

IRBM Updates

Integrated River Basin Management ————— December 2004



KEEPING THE

Fireflies Flashing

The synchronously blinking fireflies at the lower reaches of Sungai Selangor attract not only other fireflies, but also tourists who come to watch the berembang trees on the river bank sparkle like Christmas trees twinkling in the tropical night.

It was therefore with alarm that many read the recent front page headlines of a leading newspaper "Fireflies fading" and the next day "Sultan: Act now!". A team of representatives of the relevant agencies led by Datuk Dr. Lim Thuang Seng, EXCO, spent three days in

Kuala Selangor to study the problem and come up with proposals, and the Chief Minister, Datuk Seri Dr. Mohamad Khir Toyo inspected the area to get first-hand information on what is happening in Kampung Kuantan.

However, no one has presented data to show that the firefly population has declined in recent years - and some of the villagers in Kampung Kuantan actually stated that there is no change. We just don't know because there is no systematic long-term monitoring of the firefly

population. That is why the IRBM project for some time has been trying to establish just such a programme in cooperation with scientists.

The fireflies are fascinating and should be protected as part of Malaysia's natural heritage - and they provide the basis for tourism activities in Kuala Selangor. The firefly population and the state of the ecosystem of which they are part is therefore a cause of concern.

THREATS

Living at the lower reaches of Sungai Selangor, the fireflies are affected not only by activities in their vicinity, but by activities in the entire river basin. Rapid economic development in the basin and the strong demand for the

Inside

The Secret Life of Fireflies	2
Ensuring Fresh Water for the Fireflies	5
Counting the Fireflies	6
Kedah has established IRBM Working Groups	7
Flood Mitigation and River Management Master Plan Study of Sungai Kedah	9
Selangor Working Groups Progressing	10
Demonstration Projects Underway in Selangor	11
Groundwater Potential in the Sungai Selangor Basin	12
IRBM Training	12
Environmental Management in Denmark	14
Bioindicators	15

water resources puts pressure on the ecosystem.

This has been highlighted in a study carried out by Malaysian Nature Society (MNS) for the state government in 2000. MNS assessed the impact of changing the flow of the river through the SSP3 water supply project which includes the construction and operation of the Sungai Selangor dam upstream of Kuala Kubu Bahru. This study provided a great deal of information about the fireflies and gave many valuable recommendations.

INTEGRATED APPROACH CALLED FOR

The study stressed that while activities around the firefly habitat are important, they should be seen in a wider context. The recent events clearly demonstrate the need for long-term measures that take into account all the various uses and the many pressures on the ecosystem - i.e. an IRBM approach.

Many of the activities that the IRBM Project has undertaken or

initiated, in close cooperation with the relevant agencies and other stakeholders, are relevant in this context. Examples are: development of a monitoring strategy, monitoring of residual flow at the Batang Berjuntai barrage; monitoring of the fireflies and their ecosystem; IRBM planning including water resource allocation issues; land use planning in the firefly area; water quality studies in the river system; and demonstration projects on water quality improvement methods.

THE SECRET LIFE OF Fireflies

B. NADA & L.G. KIRTON - *Forest Research Institute Malaysia*



State tourism committee chairman Datuk Dr Lim Thuang Seng (left) and others searching for firefly larvae and snails among the litter in a Kampung Kuantan orchard.

Kuala Selangor has come to be synonymous with firefly watching. Tourists from near and far flock to Kampung Kuantan in Kuala Selangor to take a boat trip along the Selangor River to have a closer look at what is considered to be the eighth natural wonder of the world. What is

special about these small insects is that they display their flashes of light synchronously while congregating in large numbers on certain trees. They particularly favour 'berembang' trees (*Sonneratia caseolaris*), the branches of which overhang the riverbank. At a glance, it would seem

as if we are looking at a row of Christmas trees lighting up the night, and we cannot help but wonder how on earth such a small creature can produce such amazing light.

The display of light that we see emitted from fireflies is actually the work of chemical substances found inside special cells located in their lower abdomen. With the help of a special enzyme called luciferase, the chemical luciferin combines with oxygen and ATP, the molecule involved in energy production in living things, and the reaction produces a burst of light. Such Light is often produced together with a large amount of heat. However, in fireflies, most of the energy generated is converted into light with only about 5% as heat. For this reason, the light from fireflies is sometimes described as "cold light". In contrast, a typical light bulb gives off most of its energy in the form of heat. Fireflies, therefore, make very

efficient use of energy compared to light bulbs.

The insect that we call a firefly is far from a fly. It is actually a beetle. Beetles belong to the insect order Coleoptera, while flies belong to the order Diptera. Fireflies belong to the beetle family Lampyridae, and comprise over 2000 species. The Forest Research Institute Malaysia (FRIM) has conducted a number of studies on fireflies in Peninsular Malaysia, particularly in Kuala Selangor. The firefly species found

say it is a kind of group behaviour related to finding a mate, while others speculate that they may be attracted to certain trees because the trees provide them with food, nutrients or chemicals used to manufacture the light producing substances in their bodies. What we do know for sure is that the fireflies use their flashes for the purpose of attracting mates, and in courtship. The synchronous flashing is thought to be a response to a dominant male that displays a certain flash pattern

and other palm trees grow. The eggs are probably laid in suitable places on or near to the ground. Researchers at FRIM have observed egg laying in the laboratory. The eggs, which are tiny, translucent and pearl-like, are laid singly, mainly on mosses provided to the female fireflies in the laboratory. Each female lays around 15 to 30 eggs in the laboratory, but it is likely they may lay more under the natural conditions of their habitat.

After 15-20 days, larvae hatch



A mating pair of fireflies (Pteroptyx tener) seen from underneath a piece of glass on which they are resting. The male is on the left.



Berembang trees overhanging the banks of the Selangor River at Kampung Kuantan.



An egg of Pteroptyx tener laid amongst moss.

in Peninsular Malaysia can be grouped into four genera, namely *Pteroptyx*, *Luciola*, *Colophotia* and *Lychnuris*. However, among these genera, the most interesting of all may be *Pteroptyx* because of their ability to flash synchronously. In other words, each firefly times its flashes of light to more or less coincide with the flashes of others in the group.

In Kampung Kuantan, the dominant firefly species is *Pteroptyx tener*. When dusk approaches, the flashes of these insects begin to be seen on berembang trees that grow along the riverbank, and by nightfall numerous flashes light up stretches of the riverside. However, not all the berembang trees will have groups of fireflies on them, and the fireflies can sometimes be seen congregating on other types of trees such as durian and bachang growing slightly further from the riverbank. Many theories have been put forth as to why they congregate in large groups. Some

that others in the group follow. In addition to serving as a display for courtship, the flashes of fireflies are also a kind of warning signal to predators that fireflies are not pleasant to eat.

Because of their spectacular displays of light, adult fireflies are easily seen. But while the life of adult fireflies may be familiar to most people, very few of us are aware of the secret life of their immature stages. In fact, it often comes as a surprise to learn that the gentle looking nectar-feeding beetles that twinkle in the dark are, in fact, fearsome predators in their early stages. The lifecycle of the firefly begins with mating and egg laying. In *Pteroptyx tener*, which is the main firefly species that occurs in Kampung Kuantan, the adult female often mates more than once during its lifetime. It lays its eggs further up the riverbank from where the adult fireflies congregate, in areas where vegetation such as grasses, sago

out of the eggs. These larvae look totally different from the adult fireflies, resembling small centipedes that have only three pairs of legs. This is because fireflies go through four stages in their lifecycle (egg, larva, pupa and adult), and at each stage, their morphology and physiology is very different. This kind of life cycle is called complete metamorphosis, because of the complete change in appearance from the immature to the adult stage. The newly hatched larvae are only about 2 mm in length. They are whitish and translucent at first but gradually become darker as they consume food and grow. Like the adults, the firefly larvae can also produce light, but they do not flash continuously. Instead, they turn their glowing light on and off at will.

The larvae feed on small snails that occur in their habitat, which is sometimes submerged by water during high tides. The most common species of snail that is found along

the riverbank of Kampung Kuantan is *Cyclotropis carinata*. This snail is relatively small, with a shell size of about 7 mm. During the daytime, the snails can be found resting under decomposing palm fronds and leaves, and among grasses in marshy areas of the riverbank. They become active at night, searching for food that probably consists of algae and decomposing plant materials. It is at this time that they fall prey to firefly larvae. Upon discovering a snail, a larva will pursue it and pierce the snail's soft skin with its sharp jaws, injecting a toxin into its prey. With the aid of digestive juices injected into the body of its prey, the larva then sucks out the liquefied tissues of the snail. In the laboratory, it is quite common to see a snail being attacked by more than one larva.

After about two weeks, the newly hatched larva undergoes a moulting process in which it sheds its skin for a larger one to enable it to grow. This process is needed



Larva of *Pteroptyx tener* mounted on a glass slide and seen under a microscope.

underground again for the final time to pupate. By this time it will have reached a length of over one centimetre.

The pupa is a dormant or inactive stage. During the pupal period, the insect undergoes a complete transformation and will emerge as an adult, leaving behind an empty pupal casing. The duration of the pupal stage is just 9-12 days. Some time after they emerge from their pupae underground, the adult fireflies will mate and reproduce again. The adults may only live a few weeks, but the complete lifecycle of the firefly is thought to be around 7 to 8 months.

The lifecycle of *Pteroptyx tener* illustrates the complexity of the relationship between living things and

easily disrupted. Changes in the river water quality as a result of pollution or the building of the dam and barrage further upstream may eventually have an impact on the survival of the snail and the riverside vegetation on which the

fireflies depend. Pesticides used in oil palm plantations may also have a direct effect on the larvae of the firefly. However, loss of the riverside vegetation to development and agriculture is probably the greatest and most immediate threat to the firefly population in Kuala Selangor. In the long term, the survival of this eighth natural wonder of the world will be dependent on our ability to understand the ecology and habitat requirements of the firefly, and our determination to manage the river system in such a way that the plants and snails that the firefly depends on continue to flourish. Some progress has already been made in addressing this need. For example, studies conducted by FRIM and other institutions have unraveled the life



Larva of *Pteroptyx tener* feeding on a snail (*Cyclotropis carinata*) that has retracted into its shell. The larva has partially entered the shell.



Pupa of *Pteroptyx tener*.



Riverbank palm trees that provide the habitat of firefly larvae and their snail prey at Kampung Kuantan.

because the skin of insects is rather rigid and non-stretchable. To prepare for this moulting process, the larva digs a mud hole underground and curls up inside it, reappearing only after it has moulted and when its new skin has sufficiently hardened. The stage between each moult is called an instar, and the larva will go through several instars before going

their environment. The firefly has a close relationship with the river ecosystem at Kampung Kuantan. The ecosystem comprises the Selangor River and the different types of vegetation that grow on its banks. The larvae and adults occupy very different habitats, and each stage of the firefly has different requirements. But the delicate balance of the ecosystem can be

cycle of the firefly. FRIM is also currently conducting research on the breeding requirements of the firefly in the laboratory, in the hope that the information gained will enable us to further understand the factors important for the survival of the species. In addition, it is hoped that further funding will be obtained to study the habitats in which the larvae and snails thrive.

Ensuring fresh water FOR THE FIREFLIES



The flow at the Batang Berjuntai barrage just downstream of the water intakes will soon be monitored.

Sungai Selangor is the major supplier of water to Selangor and Kuala Lumpur and the demand is massive. In dry periods, the water demand exceeds the natural river flow and the river would be dry downstream of the main water intakes at Batang Berjuntai if measures were not taken. However, the construction of the dams at Sungai Tinggi and Sungai Selangor enable the operators to manage the water flow so that a minimum residual flow is maintained downstream.

RESIDUAL FLOW

The residual flow after the water intake points is important for environmental reasons, in particular for the fireflies and their habitat. The berembang trees only thrive in weakly saline water and a continuous freshwater outflow is necessary to

prevent the water at the firefly habitat from becoming too saline. The firefly larvae and the snails they prey on are flooded periodically and they also require water that is nearly fresh.

In the approval condition for the SSP3, it has therefore been determined that the concessionaire must ensure a residual flow of 300 MLD (3.5 m³/s). This figure is low compared to the recommendation by MNS (5 m³/s) which was based on hydrological modelling. It is also low considering that the previous median minimum of the river was 17 m³/s (environmental flow is often set at the median minimum). However, the demand for water is heavy and the figure is a compromise.

MONITORING

Until recently, the actual flow downstream of the intakes was not

known. A temporary monitoring station was therefore established by DID and LUAS with the assistance of the IRBM Project. When the water is falling freely over the weir, the flow can be calculated from the water levels upstream the barrage. However the results of the temporary monitoring showed that the tidal influence downstream of the barrage means that often one can not use such simple methods. It was necessary to establish a station that used another technique, namely a Doppler-based velocity measurement.

HOW IT WORKS

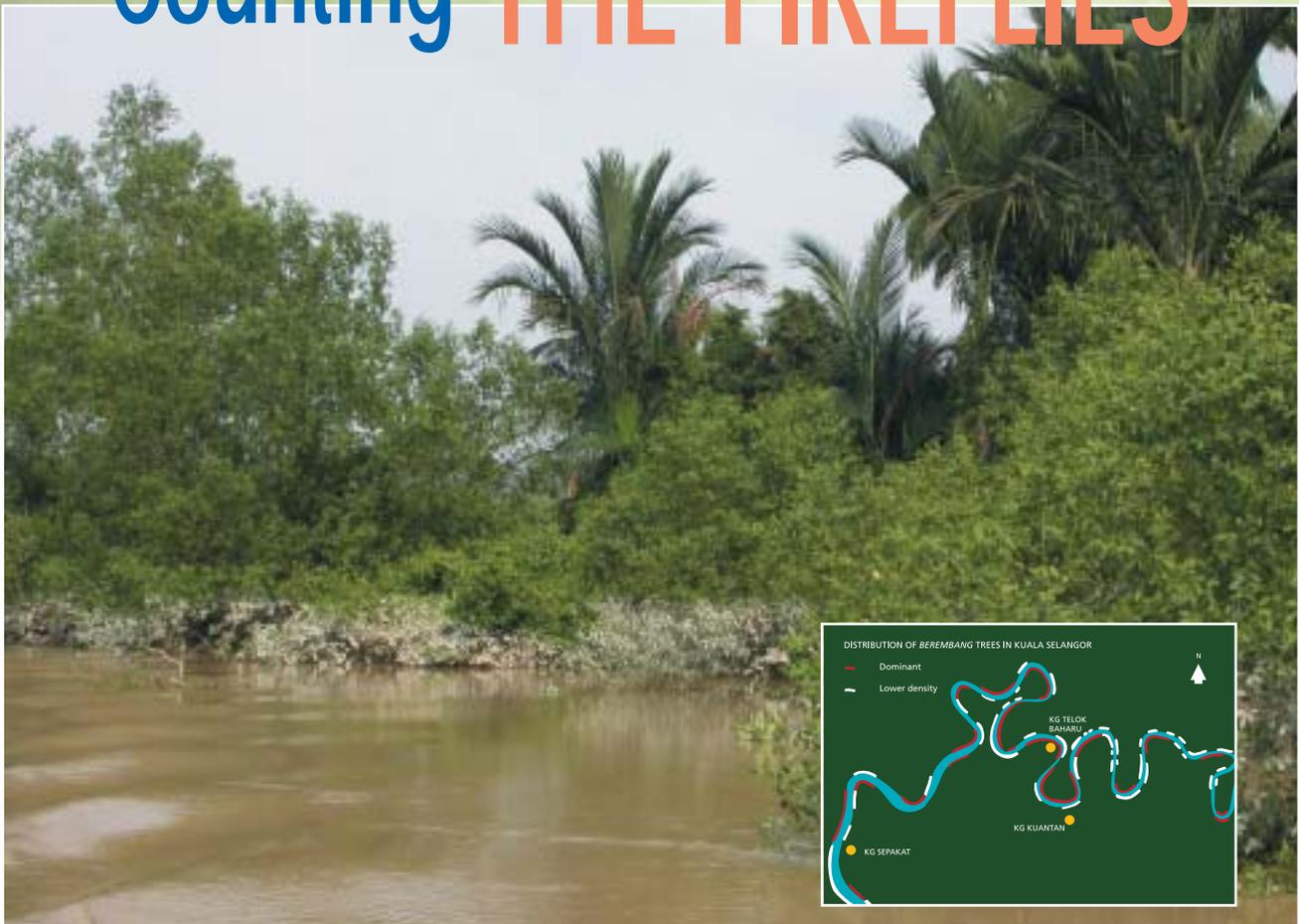
The Doppler instrument works by emitting sound impulses and then calculating the velocity of the water from the change in frequency (tone) of the echo it receives. The faster the water flows, the greater the change in sound frequency.

The data from the Doppler instrument will be transmitted via GSM (mobile phone) to a computer in LUAS. The relationship between water velocity and flow is determined by comparing the readings from the Doppler instrument with other flow measurements (traditional propeller readings or measurements done with a Doppler instrument placed on a small boat pulled across the river). When the relationship is established, it is built into a computer model.

The flow measurements will eventually be available in realtime on the Internet.

It is the first time this technique is used in Malaysia.

Counting THE FIREFLIES



Habitat for the adult fireflies - the berembang trees on the river bank.

The recent newspaper articles clearly demonstrate the need to know whether the population of fireflies is thriving - is the population size increasing, decreasing or stable?

Without a systematic long-term monitoring programme there is little

solid information and everyone may be entitled to his own views. That is why the IRBM project for some time has wanted to initiate such a programme. DID will cover the costs and hopefully the monitoring can begin soon. But how do you count the fireflies?

A traditional way of monitoring insects is to use standardised sweeps. This means that you use a certain size of net, sweep it through the vegetation in a standardised manner and then count the number of insects you catch. This does not give the total number of fireflies, but it is a simple measure of the density. By repeating this at fixed stations and at regular intervals, you get an indication of the population size.

It may sound primitive, but it is actually the best available methodology to estimate insect populations. Perhaps other techniques can be developed that take advantage of the fact that fireflies flash. Maybe one could use photographic techniques and a computer to count the number of flashes recorded on the film? Just an idea...



Firefly tourism is economically important in Kampung Kuantan.

KEDAH HAS ESTABLISHED IRBM Working Groups



The lower part of Sungai Kedah is not clean, but it still yields fish.

Kedah has taken an important step towards implementation of IRBM by forming five inter-agency working groups. The State Secretary has asked agency directors to chair the groups and thus take a lead in managing river basins in a more integrated manner.

Focusing on Sungai Kedah, the working groups will develop action plans and also identify potential demonstration projects within the river basin.

UPEN and DID is coordinating and supporting the working groups, assisted by the consultants.

WATER RESOURCES

Water supply and demand management within the Kedah river basin require close coordination

among the main stakeholders such as MADA, DID and JKR (water supply section) to best meet competing demands for water.

The Water Resources Working

Group is planning how to meet future demands for water resources for agricultural, domestic and industrial needs. It also discusses possible demonstration projects on water



The Ampang Jajar barrage has a great impact on Sungai Kedah.



Valuable recreational area on the riverbank in Alor Star.

saving measures. It is headed by the Department of Irrigation and Drainage.

The working group also looks into flood mitigation plans within the basin.

WATER QUALITY

The Department of Environment leads the Water Quality Working Group. It will identify sources of pollution within Kedah River basin and quantify the pollution loads. It will then propose measures to

improve the water quality, including sewage treatment planning and solid waste management. The working group will explore potential areas for demonstration projects within their field.

LAND USE

The Department of Town and Country Planning is chairing a working group that will review the draft national spatial plan, the structure plans and other development plans from the

perspective of IRBM. Good land use planning is important for water resources management including water quality, quantity and flood mitigation. The group will work with these issues including river corridors and flood zone.

Tourism also falls under this working group, which will consider how the state can capitalise on the natural resources within the river basin with mindful planning. In urban areas, the river is a valuable asset and beautification of the river front, particularly in urban areas, may also be taken up by this working group.

SAND MINING

Sand is an important natural resource needed for construction, but it is important that is extracted in a sustainable manner so that adverse environmental impacts are minimised.

The Sand Mining Working Group is headed by the Department of Land and Mines. At the first meeting it discussed how to improve monitoring and enforcement. At present, the agencies operating in



River tourism combining cultural and natural sights has a potential.

the field are not always aware whether the activities they observe are permitted or illegal. The working group will find practical solutions to improving communicating between the field agencies and those issuing permits.

The working group will also consider whether the comprehensive sand mining regulation drafted in Selangor is suitable for Kedah and should be adopted here in some form.

In addition, the working group will examine the planning aspects of river sand mining, i.e. which areas are suitable and how much sand can be extracted on a sustainable basis.

LEGAL AND INSTITUTIONAL ISSUES

The State Legal Adviser heads a group which will review existing legislation related to water resources and river basin management. In addition, the working group will assess institutional and legal options that may be adopted by Kedah to institutionalise the IRBM approach and thus ensure that integrated river



Sungai Raja was historically used by the royal family for baths, but it is now heavily polluted by sullage and wastewater.

basin management is implemented on a sustainable basis and not just a project activity.

In this connection the Penyemak Undang-undang Negeri and the consultants visited Sabah to benefit from their experience with the Water Resources Enactment and the Conservation of Environment Enactment. These two enactments are important examples of state legislation for environmental management that could give inspiration elsewhere.

WORKSHOP

The chairmen of the five working groups and representatives of other key departments will meet in January 2005 to coordinate and exchange views. At the workshop, the chairmen will present the initial findings of their groups, outline their work programme and indicate the need for inputs in terms of short-term consultants or special studies. They will also discuss ideas for demonstration projects.

Flood Mitigation and River Management MASTER PLAN STUDY OF SUNGAI KEDAH

A joint venture of Perunding Bakti and Perunding Bersatu is currently carrying out a master plan study for flood mitigation and river management for the Sungai Kedah / Sungai Anak Bukit basin.

The study was commissioned by DID quite some time ago as part of the Malaysian contribution to the IRBM project, but for various reasons implementation of the

18-month study only began in April 2004. The team has submitted their inception and first progress report. The interim report is expected in February 2005.

The delay means that the IRBM project cannot base its work on a completed master plan study, but rather has to work in parallel with the study team. This is a challenge as parts of the TOR for the master plan

study overlap with the issues that the IRBM project work on.

This requires both careful coordination and flexibility so that the two groups complement each other and avoid duplication of efforts. The coordination is done by DID, by inviting the master plan consultants to relevant working group meetings and through direct discussions between the individual specialists.

Selangor Working Groups progressing

WATER RESOURCES

The working group has asked SMHB to review the water resource issues in the basin. This includes the water supply infrastructure and an update of the water demand projections for domestic and industrial use.

The study is also looking into the proposed transfer of water from Sungai Selangor to the Tanjong Karang granary and its impact on water supply for domestic and industrial uses. In addition the consultant is considering the best way to manage the two reservoirs that now serve different concessionaires and have different operators.

A preliminary conclusion is that there will be a significant water shortage in a few years until the planned inter-basin transfer from Pahang will be operational. The draft report is expected in December 2004.

WATER QUALITY

Implementation of the planned water quality study has been delayed for administrative reasons. However it is expected that it will begin soon as the tender evaluation recently has been completed and sent to Ministry of Finance for approval. The study is to be covered by the Malaysian project contribution.

In the meantime, the main activity of the working group has been the work on demonstration projects.

LAND USE

IzM Consult has been asked to assist the working group on land use issues and the working group has recently discussed the consultant's inception report.

The consultant will base his work on the Master Plan Study on Flood



Intensive cattle farming is a source of pollution.

Mitigation and River Management for Sg. Selangor River Basin prepared for DID by Ranhill Bersekutu and Sepakat Setia Perunding as well on the draft National Physical Plan, the structure plans, special area plans and the local plans.

He will review those plans and suggest how IRBM can be strengthened and how the relevant recommendations can be taken one step further towards implementation both on a basin level and in smaller areas.

The study will give particular attention to flood mitigation, wetlands and other areas of critical importance to water resources. An important special issue is the protection of firefly habitats.

FRESHWATER FISHERIES

WWF Malaysia is carrying out a study of freshwater aquaculture in the basin. The field investigations have been completed with assistance from Department of Fisheries (DOF) district officers and LUAS. The field

work established the precise locations of aquaculture farms and gathered information on farm operations such as water usage, effluent discharge and treatment systems. The information has been recorded in the GIS in LUAS and a copy will be provided to DOF.

The information is now being analysed in cooperation with the land use consultant and the draft report is expected in December 2004. It will include recommendations for future management, including the proposed location of future aquaculture activities.

ANIMAL HUSBANDRY

Staff from Department of Veterinary Services (DVS) and LUAS have been busy collecting information on animal husbandry in the basin. The extensive field work was carried out in order to update the existing DVS database and record information on animal husbandry in the GIS format, including information on water supply, waste generation and waste treatment facilities. A copy of the GIS information will be provided to DVS. The report is now being prepared and the draft will be discussed by the working group soon. It will quantify the total production of animal waste and assess the related environmental issues. It will give management recommendations.



Sungai Selangor provides most of the water supply for the Klang Valley, but may soon be unable to meet the demand.

DEMONSTRATION

projects underway in Selangor

The inter-agency working group on water quality and representatives from the local councils have made field visits and identified nine project ideas - ranging from wastewater treatment, over composting of sludge to improvement of dumpsites.

The proposals have been assessed and prioritised and two have been recommended for implementation. These two projects address very common environmental problems with innovative approaches.

The first project is an integrated project for Bukit Sentosa, Hulu Selangor. In brief the project includes the following main components:

- Gross Pollutant Trap for the wet market



Wastewater from the market is discharged without treatment



Wastewater from restaurants often go directly to storm water drains and then to the river.

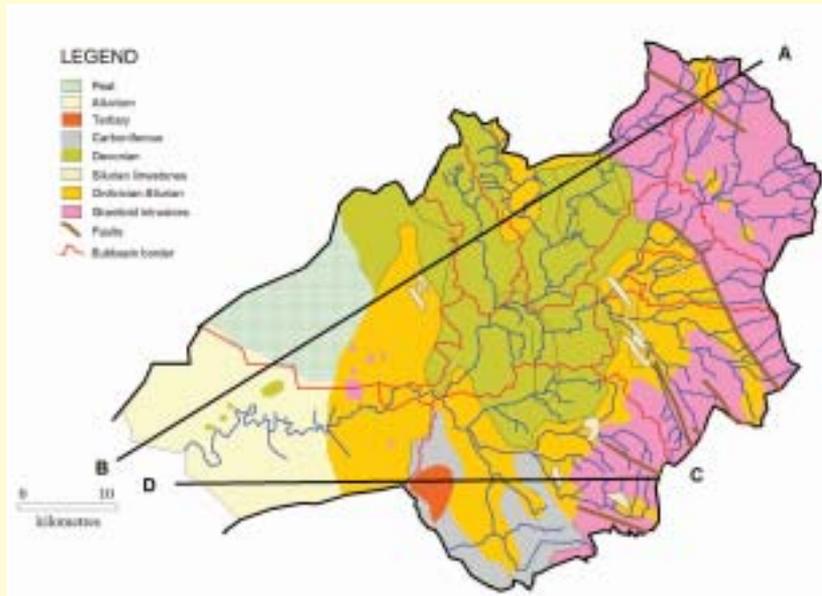
- Oil and grease traps for restaurants
- Ecological treatment of the polluted dry weather flow in the drains
- Detention/settling of storm water

The second project will upgrade a small wastewater treatment facility in Taman Rawang Jaya, Rawang. The facility is typical and consists of an Imhoff tank with stone filters. The filters of these tanks are often more or less blocked and the treatment is not very efficient. The upgrade project at Rawang Jaya STP (750 persons) will consist of an upflow lightweight biofilter, which will offer a 2-stage aerobic treatment and sedimentation. It will upgrade the treatment to meet discharge Standard A. The proposed system is very compact and will utilise existing primary settling/balancing tank. The system uses standard materials, standard equipment and modular design will therefore be replicable in many places.

The implementation cost for the two projects is estimated at RM 1,589,000 in total including operation and monitoring costs for three years.

The projects have been designed and described in reports. The next step will be to get approval and commitment from the various stakeholders so that detailed design can begin.

Groundwater potential IN THE SUNGAI SELANGOR BASIN



Geological map of the Sungai Selangor Basin.

At present Selangor, like most states in Malaysia, rely largely on surface water for water supply. This is very different from

Denmark where the water supply is almost exclusively based on groundwater. However, with the heavy demand for water, there is a

need to see whether there is a potential for development of the groundwater resources in the state.

A hydro-geologist from Sønderjylland County, Denmark, has therefore assessed the possibilities for groundwater extraction in the Sungai Selangor basin. The assessment had to be based on a geological comparison with the better known Langat basin as there is currently only little information from tube wells in the basin.

It was roughly estimated that the potential yield of groundwater could be about 20% of the surface water extraction. Since the surface water resource is heavily exploited, this indicates that there is a need for examining the groundwater potential in more detail - i.e. through drilling and test pumping of tube wells.

The IRBM project does not have resources to do this, but the Department of Mineral and Geosciences is implementing such a programme.

IRBM TRAINING

A central element of IRBM is cooperation among the stakeholders. The focus of the IRBM training programme initiated by the project is therefore to increase the understanding among the various government agencies the roles each of them play and the limitations they face in dealing with the complex issues of IRBM.

The training programme aims to provide participants with an overview of water management with the focus on water quality and water quantity, principles underlying



Integrated River Basin Management and its application in Malaysia. In addition, the training created awareness on the responsibilities and challenges of agencies involved in river basin management and provided opportunity for useful networking among these agencies.

EACH COURSE HAS TWO PARTS

For practical reasons, the course has been organised in two parts, each for three days. The first part deals with water quality issues such as pollution and wastewater treatment, while the second part is concerned with water quantity issues such as water supply and flood mitigation.

FIRST COURSE

Sixty-five participants took part in the first training course, which was held at DID's facilities in Ampang from 27-29 July 2004. The event was officiated by Deputy Director-General I, Ir Hj. Ahmad Fuad bin Embi. The second part was conducted at Quality Hotel, Shah Alam from 17 - 19 August 2004.

The target group for the training was agencies and organisations that are involved in river basin management in one way or another. The participants came from 25 different organisations.



ORGANISATION

The training programme was designed with active cooperation of key government agencies, the private sector and NGOs. This cooperation was essential for the multidisciplinary course, not only in the planning phase, but also during implementation as the various parties contributed with lecturers.

The practical arrangements were handled by River Engineering Division, DID Malaysia with support from the IRBM Project.

EVALUATION

Evaluation forms were distributed during the training and feedback given after each lecture by participants were compiled to further improve on upcoming trainings. The evaluation was based on relevance of the specific course, its usefulness to their field of work, quality of lectures and training materials.

The response from the participants was very positive and constructive and is being used to further improve the next trainings.

TWO LEVELS

The first course targeted professionals and experienced administrators. The second course aimed at junior professionals, administrators and technicians. It took place on 7-9 and 21-23 December 2004.

FUTURE COURSES

The first round of training focused on participants from Federal Government, Selangor and Kedah. Subsequent trainings next year will include participants from other states in Peninsular Malaysia.

The dates have not yet been determined. If you wish to learn more about the training, participate in future events, or contribute as lecturer, please contact us.



Environmental Management in Denmark

A total of 12 practitioners and 6 policy-makers from federal and state agencies visited Denmark in June and August respectively to learn about environmental management in that country. Here are brief reports on the organisations and sites visited by the two teams.

EUROPEAN LEVEL

The European Union plays a very important role in environmental management. The EU legislation is transposed into national laws and major parts of the environmental legislation in the member states implement EU directives such as the Water Framework Directive.

The European Environment Agency is located in Copenhagen. Its role is to collect data, assess them and provide environmental information to the European Commission as well as to the general public, media, businesses, NGOs and individuals. Water is a priority area for the EEA and interesting information on water indicators can be found at EEA's homepage: themes.eea.eu.int/Specific_media/water

NATIONAL LEVEL

The Danish Nature and Forest Agency (under the Ministry of Environment) is one of the agencies responsible for implementation of the Water Framework Directive. It also implements EU directives on nature conservation and it is involved in many nature restoration projects.

The National Environmental Research Institute (NERI) is a key environmental data collection and information centre. It also conducts research projects in cooperation with universities and regional authorities and it provides advice to the Environment Protection Agency.



Participants visiting the Danish Forest and Nature Agency.

REGIONAL LEVEL

The study tour also covered regional nature and environmental management with Sønderjylland County as an example. A county in Denmark is, in many respects, comparable to a state in Malaysia.

The counties are responsible for regional planning and environmental quality of streams and lakes. At a field visit, the participants saw how biological indicators were used for monitoring streams and lakes. The counties are also responsible for environmental regulation of major industries and many other activities. The group visited a trout fish farm that was designed to minimise the impact on the watercourse. The farm would soon mainly use recycled water.

The county has carried out many interesting projects including recreation of meandering watercourses, establishment of lakes and ponds to trap ochre, removal of weirs and

building foot and cycle paths. Most of these restoration projects took many years to implement as it was necessary to get the stakeholders on board and ensure good cooperation with the landowners.

MUNICIPAL LEVEL

In Denmark the municipalities are responsible for the provision of environmental services such as water supply, sewerage and wastewater treatment and solid waste management. The group visited some of these, including a wastewater treatment plant. It was interesting to note that all environmental services are fully financed by the users, both for investment and operations. In fact, the consumers even pay green taxes on top of the bill in order to encourage water savings. The municipalities are also responsible for environmental regulation of a wide variety of activities. This includes integrated permitting of many industries.

DANISH ASSOCIATION FOR NATURE PROTECTION

The Danish Association for Nature Protection is a long-established NGO which is playing an important role in nature conservation. This is even recognised in the legislation where the organisation has special rights. With a membership of 140,000, more than the political parties, it is also a factor in environmental policy-making.

SKJERN RIVER RESTORATION

In the 1960's, the meandering Skjern River was straightened and diked, transforming 4,000 ha of meadows and marsh into productive farmland. The drainage improved agricultural production, but there was a price to pay in terms of loss of nature and a poor aquatic environment. This included a reduction in the river's ability in self-purification and a polluted fjord.

It was therefore decided to restore part of the river. The Skjern River Restoration Project is one of the largest nature restoration projects in northern Europe. It returned 2,200 ha of



Participants visiting the Skjern River.

farmland to nature as meadow and marsh at a total cost of about RM 150 million. The restoration project has been a great success and a boom for recreation and tourism. It has enhanced the habitats for plants and animals, including the Skjern River salmon. It created an internationally important wetland frequented by many birds and it has improved the water quality.

OTHER SITE VISITS

A visit to Green Farm Energy enabled the participants to observe how slurry, solid manure and deep litter from livestock farming is transformed into pure commercial fertiliser and energy.

AQUA is Northern Europe's biggest freshwater aquarium. It has some very educational exhibits on the freshwater environment.

BIOINDICATORS

Have you, on a weekend escapade for a picnic at a pristine waterfall, noticed water skaters on the surface of streams, dancing to the flow of crystal clear water? Or during a fishing trip while waiting for the fish to bite, watched small, freshwater shrimps skirt along the river bank, among the grass in the water? What about the time when you had a leech stubbornly attached and sucking blood on your leg when you waded across a stream?

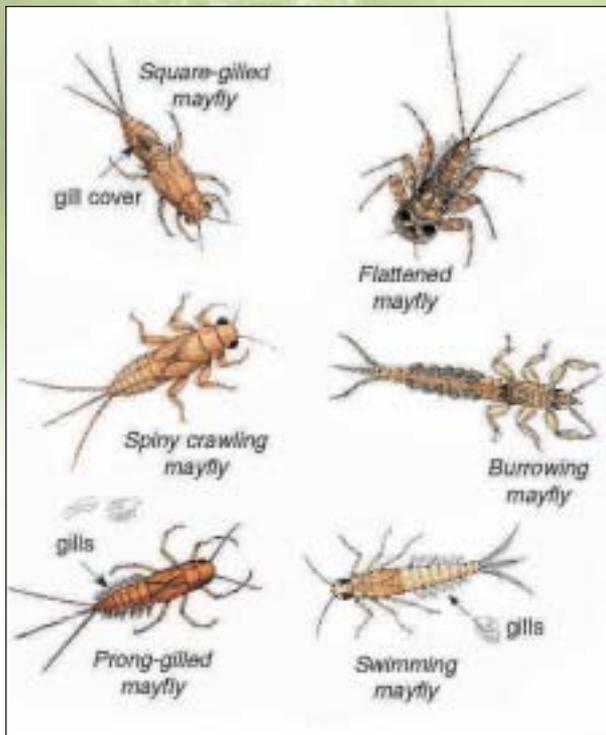
Many organisms are very particular about their habitat. Some are only found in clean streams while others thrive in polluted waters. This is

due to the fact that they have different requirements of oxygen level, temperature, availability of food and other factors. Pollution in rivers affects the living conditions for these organisms. Most animals prefer clean water and disappear when the water is polluted with sewage and organic wastes. In such waters, the oxygen level is low and there are harmful substances such as ammonia. Therefore, only organisms that can withstand low levels of oxygen survive in these conditions. However a few species actually thrive under these conditions and benefit from the abundant organic matter.

INDICATORS

Since the organisms are found in different environments, their absence or presence gives us an indication about the water quality. Species with a narrow tolerance are especially useful as indicators.

In temperate countries, macroinvertebrates are widely used as bio-indicators to assess that water quality of streams. For example, water quality monitoring of streams in Denmark is to a large extent based on systematic sampling of macroinvertebrates. More than 10,000 stations are monitored annually. In



A section of the guide.

particular to smaller streams, this method is considered more reliable than physical and chemical monitoring. The reason is because the biological indicators are usually sedentary within their habitat and therefore reflect the water quality over a longer period of time and not just the value at the moment a water sample was taken.

In Malaysia, there have been some attempts to use biological monitoring of river water quality, but a standard classification has not yet been developed. Other than that, the

adoption of methods on a large scale will also require that a sufficient number of specialists are trained.

FRESHWATER NAME TRAIL

The IRBM Project has developed a guide to freshwater macroinvertebrates in Malaysia. It is designed for use by school children to assess stream water quality and calculate a water

quality index. Using bioindicators in this way raises awareness and contributes to environmental education.

The Freshwater Name Trail was originally developed in the UK by the Field Studies Council. It has since been adapted for use in Thailand by the Field Studies Council and the Green World Foundation. There is also an Indonesian version adapted by Wetlands International Indonesia Programme.

The Freshwater Name Trail has been tested in Malaysia by an entomologist from Universiti Sains Malaysia, Dr Che Salmah Md Rawi,

and the guide has now been modified according to local stream fauna.

TRAINING COURSE

The project has planned a short course on the use of aquatic macroinvertebrates as indicators of water quality in collaboration with Dr Che Salmah Md Rawi.

The two-day course includes field visits to selected river habitats for hand-on training on sampling, identification of specimens and calculation of the Biological Water Quality Index. The course will be held in Penang in February 2005.

At the end of the course, the participants should:

- Be familiar with the common freshwater macroinvertebrates and their habitats.
- Be able to take samples and use the guide to assess water quality
- Be able to teach children these skills.

The course is intended to 'train-the-trainers'. The participants will be government staff working with environmental education and awareness as well as NGOs.

Should you be interested to find out more about this course, please contact Joanna at 012-2929470 or send an e-mail to jotsh@tm.net.my.

CONTACT DETAILS :



FEDERAL COMPONENT

Department of Irrigation and Drainage
Senior Assistant Director (River Engineering) :
Ir Hj Md Khairi bin Selamat
Tel : 03-2617 5772 Fax : 03-2691 3915
E-mail : mkhairi@water.gov.my



SELANGOR COMPONENT

LUAS (Lembaga Urus Air Selangor)
Principal Assistant Director :
Ir Mohd. Said bin Dikon
Tel : 03-5511 1800 Fax : 03-5510 1800
E-mail : said@luas.gov.my



KEDAH COMPONENT

Kedah State Economic Planning Unit (UPEN Kedah)
Assistant Director :
Mohamad Subhi bin Abdullah
Tel : 04-700 7095 Fax : 04-733 0908



Department of Irrigation and Drainage (Kedah)

Senior Assistant Director :
Ir. Hj. Juhaimi bin Jusoh
Tel : 04-733 3433 Fax : 04-733 3372
E-mail : juhaimi@didkedah.gov.my

CONSULTANT

Chief Technical Adviser :
Bo Christensen
Mobile : 012-277 1326
E-mail : bochr@tm.net.my

Assistant CTA :
Joanna Tang
Mobile : 012-2929 470
E-mail : jotsh@tm.net.my