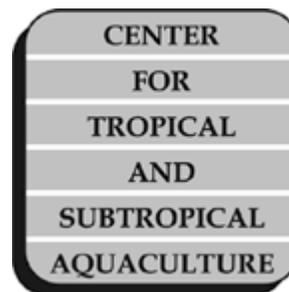


Growout Techniques for the Pacific Threadfin

Polydactylus sexfilis



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Introduction

Pacific threadfin, *Polydactylus sexfilis*, known locally in Hawaii as *moi*, were a favorite amongst the ancient kings of Hawaii, or *ali'i*. Today Pacific threadfin are still revered in Hawaii. However, as a result of the low annual catches, which range from 1500 to 2500 lb per year, culture techniques were developed at the Oceanic Institute (OI) for stock enhancement and aquaculture purposes. Funded by the Center for Tropical and Subtropical Aquaculture (CTSA), OI has been providing growout technologies and fingerling fish to farmers throughout the state, stimulating a new marine fish aquaculture industry. Currently, Pacific threadfin are being cultured in flow through tanks and raceways, Hawaiian fishponds, and more recently in an offshore submerged sea cage.

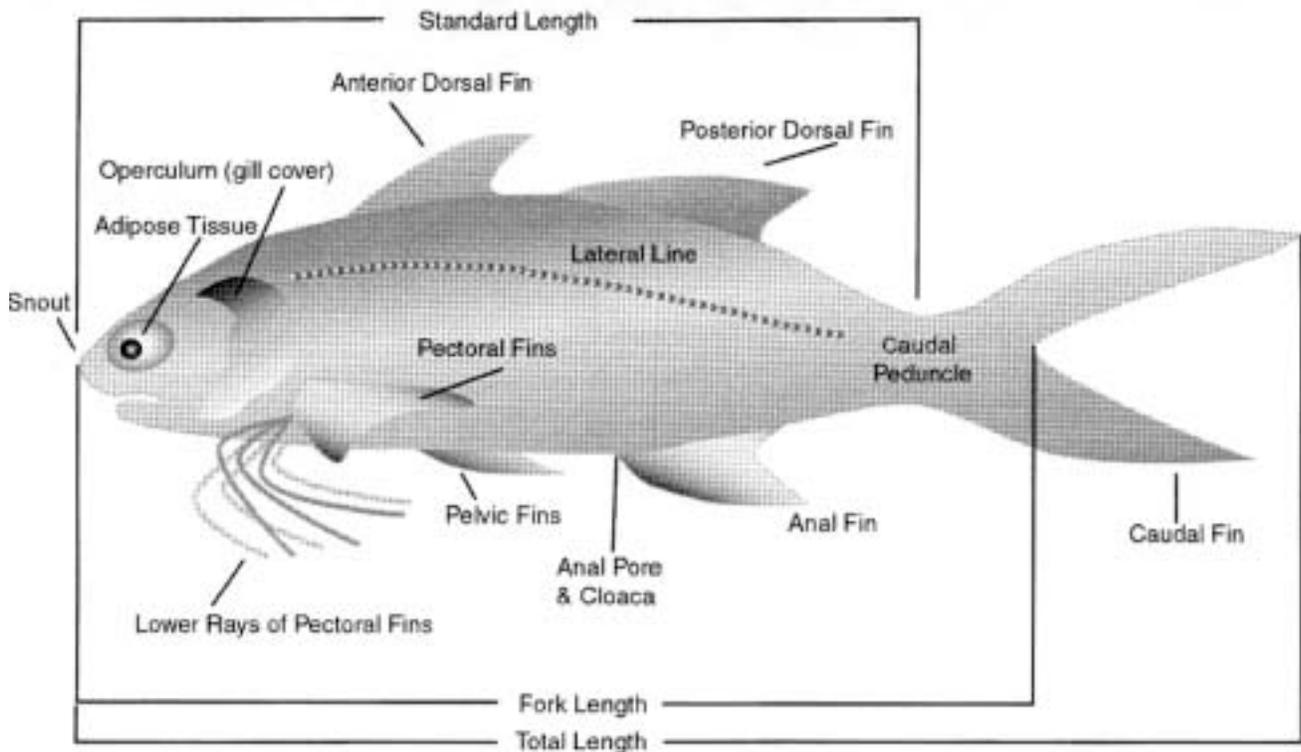
Characteristics

Polydactylus sexfilis belongs to the family Polynemidae. Several species are distributed throughout the Atlantic Ocean and Indo-Pacific, but *P. sexfilis* is the only species found in Hawaiian waters.

P. sexfilis has a deep and compressed body and its head is moderately conic in shape with a deeply forked tail. The eyes are covered with an adipose eyelid, similar to the mullet. The pectoral fins have six filaments, from which its Latin name *Polydactylus sexfilis* is derived. This near shore, sandy bottom dweller uses its whiskers (filaments) to locate prey items. Threadfins are named for the threadlike rays or "whiskers" arising from the base of the pectoral fins. When searching for food they fan their whiskers out, trailing them along the sandy bottom (Hoover, 1996). The body color is silver dorsally, gradually changing to white on the belly.

Pacific threadfin are prized in restaurants because they are perfect for steaming, poaching, and frying and are delicious when prepared Hawaiian, Oriental, or European styles.





Schematic diagram of Pacific threadfin

Growout

Pacific threadfin are grown in a variety of culture systems in Hawaii. The most common include Hawaiian fishponds, intensive round tanks, extensive raceways, and offshore cages. A 6-8 month growout period is required to raise Pacific threadfin to market size, which ranges from 0.5 to 1.0 lb. Off-the-farm prices range from \$4.00 to \$7.00/lb. The feed conversion ratio (FCR) is 1.3-1.5 lb of feed to 1 lb of flesh. This FCR can be attained when the fish are fed a high quality diet consisting of 50% protein and 12% lipid. Survival rates during growout are generally 95% or better. Threadfin should be maintained at a dissolved oxygen level of above 5.0 ppm and a salinity of greater than 20 ppt. Density rates at harvest range from 0.5 kg/m³ extensively to 35 kg/m³ intensively. The costs of raising Pacific threadfin to 1 lb range from \$2.50 to \$4.25/lb, depending on the culture system.

Feed

Feed is one of the most important components in the growout of fish. How the feed is managed, stored, and fed is critical for the health and survival of the fish. Feed that is not consumed within a reasonable time represents not only an economic loss, but can also reduce water quality (Lovell, 1989). Feed is usually the largest variable cost of operating a fish farm and can range from 40 to 50% of total production costs.

Moore Clark Marine Grower has been utilized at OI for the culture of Pacific threadfin. Experiments conducted at OI have indicated comparatively high survival and growth rates when the Marine Grower diet is utilized. The feed is nutritionally complete with a high quality fishmeal component. Feed should always be stored in a cool, dry, rodent-free place for no more than six months. After six months, the vitamins and minerals start to breakdown.

Pacific threadfin are weaned onto a #2.5 mm pellet between 44 and 50 days of age (i.e. between Days 44 and 50). The fish are then weaned onto a #5.0 mm pellet between Days 70 and 85 depending on water temperature. The feed should be administered three times daily until Day 90 when it can be reduced to twice daily. Twelve-hour belt feeders are also used to distribute feed throughout the day.

Feeding Recommendations

Age	Average Weight (g)	Average Fork Length (mm)	Feed Intake/ Fish (g)	Feed Intake Daily As % Body Weight
D 35	0.3	36	0.06	20
D 40	1.0	47	0.2	15
D 54	7.0	65	0.5	15
D 67	16	104	0.8	7.1
D 96	44	130	1.9	5.0
D 110	100	172	3.3	4.1
D 124	150	183	3.8	3.3
D 138	174	202	4.2	2.5
D 152	220	220	4.8	2.4
D 166	260	228	5.1	2.0
D 180	315	243	5.5	1.7
D 194	365	254	5.8	1.6
D 208	393	259	5.7	1.5
D 222	388	263	5.6	1.4
D 236	429	267	5.5	1.3
D 250	500	282	5.5	1.1

Recommended pelleted diet feeding levels for Pacific threadfin

Culture Systems

Hawaiian Fishpond

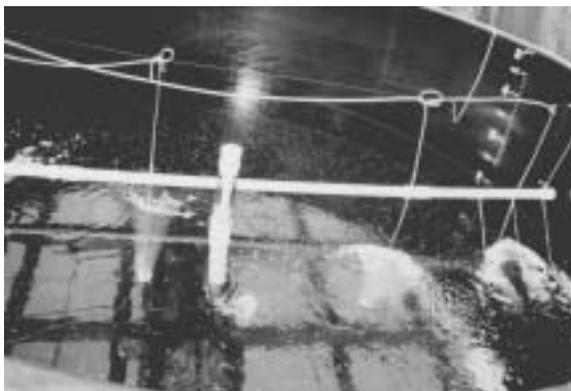
Ancient Hawaiian fishponds utilizing modern aquaculture techniques are perhaps the most integrated culture system in Hawaii. This type of system allows a farmer to grow different marine organisms together in a symbiotic fashion. Pacific threadfin may be combined with other species that may include limu (seaweed), milkfish (*Chanos chanos*), or mullet (*Mugil cephalus*). Natural productivity and daily tidal fluctuations create a secondary food source for the pond inhabitants thus decreasing feed costs. The absence of water pumps and aeration also decreases culture costs. Fish can be grown in pens made from PVC and plastic fencing within the pond's rock walls. This maintains the fish in a general area for feeding, observation, and harvesting. Additional costs would include emergency paddlewheels during periods of low oxygen in the

pond. Low levels of oxygen can occur during low tides and high temperatures, windless days, and dense algae blooms.



Intensive Round Tank

Round tank culture is currently used at OI. These systems are beneficial for commercial use because they produce large quantities of fish in a small scale. Loading rates for threadfin range from 1 to 3 kg of fish/liter/minute flow. Tanks (10-25' in diameter) are equipped with a center drain that draws effluent water from the top (surface skimmer) as well as from the bottom of the tank. Spray bars and/or venturi manifolds are used to enrich the water with dissolved oxygen and create current. The current keeps fish swimming and moves extra feed and fecal material out through the center standpipe. Shade cloth is used to cover the tanks to keep algae from growing on the sides and bottom. Aeration is supplemented to each tank from an air blower through eight air stones. Feed is distributed by hand to satiation twice/day or with a 12-hour belt feeder.



Raceway/Semi-Water Reuse

Cement raceways are used to grow Pacific threadfin on the North Shore of Oahu, Hawaii. These tanks are approximately 20 times as long as they are wide. This system utilizes a PVC water line that runs the length of the tank. The line has water jets every meter that direct water flow towards the drain in one direction. These raceways are contained under a plastic bubble roof maintained by an air blower. Because this type of system stocks a lower density of fish, the water exchange can typically be much less which can decrease overhead costs. For those farms that do not have a constant flow of seawater to their site, this culture system can be highly beneficial.

Offshore Cage

The culture of fish in sea cages has occurred throughout the world for many years. Typically, they are located in protected sites away from the high energy of the open ocean. Recent research efforts have now focused on the culturing of fish in the open ocean environment. This type of culture is currently being explored in Hawaii, where a submerged 3000 m³ sea cage has produced over 100,000 lbs of threadfin. The cage is moored to the bottom of the ocean by four anchors and a ballast weight. Juvenile fish are transferred offshore and gravity fed down a flexible pipe into the cage. The fish are fed daily from a boat through a feed pipe with a commercial sinking pellet. Scuba divers observe fish health and feed satiation. This type of culture system eliminates the need for aeration and water pumps, which tend to be expensive and can lead to a catastrophe when a power failure occurs on shore.



Photo taken by Lytha Conquest

Harvest

The harvesting of a live fish for food consumption must be carried out carefully to assure product quality and shelf life. Improper harvesting procedures will compromise the quality of the fish and not allow it to be sold for a premium price. At harvest time, the farmer has already invested long hours of labor and money into rearing the fish. Therefore, staff should not mishandle fish, which could decrease the quality and the value of the fish.



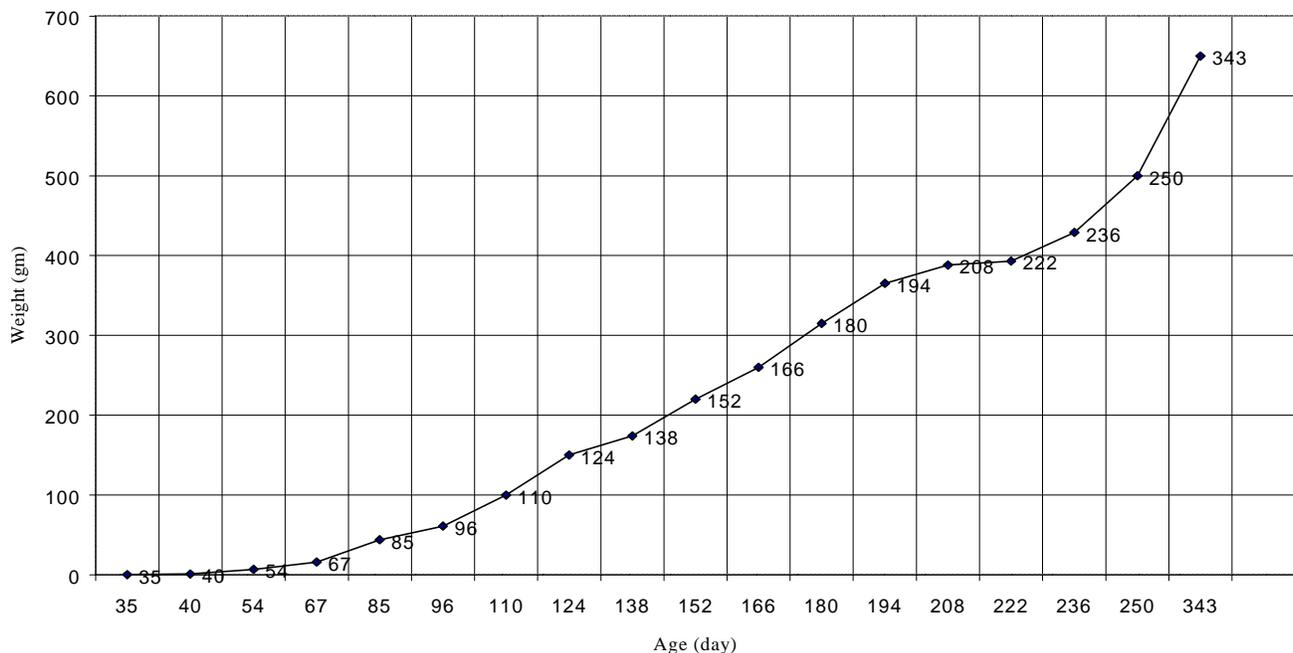
Proper brining and packing techniques

Proper brining and packing techniques include:

1. Prep harvest container (an insulated fish box or cooler with lid) with sea water, rock salt and chipped ice.
2. The ration of ice to seawater is 2:1 and salt should be added at 4 kg/1000 l.
3. Harvest day- live fish should be corralled in the tank with a barrier net, carefully netted with a soft, knotless mesh net, and placed into the brine bath.
4. The fish should be left in the brine bath for 40-75 minutes (depending on size) or until the core temperature of the fish is 2-4°C. Core body temperature can be established by inserting a thermometer through the mouth of a fish into the stomach cavity.
5. Once the fish have been properly preserved, they should then be packed into an insulated cooler with alternating layers of crushed ice and fish and then transported to market.

Proper harvest and preservation will ensure the quality of the fish, prolong the shelf life at market, and ultimately demand a higher price for the farmer.

Growth Curve



Growth of Pacific threadfin at 26-27° C

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Glossary

- Adipose:** connective tissue around the eyes containing masses of fat
- Extensive:** describes type of culture system with use of naturally occurring foods with low fish density.
- Intensive:** describes type of culture system with use of compound foods usually with high fish density.
- Symbiosis:** an intimate physical relationship between two species, where both species benefit in some way and in which at least one of the species is dependent, to various degrees, upon the other.
- Offshore cage culture:** culture system using floating or submersible cages or net pens away from near shore or coastal habitat. Cages may vary in shape and sizes.

Further reading

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