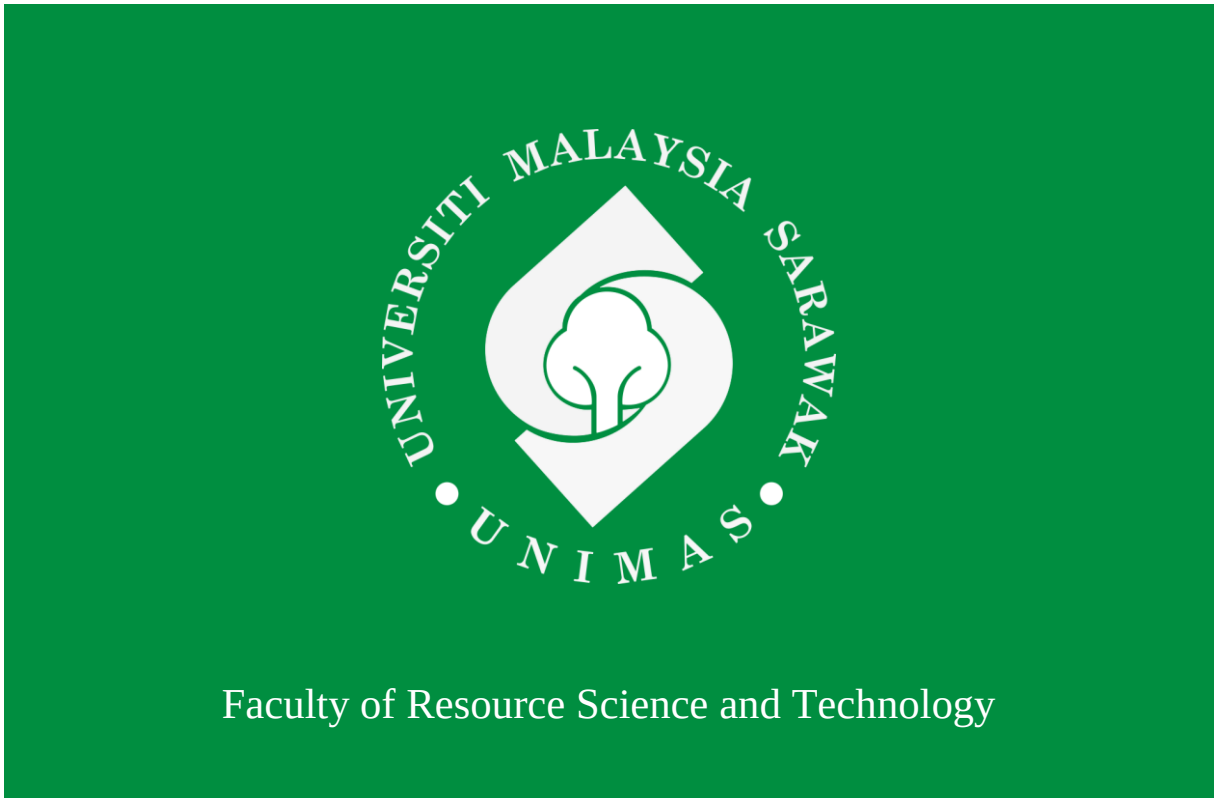

Water Quality and Vertical Profile of Katori Maru Wreck off coast of Santubong, Sarawak

Tan Xinh Guan

Bachelor of Science with Honors
(Aquatic Resource Science and Management)
2015

UNIVERSITI MALAYSIA SARAWAK

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WATER QUALITY AND VERTICAL PROFILE OF KATORI MARU WRECK OFF COAST OF SANTUBONG, SARAWAK

TAN XINH GUAN

This project is submitted in partial fulfillment of the requirement for the degree of Bachelor of Science with Honors
(Aquatic Resource Science and Management)

Department of Aquatic Science
Faculty of Resource Science and Technology
UNIVERSITY MALAYSIA SARAWAK

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

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DECLARATION

I Tan Xinh Guan 39065 of Faculty of Resource Science and Technology hereby declare that the work in this project is belongs to my original work. I have no copied from any other student's work or from any other sources with the exception where due reference or acknowledgement is made explicitly in the text, nor has any part of the work been written for me by another person.

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LIST OF ABREVIATION

SCUBA	Self-contain underwater breathing apparatus
SPG	Submersible Pressure Gauge
DO	Dissolved oxygen
BOD_5	Biological Oxygen Demand in 5 days
TSS	Total Suspended Solids
CTD	Conductivity-Temperature-Depth
GPS	Global Positioning System
m	meter
km	kilometer
nm	wavelength in nanometer
NM	nautical mile
PMSC	Premier Marine and Scuba Center
D#/T#	Depth #/Transect #; where # is number
D#	Depth#; where # is number represent stations in respective depth
T#	Transect#, where # is number represent stations along the transect

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Water Quality and Vertical Profile of Katori Maru wreck off coast of Santubong, Sarawak

Tan Xinh Guan

Aquatic Resource Science and Management
Faculty of resource Science and Technology
University Malaysia Sarawak

Abstract

The sunken Japanese cargo ship, Katori Maru is located approximately 30km off the coast of Santubong was sunk by the damage receive from the torpedo shot by Dutch submarine K-XIV during Christmas Eve 1941 during World War II. After several decades in the bottom of the seabed, Mother Nature has engulfed the sunken ship and transform to a living museum and an ecosystem for marine flora and fauna. Despite being a famous diving spot, no study has been documented. Hence this studies aim to document the water quality and the vertical profile of the Japanese shipwreck, Katori Maru. Standard method APHA is used to study the water quality and CTD casting is used to determine the vertical profiles. It is shows that the wreck act as an source of nutrient, iron to increase biological productivity, thus give a good productivity, and high dissolved oxygen in the water column as compare along the transect from wreck PMSC jetty. Chlorophyll *a* concentration ranged from 0.16µg/L, 0.19µg/L, and 0.10µg/L in surface, mid depth and bottom respectively. The presence of wreck cause localize upwelling in the water column indicate by TSS, range from surface to bottom is 20mg/L, 30mg/L and 30mg/L.

Key word: Water Quality, Vertical Profile, Katori Maru

ABSTRAK

Kapal karam Jepun, Katori Maru terletak kira-kira 30km dari Pantai Santubong telah ditenggelamkan oleh kerosakan di terima dari serangan oleh K-XIV Kapal selam Belanda semasa Krismas 1941 semasa Perang Dunia II. Selepas beberapa dekad di dasar laut, alam semulajadi telah menukar kapal karam Katori Maru dan mengubah ia kepada Muzium hidup dan sesebuah ekosistem kepada marin flora dan fauna. Walaupun Katori Maru ialah lokasi menyelam skuba yang terkenal, tiada kajian telah didokumenkan. Justeru,kajian ini bertujuan untuk mendokumentasi kualiti air dan profil menegak kapal karam Jepun, Katori Maru. Kaedah piawai APHA digunakan untuk kajian kualiti air dan CTD untuk menentukan profil menegak. Ia menunjukkan bahawa kapal karam bertindak sebagai sumber nutrient (zat besi) untuk menaikan produktiviti biologi yang baik, sekali gus memberikan produktiviti, dan konsentrasi oksigen tinggi dalam ruang air berbandingkan di sepanjang transaksi dari kapal karam ke jetty PMSC. Kepekatan klorofil a adalah dalam lingkungan 0.16µg/L, 0.19µg/L, dan 0.10µg/L pada permukaan, pertengahan kedalaman dan dasar. Ia dipercayai, kapal karam menyebabkan "localize upwelling" yang ditunjuk oleh TSS, linkungan dari permukaan air ke dasar ialah 20mg/L, 30mg/L and 30mg/L.

Kata kunci: Kualiti air, profil menegak, Katori Maru.

1.0 INTRODUCTION

Katori Maru shipwreck, a sunken Japanese cargo ship during World War II, which is located 30km off the coast from Santubong as said by Yap (2013). During World War II, tons of Japanese ships were built and named "Maru" which means round, chubby or circle in Japanese as said by Hara (1967). Her full name meant chubby or sunny boy (Hara, 1967). According to Jan (2012), Katori Maru was built at year 1941. She has a build of 130m length and 30m wide body plan. The cargo ship is powered by steam turbine and was used as to transport the Japanese soldier during World War II (Jan, 2012).

Katori Maru faced her watery grave from the damage receive from the torpedo shot by Dutch submarine K-XIV on Christmas Eve's year 1941 as said by Yap (2013). After several decades, the sunken Katori Maru is now being engulfed by Mother Nature and become into a living museum as reported by Yap (2013). Now, the sunken Katori Maru has become a famous diving spot due to its uniqueness and availability of vast diversity of marine life that dwells with her. Jan (2012) said that the whole ship is still intact and can be view from the surface of the water if water condition are good. Katori Maru now rest in the depth of 22meters.

Up until today, Katori Maru wreck is an attraction for many local and global divers as reported by Tourism Malaysia (2014). In conjunction for visit Malaysia Year 2014, a package been promoted to tourist to visit the living museum of Katori Maru. Promotion price range from RM1860-RM2400, a four day and three night dive trip.

It is unquestionable that the rate of pollution in water bodies increases with economic development throughout the year. The uncontrolled and constant exploitation for development

leads to many polluted lakes, rivers, estuaries and coastal area. Activities such as aquaculture, deforestation, oil palms plantation, building road and residential area carried out to satisfied demands of growing human population and resulted in deteriorating major river of Kuching like Sungai Santubong, Sungai Sarawak and Sungai Sampadi; cause unfavorable water quality (Michele *et al*, 2009; Lau, 2011; Mpoc, 2011; Ling *et al., 2011*). In the end, all river discharged are led to the sea and cycle through South China Sea by monsoonal seasons (Morton & Blackmore, 2001). On top of that, despite be a famous diving spot for tourism, no studies have been done and limited studies on shipwreck water quality been studies site as a comparative study.

Hence the objective of this study is:-

1. To compare the water parameter in surface water (0m), deck of Katori Maru (16m) and bottom of Katori Maru (22m) and construct its respective vertical profile. The water parameter involved are Temperature (ºC), Dissolved Oxygen (mg/L), pH, Salinity (PSU), turbidity (NTU), TSS (mg/L), BOD_5 (mg/L) and chlorophyll *a* (µg/L).
2. To compare the difference in surface water quality along the transect 0NM, 5NM, 10NM, 13NM, 14NM, 15NM and 16NM away from Katori Maru wreck toward the PMSC jetty. The parameter involves are Temperature (ºC), Salinity (PSU), Dissolved Oxygen (mg/L), pH, Salinity (PSU), turbidity (NTU), TSS (mg/L), BOD_5 (mg/L) and chlorophyll *a* analysis (µg/L).
3. To compare the vertical profiling from 0NM, 5NM, 10NM, 13NM, 14NM, 15NM and 16NM away from Katori Maru wreck toward the PMSC jetty. The water parameter involve are Temperature (ºC), Salinity (PSU).

2.0 LITERATURE REVIEW

2.1 Water quality parameters

2.1.1 Temperature

Seawater receives heat from sunlight daily and heat up the water. Seawater has a very high specific heat capacity that is 3.995Joules/ gram °C (Hanharan, 2012; Jamieson, 1969). The heat that water needs to absorb is 3.995 Joules to increase the temperature of one gram of water by 1°C. Hence water has unique properties of maintaining at a constant temperature, 28°C – 29°C to maintain the ecosystem of the marine habitat. The shipwreck Katori Maru is a habitat for many marine organisms for seven decades. Hence water temperature is one of the important factors that support the diversity of marine life there. Especially corals, since it has high sensitivity toward thermal stress. According to Well and Price (1992), coral grow optimally in between 26^0C to 27^0C.

2.1.2 Dissolved oxygen

Dissolved oxygen is amount of oxygen in water column by diffusion or exchange of oxygen from the atmosphere. Solubility of oxygen to dissolve in water column is affected by the water temperature. Study shows that increase temperature have an inversely proportional effect on the solubility of oxygen. At tropical waters, 28°C-30°C, the solubility is around 7-7.5mg/L (Lau, 2011). The diffusion is facilitated by wave, wind and strong turbulence promotes better mixing or atmospheric oxygen mention by (Kho *et al*., 2009). Dissolved oxygen in the water is also produce by photosynthetic marine organism such as phytoplankton and corals and is essential for the survival of marine organism. A healthy seawater dissolved

oxygen parameter is between 5mg/L and 14mg/L. DO range of 4mg/L to 5mg/L is dangerously low for a healthy aquatic organism (Kho *et al*., 2009)

2.1.3 Conductivity

Seawater in has tons of free moving ions in its water. Rusting from metal releases ions like Fe^{2+}, Mg^{2+}, Zn^{2+} and CU^{2+} ions and contribute to increase conductivity in seawater (Wurl, 2009). Other dissolved inorganic ions such as Mg^{2+}, Ca^{2+}, K^{+}, Na^{+}, Cl^{-}, $SO_2^{4-,}$ HCO^{3-} and CO_3^{2-} also contribute to more free moving ions in the water column which also increase conductivity (WURL, 2009). The unit to measure conductivity is µS. Sea water typically has 28800µS/cm or more (Li *et al*., 2011).

2.1.4 Turbidity

Turbidity is the suspended inorganic constituents. Places like Sungai Santubong are ideal for aquaculture activities which contribute high turbidity (Moid *et al*., 2009). Tovar *et al*. (1999) mentioned, development such as resident area, roads and deforestation been done. This contributed sedimentation to its respective river. Turbidity values in the rivers are recorded 18.0 to 254.4 NTU. The siltation rate is high and create low visibility around the water column was. High suspended sediment will inhibit or limit sunlight penetration in the water column.

2.1.5 Salinity

Salinity of the seawater is typically 31-35 PSU; typically depend on its location. Salinity is one of the important factors in seawater for the survival and growth for many marine

organisms. Salinity could be affected by several factors such as upwelling evaporation, cloud-cover, sinking and precipitation (Marghany *et al*., 1996). According to Kundell (2007), Borneo has more average rainfall which is 3000-4000mm. Hence rain and drought are balance thought the whole year. This resulted in normal range of salinity of 31-35PSU

2.1.6 pH

This particular measurement detects the concentration of hydrogen ion [H^+] in water with the formula pH = -log [H^+]. Crompton (1989) mentioned that, pH of seawater is slightly alkaline, that is pH approximately 8. When carbon dioxide is mix with seawater, it will undergo a reaction and become hydrogen bicarbonate, H_2CO_3. This hydrogen bicarbonate, H_2CO_3 acts as a buffer system to maintain the pH of the marine environment. PH of seawater should remain slightly alkali for the survival of marine organism. The buffer properties is very important to calcareous marine organism such as corals and shell fishes to build its skeleton and shell respectively. As discussed by Li *et al.* (2011), abnormal pH value indicate pollutions

2.1.7 Total Suspended Solid

Total suspended solid (TSS), as the name imply, it is the presence of suspended solid in the water column and the measurement of degree of soil erosion. Sarawak has an annual rainfall 4500mm, according to Lau (2011), region with annual rainfall more than 3500mm is subjected to have uncontrolled erosions. Additional to anthropogenic activities like agriculture, new housing area and deforestation which drastically double the amount of sediment erodes (Tovar *et al*., 1999). Due to high suspended solid presence in the water column sediments deposition on seabed from major river discharge in Kuching can harm many benthic marine organisms.

As mention by Crompton (1989), high TSS can lead to a chain reaction of limit sunlight penetration, which leads to no photosynthetic activity (primary producers), death of benthic invertebrate and ultimately death of many fishes.

2.1.8 Chlorophyll *a*

According to APHA (1998), chlorophyll *a* is a measurement of the concentration of chlorophyll *a* in water bodies. It is a green pigment present in photosynthetic plants. Photosynthetic marine organism act as a primary producer in the food chain of Katori Maru shipwreck site. Satang island chlorophyll *a* concentration recorded at sub-surface water is recorded 0.41µg/L to 0.9541µg/L and 0.3241µg/L to 1.1941µg/L at the bottom water. The bottom water has high nitrogen due to presence of high content nutrients. This is due to freshwater input from fertilizer run-off, domestic discharges and aquaculture water from Sungai Sarawak, Sungai Sampadi, Sungai Santubong and Sungai Sibu Laut (Kho *et al*., 2009).

2.1.9 BOD_5

BOD_5 is known as biological oxygen demand in 5 days. It is to test the dissolved oxygen in the water column of Katori Maru shipwreck after 5 days Crompton (1989). In Satang island dissolved oxygen recorded range for sub surface water range from 5.51mg/L to 9.27mg/L and bottom water recorded a range of 4.63mg/L to 7.40mg/L. DO range of 4mg/L to 5mg/L is dangerously low for a healthy aquatic organism (Kho *et al*., 2009).