



UNIVERSITI PUTRA MALAYSIA

**HABITAT SELECTION OF SMOOTH-COATED OTTERS (*LUTROGALE
PERSPICILLATA*) IN PUTRAJAYA LAKES AND WETLANDS**

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(*LUTROGALE PERSPICILLATA*) IN PUTRAJAYA LAKES
AND WETLANDS**

HOURIS ADLINA BINTI HUSSAINI AMIR

A project paper submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia

In partial fulfillment of the requirement for the
DEGREE OF DOCTOR OF VETERINARY MEDICINE

Universiti Putra Malaysia
Serdang, Selangor Darul Ehsan.

DECEMBER 2023

CERTIFICATION

It is hereby certified that we have read this project paper entitled “Habitat Selection of Smooth-coated Otters (*Lutrogale perspicillata*) in Putrajaya Lakes and Wetlands”, by Houris Adlina Binti Hussaini Amir, and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999 – Final Year Project.

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DEDICATION

To anyone who is afraid of doing what their heart clearly wants

and what their mind forbids due to irrational doubt,

yet in the end, relentlessly go after it anyways with hope that

it may benefit the world somehow,

this one's for you.



ACKNOWLEDGEMENT

I would like to express my heartiest appreciation to Assoc. Prof. Dr Hafandi Ahmad, my supervisor who has given me the freedom to conduct my FYP that aligns with my pure interests as well as his support and solutions to the problems I faced on the way to finishing this project.

I would also like to thank Assoc. Prof. Dr Hasliza Abu Hassim for keeping me in line with the scope that I have chosen for myself.

Next, I would like to thank the people from Perbadanan Putrajaya (PPJ) for agreeing to let me have access to their lakes and wetlands to become my study area, especially Puan Yahzam Binti Muhammad for setting a board meeting to get my ideas out to the committee of PPJ. I would also like to extend my thanks to En. Faruq who works as a wildlife contractor from the same organization whom has helped me maneuver around the otter habitats easily.

Of course, I would be nothing without the support of my parents, family and friends for all the time they have sacrificed and also the words of encouragement that has been nothing but another form of His divine help that has guided me along the way.

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ABSTRAK

Satu abstrak kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar sebagai memenuhi sebahagian daripada kursus VPD 4999 - Projek Akhir Tahun.

PEMILIHAN HABITAT OLEH MEMERANG LICIN (*LUTROGALE PERSPICILLATA*) SEKITAR TASIK DAN WETLAND PUTRAJAYA

Oleh

HOURIS ADLINA BINTI HUSSAINI AMIR

2023

Penyelia: Prof. Madya Dr. Hafandi Ahmad

Memerang licin (*Lutrogale perspicillata*) sejak kebelakangan ini, kian bertambah berani dalam memilih habitat yang berdekatan dengan kediaman manusia. Akibatnya, kes-kes pertemuan manusia dengan memerang serta konflik mula muncul walaupun tidak banyak dilaporkan. Kajian ini bermatlamat untuk menjadi perintis dalam menentukan persamaan di antara habitat-habitat memerang licin di sekitar tasik dan wetland di Putrajaya. Lima habitat yang akan digunakan sebagai sampel telah dikaji dengan bantuan Perbadanan Putrajaya dari tarikh 28 Ogos hingga 15 September 2023. Ciri-ciri habitat yang telah dikaji termasuklah; (1) ketersediaan ikan, (2) kualiti air yang didapati dari aras pH dan ammonia, dan juga (3) topografi kawasan yang diwakili oleh kecerunan gigi air

serta struktur persembunyian yang digunakan oleh memerang. Tingkah laku memerang juga telah dikaji demi memahami cara mereka menggunakan komponen habitat mereka dengan lebih terperinci. Hasil kajian telah menunjukkan bahawa kumpulan memerang licin tersebut yang terdiri daripada tiga ke tujuh individu di sekitar Putrajaya ternyata lebih cenderung untuk mendiami tali air, kawasan takungan air seperti empangan dan juga tasik. Kelima-lima habitat yang dikaji juga terbukti mempunyai persamaan dari segi kestabilan sumber makanan, kualiti air yang baik dan juga topografi yang serba sesuai bagi kehidupan memerang licin. Habitat A, merupakan lokasi yang paling dikunjungi oleh kumpulan memerang tersebut di kalangan lima habitat yang dikaji atas sebab menepati lebih banyak keinginan mereka dari segi mempunyai lebih banyak tempat persembunyian. Akhir sekali, memandangkan lima habitat memerang ini jauh daripada habitat-habitat lain yang dilindungi, adalah menjadi keutamaan untuk pihak-pihak tertentu dalam menyediakan perlindungan yang sepatutnya kepada spesis-spesis ini yang diancam kepupusan dari aspek kemusnahan habitat.

Kata kunci: *memerang licin, habitat, tingkah laku, konservasi, konflik hidupan liar, topografi, kualiti air*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999 - Final Year Project.

HABITAT SELECTION OF SMOOTH-COATED OTTERS (*LUTROGALE PERSPICILLATA*) IN PUTRAJAYA LAKES AND WETLANDS

By

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2023

Supervisor: Assoc. Prof. Dr. Hafandi Ahmad

Smooth-coated otters (*Lutrogale perspicillata*) are recently growing bolder in residing among urban cities in Malaysia. As a result, cases of human-otter encounters as well as conflicts are starting to emerge despite being heavily under reported. This study aims to pioneer in discovering the similarities in characteristics between the habitats selected by smooth-coated otters in Putrajaya lakes and wetlands. Five sampling zones were assessed through verified sighting records provided by Perbadanan Putrajaya from the 28th of August to 15th of September 2023. The habitat characteristics studied were generally; (1) the availability of fish, (2) the water quality as described by the pH and ammonia levels, as well as (3) the topography of the area that was represented by the angle of bank slopes and presence of cover structures. The behavior of the smooth-coated otters was also studied to understand the way they utilize available habitat

components. Results showed that the smooth-coated otters were found to occupy waterways, reservoirs, and lakes within the city centre in a group ranging from three to seven individuals. It is found that all five locations share similar traits in terms of stable food supply, good water quality, as well as suitable topographies for them to survive with. Out of the five locations, Location A was more frequently visited by the otters possibly due to having more desirable habitat components that tend to their needs and preferences like having more islands as cover structures. Lastly, since the locations are far from protected areas, it is hoped that necessary protection is given to these vulnerable species by the respective organizations.

Keywords: *Smooth coated otters, habitat, behavior, conservation, human-wildlife conflict, topography, water quality*

1.0 INTRODUCTION

1.1 Habitat study of urban smooth-coated otters

Out of the 13 species of otters worldwide, four of them can be found in the wetlands of Malaysia, namely the Asian small-clawed otter (*Aonyx cinereus*), Hairy-nosed otter (*Lutra sumatrana*), Eurasian otter (*Lutra lutra*), and Smooth-coated otter (*Lutrogale perspicillata*) (Abdul-Patah et.al., 2014). Among the four, the smooth-coated otter is relatively common and more widespread as there has been reports of them boldly co-existing within urban settlements throughout the Klang Valley of Malaysia, aquaculture ponds of Thailand and the reservoirs of Singapore City (Foster-Turley et al., 1992; Kamjing et al., 2017; Anusha et al., 2023) . Besides the three countries stated, they can also be found in the wetlands of Bangladesh, Bhutan, Brunei, Cambodia, India, Indonesia, Iraq, Laos, Myanmar, Nepal, Pakistan, and Vietnam. Unfortunately, it is most likely to be extinct in China (Foster-Turley et al., 1992). Globally, these otters are declining in numbers and are currently categorized as Vulnerable according to the IUCN Red List of Threatened Species (2021), as they are threatened by human persecution, habitat loss, as well as wetland and waterway pollution (Acharya and Lamsal, 2010; Dong et al., 2010; Nawab and Hussain, 2012).

In general, smooth-coated otters are known to be semiaquatic mammals with a convex forehead and snout as well as a very dense, dark brown pelage that is double in layers which functions as a protection from the cold depths of the water via insulation. This matters because their subcutaneous fat reserves are minimal as it is limited to their flat-shaped tail which is another asset besides their thick pelt and webbed feet that adds to their swimming prowess, in order to

help them swim faster underwater (Baitechman and Kollias, 2000). Having adept modifications of their anatomy holds them accountable for being one of the many bio-indicators of a healthy wetland ecosystem since they are highly dependant on the water bodies where they obtain fishes to hunt from.

In terms of social hierarchies, smooth-coated otters are some of the few otter species that actually live and hunt in groups, much like the giant otters in Peru. They are also known to be both diurnal in undisturbed habitats and nocturnal in other places (Kruuk et al., 2006). This makes them able to carry out their roles or cause problems in their respective ecosystems on a large scale, and these two scenarios will be discussed later on.

However, there is little to no research on the population of smooth-coated otters as well as their habitats in the urban settings of Malaysia. Thus, this study that has taken place in the modern city of Putrajaya is hoped to be a valuable, pioneer take on the description of potential habitats of smooth-coated otters in urbanized areas that adhere to a list of linear characteristics. As human development flourishes, coexistence with this species of otter seems to be that of an unavoidable fate which can be altered from having too many conflicts by simply understanding their needs in a habitat better.

1.2 Objectives

General objective:

To investigate the habitat selection of *L. perspicillata* around Putrajaya lake and wetlands.

Specific objectives:

- 1.2.1 To study the water quality of habitats selected by *L.perspicillata*
- 1.2.2 To identify topographical components that are preferred by *L.perspicillata*
- 1.2.3 To study how *L.perspicillata* utilizes the habitat components for their survivability through their behaviour

1.3 HYPOTHESIS

Null Hypothesis (H_0): The otters around Putrajaya Lake and wetlands do not have a specific preference in selecting their habitat.

Alternative Hypothesis (H_A): The otters around Putrajaya Lake and wetlands have a specific preference in selecting their habitat.

1.4 JUSTIFICATION

Otters in general are presently known to have grown increasingly bold in terms of living within urban settlements. This study aims to help the public and also officials who govern urban recreational sites to make more informed decisions when choosing to live nearby thriving wildlife habitats. Besides helping to mitigate human-wildlife conflicts, it is hoped that a better understanding of habitat selection of otters will help us to coexist and protect them more efficiently in the future.

2.0 LITERATURE REVIEW

2.1 Importance of habitat in conservation

The habitat of an animal becomes vital in the world of conservation when the same habitat overlaps with that of another species that shares the same resources both species need and are unable to share them without breaking into conflict. This is in support of the definition adopted by Morris et al., (2006) in which habitat is an area with a combination of resources (e.g., food, cover, water) and environmental conditions (e.g., temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of a given species (or population) and allows those individuals to survive and reproduce. In the case of the smooth-coated otters that live closer to human neighborhoods and cities, their food resource clashes with the fishes us humans culture as food stock or even as ornamental fish (Anusha et al., 2023).

Hence, it becomes important to understand the way these newly-claimed urban species are choosing their habitats because only by understanding the specific reasons why a species uses specific habitat components, will it be better to predict how changes to those components are going to affect the species (Tarr et.al., 2021). These specific changes and the radius of effect it has on the population of the species would not come to be known if a basic understanding of the habitat is unclear, which leads us to the aim of this study which is to guide future management and restoration choices by describing the resources that are most advantageous to a focal species that needs to be protected (Rodewald, 2015).

2.1.1 Key habitat parameters

The general view on habitat is that it consists of four primary aspects, namely shelter, water, food and space, and it is only habitable to a certain species if they deem each aspect as sufficient in ratio to their needs (Rutledge et al., 2023).

To further elaborate the myriad of parameters that needs to be studied when talking about habitat is by listing out examples of values under each aspect. Shelter is described by the kinds of natural landscapes an animal uses to take cover from. For example, it could be under tree roots for otters or fallen tree barks for salamanders to regain moisture from (Kruuk, 2006). These shelters can also be counted in terms of quantity by taking note of its abundance in a certain area.

The complexity of habitats again, lie in their connection to other species as well where if one habitat is destroyed, another species would suffer from loss of food resources or, another species would experience an overgrowth in population, causing an imbalance to another population of animals (Morrison et al., 2006). Hence, population demographics also can be measured to determine habitat quality.

Morrison et al. (2006) suggests that only by incorporating additional information on a species' biology into the study designs chosen, will we be able to measure the right valuables at the right places and time. This then requires researchers to undergo continuous study to the point of understanding a species'

life history strategy. Where and when crucial events like migration, breeding and hunting occurs, offer the opportunity for researchers to pop up during a rewarding time to get adequate results from a sufficient group of samples (Krausman, 2016).

2.1.2 Habitat selection and preference

Terminologies are also something that needs to be addressed for this matter in order to differentiate when a habitat is used for reaching the bare minimum for an animal and when does it become one that triumphs over other chosen habitats.

By Wecker's (1964) definition, the study of habitat selection of a certain species would mean to study the active behavioral process by an animal as it searches for components and features in an environment and determine for themselves whether they are associated with the resources that the animal would need to reproduce, survive, and persist. In the same study, it highlights that habitat selection is a compilation of innate and learned behaviors that rely on the genetic programs of each species. (Wecker, 1964).

Habitat preference takes habitat selection to the next level. It is the consequence of the species selecting several habitats to be their own but uses the habitat with more resource on a disproportional level over the others (Krausman, 2016). Smooth-coated otters in this case, are known to build several holts across different habitats.

It is vital to take note that not all habitat preferences are habitat requirements. For instance, the fact that many otters like to rest on banks with good cover is a clear preference. This is because, in places where prey are bountiful, otters can also come in numbers despite that place not having much cover - hence, it is not a requirement (Kruuk et al., 2006).

2.2 Recorded habitats of otters

In the wilderness of Malaysia's wetlands, smooth-coated otters are found along large, main rivers, reservoirs and lakes as well as rice paddies (Foster-Turley 1992; Sivasothi and Nor 1994). In another recent study by Abdul-Patah, (2014) it was found that these specific otters also prefer to hunt near habitats with large water bodies. This correlates with a study which revealed that they prefer to be in midstream, downstream and mouth areas of a river (Kruuk et al, 1994).

Otter holts or dens are usually found under tree roots or fallen trees, 20 metres from the water according to Anoop and Hussain (2004). Another thing to note is that otters, although not a migratory species, tend to depend on several holts in their lifetime and spend more time outside to rest and bask (Kruuk et al, 1994).

2.3 Human-otter conflict

Across Malaysia and Singapore, there certainly has been reports of conflict which commonly enterprises in the results having an aquaculture farm or pet koi fish pond raided by a group of smooth-coated otters or in even dire cases, being attacked by provoked otters while going out for a stroll in the park.

Due to the frequency of such events happening, these direct and indirect human encounters with smooth-coated otters have stirred up heated debates on the management of the critters in Singapore (Lee and Pierson, 2020). Smooth-coated otters within the city center have damaged property when foraging in fishponds in neighbourhoods and commercial areas (Pierson, 2020; Tham, 2021).

Unfortunately, this proximity of smooth-coated otters to human-dominated habitats in Singapore may also negatively impact otter conservation efforts. For example, similarly in Malaysia, smooth-coated otters have died after being involved in roadkill accidents, injuries from entanglement in unattended fishing traps, as well as being hunted and having their corpses hung after being caught stealing fish (Khoo and Sivasothi, 2018; Tan, 2019).

2.3.1 Zoonotic diseases

Little is known about the zoonotic diseases that otters can transmit, due to a lack of studies. However, among the several few, *Toxoplasma gondii* is known to be the most prominent cause of death to otters in general, especially those that select their habitats nearby residential areas that houses or attract cats (PA Conrad et al., 2002). No research has been done on smooth-coated otters yet.

Extensive research however, has been done on sea otters (*Enhydra lutris nereis*) affected by these protozoan pathogens following an outbreak of death which also explains about the risk factor of this disease. Apparently, the residue of the cat's feces which has been runoff into the waters by rainfall or

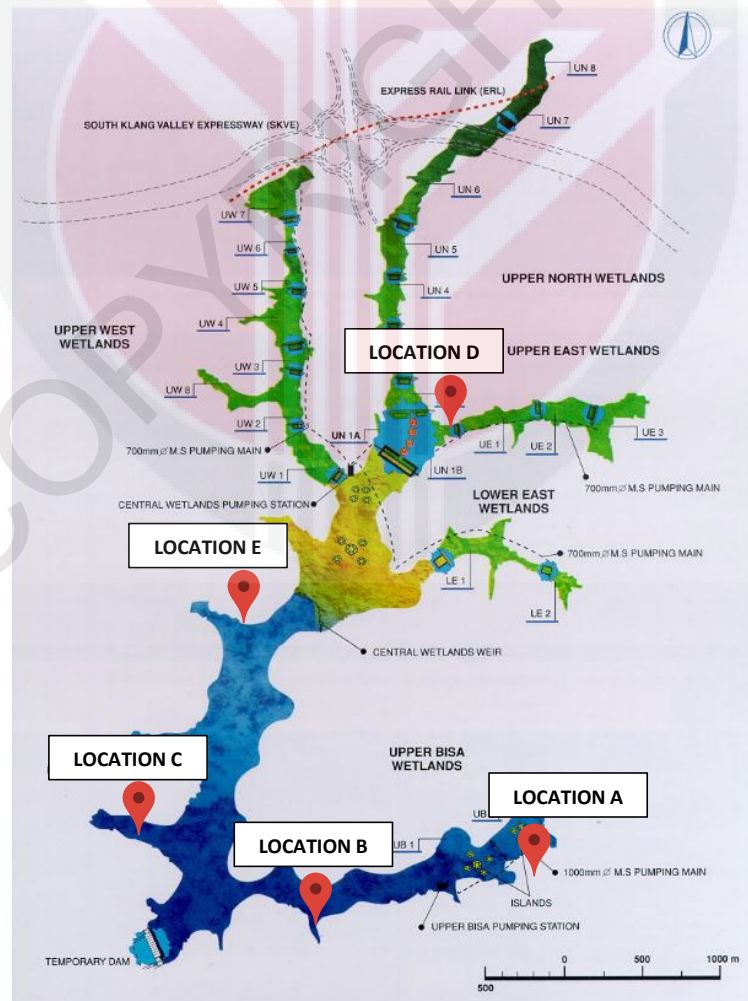
ineffective waste management is the main cause of this outbreak. Since these pathogens latch onto the snails eaten by said otters, these otters are affected the most, causing encephalitis and ultimately, death for the otters (PA Conrad et al., 2002). As of date, no such vaccinations eligible under the Food and Drug Administration (FDA) has been made known.

Other zoonotic diseases worth mentioning albeit being rarely reported and discussed about would be rabies, leptospirosis, and canine distemper disease (Noha Abou-Madi, 2019 ; Potter et al., 2007).

3.0 MATERIALS AND METHODS

3.1 Study area

The five locations were all given by Perbadanan Putrajaya (PPJ) according to their records of previous otter sightings in the same given locations. The locations required us to use both vehicle and foot to get as close as possible to the water bodies where the otters were once spotted. In general, all five locations were around the length of the Putrajaya lake and wetlands which took up to 6km in distance in total, demonstrating the ability of the otters to travel long distances.



Source: PLWMOS (Putrajaya website on lake & wetland)

3.2 Animal

There was only one group of otter family observed in the area with approximately 2 to 7 individuals spotted at the same time. How we were able to determine all otters observed are from the same family is made possible by the justification and judgement made by S. Anusha et al., (2023) where they considered two groups are from different families if they were sighted the same day in one location. They have also added that if the number of pups and adults differed in numbers of more than three, the two groups are also distinct. However, more time and area of study is needed to confirm this fully.

3.3 Habitat assessment

For habitat assessment, five characteristics that will astute for food stability, water quality and suitable topographies will be represented by namely 1) Availability of fish 2) pH level of water, 3) Ammonia level of water, 4) Angle of bank slope and 5) Presence of cover structures.

For values that are purely subjective and observed by our eyes, they were to become a nominal value, like the availability of fish and presence of cover structures. Water parameters like pH and ammonia were measured using a kit borrowed from the veterinary faculty's Aquatic Animal Health Unit (AAHU) which is the API Freshwater Master Kit and also Merck's *Universalindikator* pH 0-14. Pictures of bank vegetation, trees by the shore and also islands were taken as proof of cover structures available, whereas the slopes of the bank were

measured using a clinometer from the 'Measure' application that is available on mobile devices.

3.5 Behavior observation

The behavior of the group of smooth-coated otters were observed for a total of four days after attempting to search for them in the wild for 10 days from the 29th of August to September 15th, 2023. A group of observers consisting of students and wildlife contractors from Perbadanan Putrajaya (PPJ) worked separately to report any sightings of otters and record any behaviors acted out by the otters in a span of fifteen minutes after they are first spotted on site. Videos and photos of the otters were recorded using digital single-lens reflex (DSLR) cameras and phones of the observers. Apart from that, location, number of otters, time and date of sighting were also recorded.

The behaviors exhibited by the otters were recorded into an ethogram form, with the definition of each behaviors modified from a study on the behavior of smooth-coated otters by Travell and Fernandez, (2022). The otters' ethogram was noted every minute in a span of 15 minutes. The time we chose to observe the otters was during the early dawn to late dusk as suggested by the wildlife contractors.

3.6 Data analyses

Comparing the data of habitat characteristics between the five locations as well as presenting the behaviors shown by the otters were done using SPSS One Sample T-test as well as Microsoft Excel 2013 respectively.



4.0 RESULTS

4.1 Characteristics of each habitats

Table 4.1 shows the habitat characteristics exhibited by each location. Results shows that all five location are quite similar in characteristics, however, for the values indicating availability of fishes, presence of cover structures and also ammonia levels could be considered as a constant variable. As for the pH levels and bank slope measurements, a one-sample T-test was run to determine how much does their values vary from each other, and if yes, whether it is at a significant rate or not.

Table 4.1 : Habitat characteristics exhibited by each location

	A	B	C	D	E
Availability of Fishes	YES	YES	YES	YES	YES
Presence of Cover Structures	YES	YES	YES	YES	YES
Ammonia Level? (ppm)	0	0	0	0	0
pH Level (pH)	7.2	7.2	7.4	7.0	7.8
Angle of Bank Slope (°)	11	6	10	11	7

4.2 The pH level of water in different habitats

Figure 4.2 shows the pH values of water from 5 habitats. Running a one-sample T-test revealed that there were no significant differences between the values presented by each location with a p-value of 0.078 that is slightly higher than 0.05.

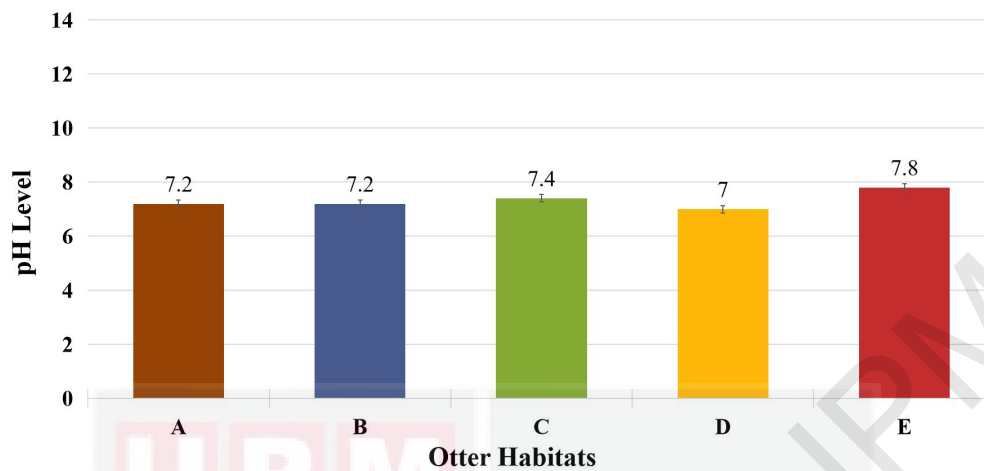


Figure 4.2 : The pH values of water from 5 habitats

4.3 Angle of bank slope in different habitats

Figure 4.3 shows the angle of bank slopes from 5 habitats. All five habitats displayed an acute angle of bank slopes with the p-value being 0.394, which is still more than 0.05, deeming the differences between the values insignificant.

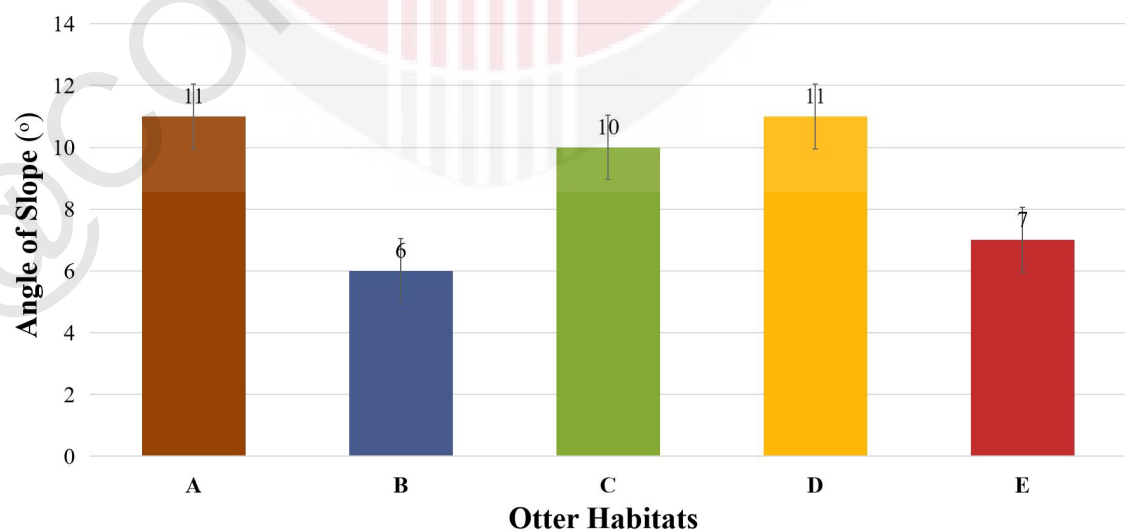


Figure 4.3: The angle of bank slopes from 5 habitats

4.4 Frequency of otter sightings

Figure 4.4 shows the number of otter sightings from 5 habitats. In a span of 10 days, the otter sightings were mostly spotted in Location A whereas the other locations showed sightings that were contributed by locals and also PPJ's wildlife contractors.

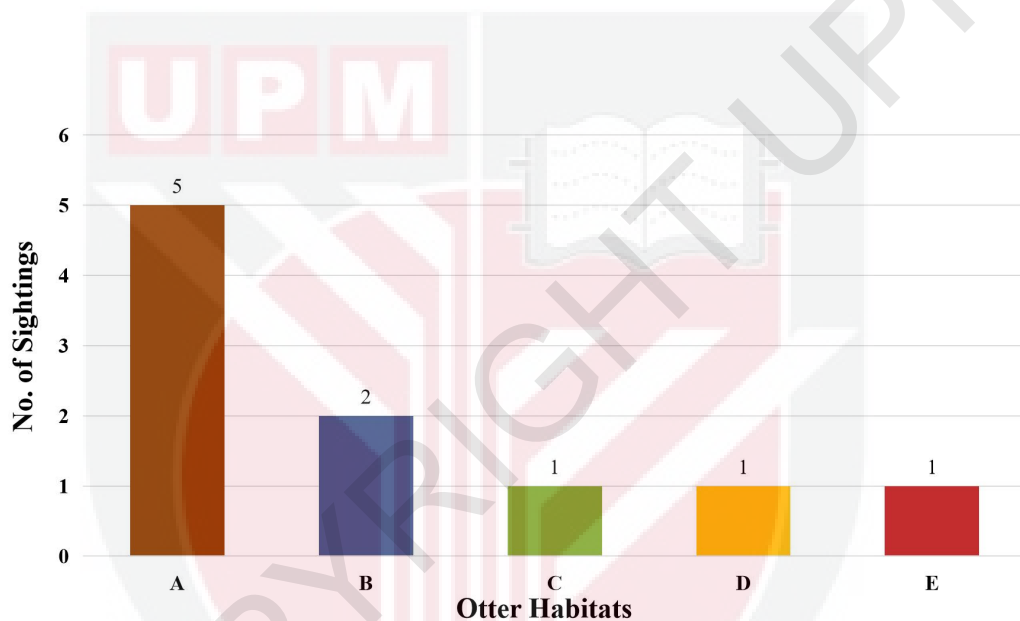


Figure 4.4 : The number of otter sightings from 5 habitats

4.5 Behavior of otters in location A

Figure 4.5 shows the behaviors exhibited by the otters that were recorded at location A. The top three behaviors seen from the otters in Location A were 1) them in locomotion, as in, moving from one place to another, be it on land or in water, 2) Hunting, as described by them diving underwater for a slightly longer period of time, occasionally resurfacing with a fish in its grasp, and 3) Not in sight, as a depiction for the times when the otters use the cover structures

provided for example, an island, to feed on or simply look for protection from onlookers.

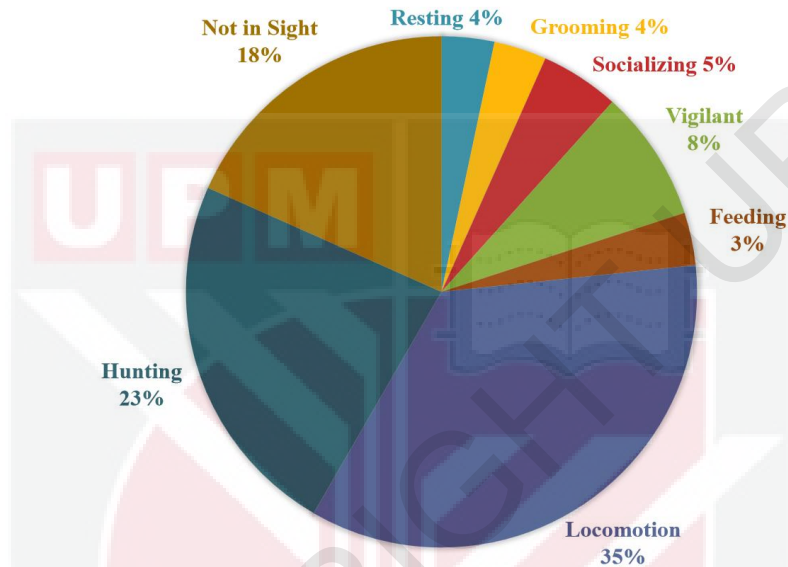


Figure 4.5 : The behaviors exhibited by otters in Location A

5.0 DISCUSSION

5.1 Description of urban habitats

The reason why Putrajaya lakes and wetlands was conveniently chosen as the study area was specifically because its an city in Malaysia where the infrastructure and theme is the closest to that of what we can see in Singapore City, an modern, bustling city that is glorified for its assimilation with otter habitats.

Similar to Singapore City, the habitats of smooth-coated otters in Putrajaya are quite close to human proximity given by the observation that all five locations have water bodies that are right beside jogging trails and neighbourhood at a distance of approximately less than 50 meters. This means that encounters of human-otters are inevitable during the times when the otters are most active which is during early dawn and late at dusk which coincides with the time locals in Putrajaya go out for a stroll near the water.

Due to limited amount of appliances and time, as mentioned, only five habitat characteristics were listed out to study. In all five locations, it can be gathered that all locations offer food stability as shown by (1) the availability of fishes, optimum water quality as represented by the water's (2) pH- level as well as (3) ammonia levels, and lastly suitable topographies as shown by (4) the presence of cover structures and (5) the slope measurement of shorelines from each location.

In addition, the water bodies utilized by the otters are classified as water reservoirs (that also act as dams), wide rivers and also lakes. These three water

bodies, in average, also share similar traits in terms of width and also depth which are approximately 50 meters wide and minimally 3 meters deep respectively. This links back to a study by which shows that in a habitat of three otter species that live together in the same vicinity, each species live on different parts of the river, where the smooth-coated otters tend to secure the part of the river that is most wide and deep.

The vegetation available across Putrajaya lakes and wetlands, despite most planted by man, also plays a huge role in habitat selection. These shrubs can be seen located by the shorelines of all water bodies that are deemed to be of otter territory and thrive well in abundance and undisturbed, despite being located in the city.

5.2 Utilization of habitat components

Habitat components used by different species are most definitely different from the kinds of components needed by other species (Krausman, 1999). This level of specificity means that a slight change made on one component done to improve the habitat quality of one animal may cause detrimental effects on other animals sharing the same location. Therefore, it is important to identify these components down to the roots in order to conserve the resources needed by the protected animals.

Based on the results we have gathered, it can be said that all five locations are quite similar in terms of water quality, food stability and also topography. Due to this, a myriad of natural otter behaviors were able to be recorded, especially in Location A where it is most preferred by the family of otters in Putrajaya. The top three behaviors being 1) Locomotion (swimming or crawling from one place to another), 2) Hunting (the act of diving underwater, foraging for fishes) and 3) Not in sight, which is related to the time the otters 'disappear' into their holts or cover structures to feed on their catch peacefully.

In the case of the urban otters of Putrajaya, it can be observed that they are able to utilize not only the bank vegetation as cover structures, but also the urban landscape and adapt to them very well. For instance, they have adapted to use the areas under the bridges of Putrajaya as spraint sites. This observation is in tangent with the observation made on the urban smooth-coated otters in Singapore where they also use areas under bridges and other areas accessible to humans to build holts and rest in (Khoo and Sivasothi, 2018). Spraint sites are vital in otter conservation because it is how these animals communicate with other species of animals and also among other group of otters to mark their territory. These spraint sites are also very hard to overlook as they smell like rotting fish (Kruuk et al., 2006).

Another thing to note about a smooth-coated otter's spraint sites is that they also distinctively use it differently in contrast to other otter species. At location A, we managed to observe them rolling and groom themselves on the same site they used for sprainting, which aligns with another study which found

that smooth-coated otters tend to flatten and spread out their faeces by rubbing and rolling on them (Kruuk et al., 1993).

The ground they used for grooming and as latrines is also very much a preference to them for two known reasons, 1) an acute angle of the bank slopes which is less than 15 degrees and 2) the combination of bank substrates. As we investigated the otters' spraint site in Location A closer, we managed to measure the slope of the bank to be at an 11 degrees and the bank substrates are a mixture of grass, soil and sand. Both of these factors are similar to the findings gathered by other researchers which concluded that smooth-coated otters prefer flat surface areas to spraint on and a combination of bank substrates for them to groom and dry their pelts easier, after a good hunt under water (Sayanti et al., 2006 ; Kruuk et al., 1993).

Moreover, the fact that their scat found on the banks of Location A and B is largely consisting of fish scales and bones prove the fact that these otters are mainly piscivorous and are able to obtain food from the location of which the scat was found, again proving that Location A, just like the other 4 locations is stable in providing food for the otters in the vicinity.

We were not able to specify the types of fishes preyed on in this study due to restraints. However, based on a study by Abdul-Patah et al., (2014), it is found out that the smooth-coated otters in other parts of Malaysia highly consumed fishes that either can be found in large schools and abundant in numbers, or simply the slower fishers which make them easier to be hunted underwater. Some examples stated by the same researchers are fishes like *T.*

trichopterus and *T. pectoralis* were highly consumed. It can be noted that some of the fishes stated are also an invasive freshwater species which may help solidify the otter's role at keeping invasive fishes at bay.

However, they are also known to be opportunistic feeders, which means that despite the fact that their diet more than 72% focused on fish, they may prey on frogs, snakes, crabs, and even marshland birds whenever possible (Foster-Turley, 1992 ; Mason and Macdonald, 1986). Perrin and Carugati, (2000) have also stated that the reason behind finding small remnants of birds preyed was because they are simply not designed to hunt on land hence proving that it may be an opportunistic hunting.

Furthermore, the smooth-coated otters around Putrajaya lake and wetlands were also found hunting using the bank vegetations that were available there such as reeds. They do this in the same manner recorded by Kruuk et al., (1994) which is by swimming alongside one another while driving fish into some reeds where they could be captured easily by making them swim erratically in different directions instead of just chasing after them in a straight line.

Last but not least, it is vital to remember that all of these findings would not be possible to gather if it was not for the good water quality provided by the area for these otters to thrive in. All five locations have shown an almost zero in terms of ammonia level whereas in terms of pH level, they are also in the range of pH that is optimum for the likes of aquatic wildlife which is from 6.5 to 8.0 pH (Baker et al., 1990)

The reason why these water parameter are studied is because they are highly responsible for the health of the residing plants, invertebrates and vertebrates alike. For example; pH levels, when fluctuated, are considered to be particularly responsible of physiologically stressing many species to the point of causing decreased reproduction, reduction of growth, and also cause diseases which may ultimately lead to fatality. In fact, even small changes of pH can affect the water composition as they alter the chemical state of many pollutants like copper and ammonia, in other words, changing their solubility and methods of transport (Baker et al., 1990). In the end, this will expose these toxins to the available aquatic plant and animals. This fact is in relation to ammonia levels because when ammonia is present in water at high levels, and it has its toxicity

altered by the temperature or pH, it becomes difficult for aquatic organisms to excrete the toxins inside its body, leading to toxic accumulation in internal tissues and blood, and lastly, death (Howells et al., 1983).

Moreover, this again reconfirms the role of smooth-coated otters as bio-indicators of a healthy ecosystem because of the fact that they mainly rely on fishes as their main food source. Fishes, on the other hand, are even more sensitive to fluctuating water parameters and will not linger for long in waters that are not healthy for them because low quality waters will definitely be a good medium for them to get aquatic parasites from, as well as diseases. In other words, optimum water quality will lead to the abundance of fish, leading to the presence of otters in a habitat of their choice.

5.3 Preference over location A

Based on the results, despite all five habitats sharing similar habitat characteristics in terms of food availability, good water quality and suitable topographies, it is shown that Location A is the habitat that is most visited by the smooth-coated otters of Putrajaya lakes and wetlands during the time of study. Reasons as to how this is possible is purely made out of observation and comparisons made with other studies found.

The first proposed reason is because Location A offers more cover structures compared to the other places. Despite the reservoir being only a mere 50 meters away from the closest house, the otters feel bold enough to rest and

groom on the bank slope. Location A wins in terms of having more cover structures that are able to make the otters feel safe because apart from being surrounded by reeds, the water body is also decorated by four mini islands in the middle of it with trees growing from them. It has been observed that otters swim towards the island while they were hunting and feed on their catch by the islands' shore. The other locations did not have any islands for them to do so.

Second, is probably because Location A is high in species richness, meaning that they are a biome to many sorts of wetland species ranging from monitor lizards, painted storks, water egrets, grey herons, and not to mention the types of fishes underwater that was not able to be identified. This scenario was not obvious in other locations studied. This richness of species offers the otters a myriad of animals to prey on and it may also be an indicator to just how resourceful and healthy the ecosystem is in Location A is.

A diverse combination of bank substrates can also be spotted in Location A, and not in other locations. This correlates with a study by Sayanti et al., (2021) who has observed that when a certain habitat has a mixture of bank substrates such as bedrock, boulders, sand and grass, it will have a positive influence on the usage of said habitat by the otters. This is due to the fact that otters use different substrate types according to their daily requirements which include denning, travelling and grooming. In this study, Location A's bank slope is that of an acute slope with a combination of sand, gravels and grass. The areas where it is sandy and has gravels are used by the otters to roll their bodies on, probably to

dry off their pelt after swimming whereas areas where it is still grassy are used at latrine sites.

Last but not least, what makes Location A exceptional is that all these characteristics and probably more, can be assessed in just one place, without having the otters to travel to other habitats to satisfy their different preferences.

6.0 Conclusion

In conclusion, smooth-coated otters (*Lutrogale perspicillata*) around Putrajaya Lake and Wetlands select their habitats according to a similar preference which includes; a stable food supply, optimum water quality, and also suitable topographies that are of benefit to the otters in that area.

7.0 Recommendation study

For future studies, I would recommend to increase the sample size to get a better idea of the population of otters in urban areas. This is because, this study is largely biased on only one group of otters in the whole Putrajaya. A bigger sample size with more groups and families of otters that are residing in urban areas would give way to more accurate conclusions and an even better understanding of their behavior towards other families when they tend to encounter one another. This might give more justice into comprehending how they mark their territories as well as the size of said territories.

Besides that, habitat assessment can actually benefit more from having a longer time duration which may span up to years of collected habitat parameters. This is because, habitats change from time to time and the resources they can provide for the otters may fluctuate as the seasons change. Understanding this will help determine the movement of otters in search of new habitats to make temporary holts in until the seasons change once more.

Furthermore, it is also recommended to study on other habitat parameters that are more specific for example, the types of fishes present in the water bodies as well their scat. A thorough assessment of habitat as well as the connection of the otters to other wildlife in the vicinity will help provide clues to understand their role in the ecosystem of the wetland habitat.

Lastly, since the smooth-coated otters are slowly encroaching upon residing in human habitats, it should be a must to also initiate studies on any risks or prevalence of zoonotic disease that may transmit from otters to humans and vice versa. This is to help raise awareness on any possible newly-minted reservoirs or carriers of harmful pathogens that has potential to harm both human and wildlife.

8.0 REFERENCES

- Koepfli K. P., Kanchanasaka B., Sasaki H., Jacques H., Louie K. D. Y., Hoai T., Dang N. X., Geffen E., Gutleb A., Han S., Heggberget T. M., LaFontaine L., Lee H., Melisch R., Ruiz-Olmo J., Santos-Reis M., Sidorovich V. E., Stubbe M., and Wayne R. K. (2008). *Conservation Genetics*, 9, 1589–1604.
- IUCN. (2021). IUCN Red List of Threatened Species, Smooth-coated otters, <http://www.iucnredlist.org>.
- Department of Wildlife and National Parks. (2010). *Wildlife Conservation Act, Peninsular Malaysia*.
- Foster-Turley P.. (1992). "Conservation Ecology Of Sympatric Asian Otters *Aonyx cinerea* and *Lutra perspicillata*", Ph.D. Thesis, University of Florida, .
- Mason C. F. and Macdonald S. M.. (1986). *Otters: Ecology and Conservation*, Cambridge: Cambridge University Press.
- Foster-Turley P. and Santiapillai C. (1990). Action Plan for Asian Otters In *Otters*. An action plan for their conservation, pp. 52-63.
- Sabrina M. S. (1985). Some Observations On Otters At Kuala Gula, Perak And National Park, Pahang, *Journal of Wildlife and Parks*, 4, 20-24 .
- Wayre P. (1974). Otters in West Malaysia with observations on their status, distribution and habits, Research Report for IUCN & World Wildlife Fund, Malaysia.
- Mohammad Mohsin A. K. and Ambak M. A., (1983) *Freshwater Fishes of Peninsular Malaysia*, Serdang: Universiti Pertanian Malaysia, pp. 284.
- Lanszki B. J. and Sallai Z. (2006). Trophic flexibility of the otter (*Lutra lutra*) in southern Italy, *Mammalian Biology*, 71(6), 336–346 .

- Perrin M. R. and Carugati C.. (2000). Food habits of coexisting Cape clawless otter and spotted-necked otter in the KwaZulu-Natal Drakensberg, South Africa, *South African Journal of Wildlife Research*, **30**, 85-92 .
- Pardin R.. (1998). Feeding ecology of the neotropical river otter *Lontra longicaudis* in an Atlantic Forest stream, south-eastern Brazil, *Journal of Zoology*, **245**, 385-391.
- Anoop K. R. and Hussain S. A.. (2005). Factors affecting habitat selection by smooth-coated otters (*Lutra perspicillata*) in Kerala, India, *Journal of Zoology*, **266**, 15-23 .
- Abou-Madi, Noha. (2019). Natural History and Medical Management of Mustelids, *Medical Management of Wildlife Species*, pp. 283-296
9781119036586
- Miller M.A. , Gardner I.A., Kruder C. Paradies D.M. , Worchester K.R., Jessup D.A., Dodd E. , Harris M.D.I., Ames J.A., Pacham A.E., and Conrad P.A. (2002). Coastal freshwater runoff is a risk factor for *Toxoplasma gondii* infection of southern sea otters (*Enhydra lutris nereis*), **32** (8), 997-1006
- Sayanti B. , Bivash P. , Antony-Johnson J., and Syed-Ainul H.. (2021). Resource utilisation by smooth-coated otter in the rivers of Himalayan foothills in Uttarakhand, India, *Global Ecology and Conservation*, Volume 32
- Onwuka M., Rajpar M.N, Nurhidayu S. and Zakaria M., (2017). Habitat Selection of *Dendrocygna javanica* in Heterogeneous Lakes of Malaysia

- Shivram A. , Sivasothi N., Chia-Da Hsu, and Karen E Hodges. (2023). Population distribution and causes of mortality of smooth-coated otters, *Lutrogale perspicillata*, in Singapore, Journal of Mammalogy, Vol 104 (3), 496 - 508
- Travell N.P. and Fernandez K.. (2022). Environmental Conditions and Vigilance Behaviour in the Smooth-coated Otter, *Lutrogale perspicillata*
- Abdul-Patah P. , Nur-Syuhada N., Md-Nor S., Hiroshi S., and Badrul-Munir M.Z. (2014). Habitat and food resources of otters (Mustelidae) in Peninsular Malaysia, Proceedings of the Universiti Kebangsaan Malaysia, Faculty of Science and Technology 2014 Postgraduate Colloquium
- Baker J.P., Bernard D.P., Christensen S.W., and Sal M.J.. (1990). Biological effects of changes in surface water acid-base chemistry. National Acid Precipitation Assessment Program, Washington DC. NAPAP Report 13
- Howells G.G. , Brown D.J.A, Sadler K.. (1983). Effects of acidity, calcium and aluminum on fish survival and productivity: a review. Journal of the Science of Food and Agriculture 34(6):559-570
- Morrison M.L. and Mathewson H.A.. (2021). The Misunderstanding of Habitat, Wildlife Habitat Conservation: Concepts, Challenges, and Solutions (Wildlife Management and Conservation) : 1-8
- Morrison, M. L., Marcot B. G., and Mannan R. W., (2006). Wildlife-Habitat Relationships: Concepts and Applications. 3rd edition. Washington, D.C.: Island Press.
- Kruuk H. (2006). Otters : Ecology, Behavior and Conservation, Oxford University Press, Oxford England & New York, New York.

Rutledge. (2023). *Habitat-Encyclopedic Entry*, National Geographic Education Website, accessed 30 November, <<https://education.nationalgeographic.org/resource/habitat/>>



APPENDICES

Appendix A: Behavior definitions used to record ethogram

Behaviour	Definition
Resting	Individual is lying down relatively motionless. Eyes can be open or closed
Grooming	Individual is using their mouth or paws to clean themselves or scrape skin against a surface, usually rolling on the ground
Socializing	Individual is interacting with one another, include play-fighting, chasing, vocalizing, and carrying offspring in mouth
Vigilant	Being alert, looking around while stationary on land or in water. Head and ears can point towards a point of interest while vocalizing.
Feeding	Individual is stationary in one spot while eating a visible prey in sight
Locomotion	Individual is crawling or swimming towards a point of destination
Hunting	Individual is alone or joining a group of other otters while swimming in the water, diving into water, struggling to hold prey
Not in Sight	Individuals are hidden from sight
Excretion	Individual is engaged in excretion of urine or fecal matter

(Source: Travell and Fernandez, 2022)

Appendix B: Pictures of the 5 habitats studied



Location A



Location B



Location C



Location D



Location E

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Appendix C: One sample T-test results of pH levels from each habitats

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
pH Level (R)	5	7.3200	.30332	.13565

One-Sample Test

Test Value = 7

	t	df	Significance		Mean Difference	95% Confidence Interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
pH Level (R)	2.359	4	.039	.078	.32000	-.0566	.6966

One-Sample Effect Sizes

	Standardizer ^a	Point Estimate	95% Confidence Interval	
			Lower	Upper
pH Level (R) Cohen's d	.30332	1.055	-.105	2.144
Hedges' correction	.38015	.842	-.084	1.711

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation.
Hedges' correction uses the sample standard deviation, plus a correction factor.

Appendix D: One sample T-test result of slope measurements from each habitats

T-Test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
pH Level (R)	5	7.3200	.30332	.13565

One-Sample Test

Test Value = 7

	t	df	Significance		Mean Difference	95% Confidence Interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
pH Level (R)	2.359	4	.039	.078	.32000	-.0566	.6966

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