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ABUNDANCE AND SPAWNING OF *KALINGA ORNATA* (MOLLUSCA: GASTROPODA: OPISTHOBRANCHIA)

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ABSTRACT

Kalinga ornata, a nudibranch was recorded from Chennai, south east-coast of India after 70 years. Maximum abundance of individuals was obtained during the month August 2011, whereas there was none observed in December 2011 in overall trawling operation made at various depths. Spawning was observed in the marine aquarium tank and it was active during night times. The occurrence on the littoral regions in Chennai coast may be to breed and their absence showed the end of spawning migration.

Key Words: *Kalinga ornata*, Abundance, Spawning

INTRODUCTION

Nudibranchs are hermaphrodite and macroscopic marine organism often noted for their naked gills and striking colour patterns. They are placed in the class Gastropoda under the subclass Ophisthobranchia. *Kalinga ornata* (Alder and Hancock, 1864) is the only species belonging to the genus *Kalinga* and only type species of sub-family *Kalinginae*. There are about 3500 species described globally (Ramakrishna *et al.*, 2010). It has been recorded throughout Indo-West Pacific (Rudman and Darvell, 1990 and Gosliner *et al.*, 2008). The first available report of ophisthobranchiate fauna from India was made by Alder and Hancock (1864). He described *Kalinga ornata* obtained from the Coromandel Coast. Subsequently, this species was reported in Gulf of Mannar (Farran, 1905; Eliot, 1906 and Sundaram 1969) Lakshadweep Islands (Rao, 1936, 1974), Chennai (Gravely, 1942) and West Bengal (Subba Rao, 1992). Rao (1936) described the morphology of *Kalinga ornata* while Nakano *et al.*, (2011) described its feeding habits based on direct observation and fecal analysis.



Figure 1: *Kalinga ornata* (Alder and Hancock, 1864)

The present study has been conducted at offshore waters of Chennai coast (Fig. 1) during July to December 2011. The coastline encompasses various types of intertidal habitat from hypersaline,

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brackishwater lagoons, estuaries, coastal marsh and mud flats to sandy and rocky shores. There are about 11 animal phyla represented in the marine ecosystem of Chennai coast among these maximum species diversity reported for Mollusca with 273 species belonging to 151 genera under 72 families (Ramesh *et al.*, 2008). Among the molluscs reported from this coast, the diversity of nudibranchs is very meager. Occurrence of *Kalinga ornata* in Chennai coast was reported initially by Gravely (1946) since then no further record on the existence of this species in Indian coastal waters till the present observation.

MATERIAL AND METHODS

A mechanized fishing trawler having trawl net of 5.5m mouth length and width of about 2m was used. Bottom trawling was made during morning hours for 30 minutes at a depth ranging from 13 to 26mts. A series of three to five trawls were laid in the months of July, August, October and December. The live specimens of *Kalinga ornata* collected through trawling operation were transferred to aerated tanks of 4 x 2' size and shifted to aquarium of the Marine Biology Regional centre, Zoological Survey of India, Chennai. *Kalinga ornata* was collected at depths ranged from 12.8-15m and brought to the aquarium with maximum care and observed in the aquarium. In the aquarium the live specimens were introduced into 8 x 2 x 2' glass tanks containing sandy bottom with gravel fill to observe its behavior. The seawater in the tanks maintained with well illumination, adequate aeration and canister bio-filters. The specimens fed with boiled or raw fish, prawns and also with live molluscs such as *Babylonia* and *Dotila* sps on alternative days. Dead specimens were collected from the trawls were fixed in 10% formalin which was then washed with freshwater in laboratory and preserved in 10% formalin for further studies.

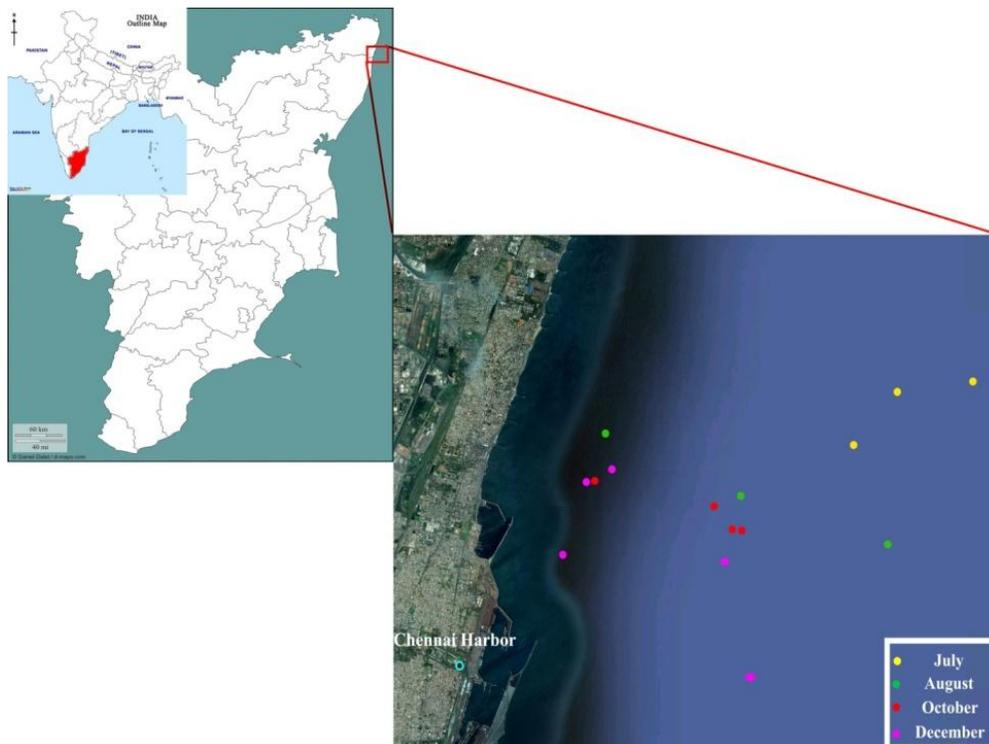


Figure 2: Trawl locations in the Chennai coast (source: Google earth)

Observation

Maximum number of individuals (12) was obtained during the month August, while there was none observed in December in overall trawling operation (Table 1). The specimens in the aquaria were observed to move around more actively during night showing they are nocturnal.

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Table 1: Occurrence of *Kalinga ornata* in various locations at Chennai coast

Months (2011)	GPS Location	No. of Individuals	Average length(cm)	Spawning details
July	13° 10'56.20"N 80°24'24.17"E	6	13.2	spawned
	13° 7'53.05"N 80°21'37.80"E	7	13.5	spawned
	13° 9'12.10"N 80°22'55.04"E	5	12.8	spawned
August	13° 9'22.47"N 80°19'28.54"E	7	14	spawned
	13° 8'28.92"N 80°21'13.31"E	12	13.8	spawned
	13° 8'24.28"N 80°22'59.53"E	9	13.5	spawned
October	13° 8'12.59"N 80°19'20.55"E	0	-	-
	13° 7'55.24"N 80°20'40.13"E	0	-	-
	13° 7'43.26"N 80°21'5.33"E	1	15	Did not spawn
	13° 7'34.29"N 80°21'11.30"E	0	-	-
December	13° 8'31.01"N 80°19'19.53"E	0	-	-
	13° 8'11.23"N 80°19'32.51"E	0	-	-
	13° 7'10.30"N 80°19'18.87"E	0	-	-
	13° 5'34.67"N 80°21'18.34"E	0	-	-
	13° 7'48.87"N 80°20'46.39"E	0	-	-

Digestive system

As very little is known about food and feeding, few specimens were dissected. Only sand particles were noticed in the gut region of fresh specimens (Fig. 3A).

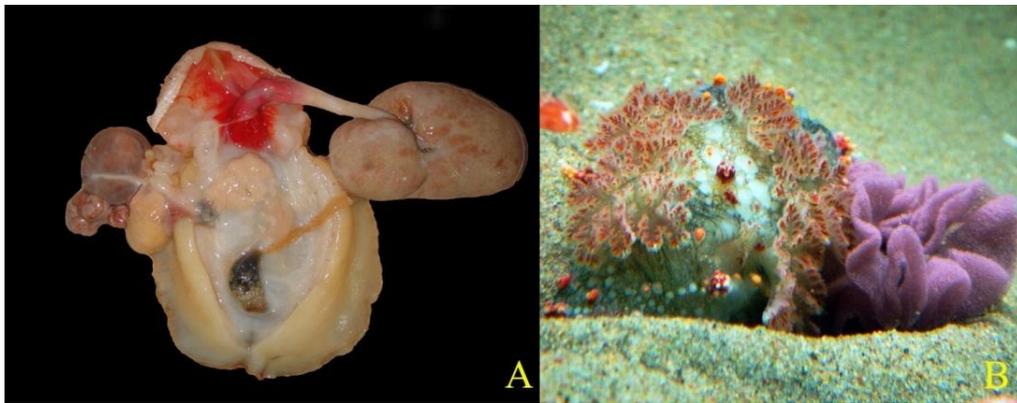


Figure 3: *Kalinga ornata* Biology and spawning A: T.S of *Kalinga ornata*. B: *Kalinga ornata* with egg mass in aquarium tank

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Spawning

The live individuals of 10-19 cm length were collected during the months of July and August 2011 spawned in aquarium tanks but the individual collected during October 2011 did not spawn. The egg mass was pinkish color laid in the form of a spiral (sea rose). Eggs were packed together in a mucous sheath which is then attached to the bottom in one end by a mucus secretion. No mortality of specimens was recorded after the spawning (Fig. 3B).

Survival

Out of the specimens introduced in tanks, some remained floating on the surface while majority buried themselves in the sandy bottom during the morning hours. During night hours they came out from the sandy bottom and attached to the inner walls of the tanks. It was observed that *Kalinga ornata* could survive for a maximum of fifteen days in sand bottom tanks where as only six to seven days in gravel bottom tanks. Mortality occurred gradually by extruding their gut.

DISCUSSION

The available study shows that it feeds widely on echinoderms. Berg (1890) noticed spicules of holothurians in the gut, skeletal parts of brittle stars by Jensen (2007). Nakano *et al.*, (2011) reported *Kalinga ornata* feeds on ophiurids based on field observation and faecal analysis. On contrary to this sand particles were observed in the gut of the fresh specimens during the present study. The species varies widely in its appetite and need more intensive studies for understanding the same.

The live individuals collected during the month of July and August, spawned in aquarium tanks while a specimen obtained in October doesn't spawn after that there was disappearance of *Kalinga ornata* in the trawls during December month. This disappearance of nudibranch can be assumed that the aggregations after spawning lead to post-spawning death rather than offshore migrations (Costello, 1938; Miller, 1961; Nybakken, 1978; Sea Slug Forum 2007). However Pelseneer (1922) inferred that sudden appearance and disappearance of littoral populations can be attributed to spawning migrations and subsequent adult death. But there was no mortality of specimens was observed in aquarium tanks after spawning activity proving post spawning death cannot be attributed for the disappearance of specimens in December months.

All the individuals caught from July and August month trawl were mature and they spawned in aquarium tanks. Miller (1962) explained breeding seasons of nudibranchs is based upon three types of information *i.e.*; the presence of mature animals in the sample, pairs of individuals copulating and individuals spawning or presence of spawn in the sample. Ibrahim (1959) explained large colonies of certain Nudibranch species may disappear as a result of migration after spawning to places where more favorable conditions of food, etc., prevail for the adults, which can be reason for *Kalinga ornata* disappearance during December month trawls.

The mass migrations of *Onchidoris bilamellata* was for spawning is proved by Pelseneer (1922) and Claveri (2008). Hence, it can be inferred that the appearance of *Kalinga ornata* in huge numbers on the littoral regions in Chennai coast may be to breed during July and August 2011. Their absence in the coast of Chennai during subsequent trawling operations made on December 2011 showed the end of spawning migration.

REFERENCES

- Alder J and Hancock A (1864).** Notice of a collection of nudibranchiate mollusca made in India by alter Elliot Esq. with descriptions of several new genera and species. *Transactions of the Zoological Society of London* **5** 113-147.
- Costello DP (1938).** Notes on the breeding habits of the nudibranchs of Monterey Bay and vicinity. *Journal of Morphology* **63** 319-343.
- Eliot CNE (1906).** On the nudibranchs of southern India and Ceylon, with special reference to the drawings by Kelaart and the collections belonging to Alder and Hancock preserved in the Hancock Museum at Newcastle-on-Tyne. *Proceedings of the Zoological Society of London* 636-691.

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- Farran GP (1905).** Report on the opisthobranchiate Mollusca collected by Professor Herdman, at Ceylon, in 1902. In: Report to the government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar. *Supplementary Report* 3(21) 329-364.
- Gosliner TM, Behrens DW and Valdés Á (2008).** Indo-Pacific nudibranchs and sea slugs, a field guide to the world's most diverse fauna. *Sea Challengers and California Academy of Sciences* 426.
- Gravely FH (1942).** Shells and other animal remains found on the Madras beach. II. Snails, etc. (Mollusca Gastropoda). *Bulletin of the Madras Government Museum, New Series, Natural History Section* 5(2) 1-110.
- Ibrahim AA (1959).** On The food of Nudibranchs. *The Biological Bulletin published by The Marine Biological Laboratory* 117(3) 439-442.
- Kathe RJ (2007).** The Opisthobranch Molluscs collected during the Thai-Danish Bioshelf project in the Andaman Sea, Thailand. *Phuket Marine Biological Center Research Bulletin* 68 21-30.
- Miller MC (1962).** Annual Cycles of Some Manx Nudibranchs, with a Discussion of the Problem of Migration. *Journal of Animal Ecology* 31(3) 545-569.
- Miller MC (1961).** Distribution and food of the nudibranchiate mollusk of the south of the Isle of Man. *Journal of Animal Ecology* 30 95-116.
- Nybakken J (1978).** Abundance, diversity and temporal variability in a California inter-tidal nudibranch assemblage. *Marine Biology* 45 129-146.
- Pelseneer P (1922).** Sur une habitude de Doris bilamellata. *Annales de la Socié'te' Royale Zoologique de Belgique* 53 28-32.
- Ramakrishna, Sreeraj CR, Raghunathan C, Sivaperuman C, Yogesh Kumar JS, Raghuraman R, Titus Immanuel and Rajan PT (2010).** Guide to opisthobranchs of Andaman and Nicobar Islands. *Zoological Survey of India, Kolkata* 196.
- Ramesh R, Nammalwar P and Gowri VS (2008).** Database on coastal information of Tamil Nadu. Report submitted to *Environmental Information System (ENVIS) centre*, department of environment, government of Tamil Nadu, Chennai–600015, Institute of ocean management, Anna University, Chennai, 26-41.
- Rao KV (1936).** The morphology of *Kalinga ornata* (Ald. and Han.). *Records from the Indian Museum* 38(1) 41-79.
- Rao KV, Sivadas P and Kumary LK (1974).** On three rare doridiform nudibranch mollusks from Kavaratti Lagoon, Laccadive Islands. *Journal of the Marine Biological Association of India* 16(1) 113-125.
- Rie N, Jiro U, Toshihiko F and Euichi H (2011).** *Kalinga ornata* Alder and Hancock, 1864 (Nudibranchia: Polyceridae): a unique case of a Seaslug feeding on Echinoderms. *Journal of Molluscan Studies* 77(4) 413-416.
- Rudman WB and Darvell BW (1990).** Opisthobranch molluscs of Hong Kong: part 1. Goniodorididae, Onchidorididae, Triophidae, Gymnodorididae, Chromodorididae (Nudibranchia). *Asian Marine Biology* 7 31-79.
- Sea Slug Forum (2007).** *Kalinga ornata*. *Australian Museum Sydney*.
- Subba Rao NV, Dey A and Barua S (1992).** Estuarine and marine mollusks. Fauna of West Bengal Part 9 (State fauna series 3) *Zoological Survey of India, Kolkata* 129-268.
- Sundaram KS, Sarvesan R, Mohamed KH and Shanbhogue SL (1969).** Catalogue of molluscs, prawns, stomatopods and marine algae in the reference collections of the central marine fisheries research institute. *Bulletin of Central Marine Fisheries Research Institute, Cochin* 9 1-52.
- Thomas C and Nicholas AK (2008).** Spawning aggregations and mass movements in subtidal *Onchidoris bilamellata* (Mollusca: Opisthobranchia). *Journal of the Marine Biological Association of the United Kingdom* 88(1) 157-159.