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Diatoms to whales: My research and field experiences in the Gulf of Mannar and Palk Bay in the vicinity of Mandapam, along the south east coast of India

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I am exhilarated and immensely thrilled to narrate my research and field experiences in the Gulf of Mannar and Palk Bay in the 1960s, 1970s and 1980s for publication in the souvenir on the occasion of the Golden Jubilee Celebrations of the Recreation Club, CMFRI, Mandapam Camp which I also served as Secretary and President for some years in the past.

The momentous and great day in my career was when I approached Mandapam Camp railway station on the 8th December 1958. I saw first the coast of Palk Bay running parallel and along side of the railway line and soon the vast Pillaimadam lagoon. The scenery was quite enchanting. After alighting from the train and as I travelled in a vehicle towards the Institute and ascended the sand hillock, the great Gulf of Mannar and the chain of islands far beyond the shore came in sight. As I entered the campus, the atmosphere looked so serene and calm with shady trees on both sides of the inner road. The beautiful and enchanting marine environment surrounding the place made instant and deep impression on my mind that it could be an ideal place for marine biological research and soon I realised it nothing short of a marine biological paradise.

Early perambulations in and around the place and on the adjacent islands and the varied nature of the coast and beaches convinced me that there could be enormous scope for a naturalist's observations. Indeed, great naturalists like James Hornell and Gravely and several others in later years laid the foundations for marine research at this remarkable place, though isolated from civilisation but strategically surrounded by the sea on three sides.

A novice for marine science and a very fresh post graduate from the Banaras Hindu University, I soon developed keen interest in the subject and set to work for the doctoral work on Fishery Biology. During the course of collection of field data, I availed the ample opportunities offered by nature to make several other significant observations on marine plants and animals right from diatoms to whales. I do not hesitate to attribute this vast scope for research to the very environs of Mandapam Camp, perhaps not found at any other place in the country. The unique location of the place at the very lands end on the south eastern corner of the country, bounded by the Palk Bay in the north, Gulf of Mannar in the south, their confluence at the Pamban channel and a remerger on the east

of Rameswaram island over the Adams bridge makes it an ideal place for marine biological and oceanographic research. Added to this, the reversal of the winds associated with the north east and south west monsoons entirely change the oceanographic phenomena in the area which characterise and govern the abundance and distribution of living resources of the Bay of Bengal in this region. Concomittant with this, the fishing seasons alternate in the Palk Bay (Apr-Oct) and the Gulf of Mannar (Nov-Mar). The proof of this lies in the seasonal roughness, ferocity and turbulence of the water masses in Palk Bay and Gulf of Mannar which largely dictate the fishing activities. These phenomena often puzzled the biologists and oceanographers due to non-availability of scientific data continuously over an year. However, efforts have been made to provide information to bridge the gaps, though not entirely satisfactory. The shores and sea bottom off the coasts of Palk Bay and Gulf of Mannar are quite diverse in nature - sandy, rocky, muddy with adjoining lagoons and mudflats harbouring an immense variety of animals and plants. The noteworthy feature is the north east monsoon winds drive ashore very large medusae to the Palk Bay coast which harbour a number of commensals. The intertidal region, especially of Palk Bay, gets exposed for good distance from the shore (upto about 0.5 km even) at zero - and low tides offering scope for collection and observations on a wide variety of marine organisms.

As it were, the ocean at Mandapam beckons one to appreciate the richness of fauna and flora and derive the pleasure of observing and studying them in their own habitats. My initiation for the first time into marine research came from the late Dr. S. Jones, Former Director of CMFRI and my mentor who encouraged and guided me at all times to pursue this field of study. I owe a large measure of gratitude to him for all the benovalence bestowed on me. My very first finding was to record the occurrence of an additional species of ribbonfish, *Eupleurogrammus intermedius* which was till then confused in its identity and merged with

the closely related *E. muticus*. Research work on this family of fishes including the biology and fishery enabled me to obtain the Ph.D. degree of the Banaras Hindu University. My camping for about a week at Idinthakarai (Gulf of Mannar coast) gave me a wonderful opportunity to witness the rise and fall of the abundant catches of the most dominant species of ribbon fish *Trichiurus lepturus* during its southward migration in large schools in the post-spawning period. The bag net catches landed by catamarans slowly increased, reached a peak in a few days and declined gradually as the schools moved away south. A similar phenomenon was observed in a sequence at Cape Comorin and Vizhingam (south west coast) as the schools evidently went round the sub-continent in the following days. However, I did miss an opportunity of describing a new species of ribbon-fish from the Gulf of Mannar due to several reasons, although I had a lot of material with me. Based on similar material, a new species, *Trichiurus gangeticus* was described later by another scientist from the Hooghly estuary. A memoir on the ribbon-fishes of India by me is one of its kind today based on comprehensive observations on this group on an all-India basis including systematics, anatomy, biology and fishery.

Another land-mark contribution is my research on the fishes of the family Leiognathidae from the Palk Bay and Gulf of Mannar which includes the description of two new species of silverbellies *Leiognathus jonesi* and *L. striatus* under joint authorship; reporting on the occurrence of two additional species of the same family, *L. leuciscus* and *L. smithursti* besides extensive observations on the biology and fishery of a number of species of the same family and a comprehensive account of the osteology of all species of the family which enabled me to draw the genealogical and evolutionary trends in the closely related three genera of *Leiognathus*, *Gazza* and *Secutor*. Except *L. equulus* and *L. fasciatus* which attain larger sizes (usually caught in gill nets in the Palk Bay),

most of these fishes have a short lifespan. Hence advice was given to the industry to fish for the resource irrespective of the size and season, for if left unfished, they are no more available. Either natural mortality would take place or they are preyed upon by predatory fishes.

My field work in Palk Bay and Gulf of Mannar for about 15 years in two spells of my stay at Mandapam during 1958-69 and 1978-82 provided me ample opportunities to make short-term observations on diverse species of marine fishes which, I am sure, no other location can provide. As a novice to marine fisheries, as early as in 1961, I saw something white reflecting sunlight on the beach near Pudumadam along the Gulf of Mannar coast as I was travelling on a mechanised boat. As the sight was unusual, I wanted to land at the place. To my astonishment, I found hundreds of the cow nose ray, *Rhinoptera javanica* heaped on the beach, the white ventral sides reflecting light. It was revealed that shoals of the species were captured in shore seines little earlier. Since such occasions are rather rare, I made several observations on the material. They appeared to be on their breeding migration as many females carried young ones. The ray is known to be predatory on pearl beds. The trawnet catches landed from Palk Bay used to contain large quantities of butterfly rays of the genus *Gymnura*. By then, I was aware that practically no information was available on these really 'butterfly' looking rays. Since I was regularly visiting the fish landing places along both the coasts, I was able to collect biological and fishery data on *G. poecilura* and published the same. These rays seem to be more abundant in Palk Bay than in Gulf of Mannar. The other elasmobranchs which attracted my attention are the large hammer-heads (*Sphyrna* spp.), sawfishes (*Pristis* spp.), the tiger shark (*Galeocerdo tigrina*) and the devil rays (*Manta manta*) landed occasionally in gillnets operated in Gulf of Mannar. They are not come across in the catches from the Palk Bay. These fishes are of great biological and fishery importance due to the massive sizes attained by them (20-25 ft

in the case of the sharks and one to two metres across the disc in the case of the ray), their highly predaceous and carnivorous nature, prey-predator interaction, food chain relationship, lack of information on the breeding and population density, damage to fishing nets, difficulties in landing them and their economic value. Due to paucity of material and unpredictability of capture and landing, I was unable to make any detailed study but derived utmost satisfaction of seeing some of the massive creatures from the Gulf of Mannar. Any one who had seen the number, structure and mobility of teeth and their arrangement in as many as seven rows in the upper and lower jaws of the tiger shark of the size I mentioned above, would not but believe the narrations or stories that these powerful and mighty fishes can chop off easily parts of human bodies if they accidentally come across any. Because of the ferocity of the fish exhibited vividly in its jaws and teeth and rarity of the fish in its coastal waters, I ventured to get the jaws of a large tiger shark and kept in the museum of CMFRI so that others could also see and appreciate.

My study and observations on a wide variety of other fishes from the Palk Bay and Gulf of Mannar brought out several biological, behavioral and fishery related data and information. The instances are important because either the fishes are less known, queer, large or peculiar in behaviour. As I was visiting Rameswaram for fishery survey work, sometimes at night also, I was attracted by the easy capture of large quantities of *Anchoviella* spp (white-bait) off the coast in Palk Bay with torches called 'soonthu'. This indigenous method of attracting fish by light produced by burning dried palm leaves was found by me to be very economical in view of the high cost of fish and demand as dry fish. The same Rameswaram coast was a sight to see when heavy landings of large *Chorinemus lysan* (75-100 cm) took place. Because they are so large, the heads, guts and gonads are removed and thrown on the beach. Dogs on the beach

used to have a feast of this material and become very fat! Taking advantage of the situation, I made a short study of the size variations, food and breeding habits of the fish, practically incurring no expenditure. Seaweeds, especially *Sargassum* spp are abundant in the shallow waters of Palk Bay at Mandapam. They harbour a variety of organisms amongst the fronds. Washing freshly collected *Sargassum* easily yields them. The numerous small pipefishes (family *Syngnathidae*) attracted my attention on several occasions. Sorting and identifying these queer-looking fishes revealed an undescribed genus and species of pipe fish from the seas around India. It was identified and described by me as *Micrognathus brevisrostris*. The Indian sand whiting (*Sillago sihama*) used to be caught in large quantities in shore seines along Palk Bay, especially in the vicinity of Mandapam in the 1960s. I found the situation entirely changed in the 1980s when the catches rapidly declined, perhaps due to indiscriminate fishing of immature fish (mostly 8 to 12 cm). Short stretches of the shallow waters at certain places along the coast were found to serve as nursery grounds for early juveniles. Large individuals of *Plectorhynchus* spp. were often found in groups in clear waters in Palk Bay and under the Pamban bridge. I found the fish very foolish and do not move even when a diver approaches and they could be easily caught by piercing with simple sharp iron rods. The Kundugal Point (Gulf of Mannar near Pamban) and many other localities in the vicinity were found to be important collection centres for the seed of milkfish (*Chanos chanos*) and mullets (*Mugil* spp) but it is still a paradox while the seed of these fishes is so abundant in the area, the adult and mature/spawning fish are very rare. Seacucumbers were found abundant in the same mudflat areas. The schools of mullets are not uncommon in Palk Bay but they have been found to be composed of immature fish, often getting disturbed and jump into the boat when schools are intentionally intercepted by the boat. Fishermen attribute appearance of mature fish

at certain seasons to be in the coastal waters of Palk Bay associated with particular wind and current direction. The team under my leadership was able to breed *Mugil parsia* and initial experiments indicated that third to fifth day is very critical for the survival of the larvae when appropriate live feed seemed essential. A series of monoculture and polyculture experiments were conducted at Mandapam with milkfish, mullets and prawns. *Tilapia* had been found to be nuisance in salt water fish culture ponds at Mandapam.

Other interesting observations I made in the Palk Bay include the occurrence of large schools of the catfish *Tachysurus dussumieri* (about 75 cm in length) which have been observed to churn up the muddy bottom, evidently in search of food. The schools can be detected due to the appearance of large brown circular patches of turbid water on the surface. During my cruises on the Indo-Norwegian Project (INP) boats in the Palk Bay I found enormous schools upto 15 ton in a haul of the catfish captured in purse-seines. *T. coelatus* is the other dominant species in the Palk Bay. Both species have been found to breed profusely in the area as they were often found with eggs in the mouth. I vividly remember a boy on the boat was very badly injured on his back when a worker accidentally threw a large fish to another side of the deck when it straight went and pierced and stuck on the back of the boy with its strong and powerful dorsal spine. Without using force, the spine could not be pulled out. So strong are the spines of catfish! The trawl net catches from Palk Bay used to land large quantities of sea snakes of various species but no study had been attempted so far. A golden opportunity for some one interested in herpatology. Fishermen used to very carefully avoid them. The eels were also quite frequent in the catches and I happened to spot out a very large moray eel, *Thrysoidea macrura* (over 10 ft long) which is the second largest on record in the world and kept stuffed in CMFRI museum at Mandapam Camp.

Systematic trawling experiments were conducted in the Palk Bay and Gulf of Mannar by the INP boats in the 1960s and 1970s and I could make use of this opportunity to collect material of silver-bellies for my research work on the group and published a joint authorship paper on trawl fishing in Palk Bay and the Gulf of Mannar. These and other observations made by me indicated that larger fish and abundant catches of the ribbon fish, *T. lepturus* can be harvested by trawling in deeper waters beyond 50m depth and in coastal water (less than 50 m depth) in the post-spawning period when they school and get caught in bag nets and shore seines.

Preliminary experiments were conducted on cage culture in Palk Bay to determine the suitability of locally available material for fabricating the cages and use of species like *Epinephelus tauvina*. Useful information has been generated. Attempts were also made to maintain large mullets and milkfish in hapas in coastal waters of Palk Bay for breeding purposes but rapid development of filamentous algae inside the hapas restricted movement of fish in the hapas by entangling them and causing mortality. Large pens erected in Bay also did not prove useful to maintain the fish as silt soon accumulated inside the pen like a mound reducing the depth of water and creating difficulty for the fish to swim. A detailed study of the hydrobiology of Pillaimadam lagoon was conducted with a view to convert a large part of the lagoon into a salt water fish farm. This was suggested because pen culture experiments conducted by other scientists in the open lagoon with milkfish and mullets hardly yielded 200-250 kg per ha/5-6 m. The very high saline conditions, retarded growth and production indicated the need for supplementary feeding for obtaining better growth and production and also diversification of species for culture.

My experience in research with algae in the Palk Bay and Gulf of Mannar though very limited, was very exciting and rewarding. Quite accidentally, I stumbled on the blue-green alga, *Trichodesmium thiebauti* to report it for the first

time in the Gulf of Mannar, though several earlier authors reported only *T. erythraeum* from the region. I sent the material to Prof. Desikachary of the Madras University who confirmed my identification. I had observed *Trichodesmium* blooms in Gulf of Mannar now and then but on one occasion

go into detail.

The aquarium suddenly started dying. The water in the tanks turned yellowish (though running water is circulated 24 hours). Fowl smell emanated inside the building. Seawater in the sump and overhead tank, when checked, emanated the same foul smell. Some lumps of floating material were observed at both places. The sea water from Gulf of Mannar from where water into the aquarium was pumped, was collected in a beaker and observed. It contained a high concentration of 'floating bundles' visible to naked eye. The winds along the beach had bad odour. Coastal waters were discoloured yellowish-brown. On examination under the microscope, the 'bundles' could be identified as *T. thiebauti*. The mortality of the fish in the aquarium was evidently due to the large scale death and decay of the alga in the water and consequent leaching of toxins and asphyxiation of fish. Some species of leiognathids are known to be symbiotic with luminiscent bacteria. But I found *Leiognathus dussumieri* collected from fish landed by bottom gillnets from the Gulf of Mannar at Kilakarai harbouring an algae on its dorsal, pectoral and caudal fins and sometimes parts of the body also.

Seagrass and seaweed beds are extensively found in the coastal waters the Palk Bay and Gulf of Mannar. However, *Sargassum* appeared to be more abundant in Palk Bay than in Gulf of Mannar and vice-versa for seagrass. During the course of my observations as leader of the lab to land programme on seaweeds, I found luxuriant growth of seaweeds could be obtained in the Gulf of Mannar compared to the Palk Bay, possibly due to the nature of sea bottom, clarity of water, wind, current and wave conditions. Large quantities of seaweeds are washed ashore along the Gulf of Mannar coast

during the south west monsoon period when rough seas are prevalent. However, the correct hydrological and ecological factors responsible for good crops and bad crops of cultured seaweeds have not yet been pin-pointed. In the meanwhile, regulated cropping of natural beds based on scientific studies have been advocated. It was felt, unless seaweed production by culture is directly linked to processing and product development, it may not be an economic venture.

Camping once for 24 hours at the Manauli island provided an opportunity to me to observe a number of marine biological phenomena and collection of material for research. The shallow, very clear waters along the shore at low tide revealed the abundance of the large greenish looking sea anemone *Stoichactis* sp. with which the anemone fish is associated. Apart from observing the fish going in and out of the stomodeum of the coelenterate, many intricacies of the association could be studied. It was a herculian task to unearth the sea anemone from its habitat even for 3 or 4 persons since the soil around the body has to be removed upto its base to dislodge the anemone whose base was found to be located at about 3 ft underground. I had the pleasure of interlocking my fingers under its base lying prostrate and 2 or 3 people lifting me up with force to uproot the anemone. The anemones with fish inside were collected and transported to the aquarium for further observations. What a wonderful experience indeed. The 'Kallan-Katti valai' (a sort of stake net) operated at the edges of Manauli and other adjacent islands at high tide is a unique and no-cost operation capturing a wide variety of fish and prawns as the tide recedes. Mulletts and other species could be collected live for research purposes. I had the oppurtunity to make some observations on the eggs of the only marine insect, *Halobates* sp. found attached to a *Sepia* shell. The colourful black and red winged butter flies of the genus *Papilio* regularly travel back and forth across the Gulf of Mannar from the mainland to adjacent islands during certain periods.

The richest and most valuable research experience I had in the Palk Bay and Gulf of Mannar is with the largest denizens from the ocean (the whales) and the meekest, the dugong or the sea cow. I must say, to my good fortune (because many would not have had), I had the personal and most exciting experience of working with several stranded whales along these coasts. The enormity of the task was as large the giants, seven or eight of which ranged between 45 to 80 ft in length. Most were baleen whales stranded only along Palk Bay coast while the sperm whales (I saw one full and another head skeleton only) appear to be stranded only along the Gulf of Mannar coast. While the reasons for stranding are yet unknown even in other locations in the world, since there was no visible injuries, signs of shooting or senility (based on sizes), the possible cause could have been the failure of the sensory system to distinguish deep sea and the open shallow waters, Which they encountered as also opined by other scientists elsewhere in similar cases. Having once entered the shallow waters, it is unimaginable the heavy bodies can be sustained by buoyancy to lift themselves and turn around. As Officer-in-Charge of the Museum and Aquarium, I was given the charge of retrieving the complete skeleton of a large baleen whale (about 80 ft) stranded at Karangadu along the Palk Bay coast. A number of us, scientific and technical staff and workers, camped in tents at the site and transported parts of skeleton by sea in boats and by road. The whole area and the coastal waters in which the carcass was decomposing for about a week was stinking, with fowl winds blowing all over the place. Having worked with the whale for a week to dismantle the skeleton, our bodies and clothes also absorbed the stink. It took a few days to get rid of the fowl odour. The coastal waters became red and oily with leaching of blood and oil from the body of the decomposing whale. Although the bones of the whale are said to be porous and buoyant helping the whale to sustain its enormous weight in water, it was amazing to see that six persons could not lift one half of the mandible.

We successfully transported every bit of the skeleton to the Institute, buried some parts on the beach, some were tied and kept in coastal waters of Gulf of Mannar and others on roof tops for complete removal of flesh and oil. Unfortunately, the 1964 cyclone devastated every thing in the area and most of the skeletal parts kept at sea were washed away and lost. Due to this unforeseen catastrophe, a very valuable exhibit has been lost and all efforts to secure the skeleton had been in vain. Years later, during my second sojourn at Mandapam Camp (1978-82), I had the opportunity to work with a complete young sperm whale (*Physeter macrocephalus*) and the head skeleton of a large sperm whale stranded at Krusadai and Manauli islands respectively. The detailed osteology of these were studied by me and a colleague, the skeletons deposited in the museum and a paper published which reviewed all strandings of whales along the Indian coast from 1748 to 1982. The study also enables one to estimate the total length of the sperm whale if the condylo-basal length of the skull is known.

During my stay at Mandapam Camp I found the capture of dugongs was quite common, especially at places like Vedalai and Kilakarai (Gulf of Mannar) and Tondi (Palk Bay), though more reports came from Gulf of Mannar. I had the opportunity to study the animal both at field and in the laboratory along with other colleagues. A few live dugongs were reared in the aquarium and others dissected for anatomical details. The extraordinary long intestine contained mostly seagrass in fresh and semi-digested condition and also a variety of parasites. I made a personal comparative study of the skeletons of an adult and a baby dugong which were deposited in the museum and a paper was published. Since the meat is a much sought after delicacy in the coastal areas, the animal appeared to have been intensively hunted and the population decimated rapidly over the years. In some cases, I observed the tail spines of rays embedded in the flesh of the dugong, indicating some sort of struggle in the habitat between the dugong and the rays

whose tail spines can be pulled off with some force. The animal is now protected under the Indian Wild Life Act but precious little had been done by the Government to protect the animal and its environment, though the Institute made repeated pleas for the same. *In-situ* and *ex-situ* conservation methods have to be urgently applied. I had made a personal plea for formulating and implementing the "Project dugong" on similar lines as 'Project tiger' but in vain. Trawling operations in the Palk Bay and Gulf of Mannar can cause great damage to the seagrass beds in the area which largely determine the distribution pattern and occurrence and well being of the animal. Observations on live dugongs in the aquarium indicated that they can be bred under those conditions given larger and deeper tanks are made, fresh sea water pumped in and changed every day and adequate quantity of food provided. Therefore, the possibilities of captive breeding of dugong to replenish the population are quite high, at mandapam Camp as done in other countries.

The foregoing account amply indicates the rich and varied marine resources of the Palk Bay and Gulf of Mannar providing immense scope and opportunities for excellent research. I feel highly gratified and satisfied that I made the best use of of my stay at Mandapam to understand and study some of the fishery resources of high economic importance and at the same time become familiar with the unique marine biological, fishery oceanographic and environmental conditions in the area. I am of the conviction that the Palk Bay and Gulf of Mannar would continue to enjoy the pride of place as the ideal environs for marine biological investigation and provide the challenges for further research, rational exploitation, conservation and management of marine resources.

In view of my intense field work and research experience for about 15 years in the Palk Bay and the Gulf of Mannar, I feel we must derive the maximum benefit of the living

resources and ideal environment offered by these two wonderful segments of the Bay of Bengal. Of particular interest would be to develop a large oceanarium at the Regional Centre of CMFRI for display and research on the highly diversified fauna and flora. Through such a facility, captive breeding of the dugong could become a reality and the endangered animal can be protected from getting extinct. A number of commercially important marine finfishes can be bred including the eel *Anguilla bicolor* and seed supplied for seafarming and sea ranching. The oceanarium would aid in the study of behaviour and physiology of marine animals. A sound foundation can be laid for marine ornamental fish breeding and culture for export. Besides its scientific and educative value, the oceanarium

would help create public awareness and concern for marine animals, especially the endangered species. I foresee, if such developments can be given effect to quickly, a National Marine Biodiversity Research Centre and National Seafarming Institute can blossom at the Regional Centre of CMFRI, Mandapam Camp.

I am singularly proud that I began my research career here and ended up to head the same Institute, which I would ever cherish in my life. But for the research work done in the Palk Bay and the Gulf of Mannar, I would not have been able to get the D.Sc. degree of Banaras Hindu University. Three cheers to Palk Bay and Gulf of Mannar!!!