ASSESSING AND MONITORING THE ECOSYSTEM OF URBAN LAKE PARKS OF KUALA LUMPUR, MALAYSIA USING AMPHIBIAN SPECIES

BY

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ABSTRACT

Frog extinction phenomenon occurs throughout the world. Around 33% of amphibian species threatened while more than 150 species have been extinct since 1980. This is due to the impact of urbanization that exploits habitats for urban wildlife, especially diversity of frogs' habitant. As animal with limited mobility, frog become the most affected species from this global threat. Although it is often described as an animal that has a bad and ludicrous appearance, frogs have a very important role in the environment. Its thin skin character makes frogs a very common animal to measure the level of environmental pollution. The aim of this research is to determine the amphibian in the urban lake garden in Kuala Lumpur as bio-ecological indicator. As the fastest growing city in Malaysia, Kuala Lumpur has become an area of study. Five lakes parks in lined with urban areas and categorized as a high potential pollution contributor. The studied lake garden is Perdana Botanical Garden, Titiwangsa Lake Garden, Batu Metropolitan Lake Garden, Kepong Metropolitan Lake Garden and Permaisuri Lake Garden. The result shows that Perdana Botanical Garden consists of the highest number of frog species (n=7) and frog population (n=80). Meanwhile, Titiwangsa and Permaisuri Lake Garden recorded the least number of species and population. The best lake garden with the least contamination is Perdana Botanical Garden. Most of the contamination measured score the least value compare to others Parks. Batu and Kepong Metropolitan Lake Garden score the highest value in contamination, especially in copper, nitrite and phosphorus score. The most favorable habitat for frogs are at the Perdana Botanical Garden and Batu Metropolitan Parks. These parks contain a numerous marginal and aquatic plants and less steep edges that suitable for frog's locomotion. Kepong Metropolitan Park becomes the most unsuitable habitat as it is consist a lot of steep edges and less suitable flora near the pond. As a summary, the result shows that mixed up findings that can lead to multiple conclusions. This result due to the characteristics of the parks that influence their suitability as frog habitat. Flora and lake edges are some example of driving factors categorize as lake character that influence frog habitat. From the observation made, most species recorded from the parks were common species found in urban area, which also considered as indicator of the adverse effects of urbanization on the ecology. In a nutshell, frog population is influenced by water quality of a park. It is vital to have a suitable habitat that address frog needs to cater their population in a lake park. Thus, the study come with a suggestions that allocation for some portion of natural habitat, whether existing natural or designed natural habitat is necessary for frog to perform its function as biological indicators for a healthy urban environment.

خلاصة البحث

تحدث ظاهرة انقراض الضفدع في جميع أنحاء العالم. حوالي 33٪ من أنواع البرمائيات مهددة بينما انقرض أكثر من 150 نوعًا منذ عام 1980. ويعزى ذلك إلى تأثير التحضر الذي يستغل الموائل للحياة البرية في المناطق الحضرية، وخاصة تنوع مواطن الضفادع. كحيوان ذو قدرة محدودة على الحركة، وأصبح الضفدع أكثر الأنواع تضرراً من هذا التهديد العالمي. على الرغم من أنه غالبًا ما يوصف بأنه حيوان له مظهر سيئ وساذج، فإن للضفادع دور مهم للغاية في البيئة حيث تجعل بشرة الجلد الرفيعة الضفادع حيوانًا شائعًا للغاية لقياس مستوى التلوث البيئي. الهدف من هذا البحث هو تحديد البرمائيات في حديقة البحيرة الحضرية في كوالا لامبور كمؤشر بيولوجي. باعتبارها أسرع المدن نمواً في ماليزيا، أصبحت كوالا لامبور مجالًا للدراسة. ثمة خمس بحيرات تقع في مناطق تصطف على جانبيها مناطق حضرية وتصنف على أنها مساهم كبير في التلوث. وكانت حديقة البحيرة المدروسة هي حديقة بيردانا النباتية، وحديقة بحيرة تيتيوانجسا، وحديقة بحيرة باتو متروبوليتان، وحديقة بحيرة كيبونغ متروبوليتان وبحيرة بيرميسوري. تظهر النتيجة أن Perdana Botanical Gardenتتألف من أكبر عدد من أنواع الضفادع (ت = 7) وتعداد الضفادع (ت = 80). وفي الوقت نفسه، سجلت Titiwangsa و Permaisuri Lake Garden أقل عدد من الأنواع والسكان. أفضل حديقة بحيرة مع أقل تلوث هي حديقة بيردانا النباتية. معظم التلوث المقاسة يسجل أقل قيمة مقارنة بالمتنزهات الأخرى. باتو وكيبونج متروبوليتان ليك غاردن يسجلان أعلى قيمة في التلوث، خاصة في درجات النحاس والنتريت والفوسفور. كانت الموائل الأكثر ملائمة للضفادع هي في حديقة بيردانا النباتية ومتنزه باتو متروبوليتان. وتحتوي هذه المنتزهات على العديد من النباتات الهامشية والمائية وحواف أقل انحدارا تناسب حركة الضفدع. يصبح Kepong Metropolitan Park أكثر الموائل غير المناسبة لأنه يتكون من الكثير من الحواف الحادة والنباتات الأقل ملاءمة بالقرب من البركة. خلاصة القول، تظهر النتيجة أن النتائج المختلطة التي يمكن أن تؤدي إلى استنتاجات متعددة. هذه النتيجة بسبب خصائص الحدائق التي تؤثر على ملاءمتها كموائل الضفادع. تعد حواف النباتات والبحيرة مثالاً على عوامل القيادة التي تصنف على أنها شخصية بحيرة تؤثر على موطن الضفادع. من الملاحظة التي أجريت، كانت معظم الأنواع المسجلة من الحدائق من الأنواع الشائعة الموجودة في المناطق الحضرية، والتي تعتبر أيضًا مؤشرا للآثار الضارة للتحضر على البيئة. باختصار، يتأثر سكان الضفادع بنوعية مياه الحديقة. من الضروري أن يكون هناك موئل مناسب يلبي احتياجات الضفدع لتلبية احتياجات سكانها في حديقة بحيرة. وبالتالي، تأتي الدراسة مع اقتراحات بأن تخصيص جزء من الموائل الطبيعية، سواء كانت الموائل الطبيعية الطبيعية أو المصممة الحالية ضرورية للضفدع لأداء وظيفته كمؤشرات بيولوجية لبيئة حضرية صحية.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science (Built Environment).

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Firstly, it is my utmost pleasure to dedicate this work to my dear parents and my family, who granted me the gift of their unwavering belief in my ability to accomplish this goal: thank you for your support and patience.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Alford and Richards(1999) believed that decreasing number of amphibian has impacted from several interrelated phenomenon that happen every day; examples the human activities that caused habitat loss and degradation. Conservation biologist has also start to show their great concern on this issues (Elmqvist, Zipperer, & Giineralp, 2016; Fontúrbel & Tarifa, 2014; Graham, Haines-Young, & Field, 2017). Meanwhile, Adams (2005) supported the statement by claiming researcher should begin to pay their interest towards wildlife research that in urban context. The ignorance of human which put less attention to the ecological necessities and nature has camouflage the significant link between human and ecosystem health (Magle, Hunt, Vernon, & Crooks, 2012). In aquatic environment, the researchers agreed that, amphibian such as frog can be the monitoring and indicator for ecosystem such as urban environments (*Before it's too late - Croaking frog*, 2004). Furthermore, Magle et al., (2012) said that the urban wildlife topic catches many interest of researcher by years, the research on amphibian itself relating to urban environment are still rated to be very low, with statistic 4 percent every decade.

Thus, it is urge for the wildlife researcher to ponder deeply upon this topic while nowadays it is relevant to carry on study and research of this topics as amphibian now are declining in its natural habitat (Blaustein & Wake, 1990). The sensitivity of the amphibian towards environment caused by its physical appearance (Halliday, 2000; Pechmann & Wilbur, 2011) further elaborated that the skin is the most sensitive part

that able to accumulate the contamination surrounding, which bring a great advantage to researcher in data collection process. They started to prepare for this through encouraging scientific research and development in the fields of communication and technology. All of this serves as clear evidence on the importance of the information and communication technology sectors where those who possess ICT infrastructure, knowledge, skills and talent are far better off in many aspects of development.

The setting of this research more focusing on aquatic, as well as some terrestrial that close to aquatic set up. A healthy urban area such as urban parks shall be obtained from a healthy aquatic environment, in which a healthy aquatic environment can be defined as "…an aquatic environment that sustains its ecological structure, processes, functions and resilience within its range of natural variability" (Council, 2008). According to (Trombulak & Frissell, 2000), the health of aquatic ecosystem is a general statement that subjected to changes at different parts of ecosystem.

Within the aquatic living creature's community, there are few classifications of so called as core species, include invertebrates, plants, fish and birds, and they were delineating the rest of species indicators(Council, 2008). For instance, the health of the aquatic ecosystem will degrade when the main water bodies badly affected by surrounding urban development ("Urbanization and Streams: Studies of Hydrologic Impacts,").

To be specific, the lifecycle and life stage of amphibian shall be take into account in this paper. Every changes and effect are relevant and can be recorded at every stage of amphibian living started from tadpoles. In that session, they breathe through their internal gills and skin. After a tadpole metamorphoses into an adult anuran, the gills will completely diminish. There were tiny blood vessels, capillaries under the outer skin layers of anuran that help them for breathing.

Amphibian, also known as anuran begin the life from tadpole before transform to adult anuran. At early stage, they use gills for breath before it disappears when they turn to adult. Few components underneath skin aid anuran's respiratory system. During breeding time, anuran's species such as African 'Hairy' frog or Trichobatrachus robustus produce hair at back legs, intended to help in breathing ("The Frog," 2014). In fact, mammals got less sensitivity than anurans skins, which very sensitive. This statement supported by (Quaranta, Bellantuono, Cassano, & Lippe, 2009) whom claimed that few heavily used herbicides detected heavily in frog compared to mammal such as pig.

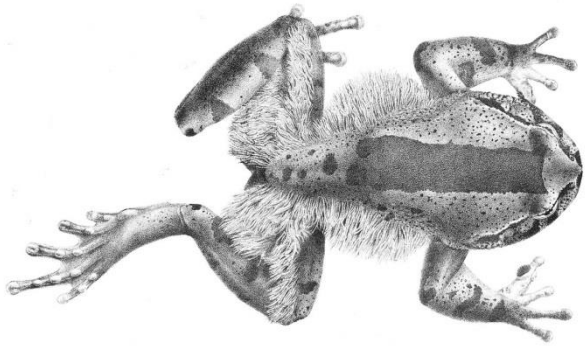

Figure 1.1 African 'Hairy' frog or *Trichobatrachus robustus* produce hair at back legs, intended to help in breathing("The Frog," 2014).

1.2 STATEMENT OF THE PROBLEM

Becoming most famous city of Malaysia, Kuala Lumpur placed about 1.76 million populations by 2016, also known as city with High Human Development Index. With 96 square kilometer, the area cramp with settlements to cater increasing human population. By ratio, every square kilometer in Kuala Lumpur placed about 6,890 people.

Besides growing very fast by year, Kuala Lumpur surround with satellite city that catalyst its rapid development, including Klang Valley located at the outskirt of

Kuala Lumpur. Placed about 7.2 million population, Klang Valley is among the busiest and dense area as it is linked to many highways and main access intercity. In sync, the rapid development occurs to cater the continuous demands of settlement, whilst area of green space was squeezed and reduced. Some potential nature set up in Kuala Lumpur was threaten due to the current situation, which also affecting wildlife habitat such as frog.

Besides that, the declining number of amphibian in their nature habitat makes it reasonable to conduct research on amphibian before the extinction of the species (Blaustein & Wake, 1990; Global Amphibian Assesment, 2005). This, can be and advantages as the research are conducted in tropical atmosphere, where globally recognized as among the hot-spot for biodiversity. Moreover, the study will evaluated richness of frogs with in urban parks in city and not include wilderness such the forests, wetlands and others which usually been done by the ecologies.

As the amphibian are very well-known for their sensitive requirement (Pechmann & Wilbur, 2011), especially by their skin (Halliday, 2000) a further research should be encourage. This attribute may related to their Habitat such as the water quality, where by the heavy metals contaminate could be observe and thus it effecting the habitats(Parris, 2006). Other, variables such as flora and fauna could be healthiness factors for habitat and diets of the Frogs.

Statistically reported frog population was continuously decreasing which can be classified as warning signal that ecosystem is not in order. Storm water from urban settlement directly flow into the natural area nearby, which come from various sources resulting from everyday human activities.

The declining of frogs in urban area may be the alarming indicator for the detiorating of environment ecosystem. It is may be due to the water sources in urban area that may contaminated with daily urban activities.

1.3 AIM OF THE STUDY

To investigate the relationship between the availability of amphibians with in the quality of urban parks ecosystems such water and habitats that can be the bio-indicator and monitoring for a healthy aquatic environment in lake gardens of Kuala Lumpur.

1.4 RESEARCH OBJECTIVES

i. To identify the variety species of amphibians that can be found at lake gardens in Kuala Lumpur, Malaysia.

ii. To measure the quality of water at the lakes and it effect towards the population of amphibians.

iii. To investigate the locality and habitat of the frogs such as flora and edges that can influence the availability of frogs.

1.5 RESEARCH QUESTIONS

From the problem statement, a few research questions have been identified

i. What are the species of amphibians found at the lake gardens in Kuala Lumpur?

ii. How is the water quality of the lakes and their influences towards the availability of amphibians?

iii. How does the locality and the habitat of the frogs such as flora and edges can influence the availability of frogs?

1.6 RESEARCH FRAMEWORK

The below framework discussing on the summary of the research. It gives a early understanding on why and how the research will be conducted. There are four stages in this framework. The aerly stage marked with light turqoise summaries the issues, aim, objective and research question. Nest stage summaries about the literature review in chapter two. There are two main part in the literature review, first is on the theoretical review and second is about the scientific prospect of the amphibian. The next darker turquoise colour summarise on the methods and procedure taken for data collection. The data collected will be analyse and disscussed on the next steps which was coloured as darkest turquoise colour.

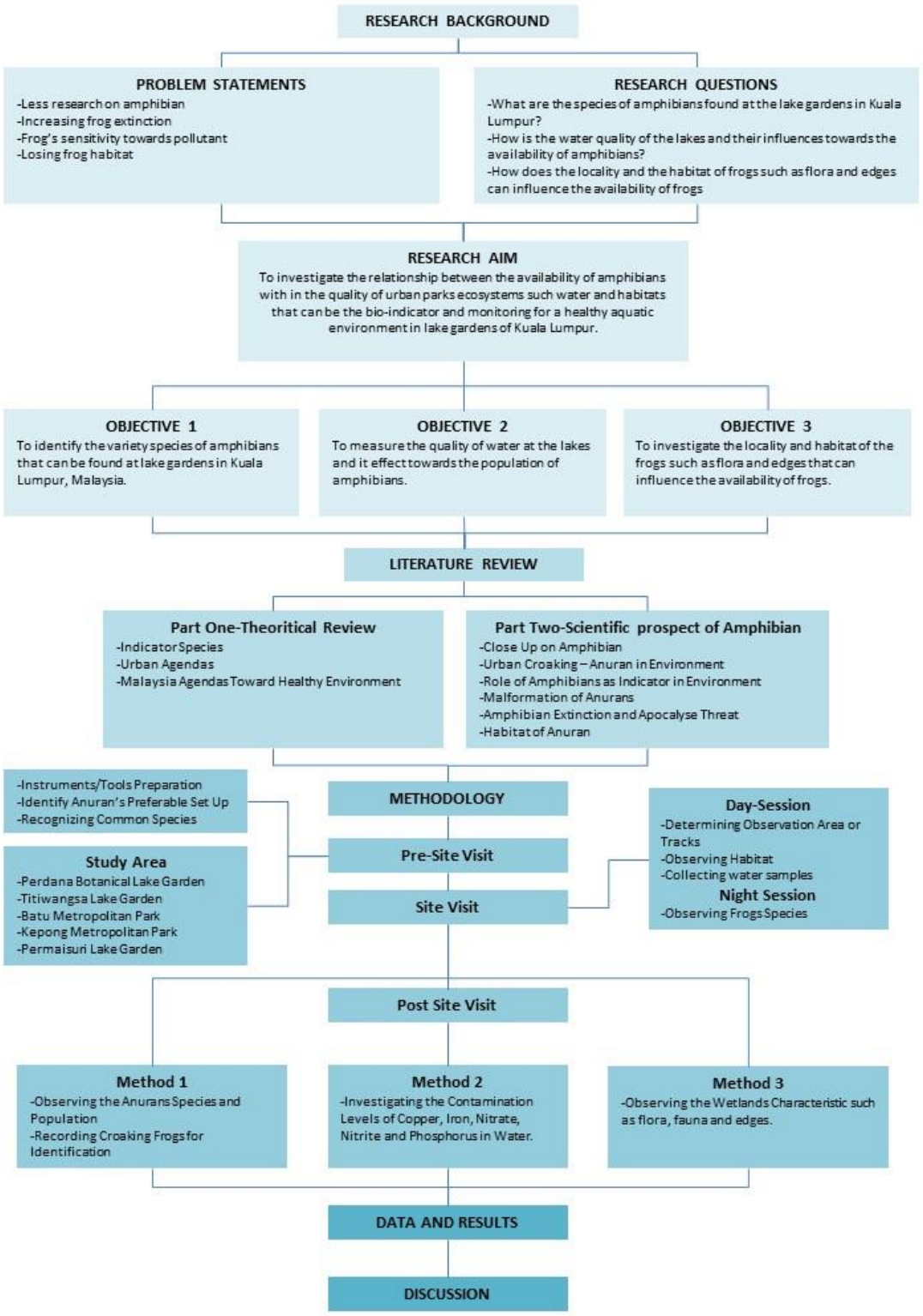

Figure 1.2 Summary of the research proposal into a framework.

1.7 RESEARCH HYPOTHESES.

The existence number of amphibian species indicate that the healthy urban ecosystems such good water quality and better food chain.

1.8 SIGNIFICANCE OF THE STUDY

1.8.1 Urbanization Trend

Urbanization is increasing globally (Dearborn & Kark, 2009). As one of the develop country in South East Asian, urbanization in Malaysia having the similar pattern as global(Siong, 2008). The trend also appears the same for the interest on researching wildlife in urban area (Adams, 2005). River and water bodies are some of the component that badly affected by urbanization ("Urbanization and Streams: Studies of Hydrologic Impacts,"). In Malaysia, most of the domestic water waste flow through the drainage into a river. This phenomenon makes the water quality worst and affected others with in the ecosystems such as plants and insects.

1.8.2 Frog and Toad as Indicator

Amphibian belongs to animal like frog, toad, salamander, caecilians and newt. However, Malaysia only has two of them which is frog and toad. Mainly an amphibian can live both in water and land (Attenborough, 2008). The terminology of amphibian refers to their two complete cycle of life.

Many researchers suggested that amphibian such as frog is the best ecological indicator for aquatic environment (*Before it's too late - Croaking frog,* 2004). The reliability of frog as indicator is less argues. The only argument is whether amphibian is treating as single or suite (Sewell & Griffiths, 2009). They have a sensitive skin that

was used for breathing ("animals which breathe through their skin,"). As their absorbed oxygen through their skin, it is believed that contamination also will easily absorb through their skin.

1.9 RESEARCH LIMITATION AND SCOPE OF STUDY

1.9.1 Site Area

Variety of untold green spaces yet to be discover by human especially commoner in Kuala Lumpur. As a versatile and robust city, most of the parks are man-made with proper designed facilities to allow accessibility. However, there are some preserved as natural as it is. For this research, five site have been selected including Perdana Botanical Garden, Titiwangsa Lake Garden, Batu Metropolitan Park, Kepong Metropolitan Park and Permaisuri Lake Garden. Some of these parks got a wide water bodies volume that restricted user to directly access the wetlands area.

Kuala Lumpur consist of a plenty of green area to be discovered. Some of the green area naturally preserve but most of them are artificially design. However, for the research purpose, only five lake garden were selected. They are Perdana Botanical Garden, Titiwangsa Lake Garden, Batu Metropolitan Park, Kepong Metropolitan Park and Permaisuri lake Garden. Within these lake garden, not all wetland can be assessed, due to some lake garden contains a very big water bodies.

1.9.2 Water Contamination Experiment

Water bodies normally contaminated with nutrients and heavy metals. Water contamination was measureable in many ways, for example through Biochemical Oxygen Demand (BOD) test, pH level, water harness and temperature. Besides they