Some Nesting Determinants of Olive Ridley sea turtles  
(*Lepidochelys olivacea*) in San Narciso Zambales Philippines:  
A Preliminary Study

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Abstract. Nesting of Olive ridley sea turtle (*Lepidochelys olivacea*) must be free from any anthropogenic threats. Sitio Lapaz San Narciso Zambales is located along the Coral Triangle in the Philippines which is rich in marine biodiversity. This study determined the history of PAWICARE Hatchery Project in sitio Lapaz, San Narciso, Zambales Philippines; describe the physical condition (distance of hatchery to shoreline, temperature during nesting-hatching period), determine heavy metals (Arsenic, Lead and Mercury) in water samples along the shoreline of Lapaz San Narciso Zambales. Mixed method was used to gather pertinent data on this study. Survey method was used (interview and focal group discussion) was used to describe the history and, physical condition of PAWICARE Hatchery Project. It was enriched with documentary analysis. Quantitative method was used to analyze water along the shoreline of PAWICARE Hatchery. Water analysis determined the Arsenic, Lead and Mercury content of water samples collected from three sampling sites near the hatchery. Results revealed that fishermen in sitio Lapaz were transformed into turtle rangers from turtle poachers. Residential houses are relocated far from the shoreline to avoid pollution. Temperature (27°C to 33°C) during nesting months (October to March) favors nesting of the turtles. Arsenic, Lead and Mercury in water along the shoreline were found at a very low level. The above determinants favored the nesting of Olive ridley sea turtles in San Narciso Zambales Philippines.

1. **Introduction**  
The Philippines is geographically located at the apex of the Coral Triangle, an area recognized by marine ecologists as a global center of marine biodiversity (Figure 1). The coastal waters of this vast marine expanse contain a wider range of species of corals, reef fishes, seagrasses, and mangroves as one of the best in the world. The other marine vertebrates, invertebrates, and plant species, as well as their terrestrial counterparts, in the Coral Triangle are also reported to be richly diverse. The Philippines’ coral reef area is estimated at 26,000 square kilometers, which is the second largest in Southeast Asia. Approximately 500 species of scleractinian or “stony” corals are known to exist in the area, 12 species of which are considered endemic. Similarly, these coral reefs are home to 3,053 species of fish, of which 2,724 are marine-based. Pelagic fish species number about 177, while demersal species total 2,351 (1,658 of these are reef-associated and 693 are associated with other nearshore habitats). There are 277 deep-sea fish species and 173 freshwater species. Similarly, the Philippines has 16 species of seagrass known to occur over an area of 978 km$^2$ [1].

San Narciso Zambales is one of the coastal municipalities in northwestern part of Philippines. Specifically, in the province facing West Philippine seas (“Figures 2.a and 2.b”). It has a land area of 71.60 square kilometers or 27.64 square miles which constitutes 1.96% of Zambales’ total area. Its
population in 2015 was 28,360. It is situated at 15.02° North latitude, 120.08° East longitude and 11 meters elevation above the sea level [2].

![Figure 1. Philippines in the Coral Triangle][3]

The olive ridley sea turtle (*Lepidochelys olivacea*) is a species is the most abundant sea turtle in the world. It is listed by the International Union for Conservation of Nature as a vulnerable species. The major threats to this species include fisheries bycatch, habitat degradation, and the unsustainable harvest of eggs [4]. Sea turtles are globally endangered and face daily anthropogenic threats, including pollution. However, there is a lack of ecotoxicological information on sea turtles, especially in the Asia-Pacific region. Research should target monitoring pollutant levels in sea turtles, within the West Pacific/Southeast Asia, regional management unit spanning East Asia to Southeast Asia to fill in knowledge gaps, in particular in areas such as Thailand, Vietnam, Indonesia, Malaysia and the Philippines where less or no data is available and where foraging grounds of sea turtles have been identified [5].

1.1. Objectives of the study
This study determined the history of PAWICARE Hatchery Project in sitio Lapaz, San Narciso, Zambales Philippines. It describe the physical condition (location of sitio Lapaz, distance of hatchery to shoreline, temperature in sitio Lapaz, San Narciso Zambales, during nesting-hatching period), and it also determine the heavy metals (Arsenic, Lead and Mercury) content of water in three sampling sites near the PAWICARE Hatchery Project.

2. Methodology
This study used mixed methods that includes descriptive and quantitative. Descriptive part involve, interviews using interview schedule, and focal group discussion with key informants. Documentary analysis and the regular visit of the project enriched the data gathered in this study. The quantitative part is the water analysis (arsenic, lead and mercury) from three sampling sites near the shoreline of the project. Water samples within 12 hours after collection was analyze in the laboratory. Arsenic, lead and mercury content were analyzed following Method 60108-using Plasma Atomic Emission Spectroscopy [6].

3. Results and Discussion

3.1. History of PAWICARE hatchery project
In 1985, marine turtles in the Philippines, was first recorded, and listed four species. Today, five of the seven existing species of marine turtles are found in the Philippines: green (Chelonia mydas), hawksbill (Eretmochelys imbricata), olive ridley (Lepidochelys olivacea), loggerhead (Caretta caretta), and leatherback (Dermochelys coriacea) [7]. A leatherback turtle has been found laying eggs in Rawis, Legaspi City, Albay [8]. From 1982 to 2007, tagging of 15,269 marine turtles was conducted, throughout the Philippines. Most of marine sea turtles tagged were from the TIWS. Olive ridleys have been sighted all over the country, with nesting sites in Subic Bay Freeport Zone; Morong, Bataan; Lian and San Juan, Batangas; and Puerto Princesa City, Palawan. Turtle tagging is still being done for captured or rescued turtles, and in nesting beaches [9]. Figure 3 shows Zambales and Bataan provinces with its shoreline facing West Philippine Sea, which is included in the Coral triangle. PAWICARE Hatchery Project in sitio Lapaz, San Narciso Zambales Philippines started in 2011.

![Figure 3 Zambales and Bataan provinces with its shoreline facing West Philippine Sea](image-url)
Respondents had multiple and favourable responses in partnership with the municipal government and KATIMPUYOG INC. Transformation of fisherfolks residing near the coastlines, from turtle poachers to turtle rangers happened. These turtle rangers had gained popularity in the community as Lapaz turtle rangers. From 2011 to date, there are eight volunteer turtle rangers, collect and place turtle eggs in hatcheries, every October to March of the following year in shifting schedules. From 2011 to 2012 estimated 60,000 turtle eggs had been collected and hatched and hatchlings were fled to West Philippine seas. Shoreline of sitio Lapaz

3.2. Physical Condition of Sitio Lapaz, San Narciso Zambales Philippines
San Narciso Zambales is found along the coastline of West Philippines seas, which belong to the Coral Triangle. Stretching across six countries in Southeast Asia and Melanesia (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste), the Coral Triangle (CT) is the global center of marine diversity [10]. Covering less than 1% of the Earth’s surface, it comprises over 30% of the world’s coral reefs and 76% of the world’s reef-building coral species. These unparalleled marine and coastal resources provide numerous socioeconomic benefits to over 370 million people who reside there, along with benefits to millions more outside the region [11]. Recently, a global assessment found that the coral reefs of Southeast Asia (particularly Indonesia and the Philippines) are among the most threatened in the world. The Coral Triangle - the nursery of the seas - is the most diverse marine region on the planet, covering some 6 million km2 of ocean across 6 countries in the Asia-Pacific region. This ecological wonder is home to 76% of the world's reef-building coral species and 6 out the 7 known species of marine turtles. Long before humans appeared in the Coral Triangle, marine turtles were already swimming the region's seas and laying eggs on its beaches [12].

The shoreline of sitio Lapaz San Narciso Zambales is composed of loose sand that favors nesting and hatching of turtles. On hard-packed sand at the water’s edge turtles push forward by digging a claw on their flipper into the ground so that they don’t slip, and on loose sand they advance by pushing off against a solid region of sand that forms behind their flippers [13].

Residential houses are located approximately 100 meters from the shoreline so as not to cause any water pollution. Temperature of San Narciso Zambales also favors the nesting of turtles. Temperature for October ranges from 24°C-32°C. For the month of November, it sets from 23°C-32°C. Decrease in temperature during cold months of December and January which is 22°C-31°C. February temperature ranges from 22°C-32°C. For the month of March, 24°C-33°C and increase to 34°C on the last week of the month, the onset of summer month (Figure 4). Last batch of hatchlings are fled on the last week of March, very seldom on the month of April due to summer months in the country. Constant temperatures for incubating turtle eggs, is ranging from 27°C to 33°C [14].

![Figure 4](image-url)  
**Figure 4.** Average Temperature, and Rainfall Pattern in Zambales, Philippines [15].
3.3. Water Analysis in Three Sampling Sites along the shoreline of Pawicare Hatchery Project

The lives of sea turtles all over the world are in danger due to several factors. Pollution which is anthropogenic in nature posed an alarming threat. Threats resulting from pollution can be divided into the following categories: Plastic and Other Debris Oil Pollution Persistent Chemicals (Organochlorines and Heavy Metals) [16]. Heavy metals like Mercury and Lead are detrimental to sea turtles. Lead cause a range of health problems, including infertile eggs, slow growth, changes in behavior and ultimately reduced chances of survival. Mercury can cause a variety of neurological disorders [17].

Table 1 posited the result of Water Analysis (Arsenic, Lead and Mercury content) from three sampling sites in the shoreline of PAWICARE Hatchery Project. It revealed that sea water favored the nesting of the turtles, since heavy metals is too low. Level of Arsenic in 3 sampling sites is less than 0.000416 mg/L, Lead content is only 0.00517 mg/L, and Mercury is 0.0002 mg/L. This further implies that the water, along shoreline of PAWICARE Hatchery Project favors nesting of Olive ridley which is observed by fishermen during the months of October to March of the following year.

### Table 1. Summary of Water Sampling Analysis from Three Sampling Sites along the shoreline in sitio Lapaz, San Narciso Zambales

| Sample ID   | Analysis | Unit | Results as received | Remarks |
|-------------|----------|------|---------------------|---------|
| M19C429-01  | Arsenic  | mg/L | <0.00416            | A-02    |
| Site 1      | Lead     | mg/L | <0.00517            | A-02a   |
|             | Mercury  | mg/L | <0.0002             | -       |
| M19C429-02  | Arsenic  | mg/L | <0.00416            | A-02    |
| Site 2      | Lead     | mg/L | <0.00517            | A-02a   |
|             | Mercury  | mg/L | <0.0002             | -       |
| M19C429-03  | Arsenic  | mg/L | <0.00416            | A-02    |
| Site 3      | Lead     | mg/L | <0.00517            | A-02a   |
|             | Mercury  | mg/L | <0.0002             | -       |

4. Conclusion

Result implied that the nesting determinants identified in this study favors the continuous nesting of Olive ridley sea turtles in sitio Lapaz, San Narciso Zambales, Philippines. Therefore, law enforcement on maintaining the pollution free shoreline of PAWICARE Hatchery Project should be continuously imposed. Support from the government and non-government organizations be secured to help turtle rangers suffice means of livelihood other than fishing.

5. References

[1] Asian Development Bank 2014 *State of the Coral Triangle Philippines* (6 ADB Avenue, Mandaluyong City 1550 Metro Manila, Philippines) p 2

[2] Philippine Atlas nd. San Narciso Province of Zambales. Retrieved January 15, 2019 from:https://www.philatlas.com/luzon/r03/zambales/san-narciso.html
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