Buffer zone characteristics for protected areas: a preliminary study of Krau Wildlife Reserve

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Abstract

Natural resources must be sustainably planned, managed and wisely utilized today and conserved for future generations to come. This will ensure stability for proper functioning of the ecosystem that will accrue to every sector of society. As one of the natural resources, protected areas have been defined as an attempt to uphold the cyclical relations within the ecosystem and hence maintain ecological services such as clean water and air. Various researches have proven that land cover and land use surrounding the protected areas could increase the pressure on these areas. The buffer zone concept has been suggested as one possible solution to safeguard the protected areas, providing an extra layer of protection through sustainability of human activities and environment. Establishing its characteristics is necessary prior to the delineation and management of the zone. This study focuses on land cover and land use around the selected area representing typical protected areas in Malaysia. Datasets used were based on existing topographical maps and Global Positioning Systems (GPS). This study has confirmed that human activities occurred mostly at the flat area but minimum at hilly and non accessible areas. Therefore, low land and flat area and areas which involved water bodies, road networks and similar activities required bigger size of buffer zones while hilly, high peak and dense forest required smaller size of buffer zones.
Keywords: protected areas, buffer zones, biological diversity, land cover, land use, GPS.


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1 Introduction

Protected areas have long been one of the main strategies for safeguarding the world's biological diversity. According to Bennett [4] pressures on the environment caused by economic development and other human activities make it difficult to protect natural areas that are large enough to accommodate entire ecosystems. The ecosystem approach works best if special care is taken to set aside habitat that is sufficient enough to retain the original biological diversity. This includes the protection and careful management of neighboring land called buffer zones, Ministry of Science, Technology and Environment [5]. The establishments of buffer zones are an essential element, increasingly recognized as a valuable tool for the creation and management of the protected areas. Its management and resource protection are not confined by park boundaries, and should be undertaken within the context of the formal development planning system. This is because the activities on adjacent lands may significantly affect the environmental quality of the protected areas. Equally true, the activities of the protected areas might also have affected outside of its boundaries (Noor [6]). In recent research, Jotikapukkana, *et al*. [7] suggested that buffer zones are supposed to serve the dual purpose of 'extension buffering', or an extension of core habitat areas, and 'socio buffering' to provide goods and services to human.

2 Research area

The research area known as Krau Wildlife Reserve (KWR) is located partly in the district of Temerloh, Bentong and Raub in the state of Pahang, Malaysia. It covers approximately 65,000 hectares (Fig. 1). With the diversity of flora and

Figure 1: Krau Wildlife Reserve area.

fauna within KWR area and activities surrounding the area, it was chosen as a study area to represent other existing protected areas in Malaysia. Daim [8] suggested KWR faces many problems including encroachment and conversion of land title, degazettment, over hunting and over harvesting of non-timber products. Furthermore the existence of stakeholders and local community, especially indigenous people in and around KWR contributed to its complex system as well. Thus, buffer zones are necessary to protect the protected areas such as national park and wetland in order to reduce the impact on wildlife and also not to affect the biological diversity of the reserve, World Wide Fund for Nature (WWF)-Malaysia [9]. Debatable issues concerning the buffer zones are wide ranging and it spans across a wide area of study. However, within the limits of the investigations of this research, its focuses on the characteristics of the buffer zone only. This study attempt to identify the buffer zone characteristics for KWR based on current land cover and land use activities along the protected area boundary using GPS. It is also demonstrates the important utilization of GPS in ground truthing works.

3 Methodology

Referring to Figure 2, the method used in this research is Ground truthing – ground positioning and verification using GPS in meeting the research objectives which are to identify current: 1) built-up area, 2) agriculture, 3) natural hydrographic features, and 4) vegetation along the protected areas.

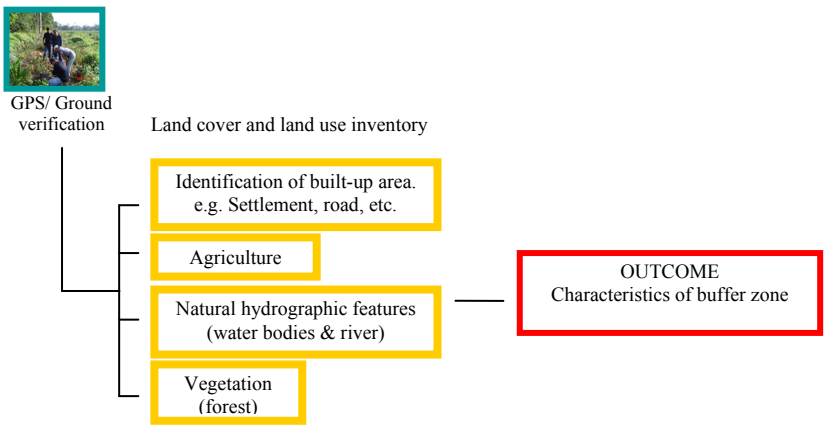

Figure 2: Work flow of research approach.

Figure 3 below showed the flow chart of ground thruthing process which involved 3 stages and ground records were recorded using Inventory Form shown in Table 1 below.

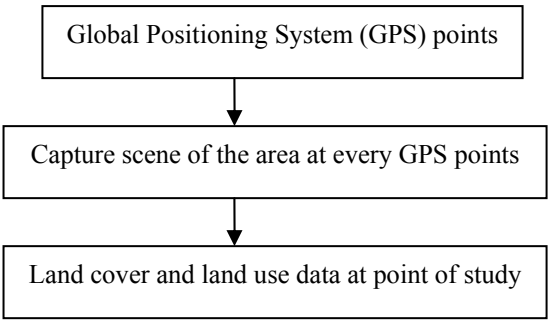

Figure 3: Flow chart of ground thruthing process.

Table 1: Land cover and land use inventory form.

POINT ID: 1
GPS READING/COORDINATES: E 468825
N 426673

FEATURES

A Hydrography	B Accessibility	C Settlement	D Vegetation	E Agriculture	F Slope	Remarks
1 Lake	1 Railway	1 Research office quarters	1 Primary forest	1 Plantation	1 Flat	Boundary
2 Pool	2 Highway	2 Orang Asli settlement	2 Secondary forest	2 Farm /	2 Gentle /	line
3 Reservoir	3 Carriage track /	3 Malay settlement /	3 Grassland /	3 Orchard	3 Moderate	crossing
4 River	4 Unsealed track	4 Chinese settlement	4 Open space /	4 Others	4 Steep	carriage
5 Stream	5 Motorable track /	5 Others	5 Others	(eg. Nomad)		track
6 Swamp area /	6 Footpath /					
7 Others	7 Others					

The variables used in the form above were derived from standard topographic map acquired from the Malaysia Surveying Department such as accessibility, settlements, vegetation and hydrology. GPS receiver (Garmin GPS e_Trex Summit) with Differential Global Positioning Systems (DGPS) of 1 to 5 meters accuracy was used to locate the position of land use and other ground activities during the works. The examples of coordinates recorded were E 468825, N 426678. Other field works equipment included photo recorded at every GPS point using a Cyber Shot Sony P4 digital camera. Images were captured at selected points along the boundary of the protected areas with the approximate coverage of two kilometers radius and the arrangement method (Fig. 4) of the captured photos at the specific areas is divided into four (4) sectors.

The sectors (Fig. 4) were divided into A (information taken facing the north), B (scene facing the east - outside the protected areas boundary), C (records the south information) and D (covered the west - inside the protected areas boundary). Some sectors with similar information represented by less than 4 photos. Figures 5 to 8 below showed the example of photos taken during the fieldwork at the respective points.

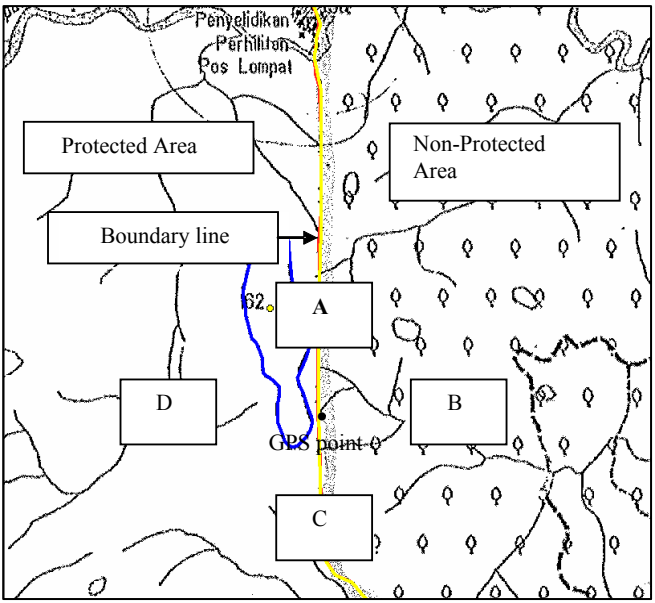

Figure 4: Image Point Index.

Figure 5: Community hall on the boundary (A).

Figure 5 is the example of photo taken for Area A at Point ID: 6 (coordinates: E 471949m, N 417334m) while figure 6 is for Area B at Point ID: 17 (coordinates: E 479230m, N 406035m), Figure 7 is for Area C at Point ID: 23 (coordinates: E 47712m, N 402049m) and Figure 8 for Area D at Point ID: 27 (coordinates: E 477031m, N 401374m).

Figure 6: Oil palm plantation next to the boundary (B).

Figure 7: Open space next to the boundary (C).

Figure 8: Settlement of indigenous people inside the protected areas (D).

4 Data analysis and findings

Forty-three (43) GPS points had been identified along the protected area boundary and seventy three (73) photos had been taken to represent the points. At points with similar land cover and land use, only one or two photos were taken to represent the area. The point's intervals were two (2) kilometers but the distance varies at areas with difficulties to access such as no access road at all, dense forest or steep slopes. Each point has been elaborated by information of land cover and land use such as vegetation, built-up and agricultural areas. Data gathered from the field work was divided into 4 quadrants based on the assumption that the land cover and land use of a quadrant is reasonably typical and quite similar. The designated areas namely Area 1: North East covered the GPS points from 1 to 12, Area 2: South East covered the GPS points from 13 to 35, Area 3: South West covered the GPS points from 36 to 43 and Area 4: North West covered none of GPS points due to the difficulty of accessed into the dense forest and very hilly area.

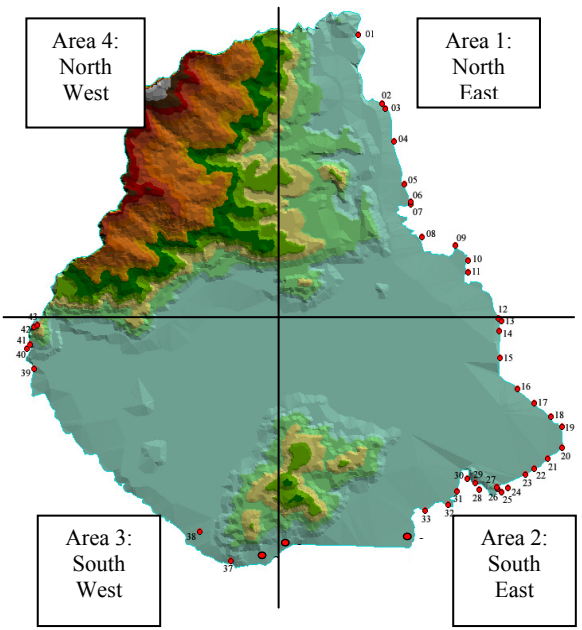

Figure 9: The quadrants designated and GPS coordinates along the boundary of the protected areas.

With respect to buffer zoning, factors to be observed in zoning characteristic should include the historical land use of the area. It is in relation to Sorensen [10], mentioned that protected areas are important to local communities especially indigenous people who demand for their survival and economic buffers is needed to reduce the needs of villagers to take resources from

protected areas. 'Bigger' zoning size should be implemented for the area and should be monitored periodically to stop encroachments. It is also found that, human activities along the protected areas involved low land areas with moderate slopes to support farming such as paddy and rubber. Area 1 also showed that more human activities had taken place at the area where there are road networks and water bodies. Zoning size should be implemented at these areas to avoid human activities and easy encroachment. At certain area, the boundary line runs along the river. It's proven that natural physical structures such as river reserved areas, ponds and lakes can become buffer zones. This 'intermediary' land use (river) helps minimizing the movement of wildlife from the protected areas to its surrounding and also reduced the man-wildlife conflicts. Similar to Area 2, activities such as oil palm with the tendency to encroach towards the protected areas is high. Settlement units along and inside this area are also part of the human activities perceived. Area 3 experienced similar activities to Area 1 and 2 whilst at some areas, tendency of encroachment of orchard into the protected areas are in vicinity. Surprisingly, Area 4: North West section experienced little or no human activities. This might due to the area concern comprises of hilly and dense forest. Little to no human settlement and minor farming such as non-seasonal fruit trees (banana) are recorded. This shows that, dense forest, hilly and high elevation areas are not prone to human activities and settlement and thus buffer zoning at this area could be of minimum in size.

5 Conclusion

The study has shown that land cover and land use of the area which is built-up, agriculture and vegetation has shown significant occurrence at lower, accessible and water body areas. This study has also demonstrated that GIS technologies provide powerful tools for mapping and detecting the land cover and land use. This research further demonstrated that these modern technologies together with field observation can be a very good tool in land cover and land use study.

From the research analysis, it is proven that the characteristics of the buffer zones can be determined by analyzing land use activities around the protected areas. In this study the following had been noted: 1) Flat areas required bigger size of buffer zones due to the high possibilities of encroachment activities. It has provided an easy access to the indigenous people and other local communities to enter the protected areas. This factor suggested that land use activities occurred mostly at low land and flat areas. These areas are critically required buffer zones in order to protect the protected areas and further safe-guard the valuable biodiversity; 2) However, areas which are subject to hilly, high peak and dense forest should maintain the minimum width of zoning sizes. The experienced gained in this study shows that minimum to no encroachment activities are carried out at these areas. This may due to the difficulties to access the areas; 3) Historical land use of a particular area should be observed in determining the buffer zoning characteristics. This is due to the encroachment activities observed are mostly involved indigenous people. The activities include farming and settlement. From the literature review, indigenous people are

permitted to extract the forest products from the protected areas for the purpose of self use. Therefore, regarding the buffer zoning characteristics, special land use (agriculture) provision of productive buffer zones could be proposed to serve as nature protection for protected areas while serving the living needs of indigenous people; and 4) Ground verification (using GPS) where possible should be the main source of information towards an establishing the characteristics of the buffer zone. Zoning which involved water bodies (river) and road networks should take into account the changes of the land use activities for the particular area. It is shown that, water bodies and road infrastructure support various human activities such as farming and settlements.

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