

**ACTION PLAN ON CONSERVING THE**

# **FIREFLIES**

**OF SELANGOR RIVER**

**2022-2030**

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**2022**

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## FOREWORD

The Action Plan on Conserving the Fireflies of Selangor River for 2022–2030 has been developed by researchers from the Forest Research Institute Malaysia (FRIM), working closely with stakeholders in Selangor State Government as well as support and contribution by local communities in Kuala Selangor. FRIM has been actively involved in firefly research since the 1990's, with the main focus on the fireflies of the Selangor River.

In relation to the decadal decline in firefly population, this Action Plan is developed to complement the existing Selangor River Basin Management Plan under the purview of Lembaga Urus Air Selangor (LUAS). The fourth policy in the Integrated River Basin Management (IRBM) Plan focuses on firefly conservation; however, this Action Plan covers scopes not mentioned in the IRBM. Both Plans are pertinent reference tools for agencies involved in firefly conservation. Basic understanding on the fireflies' biology and ecology requirements has given FRIM an insight to identify further measures that are needed to overcome the various challenges that negatively impact the viability of firefly population.

I thank the research team in taking the initiative to address this challenge. It is my hope that all stakeholders and local communities would support the Action Plan and further enhances its implementation. Together, we will take the necessary actions to ensure these iconic beetles continue flashing their mesmerizing lights.

Dr. Ismail Hj. Parlan  
Director-General, FRIM

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We are also grateful to the Selangor State Government and LUAS for their interest and their cooperation in addressing habitat loss issues, gazettement of sections of the Selangor River as a Protection Zone and reacquiring degraded land for rehabilitation work.

The Action Plan would not be materialised without our dedicated and passionate team at the Entomology Branch, namely, Shaiful Amri Mohd Som, Nafaruding Che Nan, Zaini Soit and former staff, Khirul Faizal Othman, Nor Azlan Muhammad Nor, Muhaimin Musa and Noor Baihaky Che Jamaludin. We are grateful to Dr. Laurence Gordon Kirton, retired Faunal Biodiversity Programme Head that has been our advisor since the very beginning of firefly research in FRIM, and remains actively advising us. Staff from Forest Biodiversity Division, Adi Purba Fadzilah and Mohd Fakhruddin Baharudin is ever ready to assist us in the field when we needed extra assistance.

Through the years of working together with the local community in Kuala Selangor, we have been grateful to cross paths with like-minded beings such as Abdul Razak Jalaludin, Samsul Afissam Mahad, Masbudi Abdul Malek, Inspirasi Kawa (youth environmental group) founders Affan Nasaruddin, Siti Norasiah Abd Kadir and Dr. Zeeda Fatimah Mohamad. Their passion and commitment to play a role in firefly conservation besides creating awareness one way or another has inspired us to persevere and continue to work closely with all parties for the betterment of the luminous beetles. Not forgetting the former Headman (Penghulu) of Pasangan District, Mohd Rizan Haron, village heads (Ketua Kampung) of Bukit Belimbing, Kampung Kuantan, Kampung Tanjung Siam, Kampung Asahan and Kampung Sepakat.

Input, feedback and ideas from the participants of the Stakeholder Workshop held in De Palma Eco-Resort Kuala Selangor on 10 December 2019 are most appreciated and much valued in our attempts to ensure sustainability of the firefly population along Selangor River.



## ACRONYMS AND ABBREVIATIONS

DOA	Department of Agriculture
FRIM	Forest Research Institute Malaysia
JKR	Jabatan Kerja Raya
JPS	Jabatan Pengairan dan Saliran
JPNS	Jabatan Perhutanan Negeri Selangor
LUAS	Lembaga Urus Air Selangor
MPKS	Majlis Perbandaran Kuala Selangor
MPKK	Majlis Pengurusan Komuniti Kampung
MPOB	Malaysian Palm Oil Board
NGO	Non-Governmental Organisation
PDT	Pejabat Daerah/Tanah Kuala Selangor
PERHILITAN	Department of Wildlife and National Parks
Tourism Selangor	Tourism Selangor Sdn. Bhd.
IPTA/IPTS	Institusi Pengajian Tinggi Awam/Swasta
UPEN	Unit Perancang Ekonomi Negeri Selangor

## EXECUTIVE SUMMARY

The Selangor River estuary is famously known for its large population of fireflies congregating mainly on *Sonneratia caseolaris* (Sonneratiaceae; *berembang*) that grow along the riverbank. Three out of the nine *Pteroptyx* species in Peninsular Malaysia occur along the river with the dominant species being the synchronous flashing *Pteroptyx tener*. These small beetles play an important role for ecotourism in the coastal town of Kuala Selangor and its adjacent villages, generating livelihood and income for the local communities. In response to the decline in firefly population, gathered through monthly monitoring programme using a non-destructive technique, this Conservation Action Plan (CAP) is developed as guidance for stakeholders and local communities to play an active role in firefly conservation.

This CAP for fireflies in Selangor River consists of five Strategies:

1. Controlled development within the Protection Zone;
2. Conservation of firefly ecosystem;
3. Sustainable firefly ecotourism;
4. Awareness on firefly conservation; and
5. Develop sustainable funding mechanisms for firefly conservation.

The strategies complement the existing Selangor River Integrated River Basin Management Plan (IRBM) Plan 2015–2020 Policy 4: Conserve fireflies and ecosystems. The IRBM for the period of 2022–2030, published in March 2022, is currently in the process for gazette under the State's regulations. Under this new Plan, Policy 4 is to be known as "Conservation of fireflies and ecosystems". The CAP will also be supported by measures, namely:

1. Research – Findings obtained from different fields of study will provide the basis for each strategy; and
2. Legislation – Protect the existing gazetted area to control development and pollution.

To undertake each measure, this CAP is divided into short (1–3 years), mid (4–6 years) and long-term (7–10 years) timelines. The list of various stakeholders and implementing agencies are included. Progress on the activities of each measure can be re-evaluated during periodic meetings held to monitor the progress of the Action Plan.



## Fireflies of Selangor River

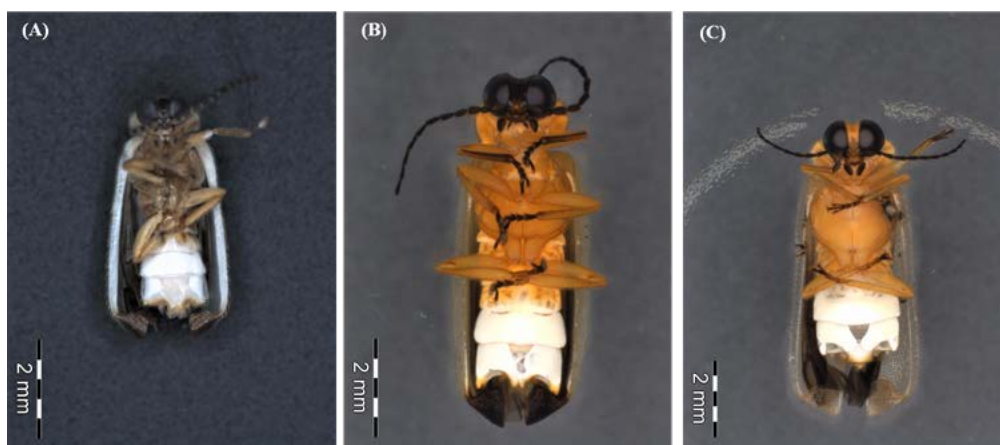
Kuala Selangor, a small coastal town about an hour's drive from Kuala Lumpur is famous for firefly watching tours operated along Selangor River. Between the years 2011–2016, a total of 475,000 foreign and local visitors visited the Kampung Kuantan Firefly Sanctuary Jetty (MDKS, 2017), not accounting the number of visitors in privately operated tours around Kuala Selangor. As the fireflies are the star attraction to this town, concerns about the declining population as observed by the concerned local nature enthusiasts and those actively involved in firefly tours were frequently reported by the media (Salina, 2004; Devid & Teoh, 2004; Arziana, 2009; Perumal, 2009; Premananthini *et al.*, 2015). Decline in the congregating firefly population is mainly caused by depleting natural riverine vegetation (Nada & Kirton, 2004; Nada *et al.*, 2010; Jusoh & Hashim, 2012; Khoo *et al.*, 2012), however, other factors such as pollution in the water or artificial light at night (ALAN) could also contribute to their decline (Yiu, 2012; Khoo, 2018). The riverine vegetation located just behind the *berembang* trees utilised by the adult fireflies to display their flashes on a nightly basis serves as a firefly breeding habitat.

Fireflies of Selangor River achieved many firsts, among them: 1) The most popular firefly watching destination in Malaysia; 2) A policy advocating firefly conservation under the IRBM Plan; and 3) Gazettement of sections of the Selangor River in the Pasangan District, Kuala Selangor as a Protection Zone under Section 48 of the Lembaga Urus Air Selangor Enactment 1999 following the detection of land clearing in the firefly habitat. The availability of a policy and Protection Zone, together with a Conservation Action Plan (CAP) can serve as a guidance for stakeholders and implementing agencies in Selangor and other states.

Fireflies are beetles from the family Lampyridae. The genus *Pteroptyx* are recognised for their marvellous group displays on certain trees, usually along riverbanks (Lloyd, 1973; Buck & Buck, 1976; Lloyd *et al.*, 1989; Nallakumar, 1999; Nagelkerken *et al.*, 2008) and can be found in Hong Kong (Ballantyne *et al.*, 2011, 2019; Jusoh *et al.*, 2018), towards the South through Philippines (Ballantyne, 2001), Southeast Asia and towards the West of India (Ballantyne & McLean, 1970; Ballantyne *et al.*, 2015). Flashing in fireflies is a means of communication and sexual attraction during the mating process

(Carlson & Copeland, 1985). At least two species, *P. tener* and *P. malaccae*, are able to flash in synchrony (Buck & Buck, 1968; Case, 1980). Synchronous fireflies were also found to occur in North America, in which the species *Photinus carolinus* (Copeland & Moiseff, 1995) and *Photuris frontalis* (Copeland & Moiseff, 2004) are synchronizers and do not congregate.

Based on studies conducted by Malaysian Nature Society, the fireflies can be found along an approximate 10-kilometer stretch at the upper reaches of the Selangor River estuary (MNS, 2002). *Pteroptyx tener*, a synchronous flashing firefly that is 4.0–6.2 mm in body length (Ballantyne & McLean, 1970) is the dominant species (Nallakumar, 2002) of the three found. Besides *P. tener*, the other two species, *P. malaccae* and *P. valida*, also occur, although in much lower abundance (Figure 1). *Pteroptyx malaccae* were mostly found downstream (Khoo, 2018) while the *P. valida* can be found high in the tree canopy. To the uninitiated, it is difficult to differentiate the three species if they were observed from the dorsal view. A quick identification in the field is ascertained through the male's flash patterns and shape of the light organs located at the ventral side.



**Figure 1:** Ventral side of three male *Pteroptyx* species found along Selangor River (A) *P. tener*, (B) *P. malaccae* and (C) *P. valida*.

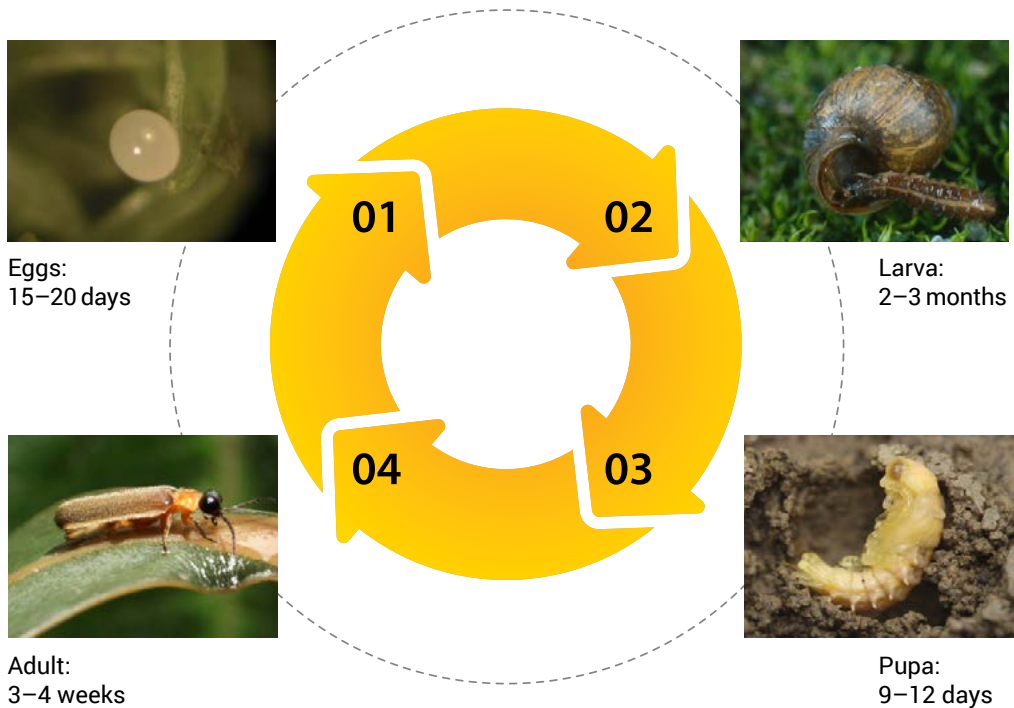
### ***Pteroptyx tener*: The habitat, biology and life cycle**

Adult *Pteroptyx* fireflies congregate in large groups on the mangrove trees, *Sonneratia caseolaris* lining the river on a nightly ritual throughout the year, although not all trees have aggregations. Only the males display synchronous flashes



(Case, 1980) beginning at dusk, whereby the flashes are brighter during early of the night and lasts till early hours of the morning, but with less flashing activities (Khoo & Kirton, 2012). They can also display on other tree species, although rare, such as *Talipariti tiliaceum* (Malvaceae; sea hibiscus), *Shirakiopsis indica* (Euphorbiaceae; mock willow), *Metroxylon sagu* (Arecaceae; sago), *Gigantochloa ligulata* (Poaceae; bamboo), *Ficus microcarpa*, *F. retusa* (Moraceae; ficus), *Urena lobata* (Malvaceae; caesar weed), *Tetracera indica* (Dilleniaceae; sandpaper vine), *Avicennia* spp. (Acanthaceae; *api-api*), *Durio* spp. (Bombaceae; durian) and *Garcinia* spp. (Clusiaceae; mangosteen) (Ohba & Wong, 2004); *Mangifera foetida* (Anacardiaceae; horse mango) (Nada & Kirton, 2004); bamboo from the sub-family Bambuseae (Nada, 2011); *Nypa fruticans* (Palmae; *nipah*) (Wong & Yeap, 2012) as well as *Barringtonia* spp. (Lecythidaceae; *putat*) and *Gluta* spp. (Anacardiaceae; *rengas*) (V. Khoo pers. obs.). During the day, the fireflies are often found underneath the leaves of the display trees. *Pteroptyx tener* is also found in mangroves in other states, namely, Johor (Benut, Kota Tinggi, Endau River), Negeri Sembilan (Kampung Sungai Timun, Rembau River), Perak (Sepetang River), Terengganu (Kerteh River, Chukai River), Sarawak (Kuching, Saratok) and in Sabah (Sandakan, Tawau, Kudat, Sipitang River) (Jusoh *et al.*, 2013).

Like other beetles, fireflies undergo a complete metamorphosis. *Pteroptyx tener* has a life span ranging from four to seven months (Figure 2) (Nada & Kirton, 2004; Nada *et al.*, 2005). The early stages of fireflies are found in habitats behind the display trees; in Selangor River, the predatory larvae and the snails (prey) are found abundantly in vegetation of *Metroxylon sagu* stands that are periodically inundated by river water (Nada, 2011). Females fly to the vegetation behind the display trees to look for suitable egg-laying sites along the crack and crevices of moist grounds. After 15–20 days, the eggs hatch into tiny larva and after several instars, the larva can grow up to 10 mm in size. Almost 60% of its life is spent as a predatory larva, feeding on the mangrove snail, *Cyclotropis carinata* (Assimineidae). After several molts, the larva transforms into pupa, in which it lays inactive for 9–12 days. The early stages of the firefly are spent behind the display trees, and once the pupa has developed into the adult stage, it will fly towards the trees lining the riverbank to begin the nightly flashing ritual, all for the purpose of attracting potential mates with a short lifespan of 3–4 weeks (Nada & Kirton, 2004; Nada *et al.*, 2005). There is not much information on firefly predators; however, there were observations on ants attacking firefly larvae (V. Khoo pers. obs.).



**Figure 2:** Life cycle of *Pteroptyx tener*.

## The Selangor River

According to DID (2007), the headwaters of the Selangor River flow from the foothills of Fraser's Hill and passes through the northeast region of Selangor, approximately 110 km before reaching the coast. In the upper catchment, the river is restricted to rocky banks and steep riverbeds, causing low accumulation levels of sediment and organic matter. This soil type and structure causes fast rising waters and swift river flows during heavy rainfalls. In contrast, the water velocity decreases, and the river width increases in the lower catchment. In this section, sediments accumulate in the flood plains.

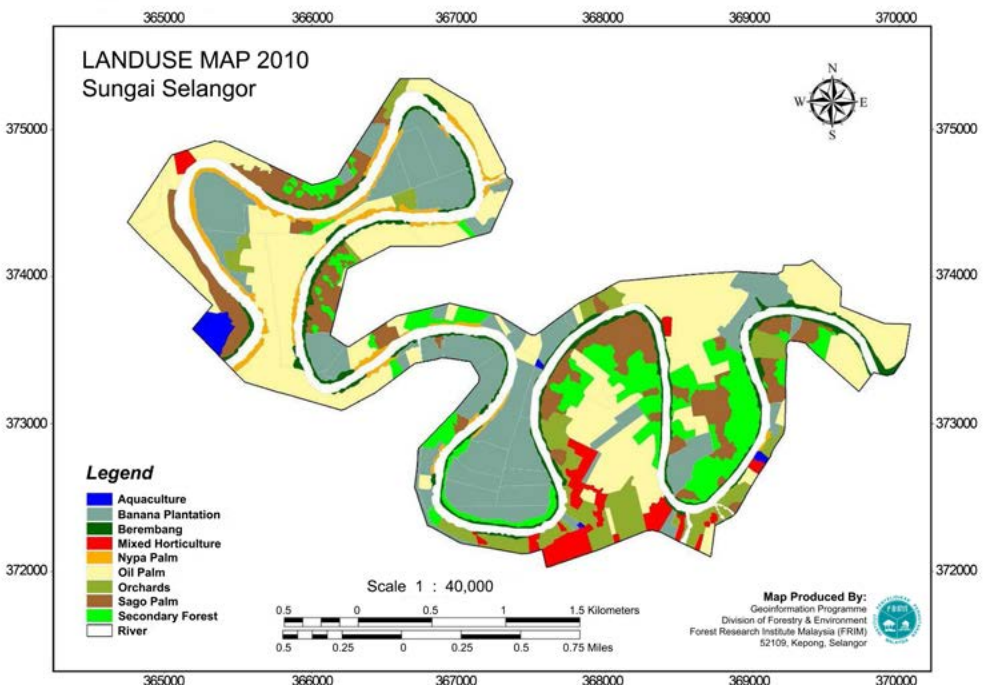
The upstream section is largely under forest cover dominated by hill forest and secondary forest. Many of the areas in the upper basin have been allocated as reserves, including parts of the Hulu Selangor Forest Reserve, Semangkok Forest Reserve and Bukit Kutu Forest and Wildlife Reserves. The midstream section has an



undulating terrain covered by rubber plantations and oil palm estates. This section has predominantly been used for agriculture; however, urban and industrial development has been on the rise. The lower part of the catchment area is a flat coastal plain predominantly covered by oil palm and mixed agriculture, towns and a large peat swamp. Majority of the areas along the river that once were mangrove swamps have been converted for agricultural purposes, however, a narrow fringe of this swamp is still present along the coast and in the estuary.

### Land use in sections of the Selangor River's Protection Zone

An effort to map the riparian vegetation was conducted by Khali Aziz *et al.* (2012) along the sections of the river utilised by FRIM's Entomology Branch to monitor the firefly population. The study area covered 637.1 ha (approximately 16.5 km of the river length) and confined to approximately 200 m on each side of the riverbank is located within the Protection Zone (1,104 ha) that was gazetted in 2009 (Figure 3). The distribution of the firefly population within the Protection Zone can be seen in Figure 4.



**Figure 3:** Land use map indicating the different vegetation and industries found along certain sections of the Protection Zone. Habitats suitable for fireflies as display trees and breeding grounds only covered 30.5% of the mapped area. Map source: Khali Aziz *et al.* (2012).

Based on Khali Aziz *et al.* (2012), vegetation utilised by the fireflies as display trees or breeding grounds such as *berembang*, sago, *nipah* and secondary forest (Nada, 2011; Nagelkerken *et al.*, 2008; Nada & Kirton, 2004) consists of only 30.5% of the total mapped area. The breakdown of the vegetation comprises of sago (11.2%), secondary forest (11.0%), *berembang* (5.3%) which was found all along the riverbank, stretching between 10–40 m and *nipah* (3.0%). Oil palm plantations recorded the highest percentage of land use at 32.8% followed by banana plantations at 25.0%. Aquaculture (0.9%) was the least found in this area and were mostly operated further downstream.



**Figure 4:** Distribution of the congregating fireflies in the Protection Zone (Indicated by the yellow dots). Map source: Google Earth.

## Threats to the fireflies

In a global survey conducted in January 2019 by the Fireflyers International Network (FIN, a scientific organisation comprising individuals with interests and expertise in firefly ecology, behaviour, taxonomy and conservation), the Southeast Asian respondents ranked habitat loss as the greatest threat followed by light pollution, water pollution and pesticide usage (Lewis *et al.*, 2020). In Selangor River, the major threats to the firefly population are habitat loss, salinity intrusion due to the



extraction of river water for agriculture and human consumption as well as pollution (Nada & Kirton, 2004; Nada *et al.*, 2010). Conversion of natural riverine vegetation behind the display trees is likely to have a higher impact on the younger stages of the fireflies, i.e., the eggs, larvae and pupae as well as the snails (food source for the larvae). These habitats are periodically inundated by tidal water and rich in decomposing plant material with shades from canopy closures, providing a suitable environment for the immature stages (Nada & Kirton, 2004). Natural habitat loss was substantiated through satellite images taken on 15 March 2005, indicating approximately 70% of the land had been modified or developed in a 5 km x 5 km area centering on Kampung Kuantan (Kirton *et al.*, 2006). Visible changes in the natural vegetation behind the firefly display trees of the sites monitored under FRIM's firefly monitoring programme were first observed in late 2007 and occurred gradually, affecting six out of the seven sites (Khoo *et al.*, 2009).

Salinity intrusion occurs when the natural flow of freshwater from catchment areas are obstructed by hardscapes such as dams (e.g., Sungai Selangor Dam) and reservoirs built upstream to cater to the demand for clean water supply. Furthermore, the operation of water intake facilities downstream could be another factor for salinity intrusion. The key water treatment plants in the Selangor Basin are the Sungai Selangor Phase 1, 2 and 3 plants at Bestari Jaya and the Rasa (IRBM Main report, 2015). The display trees, dominantly *berembang*, are less tolerant to high salinity levels that could cause stunted growth in height, leaf area and leaf length (MNS, 2002) and a decrease in net photosynthesis and stomatal conductance (Liao & Chen, 2007). During dry periods, there is a possibility of salinity intrusion exceeding the tolerance levels of trees. These could cause the fireflies to lose their display and mating sites and further affecting the sustainability of the firefly population and other species of flora and fauna inhabiting the downstream ecosystem. An increase in salinity is also associated with a decrease in pH level of the river water (more acidic). The mangrove snail's survival could be threatened as high acidity (pH < 4.0) may erode the shell that is made of calcium carbonate (MNS, 2002).

Pollution occurs in many forms and among those that directly threaten the fireflies' survival are water, air, and light. Studies by Leong *et al.* (2007) in the years 2002–2003 recorded high levels of chlorpyrifos (organophosphate found in pesticides) downstream that exceeded the US Environmental Protection Agency (EPA) limits for freshwater aquatic organisms. The leaching of residual agro-based chemicals into the river water could harm the firefly larvae and snails as their habitat is periodically

flooded by river water. Air pollution, in the form of haze is not known to cause an effect on insects. However, our long-term firefly population data recorded a decrease in the index of abundance of the adult firefly population in the months that recorded high readings of Air Pollution Index (API) (Nada *et al.*, 2012; Khoo & Nada, 2014; Khoo & Nada, 2016) except for one record that did not show a decline in firefly population with an unhealthy API level (Khoo & Nada, 2018). Effects of artificial light pollution on congregating fireflies were not studied previously, until recent studies showed that artificial lights sources emitting short wavelengths in the visible light spectrum had an effect on the firefly flashing behaviour (Khoo, 2018).

## Key findings from firefly research in the Selangor River

Findings from the various research conducted on the congregating fireflies of Selangor River are useful for the development of the Conservation Action Plan (CAP). The CAP can be customised to include findings in specific strategies and address the gaps of information on the firefly and habitat requirements. Firefly research in Selangor River had largely been conducted by the Forest Research Institute Malaysia (FRIM), Malaysian Nature Society (MNS) and some public universities' undergraduate final year projects. Among the highlights of the studies are as below:

### *Impact of the construction of the Sungai Selangor Dam in July 2000*

MNS (2002) showed that an increase in salinity and acidity downstream of the dam may possibly threaten the *berembang* trees and the mangrove snail, two important sources for the adult and larvae. Adequate freshwater supply is crucial to flush pollutants coming from river discharges such as oil from palm oil mills besides suppressing salinity intrusion. Conversion of vegetation in the flood belt behind the *berembang* trees into plantations and light industrial activities will have an effect on the firefly population from the aspects of water quality, habitat conditions and light pollution.

Some of the recommendations proposed in this study include:

1. Acquiring all river reserve properties to fully protect the area;
2. Attract the interests of land-owners involved in firefly ecotourism industry to stay motivated to protect the river reserve;
3. Enforce new sets of regulations and conditions on any development within the river reserve corridors in order to minimise impacts on the firefly population; and
4. Increase awareness of the local community on the importance of retaining the vegetation and habitat condition in the river reserve.



*FRIM's studies on the biology and ecology of P. tener showed the following:*

1. *Natural habitats*

Undisturbed natural riverine vegetation such as sago patches had higher abundances of firefly larvae and snails compared to oil palm plantations and fruit orchards (Kirton *et al.*, 2006). Preliminary observations also showed a low abundance of the firefly population in areas with higher human habitation (Nallakumar, 2002). Sago patches that were sampled had significantly lower air temperature and light intensity measurements and higher relative humidity in the understorey and the highest carbon dioxide level in comparison to oil palm plantation or fruit orchard. The results could possibly indicate that the larvae and snails have a better survival rate in a shaded, cool and humid environment (Kirton *et al.*, 2006; Hui *et al.*, 2006).

2. *Adult firefly population: an index of abundance*

Between 2007–2013, there was a 38% decline in population (Khoo *et al.*, 2016), and a further decline was observed at 42% between the years 2007–2018 (Khoo & Nada, 2018). Recent trends between the years 2007–2021 have shown an encouraging recovery, with the decline recording at approximately 23% (Khoo & Nada, 2022). Year 2007 is used as a baseline data as it is the only data available for the adult firefly population. The monthly monitoring programme conducted not only recorded the health of the firefly population, it had detected land clearing activities at the vegetation behind the display trees (Khoo *et al.*, 2009). The swift action taken by the local authority (MPKS), and the State led to the gazettement of sections of the Selangor River in the District of Pasangan, Kuala Selangor as Protection Zone under Section 48 of the Lembaga Urus Air Selangor Enactment 1999; this took effect on 2 July 2009 (Khoo *et al.*, 2012).

3. *Life cycle, its association with snails and the environment*

Adult *P. tener* prefers young *berembang* as display trees and there was no interaction between them and other invertebrates (Nallakumar, 2002). The abundance of adults was influenced by rainfall but not by the different moon phases or brightness (Nallakumar, 2002). Females were documented for the first time laying viable eggs naturally in captivity, besides obtaining data on the duration of each stage in their lifecycle (Nada *et al.*, 2005). Larvae feed on the snail, *Cyclotropis carinata*, a tiny mangrove snail found abundantly in sago stands that are periodically inundated by river water (Nada, 2011).

#### 4. *Artificial light at night*

Studies on artificial light pollution on display trees showed that brief short-term exposure to artificial light may interfere with their flashing behaviour briefly, however, long-term exposure causes the fireflies to move away from those trees. Khoo (2018) also showed that fireflies were insensitive to sources that emit longer wavelengths within the visible light spectrum.

#### *Social studies*

On social aspects, a social network analysis conducted by Mohd Shahwahid *et al.* (2016) indicated there was inclusivity with regards to boat ride and tour services, however, the involvement in the management decision-making by the district office could be further improved. On the satisfaction of services provided, Mohd Shahwahid *et al.* (2013) highlighted visitors' frustration with the quality of attractions, facilities and inadequate responses, tourist expectations before the visit, employees' inadequate knowledge of fireflies and inappropriate behaviours of employees and visitors.

Nadirah *et al.* (2020) indicated that the local community and visitors had considerable level of awareness on the firefly and habitat conservation, and acknowledged the on-going efforts taken to protect the habitat and population. The locals also perceived Kampung Kuantan Firefly Sanctuary to be the most popular firefly attraction site in Malaysia.

### **Efforts by various stakeholders on firefly conservation**

Sections of the Selangor River that are firefly habitats were gazetted as Protection Zone (Gazette Notice No. 2171/2009) on 2 July 2009 under Section 48, LUAS Enactment 1999. The Zone encompasses 1,104 ha of land including river reserves ranging from 150–400 m from the left and right banks of the Selangor River in the District of Pasangan (Portal Rasmi Dewan Undangan Negeri Selangor, 2010) (Figure 5). This gazettelement further strengthens the target in the IRBM Plan for Selangor River 2007–2012 under Policy 4: Conserve fireflies.

In addition to the Protection Zone, the State of Selangor had also reacquired disturbed land from private owners opposite the Kampung Kuantan Firefly Sanctuary for rehabilitation purposes (Figure 6). A pilot-scale rehabilitation effort began in late 2011, with five tree species planted along the riverbank (Ang *et al.*, 2013). Funds were procured through collaborations between the State and a private company.



More planting programmes followed, and these were jointly organised and funded by the private sector, local communities and state agencies. The planting sites and adjacent areas have since recorded a slow but increasing trend of firefly abundance (unpublished data). The firefly monitoring programme will continue to assess the success and efficacy of the rehabilitation efforts through temporal changes in population patterns.



**Figure 5:** Map of the Protection Zone of Selangor River in Pasangan District, Kuala Selangor. Map source: LUAS.



**Figure 6:** The rehabilitation site at its implementation phase in 2011 (left) and after two years (right).

Continuous support and involvement from key stakeholders, namely the Selangor State government, MPKS, PDT Kuala Selangor and LUAS are needed to implement firefly conservation. The Kuala Selangor Local Planning 2025 (*Rancangan Tempatan Majlis Daerah Kuala Selangor 2025*) fourth core value states “Sustainable conservation and management of the environment” (MDKS, 2013). Among its objectives are to preserve and conserve the river reserves and coastal areas as firefly and bird habitats, upgrade the Firefly Protection Zone, upgrade the status of Kampung Kuantan firefly sanctuary into a Wildlife Protection Zone and gazette Kampung Kuantan-Kampung Bukit Belimbing as an Environmentally Sensitive Areas (ESA) Rank 1. In addition, MPKS had selected Kampung Kuantan Firefly Sanctuary as an area for the development of *Rancangan Kawasan Khas (RKK) Ekopelancongan Kampung Kuantan-Taman Alam*; from this, an environmental management plan along the river at Kampung Kuantan towards the Kuala Selangor Nature Park (KSNP) and plans for *Pusat Pertumbuhan Desa (PPD)* in Kampung Kuantan is to be produced.

LUAS is also implementing some of the recommendations given by stakeholders, such as establishing the river buffer zone and the IRBM Plan for Selangor River and releasing sufficient water from the Sungai Tinggi and Sungai Selangor dams during dry periods. Integrated Water Resource Information Management System (IWRIMS) real-time monitoring system has been established state-wide to monitor the water levels at eight of its stations, and this includes the Selangor River.

## Conservation Action Plan (CAP)

The CAP is developed to mitigate firefly population decline that directly affects the livelihoods of local communities. The proposed CAP is derived from research findings, consultation with stakeholders’ and the local community. Each strategy has several measures with recommended actions to address the issue. Relevant agencies are responsible to execute the actions within the timeline suggested and outcome of the actions are measured through indicators and means of verification.

The stakeholders’ workshop for the preparation of this CAP was carried out on 10 December 2019 in De Palma Eco-Resort Kuala Selangor and was attended by 49 participants from government agencies, government-link agencies, institutions of higher learning, non-governmental organisations, private agencies and local community. The objective of the workshop was to obtain feedback on the draft CAP. Participants were grouped according to the five strategies based on the roles of the relevance of the agency to the strategy.



This CAP is developed to complement the existing IRBM Plan for Selangor River in particular to support Policy 4: Conserve fireflies and ecosystems in the Selangor River Integrated River Basin Management Plan (IRBM) 2015–2020 and an on-going Plan that is being finalised for the period of 2022–2030. The measures and actions proposed in this plan will require support and involvement of all agencies and the local community. The CAP considers aspects ranging from development to environment, tourism and public awareness with each of the aspects having research and development (R&D) elements. The plan should be reviewed and revised in tandem to the latest management plan prepared at the district level or the IRBM Plan.

The five strategies for the CAP are as follows:

Strategy 1: Controlled development within the Protection Zone;

Strategy 2: Conservation of firefly ecosystem;

Strategy 3: Sustainable firefly ecotourism;

Strategy 4: Awareness on firefly conservation; and

Strategy 5: Develop sustainable funding mechanisms for firefly conservation.

Strategy 1 covers controlled development within the Protection Zone. The first measure is through enhancement of the Local District Plan by including green technology. Development planning needs to have a balance between nature and environment with agricultural and infrastructure. Plantation practices and development of settlements within the Protection Zone require technical expertise from aspects such as river engineering and adopting green technology for buildings and nature-friendly measures to minimise impact on the ecosystem. Remote sensing technologies can be used to efficiently enforce and monitor existing activities within the Protection Zone and detect land-use changes within the Protection Zone.

Majority of the area within the Protection Zone consists of agri-food crops, mainly oil palm and small-scale inter-planting of banana between oil palm. These plantations can be managed sustainably through the implementation of Good Agricultural Practices (MyGAP), a scheme established by the MPOB. Small-scale plantation owners can be encouraged to adopt the practices by ensuring technical expertise and advice are readily available. Certification from MPOB comes with costs and this can be overcome by providing subsidies to these small-scale plantation owners. In 2002, MPOB established TUNAS (*Tunjuk Ajar dan Nasihat Sawit*) as a service to group 1000–2000 small-scale plantation owners for certification under a single certificate (Parthiban *et al.*, 2021).

Enhancing the existing Protection Zone through further gazettelement or classification of the Protection Zone could ensure that the firefly habitat has minimal risks to negative impacts. There are no forest reserves within and adjacent to the Protection Zone, therefore, it is important to consider this measure under existing Acts and according to the Local Plan. The *Akta Perhutanan Negara (1984) dan Pindaan (1993) Section 7-10* under Federal Government and under State *Enakmen A55 – Enakmen (Pemakaian) Akta Perhutanan Negara (Pindaan) 2018* as well as the Wildlife Conservation Act 2010 (Wildlife Sanctuary/Wildlife Reserve) are relevant acts. Monitoring of illegal land development and encroachment could be supplemented with the assistance from local communities. This could prevent encroachment into areas that had been acquired previously for rehabilitation. A reporting channel needs to be established to encourage communication between local communities and authorities.

Research is needed to better understand the long-term effects of development on the riverine ecosystem. Assessing the health of the riverine ecosystem through regular monitoring of the water quality, land-use and firefly population should be carried out when adequate funding is available. These assessments are useful indicators on the success of the actions proposed in this CAP.

Strategy 2 focuses on conserving the firefly ecosystem. To profit from maximum cost effectiveness, the State would need to identify, conserve and maintain existing areas that have intact riverine vegetation. As large tracts of the land along the river are privately owned, measures to minimise conflict-of-interest between the State and land-owners may include funding to rent-a-plot, full or partial adoption or lease of predetermined parcels of owned-lands. The land-owners who are not keen can be encouraged to retain a portion of their land for firefly conservation activities, in return of financial benefits.

Rehabilitation of the least degraded areas should be prioritised to maximise cost effectiveness. Activities of replanting, tree planting and tending need to be coordinated at all levels with appropriate guidance on the planting techniques with the involvement from stakeholders and local communities. The corporate and private sectors can be encouraged to conduct Corporate Social Responsibility (CSR) programmes via tree planting activities. To ensure the planting techniques are suitable for the habitat, research on soil properties, planting design and tree species suitability needs to be conducted before, during and after the rehabilitation programmes commence. This enables monitoring the progress of the rehabilitation efforts.



Efforts to carry out firefly conservation programmes require knowledge on the firefly's biological, ecological and physiological aspects. Technical information is obtained through continuous research conducted by research institutions and universities with adequate funding received. Scientific data is then converted to simplified terminology to enable the participation of non-scientists willing to contribute to nature. Citizen science plays an important role as it encourages the local community and nature enthusiasts to conduct rapid assessments on the environment, indirectly helping the science community in compiling data.

Strategy 3 is proposed for sustainable firefly ecotourism. Those involved in firefly ecotourism needs to have adequate and up-to-date knowledge on fireflies before embarking on firefly-friendly tours. The tour guides and boat rowers can be easily trained through courses taught by subject matter experts (SMEs). Findings from socioeconomic studies can be used to determine visitor carrying capacity to minimise impact of tourism on the firefly population and the environment. Brochures and information, validated by SMEs and revised regularly, should be disseminated to the public to ensure accurate and updated information is provided.

Sustainable and environmental-friendly development within the tourist area will have minimal impact on the fireflies and the ecosystem. The construction and upgrading of firefly tour centres should remain nature-oriented and visitor-friendly such as the types of lighting, construction materials used and safety aspects of facilities, boat rides and tours. Job opportunities for the local communities, direct or indirectly related to fireflies, will undoubtedly spearhead the success of firefly tours and the intended benefits aimed for the local community.

Awareness on and appreciation of firefly conservation is Strategy 4 in this Plan. The local community's participation through dialogue sessions and awareness programmes will instil knowledge on the importance of conserving the firefly habitat through MyGAP and maintaining natural riverine vegetation. Involvement in river clean-up programmes, citizen science research and other incentive mechanisms to enhance awareness among local communities, students in learning institutions and the general public can be instilled through regular programmes. Modules for extra-curricular activities can be easily prepared by SMEs that contribute to the conservation of the environment and fireflies.

The final strategy, Strategy 5, is crucial for the success of this CAP. Ensuring funding in a sustainable manner would enable the execution of the measures and actions in this Plan. It is proposed that a Firefly Conservation Trust Fund be set up with a goal to implement the related activities outlined in this CAP. Support for funding can be sourced from public-private sector partnerships, international sources available under various sustainable financing mechanisms and financial sectors.

### **Roles and responsibilities of implementation**

The Plan consists of five strategies with various measures and actions that require involvement of stakeholders at all levels. Within each action, it indicates which stakeholder works best with one another for the purpose of conserving the fireflies of Selangor River.

Establishing a new or having an existing committee conduct Steering Committee meetings is an important step to coordinate the CAP. The committee, comprising of main stakeholders, namely, UPEN, LUAS, MPKS, JPS, JPNS, DOA, DOE and FRIM can have periodical meetings to report, coordinate and review the progress of the firefly conservation activities proposed in the Plan.



### Strategy 1: Controlled development and land use activities in the Protection Zone.

**Objective:** To regulate and implement LUAS Enactment of the Protection Zone and incorporate nature-friendly initiatives in the Local District Plan (Rancangan Tempatan Daerah) for the Protection Zone.

**Outcome:** Minimise impact of development on the firefly habitat and population in the Protection Zone.

Measure	Action	Responsible Agency	Indicator	Mean of verification		Timeline	
				S	M	S	M
1.1 Enhance the Local District Plan to include a nature-friendly plan within the Protection Zone	1.1a Consult various experts to enhance the existing plan in various aspects such as: <ul style="list-style-type: none"> <li>Use environmentally friendly building materials for infrastructure and access roads.</li> <li>Minimise riverbank erosion.</li> <li>Use firefly-friendly lighting in public areas within the Protection Zone.</li> <li>Clear signages to indicate the gazetted sections of the Protection Zone.</li> </ul>	MPKS / JPSM / JKR / JPS / TNB	A nature-friendly Local District Plan developed for the Protection Zone.	Nature-friendly elements incorporated in the local planning within the Protection Zone.			✓
	1.1b Enhance enforcement activities through usage of updated remote sensing data for monitoring land-based activities within the Protection Zone.	MPKS / LUAS / PTD	Latest land-use maps within the Protection Zone acquired.	Changes to land-use in the Protection Zone identified.	✓	✓	✓

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
1.2 Implement good agricultural practices in the Protection Zone	<p>1.2a Encourage small-scale plantation owners to conduct myGAP; Malaysia Standard MS 1784: 2005 Crop Commodities – Good Agricultural Practices (GAP) and/or Malaysia Sustainable Palm Oil (MSPO) Certification.</p> <ul style="list-style-type: none"> <li>• myGAP scheme.</li> <li>• Certification scheme with premium pricing and affordable certification cost.</li> <li>• Collaboration between local authorities (MPKS) and DOA/ MPOB to create awareness on the importance of certification.</li> </ul>	MPKS / DOA / MPOB	Incentives and technical assistance rendered.	Small-scale plantation owners benefited financially from implementing good agricultural practices.	<p>✓</p> <p>✓</p> <p>✓</p>
	<p>1.2b Provide subsidies for certification costs under MyGAP and MSPO.</p> <ul style="list-style-type: none"> <li>• Financial assistance for certification through Roundtable for Sustainable Palm Oil (RSPO) Smallholder Support Fund and the jurisdictional certification scheme.</li> </ul>	MOA / DOA / MPOB / MPKS	Best-practices implemented among small-scale plantations.	Small-scale plantation owners certified.	<p>✓</p>



Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
1.3 Enhance the status of the Protection Zone	1.3a Consider further gazettement or classification of the Protection Zone through: <ul style="list-style-type: none"> <li>• Akta Perhutanan Negara (1984) dan Pindaan (1993) Section 7-10 under Federal and under Selangor State Enakmen A55- Enakmen (Pemakaian) Akta Perhutanan Negara (Pindaan) 2018</li> <li>• Wildlife Conservation Act 2010 (Wildlife Sanctuary/ Wildlife Reserve)</li> <li>• Rancangan Tempatan Majlis Daerah Kuala Selangor</li> </ul>	MPKS / JPSM / LUAS / PERHILITAN	Current gazetted area expanded with reference to existing Acts and incorporation in the Local Planning.	Firefly habitat legally protected and enforcement aspects improved.	<div style="display: flex; justify-content: space-between;"> <span>✓</span> <span>✓</span> </div>

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
1.4 Monitor illegal land development in the Protection Zone	1.4a Regular patrolling by local authorities to ensure the activities are as prescribed by the Protection Zone.	MPKS	Periodical patrolling by local authorities in the Protection Zone.	Patrolling activity reported periodically.	✓	✓	✓
	1.4b Engage local communities to assist in patrolling.	MPKS / MPKK	Local people appointed as patrolling volunteers.	Reports from patrolling volunteers received.	✓	✓	✓
	1.4c Prevent encroachment of acquired and rehabilitated areas in the Protection Zone.	MPKS	Periodical patrolling by local authorities in the acquired and rehabilitated areas.	Log of patrolling kept.	✓	✓	✓
	1.4d Identify a reporting channel for locals to inform authorities of land encroachment or uncontrolled development.	MPKS / LUAS / MPKK	Early detection of encroachment activities in the areas. Reporting channel identified.	Incidences of encroachment reported immediately to relevant enforcement agencies. Land encroachment and uncontrolled development reports channelled to relevant enforcement agencies.	✓	✓	✓



Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
1.5 R&D on long-term effects of development on the health of the riverine ecosystem	1.5a Assess the health of the riverine ecosystem through monitoring of water quality, land-use and firefly population.	LUAS / JAS / PTD / FRIM	Monitoring data obtained and analysed.	Status of the riverine ecosystem defined.	✓	✓	✓
	1.5b Provide adequate funds to conduct research relevant to effects of development on the health of the riverine ecosystem.	UPEN / LUAS / MPKS / NGO	Funds received by research institutes / IPTA / IPTS from various agencies.	Possible effects on the riverine ecosystem determined.	✓	✓	✓

### Strategy 2: Conservation of firefly ecosystem

**Objective:** To conserve, maintain and rehabilitate the firefly habitat.

**Outcome:** Conservation of firefly population will ensure sustainability of firefly ecotourism.

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
2.1 Identify, conserve and maintain existing areas that has intact (natural) vegetation	2.1a Identify areas that have existing intact vegetation.	PDT / MPKS / LUAS / FRIM	Intact land identified.	Potential land identified for re-acquirement.	✓	✓	✓
	2.1b Acquire privately owned intact land.	UPEN	Intact land acquired.	Land became State-owned.	✓	✓	✓
	2.1c Maintain existing natural vegetation (minimal tending).	MPKS / MPKK	Acquired land maintained.	Maintenance scheduled and implemented.	✓	✓	✓
2.2 Minimise conflict-of-interest pertaining to maintaining private lands adjacent to firefly habitats	2.2a Provide funding to rent-a-plot, adopt parcels of land as "anak angkat", or lease partial plot of owned-lands that had been predetermined.	UPEN / PDT / MPKS	Parcels of land identified.	Owned lands within the Protection Zone allocated for conservation efforts.	✓	✓	✓
	2.2b Provide financial benefits to existing landowners to retain a portion of their land for firefly conservation activities.	UPEN / PDT	Financial benefits received by landowners.	Landowners received financial benefits from retaining their land for firefly conservation.	✓	✓	✓



Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
2.3 Rehabilitate degraded areas in the Protection Zone	2.3a Identify critical areas for rehabilitation.	PDT / MPKS / LUAS / FRIM	Critical areas for rehabilitation identified.	Critical areas for rehabilitation assessed and mapped.	✓	✓	✓
	2.3b Undertake and/or coordinate restoration and tending activities through the engagement of local community and various agencies including NGOs in tree planting and tending in the critical areas.	UPEN / LUAS / MPKS / MPKK / NGO / Corporate sectors (local and foreign)	Funding provided for tree planting and tending activities in critical areas.	Number and status of planted trees in the rehabilitated areas monitored.	✓	✓	✓
	2.3c Encourage Corporate Social Responsibility (CSR) programmes for habitat rehabilitations.	MPKS / TNB / NGO / MPKK	Corporate and private sectors approached to carry out CSR programmes.	CSR programmes relevant to firefly conservation are conducted by corporate sectors in the area.	✓	✓	✓
	2.3d R&D on suitable techniques for rehabilitation and replanting purposes.	FRIM / IPTA / IPTS	Suitable techniques adapted for rehabilitation and replanting.	Status of planted trees and on-going rehabilitation areas monitored.	✓	✓	✓

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
2.4 Conduct research on aspects relevant to firefly conservation	2.4a Carry out research on biological, ecological and physiological aspects of the firefly population and its habitat.	FRIM / IPTA / IPTS / LUAS / JPNS	Number of research grants and amount of funding.	Scientific publications published and information disseminated to stakeholders.	✓ ✓ ✓
	2.4b Develop citizen science projects using rapid assessment on the environment.	FRIM / LUAS / IPTA / IPTS / MPKK	Number of interested local communities involved in various projects.	Reports/findings submitted to stakeholders.	✓ ✓
	2.4c Ensure adequate funds to conduct research and citizen science projects relevant to the conservation of the firefly population and its habitat.	UPEN / LUAS / MPKS / NGO	Funds received by research institutes / IPTA / IPTS from various agencies.	Firefly population and habitat sustained through evidence-based conservation efforts.	✓ ✓



### Strategy 3: Sustainable firefly ecotourism

**Objective:** To manage and conduct firefly watching tourism sustainably.

**Outcome:** Minimising tourism impact on firefly population and the environment.

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
3.1 Firefly guides have adequate and up-to-date knowledge on fireflies to conduct firefly-friendly tours	3.1a Conduct courses and refresher courses on fireflies for boat rowers and tour guides.	FRIM / MPKS / Tourism Selangor / tour operators	Courses conducted.	Certificate of training received by the boat rowers and tour guides.	✓	✓	✓
	3.1b Conduct firefly-friendly tours, example: <ul style="list-style-type: none"> <li>Tours that minimise disruption to the fireflies and ecosystem such as no usage of artificial lights to lure the fireflies to the boat, no capturing of fireflies, no disturbing/shaking the display trees.</li> </ul>	MPKS / Firefly tours management	Firefly-friendly tour conducted.	Feedback from visitors provided to MPKS and firefly tour operators.	✓	✓	✓

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
3.2 Limit the number of visitors to watch the firefly	3.2a Conduct research to identify visitor carrying capacity to reduce impact of tourism on the firefly population and the environment.	MPKS / LUAS / FRIM / IPTA / IPTS	Visitor carrying capacity identified. Profit maintained.	Feedback forms from visitors analysed. Sustainable and profitable tour package developed.	✓	✓	✓
	3.2b Implement visitor carrying capacity limit.	MPKS	Number of visitors limited.	Limited number of tickets sold daily.	✓	✓	✓
3.3 Accurate firefly information on medium accessible to general public (including at information centre, on billboard, social media)	3.3a Acquire, verify and update information of fireflies from reliable sources.	MPKS / LUAS / FRIM / Tourism Selangor	Accurate information provided to the public.	Posters/articles based on reliable sources produced for various media.	✓	✓	✓



Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline		
					S	M	L
3.4 Infrastructure of the firefly tour centre is nature- and visitor-friendly	3.4a Ensure the tour centre; its jetty and surrounding area receive controlled lighting, regularly upkeep and provide safety precautions (life jackets, safety and first aid equipment).	MPKS / TNB / JKR / JPS	Facilities and infrastructure maintained accordingly.	Tourist satisfaction increased/ maintained, and firefly population minimally impacted.	✓	✓	✓
	3.4b Involve experts from various fields in development planning.	MPKS / FRIM / IPTA / IPTS	Informed development planning.	Development planning implemented.	✓	✓	
3.5 Enhance job opportunities for local community linked to firefly attraction	3.5a Encourage more local people to generate income from enterprises linked to firefly attraction, example: nature guides, cottage industry, arts and crafts.	MPKS / MPKK	Trainings, business start-up packages and opportunities provided.	New enterprises benefited from linking their business with firefly attraction.	✓	✓	✓

### Strategy 4: Awareness on firefly conservation

**Objective:** To disseminate information on firefly conservation to the public.

**Outcome:** Increase public awareness of the importance of conserving the firefly population.

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
4.1 Local community participation	4.1a Conduct dialogue sessions and awareness programmes involving local community to create a better understanding on the importance of conserving the firefly habitat through good agricultural practices and maintenance of natural riverine vegetation.	MPKS / LUAS / JPS/ DOA / MPOB/ MPKK	Dialogue sessions and awareness programmes held.	Local community attended sessions/ programmes and feedback recorded and reported to relevant Committee.	✓ ✓ ✓
	4.1b Encourage river clean-up programmes.	UPEN / LUAS / MPKK / Tourism Selangor	Incentives provided.	River clean-up activities received financial support.	✓ ✓ ✓
	4.1c Conduct citizen science.	MPKK / NGO / FRIM / IPTA / IPTS / Tourism Selangor	Citizen science developed, and training conducted.	Citizen science modules developed, and training participated by interested parties including local community.	✓ ✓ ✓



Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
4.2 Acknowledge direct contributions of local community in firefly conservation	4.2a Enable incentive mechanisms for local community involved in conservation efforts, example: <ul style="list-style-type: none"> <li>• patrolling</li> <li>• establishing nurseries for replanting</li> <li>• tending/maintaining of rehabilitation areas</li> <li>• reporting encroachment activities</li> </ul>	UPEN / PDT / MPKS / MPKK	Continuous involvement of local community to directly conserve the fireflies gained.	Local community directly involved in firefly conservation gained financial support.	✓ ✓ ✓
4.3 Activities for learning institutions	4.3a Learning institutions adopt projects focussing on firefly conservation, example: <ul style="list-style-type: none"> <li>• Tree-planting and tending of natural river vegetation and display trees such as berembang.</li> <li>• Water quality monitoring.</li> <li>• Firefly habitat monitoring.</li> </ul>	MPKS / NGO / FRIM	Firefly conservation projects conducted by learning institutions.	Number of learning institutions involved.	✓ ✓ ✓
4.4 Activities for the general public	4.4a Organise firefly awareness talks, set up firefly exhibition booths and hold World Firefly Day events.	MPKS / NGO / FRIM	Talks and awareness programmes targeting the general public conducted.	Periodical awareness programmes planned and organised.	✓ ✓ ✓

**Strategy 5: Develop sustainable funding mechanisms for firefly conservation**

**Objective:** To ensure efforts on the conservation of firefly population and its habitat can be implemented continuously through availability of sustainable funding.

**Outcome:** Continuous conservation efforts ensure a sustainable firefly population.

Measure	Action	Responsible Agency	Indicator	Mean of verification	Timeline S M L
5.1 Establish a Firefly Conservation Trust Fund	5.1a Trust fund set up opens opportunities to corporate sectors and agencies to financially support research and activities related to firefly conservation.	UPEN / LUAS / Corporate sectors	Trust fund established.	Funds received channelled to conduct various activities relating to Selangor River firefly conservation.	✓ ✓ ✓
5.2 Alternative funding sources	5.2a Seek support from public-private sector partnerships, international sources available under various sustainable financing mechanisms and the financial sectors.	UPEN / LUAS / MPKS	Funding secured.	Funds utilised to carry out firefly conservation activities.	✓ ✓ ✓



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# ACTION PLAN ON CONSERVING THE **FIREFLIES** OF SELANGOR RIVER 2022-2030

This Conservation Action Plan (CAP) is developed through input, feedback and ideas from participants of the Stakeholder Workshop consisting of implementing agencies and concerned local communities. The five Strategies in this plan are meant to complement the existing Selangor River Integrated River Basin Management (IRBM) Plan 2015–2020 Policy 4: Conserve fireflies and ecosystems. The IRBM Plan for the period of 2022–2030 has been published in March 2022 and Policy 4 is now known as “Conservation of fireflies and ecosystems”. It is hoped that this action plan will be a useful reference for stakeholders and local communities to play an active role in conserving the fireflies of Selangor River.

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