ISSN 0859-600X

Volume XX No. 4 October-December 2015

AQUACULTURE ASIA

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Gastropod and bivalve fishery of Kakinada Bay, Andhra Pradesh, India: Management and conservation issues

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Several species of shellfish, both bivalves and gastropods, are regularly fished from the Kakinada Bay in Andhra Pradesh, India. An organised ornamental shell trade and lime industry flourishes in the villages along the Kakinada Bay. The bay opens into the Bay of Bengal on its northern side and is bordered by mainland on the western side, by mangrove forests on southern side and by a narrow sand bar called Hope Island on its eastern side. The bay is shallow and large mud flats are exposed during low tides, on the southern and western sides. The total area fished for molluscs in the bay is about 100 km^2 mostly confined to the southern and eastern sides where depth is 2-4 m and there is no fishing in the northern section where the depth is more than 9 m. The bottom of the major part of the Bay is of soft fine clay with good amount of silt while the eastern side of the bay is sandy and western side is rocky (Narasimham, 2004).

The unique ecology, resources and the bivalve and gastropod fisheries of the Kakinada bay have been described in detail (Narasimham, 1973, Narasimham et al. 1984, Narasimham, 1985, Rao and Somayajulu 1996). Clam culture experiments in the Bay have been described by Narasimham (1980, 1882). In recent times, a significant decline in the landings of the commercially important bivalves and gastropods has been recorded which raises issues of management and conservation of the resources. This study presents the present status

of the bivalve and gastropod fishery of the Kakinada Bay, the management issues and conservation strategies to sustain the bay's valuable bivalve and gastropod resources.

Approach

Catch and effort data of the bivalves and gastropods fished from the Kakinada Bay was collected for 30 months (2011-June 2013) from the Chollangi and Peddavalsala landing centres of Kakinada Bay at fortnightly intervals and monthly production was estimated for the month based on the number of fishing days. Details regarding fishing, utilisation and price were collected through observations and enquiry.

Fishery

Fishermen belonging to 15 villages namely Dummulapeta, Yetimoga, Putrayapakulu, Boddu Chinna Venkatpalam, Lakshmikathapuram, Gadimoga, Bhairavpalam, Girijampeta, Yerragaruvu, Balusutippa, Kothapalem, Mulletimoga, Masanitippa, and Neelaurevu, exploit the bivalves and gastropods from the bay.

Two types of craft are used in this fishery: "kakinada nava" and the "shoe dhoni". On each shoe dhoni, 4 to 6 members live and go for fishing with ring nets and scoop nets. The fishermen also operate gill nets and drag nets for catching fish and shrimp. Generally, men operate the gear (gill nets / drag nets for catching fish, shrimps and crabs) while women and children are involved in hand picking of shells. In all, 40 men, 32 women and 90 children are involved in the collection of bivalves and gastropods from the Kakinada Bay. Fishing is carried out for 25-28 days of the month; fishing is not carried out on festival days and during unfavourable climatic conditions.

The total bivalve and gastropod landings from the Kakinada Bay during 2011-2013 was estimated at 3,192 tonnes and the total effort was 16,753 units. The production during 2011 was 1,490 tonnes which declined to 957 tonnes in 2012 and further to 745 tonnes in 2013. Effort also declined from 8,212 to 5,565 (2012) and 2,976 (2013).

The bivalve fishery of Kakinada Bay

The estimated total bivalves landed from Kakinada Bay during the study period was 1,816.8 tonnes, total effort 16,753 and the catch per unit effort (CPUE) 110 kg. The estimated total bivalves landed from Kakinada Bay during 2011 was 836.9 tonnes, with an average monthly landing of 72.5 tonnes. The total effort was 8212 units and the average catch per unit effort was 131.2 kg (Fig. 1). The species landed were *Anadara sp.* (276.65 tonnes), *M. meretrix* (72.83 tonnes), *Meretrix casta* (24.71 tonnes), *Paphia malabarica* (14.0 tonnes), *Geloina sp.* (9.3 tonnes), *Katelysia opima* (4.5 tonnes) and others (6.6 tonnes). The total clam production was 401.9 tonnes. Oysters landed were window pane oyster, *Placuna placenta* (383.8 tonnes), edible oyster *Crassostrea madrasensis* (51.2 tonnes) and other oysters (5.8 tonnes.) The total oyster production was 435 tonnes. The price of the bivalves ranged from INR 5 to 12 per kg.

The estimated total bivalve landed from Kakinada Bay during 2012 was 914.1 tonnes, with an average monthly landing of 47 tonnes. The total effort was 5,565 units and the average catch per unit affort was 99.5 kg. The species landed were *Anadara sp.* (250.6 tonnes), *M. meretrix* (120.3 tonnes), *Paphia malabarica* (28.9 tonnes), *Katelysia opima* (20.8 tonnes) *Meretrix casta* (3.1 tonnes), *Geloina sp.* (0.75 tonnes), and others (26.1 tonnes). The total clam production was 424.4 tonnes (Fig. 2). Oysters landed were windowpane oyster, *Placuna placuna* (56.4 t), edible oyster *Crassostrea madrasensis* (42.2 tonnes) and other oysters (14.5 tonnes).

Fig. 1. Bivalve & Gastropod production, Kakinada Bay.

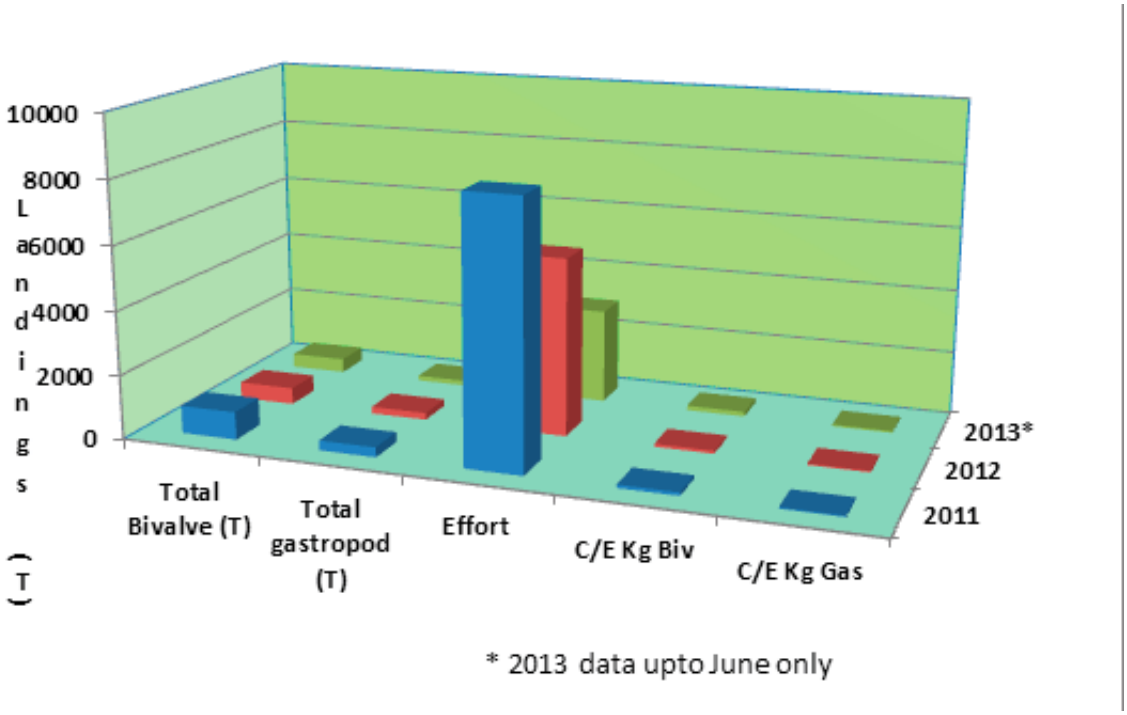
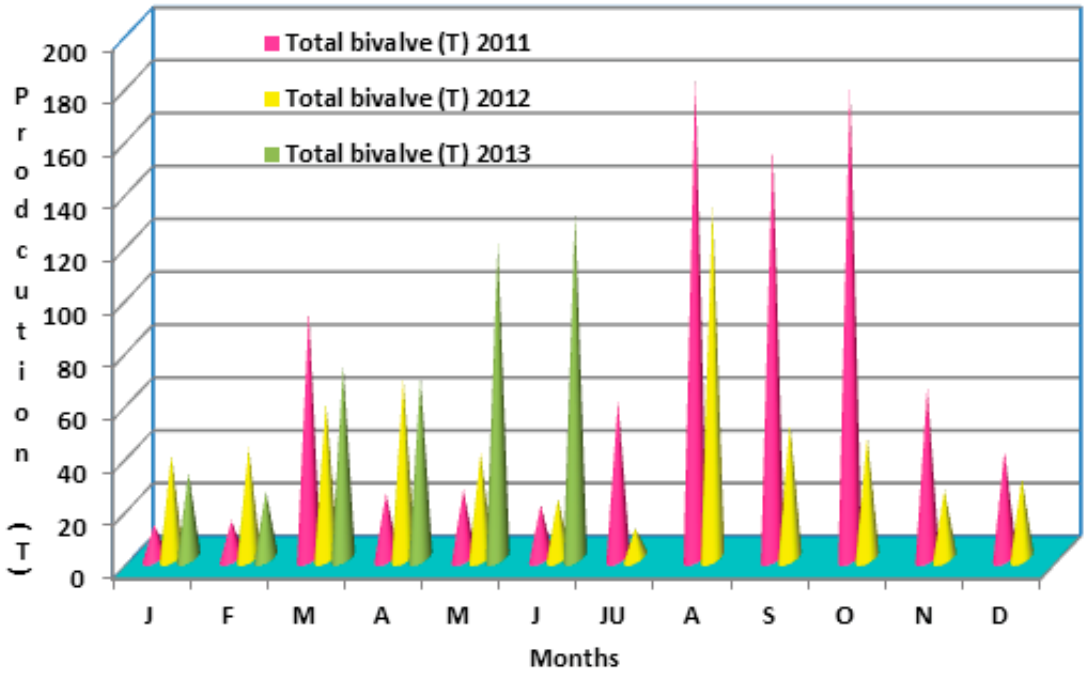


Fig. 2. Bivalves, Kakinada Bay, monthly landings 2011-2013.



The total oyster production was 504.1 tonnes (Fig. 2). The peak landings occurred during August to September (Fig.2). The price of the bivalves ranged from INR 8 to 12 per kg.

The clam production in Kakinada bay increased by 22.6 tonnes (5.6%) in 2012 compared to the previous year. The landings of *M. meretrix* increased by 47.5 tonnes (39.5%), *P. malabarica* by 14.9 t (51.6%), *K. opima* 16.3 tonnes (78.4%). However, the landings of *Anadara sp* declined by 26.1 tonnes (9.4%), *M. casta* by 21.6 tonnes (87.5 %), *Geloina sp.* by 8.5 tonnes (91.9 %) (Figs. 1, 2).

The estimated total bivalve landed from Kakinada Bay during 2013 (up to June) was 449.2 tonnes, with an average monthly landing of 47 tonnes. The total effort was 5,565 units and the catch per unit effort was 142.9 kg. The species landed were *Anadara sp.* (202.8 tonnes), *M. meretrix* (135.4 tonnes), *Paphia malabarica* (22.5 tonnes), *Katelysia opima* (18.6 tonnes) and others (12.6 tonnes). *Meretrix casta* and *Geloina sp.* were not landed during the period. However, nearly 3.6 tonnes of *M. casta* collected from Gautami River were stocked at Pedavalsala. The total clam production was 489.4 tonnes (Fig. 2). Oysters landed were windowpane oyster, *Placuna placenta* (0.8 tonnes), edible oyster *Crassostrea madrasensis* (43.3 tonnes) and other oysters (13.2 tonnes.) About 1.8 kg of *C. madrasensis* was collected from Kakinada Fishing Harbour. The total oyster production was 57.3 tonnes. (Fig. 2). The price of the bivalves ranged from INR 10 to 15 per kg.

The gastropod fishery of Kakinada Bay

The estimated total gastropod landed from Kakinada Bay the study period was 687.4 tonnes, total effort 16,753 units and the catch per unit effort (CPUE) 41 kg.

The estimated total gastropod landing from Kakinada Bay during 2011 was 328.8 tonnes with average monthly landings of 23.4 tonnes. The total effort was 5,010 units and the average catch per unit effort was 48.6 kg. The species landed were *Cerithidea fluviatilis*. (257.7 tonnes), *Telescopium telescopium* (23.7 tonnes), *Thais sp.* (15.3 tonnes), *Murex sp.* (10.3 tonnes) *Hemifusus pugilinus* (9.9 tonnes), *Umbonium sp.* (3.1 tonnes), *Dolostium sp.* (0.3 tonnes) and other gastropods (8.5 tonnes). Maximum landings were during August- September. The price of gastropods ranged from INR 5 to 8 per kg.

The estimated total gastropod landing from Kakinada Bay during 2012 was estimated at 216.9 tonnes with average monthly landings of 18.1 tonnes. The total effort was 2,976 units and the average catch per unit effort was 37.9 kg. The species landed were *Cerithidea fluviatilis*. (99.5 tonnes), *Telescopium telescopium* (26.3 tonnes), *Thais sp*. (15.2 tonnes), *Murex sp.* (20.8 tonnes) *Hemifusus pugilinus* (20.7 tonnes), *Umbonium vestiarium* (14.24 tonnes), and other gastropods (20.2 tonnes). Maximum landings were during March and August - October. The price of gastropods ranged from INR 6 to 12 per kg.

The total gastropod landings declined by 96 tonnes (31%) as against the previous year. The effort declined by 555 units (10%); however the catch per unit effort increased by 10.2

kg (21%). The landings of *Cerithidea fluviatilis* registered an increase of 141.4 tonnes (58.7 %); all other species recorded a decline in landings viz. *Umbonium vestiarium* 11.1 tonnes (78.2 %), *Hemifusus pugilinus* 10.9 tonnes (52.7%), Murex sp 10.5 tonnes (50.5%), *Telescopium telescopium* 3.3 tonnes (12.5%) and *Thais sp.* 1.3 tonnes (8.6%).

The estimated total gastropod landing from Kakinada Bay during 2013 (up to June) was estimated at 160.6 tonnes with average monthly landings of 26.8 tonnes. The total effort was 2,976 units and the average catch per unit effort was 57 kg. The species landed were *Cerithiidea fluviatilis*. (96.9 tonnes), *Telescopium telescopium* (18.4 tonnes), Thais sp. (5.9 tonnes), *Murex sp.* (11.1 tonnes) *Hemifusus pugilinus* (16.1 tonnes), *Umbonium vestiarium* (1.61 tonnes), and other gastropods (10.6 tonnes). The price of gastropods ranged from INR 7 to 10 per kg.

Utilisation

Meat is used for human consumption and also as bait for catching crabs. It is also used as feed for fattening water crabs. Shell is graded as big and small. The small shells are used in the snowcem industry while the big ones are used in the preparation of lime, which is used in shrimp culture ponds, painting of walls etc.

Blood clam *(A. granosa)* meat is sold regularly for human consumption @ INR 40 per kg at Chollangi Landing Centre along with shrimp, crab, fishes and cephalopods. The meat is also used as bait for trapping crabs in ring nets. The meat of *Meretrix sp.* is used as supplement feed by shrimp farmers and in fattening of water crabs. However, although culture of *Penaeus vannamei* is expanding in Andhra Pradesh, clam meat as feed is being discontinued after spread of viral diseases as a result of cyclones.

Dead shells of *A. granosa* are segregated into three sizes; the smaller sized shells fetch higher price compared to the medium and larger shells. Live as well dead shells of other bivalves such as *Meretrix sp., Paphia malabarica, Marcia opima,* edible oysters and gastropods such as *Murex sp., Telescopium sp., Thais sp.* and *Hemifusus pugilinus* are left in the forest land in the bay and allowed to putrefy. Later as per demand the shells are brought to the shore and sold to the buyers after drying.

Placuna placenta collection (though banned) is carried out clandestinely and stocked inside the forest area until putrification. As and when traders from Yanam or Pedavalasa request for the shells, the fishermen are informed and they transport the shells through the bay by motorised fibre boat or Kakinada Nava to the respective areas.

Shell trade

The shells of bivalves and gastropods are in high demand for their ornamental value and the exploitation in the Kakinada Bay is entirely linked to the shell trade in Tamil Nadu, Maharastra, and other States. Shells are measured in baskets. Live shell baskets weigh about 40 kg and are priced at INR 600-700/ for bivalves and INR 300-350/- for gastropods-. Dead shell baskets weigh about 30 kg and are priced at INR 120 to 130/-. Marketing of shells is carried out at Chollangi Landing Centre and merchants buy the shell baskets from there.

Fig. 3: Gastropods, Kakinada Bay, monthly landings 2011-2013.

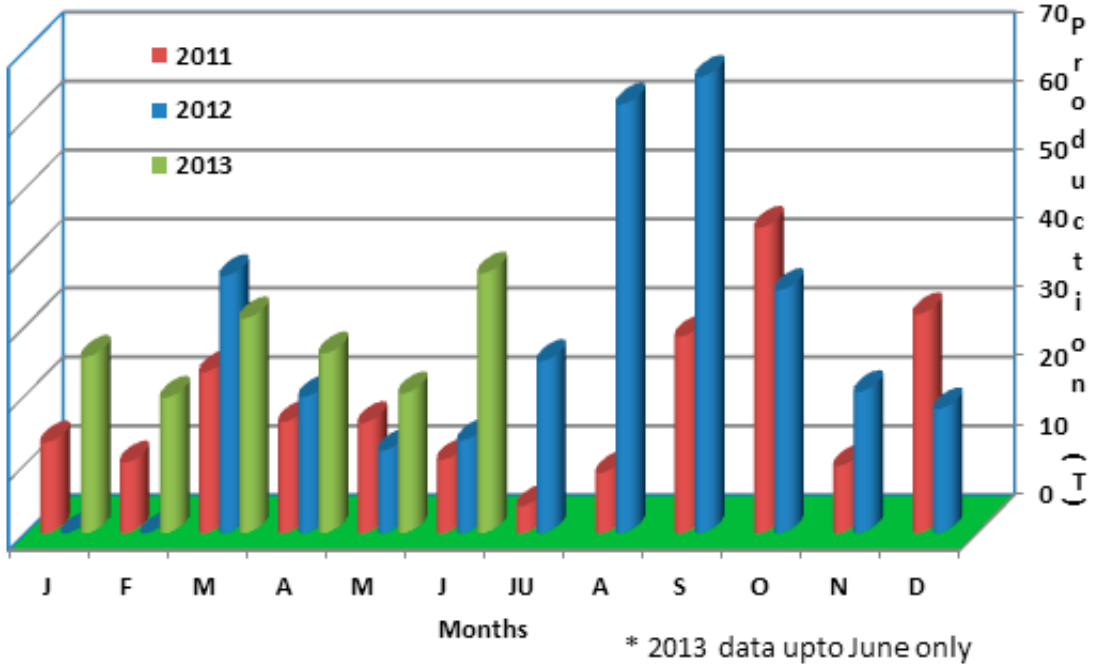
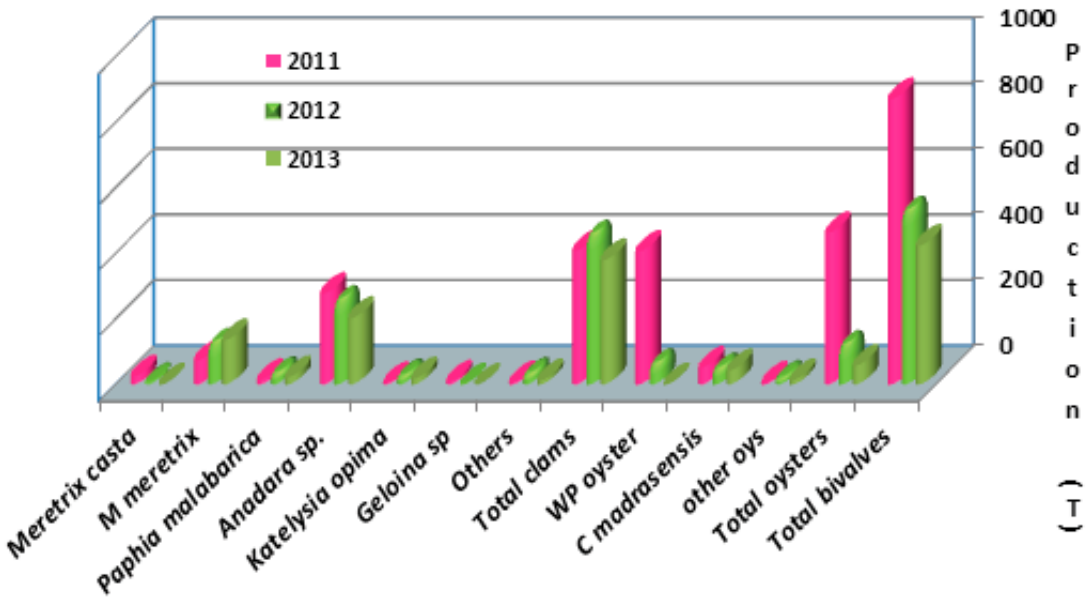


Fig. 4. Bivalves, Kakinada Bay, 2011-2013.



Discussion

Kakinada Bay has historically been a rich ground of bivalve and gastropod resources and supported the livelihood of hundreds of fishers from the nearby 15 villages (Narasimham, 2004). An estimated catch of 6020 tonnes were landed in 1968 (Narasimham, 2004). Major contribution was *Placuna placenta* at 4,000 tonnes and *A. granosa* 1,000 tonnes. (Narasimham, 2004). In 1984, P. placenta landed was 12,420 tonnes, *A. granosa* 6,895 tonnes and *M. meretrix* 1,082 tonnes (Narasimham et al. 1984). The present total production is 745 tonnes (2013) which reflects the decline in landings of almost all the species in the bay.

The average total landings of bivalves and gastropods for the period 1988-93 was estimated at 3,065 tonnes, total effort at 70,697 units and mean CPUE of 43.4 kg (Rao and Somayajulu, 1996). Average landings of bivalves and gastropods for the 2011-2013 period was 1,064 t which indicates a decline of over 65% in 20 years. Significant decline in landings occurred among the major species; *Anadara granosa* declined by 80%, *P. malabarica* (27.3%), *Geloina sp.* (75%), *Cerithidea sp.* (85.3%), *Telescopium sp.* (89.8 %), *Hemifusus pugilinus* (55.7%), *Umbonium sp.* (97.8%) and *Thais sp.* (85.2%) when compared to the 1988-1993 period (Rao and Somayajulu, 1996), *Meretrix meretrix* (26.9%), *Katelysia opima* (52.2%), *Placuna placenta* (50%), *Crassosterea madrasensis* (36.4%) registered an increase compared to the 1988-1993 period. This may be due to the increase in demand for these species. However, there has been a significant decline in the landings compared to two decades ago.

The Coringa and Bhairavpalem Reserve Forest area which includes major part of the Kakinada bay was declared as the 'Coringa Wildlife Sanctuary' in 1998 under the Wildlife Protection Act, 1972. The window pane oyster and blood clam beds fall within Sanctuary which has affected the fishery of these two economically important species. More significantly, it has impacted the livelihood of several fishers dependent on fishing these bivalves. Moreover, the Ministry of Environment and Forests, Government of India, included the window pane oyster *Placuna placenta* in Schedule 1 of the Wildlife Protection Act, 1972 through a notification dated July 21 2001.

Shellfish fisheries management measures need to be urgently implemented in the traditional fishing area of the Coringa Wildlife Sanctuary. The major management and conservation concerns in the bivalve and gastropod fishery of the Kakinada Bay are decline of stocks, livelihood of the fishers involved in the fishery and pollution. The demand for shells in the ornamental shell trade and lime industry has led to the indiscriminate exploitation of very small sized shells *(Anadara sp., Meretrix sp.)*. This has led to the decline in the stock over the decade. Fishermen land their catches on the road side which is a matter of grave concern due to the pollution caused by the putrefying meat. Apart from the obnoxious stench, the public is exposed to health hazards as a result of proliferating worms, flies, insects etc. The following shellfish fisheries management measures are suggested to manage and conserve the bivalve and gastropod resources of the Kakinada Bay which have declined significantly over a period of 20 years.

The traditional fishers can be motivated to adopt the simple low cost method of clam farming / relaying in the bay. Farming of blood clam in the Bay has been successfully attempted earlier (Narasimham, 1982). Window pane oysters also can be cultured in the Bay (Narasimham and Laxmilatha, 1996).

To revive the declined stocks, hatchery produced seed should be re-stocked in the clam and oyster beds. Hatchery technology has been developed by Central Marine Fisheries

Research Institute for *Meretrix meretrix* (Narasimham, 1988), *A. granosa* (Muthiah et al. 1992), *Paphia malabarica* (Sivalingam et al.1996), window pane oyster (Dharmaraj et al. 2004) and the gastropod *Hemifusus pugilinus* (Laxmilatha et al. Pers comm.). Areas should be clearly demarcated for shell fishing by the traditional fishers.

Restrictions on minimum size of exploitation should be strictly enforced to prevent indiscriminate exploitation of small sized clams, oysters and gastropods. The livelihood concerns of the traditional fishers dependent on the Kakinada Bay need to addressed and alternate livelihood options such as farming should be promoted.

Awareness camps and regulatory measures should be implemented to prevent the landing of the shells along the roadside and causing health hazards to the public. These shellfish fisheries management measures will go a long way in conserving and sustaining the abundant and diverse bivalve and gastropod resources of the unique ecosystem in the Kakinada Bay.

Acknowledgement

The author is thankful to the Director, Central Marine Fisheries Research Institute, Cochin for support in carrying out this work. The assistance rendered by Shri. K. Dhanaraju in collecting the catch-effort data from the Kakinada Bay is appreciated and acknowledged.

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Fig. 5. Gastropods, Kakinada Bay 2011-2013.