

CORAL REEFS IN AMBON BAY (INDONESIA) NEED SUSTAINABLE MANAGEMENT (Insights from 40 years of monitoring)



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Ambon Bay (Maluku, Indonesia)

INTRODUCTION

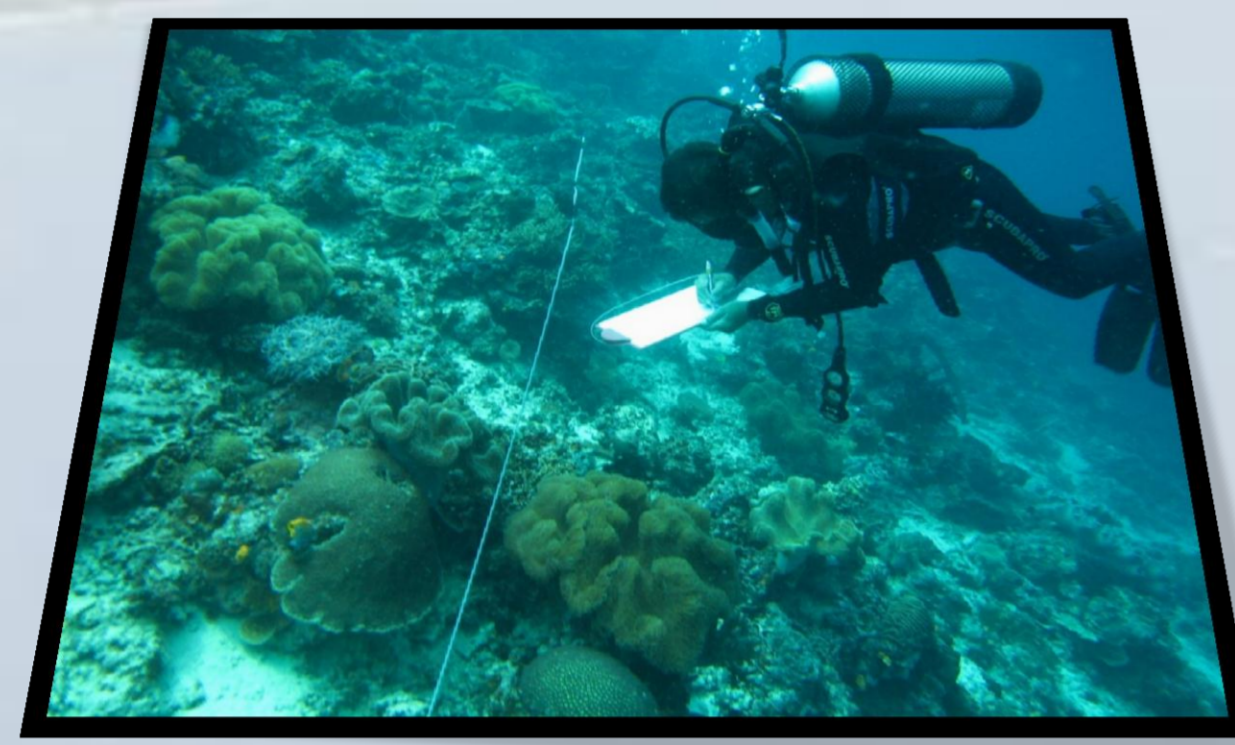
Ambon Bay is a part of Ambon Island located in Eastern Indonesia. The bay has an area of 124.5 km², and consists of a shallow inner bay and a deeper outer bay. These two parts of Ambon Bay are linked by a narrow channel (0.8 km long and 0.6 km wide). In Ambon Inner Bay (AIB), the deepest water is around 42 m, while in Ambon Outer Bay (AOB), it is at least 600 m, and the channel has variation in depth, 9-13 m.

Coral reef forms a key ecosystem along the coastal area of AOB and to a lesser extent in AIB. We have monitored the condition of coral since 1985 (1). We found 85 species in AOB, and 43 species in AIB. Flaviidae, Poritidae and Acroporidae were categorized as dominant coral families. The overall condition of corals in AOB was healthier than in AIB.



MAIN OBJECTIVES

- To monitor the condition of coral reefs in Ambon Bay
- To identify the main problems related to decreased coral condition
- To recommend the implemented strategies for coral reef sustainability

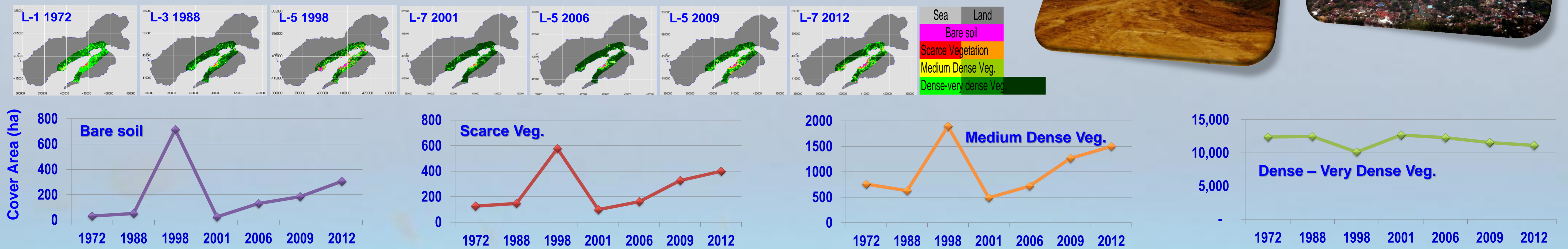


METHODS

- To monitor and evaluate the changes of upper-land areas, long-term Normalized Difference Vegetation Index (NDVI) derived using multi-temporal of Landsat satellites remote sensing data were used, $NDVI = (NIR\ band - Red\ band) / (NIR\ band + Red\ band)$, NIR = Near infrared. The NDVI was analyzed only 5 miles from the coast line of Ambon Bay (2).
- To examine the condition of coral reefs, a 50 m line transect was applied (3) at 7 sites along the coast of Ambon Bay (4).
- To describe water quality (suspended solids, chlorophyll-a concentration, water transparency, Trophic State Index) we used a standard sampling procedure and combined this with Landsat satellite data.

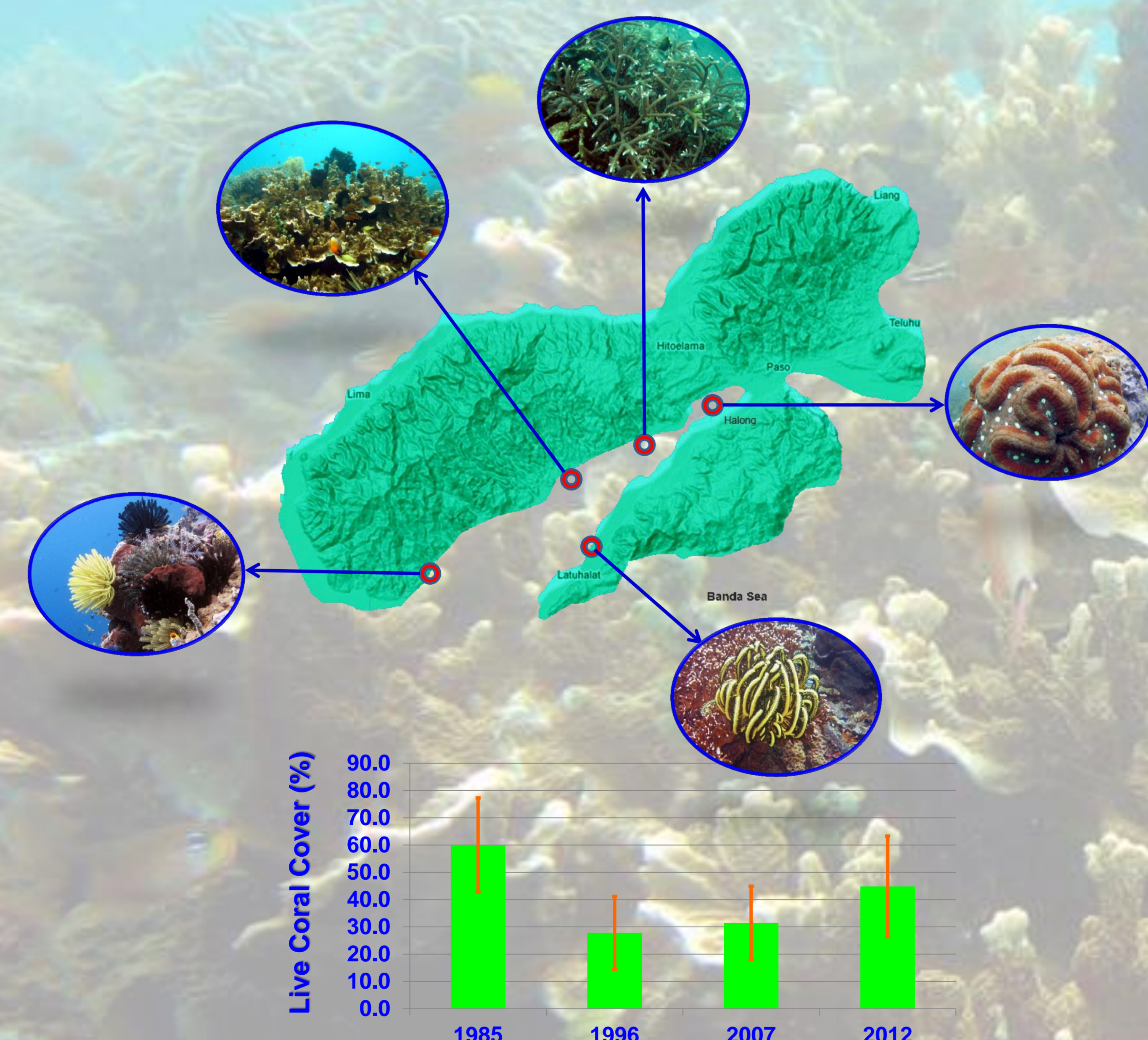
MAJOR FINDINGS

Vegetation Index of Ambon (1972-2012) derived using Landsat Satellites

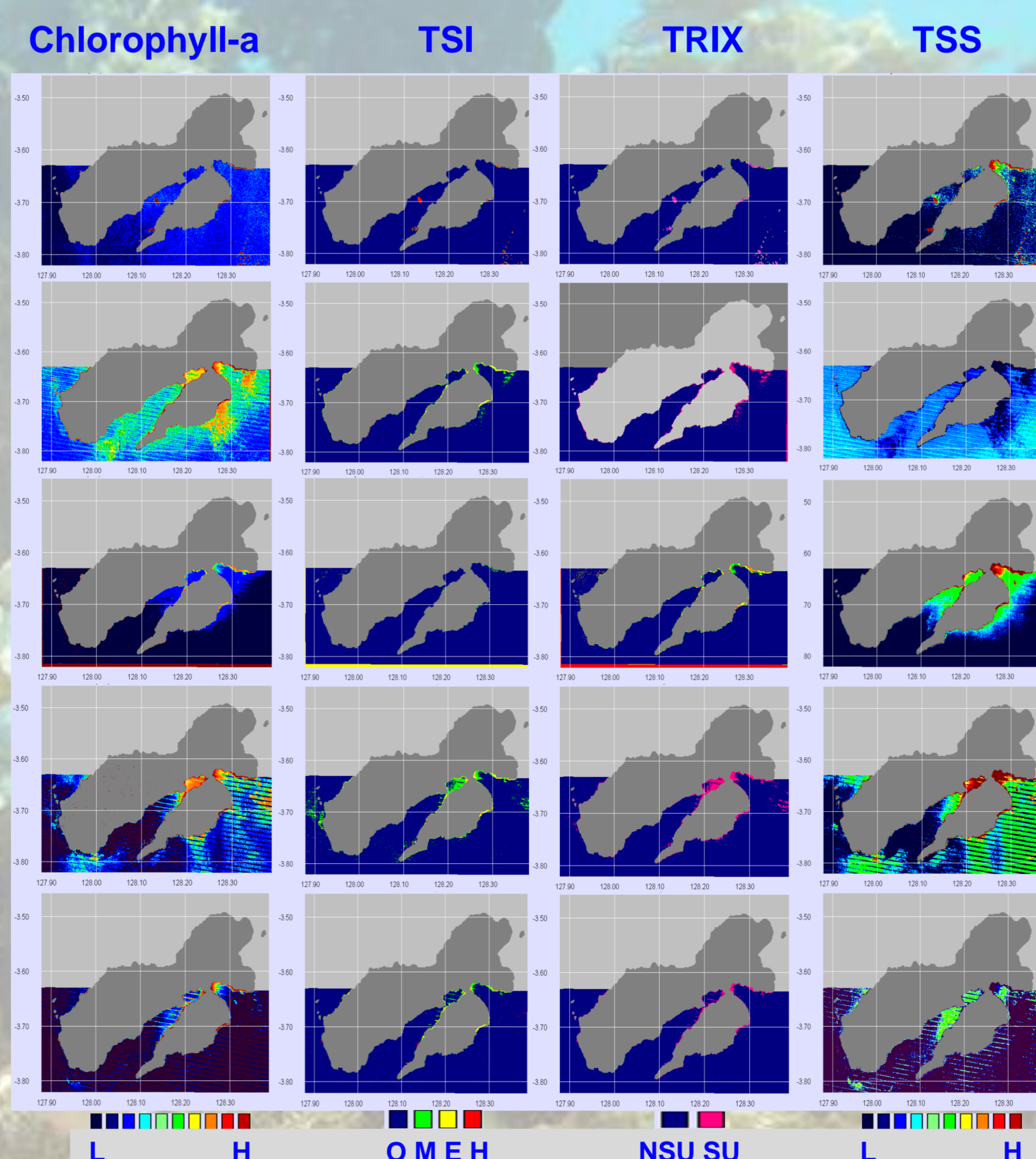


Long-term vegetation index from 1972 to 2012 (40 years) of the upper-land of Ambon showed two distinct periods of land cover changes. The first period from 1972 to 1998, the bare soil increased from 31.2 ha to 714.2 ha, while the dense vegetation decreased from 12,389.3 ha to 10,119.9 ha. In 2001, the land cover recovered slightly (bare soil was only 24.6 ha and dense vegetation was high at 12,691.7 ha). This was due to less human activities inland as a result of social conflict between 1999 and 2000. The second period of land cover changes (2001 to present) as the bare soil area gradually increased again from 24.6 ha (2001) to 305.2 ha (2012), while the dense vegetation decreased from 12,691.7 ha to 11,124.3 ha.

Coral condition in Ambon Bay (1985-2012)



Coral reef monitoring in 1985, 1996, 2007 and 2012 indicates that coral condition over the last 30 years has gradually declined from excellent / good to bad. In 1985-1996, the average live coral cover decreased from 60% to < 30%, and in 1996-2012, it has increased steadily to 44%. Overall, the coral in good condition was only 6%, fair (15%), bad (79%), while no corals here in excellent condition.



Water Quality in Ambon Bay:

The water quality (WQ) including chlorophyll-a concentration, TSI, and TRIX indexes monitored using multi-temporal of Landsat Satellite data (1972-2010) tended to show a decrease. The WQ derived from chlorophyll-a data and total suspended solids (TSS) showed that in 1972-1991, the WQ was in good condition. However, since early 2000, eutrophication has tended to occur in this bay, especially in AIB. This was indicated by an increase in chlorophyll-a concentration, TSI and TRIX indexes. The TSI Index showed the changes of WQ from oligotrophic (1972-1991) to mesotrophic (2006-present), while TRIX index showed an evidence of strong eutrophication in this bay. The TSS also has increased since 2006. Therefore, the WQ of Ambon Bay will likely deteriorate further without better management.

L: Low, H: High, O: Oligotrophic, M: Mesotrophic, NSU: eutrophication not occurred, SU: Strong eutrophication.

CONCLUSION

Long-term monitoring on the upper-land of Ambon shows that human activities such as land clearing has had a destructive impact not only the upper-land itself, but also the coastal ecosystem along Ambon Bay. Evidence of the impacts from those activities have been identified, demonstrating the need for sustainable management to recovery upper-land environments as well as coral reef ecosystems.

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