

**FEATURE ARTICLE****GENERAL FEATURES AND FISHERIES POTENTIAL OF PALK BAY, PALK STRAIT AND ITS ENVIRONS**

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**Abstract:** The issue of possible social and environmental impacts of the shipping canal proposed for the Palk Bay and Palk Strait area is a much debated topic. Therefore it is necessary to explore the general features of the said area to assess such impacts when formulating the development and management programmes relevant to the area. This paper discussed the general features of the area, its environmental and ecological condition and the fisheries potential in detail so as to give some insight to the reader on this important topic. This article is based on the data collected from earlier field visits and other published information relevant to the subject.

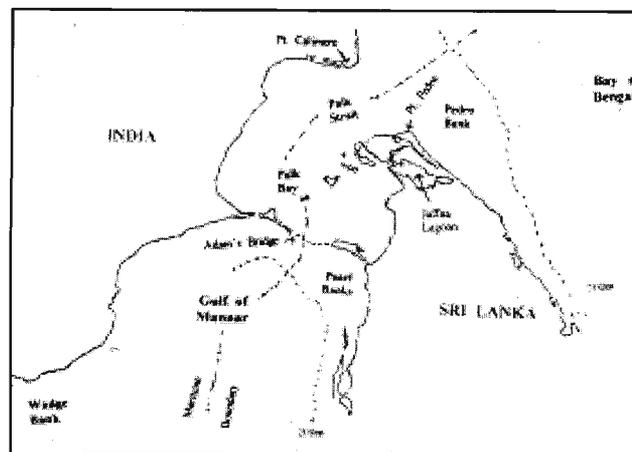
**INTRODUCTION**

Considerable interest has been created in the Palk Bay, Palk Strait and its environs recently as a result of the Indian project to construct a shipping canal to connect Gulf of Mannar (GOM) and Bay of Bengal (BOB). To assess possible impacts of this project, a detailed knowledge of these areas and their fisheries potential is essential. This information is also equally important in formulating development and management programmes to exploit its fisheries resources. Valuable information on the general conditions and fisheries activities in these areas were collected during field assignments while

serving in the former Department of Fisheries, Colombo (now Ministry of Fisheries and Aquatic Resources) and also recently when consultation assignments were done in these areas. Other available data have also been brought together and a comprehensive picture of the general features and fisheries potential of the areas under study is presented below.

**GENERAL FEATURES**

Palk Bay and Palk Strait together (also called Sethusamudram), consist of an area of about 17,000 km<sup>2</sup>. This is an almost enclosed shallow water body that separates Sri Lanka from the mainland India and opens on the east into the BOB ( Figure 1 ). This opening is 65 km wide from Pt. Callimere to Pt. Pedro with an average depth of 9.35 m. The lowest point is 13 m deep. Outside the opening, the continental shelf slopes down to the continental shelf edge, 200 m deep. The opening on its western side into the GOM is narrower and shallower, interrupted by a larger Pamban Island and other minor sand bars referred to as Adam's Bridge between Pamban Island and western tip of Mannar Island



**Figure 1: The location of Pedro Bank, Palk Strait, Palk Bay and Pearl Banks in relation to Sri Lanka and India.**

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(Figure 2). Compared to the eastern opening, the average depth is less than 1 m except at the narrow Pamban Pass which is 7 m deep. To the south east of this western opening are the Pearl Banks. Both these openings restrict the entry and mixing of fresh oceanic waters with that of the Bay and Strait.

The deepest area of the Bay and Strait is only 16 m with gradually sloping sides and is generally flat over a major part. The narrow Pedro Channel (Figure 3) starts at the northwestern tip of the Jaffna Peninsula, follows close to the coastline of the Peninsula and ends beyond Elephant Pass. Like the Adam's Bridge, there is an elevated bank near the eastern end of the Strait in a line from Kankesanthurai (KKS) on the Peninsula to Pt. Calimere (Figure 3). The sea bed profile on this line is very irregular with occasional peaks and valleys. The highest point on this bank comes to within 3 m of the sea level. Like the Adam's Bridge, this ridge too would retard free flow or exchange of water between the Strait and BOB.

Just outside the mouth of the Strait in the east is the Pedro Bank which is that part of the continental shelf lying to the Northeast(NE) and East(E) of Pt. Pedro (Figure 1) and is contiguous with the continental shelf along the eastern coast of India<sup>1</sup>. It is broadest NE and East of Pt. Pedro and narrows rapidly down to Mullaithivu. Pearl Banks on the other hand is on the west coast south of Mannar Island and is the broadest part of the continental shelf around the Island. But unlike the Pedro Bank a large portion of the Pearl Banks is less than 20 m deep. There is a reef of mostly dead coral and fossilized limestone rock about 10 km from the shoreline extending from off Silavathrai up to Vankalai in the north.

The Jaffna Lagoon is part of the Palk Bay-Palk Strait complex and it opens into the northeastern part of the Bay by three narrow and one wide opening. Its total area is about 450 km<sup>2</sup> and is long and narrow extending from Elephant Pass in the southeast to Kayts in the northwest. Details of the topography and substratum are given by Sachithanathan and

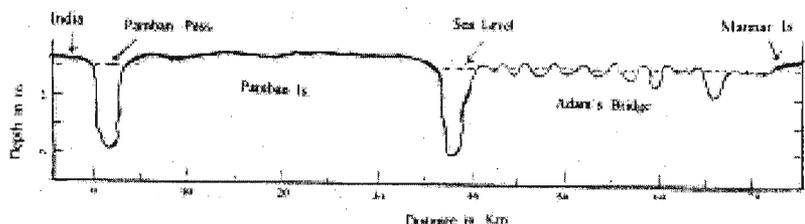


Figure 2: Profile of the sea bed from Pamban Pass to Mannar (Adam's Bridge) (Based on Admiralty chart No. 68a soundings).

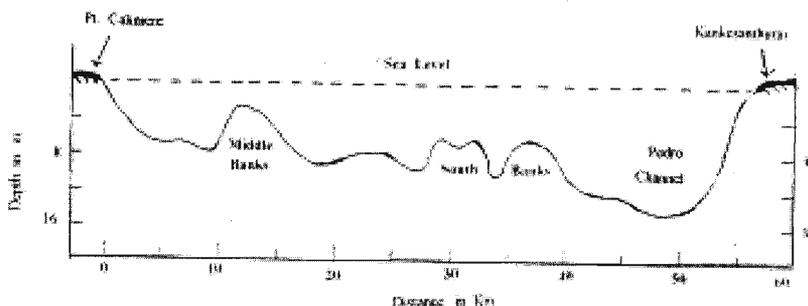


Figure 3: Profile of the sea bed from Pt. Calimere to Kankesanthurai. (Based on admiralty chart No. 68a soundings).

Perera.<sup>2</sup> According to their findings the entire lagoon is shallow being less than 3 m deep.

### SALINITY

The Bay, Strait and the Lagoon being surrounded by dry zone land mass except for the two openings into the BOB and GOM, have conditions quite different from that of BOB and GOM which are oceanic in nature. The few rivers flowing into them during the NE monsoon causes fluctuation in the salinity of these waters. Year round salinity values for the Bay and Strait area are not available but for the month of March 1963 the salinity values determined by previous studies indicate that salinity value change from a high of 32.8 ppt near the opening of the Strait into BOB to a low of 30.8 ppt near Adam's Bridge and to even a lower value of 29.4 ppt in the southwest corner of the Bay. There is no indication of a definite pattern in the distribution of salinity. According to previous investigations<sup>4</sup> at Myliddy on the northern shores of the Jaffna Peninsula (southern shores of the Strait) salinity was 28.39 ppt in December and at the Kayts Channel opening into the Bay it was 13.04 ppt in December, but in the BOB off Pt. Calimere according to Sheyto *et al.*<sup>5</sup> the salinity was 28 ppt in December 1991, at the height of the Northeast Monsoon. If there is any water movement from the BOB through the Strait and Bay into GOM during this monsoon, the salinity at the Kayts channel would be expected to be higher.

Within the Jaffna Lagoon on the other hand, the salinity values ranges from a low of 10.3 ppt in December at some locations as result of the Northeast monsoon rains to a high of 45.49 ppt in June due to the long dry spell. Jaffna lagoon, being a small body of water with more rainfall runoff water coming in, shows a higher range of fluctuation.

### BOTTOM CONDITIONS

The northern shoreline of Jaffna Peninsula is characterized by the presence of fossilized limestone rocks from the shore to various

distances into the sea, in some places extending to about 50 m from the shoreline. This is quite prominent from Pt. Pedro to the west, past Keerimalai. Hardly any live coral is present in any of these locations. Westwards from west of Keerimalai and around the islands it is sandy or sand mixed with mud or with isolated rocky patches. The rocks around the jetties and causeways are not natural for that area but brought from inland and placed there to prevent erosion. The situation is the same, it is sandy or sand mixed with mud along most parts of the west coast of the mainland up to Mannar Island. Its northern sector is very shallow with dense vegetation. The northern and southern shores of Mannar Island are sandy permitting beach seine operations. Similarly on the east coast of the Peninsula from Pt. Pedro downwards past Elephant Pass the shoreline is sandy with no rock or coral where beach seine operations are popular.

Admiralty Marine Chart (U.K. Hydrographic Office) indicates that both the Bay and Strait are characterized by the absence of hard bottom areas. It is mostly sand and mud, mud and shells or mud only. Berg<sup>6</sup> from his investigations of the bottom conditions in the north and east coast of Sri Lanka confirms that a large portion of the Bay area below the 2 fathom (6 m) contour is soft including organic material and clay. In the case of the Jaffna lagoon, while the shoreline is sandy like the Bay area, the bottom is mostly mud.<sup>2</sup> Most of the shallow areas are full of vegetation. On the Pedro Bank on the other hand, the bottom is generally hard and flat sloping down to the continental edge. Spots have also been found with rocks.<sup>6</sup> Long lining trials indicated that bottom conditions vary considerably within short distances.<sup>1</sup> On the Pearl Banks unlike in the Bay and Strait, there are many areas of hard ground called "paar" made up of mostly Lithothamnian coral, small stones, shells etc. on which the pearl oysters attach themselves and mature. Between these patches it is mostly sand mixed with shells and pieces of dead coral. Between the shoreline and the reef it is sand mixed with mud and most areas with dense vegetation. The continental edge of the shelf is very rocky.<sup>6</sup>

## TIDES AND CURRENTS

Tidal pattern within the Bay and Strait can be worked out from data given in the Admiralty Tide Tables.<sup>7</sup> It indicates that the high tide sets in from Pt. Pedro and moves westwards and then southwards to reach the areas in the southern end of the Bay. Jaffna Lagoon, opening into the Bay, is also influenced by the tides in the Bay. Unlike in the case of the ocean currents where the water flows in a particular direction continuously depending on the season, in the case of tides, the water mass moves back and forth without flowing through continuously. However there is bound to be some mixing during the tidal movement specially at the two entrances, more in the east than in the west.

Regarding ocean currents in the Bay and Strait, no detailed information is available due to lack of proper investigations. However, from other investigations available, it is possible to infer that there is no rapid oceanic current movement in either direction within the Palk Bay / Palk Strait area. Studies on the hydrography and circulation in the western Bay of Bengal during December 1961<sup>5</sup>, peak of the NE monsoon, indicate that the East India Coastal Current (EICC) during the NE monsoon flows southwards along the entire eastern coast of India. Though the investigations were limited up to Pt. Calimere, it can be assumed that the current cannot just stop at that point but will continue southwards parallel to the Sri Lankan eastern continental shelf edge like off Pt. Calimere, unless there are other forces obstructing or deviating its southerly movement. The study also indicates that the core of the EICC flows southwards at speeds of more than 120 cm/s about 130 km from the shores off Pt. Calimere. That means that the core of the current is about 120 km away from the eastern mouth of Palk Strait. The southerly current movement reduces speed as we proceed from the core area towards the shore and there is no water movement about 35 km from the shoreline off Pt. Calimere. Under these circumstances with no water movement nearer the shore, westward current movement entering the Strait towards Palk Bay cannot be expected. Fishermen operating

in the Bay area confirm that they do not encounter any rapid current movement in the Bay other than tidal movement. However, according to the boatmen operating ferries among the islands southwest of the Peninsula, there are fast flowing local tidal current movements set up within a restricted area where the Islands are located but not in the open areas. This is due to the Islands being close together with narrow channels separating them which interferes with the normal tidal pattern in the open area of the Bay causing rapid tidal flows in the narrow channels.

Another prominent feature that confirms absence of current flows within the Bay and Strait is the chlorophyll distribution. With the help of data obtained from the onboard Indian Remote Sensing Series Polar Satellite (IRS-P4), studies<sup>8</sup> have shown that the chlorophyll concentration during November and May (Northeast monsoon) in the Bay and Strait varies from a low of 3.62 mg/m<sup>3</sup> in December to a high of 7.0 mg/m<sup>3</sup> in January. In the Gulf of Mannar the chlorophyll concentration is much lower with a low of 0.4 mg/m<sup>3</sup> in March to a high of only 0.9 mg/m<sup>3</sup> in January. The colour prints obtained from IRS-P4 shows the chlorophyll distributed more or less evenly in the Bay and Strait except for a small patch just south of the islands off the Peninsula. There is no indication of a flushing out of the chlorophyll into the Gulf of Mannar. If there is any southerly current flow from BOB through the Strait and Bay into the GOM during the Northeast Monsoon there will be no accumulation of chlorophyll in the Bay and Strait and the chlorophyll concentration in the Bay and GOM will be fairly close.

## FISH POPULATIONS

Hydrography, water depth and bottom conditions are important factors that determine the type of fish population that inhabits any area. The shallow nature of the Bay mostly with mud, with no hard or rocky conditions and with limited water exchange with the oceanic waters resulting in stagnant conditions, do not attract popular high grade demersal varieties (sea bottom dwellers) like Lethrinids {breams, *meevatiya* group (S), *villai meen* (T)} Lutianids

{snappers, *rathu gal malu* group (S), *sev-villai* (T)) Epinephelids {reef cods, *laveya* group (S), *kalavai* group (T)}, Elasmobranchids { sharks, skates, rays, *mora* group (S), *sura* group (T)} etc. which prefer hard bottom, deeper waters and stable salinity conditions like Wadge and Pedro Banks.<sup>1,9</sup> Initial trawling trials in the Bay<sup>10</sup> indicated the presence of large quantities of Leiognathids {silver bellies, *karalla* (S), *karal* (T)}. Subsequent trawling trials resulted in as much as 1000 lbs (450 kg) per hour of trawling,<sup>11</sup> mostly Leiognathids which are of very little commercial value and used mainly for fish meal. However, the muddy nature of the bottom favours prawns. According to previous investigations<sup>12</sup> prawns are not uniformly distributed in the Bay but are restricted to certain areas composed of very soft green mud. They are also found in certain other locations specially around the Islands. Around Kachchaithivu only two species are listed.<sup>12</sup> Prawns have also been found along the three fathom (6 m) contour north of Mannar Island up to Rameshwaram resulting in an average catch of 20 kg per hour<sup>11</sup> when a larger 45 foot (13.63 m) boat was used for this survey. Due to security restrictions the smaller coastal crafts based around the Bay area have not been exploiting the resources of the Bay, specially the prawns, for a long time.

Off the western coast of the Island in the shallow waters off Negombo, the catches of traditional crafts and mechanized 3.5 t boats averaged 3.75 kg per hour of which 50-60% were prawns.<sup>13</sup> Off Chilaw for log rafts (*kattumaram*) the catch was only 3.47 kg per day of which only 24% were prawns.<sup>14</sup> Based on the results of the large trawler<sup>11</sup> and the fact that it is well known that there has been considerable poaching by foreign traditional crafts, which confirms that the potential of the prawn resource is considerable, the catch rates by the smaller crafts based around the Bay area may prove to be as good or even better than that of the west coast if security restrictions are lifted. Unfortunately, no size data on the prawn species caught in this area is available and it is difficult to know whether they are adults or juveniles. The price factor would depend on the size of the prawns caught. Also information on

the size composition is essential to formulate management programmes.

Along the eastern coastline of the Bay, north of Mannar, where there is abundant vegetation, small scale fishery operations are carried out for mixed inshore varieties using mainly gill nets. Unlike in the open areas, Leiognathids are less in areas with vegetation. These areas with vegetation are also home for the Holothurians (*beche-de-mer*) and chanks which are collected by diving. Along the northern shores of Mannar Island, the coastal waters are to some extent influenced by oceanic waters across the Adam's Bridge. The sandy nature of its entire coastline permits beach seine operations and inshore varieties like Engraulids {sprats, *hal massa* group (S), *nehtali* (T)}, Clupeids {sardines, *salaya* (S), *salai* (T)}, Carangids {trevallies, *parawa* group (S), *parai* (T)} etc. are caught. Appreciable quantities of juvenile Leiognathids which are caught, being of no commercial value are discarded on the beaches. Along the southern shores of the Mannar Island, the waters being oceanic, Leiognathids are rare and popular varieties like Clupeids, Carangids, pelagic species (surface dwellers) like Sphyraenids {barracuda, *jelawa* (S), *seela* (T)}, Scomboromorids {seer, *thora* group (S), *arakula* (T)} etc. are caught in the beach seines.

The abundance of Leiognathids in the Bay area should be taken notice of. Though it is not popular for edible purposes, considering its abundance and easy access to the resource and the waters being shallow, its exploitation for manufacture of fish meal requires early attention. Fish meal is a major ingredient for the manufacture of prawn feed, large quantities of which are imported by prawn farmers regularly. Since feed cost is almost 50% of the prawn production cost, local manufacture of the feed will reduce the foreign exchange component of the production costs. According to the fishermen, Indian crafts do fish for Leiognathids for the manufacture of fish meal in Tamil Nadu.

In the western parts of the Strait there is very little fishing activity due to lack of exploitable

fish stock. Trawling trials off Kankesanthurai yielded catches of only 0.1 kg of prawns and 111 kg of fish per hour.<sup>11</sup> In the eastern end of the Strait which is closer to the opening into BOB, fishing activity is more productive and fishermen from the western parts like Mathagal sail to areas closer to the mouth of the Strait or just outside for their fishing operations.

The Jaffna lagoon has a higher salinity and is shallower than the Bay and Strait. The bottom is muddy in a greater part of the lagoon. The presence of dense vegetation serves not only as a sanctuary for the early juvenile stages of some of the popular commercially important varieties, but also provides feed for some of the common lagoon varieties like Siganids {rabbit fish, *orava* (S), *ora* (T)} and the lagoon supports a reasonably good fishery. It is essentially a mixed population made up of mostly juveniles of the deep water demersal varieties like Lethrinids, Lutianids, Epinephelids and some of the common lagoon varieties like Siganids Hemirhamphids {half beaks, *moralla* (S), *mural* (T)}, Chanos chanos {milk fish, *vaikka* (S), *pal meen* (T)} juvenile Sphyraenids Mugillids {grey mullet, *godeya* (S), *manalai* (T)}, cuttlefish etc. Jaffna lagoon is also well known for prawns and crabs. De Bruin<sup>11</sup> lists six species of prawns while Puvanendran<sup>15</sup> has recorded only five different species of prawns in the lagoon. The largest total length recorded for any prawn species is 13.3 cm. Comparison to the sizes caught off Chilaw in the shallow waters of the sea where the smallest size is larger than the above sizes<sup>14</sup> confirms that the Jaffna lagoon catches are all juveniles. The larger sizes probably migrate into the Bay as they mature or are largely exploited within the lagoon before they mature. But unfortunately, no size data for the prawn catches from the Bay are available. While all these are for local consumption, the high valued holothurians, an exportable commodity which is a delicacy in the far east, is quite common in the lagoon and around the Islands, specially in areas with vegetation. Due to its export demand, it is feared that it is being over exploited. However due to security reasons, the area of operation is restricted thus providing a sanctuary for its survival within the security zones. Chanks, another export commodity, is

generally collected by diving mainly around the islands. Although the lagoon fishery supports a large fishing community, the income per fisherman is more at a subsistence level.

Pedro Bank with a wide continental shelf is the best area for the exploitation of demersal varieties around the Island. The fish population is somewhat similar to that of Wadge Bank<sup>1</sup> and made up of adult sizes of the popular varieties like Lethrinids, Lutianids, Epinephelids, Elasmobranchs and similar demersal varieties. The juveniles of these varieties are not present on the Bank. They are found in lagoons and shallower areas. Earlier surveys and commercial fishing operations on this Bank are well documented.<sup>1</sup> Subsequently there were irregular commercial trawling operations by the Ceylon Fisheries Corporation. At present there is no commercial fishery activity on this bank by crafts based in Sri Lanka. It is understood that there is some poaching by foreign vessels. During the 2002 visit to Pt. Pedro, it was observed that due to security reasons high powered crafts based in the Peninsula were not permitted and the fishermen were not allowed to go up to the Pedro Bank proper for their fishing activities. However, large meshed bottom set nets, bottom long lining and hand lining was popular with smaller crafts based along the northern shores of the Peninsula and operating just outside the opening of the Strait into the BOB. In spite of security limitations, the fishermen have considerable success operating these gears and catch mainly Elasmobranchs (sharks, rays and skates). Only limited quantities of the good quality demersal varieties like Lethrinids, Lutianids, Epinephelids etc, which is the main stay of the Bank, were being caught. Those operating around Pt Pedro seem to bring in the best returns. Once they have access to Pedro Bank proper, their returns should be even better.

Taking into consideration the results of previous commercial operations, surveys and recommendations<sup>1,16,17,18</sup> and results from current operations in that area, the present gears (bottom set nets, bottom long lining and hand lining) appear to be the best choice for the exploitation of the Pedro Bank demersal stock.

This requires more larger crafts than at present which can reach the Banks and are capable of using the existing harbours in Pt. Pedro and Valvettithurai instead of the large trawlers that were operated earlier which require deep water harbours. These crafts will provide more employment and require low capital input.

The Pearl Banks are famous for its pearl oysters and natural pearls than for fish species. This is because a major portion of the Bank is less than 20 m deep and is favoured by the pearl oysters. The popular adult demersal varieties like those that occur on the Pedro and Wadge Banks prefer depths from 20 to 40 m. On the Pearl Banks beyond the 20 m contour, the shelf drops steeply and the belt between the 20 m contour and the continental edge is narrow. During the 1955 Pearl Banks survey<sup>20</sup>, an exploratory trawl haul indicated that the width of the shelf between 20 and 200 m depth was very narrow and steep and very rocky but adult demersal varieties were present. The rocky nature was also confirmed by a later survey.<sup>19</sup> The pearl oyster beds are mostly found between the depth of 8 and 20 m. The shallow areas close to shore has considerable amount of vegetation and though the shoreline is sandy, it is not possible to operate large beach seines because of the vegetation and scattered coral heads and rocks. The presence of pearl oysters on the Pearl Bank is not regular with many blank years between successful commercial operations. History of the earlier Pearl Bank surveys and commercial operations are detailed by Sivalingam.<sup>20,21</sup>

There is no indication of lobsters which are a very valuable export product, being a major product in these areas as shown by past surveys.<sup>22</sup>

The main stay of the Palk Bay, Palk Strait, Pedro Bank and Pearl Banks are the demersal varieties. However pelagic varieties, generally found in the surface layers like Scomberomorids {seer - *thora* (S), *arakulla* (T)} Sphyraenids { barracuda - *jeela* (S), *seela* (T)} which are classified as grade 1 and higher priced, are found in the above areas but not in abundance like the demersal varieties. Most pelagic varieties like

Scomberomorids, Sphyraenids etc. swim around over large areas but are not known to travel in a migratory pattern like the tunas. On the other hand the demersal varieties in their adult stage are essentially resident in character and stay on the same bank. They are found year-round in the same area. They favour 20 – 40 m depths and the water quality and shallow nature of the Bay and Strait discourage any movement of these demersal varieties in either direction across the Strait and Bay. In the case of the Pedro Bank, there is ample area north of the Pedro Bank proper along the East India coastline and southwards up to Mullaitivu to prevent over crowding and there is no reason for these demersal varieties to move across the Strait and Bay, an area not favoured by them. For the Leiognathids, the favoured environment appears to be that of the Bay. They grow and multiply within the Bay as indicated by the appreciable quantities of their juveniles which are caught in beach seines operated on the northern shores of Mannar Island. They are present in small numbers outside the Bay as indicated by catch landings and not as a major item indicating that the open oceanic environment is not favoured by them. There is no indication of any migration by this group. The Carangids are made up of many species and a detailed list for the Wadge Bank (more than 15 species) with their fluctuation characteristics have been presented by Sivalingam<sup>23</sup> but no detailed data is available for the area concerned. It has however been observed that they form an important component of the catch landings from both Pedro<sup>1</sup> and Wadge Banks<sup>23</sup>, beach seines and inshore gill net catches. Carangids as a group are considered as grade one and hence their importance.

The details of the general features presented above would help in assessing possible impacts of the proposed shipping canal to connect the Gulf of Mannar and the Bay of Bengal. The Palk Bay, Palk strait and its environs with varying ecological and environmental conditions are inhabited by different varieties of fish and prawns which at present are not fully exploited due to security reasons. They should be exploited on a rational basis to get the full benefits.

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