

Review on *Sperata seenghala* (Sykes, 1839), A Freshwater Catfish of Indian Subcontinent

Sandipan Gupta*

Central Inland Fisheries Research Institute (ICAR), Barrackpore, Kolkata-700120, India

Abstract

Sperata seenghala is one of the largest freshwater catfish of Indian sub-continent. This fish has good market demand as food fish due to its good taste with high nutritional value and for this reason it constitutes an important capture fishery of all the major rivers and reservoirs of India, Bangladesh and Pakistan. Earlier number of works has been carried out on its food and feeding habit, reproductive biology, morphology, fishery, captive culture etc, but no such consolidated review report is available. With this view the current review work has been carried out to sum up all available information along with gathering up the lacunae of information which will be helpful for future fishery and management of this fish species. It has been documented that comprehensive information is available on its food and feeding habit but further investigations are needed to put firm conclusion on some aspects of its reproductive biology and to gather proper knowledge on its captive culture technique.

Keywords: Food; Reproduction; Biology; Morphology; Fishery; Captive culture; *Sperata seenghala*

Introduction

Sperata seenghala (Sykes, 1839) is one of the largest freshwater catfish; widely distributed in rivers, reservoirs, lakes, floodplains, inundated swamp fields, ditches, canals and other freshwater areas of Afghanistan, Pakistan, India, Bangladesh, Thailand, Myanmar and Nepal [1-10], its availability in China waters has been reported by Jayaram [3]. This species can tolerate high range of temperature, salinity and variable water conditions [8,11]. Its adults and juveniles are bottom and marginal dwellers; fry are used to inhabit the shallow marginal area of river and marginal pits connecting the river; larvae live in the nests formed among rocks and soft muddy beds of rivers [8]. It has been considered as one of the most admired edible fishes due to its good taste and low number of intramuscular bones [10,12,13], it has high nutritional value with good protein content [14-16]; each gram of its flesh contains 200 unit of vitamin A [17]. It is a popular species of catfish to capture because it fetches a higher price than carp [7]. Recently it has also got its importance in ornamental fish market and has been reported to be exported from India as indigenous ornamental fish [18,19]. Earlier number of works has been carried out on different aspects of its morphology, biology, fishery and captive culture but no consolidated report is available on these. With this view, the current review work has been conducted to sum up all those previously documented information with noting down the lacunae of information which will be helpful for its future fishery and management.

Morphology

Day [1], Talwar and Jhingran [6] and Chondar [8] have earlier well documented the morphological characters of *Sperata seenghala* which have been compiled here:

Body devoid of scales, elongated and compressed; dorsal profile from rayed dorsal fin shallowly concave up to caudal peduncle; abdomen convex and broad. Head long, 4.1 to 4.5 in the total length. Snout broad and spatulate, upper jaw rather the longer. Mouth almost terminal, with shallow cleft reaching half the way to the orbit, and width of gape equals to 1/3rd of head length. Upper surface of the head granulated in ridges, its median longitudinal groove extends up to the base of occipital process which is twice as long as wide at its base, separated from basal bone of dorsal fin by an intermediate interneural

shield and from 4 times as long as broad in the young to half that width in the adult. Barbels-4 pairs; the maxillary ones extend to the middle or just beyond the hind margin of the dorsal fin, the nasal to opposite the middle of the orbit, the external mandibular ones to the base of the pectoral fin, whilst the internal ones are one-third shorter. Teeth- Palatine teeth in an uninterrupted crescentic band. Fins- Two dorsal fins, the first with one spine and a few rays, and the second dorsal is adipose. Dorsal spine weak, rugose anteriorly, weakly serrated posteriorly, and as long as the head excluding the snout. Adipose dorsal markedly large, its basal length equals or exceeds the length of the base of the rayed dorsal, whilst the intermediate distance is of the same length. Pectoral extends rather above half way to the pelvic; its spine is stronger than that of the dorsal and half as long as the head, roughened externally, denticulated internally. Pelvic fin abdominal, originating behind last ray of dorsal and reaches 2/3rd of the distance to the anal. Caudal fin deeply forked, upper lobe longer with its tip bending downwardly. Color- brownish along the back, silvery on the flanks and beneath; a round black spot is present at the posterior end of the base of the adipose dorsal fin.

In adult stage, *Sperata seenghala* is almost alike with *Sperata aor*, but it can be chiefly distinguishable from *Sperata aor* by few characters like chisel-shaped snout, distantly placed rayed and adipose dorsal fins and much shorter maxillary barbels not exceeding beyond the tip of the pelvic fin.

Sperata seenghala usually attains large size; Job et al. [20] have reported specimen of 122 cm from Mahanadi while Alikunhi [21] has documented maximum length of about 183 cm for this fish species.

*Corresponding author: Sandipan Gupta, Central Inland Fisheries Research Institute (ICAR), Barrackpore, Kolkata-700120, India, Tel: 9830082686; E-mail: sandipangupta2007@gmail.com

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Misra [22], Saigal and Motwani [2], Kolekar and Choudhury [23] and Ratanatrivong et al. [24] have documented maximum length of about 224 cm, 114.6 cm, 130 cm and 100 cm respectively. Jayaram [3], Talwar and Jhingran [6] and Tripathi [7] all have reported *Sperata seenghala* with maximum length of 150 cm in their collected specimens.

Food and feeding habit

Sarkar [25] has well documented gross anatomy and histology of the alimentary tract of *Sperata seenghala*; the anatomical details are as follows: the alimentary tract is comprised of mouth, buccal cavity, pharynx, oesophagus, stomach and intestine. Mouth is a transverse inferior crescentic slit, bordered by lips and jaws; upper jaw projects a little beyond the lower one. The buccal cavity is spacious and dorso-ventrally compressed; its roof is slightly arched and the floor is flat. The roof, the floor and the sides are formed of cranium, hyal bones and branchial arches respectively. On the anterior portion of the floor a thick elevated mucosal lining forms the tongue. The teeth (which are homodont and polyphyodont) are arranged in groups in the buccal cavity; they are maxillary, mandibular, vomerine, supra and infra pharyngeal teeth. The vomerine teeth patch is a single crescent patch. Teeth on the jaws are directed inward and are fixed on to the underlying bones by fibrous ligaments. The teeth of supra and infra pharyngeal patches are superficially embedded in the integument. The jaw-teeth are curved and pointed and are largest in the whole set. The pharynx is dorso-ventrally compressed and broad; four pairs of branchial arches are situated on ventro-lateral wall of the pharynx. First and second gill arches bear a single row of 15-16 rakers while the third and fourth carry two rows each with 14-19 rakers. The gill rakers are strong, pointed and antero-dorsally directed. In addition to these, on each side of the pharynx there is row of 14-15 rakers behind the last gill slit. Gill rakers, pharyngeal and other teeth patches help to crush and masticate food items and also prevent to escape of the food material. The pharynx passes into a short, narrow, thick walled oesophagus. The long thick walled stomach is differentiated into cardiac, pyloric and a fundus region. Pyloric stomach opens into coiled intestine which is with three parts- duodenum, intestine and rectum. Duodenum arises from pyloric stomach and runs in close proximity with the sides of the stomach in the upward direction and takes the course of an inverted "U" over the oesophagus. It then continues downward as intestine along the other side of the stomach, makes a simple coil below the fundus and then runs down straight towards the posterior end as rectum. There lies variation in the mucosal surface of different regions of the alimentary tract; buccal mucosa is thick and smooth while pharyngeal mucosal folds are longitudinal and wavy; becomes very prominent at the oesophagus. Height and intensity of folds is higher in fundus region comparative to other regions of the stomach. Duodenum has small web-like folds whose thickness and complexity increase towards the constriction of the duodenum; intestinal folds are complex and fully web-like with different heights while in the rectum they are less intense and wavy with hexagonal or oval folds.

Adult of *Sperata seenghala* is column feeder [25] and predacious in nature [26,27]; carnivorous feeding habit has been reported by maximum of workers [8-9,11,21,25,28-36], except Agarwal and Tyagi [37], Yeragi and Yeragi [38] and Chacko and Job [39]; Agarwal and Tyagi [37] and Yeragi and Yeragi [38] have reported omnivorous feeding habit while Chacko and Job [39] have documented herbivorous feeding habit for this fish species. Piscivorous feeding habit has been documented by Chacko [28], Alikunhi [21], Karamchandani [40], Menon and Chacko [29], Sarkar [25], Sehgal [11], Bhatt [31], Jayaram [32], Saigal [33], Vinci [34], Anwar and Siddiqui [41], Chondar [8] and

Arif [35] along with presence of considerable amount of insects and insect larvae, prawns, shrimps, crustacean, molluscs, worms and very rarely algae and aquatic weeds in the diet. Chacko and Job [39] have reported algae like *Spirogyra*, *Oscillatoria*, *Navicula* and *Pinnularia* as the dominant food items in its diet. Bhatt [31] has reported that during guarding the nest, male mainly feeds on debris and do not go out for hunting of fish and other organisms, leaving the larvae unguarded. At fry stage, it mainly feeds on water fleas, insects, fish fry, prawns, copepods and beetle larvae while in fingerling stage its main food items are insects, prawns, copepods, beetle larvae, fish fry and fingerlings of other fish species [21,40]. Juveniles are mainly bottom and marginal feeders; predominantly piscivorous, feed mainly on fish fry and fingerlings of other fishes, prawns, shrimps, insects, crustacean, rarely plant matter including debris [33].

Stage wise variation of food preference in *Sperata seenghala* has been reported by Sehgal [11] and Yadav [42], though Arif [35] has reported no such change in his study. No difference of food preference between juvenile and adult has been reported by Saigal [33].

Seasonal fluctuation in feeding activity in respect to breeding periodicity has been reported by Sehgal [11], Bhatt [31], Vinci [34] and Arif [35], poor feeding intensity has been reported during breeding season while active feeding has been reported after spawning. Saigal [33] has also documented maximum fishes with empty stomach during the breeding season.

Babare et al. [36] have documented increment in amount of animal matter in the diet comparative to plant matter with increase in body size; though Yeragi and Yeragi [38] have reported no such significant change in such amount with body size; they have reported this kind of changes with respect to season and habitat.

Bhatt [31] and Rajagopal [43] have reported cannibalistic nature of *Sperata seenghala*.

Growth pattern

Jatoi et al. [44] have reported positive allometric growth for females while isometric growth for male and combined sex of *Sperata seenghala* in Indus river. Kolekar and Choudhury [23] and Sani et al. [45] have reported negative allometric growth for combined sex from Brahmaputra river and Betwa and Gomti rivers respectively.

Sexual dimorphism

Males of *Sperata seenghala* can be distinguished externally from the females by the presence of a small stout projection, the urinogenital papilla just above the urino-genital pore which is lacking in females [28,46].

Sex ratio

Bhatt [31] and Vinci [34] have reported equal proportion of male and female while Jatoi et al. [44] have reported male dominance in their studied samples of *Sperata seenghala*.

Size and age at maturity

Bhatt [31] has reported mature specimens of *Sperata seenghala* with 40 cm and above 50 cm in length for male and female respectively. Saigal [33] has observed none of the Gangetic *seenghala* to be matured below 77 cm in total length and above 99 cm 100% maturity has been reported. Regarding the age at first maturity few reports are there; Yeragi and Yeragi [38] have reported that this fish species is used to attain maturity at the age of 4-5 months; though Bhatt [31] has reported

that both the sex mature in their second year of life and Chondar [8] has documented that *Sperata seenghala* mature in the third or fourth year of their life when size is of 45 cm.

Fecundity

Chacko [28] has reported fecundity of *Sperata seenghala* to be ranged between 200-1,000; later Bhatt et al. [47] and Saigal [33] have documented fecundity range of 20,064-46,443 and 1,31,820-4,28,376 respectively. High correlation of fecundity with ovary weight and total length in *Sperata seenghala* has been reported by Saigal [33].

Breeding season

April to August has been reported as the spawning season for *Sperata seenghala* in north Indian rivers, Bangladesh and Pakistan and June-July in Punjab [48]. Early May to early June has been reported as the spawning period in Yamuna river at Aligarh [31]. Saigal and Motwani [2] have documented spawning period of *seenghala* during pre-monsoon and monsoon months (April to August) in river Ganga while Saigal [33] has reported a protracted breeding season of Gangetic *seenghala* commencing in March and terminating in August with spawning peak in April-May. Seth and Kathia [12] have reported late March to August as the breeding season with April-May as peak breeding months in river Ganga. Sathyanesan [46] has observed breeding season of *Sperata seenghala* in between March to May in river Ganga at Banaras; Sathyanesan [49] later has documented extension of the breeding period from March to early June at Banaras. Arif [35] has reported July-August as spawning months for *seenghala* in Gomti river. David et al. [50] have reported its spawning season in between March to May in south Indian rivers; Raj [51] has reported April-May as spawning season in Cauvery river and later also in Bhavani river [26], Chacko and Kurian [52] have reported breeding of *seenghala* in river Tungabhadra above Sunkesula anicut in between September and December; April-August has been documented as the spawning months in Nagarjunasagar, Andhra Pradesh by Vinci [34]. Kolekar and Choudhury [23] have reported April and October as spawning months in Brahmaputra river, Assam. Alikunhi [21] has reported that *Sperata seenghala* breeds in rivers as well as in ponds during April to July. Ratanatrivong et al. [24] have reported its spawning season in between January to April in Pai River, Thailand.

Raj [26] has reported synchronization of its breeding periodicity with monsoon floods but Bhatt [31], Talwar and Jhingran [6] and Tripathi [7] have reported that in *Sperata seenghala* spawning is not at all synchronized with monsoon.

Bhatt [31] and Sugunan [53] have reported *Sperata seenghala* as a single spawner while Sathyanesan [49], Saigal [33], Kolekar and Choudhury [23], Vinci [34] and Rahman et al. [13,54] have documented it as a multiple spawner.

Migration of *Sperata seenghala* for breeding purpose from lacustrine environment to riverine conditions has been reported by Ranganathan and Natarajan [55]. Saigal and Motwani [2] while studying early stages of *Sperata seenghala* from river Yamuna have made similar kind of observation. They have indicated that *Sperata seenghala* prefer certain environmental condition for its breeding, but no explanation has been given for this. Moderately high water temperatures (22.3-31°C), sluggish water current and sandy bed have been reported as some of the important factors for breeding of *Sperata seenghala* in Ganga river [33,49].

Parental care and nest formation

Phenomenon of parental care in *Sperata seenghala* has been

reported by Raj [26,51], Chacko and Kurian [52], Saigal and Motwani [2], Seth [56] and Seth and Kathia [57].

In natural condition, a sort of nest in the form of circular depression is prepared by the pair of *Sperata seenghala* at the bottom of the river at shallow water depth by scooping out the earth, among pebbles, amidst rocks, or on the soft muddy beds of rivers or streams for its young ones which are nursed and fed by the male fish for a considerable duration. The breeding pits measure about 0.9-1.2 m in diameter and 25-45 cm deep at the centre [51] and at a distance of about 5 m or more from the water edge [58]. Seth and Kathia [12] have reported that *Sperata seenghala* used to avoid closed or blind river channel for excavating its nest, primarily for the apprehension that such areas might either get dried in hot summer months causing destruction of the nest or restrict movement of the male parent guarding the nest. Preference of *Sperata seenghala* for the same nesting sites has also been reported by them. The white secretion (scum) exuding from the inflamed ventral surface of the male parent is eaten by the hatchlings [2,51], this secretion is proteinaceous in nature [51]. Fry after attaining a size of 40-45 mm has been documented to gradually begin to leave the nest for free life [12].

Fishery

Sperata seenghala constitutes an important capture fishery of all the major rivers and reservoirs of India, Bangladesh and Pakistan. It constitutes a major component of the fishery in middle and lower stretches of Ganga and Yamuna rivers, ranking next to *Hilsa ilisha* and *Cirrhinus mrigala* [8]. Saigal and Motwani [2] have ranked this fish as only next to Hilsa in commercial importance in the Ganga river system. Saigal [33] has reported dominant fishery of this species in Ganga during certain months mainly in late winter and early summer. Kolekar and Choudhury [23] have documented modest fishery of *seenghala* in Brahmaputra river at Assam.

Seth and Kathia [59] have reported popularity of drag net (locally known as chanta, mahajal and chaundhi), gill net (locally known as ranga, phasla and gochail), purse net (locally known as kamel), hook and line (locally known as jor) and trap (locally known as kurian and gopal jal) for capturing *Sperata seenghala* in Ganga river system near Allahabad. The 'chir' fishing which is somewhat similar to gopal jal is a special type of fishing method for *Sperata seenghala* in Narmada river [60]. Use of gill nets, long lines and sometimes bag nets has been documented by Kolekar and Choudhury [23] in Brahmaputra river for capturing *seenghala*.

Captive culture and rearing

Earlier aquaculture potential of *Sperata seenghala* has not much been explored; complete demand of this fish species in domestic fish markets has been met through capture fishery. Several reasons are there behind the lack of aquaculture of this fish species: brood fishes are difficult to spawn artificially; are sensitive to water quality changes and are easily stressed [13,54]. Along with these problems, hatcheries have difficulties in synchronizing the maturity between male and female brood stock, which makes it hard to artificially produce seeds for stocking in grow-out ponds [54,61]. Even earlier it was found difficult to rear hatchlings in captivity as no such suitable substitute for scum was there.

Few experimental works have been performed which have shown some silver line for future development of its fishery. Singh et al. [62] have reported successful rearing of *seenghala* hatchlings by feeding initially with chironomid egg-mass and subsequently with semi-boiled trash fish; thus a substitute of scum has been documented by

them which will pave the way for successful culture of this species. Rahman et al. [54] earlier tried for captive culture of *Sperata seenghala* but failed; later Khan et al. [63] have achieved a bit of success using Human Chorionic Gonadotropin (HCG) with 80% fertilization rate; 75% hatching rate and 56% survivability. Rahman et al. [64] have conducted an experiment of captive culture of *Sperata seenghala* involving naturally propagated fry; they have concluded that growth, survivability, production and net benefits of *seenghala* fingerlings are inversely related to the stocking densities of fry; and stocking density of 1,00,000 fry/ha has been recommended by them for rearing of *seenghala* fingerlings for 8 weeks in earthen nursery ponds. Ratanatrivong et al. [24] also tried to culture *seenghala* in captivity; they have reported 70-90% survivability of *seenghala* fingerling while stocked @ 50 fingerlings/m² in a 20 m² concrete ponds and 80-95% survivability in cage culture with stocking rate of 100 fingerlings/m². Polyculture of *Sperata seenghala* with Indian Major Carps (IMCs) has been tried by Rahman et al. [13] in earthen ponds; they have reported its suitability to be polycultured with major carps with maximum production stocking them in the ratio of 4:3:1.5:1.5 for catla, rohu, mrigal and *seenghala*. They have concluded that polyculture of *seenghala* increases the total production of indigenous major carps due to higher growth performances and survival rates; no negative effect of *seenghala* has been reported by them on major carps in respect to overall growth and production.

Conclusion

Food and feeding habit of *Sperata seenghala* has so far been studied by number of workers but except Sarkar [25], none of them have studied it in more details. Maximum of the workers have concluded on food and feeding habit of this fish species just by analysing the gut content of their collected specimens which is a basic technique to ascertain on food and feeding habit of any fish species. Study of morpho-histology of the digestive tract is an effective methodology to conclude properly on food and feeding habit of any fish species and Sarkar [25] has studied the same for *Sperata seenghala*. Apart from this, enzymatic study of the alimentary canal is also a fine methodology to ascertain on feeding habit of a fish species. So it can be concluded that, though so far, fare information is available on food and feeding habit of *Sperata seenghala*, more detail study is needed in this aspect. On the other hand, except adult stage, information on food and feeding habit of *Sperata seenghala* in other life history stages is scanty, just few workers earlier have documented on this aspect; so this should also be studied in details as these information are necessary for proper rearing of fry, juvenile and fingerling stages to get success in captive culture. Scope of research is also there regarding change of feeding habit of this fish species in respect to age, size, sex and habitat if any.

On the other hand, different aspects of reproductive biology of *Sperata seenghala* has been studied by many workers, but more detail study is needed in all these aspects as most of the information available are full of contradictions. Not much work has been done so far on sex-ratio in natural population of *Sperata seenghala*; Bhatt [31] and Vinci [34] have reported equal proportion of both sexes while Jatoti et al. [44] have reported male dominance in their studied specimens; so this should be studied properly as information of sex-ratio in natural environment will help out to finalize the ratio of brood stocks to be kept for captive culture. Contradictory information is also available on size at maturity for *Sperata seenghala*; Bhatt [31] has documented mature specimen of 40 cm and above 50 cm for male and female respectively which is close to the report of Chondar [8] while mature specimen with minimum length of 77 cm has been reported by Saigal

[33]. Contradiction also exists regarding its age at maturity, Yeragi and Yeragi [38] have reported that this species used to mature at the age of 4-5 months while Bhatt [31] and Chondar [8] have documented second and third/fourth year as age at maturity for *seenghala*. None of the workers have studied length at first maturity (length at which 50% of the studied samples is at maturity) which is really needed in culture and conservation aspects and to be studied. Information on its fecundity is also scanty and this is also full of contradiction; Chacko [28] has documented low fecundity while Bhatt et al. [47] and Saigal [33] have reported moderate and high fecundity for this fish species. Regarding breeding periodicity little variation has been observed in between north and south Indian rivers; this variation may be due to number of factors like climatic, hydrological, habitat etc though very little work has been done so far on factors affecting breeding of this fish species. Monsoon floods, water temperatures, sluggish water current, sandy bed etc have been documented as factors affecting breeding of *seenghala*; but firm conclusion is not there and thus detail investigation is really needed to explore much more on this aspect. But most important part to be investigated is its captive culture; information on brood stock rearing and management, suitable artificial breeding methodology, proper rearing technique of larvae, fry, fingerling and juvenile stages to be gathered properly following suitable experiments otherwise it will be really impractical to continue its fishery solely based on capture from nature.

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