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Modelling complex terrain of reef geomorphological structures in Harapan-Kelapa Island, Kepulauan Seribu

Tarlan Subarno*, Vincentius Paulus Siregar, Syamsul Bahri Agus, Adriani Sunuddin

Department of Marine Science and Technology, Bogor Agricultural University, Kampus IPB Darmaga, Bogor 16680, West Java, Indonesia

Abstract

Detail and accurate information on reef geomorphology structure feature as one significant factor for ecosystem based management of coastal and small islands resources. Most applications of remote sensing and GIS in coral reef studies were directed to map reef substratum and coverage of benthic habitats. The objective of this study was to analyze bathymetric dataset in order to classify reef geomorphology structure in Harapan-Kelapa Island, Kepulauan Seribu. Bathymetric data-set applied were, collated from WorldView-2 satellite and single-beam acoustic remote sensing using Mapsounder 585, examined using ArcGIS®, Benthic Terrain Modeler (BTM) to classify seabed environment into several geomorphology classes. Stepwise calculations of broad and fine Bathymetric Position Index (BPI) were applied into each grid, surficial characteristics of the seabed were analyzed according to several sets of scale-factor, and finally structures of the seabed were classified into 13 geomorphic classes.

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Keywords: reef geomorphologhy; seabed; Benthic Terrain Modeler (BTM); Bathymetric Position Index (BPI); Harapan-Kelapa Islands.

1. Introduction

Among other earth's surfaces, modern coral reefs feature as one of the most spatially heterogeneous in where ecological and geological processes interact across land and sea [1]. Being the only seabed feature can be observed from the outer space, detail and accurate information on reefs' geomorphology can easily be extracted from satellite remote sensing [2] and their interpretations would be important for reliable decision within environmental management context, due to various interactions between biophysical components, human activities and interferences took place

* Corresponding author. Tel.: +62-821-1475-6510.
E-mail address: allanawani@gmail.com.

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on, above, and surrounding them. Given the great variety of coral reef surface morphology, interpretation of reef geomorphology was mainly restricted into several zones only, for example reef crest, lagoon, reef flat, and reef slope [3]. Defining multiple spatial scales of biophysical features on coral reefs requires interpretive process of manually delineating seabed features using base map and combined with robust dataset, which traditionally obtained through laborious and time-consuming field observation. Landscape scale mapping with detail spatial elements of benthic assemblages may provide information on geomorphology structure at different reef zones [4,5], rugosity in relation to conservation measures [6,7], also multi-scale correlation between habitat and important reef resources or life-history processes [8,6]. Hierarchical and multi-scale approach in creating rich thematic maps can be grounded in geographic information system (GIS) with major advantage in allowing the use of integrated data set, both from optical and acoustic remote sensing, which was applied in this research. Benthic Terrain Modeler (BTM) is an efficient and consecutively improved geospatial toolbox for algorithm classification of seabed geomorphology developed by NOAA Coastal Service Centre and embedded in ArcGIS® since version 8.* [9]. Further application of BTM toolbox was applied for delineating critical habitats for fish spawning aggregation and marine reserves [8], particularly in American Samoa and Belize.

In Indonesia, such feature has been applied by Agus [9] for investigating reef benthic habitats and geomorphology in Panggang-Pramuka Island of Kepulauan Seribu, which resulted in association of several geomorphic classes with reef fish spawning habitats. In order to expand the importance of underwater geomorphological feature for application in environmental management, this study aimed to classify reef geomorphology structure in Harapan-Kelapa Island, Kepulauan Seribu, using integrated bathymetry data.

2. Methods

2.1. Study area

Harapan(2)-Kelapa(1) Islands are two islands positioned side by side in the northern region of Kepulauan Seribu. There are three islands which surrounded in Harapan-Kelapa Islands (Kelapa Dua Island (3), Panjang Island (4), and Kaliageh(5)). Field data collection and analysis was conducted from March to June 2015. Fig. 1 showed the location of field survey with the corresponding islands.

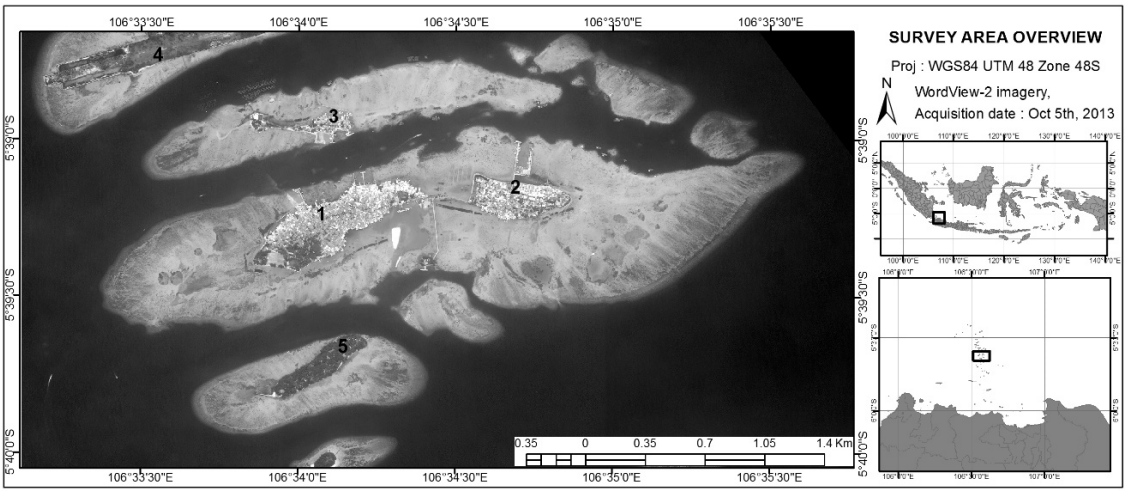

Fig. 1. Map overview of survey area.