SOUTHERN REGIONAL AQUACULTURE CENTER

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Species Profile: Pinfish, *Lagodon rhomboides*

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The pinfish, *Lagodon rhomboides* (Fig. 1), is a member of the Sparidae or porgy/sea bream family. The pinfish is named for the single small, forward-projecting, pin-like spine that is most anterior to the other twelve dorsal fin spines. The body is oval and compressed. The mouth is comparatively small with the maxilla reaching only to the anterior margin of the eye. Both jaws have eight broad, notched, incisor-like teeth and two and one-half rows of molar-like teeth. Pinfish have a distinctive black spot near the origin of the lateral line behind the gill plate. The body is a bluish silver with alternating blue and yellow longitudinal stripes and six dark, diffuse, vertical bars. Fins are light yellow with broad, light blue margins.

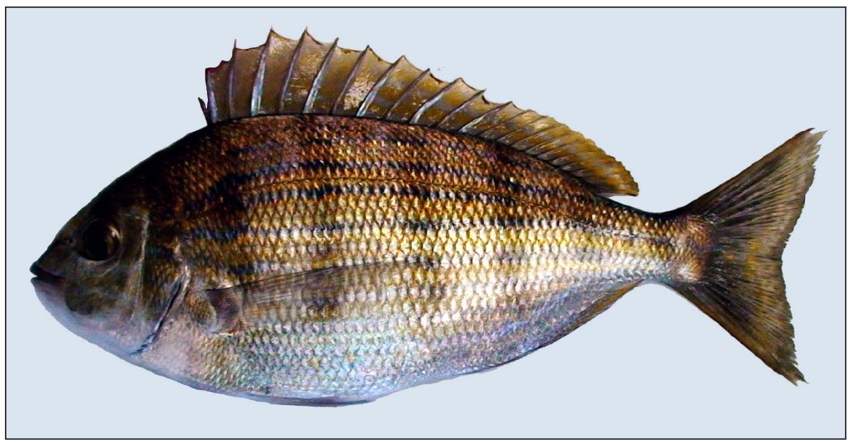

Figure 1. Adult pinfish, *Lagodon rhomboides.*

Pinfish have many attributes that make them a good candidate for aquaculture. They are hardy, euryhaline, and withstand handling. They tolerate high densities, reproduce in tanks, grow rapidly, and have established markets with high demand as a baitfish.

Geographic distribution and habitat

Pinfish are found along the coast of the United States from Massachusetts to Florida and from Bermuda throughout the Gulf of Mexico to the Yucatan Peninsula. Pinfish are important forage for many fish, including grouper, snapper, spotted seatrout, red drum, snook, ladyfish, and flounder. Pinfish are euryhaline and are abundant in many coastal ecosystems. Juveniles inhabit vegetated shallow estuaries and mangroves. Adults inhabit vegetated deeper channels, jetties, and offshore reefs. Pinfish tolerate water temperatures ranging from 50 to 95 °F (10 to 35 °C) and salinities from 0 to 75 g/L (ppt).

Age estimates obtained from otoliths of wild-caught pinfish indicate that they can live up to 7 years. Pinfish rarely exceed 12.2 inches (310 mm) in the wild. At sexual maturity, which occurs at 1 to 2 years of age, fish measure at least 4.3 inches (110 mm) standard length (SL). Pinfish migrate offshore to spawn from late fall to early winter. Females likely spawn several times within a single spawning season. It is believed that larger fish spawn earlier in the season, followed by smaller fish later in the season.

Pinfish are voracious predators and consume a variety of prey at different stages of their development. Post-larval pinfish feed primarily on planktonic calanoid copepods, whereas juveniles feed mainly on shrimp,

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mysids, and amphipods. Food items for adults include shrimp, mysids, amphipods, fish eggs, crabs, and plant matter. Changes in diets appear to be mainly a function of mouth size and tooth structure.

Culture techniques

Broodstock

Bait-sized pinfish are commonly collected along the Atlantic and Gulf of Mexico states by commercial and recreational anglers using cast nets, traps, and seines. Adult brood-sized pinfish are collected with cast nets, seines, and hook and line. Wild-caught pinfish to be used in aquaculture should be placed in quarantine tanks with a salinity and temperature similar to their collection environment. They should be assessed for pathogens and treated, if necessary, before they are introduced into established systems. A prophylactic 250 mg/L (ppm) formalin bath (Paracide-F, Argent Chemical Laboratories, Redmond, Washington, USA) will help reduce external parasite loads. Formalin baths should last 1 hour and occur on alternate days for a total of five treatments. During this time fish should be introduced to a commercial pelleted feed with feed training culminating within a few days.

An optimal broodstock diet is essential to successful larval rearing, as nutrients are passed from adult to eggs and nutritional deficiencies may cause poor egg and larval quality. Formulated broodstock diets have not been evaluated for pinfish, although broodstock diets have been developed for other sparids such as the commonly cultured sea bream. Broodstock diets should contain essential amino acids and elevated levels of n-3 (omega-3) highly unsaturated fatty acids (HUFA), which have been shown to improve oocyte maturation and egg and larval quality. Successful volitional spawning with protracted larval rearing has been achieved by feeding broodstock a 0.08-inch (2.0-mm), slow-sinking, pelleted commercial diet (50 percent crude protein and 15 percent crude lipid) supplemented with frozen squid and krill for 2 to 3 months before spawning.

In the wild, brood fish spawn offshore in 35 g/L salinity in the fall and winter. Exact temperature and light cycle requirements are not fully known, but captive brood fish spawn successfully when temperatures are 68 to 77 °F (20 to 25 °C) and light cycles are 12 hours.

Brood fish need to be sampled periodically to determine gamete development. Fish should first be anaesthetized by immersing them in a bucket of culture tank water mixed with 100 mg/L MS-222 (tricaine methanesulfonate). Sexually mature males are distinguished from females by palpating the coelom to check for the presence of flowing milt. Ovarian maturity of female broodstock is assessed by intraovarian biopsy. A teflon catheter tube (0.97 mm inside diameter, 1.27 mm outside diameter) is inserted into the urogenital opening and a sample is removed by oral suction. Samples may be viewed under a microscope outfitted with an optical micrometer to determine oocyte maturation stage and size. Females targeted for injection should have a vitellogenic oocyte diameter of 450 to 550 µm.

A sex ratio of 1:1 (male:female, M:F) has worked in experimental spawning trials with pinfish broodstock. Increasing the sex ratio to 2:1 M:F will ensure adequate fertilization but is not required because a single male may fertilize the spawns of many females. Aggregation size may affect spawning success in captivity. While there is no empirical ecological data regarding natural spawning behavior in this species, anecdotal accounts suggest that these fish most likely spawn in large aggregations. Maintaining large aggregations in a captive setting may not be practical, however, and researchers have successfully induced spawning with just two fish (1M:1F). The availability of broodstock and production goals will ultimately shape decisions regarding spawning aggregation size.

In the 1970s, pinfish eggs were induced to mature with human chorionic gonadotropin (HCG) and a pituitary luteinizing hormone (PLH) of mammalian origin consisting of an estradiol benzoate, testosterone propionate, and progesterone mixture. These spawning aids were administered in a single injection of 1,000 international units (IU) of HCG and 0.7 mg steroid mixture in the muscle just below the dorsal fin. A second injection, or resolving dose, of 5 mg of PLH was given 24 hours later if oocyte maturation had not been completed.

Recently, pinfish have been induced to spawn volitionally using Ovaprim® (Western Chemical, Inc.), an injectable salmon GnRHa and domperidone solution. However, Ovaprim® is not currently legal in the U.S. for commercial use in baitfish production. Males and females showing final gamete maturation (vitellogenic oocytes > 0.5 mm) can be given a single intraperitoneal injection of Ovaprim® at a dosage of 0.25 mL/kg for males and 0.50 mL/kg (ppm) for females. Volitional spawning occurs 48 hours after injection at a brood sex ratio of 1:1. Subsequent experiments with Ovaprim® have shown dosages ranging from 0.25 mL/kg to 2.0 mL/kg administered intramuscularly to be effective at inducing ovulation and spawning, although further research is needed to define an optimal dose. Volitional spawning has produced as many as 17,000 eggs from a single female. As pinfish employ a multi-batch group synchronous spawning modality, fecundities approaching or exceeding the maximum reported fecundity of 90,000 eggs per female are likely possible using this hormone induction method.

HCG is approved for use as a spawning induction aid in marine finfish. Recent research has shown that a single dose of 500 to 4,000 IU/kg is effective for ovulation and volitional spawning in pinfish. Using HCG, single spawns of up to 50,000 eggs have been collected. Future research will determine effective doses based on production goals.

Captive pinfish have only rarely produced natural volitional spawns, and spawning cues are not fully understood. Spawns have been collected at a salinity of 35 g/L and temperatures of 68 to 77 °F (20 to 25 °C). However, it is not known whether light cycle, aggregation size, tank size, moon phase, or tide influence spawning in the wild.

Artificial fertilization, also known as strip spawning, may be possible and can be accomplished by mixing the mature ovulated eggs with freshly collected milt in seawater. This may be useful, but further research is needed to define missing spawning cues and to learn whether individual fish will spawn multiple times per spawning season.

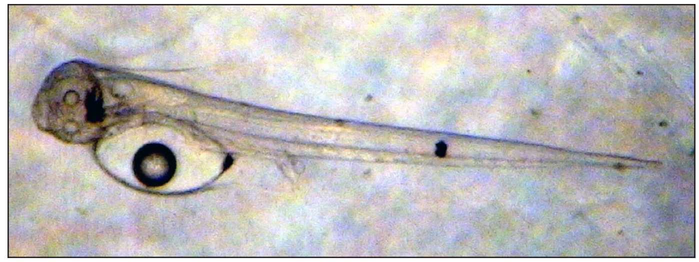

Figure 3. Pinfish larva 2 DPH.

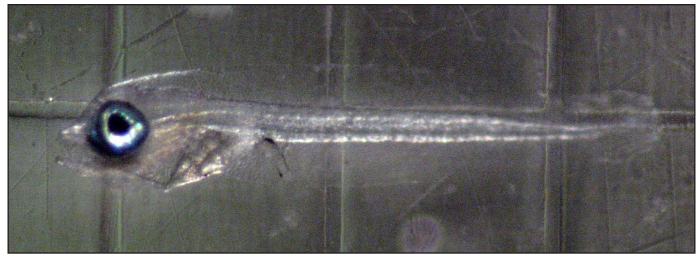

Figure 4. Pinfish larva 3 DPH.

Eggs and larvae

Fertilized pinfish eggs (Fig. 2) have a single oil globule and a spherical yolk and are buoyant in seawater. Eggs range in diameter from 0.90 to 1.05 mm. Fertilized eggs can be collected by skimming water from the surface of spawning tanks and concentrating the eggs in screened collection devices. Many different designs will work; the most common design is to collect eggs in an external collection tank equipped with a screen (≤ 0.8-mm mesh diameter) to concentrate the eggs. Water leaving the culture tank through an open standpipe on the surface of the water will collect floating, viable eggs. Sinking, non-viable eggs can be collected through a pipe near the bottom of the culture tank. The eggs should be incubated in static cylindrical tanks filled with seawater from the broodstock system and gently aerated with a submerged airstone. Eggs hatch after 24 hours of incubation at 77 °F (25 °C).

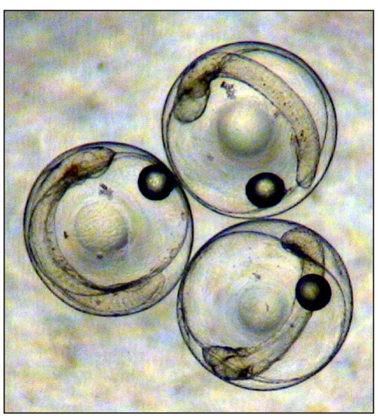

Figure 2. Pinfish late-stage embryos.

Endogenous nutrients in the larval yolk sac are crucial for early post-hatch development (Fig. 3). Larvae are extremely fragile during this early developmental period, when eye pigmentation, swim bladder inflation, and jaw formation occur. The yolk sac is absorbed at approximately 3 days post-hatch (DPH) at 77 °F (25 °C), and at this time larvae must consume exogenous food to survive (Fig. 4). Live zooplankton such as rotifers and/or copepods should be introduced into the larval culture tanks at this point. Although copepods are the natural food source for wild larval pinfish, protocols for efficient feeding of larvae need to be developed and cost effective live feeds need to be identified.

Pinfish larvae should be cultured at approximately 77 °F (25 °C) and fed rotifers, *Branchionus* sp., at first feeding (3 DPH) because they are small enough to be consumed. Rotifers should be fed to larvae at a density of 5 to 15 rotifers per mL from 3 to 21 DPH (Fig. 5). Rotifer cultures can be fed live microalgae or algal paste and supplemented with Super Selco® (INVE Aquaculture Inc., Salt Lake City, Utah, USA) twice daily to enhance the nutritional composition. Rotifers also must be enriched to attain adequate HUFA concentrations to meet the nutritional requirements of larvae. After enrichment, rotifers should be fed immediately or stored in a refrigerator at 48 °F (9 °C) to slow the digestion of the enrichment product.

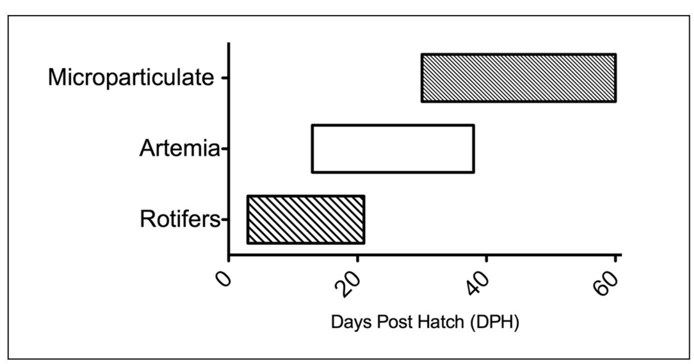

Figure 5. Larval feeding regime.

As fish larvae increase in size, so should feeding frequency and prey size. Larger *Artemia* or adult copepods should be fed to pinfish larvae as they grow. Unenriched instar I *Artemi*a should be introduced to pinfish larvae at 13 DPH and a feeding density up to 1.3 *Artemia* per mL should be maintained until 38 DPH. Larvae can be completely weaned onto a microparticulate diet by 39 DPH, and as fish size increases, a finfish starter #1 crumble (50 to 55 percent protein and 15 percent lipid) should be gradually introduced. Weaning to an artificial diet should begin about 30 DPH and after the feeding of *Artemia*, but the dietary shift must be gradual to ensure a successful transition. Uneaten feed should be removed to prevent water quality problems.

Juveniles

Early juveniles have fully formed fins and range in size from 0.47 to 0.55 inches (12.0 to 13.9 mm) SL. Pinfish grow rapidly and can reach a marketable size of 1.97 to 4.9 inches (50 to 125 mm) midway through their first year of life. Juveniles 0.43 to 0.71 inches (11 to 18 mm) long have been found to survive in a wide range of water temperatures and salinities. This inherent tolerance may give producers more flexibility in culturing pinfish. Culture success will depend on growth, survival, system design, environmental conditions (temperature, salinity, dissolved oxygen), and diet (feed composition and ration).

Growout

Captive juvenile pinfish are easily feed trained and readily consume formulated commercial diets (50 to 55 percent protein and 15 percent lipid). Juveniles survive well when cultured in recirculating aquaculture systems and will grow to marketable bait size at high densities and reduced salinity. Densities of 0.05, 0.2, 0.4 and 0.6 fish per L have been evaluated at a salinity of 27 g/L with temperatures ranging from 71.6 to 84.2 °F (22 to 29 °C). Pinfish grew 0.35 to 0.39 g/day with a mean survival of 94 to 99 percent over 82 days. Mean food conversion ratios (FCR) ranged from 1.7 to 1.9. Growth in different densities is shown in Figure 6. This graph will help producers estimate the time required from culture to market size for two size classes at the initiation of growout.

Two salinities (9 and 27 g/L) have been evaluated for pinfish. Mean percent weight gain ranged from 234 to 284 percent with no significant differences between salinities. Food conversion ratios ranged from 2.5 to 3.1. Survival was not different between salinities and exceeded 98 percent in all tanks over 65 days.

Further studies in recirculating aquaculture systems and land-based ponds are needed to develop the most appropriate culture techniques and protocols. Further research is warranted to identify low-salinity culture methods and systems.

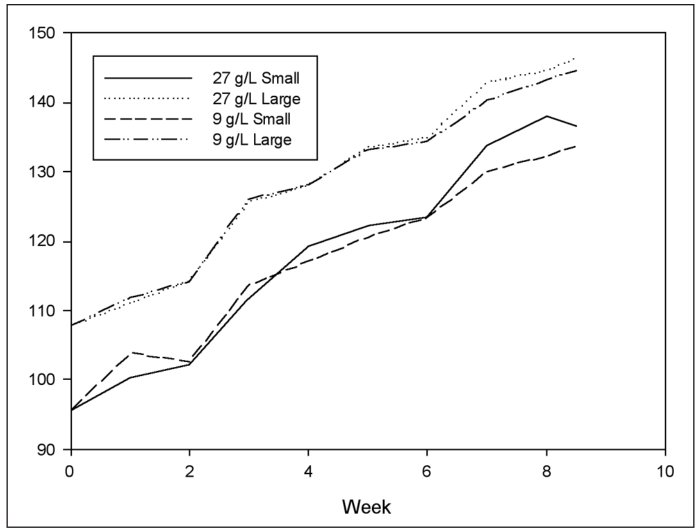

Figure 6. Pinfish growth at various stocking densities.

Markets

Pinfish are a popular live bait used by recreational and commercial fishermen. They are sold in wholesale and retail markets along the Atlantic Coast and Gulf of Mexico. Market-size pinfish are harvested from the wild. The availability of pinfish varies by season and from one location to another, and the size of fish available from the wild is not always what is in high demand. The size pinfish anglers want depends on the species they are trying to catch. Pinfish ranging from 1.5 to 6.0 inches (3.75 to 15 cm) are frequently used by both inshore and offshore anglers. Wholesale prices of pinfish are $0.30 to $0.66 per fish, with retail prices ranging from $0.45 to $1.50 per fish. Wholesale and retail prices fluctuate throughout the year and are dependent on previously mentioned variables.

Conclusion

Pinfish show great potential as a new aquaculture species for the southeastern U. S. Pinfish are hardy, grow rapidly, tolerate a wide range of environmental conditions, have a high market demand, and thrive in captivity. Well-established wholesale and retail markets and distribution networks for pinfish as live bait already exist. These characteristics strongly justify further research with pinfish aquaculture to improve the hatchery stage of culture (possibly through brood and larval nutrition), to evaluate growout systems (including low-salinity tank and pond culture), and to study the economics of pinfish production.

Selected readings

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USDA United States Department of Agriculture National Institute of Food and Agriculture

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