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Policy and management brief 1: Impacts and mitigation of sediment pollution on coral reefs.

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Appendix A2.1

Brief 1: Impacts and mitigation of sediment pollution on coral reefs

Sediment pollution is a known source of stress to coral reefs. Throughout the tropics there are numerous cases where sediment pollution has killed or damaged reefs. Sediment pollution sources include land that has been cleared for agriculture or development, coastal construction and dredging. Such practices are increasing in St Lucia as the island develops. In this brief, we examine the severity of sediment pollution effects on St. Lucia's coral reefs and describe management options for reducing pollution impacts.

KEY FINDINGS

Between 1997 and 2001, inputs of sediment pollution to coral reefs in the Soufriere Marine Management Area (SMMA) and at Anse La Raye were measured using an array of sediment traps at 14 different sites. Traps were emptied every two weeks over seven periods ranging from 2-6 months and encompassing both dry and rainy seasons. Monitoring sites were located in areas that differed in their exposure to river runoff.

Sediment inputs to traps were highest during times of heavy rainfall and greatest in sites close to river mouths. This indicates that most sediment pollution has a land-based origin and is carried into the sea via rivers during periods of high rainfall. There were also two large pulses of sediment input to traps near Beausejour and Anse Cochon when a coastal road was being built at Beausejour and a hotel was under construction at Anse Cochon. This shows that coastal development can also make a significant contribution towards sediment pollution. Coastal projects, such as the road to Jalousie and the rock armour at Soufriere's waterfront, will also have increased sediment loads but they took place outside monitoring periods.

Within the same stretch of coastline where the sediment traps were established, 23 sites were monitored annually between 1995 and 2001 for coral cover and other bottom-living organisms. During this period reefs have been seriously degraded, with cover falling from an average of 40% in 1995 to 18% in 2001. This represents a relative loss of 55% of the coral that was present at the establishment of the SMMA. Losses of coral cover can be attributed to storms, sediment pollution and coral diseases. Hurricane Lenny in 1999 was particularly destructive and was responsible for relative losses of 44% coral cover in shallow water and 29% deeper down.

In addition to causing direct damage, storms with heavy rainfall can also generate large quantities of sediment which is very damaging to corals. Sudden storm-related inputs of sediment can kill corals directly by smothering them. Smaller quantities of sediment released over longer periods can also be extremely damaging because of the chronic stress they cause to corals. This happens because sediment pollution interferes with a coral's ability to feed itself. Corals derive their food from catching prey with their stinging tentacles and also by absorbing nutrients released from the plants (algae) that live within their tissues. Before they can use their tentacles to hunt, corals must first remove any sediment that has fallen on to them, and this costs energy. Their source of algal food is compromised because sediment in the water reduces the amount of light present and so diminishes energy production by plants in the coral tissue. This means that less food is transferred from the algae to the coral.

Over the period 1996-1998, a time when storm disturbances were slight, it was possible to estimate direct damage from sediment to St Lucia's reefs. Sediment impacts accounted for loss of 3% of coral cover in shallow water but 19% of cover at 15m deep. However, these are average figures, which take into account sites where there is little sediment pollution. In areas that were most badly affected by sediment inputs – sites close to rivers – more than half of the coral cover has been lost since 1995.

Throughout the SMMA, there is clear evidence that adult corals are continually suffering from sediment pollution. Rates of partial mortality in two species of coral that are important reef-builders were significantly greater around river mouths where sediment loads are highest. And in the places where partial mortality was highest, so too were coral death rates. This illustrates that sediment pollution is not only stressing St Lucia's corals, it is killing them.

A further hazard of sediment on coral reefs is that by smothering hard surfaces it can affect the ability of reefs to replenish themselves. Adult corals release eggs or larvae into open water, which then disperse, settle to the bottom and grow. Juvenile corals need to settle somewhere solid. In order to test whether sediment pollution is affecting replenishment of corals on St Lucia's reefs, artificial settlement plates were set up throughout the SMMA at depths of 15m in areas with high and low levels of sedimentation. From this experiment, sediment did not appear to be depressing overall levels of coral settlement onto artificial plates, but it did influence the species composition present. However, when juvenile corals on the reef itself were studied, sediment did reduce settlement and growth rates and increased rates of partial mortality and overgrowth by other organisms.

There is no doubt that sediment pollution is having direct negative effects on both adult and juvenile corals in St Lucia. It is a major cause of reef degradation around the island. By causing chronic stress to corals it is also likely to be reducing the ability of reefs to recover from natural impacts such as storms or outbreaks of disease, several of which were recorded over the study period. This is particularly serious, because storm impacts are a recurrent natural phenomenon and cannot be managed. If reefs are to persist, they need to be maintained in a healthy, resilient state. This means that sediment inputs must be reduced.

MANAGEMENT OPTIONS

The main sources of sediment to St. Lucia's reefs are easy to find. They include soil erosion and runoff from agriculture, land clearing for development, especially on the coast, dredging, coastal defence works, and clearing of vegetation from roads and gardens. At present there is little monitoring or management of most of these sources. Inputs are growing as the island becomes more developed. If St. Lucia is to sustain the quality of its coastal environment, and protect its valuable reef assets these sediment sources will have to be controlled.

What can be done to reduce sediment inputs?

1. Increase **public awareness** of the problem and show ways in which individuals can help reduce soil loss. These include:
    - Avoid cutting back vegetation to ground level
    - Ensure access roads are sealed with tarmac, concrete, or rock
    - Avoid repeated filling of potholes on unsealed roads with loose soil
    - Keep road verges vegetated
    - Minimize areas of bare soil in gardens

2. Enact policy changes within agencies and departments. Key actions include:

    - When clearing road verges, cut vegetation to above ground level rather than exposing soil
    - Implement vegetated buffer zones around storm drains, ditches and rivers

3. Develop new national legislation. Key steps include:

    - Require environmental impact assessments that explicitly address sediment pollution for all new land-based and coastal developments, land changing activities, coastal protection measures and dredging.
    - Require sediment control measures to be an integral component of all of the above activities (models of such legislation can be found elsewhere in the Caribbean such as the U.S.Virgin Islands).

4. Reduce soil loss from farms. Measures could include:

- Continue and support development of soil and slope vulnerability maps in St. Lucia to identify places that should not be farmed. Legislate to prevent farming on unsuitably steep slopes and vulnerable soils.
- Develop riverine vegetated buffer zones, including agro-forestry.
- Work to improve soil conservation measures used on farms and small-holdings. Develop incentives for their use.

5. Continue monitoring rates of sedimentation around coastal areas of St. Lucia.

- Continue and support monitoring of sediment loads being undertaken by the SMMA
- Consider expanding the scope of the work to look at sediment composition (terrestrial versus marine origins), organic matter in sediment and levels of suspended particulate matter. Consider using fluorescent tracers to identify suspected sources of sediment on land. In addition, studies of hydrology, marine circulation and water movement could link terrestrial sources to site of deposition.

Conclusions

Tackling sediment pollution is critically important to St. Lucia. Prospects for tourism growth are closely tied to the quality of the environment, especially coastal areas. The economic prosperity of fishers and those dependent on the tourism industry depends on maintaining beautiful and rich environmental assets. Coral reefs are the jewel in St. Lucia's environmental crown. The quality of life and livelihoods for St. Lucia's people will fall if environmental degradation continues. Tackling sediment pollution deserves to be a matter of high national priority. The solutions to sediment pollution are not difficult and will not be particularly expensive or involve great sacrifices. But implementing them will take great commitment.