Brood survival rate 100%

Male female ratio = 4:6

**CONCLUSION:**

Livebearer breeding is simple because they release fry immediately, but the fry may need to be raised in a separate environment to avoid cannibalism from their parents. Both the ornamental fish belong to same family i.e. Poecilliadea, life span of both fishes i.e. sawdust & sword tail fish are 3-5 years. The number of fry are also more or less same in both the species.

But with this comparative study, we able to conclude that as compared to swordtail fish, survivability of common fish was 100%. Still both have same breeding cycle .Sawdust or common molly are genetically more improved as compare to sword tail.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERENCE**

Ayyappan S**. 2018**. *Handbook of fishery science and aquaculture.*

Dawes, J.A. 1991. Livebearing Fishes. A Guide to Their Aquarium Care, Biology and Classification. Blandford, London, England. 240 pp.

Debnath S, Sarker DS, Kundu P, Parvez MS, Arafat ST, Mathew RT, Alkhamis YA, Rahman MM, Rahman SM (2022).Growth, survival and body protein content of swordtail (Xiphophorus helleri) fed live and formulated feeds. *Adv. Anim. Vet. Sci. 10(2): 335-341.* DOI | <http://dx.doi.org/10.17582/journal.aavs/2022/10.2.335.341>.

Durgude, A., Pathan, D., Sawant, N. S., Patil, P., and Shelar, G. (2020). Effect of stocking densities on reproductive performance of black molly, *Poecilia sphenops* in cages. *Journal of Entomology and zoological studies, 8(3).*

Ghosh S, Sinha A, Sahu C (2008). Dietary probiotic supplementation in growth and health of live-bearing ornamental fishes. *Aqua. Nutr., 14(4): 289–299. https://doi. org/10.1111/j.1365-2095.2007.00529.*

Gorelsahin S, Yanar M, Kumlu M (2018). The effects of stocking density, Tubifex feeding and monosex culture on growth performance of guppy (*Poecilia reticulata*) in a closed indoor recirculation system. *Aquaculture, 493: 153–157. https:// doi.org/10.1016/j.aquaculture.2018.05.004*

https:\\nfdb.gov.in\PDF\Fish%20&%30Fisheries%20of%20India\3.Ornamental%20Fisheries%20of%20India.pdf

James, R. and Sampath, K. (2003) Effect of Animal and Plant Protein Diets on Growth and Fecundity in Ornamental Fish, Betta splendens (Regan). *Israeli Journal of Aquaculture—Bamigdeh, 55, 39-52. http://hdl.handle.net/10524/19067*

Biology and invasive potential of the introduced swordtail

Xiphophorus hellerii Heckel (Poeciliidae) in Western Australia

M. G. MADDERN



, H. S. GILL and D. L. MORGAN

Centre for Fish and Fisheries Research, Division of Science and Engineering, Murdoch Universit

M. G. MADDERN



, H. S. GILL and D. L. MORGAN

Khanna.S.S. **2011**. *Textbook of Fisheries*

Mahapatra B.K, Lakra D.S. **2014**. *Ornamental Fishes of East Kolkata Wetland, West Bengal, India. ISSN NO 227-8179. Volume:3.*

Milton, D.A. and A.H. Arthington. 1983. Reproductive Biology of *Gambusia affinisholbrooki* (Baird and Girard), *Xiphophorus helleri* (Gunther) and *X. maculatus* (Heckel) (Pisces; Poeciliidae) in Queensland, Australia*. J. Fish. Biol., (23):23-41.*

Mukherjee M., Chattopadyay M., Datta S. K. and Biswas S. **2000**. Problems and prospects of aquarium fish trade in West Bengal. *Fishing Chimes. 20(1): 90-93.*

Naik, K. S. (2020). Inter-species hybridization among molly (*Poecilia sp*.) species. *International Journal of Fisheries and Aquatic Research, 8(II).*

Nair S. G., Vidhya V.and Gopukumar S.T. **2020**. Importance of optimum water quality indices in successful ornamental fish culture practices*. Volume IX, Issue II*

Ngueku B.B. **2014**. The design and construction of aquaria.*International Journal of Fisheries and Aquatic Studies 2(3): 01-04.*

Roy P. E. Y. **1996**. Reproductive management of freshwater ornamental fish. Seminars in Avian and Exotic Pet Medicine. Seminar in Avian and exotic pet medicine. *Volume 5: P-222-235*

Sharma M (2020). Ornamental fish rearing and breeding-a new dimension to aquaculture entrepreneurship in Himachal Pradesh. *Int. J. Fish. Aquat. Stud., 8(2): 157–162. https:// doi.org/10.22271/fish.2020.v8.i5e.2346.*

Siddiky M.M, Mondal B. **2016**. Breeding technique of gold fish, molly, guppy and its impact on economy in the rural area of the Purba Midnapore district, West Bengal, India. *International Journal of Advanced Multidisciplinary Research* Volume 3, Issue 8.

Sudha, C. (2012). Study on induced breeding in ornamental fish, *Poecilia sphenop.* *European Journal of Experimental Biology, 2(4): 1250-1255.*

Swain KS, Sarangi N, Ayyapan S. Ornamental Fish Farming. Publications of Agriculture*, Indian Council of Agricultural Research, New Delhi, India. 2010, 145.*

V. sriramachandra murti(1996) .Marine ornamental fishes of India .*Central Marine Fisheries Research Institute.*

Venugopalan K.M. **2015**. Aqaurium making and maintenance. *CMFRI*

Yanar M, Yanar Y, Genc MA (2003). Nutritional composition of Tubifex tubifex Müler, 1774 (Annelidae). EU. *J. Fish. Aquat. Sci., 20(1): 103–110.*

Ashqolani, M. M., Haetami, K., Maulina, I., & Mulyani, Y. (2023). The Effect of Black Soldier Fly (Hermetia illucens) Larvae Feeding on the Growth of Mutiara Catfish Seeds (Clarias gariepinus). Asian Journal of Fisheries and Aquatic Research, 21(4), 48–54. <https://doi.org/10.9734/ajfar/2023/v21i4548>

Morial , V. A. (2024). Automated Fish Feeder Using Scheduler Mobile Application. Advances in Research, 25(2), 1–16. <https://doi.org/10.9734/air/2024/v25i21028>

Olivotto I, Cardinali M, Barbaresi L, Maradonna F, Carnevali O. Coral reef fish breeding: the secrets of each species. Aquaculture. 2003 Jun 30;224(1-4):69-78.