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Influence of the parameter, body weight, on fecundity performance in Lates calcarifer

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Abstract

The present study was carried out to study the relationship between the body parameter, weight and the fecundity performance of the Asian Seabass. The study was conducted during December through January to February. The live fish were collected from fisherman on the coast of Kavali. Their weight ranges from 4 kg to 12 kg. The collected females were conditioned. They were separated into two groups basing on the body weight. The fecundity performance was measured by stripping. In the second group with superior weight (Tank B), the fecundity potential was found to be higher with mean value of 0.85 million compared to that of Tank A (0.36 million) and it is statistically highly significant at (p=0.005).

Key words: Asian seabass; fecundity performance; allometric relationship, domestication.

Introduction:

Aquaculture has become one of the fastest-expanding food-producing sectors in the world (FAO, 2022). Although over 800 aquaculture species are cultured across the globe for food (FAO, 2022), the majority of aquaculture food products come from unimproved species (Gjedrem, et al., 2012). One of the most priced fish of the recent times for culture is Asian Seabass, *Lates calcarifer.* This is one of the mostly cultured and captured food fish in Asian countries (Huang, K.C et al. 2023). It is a good source of protein and its meat is tasty (Abou-Okada, M et al., 2023). The Asian seabass (Lates calcarifer), also known as barramundi, is a widely distributed catadromous fish in the family Latidae of the order Perciformes (Yue et al., 2023)

It is tropical finfish species with high-value white flesh and desirable firm texture. The protein percentage of the meat of Asian Seabass usually ranges from 17-25 (Kamruzzaman, S et al.,.2015). The delicious meet of the Seabass is one of the reasons for the growing demand. This fish is considered a hardy culture species of fin-fish which can tolerate wide ranges of salinity from fresh water (0% salinity) to high saline waters (56% salinity) while displaying better growth parameters (Sorphea et al., 2019, Ganzon-Naret, 2013).

It adapts better to diverse culture practices and culture systems such as monoculture, Polyculture methods and cages, ponds and Recirculating Aquaculture Systems (Joerakate, W et al. 2018). It is popularly known as Barramundi in India. This species is commercially valuable, carnivorous, marine fish whose order is Perciformes (Nelson, 2006). The distribution of the species is far and wide in Indo-West Pacific region ranging

from the eastern margin of the Persian Gulf to China, Taiwan, and southern Japan, and southward to southern Papua New Guinea and northern Australia (Ilham et al., 2016).
It is also found in the eastern coast in the Bay of Bengal and the Western part of India (Yue et al., 2012). The annual production of Asian sea bass has increased during the last years, and the world grand total production of this species went up to 69,116 (t) in 2011 (FAO, 2012). There has not been a significant progress in the expansion of production with respect to Area Under Culture and total production. The shortage of seed is the bottleneck in the expansion of seabass culture. Despite the proven profitability, when compared to the culture of shrimp, the culture lags behind given the scarcity of seed (Shiva Shankar & Tirunavukkarusu, 2010).

Morphologically, the female Barramundi is normally larger than its male counterpart (Che-Zulkifli, C. I et al, 2023). They are initially sexually mature as males at 2–3 years (2–4 kg body weight; BW). However, they change sex to females at 4–6 years (>6–8 kg BW). Given this reason, the males and females of the same age and generation can't mate. Seabass spawns all year round (Kungvankij 1984). The seabass spawning coincides closely with the lunar cycle. The spontaneous spawning occurs during the new and full moon during the transitional period of monsoon i.e April-June. The peak spawning period is in May (Haque, M. A., et al., 2023). The Asian seabass fish spawns repeatedly in batches for 7 days during the spawning time. This spawning occurs during late evening (1800–2200 hours).

Body Size and Fecundity Performance:
Studies on length-weight (Body size) relationships are important to assess the reproductive status in fish. Length-weight is crucial in studying various important parameters such as growth, rate of feeding, metamorphosis, fatness, onset of maturity, gonadal development and general well-being of the fish population (Solanki, H.G, et al., 2014). Asian seabass is a highly fecund species of fish (Lawley, D, 2010). Understanding how reproductive output scales with female size is implicated in fecundity estimates. Such an understanding helps in estimating the relationship between standing biomass and egg production (Barneche, D. R, 2018). The per-capita reproductive output of fish increases with size.

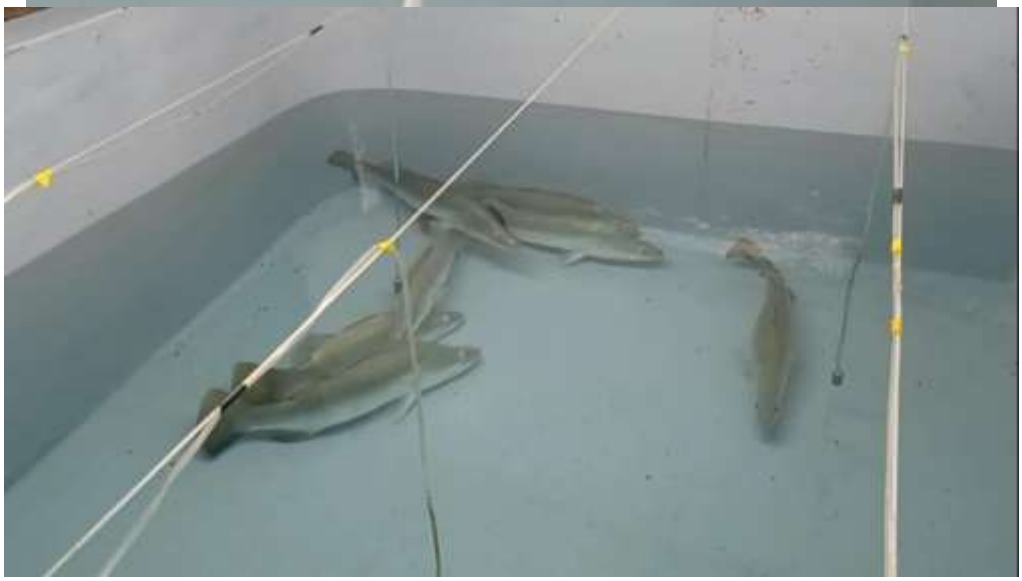
Many studies done earlier reported the body size of the marine fishes has been declining with the increase in global warming and climate change(Barneche, D. R, 2018), the current study was done to see if the same has any bearing on the fecundity performance of the fish Asian seabass. This is vital information for hatchery operators as it provides them with guidance on what is the appropriate amount of resources they should commit to broodstock to obtain the desired reproductive output. It can be a reference about the right size of fish that is suitable for egg production in the hatcheries.

Materials & Methods:

Sexually matured females (broodstock), measuring 4 to 12 kg were collected and transported to the laboratory in aerated 750 l plastic tanks. These brooders were acclimated for 3 weeks prior to size homogenization.These female fish were obtained from the local fishermen at the coast of Kavali, Nellore District, Andhra Pradesh, India. The study was done during December, 2023 to February, 2024 when temperatures of spawning grounds on the coast of Bay of Bengal were 26.2^0 C (Dec); 25.1^0 C(Jan), 26.5^0 C (Feb).

Two 20-ton cement tanks were stocked with 20 each of females. The Stocking Density was approximately 1 kg/m^3 with aeration. This research used two different size groups to see the differences in the fecundity potential. The fish were fed with beheaded shrimp at 5% of the body weight and reduced to 1% before spawning. The eggs were extracted for counting by stripping which applies slight pressure along the length of their abdomen . The eggs from each female were collected and preserved in 5% neutral buffered formalin and counted.

Statistical analyses were performed using SPSS version 22.0. Data were checked for normality using the Shapiro-Wilk test. Parametric data were analyzed using independent samples t-test.



Tank A

Weight (Kg)	Number of fish	Mean Weight(Kg)	Std Dev	Std. Error
4.1	4	4.13	0.175	0.04
4.0	3			
4.2	5			
3.9	4			
4.4	4			

Tank B

Weight (Kg)	Number of fish	Mean Weight(Kg)	Std Dev	Std. Error
7.5	3	7.14	0.23	0.05
7.1	4			
6.8	3			
7.0	5			
7.3	5			

Result and Discussion:

Average Comparative Fecundity Performance in two body weight groups

Average Fecundity (number of eggs)	
Tank A (Millions)	**Tank B (Millions)**
0.36	**0.85**

Statistical Analysis: Independent Samples t-Test

Tank A (Fecundity)	Tank B (Fecundity)
0.345	**0.822**
0.345	**0.852**
0.411	**0.842**
0.331	**0.881**
0.372	**0.865**
0.352	**0.862**
0.351	**0.853**
0.363	**0.855**
0.355	**0.877**
0.365	**0.840**
0.349	**0.821**
0.371	**0.864**
0.365	**0.862**
0.348	**0.849**
0.371	**0.832**
0.364	**0.882**
0.370	**0.850**
0.348	**0.861**
0.351	**0.866**

t-Test: Two-Sample Assuming Unequal Variances	***Tank A***	***Tank B***
Mean	**0.35895**	**0.8544**
Variance	**0.000271313**	**0.00029309**
Observations	**20**	**20**
Hypothesized Mean Difference	**0**	
df	**38**	
t Stat	**-93.26491326**	
P(T<=t) one-tail	**8.7033E-47**	
t Critical one-tail	**1.68595446**	
P(T<=t) two-tail	**1.74066E-46**	
t Critical two-tail	**2.024394164**	

The broodstock in Tank B showed higher fecundity with the mean fecundity value of 0.85 million eggs than the fish in Tank B with the mean value of 0.36 million. The two mean values are very different indicating the influence of body parameter, weight on the fecundity performance. The normal reported fecundity in Asian Seabass in the wild is 0.15-0.3 million/kg of the body weight at optimum temperature and salinity of 27-32^0 C and 30-32 ppt salinity. The study was conducted during winter when the temperatures were 26.2^0 C (Dec); 25.1^0 C(Jan), 26.5^0 C (Feb). The t-Test statistic value shows that the fecundity performance is hugely significant at p= 0.05.

In Atlantic cod, Gadus morhua, Barneche, D. R, (2018) found that a single 30-kg female produces more eggs than ~28 Kg 2-kg females (weighing a total of 56 kg). The study revealed hyper-allometric reproductive scaling holds for almost all species (95.0%). The larger females were found to exhibit a disproportionately higher fecundity performance than their smaller counterparts. Also, the offspring were found to be of bigger

size and quality. The larger females have as many reproductive bouts during each reproductive season as their smaller counterparts. However, the number of offspring they produce differs markedly. This is implicated in the replenishment of marine fish stocks in nature and production of enough quantity and quality of seed for culture as well.

The allometric relationship between body size and the fecundity performance is evident from the current study also as has been corroborated by many studies such as the study by Barneche, D. R, (2018). The study once again proves hyper-allometric body-mass scaling of reproductive output in Asian seabass. The age-old studies also testify that the fecundity performance of any fish is directly proportional to the size and weight of the fish. The results of the study by Wongsomnuk and Maneewongsa, 1979 show that Gonad samples obtained from 18 females of body weight ranging from 5.5 to 11 kg gave a range of 2.1 to 7.1 million eggs in the Asian seabass. Multiple studies carried out by the Australian Department of Agriculture (Anon.1975) also gave similar data. The data of those studies show that a 12 kg fish had 7.5 million eggs; a 19 kg fish 8.5 million and a 22 kg. fish, 17 million.

Across the fin fish class, there is a linear relationship between body parameters such as length, weight, ovary size etc and the egg output from the female. Dobriyal and Singh (1987) reported relatively higher fecundity (900–5048 eggs) in *B.bendelisis* of snow-fed rivers. Bahuguna et al.observed in same fish and reported the breeding capacity increases with an increase in all the body parameters. The study by Nikolsky (1961) showed that the food consumed by fish determines not only the fecundity but also the quality of eggs and percentage of their fertilization. Koops, M.A. et al., (2004) reported that somatic weight, rather than length, was the better metric for predicting fecundity in all fishes. These results suggest that body weight is the most important factor influencing the reproductive capacity of female Asian seabass.

Conclusion:

This study found that body weight is a significant predictor of fecundity in female Asian seabass. These findings have important implications for the management and breeding of this species in aquaculture. By selecting brood fish with higher body weights, hatcheries can improve the reproductive performance and overall productivity of their stocks. Further research is needed to investigate other factors that may influence fecundity in Asian seabass, such as diet, environmental conditions, and genetic factors.

Ethics statement: The fish obtained from the fishermen were not put to any treatment. They were stocked for 45 days and fed with live prey fish and trash fish as they naturally prey in marine environment. The other pond was fed with pellet feed which is used in the regular culture of Asian seabass.

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