Taxonomy, identification and biology of Seabass (*Lates calcarifer*)

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Introduction

Lates calcarifer (Bloch), commonly known as giant sea perch or Asian seabass, is an economically important food fish in the tropical and subtropical regions in the Asia –Pacific. They are medium to large-sized bottom-living fishes occurring in coastal seas, estuaries and lagoons in depths between 10 and 50m. They are highly esteemed food and sport fishes taken mainly by artisanal fishermen. Because of its relatively high market value, it has become an attractive commodity of both large to small-scale aquaculture enterprises. It is important as a commercial and subsistence food fish but also is a game fish. The most important commercial fish of Australia, and the most sought after game fish, generates millions of dollars per year in revenue for the sport fishing. *Lates calcarifer*, known as seabass in Asia and barramundi in Australia, is a euryhaline member of the family Centropomidae that is widely distributed in the Indo-West Pacific region from the Arabian Gulf to China, Taiwan Province of China, Papua New Guinea and northern Australia. Aquaculture of this species commenced in the 1970s in Thailand, and rapidly spread throughout much of Southeast Asia.

Among the attributes that make seabass an ideal candidate for aquaculture are:

It is a relatively hardy species that tolerates crowding and has wide physiological tolerances. The high fecundity of female fish provides plenty of material for hatchery production of seed. Hatchery production of seed is relatively simple. Seabass feed well on pelleted diets, and juveniles are easy to wean to pellets. Seabass grow rapidly, reaching a harvestable size (350 g – 3 kg) in six months to two years.

Today Seabass is farmed throughout most of its range, with most production in Southeast Asia, generally from small coastal cage farms. Often these farms will culture a mixture of species, including Seabass, groupers (Family Serranidae, Subfamily Epinephelinae) and snappers (Family Lutjanidae).

Australia is experiencing the development of large-scale seabass farms, where seabass farming is undertaken outside the tropics and recirculation production systems are often used (*e.g.* in southern Australia and in the north-eastern United States of America). Seabass has been introduced for aquaculture purposes to Iran, Guam, French Polynesia, the United States of America (Hawaii, Massachusetts) and Israel.

Taxonomy

Phylum	Chordata
Sub-phylum	Vertebrata
Class	Pisces
Sub-class	Teleostomi
Order	Percomorphi
Family	Centropomidae
Genus	Lates
Species	*Lates calcarifer* (Bloch)

The above is an accepted taxonomic classification of seabass or giant perch. Seabass has been placed under several families by various authors in the past (*e.g.* the grouper family, Serranidae and family Latidae, *etc.*) However, Centropomidae is the commonly accepted family name of this species, and the recognized generic name is *Lates*. Other names such as *Perca, Pseudolates, Holocentrus, Coins, Plectropoma, Latris*, and *Pleotopomus* were also given by various authors who collected the fish specimens from different areas. Bloch (Schneider 1801) stated that *Lates calcarifer* occured in Japan Sea but named it as *Holocentrus calcarifer.*

English: Asian seabass, Barramundi perch; French: Brochet de mer.

The common local names of this species are listed below:

English	:	Giant perch, white seabass, silver seaperch, giant perch, palmer, cock-up seabass
India	:	Begti, bekti, dangara, voliji, fitadar, todah
East Bengal	:	Kora, baor
Sri Lanka	:	Modha koliya, keduwa
Thailand	:	Pla kapong kao, pla kapong
Malaysia	:	Saikap, kakap
North Borneo	:	Ikan, salung-sung
Vietnam	:	Ca-chem, cavuot
Kampuchea	:	Tvey spong
Philippines	:	Kakap, apahap, bulgan, salongsong, katuyot, matang pusa
Indonesia	:	Kakap, pelak, petcham, telap
Australia and Papua New		
Guinea	:	Barramundi

Morphology and distinctive characters

\Body elongated, compressed, with deep caudal peduncle. Body large, elongate and stout, with pronounced concave dorsal profile in head and a prominent snout; concave dorsal profile becoming convex in front of dorsal fin. Mouth is large, slightly oblique, upper jaw reaching to behind eye; teeth villiform, no canine teeth present. Lower edge of pre-operculum is with strong spine; operculum with a small spine and with a serrated flap above original of lateral line. Dorsal fin with 7 to 9 spines and 10 to 11 soft rays; a very deep notch almost dividing spiny from soft part of fin; pectoral fin short and rounded; several short, strong serrations above its base; dorsal and anal fins both have scaly sheath. Anal fin round, with three spines and 7–8 soft rays; caudal fin rounded. Scale large ctenoid (rough to touch). Colour: two phases, either olive brown above with silver sides and belly in marine environment or golden brown in freshwater environment. In adult, it is usually blue-green or greyish above and silver below. Fins are blackish or dusky brown. Juveniles have mottled pattern of brown with three white stripes on head and nape, and white blotches irregularly placed on back. Eyes are bright pink, glowing at night.

Distribution

Geographic distribution

Seabass is widely distributed in tropical and sub-tropical areas of the Western and Central Pacific and Indian Ocean, between longitude 50°E - 160°W latitude 24°N – 25°S (Fig. 1). It occurs throughout the northern part of Asia, southward to Queensland (Australia), westward to East Africa. Found in coastal waters, estuaries and lagoons. Usually occurs at depths of 10 to 40m.

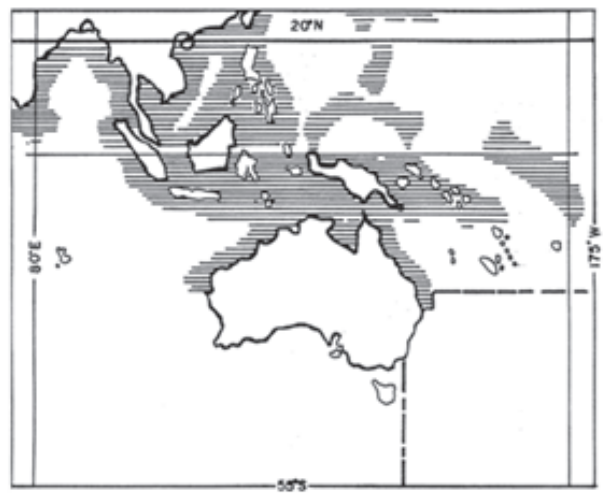

Fig. 1 Geographic distribution of Lates calcarifer (FAO, 1974)

Ecological distribution

Seabass is a euryhaline and catadromous species; inhabit freshwater, brackish and marine habitats including streams, lakes, billabongs, estuaries and coastal waters. Sexually mature fish are found in the river mouths, lakes or lagoons where the salinity and depth range between 30–32 ppt and 10–15m, respectively. The newly-hatched larvae (15–20 days old or 0.4–0.7cm) are distributed along the coastline of brackishwater estuaries while the 1-cm size larvae can be found in freshwater bodies *e.g.* rice fields, lakes, *etc.* (Bhatia and Kungvankij, 1971). Under natural condition, seabass grows in fresh water and migrates to more saline water for spawning. Adults and juveniles tend to be solitary, patrol home ranges near structure, and may be territorial. Migration is seasonal.

Life history

Seabass spends most of its growing period (2–3 years) in freshwater bodies such as rivers and lakes which are connected to the sea. It has a rapid growth rate, often attaining a size of 3–5 kg within 2–3 years. Adult fish (3–4 years) migrate towards the mouth of the river from inland waters into the sea where the salinity ranges between 30–32 ppt for gonadal maturation and subsequent spawning. The fish spawns according to the lunar cycle (usually at the onset of the new moon or the full moon) during late evening (1800–2000 hours) usually in synchrony with the incoming tide. This allows the eggs and the hatchlings to drift into estuaries. Here, larval development takes place after which they migrate further upstream to grow. At present, it is not known whether the spent fish migrates upstream or spends the rest of its life in the marine environment.

Smith (1965) noted that some fish spend their whole life in freshwater environment where they grow to a length of 65 cm and with 19.8 kg body weight. The gonads of such fish are usually undeveloped. In the marine environment, seabass attaining a length of 1.7 m have been recorded in the Indo-Australian region (Weber and Beaufort 1936).

Eggs are pelagic, hatch within 24 hours, and the larvae grow quickly as they move into mangrove areas, mudflats, and floodplain lagoons. Juveniles move into coastal waters after one year, and then migrate upstream where adults reside for three to four years. Populations landlocked by dams migrate to the dam face, but do not spawn. It is reared extensively by aquaculture as food or for game fish-stocking programs. Catadromous migration is observed, where the fish migrates downstream to shallow mudflats in estuaries during the wet season.

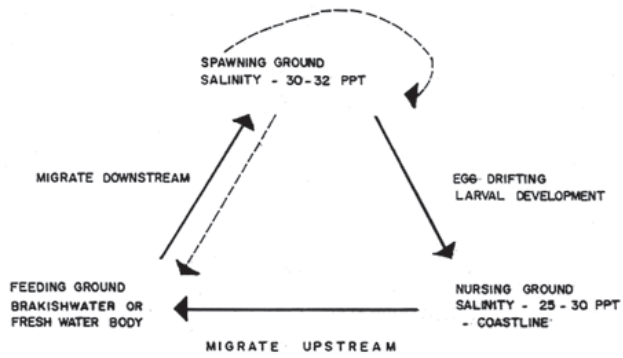

Fig. 2 Migration pattern of Lates calcarifer Bloch

Feeding habits

Seabass or barramundi are opportunistic predators; crustaceans and fish predominate in the diet of adults. Although the adult seabass is regarded as a voracious carnivore, juveniles are omnivores. The fish is skilled at stalking or ambushing prey. Analysis of stomach content of wild specimens (1–10 cm) show that about 20% consists plankton, primarily diatom and algae and the rest are made up to small shrimp, fish, *etc.* (Kungvankij 1971). Fish of more than 20 cm, the stomach content consists of 100% animal prey: 70% crustaceans (such as shrimp and small crab) and 30% small fishes. The fish species found in the guts at this stage are mainly slipmouths or pony fish (*Leiognatus* sp.) and mullets (*Mugil* sp).

Sex determination

Identification of the sexes is difficult except during the spawning season. There are some dimorphic characters that are indicative of sex (Fig. 3).

- Snout of the male fish can be slightly curved while that of the female is straight.
- The male has a more slender body than the female.
- Weight of the female is heavier than males of the same size.
- The scales near the cloaca of the males are thicker than the female during the spawning season.
- During the spawning season, abdomen of the female is relatively more bulging than the males.

Sexual maturity

In the early life stages (1.5–2.5 kg body weight) majority of the seabass appear to be male but when they attain a body weight of 4–6 kg majority become female. After culture period of 3–4 years, however, in the same age group of seabass both sexes can be found and identified as mentioned above. In a fully mature female, the diameter of the oocysts usually ranges from 0.4 to 0.5 mm.

Fecundity and spawning

Females are larger than males, are highly fecund, and may be courted by one or more males at the same time. The fecundity of seabass is related to the size and weight of the fish Spawning occurs between September and March, with peaks in November to December and again in February to March. Spawning seasonality varies within the range of this species. Barramundi in northern Australia spawn between September and March, with latitudinal variation in spawning season, presumably in response to varying water temperatures. In the Philippines barramundi spawn from late June to late October, while in Thailand spawning is associated with the monsoon season, with two peaks during the northeast monsoon (August – October) and the southwest monsoon (February – June).

Fig. 3 Photograph of adult male and female seabass

Spawning occurs near river mouths, in the lower reaches of estuaries, or around coastal headlands. Barramundi spawn after the full and new moons during the spawning season, and spawning activity is usually associated with incoming tides that apparently assist transport of eggs and larvae into the estuary.

Seabass being highly fecund; a single female (120 cm TL) may produce 30–40 million eggs. Consequently, only small numbers of broodstock are necessary to provide adequate numbers of larvae for large-scale hatchery production.

Table 1 Relationship between size of fish and number of eggs from the gonads of seabass (*Lates calcarifer* Bloch) (After Wongsomnuk and Maneewongsa, 1976)

Total length(cm)	Weight	No. of fish	Fecundity (million eggs)	
			Range	Average
70 – 75	5.5	3	2.7 – 3.3	3.1
76 – 80	8.1	5	2.1 – 3.8	3.2
81 – 85	9.1	4	5.8 – 8.1	7.2
86 – 90	10.5	3	7.9 – 8.3	8.1
91 – 95	11.0	3	4.8 – 7.1	5.9

Based on studies of spawning activity under tank conditions, mature male and female fish separate from the school and cease feeding about a week prior to spawning. As the female attains full maturity, there is an increase in play activity with the male. The ripe male and female, then swim together more frequently near the water surface, as spawning time approaches. The fish spawns repeatedly in batches for 7 days. Spawning occurs during late evening (1800- 2200 hours).

Embryonic development

First cleavage occurs 35 minutes after fertilization. Cell division continues every 15 to 25 minutes and the egg develop to the multi-celled stage within 3 hours. Its development passes through the usual stages: blastula, gastrula, neurola and embryonic stages. Embryonic hear starts to function in about 15 hours and hatching takes place about 18 hours after fertilization at temperatures of 28–30°C and salinities of 30–32 ppt (Table 2, Fig 4a & b).

Larvae

Newly-hatched larvae have total length ranging from 1.21 to 1.65 mm averaging 1.49 mm. The average yolk sac length is 0.86 mm. One oil globule is located at the anterior part of the yolk sac which causes the hatchling to float almost vertically or about 45° from its usual horizontal position. Initial pigmentation is not uniform; the eyes, digestive tract, cloaca and caudal fin are transparent. Three days after hatching, most of the yolk sac is absorbed and the oil globule diminishes to a negligible size. At this stage, the mouth opens and the jaw begins to move as the larva starts to feed.

Larvae recruit into estuarine nursery swamps where they remain for several months before they move out into the freshwater reaches of coastal rivers and creeks. Juveniles remain in freshwater habitats until they are three–four years of age (60–70 cm TL) when they reach sexual maturity as males, and then move downstream during the breeding season to participate in spawning.

Because they are euryhaline, they can be cultured in a range of salinities, from fresh to seawater. When they are six–eight years old (85–100 cm TL), seabass change sex to female and remain female for the rest of their lives. Sex change in Asian populations of this species is less well defined and primary females are common.

Although seabass have been recorded as undertaking extensive movements between river systems, most of them remain in their original river system and move only short distances. This limited exchange of individuals between river systems is one factor that has contributed to the development of genetically distinct groups of barramundi in northern Australia, where there are six recognised genetic.

Table 2 Embryonic development of seabass eggs (Kungvankij 1981).

Embryonic stage	Hours & minutes after spawning	
	Hours	Minutes
Fertilization	-	5
2-cell	-	35
4-cell	-	55
8-cell	1	10
16-cell	1	30
32-cell	1	50
64-cell	2	20
122-cell	3	-
Blastula stage	5	3
Gastrula stage	7	00
Neurola stage	9	10
Embryonic stage	11	50
Heart functioning	15	30
Hatch out	18	-

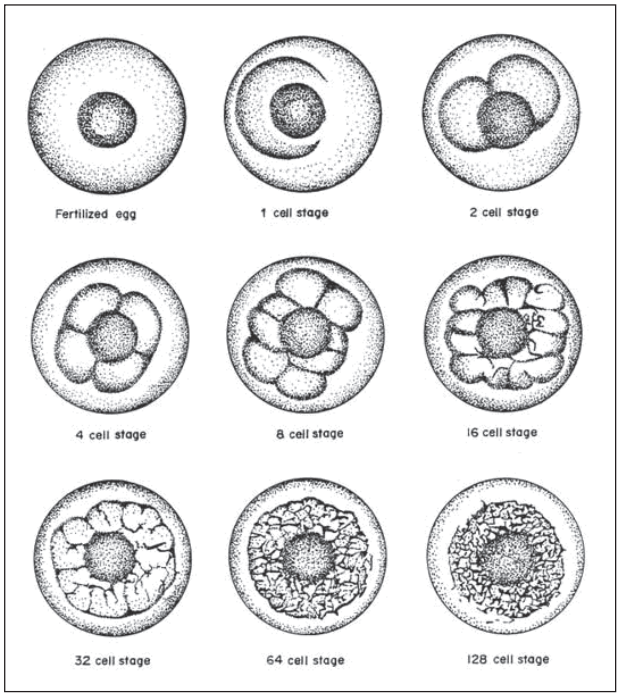

Fig 4a Development of egg

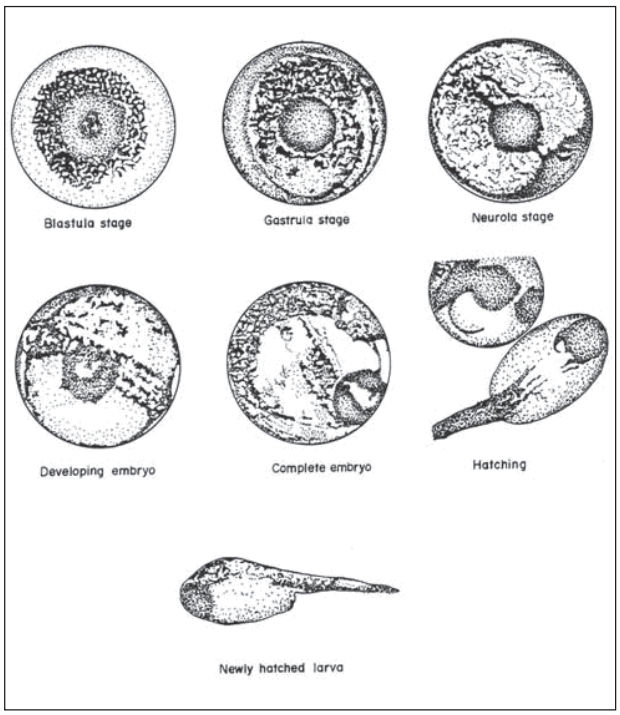

Fig 4b Development of egg

There are at least two pigmentation stages in seabass larvae. At 10–12 days after hatching, the pigmentation of larvae appears dark gray or black. The second stage occurs between 25–30 days old where the larvae develop into fry. In this stage, the pigmentation changes to a silvery-coloration.

It has been observed that only healthy fry of this stage (20–30 days) swim actively. They are always lighter in color. Unhealthy post larvae have dark or black body coloration.

Growth

The growth rate of seabass follows the normal sigmoid curve. It is slow during the initial stages but becomes more rapid when the fish attains 20–30 gm (Table 3). It slows down again when the fish is about 4 kg in weight.

Table 3 Age, average body length and weight of seabass under tank conditions

Age(days)	Average length(mm)	Average body weight
Fertilized eggs	0.91	
0	1.49	
1	2.20	
7	3.61	
14	4.35	
20	9.45	
30	13.12	0.1
40	17.36	0.5
50	28.92	

Conservation status

Not listed by the IUCN, but has been threatened by habitat destruction and over fishing.