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# Analysis of riparian vegetation of a recreation site in Jeli, Kelantan

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**Abstract.** Lata Keding is recognised as one of the recreational areas in Jeli, Kelantan. It has the function to protect the riparian plant habitats but it is potentially threatened by anthropogenic activities. This study was aimed to determine riparian plant species diversity and estimate species abundance of riparian plant vegetation at Lata Keding, Jeli, Kelantan. The line transect method was used to collect vegetation data. The line transect was established about one km long and each plant species that exist within 3 m up to 5 m from the river bank were recorded. A total of 2389 individuals belonging to 36 families and 49 species were recorded in the study area. Species diversity with Shannon-Wiener Diversity Index ( $H'$ ) with a value of 2.89, while  $H_{max}$  was 3.99 and Evenness Index ( $E_H$ ) value was 0.72 for the study area. The most dominant families recorded with a high diversity of plant species were Family Melastomataceae (5 species), Asteraceae (5 species) and Fabaceae (3 species). A total of 529 individuals of *Clidemia hirta* from Family Melastomataceae was recorded as the most dominant species. Thirty-six species are classified as Not Evaluated (NE), six species classified as Least Concern (LC), four species as Near Threatened (NT), two species Vulnerable (VU) and one species listed as Critically Endangered (CR).

**Keywords:** Diversity; abundance; riparian; plant species; Lata Keding.

## 1. Introduction

Riparian vegetation includes plant communities in streams, on the river bank and in floodplains and is an integral part of riverine ecosystems. According to Maingi and Marsh [1], riparian vegetation along streams and rivers is diverse in species, structure and regeneration process, it plays an ecological function such as maintaining landscapes and biodiversity [2]. Besides that, it significantly plays an important and critical role in our ecosystem such as stabilising stream banks, storing nutrients, providing shade to stream banks and migratory fish, maintaining moisture in riparian soils and improving water quality [3,4].

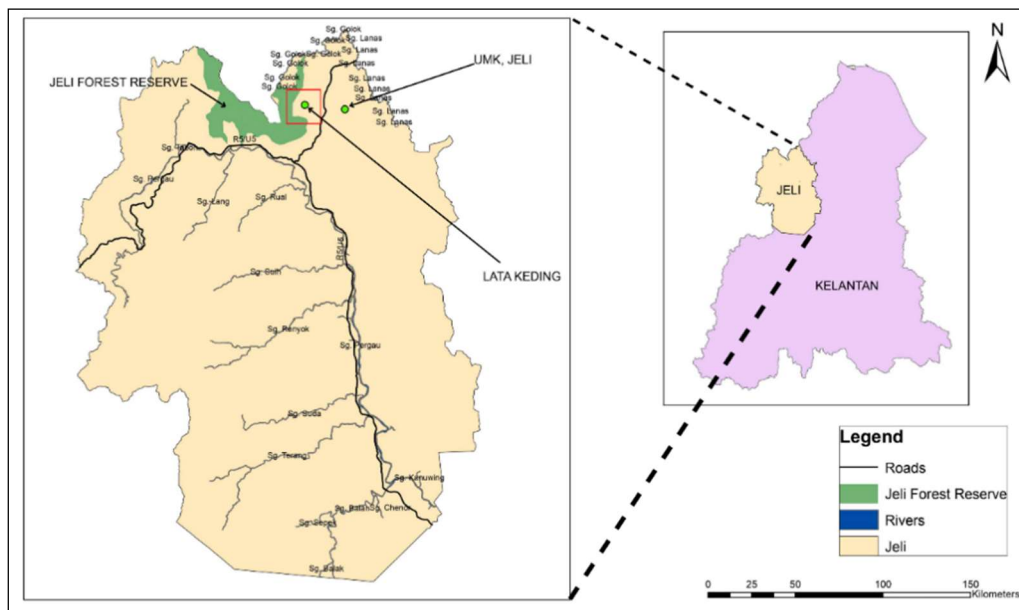
Jeli, Kelantan is known as a remote area but is currently being discovered with ecotourism hotspots such as Lata Turbo, Lata Kashmir and Lata Janggut. Recently, Lata Keding is actively being developed as a recreational area. However, this may cause a disturbance to the environment although the development on a small scale might affect the riparian species diversity. Thus, there is a lack of information on riparian diversity and conservation studies conducted in this area. Therefore, this study was carried out to document the riparian diversity and provide information to the recreational operator. Thus, this may guide the landowner to plan and sustainably develop Lata Keding.



## 2. Materials and methods

### 2.1 Study site

Lata Keding or popularly known as Lata UMK among UMK students and the Jeli community. It takes approximately 87 km from Kota Bharu, Kelantan and 257 km from Penang via East-West Highway. Lata Keding is geographically situated in Jeli District, in Kelantan state and lies between 5° 44' 51.396"N and 101° 50' 54.6"E (Figure 1).



**Figure 1.** Location of the study area in Lata Keding, Jeli, Kelantan.

### 2.2 Data collection sampling design

The line transect method was used to enumerate riparian plant species recorded in Lata Keding, Jeli. The transect line was set up for 1 km along the river and 3 m away from the river bank. Ten parts were divided in each 100 m distance along 1 km line transect and plants that exist along the transect area were recorded. Equipment such rafia ropes, measuring tape and poles and a hand-held Global Navigation Satellite System (GNSS) receiver was used to establish line transect. There are only certain plant species in each plot that were collected for preservation as a voucher specimen includes leaves, fruit, flowers and roots in the identification process. All specimens were processed at the Laboratory of Universiti Malaysia Kelantan Jeli Campus.

### 2.3 Data analysis

In this study, the calculation of frequency, density, abundance and their biological diversity indexes such Shannon-Wiener's Index was calculated. In addition, the calculation on of importance value of vegetation as referring to [5] equations as follows:

$$\text{Density} = \frac{\text{Total number of individuals of each species}}{\text{Extent of sampling area (1 km)}} \quad (1)$$

$$\text{Frequency} = \frac{\text{Number of parts where the tree species existed}}{\text{Total number of sampling units sampled}} \times 100 \quad (2)$$

$$\text{Abundance} = \frac{\text{Number of respective plant species}}{\text{Extent of sampling area (1 km)}} \quad (3)$$

The biodiversity indices were used to calculate the species abundance including species evenness by using Shannon-Wiener Index. Shannon-Wiener's Diversity Index [6] as in Equation (4).

$$H = - \sum_{i=1}^s p_i \log p_i \quad (4)$$

Where:

$H'$  = The value of Shannon Wiener's Diversity Index

$p_i$  = The proportion of the  $i^{\text{th}}$  species

Log = Natural logarithm of  $p_i$

$S$  = The number of species in the community

The maximum diversity ( $H'_{max}$ ) of a sample is found when all species are equally abundant as shown in Equation (5).

$$H'_{max} = \ln S \quad (5)$$

Where  $S$  is the total number of species.

Species Evenness ( $E_H$ ) can be computed from the Shannon-Wiener ( $H$ ) and species richness values as Equation (6):

$$E_H = H' / H'_{max} \quad (6)$$

### 3. Results and discussion

#### 3.1 Species composition

A total of 2389 individual plant species representing 49 species belonging to 46 genera in 34 families were identified along 1 km river in Lata Keding, Jeli (Table 1). The three highest families collected across all categories were Melastomaceae with 5 species, followed by Asteraceae (5 species), and Poaceae (2 species). Family Melastomaceae is most dominant with 573 individuals from 5 species and 5 genera while the least are Celastraceae, Anisophylleaceae, Loganiaceae and Burseraceae with 1 individual from 1 species and 1 genus each. A study conducted for the first time after 34 years of the establishment of the Sultan Mahmud Hydroelectric dam recorded a total of 41 families and 90 species of riparian plants [7]. A total of 27 species from 26 genera and 18 families of riparian flora were recorded along the riparian zones of Sungai Selangor [8].

**Table 1.** Numbers of genus and species along with total individual of each riparian plant family in the study area in descending order.

Family	Number of genera	Number of species	Number of individuals
Melastomataceae	5	5	573
Asteraceae	5	5	417
Poaceae	2	2	315
Selaginellaceae	1	1	161
Fabaceae	2	3	153
Zingiberaceae	1	1	127
Tectariaceae	1	1	110
Euphorbiaceae	2	2	103

Lecythidaceae	1	1	65
Annonaceae	1	1	64
Araceae	2	2	48
Musaceae	1	1	36
Violaceae	1	1	30
Moraceae	1	2	28
Apocynaceae	1	1	23
Aristolochiaceae	1	1	23
Arecaceae	1	1	16
Lindsaeaceae	1	1	13
Rubiaceae	1	2	12
Asparagaceae	1	1	12
Vitaceae	2	2	10
Lomariopsidaceae	1	1	9
Toricelliaceae	1	1	8
Aspleniaceae	1	1	7
Malvaceae	1	1	5
Dilleniaceae	1	1	4
Pandanaceae	1	1	3
Alismataceae	1	1	2
Phyllantaceae	1	1	2
Celastraceae	1	1	1
Anisophylleaceae	1	1	1
Loganiaceae	1	1	1
Buseraceae	1	1	1
Total	46	49	2389

The invasion of *Clidemia hirta* is the most dominant at Lata Keding as same reported by [9] at the Pasoh Forest Reserve (PFR) and also reported by [7]. According to [10] the presence of invasive non-native species, *Clidemia hirta* in PFR as the second most abundant species is a matter of concern. The invasion of *C.hirta* in the Pasoh forest may be the main source of soil disturbance and logging is most likely. The same issue discussed by [11], *Clidemia hirta* seemed to prefer habitat with such minor disturbances mostly along dark and nutrient-poor and trail edges in Endau Rompin National Park. This is most probably the reason *C.hirta* populations could thrive in riparian habitats because Lata Keding is in the development phase.

### 3.2 Species density, frequency and abundance

A total of 2389 individuals were recorded in the study area. The highest density was recorded with *Clidemia hirta* L. (Melastomataceae) with 571 529 ind/km, followed by *Imperata cylindrica* L. (Poaceae) with 273 ind/km density and *Chromolaena odorata* L. (Asteraceae) with the density of 164 ind/km.

The highest frequency is *Pleocnemia irregularis* C.Presl. Holttum (Dryopteridaceae) with 90% (110 individuals) and evenly dispersed along the stream at Lata Keding. Whilst, *Imperata cylindrica* L. (Poaceae) 80% (273 individuals) and *Selaginella willdenowii* Desv. (Selaginellaceae) 80% (161 individuals) were recorded along a 1 km river.

Species abundance is the number of individuals per species, and relative abundance refers to the evenness of individual distribution within a group between species. *Clidemia hirta* L. (Family Melastomataceae) is the most abundant with a total of abundance 75.57 S/N. *Chromolaena odorata* L.

(Asteraceae) followed with 41.00 S/N then followed by *Imperata cylindrica* L. (Poaceae) with an abundance 34.13 S/N. According to [7] among the recorded riparian plant species two species are introduced which are *Clidemia hirta* and *Mimosa pigra*.

### 3.3 Species diversity

As calculated, Table 2 shows that the  $H'$  is 2.89 and the  $H'_{max}$  recorded is 3.99. In most environmental studies, standard values are usually between 1.5 and 3.5 and the index is rarely higher than 4. These data are in standard value as they range in between 1.5 and does not exceed 4. Meanwhile, Shannon-Evenness Index ( $E_H$ ) was recorded with a value of 0.72. Based on the range from 0 to 1.0 the  $E_H$  value can be interpreted that the tree species along a 1 km river in Lata Keding is uniformly dispersed and distributed in 1 km of the study area as 0.72 is close to the value of 1.

**Table 2.** The list of diversity index  $H'$ ,  $E_H$ , and  $H'_{max}$  at Lata Keding.

Diversity Index	Value
Shannon- Wiener Diversity Index ( $H'$ )	2.89
Evenness Index ( $E_H$ )	0.72
Shannon-Wiener Maximum Index ( $H'_{max}$ )	3.99

### 3.4. Conservation status

A total of 49 species from this study are listed in the IUCN Red List. It was found that two species (*Bolbitis heteroclita* Pr. Ching) and (*Schismatoglottis calyptrata* Roxb.) fall under Vulnerable (VU), one species (*Macaranga tanarius* Müll.Arg.) is Critically Endangered (CR) whereas the rest of the species are listed as under Least Concern (LC) (6 species) and Not Evaluated (NE) (36 species). Species under Critically Endangered (CR) and Vulnerable (VU) are facing a high risk of extinction.

## 4. Summary

The present study showed that the riparian plant species in these recreational areas has a diverse population of riparian plant species with the potential to support biodiversity. A total of 49 species comprising 46 genera and 34 families were found within the study site. Our results indicated that Lata Keding, Jeli comprises riparian plant species with only 3 species fell under Critically Endangered (1 species) and 2 Vulnerable (2 species). Therefore, sustainable development is important to maintain and preserve the recreational area from improper development and destruction.

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