FACTS ABOUT

Dredging Around Coral Reefs

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What are Coral Reefs?

Coral Reefs are large, long-lived bio-geological structures that include all associated plants and animals. They are marine ridges or mounds formed from the deposition of calcium carbonate by living organisms, predominantly hard corals, but also by other organisms such as coralline algae and shellfish.

Specifically, coralline algae are *marine algae*, or seaweeds, that deposit calcium carbonate, thus contributing to Coral Reef formation. Corals are particular *marine animals* that are characterised by polyps; they are predominantly colonial and they secrete a calcium carbonate skeleton. Corals exist as a variety of species, some of which have symbiotic relationships with algae, making them dependent on sunlight as well as on filter feeding to meet their energy requirements. They can develop distinct growth forms including branching to digitate (finger-like), foliose (plate-like), encrusting, massive (boulder-shaped), and mushroom shapes. Different forms and species have different characteristics which affect where the corals are found, how they react differently to stress which, for instance, affects how fast they grow.

Although Coral Reefs are robust and have often withstood the forces of storms, climatic change, sea level change and predators, the living elements – coral, coralline algae and shellfish that build these structures – are just a very thin veneer of delicate tissue, highly sensitive to the surrounding environment.

Why are Coral Reefs important?

Healthy Coral Reefs provide an array of services to human communities, including food (especially protein), protecting shorelines, supporting the livelihoods of local communities, such as fishing and tourism and sustaining cultural traditions. In contrast, unhealthy or degraded Coral Reef systems can be linked to a decline in natural resources upon which local people are dependent, an increased vulnerability in the coastal area and loss of cultural traditions. One estimate puts the economic value of the world's coral reefs at € 265 billion (US$ 350 billion) per year. In contrast the cost of damages and cost for restoration of Coral Reefs has been estimated to be in the order of US$ 1,000 per m^2.

Where are Coral Reefs found?

Globally, Coral Reefs occur in two distinct marine environments: Deep, cold water (3 to 14°C), and shallow, warm water (21 to 30°C). So far, cold-water corals have been identified in 41 countries at a prevailing water depth greater than 39 m. Warm-water Coral Reefs form in the shallow, clear seas of the tropics with an essential combination of low nutrient waters and high levels of available sunlight. Although warm-water Coral Reefs cover just under 0.1% of the ocean floor, their location often overlaps with preferred port locations.

Why study the interaction of Coral Reefs and Dredging?

One third of the world's population lives in coastal areas, where rapid development has meant increased construction of coastal infrastructure such as ports, waterways, coastal defences, land reclamation and beach nourishment. This has inevitably led to conflicting priorities between Coral Reef conservation and economic growth. The concern is that development of waterways, ports and harbours can lead to the direct loss of Coral Reefs caused by the removal or burial of reefs, as well as through stress to corals caused by elevated turbidity and sedimentation during dredging and actual operation of the ports. This concern raises several questions: Are these negative effects to Coral Reefs immediate or will they develop over a longer time frame? Are they temporary or permanent?

To answer these questions, the impact of dredging projects on this sensitive and valuable resource must be systematically evaluated, and careful consideration must be given as to how to monitor these impacts and, ultimately, how to avoid or mitigate them.

Why is it difficult to dredge near Coral Reefs?

Limestone and coral materials tend to break into extremely fine particles when dredged. This creates milky white "clouds" of suspended sediments and these "clouds" of fine sediments can stay in suspension for a long time, spreading over a large area and often causing increased sedimentation. Because they result in significantly reduced light

penetration, even in low concentrations, they can impact corals over a wide area. For this reason, it is critical to avoid or at least to minimise the dredging of coral rock.

How and when does dredging impact Coral Reefs?

Impacts can be divided into:

- *Project impacts:* These are associated with the developer's decision on the location and layout of a project (e.g., direct loss of Coral habitat within the project footprint). The mitigation of project impacts is firmly rooted in the Planning and Environmental Impact Assessment (EIA).
- *Process impacts:* These are associated with the physical construction of the port, including dredging, breakwater construction and land reclamation, e.g., turbidity and sedimentation impacts. The mitigation of process impacts is associated with effective management of the construction process (e.g., the choice of equipment and operating policies).

The severity of impacts is directly related to the magnitude, duration and frequency of impacts. These impacts may be "lethal", causing mortality and changes in species composition; or they may be "sub-lethal", that is, they may cause (temporary) stress resulting in reduced growth rate, bleaching and reduced reproductive performance of the corals.

Do all Corals suffer when dredging impacts them?

The responses of different hard coral species vary widely and seem to be partially related to the growth forms of the coral. Branching corals, which usually grow vertically, tend to be sensitive to turbidity, but tolerant to sedimentation. Plate corals, which usually grow horizontally tend to be sensitive to sedimentation but tolerate turbidity. Some coral species are able to change or adapt this growth form or actively remove sediments from their tissue, for instance, by producing mucous or by tenticular or ciliary action.

Vulnerability and recovery also depend on the coral ecological conditions. Are the Coral Reefs degraded or pristine? Are they dominated by algae, bio-eroders or reef-builders? Are the reefs resilient? And what are the ambient conditions?

If Coral Reefs suffer losses, are they permanent?

Frequent short-term exposures or chronic long-term exposure to sedimentation and turbidity will result in mortality for many coral species. If moderate levels of impacts on a Coral Reef persist for particularly long periods of time, the Coral Reef may undergo changes in diversity, with more sensitive Coral species gradually being replaced by more tolerant ones. This may result in an overall reduction in the biodiversity of the Coral Reef. The risk and severity of impacts from dredging and port construction-related activities on Coral Reefs are directly related to both the intensity and duration of impacts causing stress.

Can Coral Reefs be preserved and protected during dredging?

Most recently, experts from PIANC and UNEP have joined forces to explore this subject. Working together, the United Nations Environment Program (UNEP) and PIANC EnviCom Working Group 15 have developed guidelines for the implementation of best practice methodology in environmental assessment and environmental management for dredging and port construction activities around Coral Reefs and their associated communities.

Whilst the Working Group recognises that knowledge gaps still exist and that the methods for monitoring and mitigating unwanted impacts on corals and associated organisms and ecosystems still need improvement, experience has shown that by adopting sound planning, impact assessment, monitoring and management practices, large benefits can be achieved in terms of avoiding or minimising adverse effects on the Coral Reef environment from dredging and port construction.

How can sound strategic planning protect Coral Reefs?

Impacts can be minimised by planning ahead. An initial risk assessment based on available secondary data, initial field surveys, preliminary numerical modelling and an understanding of local and regional coastal processes should be conducted in conjunction with Coral Reef and impact assessment specialists. If possible stakeholders should as well be involved. This will help determine the level of impact assessment that will be required and identify potential impacts for early mitigation during the design phase.

A key issue in the planning phase is an assessment of alternative locations and layouts that minimise the "direct" impact of a project's footprint on Coral Reefs. In addition, considering the potential for a wide range of "indirect impacts", such as current patterns, wave conditions, sediment transport, shoreline stability, is also critical as these can be difficult to mitigate.

Also in the planning stage, periods of high risk – such as cyclone/hurricane seasons or periods of high water temperature and sensitive phases of the life cycles of Corals,

One means of mitigating impacts to sensitive Coral Reefs is to relocate the coral prior to commencing dredging operations in the area. This can be costly and should not be seen as a substitute for prevention or mitigation.

such as spawning – should be identified. In addition, areas designated for protection under national or international legislation should be recognised. This kind of early consideration during the initial planning phase can prevent or minimise impacts to corals, expedite the approval and permitting processes, and minimise the requirement for time-consuming and costly monitoring and management programmes before, during and after the project.

What are key activities that should be undertaken during the planning process?

Decision-makers need to consider environmental impacts before deciding whether to proceed with a new project. Part of the process of doing this is the use of an Environmental Impact Assessment (EIA), which can identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management and monitoring measures. The EIA supports planners with certainty that they are complying with local and national legislation, and international guidelines or treaties formulated by, for instance, the World Bank and the Equator Principles. Obtaining relevant and accurate baseline data about the Coral Reefs in the potential project area is essential to ensuring the safety of the Coral Reefs.

How can impacts to Coral Reefs be mitigated and/or compensated?

Where impacts to the Coral Reef cannot be prevented, a number of mitigation techniques are available. Most of these aim to reduce the sediment release and thus reduce turbidity and sedimentation. If mitigation cannot reduce impacts to an acceptable level, compensation measures may be required to offset the impacts. For instance, in some cases, larvae can be reproduced and released at affected areas. Or adult or juvenile corals, or fragments of corals, can be collected from natural, high density coral areas and transplanted. Although these compensation methods have occasionally been successfully applied they should not be seen as a substitute for prevention or mitigation. They are only a supplement to best practice prevention and mitigation.

Can Coral Reefs recover from impacts during dredging?

The main process impacts from dredging and port construction (turbidity and sedimentation) stop once the project is completed. If environmental conditions then return to the pre-impact situation, timescales for natural recovery of Coral Reefs are in the order of a few years to several decades, with recovery times depending on the types of species affected, the scale of impact, and recruitment potential. In general, corals *may* recover from short-term acute disturbances, but *not* from long-term chronic disturbance, which means that taking the utmost precautions when planning and executing a dredging project in the vicinity of Coral Reefs is absolutely critical.

What best technical practices can be used to prevent, minimise, mitigate and/or compensate impacts, when dredging near Corals Reefs?

Best technical mitigation practices include, for instance, the proper type of dredging equipment, control over leakage, sediment spill and propeller wash, the use of an environmental

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valve, relocating the dredger when necessary and conforming with environmental "windows". Compensation measures may include the transplantation of coral colonies or fragments as mentioned above. In all cases when dredging near Coral Reefs, an Environmental Management Plan (EMP) should be developed and implemented.

What is an EMP and how can it help?

As part of the EIA, a Draft Environmental Management Plan (EMP) should be prepared, and incorporated into the construction tender documents. Once the Contractor is appointed and project layout, methodology and timing are finalised, a review should be conducted to ensure the project still falls within the "environmental envelope" of the EIA. As there is usually a gap between the EIA and the start of work, additional surveys are often required to establish the EMP baseline. Therefore, the EMP must be updated by the EMP consultant in consultation with the dredging contractor on behalf of the developer during the entire lifecycle of the project.

Common baseline survey components with respect to corals include monitoring of: light attenuation and /or turbidity; sedimentation; the health of the Corals, for instance, hard coral cover, growth rate and photosynthetic efficiency; the quality of the water such as dissolved oxygen, temperature, and nutrients; and the Met-ocean ("meteorology and oceanography") conditions such as currents and waves.

Can monitoring help protect Coral Reefs?

Monitoring before, during and after a project near Coral Reefs can help quantify risks. Monitoring can confirm that a project is meeting/ has met the agreed levels of impact and that the predictions of impacts during the EIA have been accurate. When monitoring indicates that impacts are being exceeded, timely action can be taken.

By following an adaptive management process, dredging and port construction near Coral Reefs can be managed in such a way that maximum productivity can be maintained – whilst still meeting environmental protection criteria. To develop an effective environmental monitoring and management programme, the environmental receptors in the Coral Reef area as well as the impacting processes that may affect each receptor must be identified. The monitoring programme must be designed to ensure that the monitoring will be able to isolate and distinguish impacts of the project from other external (natural or human) impacts.

To create a successful dredging project in a sensitive Coral Reef environment demands that all parties involved work with transparency, with a clear understanding of the issues, and with a management plan that allocates responsibilities. In this way, potential impacts may be avoided and, when necessary, the contractor and consultants can respond adequately to significant non-compliance events, in the event of external impacts, unforeseen developments or in response to stakeholder requirements.

For further reading and information

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This brochure is presented by the International Association of Dredging Companies whose members offer the highest quality and professionalism in dredging and maritime construction. The information presented here is part of an on-going effort to support clients and others in understanding the fundamental principles of dredging and maritime construction.

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