

CHAPTER 3. ESTIMATING HUMAN THREATS TO CORAL REEFS: THE REEFS AT RISK INDEX



Across Southeast Asia, monitoring capacity varies widely among countries, resulting in uneven and often incomparable information about reef conditions.¹⁴ The RRSEA model aims to create standardized indicators that raise awareness about threats to coral reefs, identify areas most at risk, and highlight the linkages between human activity and coral reef condition.

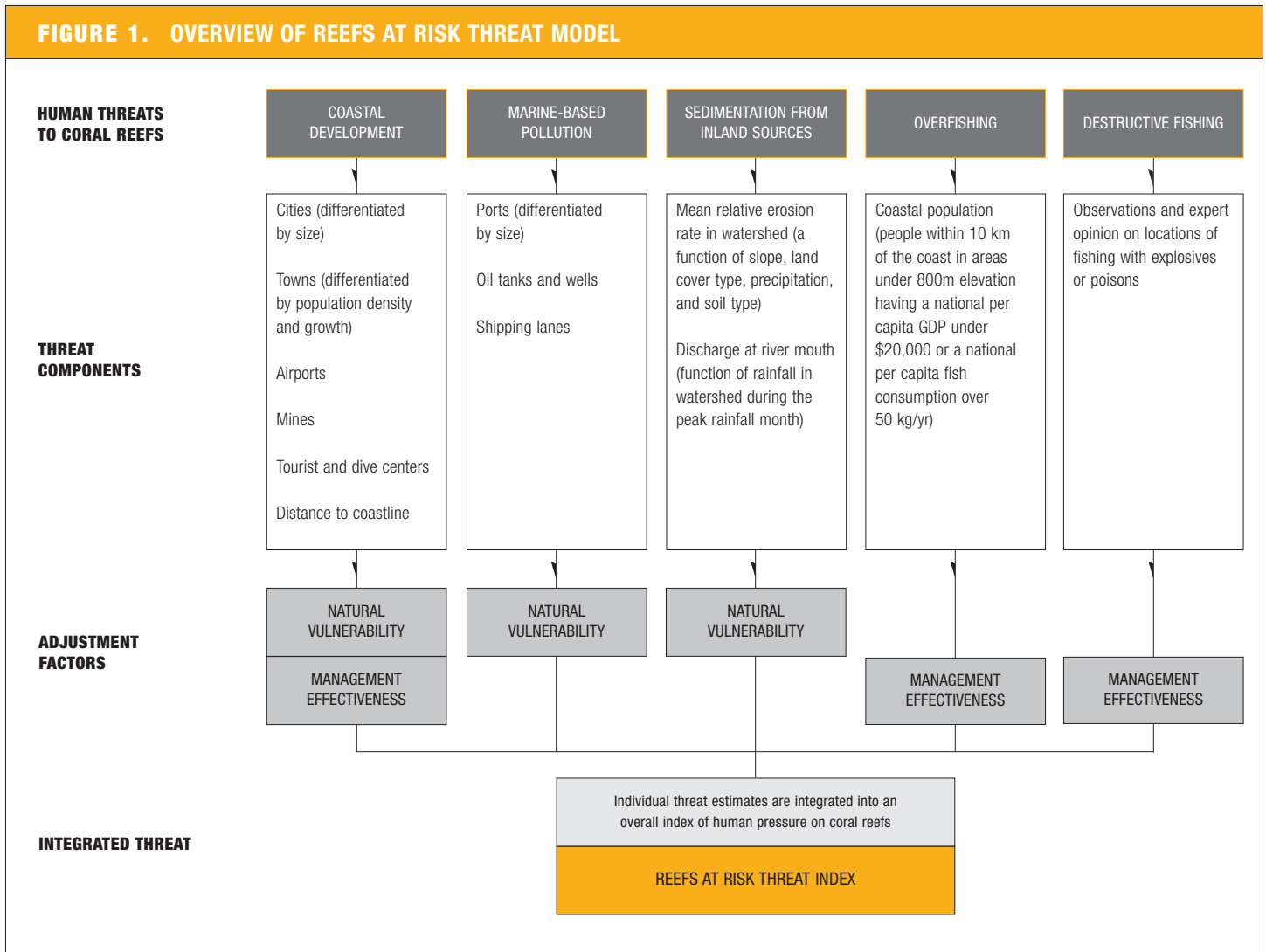
PRINCIPLES

The model produces map-based indicators of human pressure on coral reefs from five broad categories: coastal development, overfishing, destructive fishing, marine pollution, and sedimentation and pollution from inland activities. The modeling approach involves identifying component sources of stress that can be mapped for each threat category. These “stressors” include simple population and infrastructure features such as cities, ports, and oil rigs as well as more complex modeled layers of riverine inputs. Once these components have been selected, model rules are developed for translating them into measures of threat. These guidelines typically involve the development of distance-based rules by which the level of threat

declines with distance from the location of a stressor. Each threat estimate for the five categories is developed with considerable input from scientists in the region and is calibrated against available information from observed impacts to coral reefs or from satellite imagery. With some variation, this process is similar for each of the five threat categories. (*Figure 1 provides an overview of the threat categories and stressors. See Appendix 1 for more details on the modeling methodology.*)

The RRSEA model accounts for the effects of management and incorporates natural features that influence how human pressures impact coral reef ecosystems. Natural features such as depth, degree of embayment, fetch, and tidal range that affect flushing rates were integrated into the model to estimate how

FIGURE 1. OVERVIEW OF REEFS AT RISK THREAT MODEL



susceptible a reef may be to pollution or sedimentation. The threat estimates for coastal development, marine-based pollution, and inland pollution and sedimentation were adjusted for natural vulnerability. Similarly, the threat estimates for overfishing, destructive fishing, and coastal development were adjusted to take into account how effective management mitigates those threats. The threat estimates from the five adjusted threat indicators were then combined to create a map of integrated threat for the region—the Reefs at Risk Threat Index.

The index is designed to highlight areas where, in the absence of good management, coral reef degradation might be occurring or where it is likely to happen in the near future given ongoing levels of human activity. The index provides a regionally consistent indicator of human pressure on coral reefs that serves as a proxy guide to coral reef condition across Southeast Asia.



Scientists and managers from across the region contributed to the RRSEA database and model development.

PHOTO: UNIVERSITY OF THE PHILIPPINES, MARINE SCIENCE INSTITUTE



Sewage discharge from a coastal development coupled with intense visitor pressure have killed large sections of this reef.

LIMITATIONS

Pressures associated with elevated sea-surface temperature (SST) anomalies and coral bleaching have not been incorporated into the model. At this time, the data are too coarse and local heterogeneity is so strong that predicting the impact of SSTs on the condition of coral reefs is not possible. However, the general threats from bleaching are discussed in Chapter 4.

By their very nature, model predictions are not perfect. The RRSEA model is a simplification of human activities and complex natural processes. The threat indicators gauge current and potential risks associated with human activities, not actual reef condition. Consequently, the model relies upon available data and predicted relationships but cannot capture all aspects of the dynamic relationships between people and coral reefs across Southeast Asia. Reefs classified as low risk are not necessarily healthy. In fact, some scientists argue that all reefs in the region have already been adversely affected by human activity.¹⁵ The model inevitably underestimates threat in some areas and overestimates it in others. Because the model does not capture

threats from commercial overfishing, including trawling, and cannot predict sediment plumes in areas with small watersheds, it probably underestimates threat in these two categories. Some reefs classified as threatened may be relatively pristine owing to physical factors or management mitigation not identified in the model. For instance, all tourism centers or settlements of a specific size do not exact the same pressure, but the model treats them uniformly.

The picture of reef health in Southeast Asia is extraordinarily dynamic. New development projects are constantly underway. Land use in the region changes from year to year because of agricultural conversion, massive fires, and logging. The RRSEA analysis used regionally consistent datasets even when better national-level data were available in order to gain a more consistent regional portrait. The maps presented in this report are only static images of the pressure on reefs. Conditions on individual reefs may be different from the threat presented on the maps.