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## Research Article

# A model of a digital biological ecosystem

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SARINDER KAUR DHILLON<sup>1,2\*</sup>, S.L. CHIEW<sup>1</sup>, L.K. LEOW<sup>1</sup>, AMANDEEP S. SIDHU<sup>3,4</sup>, N.I. SHUHAIMI<sup>1</sup>,  
Y.M. LEONG<sup>1</sup> & V.C. CHONG<sup>1,5</sup>

<sup>1</sup>Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia

<sup>2</sup>Center for Tropical Biodiversity Research, University of Malaya, Kuala Lumpur, Malaysia

<sup>3</sup>Curtin Sarawak Research Institute, Curtin University, Sarawak, Malaysia

<sup>4</sup>Faculty of Health Sciences, Curtin University, Perth, Australia

<sup>5</sup>Institute of Ocean & Earth Sciences, University of Malaya, Kuala Lumpur, Malaysia

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In this paper, we propose a model of a digital biological ecosystem of fish. Collections of fish data by scientists in Malaysia have been converted and developed into a digital biological ecosystem using computational technology and methods. We used a combination of Geographical Information System, databases and ontologies for storing, retrieving and visualizing fish species distribution and their abundance as well as their relationship with the environment. We used ArcGIS to build the fish and environmental geodatabase, which is linked to Google Earth for real-time visualization, and Surfer 8 to create contour maps which are superimposed as layers on the ArcGIS interface. Individual fish species on the map are hyperlinked to the FishBase Portal (<http://www.fishbase.org/>) while the published map is displayed using ArcReader. The three databases that we created contain information about fish species, environment and contours. These are also integrated using a fish ontology which will link all the available information for various fish species. The proposed system can be adopted by marine scientists to better convince economists, fishery managers, coastal developers and government bodies who make important decisions on conservation policies and laws.

**Key words:** digital biological ecosystem, fish species, Geographical Information System, Matang waters, ontology

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## Introduction

A typical biological ecosystem constitutes of living organisms and non-living elements interacting in a networked system. In a typical natural marine ecosystem, for example, we have fish, prawns, zooplankton, phytoplankton, mangrove and other organisms surviving due to their interactions with the environment. Without a network of these interactions, the organisms will not survive. Similarly, in the age of information communication technology, we now have digital ecosystems that have helped solve many problems especially in the business world. While digital ecosystems are prominent in business applications, here we have stretched the use of a digital ecosystem to model a biological environment. We model a digital ecosystem on biological data to create a user-friendly application for scientists. In this paper we propose a digital biological ecosystem of fish by converting the biological data collected by scientists using

computational technology and methods. [Figure 1](#) shows an example of a natural mangrove ecosystem in a coastal area. In this ecosystem, the living organisms have various harmonious interactions with the non-living elements for survival.

In this paper we present a digital biological ecosystem for storing, retrieving and visualizing fish species distribution and abundance. It will also analyse fish–environment relationships using ArcGIS, Google Earth and Surfer 8. ArcGIS 9.3 is used for building the fish and environmental geodatabases, which are linked to Google Earth for real-time visualization. Surfer 8 is used to create contour maps which are superimposed as layers on the ArcGIS interface. A fish species on the map is hyperlinked to the FishBase Portal (<http://www.fishbase.org/>) while the published map is displayed using ArcReader (Esri, 2012). In previous works, Geographical Information System (GIS) has been commonly used in environmental science for species distribution and prediction (Guisan & Zimmermann, 2000; Calamusso *et al.*, 2008; Zhang & Gruenwald, 2008; Meixler & Bain,

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\*Correspondence to: Sarinder K. Dhillon. E-mail: [sarinder@um.edu.my](mailto:sarinder@um.edu.my)