MANAGING BIOLOGICAL RESOURCES IN THE BEST MANAGED STATE PARK: GUNONG STONG STATE FOREST PARK, KELANTAN, MALAYSIA

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Abstract: - Forest eco-tourism in relation to biodiversity is one of the fastest growing sectors in the Malaysian tourism industry at present. It has attracted increasing attention in recent years, especially as a means of state economic development, preserved unique biodiversity, endangered wilderness and forestry environmental conservation. Its main aim is to safeguard the forest environment, making it beneficial to the state as well as local people by generating revenue, education and pleasure for the domestic and foreign tourists. A ground survey by the World Wildlife Fund to Gunong Stong Forest Reserve and in addition to an airborne hyperspectral imaging survey using a UPM-APSB's AISA sensor in 2005 discovered that the area has a unique and diverse ecosystem, rich in bio-diversity and many endemic species. This findings prompted the State of Kelantan to gazette the entire Gunong Stong Tengah Permanent Forest Reserve, one of it's prime production forest, totaling 21,950 hectares, into a state forest park. Consequently, the State Forestry Department of Kelantan has gazzetted this forest park into the best managed and successful forest park and to achieve this, an integrated and multi-functional approach were adopted. Initially, a thorough study of the park resources involving the use of an airborne hyperspectral imaging survey together with the related government agencies and NGOs' were recently undertaken. Studies in the other related fields in this park are also being planned. Once completed, a hundred year management plan will be formulated to assist the management to undertake the best strategies towards implementing programs such as forest ecotourism, publicity, local or international events, research facilities, and infrastructure appropriate for the best managed and successful state forest park.
Key-Words: - Best managed, biodiversity, airborne, hyperspectral, imaging, forest park

1 Introduction

Parks systems are a vital component in protecting the living diversity of the Earth and maintaining the species that inhabit it, including people. The quality of human life depends on biological diversity. Biological resources are necessary for many life-sustaining processes we take for granted, including oxygen supply, clean water, soil formation, flood prevention, climate regulation and waste cleansing. We have an economic reliance on nature to provide food, medicine and other raw materials. In addition to this, quality of life is also enhanced by visiting and interacting with natural areas. Parks also help preserve the genetic variety and the potential for continuing evolution of native plants and animals in their natural habitats, and this is essential to sustain and enhance forestry, agricultural and fishery production. Protected areas provide opportunities for future expansion of ecologically-based industries, such as the pharmaceutical industry. The loss of species diversity means options for future benefits are foregone forever.

Parks are necessary elements in environmental education and in better understanding the importance of the natural environment for sustaining human life. Not only do they provide opportunities for further scientific research, but they also provide valuable benchmarks against which landscape changes can be monitored outside parks. The importance of well functioning ecosystems in helping reduce poverty and improve livelihoods, societies and economies is clear to scientists. However, this knowledge needs to be integrated into the decisions and actions of local, national and international policy makers in all sectors, as well as business leaders.

While the idea of conserving the environment has steadily gained political acceptance over the past few decades, people still misunderstand and ignore the goods and services that nature, bio diversity and the ecosystem provide us. For example 15,589 species of plants and animals are threatened with extinction and many ecosystems, wetlands, forests – are being degraded and destroyed while we know that natural ecosystems provide humans with a large range of highly valuable service.

2 Brief Overview of Forest in Kelantan State and Stong Forest Park

The state of Kelantan covers an area of 1.5 million hectares of which about 894,271 hectares or 60% is under forest cover. It is still very much endowed with a rich and diverse biodiversity, such as in the dipterocarp forests of the reserves, in the National Park, limestone hills of Gua Musang, mountain forests of the Main Range, Virgin Jungle Reserves etc. It is fortunate in that it has vast areas of lowlands, high rolling mountains and hills, which therefore possess many species of plants and animals associated with those ecosystems.

Stong Forest Park, which occupies the whole of Gunong Stong Tengah Forest Reserve of 21,950 hectares in the mid western region of Kelantan, is under the administration of the West Kelantan District Forest Office (Fig.1). It is accessible from a number of routes i.e. from Jeli from the north and Gua Musang from the south. Presently the Stong Hill Resort is sited at the entrance of the Park. The Stong Forest Park covers three different forms of forest ecosystem ranging from the hill dipterocarp forest to the upper hill dipterocarp forest and the mountain forest. Gunong Stong is one of Kelantan's highest (1,442 m) mountains in the Forest Reserve. It is also part of the Stong Magmatite Complex forming the mountainous landscape. In order to ensure the successful establishment of the Stong State Forest Park as the best managed park, three committees have been formed, namely, Steering, Management and Technical Committees.

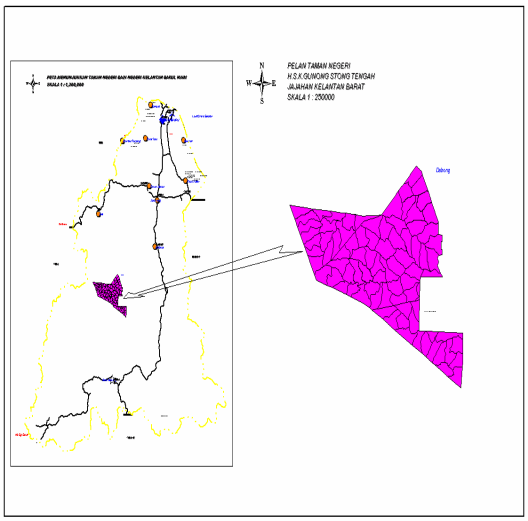

Fig.1. Location of Stong Forest Park

The daily administration and management of the Park will be carried out by the Technical Group headed by the State Forestry Department. At the two top-level committees formed, representatives from the political, state agencies, non-governmental organizations as well as interested groups, are committee members.

3 UPM-APSB's Airborne Sensing Technology for Biological Resources of the State Park

The UPM-APSB's technology in question is based around an airborne digital push broom scanner operating in the visible/near-infrared range. UPM-APSB integrates the scanner (AISA) which uses on-board real time differential GPS for positioning and Precision INS for measuring and recording aircraft pitch, roll and yaw (Fig.2). This gives AeroMAP^{TM} the ability to produce accurate base maps for State Forest Park development and management planning in G. Stong.

Resolution and accuracy of 0.5 m and above is achievable, and the base maps can be produced and draped over the digital terrain model. The advantages of airborne hyperspectral high resolution scanners and associated technology are flexibility and opportunistic deployment when ever required (i.e monitoring unpermitted logging) and measured information content more than a thousand times greater then satellite-based "observations". Most satellites have between three and five spectral bands; i.e, you can look at the forest in red, green or blue (RGB)- but the airborne kit has up to 288 spectral bands, so it is almost like flying a spectroradiometer in the sky. As such, the type of geospatial information which can be obtained from the images produced by this "bread-box" sized scanner, flown back and forth over areas of up to 600 ha; imaging 20 km strips of forested lands, can be characterized into two types: spectral and spatial information. The spectral information will allow for separation and identification of the differences in reflected radiation between surface objects. The spatial distribution of these objects and ground features allows for analyses in the spatial domain, such as identification of tree crowns of individual species, geological parent materials, etc.

Fig.2.The UPM-APSB airborne hyperspectral imaging system kit

3.1 Species Identification and Mapping

Species identification is only possible with the UPM-APSB's AISA if a spectral library for all the likely tree species in the area is available, and at the same time, if there are sufficient spectral differences among species for the differentiation process. With the UPM-APSB's AISA, we have an advantage over all other technologies for this to succeed since spectral library profiles of more than 100 dipterocarp and non-dipterocarp species have been developed (Fig.3). We can airborne at high enough resolution to obtain spectrally 'pure" pixels for the crowns of the species to be identified, and in addition, the AISA is a calibrated spectroradiometer with high enough signal-noise ratio to be able to detect very small differences between spectra, if there are any**.** Fig.4 shows the image species identification and classification map of G.Stong based on an individual *S. curtisii* spatial distribution for field tree marking purposes. Higher classification accuracies are possible, if the UPM-APSB data is combined with data from other instruments like multi-band radar or other ecological information such as topography, meteorology, soil, etc.

The UPM-APSB's airborne scanner data alone cannot determine timber volumes directly, which is what an imaging radar or laser claimed can do. However, Kamaruzaman and Dahlan (2005) reported that assessment of crown size and identification of most likely "big sized" species are possible with this sensor (Fig.5). If this data is combined with ground derived models that relate crown size to tree height and diameter or tree size for the various individual species in the area, it would be possible to derive the average standing timber volume per hectare. As an example, there were 7,667 trees of *Shorea curtisii* (Meranti Seraya) counted and mapped in G. Stong F.R producing a standing timber volume of 26,604 m^3 in an area of 9,562 ha of G. Stong F.R. Hopefully, with the imaging profiling radar to be flown together with the existing optical UPM-APSB airborne sensor in the near future, we can directly measure forest height as well as general (ground) topography in the area of interest.

3.2 Understorey Flora and Fauna

The understory flora and fauna can be mapped and identified only if there are visible through the forest canopy, and if their spectral signatures are different enough from the upper canopy signatures. Possible ecological associations may exist between upper-canopy species and understorey species, which could be used to identify possible under storey species and fauna. For this study, the biodiversity were not able to be mapped due to the inherent capabilities of such sensor at the time of operation to fulfill such task. However, it was noted from field verification that the peak of G. Stong is rich in biodiversity with some understorey species and fauna. Again, with the radar or LIDAR profiler which is to be incorporated in future can detect and measure under storey fauna and plant growth. However, flora and fauna species determination and mapping from the radar data would not be directly feasible.

3.3 Forest Stream, River Siltation Levels and Water Quality

The only quality parameters we can confidently measure in an undisturbed virgin mountain forest with the airborne sensor are turbidity and chlorophyll content. However, in this area, small streams and rivers are overshadowed by the dense forest canopies at most time. Pixel sizes in the UPM-APSB's AISA data need to be small enough (less than 1 m) to be able for use in smaller forest streams that are visible from the air. However, most of the clear unpolluted streams can be easily mapped and quantified from the image as shown in Fig. 6.

4 Best Maagement Practices of Biological Resources in G. Stong with a Vision as the Best Managed State Park

The Stong Forest Park as revealed by Latif and Faridah (2005) qualifies the area for a forest park due to certain qualities it possesses, which are as follows: (a) comprehensive meaning that the Park covers a significant range of samples of regional ecosystems of the Peninsular, (b) adequate meaning that the Park is of a sufficient size to enable natural integrity, including the species diversity, of the park to be maintained; and (c) representative meaning that the samples of regional ecosystems include the maximum possible diversity of their plant and animals communities.

The rich natural assets of Stong Forest Park however need to be managed based on a world class system of management. In this respect, a long term Master Plan over a hundred years will be drawn up. This Master Plan will be reviewed every five years, with public participation to evaluate the progress towards the stated principles and aims, and to consider new issues and circumstances. At each internal geological process of injections of magma granite, G. Stong is one of the only two locations in Malaysia. In addition, G. Stong features one of the highest waterfalls in Southeast Asia i.e. the Jelawang Falls where from a height of 590 m (1 500 ft) the water falls onto a 7-tiered cascade. Other places of interests includes the crystal clear water at the rapids of Lata Chenai and Jeram Renyok. Many new records of lower and higher plant and animal species were revealed in the 2003 Expedition and one new ginger species was discovered. The Expedition only covered 800 ha or 3% of the Park area and thus a large area still abound for further study.

The Stong State Forest Park is still in its infancy stage. The ultimate aim of the State Forest Department of Kelantan for the Forest Park is to be recognized as the best managed forest park. Our vision recognizes that (a) the Park is the cornerstone to conserve nature at the state level and probably in the future, be integrated at the state level and probably later, be integrated as part of a national forest park system under the National Forestry Act 1984, (b) the Park should ensure conservation of natural values for all time and for all peoples, (c) continuing engagement between people and parks, including enhance opportunities for all to visit, participate in, learn, respect, enjoy and preserve the Park as a fundamental purpose of management, and (d) the only use of the Park is nature-based and ecologically sustainable.

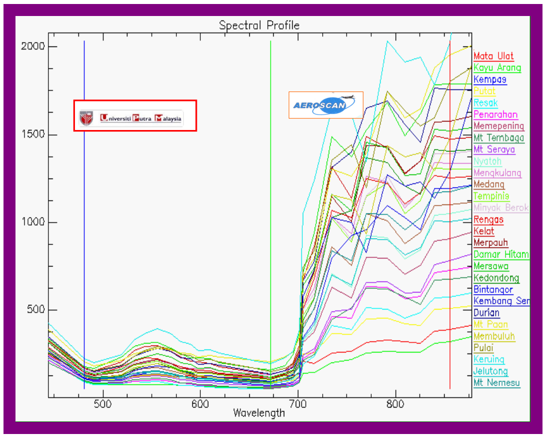

Fig.3. Some selected image spectral signature library profile of timber species

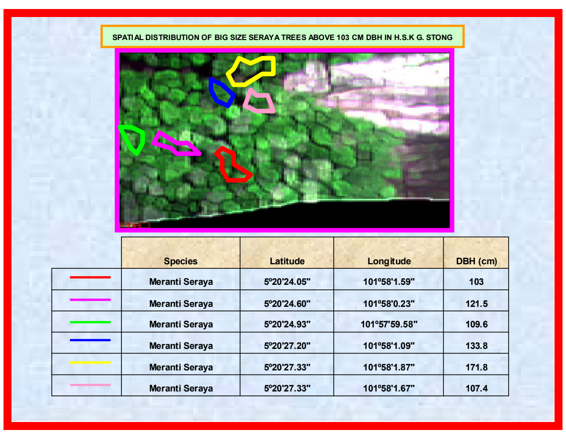

Fig.4. An individual species classification map of *S. curtisii* showing their precise locations of "big-sized" trees greater than 103 cm DBH

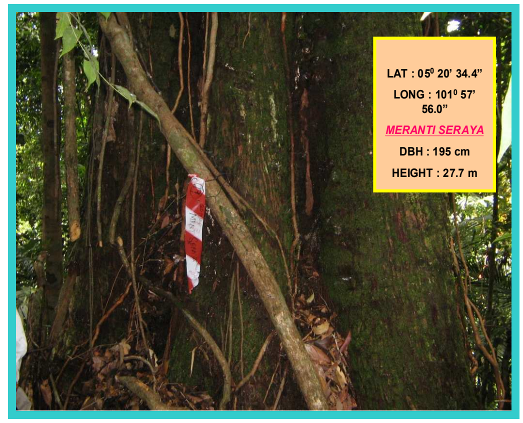

Fig. 5. An estimated 40 years-old *S. curtisii* in G. Stong F.R.

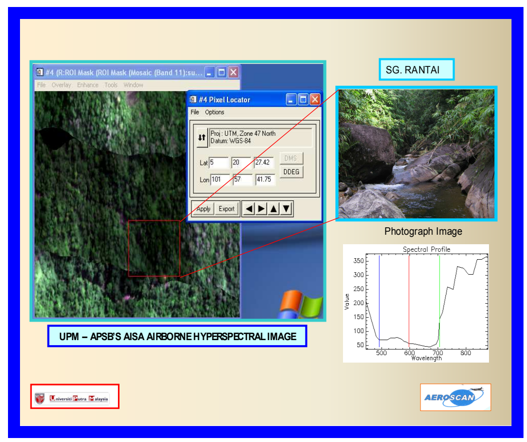

Fig.6. The unpolluted Sg.Rantai in Stong

This vision can be made possible by establishing and managing with the involvement of interested stakeholders. Following this, a State Steering Committee for the Park headed by the *Menteri Besar* was established specifically to clearly state the vision, principles and aims for the Park future management. Subjected to a Five-Year Review, the Plan will be refined to ensure it remains a dynamic blueprint, responsive to emerging issues while providing a firm and clear overall direction, rolling into the future.

The Plan is divided into four core dimensions of Best Management

Practices of a State Forest Park, namely (a) protecting Stong Forest Park for its natural heritage, (b) working with the local communities, (c) sustaining recreational and forest eco-tourism opportunities, and (d) enhancing state forest department management capabilities.

5 CONCLUSION

Though the Stong Forest Park was only recently established, it is the aspiration of the State that it be rightfully managed from the start. Thus, the appropriate legal status for the Park was initiated and a committed and determined management team formed to administer the success of the Park. Finally, the necessary strategies required for the Stong Forest Park to be best managed will be incorporated in a 100^{th} Year Master Plan.

Nature is under pressure from many influences including urban growth, land clearing and habitat destruction, climate change and pest plants and animals. It is our moral obligation that as much of it is conserved for it must be remembered that we do not merely inherit our state's beautiful natural environment from our parents: we borrow it from our children and our children's children. We have a duty to hold it in trust, for the benefit of future generations.

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