



Received: 12th Dec-2011

Revised: 16th Jan-2012

Accepted: 20th Jan-2012

Research Article

A REVIEW ON BIOLOGY AND AQUACULTURE POTENTIAL OF RABBIT FISH IN TAMILNADU (*SIGANUS CANALICULATUS*)

M.Jaikumar

Aquaculture Foundation of India, 40/4, Kapaleeswarar nagar, Neelakarai,
Chennai.600115, Tamilnadu, India

E-mail: jaikumarmarine@gmail.com

ABSTRACT: Preliminary investigation on the culture of *Siganus canaliculatus* in floating cages in mandapam coastal water has revealed that the fish has high culture potential in the region. It is euryhaline, inhabiting areas where salinities range from 17 ppt to 37.0 ppt. The Juvenile are abundant in the area of reef and seaweed bed and collecting in traps near mandapam. Natural occurrence of juveniles of *S. canaliculatus* in large quantity was noticed during February through May in the Gulf of Mannar. The fish feeds mainly on seaweeds. It is reported that the fish can reach a marketable size of 20 cm fork length in 6 months. The rabbit fish is cultured in South East Asian countries. India has enormous potential for rabbit fish culture.

Key words: *Siganus canaliculatus*, south coast, traps, Fisher folk.

INTRODUCTION

Aquaculture is a fast-expanding sector of food production in the world. Currently fish farming accounts for nearly 50% of the total fish production consumed by human beings. About 220 finfish and shellfish species are involved in aquaculture [1](Naylor et al., 2000). Aquaculture has been growing at a rapid pace and is indeed one of the fastest growing food industries with a growth rate of around 10% per annum. According to FAO, it is reported that the total world fisheries production in 2009 amounted to 145.1 million tones, out of which the total capture fisheries shared 90 million tonnes and culture fisheries 55.1 million tones[2] (FAO 2011). It is predicted that by 2015, the increase in the production of farmed fish in the world would exceed that of capture fisheries.

In Philippines, *Siganus* (Siganids or rabbitfishes) is commercially-important contributing 560 mt/yr to the total fishery production, in which juveniles account for 60 mt[3] (Soliman et al 2008). It is olive-green in colour with characteristic small white spots on the sides [3]. Also common in Srilankan[4] and Indian coasts[5], where it grows to about 250 mm. This species is frequently referred to as [5,6,7,8], Herre and Montalban, 1928; Munro, 1967; Von Westernhagen, 1973a). It is also found in the tropical Indo-Pacific [9], [6]. The common species found in Malaysia, Philippines and Indonesia are *Siganus canaliculatus*, *S. guttatus*, *S. virgatus*, *S. spinus*, *S. punctatus*, *S. fuscescens* and [10,11]. *S. canaliculatus* is common on the east coast of Africa [12]. *S. rivulatus* in the Middle East and Mediterranean region [13] and *S. randalli*, *S. lineatus* and *S. fuscescens* in the Pacific region [14]. Rabbit fish occur in schools in coastal waters, It is distributed throughout the Indo-Pacific from the Arabian Gulf to the Indo-Malay region, Western Australia and north of Hong Kong and Taiwan [15].

There has been interest in the culture of these fishes in ponds or cages in several areas including Guam and Micronesia [16, 17, and 18]. The mariculture enterprise of Hong Kong is expanding the culture of *Siganus canaliculatus*, in cages [19] (Tseng and Chan 1982). Traditionally, the Rabbit fishes are cultured in brackish water ponds as in Philippines and in embanked lagoons in Mauritius. In Malaysia, Singapore, Guam, etc. experimental culture has been attempted in floating net cages, pens, ponds and raceway systems [20]. In coastal ponds of Philippines, *Siganus vermiculatus* and *S. canaliculatus* have been reported to attain a marketable size of 150 gm within 5-7 months. This species is preferred for culture because of their herbivorous food habits, fairly good growth and economic value [20].

Taxonomy

Rabbit fishes belong to the genus *Siganus* of the family Siganidae [21]. *Siganus* species are all remarkably similar to each other in most of the features. All species possess thirteen dorsal fin spines, and seven anal fin spines. The genus *Siganus* is also unique among marine fish having two pectoral spines on each side which are separated by three soft rays. Along with these twenty-four spines, one procumbent spine is found in front of the first dorsal spine which is part of the proximal pterygiophore. It is completely embedded or sometime protrudes from a small groove and collectively makes up the main defense of fish. The spines are poisonous [21]. The teeth are also remarkably similar to each other. The number of teeth and the overall shape are "identical." with a single row on top and the bottom jaw. They are very compressed and incisiform in shape. The teeth also overlap and are individually spade-like and pointed [21].

***Siganus canaliculatus* (Park, 1797)**

DISTINCTIVE CHARACTERS:

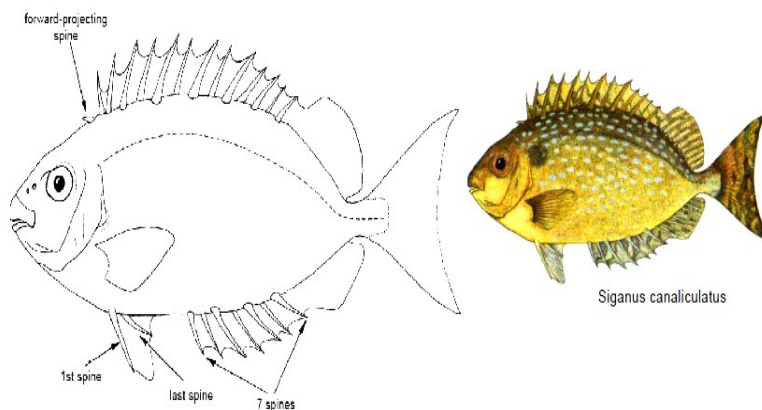
Body compressed, fairly slender, head is concave above eye, Snout is blunt and anterior nostril is with a long flap in juveniles (shortening with age, absent in old fish) and tip of flap reaching less than halfway to posterior nostril in specimens larger than 12 cm standard length. A forward-directed spine is present in front of dorsal fin; last dorsal spine the shortest, contained 0.5 to 0.6 times of the longest dorsal spine; last anal spine contained 1.2 to 1.5 times of the longest anal spine (usually the third). Caudal fin is almost emarginated in specimens under 10 cm standard length, forked in larger fish (but median rays never less than half length of longest rays). Scales minute; cheeks scaleless, or with few to many very fine scales; 21 to 27 scale rows between lateral line and bases of leading dorsal spines. Colour in live fish is highly variable from greenish grey on dorsal side to silver on ventral side; numerous pearly blue match-head size spots covering nape and sides, arranged more or less in horizontal rows. Caudal fin plain grey or irregularly barred with pale and dark grey; pectoral fins hyaline; dorsal, anal and pelvic spines and rays have same colour as adjacent areas of sides; fin membranes grey; after death fins usually with pale and dark grey, dorsal fin rays banded[22].

Biology of Rabbit Fish

In India, *Siganus javas*, *S. Canliculatus*, *S. lineatus*, *S. stellatus*, *S. vermiculatus* (Fig.) are the common species. *S. Canliculatus* is frequently found and its sizes vary from 20-25cm, with a maximum of 45 cm in length. In nature they are found in coral reef areas, mangrove swamps and shallow lagoons [23] (Saoud et al., 2008a). They are able to tolerate a wide range of salinity (17-37 ppt). They grow well in temperatures between 23 and 30° C. They tolerate low dissolved oxygen upto 2 ppm and pH upto 9 and high stocking densities in culture system[23]. All these characters make this species suitable for culture.

Siganus canaliculatus grows to a mean standard length of 8 cm in about 3 months, 10 cm in about 4½ months and 14 cm in 7–8 months[24]. The juveniles and adults are primarily herbivorous, feeding on different kinds of benthic algae. Under captivity, they become omnivorous, feeding on a variety of food of both vegetable and animal origin, including feed pellets in the culture system. Juveniles form schools in algal and seagrass beds, feeding mainly on filamentous algae. In summer, large amounts of juvenile, gravid mature siganids are caught in the islands along the gulf's of south coast, throughout the year [3](Soliman et al.2008). The results of recent feeding trials with *S. canaliculatus* have suggested that the dietary protein requirement for this species is above 30 percent; fish fed with high dietary protein levels displaying faster growth than fish fed low protein diets or live seaweed [12,25,26,27]. Furthermore, the fact that rabbitfish have also been reported to eat amphipods, copepods, sponges, foraminifera, crustaceans and brittle stars [12] which suggest that these species may in fact be opportunistic omnivores. Adults are also schooling and move into shallow water with the rising tide to feed on benthic plants[20]. The seeds are usually collected from the wild by scoop nets, dip nets, seine nets, etc during season. The larvae can be fed with a mixture of phytoplankton, rotifers, copepods and the larvae of *Artemia* in culture[28] (Bensan. 1993). Two-fold increase in the length and ten fold increase in weight over 5 weeks have been reported in the fry fed with algae and fish feed pellets[28].

SIGANIDAE –Rabbit Fish



Reproduction

Siganids are lunar-spawners. April and May are the peak months. The arrival of juveniles starts from the fringing reefs, to the patch reefs and associated seaweed beds and finally onto the seagrass (mostly *Enhalus acoroides*) beds. The main spawning season of *Siganus canaliculatus* in Singapore and Philippine waters has been reported to be from January to April [29, 30] (Lam, 1974; Manacop, 1937). In Palau, *S. canaliculatus* spawns during March to May [31] (Hasse et al, 1977). Occurrence of juveniles of *S. canaliculatus* was reported during February through May in the Gulf of Mannar [32] (Mohan, 1985). The spawning season of the species also extends from November to February. [33]. In HongKong *S. canaliculatus* has a definite spawning period from March to June [19] (Tseng and Chan 1982). Mating occurs in synchronization with the lunar cycle for some of the rabbitfish. *Siganus canaliculatus* spawns four to seven days after the new moon in both Guam[34]. Study on reproductive biology of *S. canaliculatus* in the Southern Arabian Gulf [35] (Grandcourt et al 2007) and research on schooling of rabbitfish within mariculture facilities [29,36] indicates that the eggs are adhesive, though not demersal, hatching within three days [29]. After four weeks of a pelagic life, the larvae settle and begin feeding on filamentous algae.

The defined spawning period of *S. canaliculatus* supports the contention that seasonal reproductive cycles are common among tropical fishes [37] (Robertson, 1990). Spawning of this species has been reported to occur between January and April in Philippines. In Singapore [38] Sadovy (1998) has reported similar spawning. Furthermore, there was a small peak in the gonadosomatic index in November, suggesting that a second but less well-defined spawning season exists. A second, although less pronounced, spawning period has also been reported for this species in Singapore, Philippines and Palau. Studies on Induced spawning of *S. canaliculatus* has been carried out by [39] Patrick G. Bryan 1974.

The reproductive cycle of *S. canaliculatus* in the southern India, therefore appears to be the same as it is observed in other locations of the Indo-Pacific. Female influenced sex ratios are a characteristic (though not diagnostic) feature of protogynous species [40] (Sadovy, 1996).

Rabbit Fish (*Siganus canaliculatus*) is one of the most economically important herbivorous fish captured in the Palk bay and Gulf of Mannar in Tamilnadu coast. In some landing centres it forms up to 30% of the total catch, with an average between 5% and 10%. The species is mainly captured in traps [41] (Bwathondi, 1980) baited with seaweed of the genera *Kappaphycus alvarezii*, *Ulva* spp, *Hypnea* spp and *Enteromorpha* spp. The herbivorous habit coupled with the great demand for this species along the coast make it a most suitable fish for culture in the region. Palk Bay, Gulf of Mannar, Lawsons Bay near Vizag, Karwar, Goa, Ratnagiri, Lakshadweep, Andaman & Nicobar Islands, have great potential for mariculture.

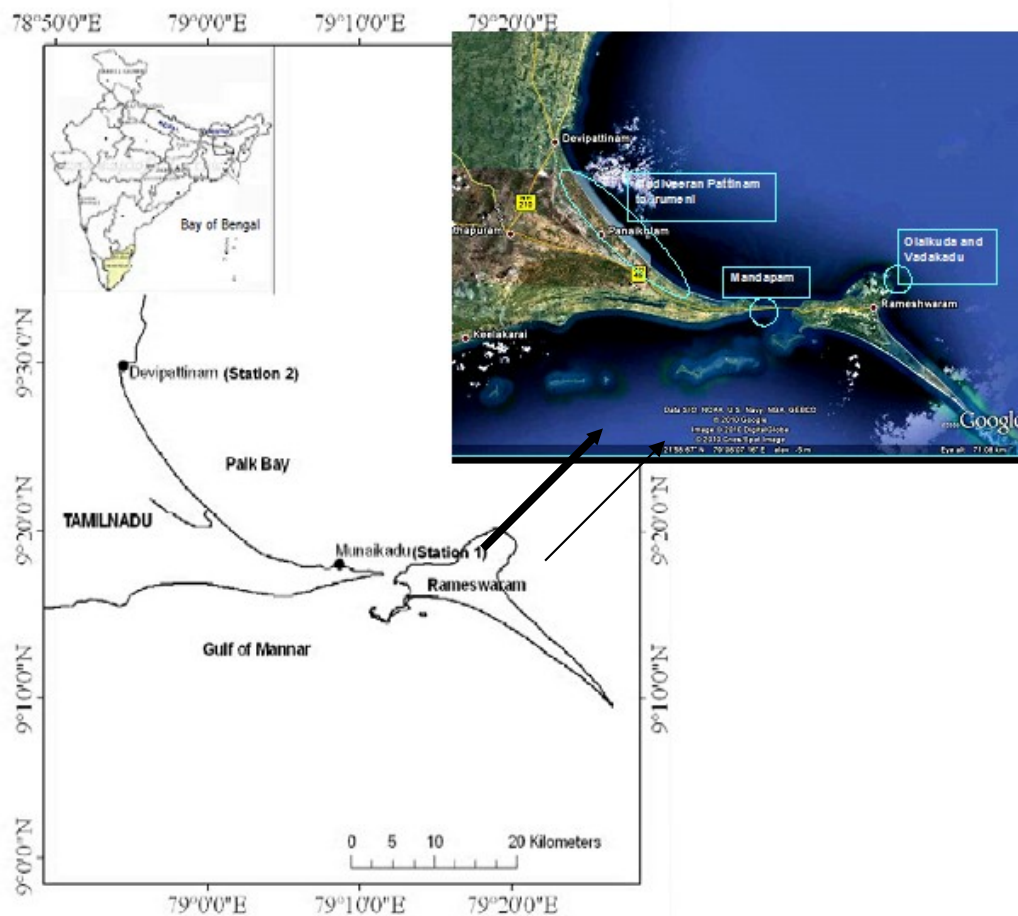


Fig-1 Map showing Potential site Rabbit fish culture in Palk Bay region



Fig.2 A Bamboo Trap for collecting rearing *S.canalicullatus* in Olaikuda near Rameswaram

Discussion

Wild Juvenile rabbitfish, can be collected near seaweed culture area in Olaikuda, Vadakudu and Vethalai near mandapam(Fig-1).. About 500 families are engaged in bombooo trap fishing and seaweed farming (Fig-2). In Philippines bagnets are operated with light-attraction from midnight till early morning. They are set at 50-100 m away from the reef edge. Seine nets are operated from early morning until afternoon in the reefs, seagrass, and seaweed beds[3] (Soliman et al 2008). Bagnets catch pre-settling juveniles while seines catch the settled juveniles. The total annual harvest (66-175 mt/yr) of juveniles is almost equally shared by the two gears [3](Soliman et al 2008). Sea cage culture of *siganus* spp requires careful nursery rearing. Nursery rearing is to be done in suitable areas to achieve better growth.

Conclusion

Cage farming of fin fishes and shell fishes are required to increase production and also to increase employment opportunities for the fishermen community in the coastal areas. Results obtained worldwide over have shown that cage culture of rabbit fish can yield high returns. Finfish culture with huge potential is yet to takeoff in India. Rabbit fish has great potential for culture in our seas. The non-aggressive feeding behavior of rabbitfish on extruded pellets indicates that they would not be significant competitors to a primary species in ocean cages [42,43] (Michael C. Cremer et al 2004). Sabapathy and Teo (1993) reported that carbohydrases (amylase, laminarinase, maltase, sucrase and trehalase) are present in greater amounts and are more abundant in *Siganus canaliculatus* than in the carnivorous sea bass *Lates calcarifer*. It is possible to start small-scale commercial farming in Palk bay area. More focus is needed to identify the causes of occational high mortalities during summer time and how to contain them. Formulated feed containing Soya meal, fish meal, maize and vitamin-mineral mix could also be tried. In Palau, *S.canaliculatus* cultured in floating cages has grown faster in areas with good water circulation and fed with trout chow than that fed with algae only.[44,45](Yousif et al., 2005,Jaikumar et al.,2011) In India also there are good prospects for developing their breeding and culture on commercial scale if similar attempts are made.

Acknowledgement

I want to thank Dr.M.Sakthivel President Aquaculture Foundation of India, Neelankarai, Chennai for Valuable discussion.

REFERENCES

- [1] Naylor R, Goldburg R, Primavera J, Kautsky N, Beveridge M, Clay J, Folke C, Lubchenco J, Mooney H and Troell M. 2000. Effect of aquaculture on world fish supplies. *Nature* 405(6790):1017–1024
- [2] Sally Washington and Lahsen Ababouch FAO 2011. Private standards and certification in fisheries and aquaculture . Current practice and emerging issues FAO , Fisheries and Aquaculture Technical Paper 553.FAO Rome, 2011.
- [3] Soliman Victor S, Antonino B. Mendoza, Jr, and Kosaku Yamaoka 2008. Seaweed-associated Fishes of Lagonoy Gulf in Bicol, the Philippines -with Emphasis on Siganids (Teleoptei: Siganidae) *Kuroshio Science* 2-1: 67-72, 2008
- [4] Munro I S R 1955. *The Marine and Fresh Water Fishes of Ceylon*. Halstead Press, Sydney, N.S.W., 351 pp.
- [5] Day F 1958. *The Fishes of India*. William Dawson, London, Vol. 1, 778 pp.
- [6] Herre A W C T, Montalban HR(1928). The Philippine siganids. *Philipp. J. Sci.*, 35: 151-185.
- [7] Munro I S R 1967. *The Fishes of New Guinea*. Dep. Agric. Stock Fish., Port Moresby, Papua, 650 pp.
- [8] Von Westernhagen H 1973. The natural food of the rabbitfish *Siganus oramin* and *Siganus stiolata*. *Marine Biology*, 22(4): 367–370
- [9] Smith J L B. 1965. *The Sea Fishes of Southern Africa*. Central News Agency, Cape Town, 580 pp.
- [10] Pacoli M E. 1983. The farming of siganid in the Philippines. *Fish Today*. Vol. 5, no. 2, pp. 50-52.
- [11] Von Wersternhagen H, Rosenthal H. 1976. Some aspects of the suitability of various Philippine siganid species for mariculture. *Aquaculture* (9).
- [12] Bwathondi P O J . 1982. The potential of marine polyculture in developing countries: Case study in Tanzania. *Atlantica*, 5(2): 18
- [13] Cagiltay F. 2003. Culture of the rabbitfish (*Siganus luridus* Rueppell, 1828). *Surunleri dergisi/Journal of Fisheries and Aquatic Sciences*. Vol. 20, no. 1-2, pp. 257-261.
- [14] Brown J W, Chirichetti, Crisostomo P D (1994). A cage culture trial of *Siganus randalli* on Guam. *Asian Fisheries Science*. Metro Manila Vol. 7, no. 1, pp. 53-56.
- [15] Randall J E. 1995. *Coastal fishes of Oman*. University of Hawaii Press, Honolulu, HI, 439 p.
- [16] Duray MN. 1990. *Biology and culture of siganids*. Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan, iloilo, Philippines.
- [17] Tacon A G J, Rausin N, Kadari M, Cornelius P .1990. The food and feeding of marine finfish in floating net cages at the National Seafarming Development Centre, Lampung, Indonesia: Rabbitfish, *Siganus canaliculatus* (Park). *Aquaculture and Fisheries Management* 21 :375-390.
- [18] Tawada, S. 1991. Rabbitfishes (*Siganus* sp.). p. 114-126. In S. Shokita, K. Kakazu, A. Tomori, and T. Toma (eds.), *Aquaculture in tropical areas*. Midori Shobo Co., Ltd., Tokyo
- [19] Tseng.W. Y and K. L. Chan. 1982. The Reproductive Biology Of The Rabbitfish In Hong Kong .*Journal of world mariculture society*.13:1-4. pp 313-321
- [20] Randall J E, Allen G R, Steene R C 1997. *Fishes of the Great Barrier Reef and Coral Sea*. University of Hawaii Press, Honolulu, HI, 507 p.
- [21] Woodland D J 1990. Revision of the fish family Siganidae with descriptions of two new species and comments on distribution and biology. *Indo-Pacific Fishes*. 19, 1-136.
- [22] Woodland D J 1984. Siganidae. In: *FAO species identification sheets for fishery purposes*. Western Indian Ocean (Fishing Area 51), vol. IV. W. Fischer; G. Bianchi (Eds), FAO, Rome

- [23] Saoud IP, Ghanawi J, Lebbos N 2008a. Effects of stocking density on survival, growth, size variation and condition index of the rabbitfish *Siganus rivulatus*. *Aquaculture International* 16, 109–116.
- [24] Lavina E M, Alcalá A C 1973. Ecological studies on Philippine siganid fishes in southern Negros, Philippines. Abstract (no. MSS/ABS/2/1) submitted to the Marine Sciences Special Symposium, Hong Kong, 7–14 December 1973.
- [25] Ismail W, Wahyuni I S, Pangabea T 1986. Studi pendahuluan pemberian komposisi pakan yang berbeda pada ikan beronang *Siganus canaliculatus*. (Preliminary study on the combination of feed for Siganids). *J. Penelitian Perikanan Laut*, 10(36): 1–5
- [26] Basyari A, Tanaka H 1988. Study on rearing of siganid fishes by using formula feed with different crude protein levels. In *Seafarming Workshop Report*, Bandar Lampung, Indonesia. Technical Report Part 2, 28 Oct. - 1 Nov. 1985, INS/81/008 /GEN/2, June 1988, pp. 58–62
- [27] Meyers SP, et al 1989. Observations on the growth and survival of Rabbitfish (*Siganus canaliculatus*) on three formulated diets. *FAO Seafarming Development Project INS/81/008, INS/81/008/Technical Paper 5*, 1989.
- [28] Bensen P 1993. *Sea Fishes Oceanic Cage Culture Hand Book on Aqua farming, the marine products export development authority, Kochi, Kerala*. pp.1-65.
- [29] Lam T J 1974. Siganids - their biology and mariculture potential. *Aquaculture*, 3 : 325-354.
- [30] Manacop P R 1937. The artificial fertilization of dangit, *Amphacanthus oramin* (Bloch and Schneider). *Phaipp. J. Sci.*. 62 : 229-237.
- [31] Hasse JJ, Madraban BB, Mcvey J P .1977. some aspects of the life history of *Siganus canaliculatus* (Park) (Pisces: Siganidae) in Palau. *Micronesica*,13 (2): 297-312.
- [32] Mohan R S, Lal (1985). A note on the changing catch trend in the traditional trap-fishery of Keelakarai and Rameswaram. *Indian. Fish*, 32 (3): 387-391.
- [33] Jayasankar P (1990). Some aspects of biology of the white-spotted Spine-foot, *Siganus canaliculatus* (Park, 1797) From the gulf of Mannar Indian]. *Fish.*, 37 (1): 9 -14
- [34] Bryan PG, Madraisau BB, McVey JP 1975. Hormone induced and natural spawning of captive *Siganus canaliculatus* (Pisces: Siganidae) year around. *Micronesica* 11: 199-204.
- [35] Grandcourt E, Abdessalaam Al, Francis F, Al Shamsi A 2007. Population biology and assessment of the white-spotted spinefoot, *Siganus canaliculatus* (Park 1797) in the southern Arabian Gulf. *J. Appl. Ichthyol.* 23 :53–59
- [36] Coche AG, Cuzon G, Lichatowich T 1979. *Mariculture Development in Bahrain. Report on Feasibility Mission*. FAO, Rome. FAO FI-DP/RAB/71/278/6:33-41.
- [37] Robertson D R. 1990..Differences in the seasonalities of spawning and recruitment of some small neotropical reef fishes. *J. Exp.Mar. Biol. Fish.* 9, 193–223.
- [38] Sadovy Y.1998. Patterns of reproduction in marine fishes of Hong Kong and adjacent waters. In: *The marine biology of the South China Sea. Proceedings of the Third International Conference of the Marine Biology of the South China Sea*, Hong Kong, 28 October - 1 November 1996. B. Morton (Ed.). Hong Kong University Press, Hong Kong, pp. 261–274.
- [39] Patrick G Bryan , Robert C May, Beketaut Madraisau, James P McVey. 1974 Induced spawning and larval rearing of the rabbitfish *Siganus canaliculatus*., south pacific commission, seventh technical meeting on fisheries (Nuku'alofa, Tonga, 15 - 19 July 1974)
- [40] Sadovy Y J 1996. Reproduction of reef fishery species. In: *Reef Fisheries*. N. V. C. Polunin and C. M. Roberts (Eds), Chapman and Hall, London, pp. 15–59.
- [41] Bwathondi P O J 1980. The spiny lobster fishery in Tanzania. Paper presented at a Symposium on Coastal and Marine Environments. Khartoum, Sudan (January, 1980).

- [42] Michael C. Cremer, Hsiang Pin Lan , Jim Zhang. 2004. Evaluation of Rabbitfish as a Culture Species in Ocean Cages at Hainan, China Results of ASA/China 2004 Feeding Trial 35-04-106, American Soybean Association.
- [43] Sabapathy U, Teo L H 1993. A quantitative study of some digestive enzymes in the rabbitfish, *Siganus canaliculatus* and the sea bass, *Lates calcarifer*. *Journal of Fish Biology* 42, 595–602.
- [44] Yousif O M, M F Osman, AR Anwahi, M A Zarouni, T Cherian 2005. Growth response and carcass composition of rabbitfish, *Siganus canaliculatus* (Park) fed diets supplemented with dehydrated seaweed, *Enteromorpha* sp. *Emir. J.Agric. Sci.* 16(2): 18-26
- [45] M.Jaikumar, L.Kanagu, C.Stella, Gunalan 2011. Culturing A Rabbit Fish (*Siganus Canalicullatus*) In Cages an Alternative Source For Fisherflok In Mandapam Coast (Palk – Bay South East Coast of India) *IJWREE*, (*International Journal of water resources and Environment Engineering*) 3(11):251-257