Marine effect of dredging on the marine environment

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Introduction

One of the greatest challenges is to manage and ameliorate physical changes to aquatic ecosystem. Physical alteration to aquatic ecosystem through such process as erosion, siltation and hydrologic modification are among the leading causes of water quality impairment and a key understanding avenue for restoration. Many physical disturbances are the result of specific actions (e.g. Channelization, shoreline hardening and dredging). While some others are the result of less specific non-point activities that result from land use. As ocean is the eventual receiving basin for all land runoff water it carriers, any uncontrolled development activity located anywhere near coastal area-in, watersheds, floodplains, wetlands, tidelands or water basin has the potential for damage to the coastal ecosystem.

What's at stake?

The diversity- of life is relatively high along the coast as there are so many different types of habitats viz. estuaries, mangroves, salt marshes, intertidal areas bays, lagoons, inshore water, coral reefs etc. This is especially true in the case of Palk Bay and Gulf of Mannar. When habitat loss occurs, chain reactions of problems occur which ultimately affects all life on earth. Breeding and nursery areas for coastal zone inhabitants –marine mammals, fish, turtles, invertebrates, birds and other animals are damaged or worst lost forever. The loss or removal of plants such as mangroves, sea grasses and other marine algae along with loss of coral reefs increases land erosion and makes coastlines vulnerable to storm damage. Coral reefs are the primary source of food and income for millions of people, produce valuable chemical compounds for medicine and provide a natural wave barrier.

Importance of sediments

On a global scale, shorelines and shallow marine environment receive approximately 80% of their- sediments from rivers and remaining 20% for biogenic production and transport by a combination of ice, wind and volcanoes (The open university, 1989).

Changes in sediment delivery, whether natural or anthropogenic produce effects, which range from moderate to profound on the geomorphology of coastal environments. The impacts on humans, even from moderate geomorphological effects, are usually significant because an astonishing 70% of the world's population lives within 60Km of the coast (U.N., 1985).

Sediment in the sea

Marine sediments can be classified based on size or origin. Size classification divides sediments by grain size into gravel, sand, and clay. Mud is a mixture of silt and clay.

Origin classification divides sediment into five categories viz. Terrigenous sediments, biogenic sediments, authigenic sediments, volcanogenic sediments and cosmogenic sediments. Factors that control sedimentation include particle size and turbulence of the deposition environment. Terrigenous sediments strongly reflect their source and are transported to the sea by wind, rivers and glaciers. Major Pelagic sediments in the ocean are red clay and biogenic oozes. Authigenic deposits are chemical and biochemical precipitates that form on the sea floor and includes ferromanganese nodules and phosphorite. Rate of erosion is important in determining nature of sediments. Experiments have shown that the erosive power of water, flowing with a velocity V varies as V^2 while the transporting ability of water varies as V^6 (Ragunath, 199 1).

Based on the depth, the ocean environment can be divided into the shelf, which is shallow and near a Terrigenous source, and the deep ocean basin which is far from a Terrigenous source. Shelf sedimentation -is strongly controlled by tides, waves and currents but their influence decreases with depth. Shoreline turbulence prevents small particles from settling and transports them seaward where they are deposited in deeper water. Particle size

decreases, seaward for recent sediments. Major sedimentary processes in the deep sea include bulk emplacement, debris flows and turbidity currents.

Site condition which could adversely affect marine environment due to dredging of Sethusamudram canal

a. Geomorphology of PalkBay and Gulf of Mannar

Both Palk Bay and Gulf of Mannar regions are shallow with depth not exceeding 10-12 meters even up to a distance of 17 Km from the shore- The Palk Bay is more or less land locked sea, while the Gulf of Mannar is more open. The inshore region of Palk Bay is mostly muddy while the Gulf of Mannar inshore region is full of rocky patches with small areas of sand and mud in between. There is Margarita shoal located on the Indian side of Adams Bridge adjacent to which is the Mansfield patch and Batt patch, Manalli shoal, Arundel shoal and the chain of 21 islands in the Gulf of Mannar. The gaps between adjacent islands establish continuity of waters between deeper portions of the sea. Enormous quantity of materials will have to be dredged and dumped for the creation of the navigational canal in addition to the periodical dredging, for maintenance. The realigned Sethusamudram canal is only 3 Km away from the Srilankan boundary and cuts across Adams bridge starting from Tuticorin to a total distance of 260km extending into the Palk Bay for a depth of 12.8 m.

b. Current pattern of the region

The currents are monsoonal in character. Away from the coast in the southern part of the region, the predominant current is southeasterly from May to the end of September (the south west monsoon) the average rate being highest (about 0.5Knot) from June to August. In December and January predominant current is west to west-southwest average rate 0.5Kn. In October and from February to the end of April the currents are variable. During the south West monsoon there is a branching, towards the Northeast, from the northern flank of the general southerly flow across the entrance to the gulf. This continues as Northerly flow through the narrow channels connecting the northern gulf with Palk Strait.

In December and January (North East monsoon) the flow is southward through these channels which implies a mainly southerly flow across the gulf turning more westerly as in the more open waters in the south. In Pamban pass the current sometimes reaches 5-6Kn. The currents may on occasions be markedly different from these average conditions and rate up to 2Kn may occur with prolonged strong winds. (Naval hydrography office chart, 1982). Dredging of the canal may cause changes in, current pattern as well as change in migrating pattern of marine resources.

Most likely impacts of dredging

The effects of dredging are highly site specific depending on type (mud, sand or gravel and organic matter) and quantity of dredged material disposed whether on land or in sea. In addition the shore line configuration (embayed or open), wave energy and offshore slope, rate of sea level rise, type of benthic habitats and their susceptibility to sedimentation and potential for- sediment dispersal (types of water motion). The most likely general responses will be:

1. Higher water column turbidity and increased sediment trapping in estuaries.
2. Shoaling and increased navigational hazards in tidal inlets and river entrances.
3. Destruction of Mangroves, coral reefs, algal and oyster communities due to high concentration of suspended sediment.
4. Change in offshore profile and shelf transport processes.
5. A shift in current pattern my create condition of extremes in salinity and temperature than now prevalent.
6. Reduction of tidal channels and grass flats will reduce the areas available for many fish.
7. Scouring and redistribution of bottom material will take place. Recolonization of the affected area will depend upon the rapidity with which currents stabilize the bottom conditions.

Conclusion

Reduction in the size of the sand dredging area, limiting the mud disposal rate, limiting the overall dredging rate and restricting the type and number of dredgers permitted within the main navigation channel would help minimize and mitigate adverse impacts to acceptable level. If material placement can be planned to be analogous to natural events then community responses will follow natural seasonal and successional trends. When sedimentation exceeds natural thresholds, ensuing impacts will likely involve total loss of the community and subsequent colonization by pioneer species. Thus an entirely different suite of ecological processes will drive impacts and recovery, potentially leading to dramatically altered benthic communities. Unfortunately there is little quantitative information vital for predicting how material placements will affect ecology of these environments. We need to determine what rates and frequencies of sediment movement are natural events and further, what rates and frequencies are detrimental to various marine resources. A wide variety of factors affect the carrying capacity of a water body (water quality, nutrient cycling, turbidity, hydrodynamic regime, primary and secondary production) and these must be considered with respect to the proposed dredging of the canal. In addition to this site specific data on depth, current flows, wave action and other hydrodynamic properties should necessarily be periodically monitored even during dredging, for a full impact assessment.

References

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