

Distribution and conservation status of Bornean Peacock-pheasant *Polyplectron schleiermacheri* in Central Kalimantan, Indonesia

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Summary

We distributed questionnaires and conducted interviews between July and November 1996 to develop a better understanding of the status and distribution of Bornean Peacock-pheasant *Polyplectron schleiermacheri* in Central Kalimantan, Indonesia. We found that many people were familiar with the species, that it is apparently widely distributed but rare in lowland forest, and that populations may be declining. We received reports of recent sightings of the pheasant at 23 locations in 9 survey areas. The primary threats to Bornean Peacock-pheasants are habitat loss within logging concessions and hunting. Recommendations for future conservation action include increasing the representation of lowland rainforest in Kalimantan's protected area system, specifically the proposed extension of Bukit Raya National Park, and control of hunting within logging concessions.

Introduction

The distribution and population status of most galliform birds in Indonesia is still poorly known (Holmes 1989, McGowan and Garson 1995, McGowan *et al.* 1995). Indonesian pheasants and partridges primarily inhabit forests of Borneo and Sumatra, areas that are not easily surveyed due to poor access and rugged terrain. The island of Borneo alone hosts six endemic, threatened pheasants and six endemic, threatened partridges (McGowan and Garson 1995, McGowan *et al.* 1995). Indonesian pheasants and partridges are believed to suffer from three main threats: hunting by local people for subsistence and for markets, loss of habitat through land conversion, and degradation of lowland forests through logging (Holmes 1989, E. Bennett 1996 pers. comm.). Among the pheasants most threatened by anthropogenic activities is the endemic Bornean Peacock-pheasant *Polyplectron schleiermacheri*.

The Bornean Peacock-pheasant is one of the most elusive pheasants in the world. First collected in Central Kalimantan, Indonesia (Brüggemann 1877), it was rarely observed or collected until the early twentieth century (Beebe 1922). Observations came primarily from Central Kalimantan but also from Sarawak and Sabah in Malaysian Borneo (McGowan and Garson 1995), but Smythies

(1960) extended its range to Balikpapan, East Kalimantan. Birds were collected at two more sites in Kalimantan in 1969 and 1973 by biologists of the Indonesian Museum of Zoology. Unconfirmed records are also sparse. Holmes and Burton (1987) reported the species from a site in West Kalimantan, based on a vocalization. Dutson (1990) reported that local people considered the species rare in the upper Barito River, Central Kalimantan. S. van Balen (pers. comm.) also reported knowledge of the bird from local people near Lake Sentarum, West Kalimantan. Thus the records of Bornean Peacock-pheasants are distributed throughout Borneo, a 755,000-km² area, but most records are from the province of Central Kalimantan, Indonesia.

Because of the paucity of information, the continued survival and conservation status of the Bornean Peacock-pheasant remains uncertain (McGowan and Garson 1995). The lack of recent sightings, its presumed low density and apparent preference for forests subject to anthropogenic activities, justified the pheasant's critically endangered status (McGowan and Garson 1995). In this paper, we report the results of recent surveys to assess the status of the Bornean Peacock-pheasant in Central Kalimantan, Indonesia.

Methods

Study Area

Central Kalimantan is the second largest province of Indonesian Borneo, covering 153,600 km² (Figure 1). The area is sparsely populated with rural population density estimated in 1986 as 7 people/km² (MacKinnon *et al.* 1996). The local people make extensive use of the forests for every aspect of daily life. Central Kalimantan is heavily forested; dominant forest cover includes low-lying swamp and heath forest in the south, lowland plain forest and dipterocarp forests in the central region and hill forest in the north (Figure 2, Table 1). The climate of Central Kalimantan is wet, and most of the province receives more than 200 mm/month average rainfall for seven or more months of the year and the dry season (less than 100 mm of rain per month) generally lasts only two months. Temperatures range from 25° to 35°C in lowland areas (MacKinnon *et al.* 1996).

Questionnaire survey

During July, August, October and November 1996, we distributed stamped, self-addressed, illustrated questionnaires in villages throughout six major river drainages of Central Kalimantan: the Barito, Kapuas, Kahayan, Katingan, Mentaya and Lamandau Rivers (Figure 3). Our survey concentrated on lowland forest areas but we also conducted surveys in areas dominated by heath forest along the Kapuas River. Questionnaires were illustrated with a colour picture of male and female Bornean Peacock-pheasant, a male Bulwer's Pheasant *Lophura bulweri*, and a female Hoogerwerf's Pheasant *L. hoogerwerfi*, a Sumatran endemic. The Sumatran endemic was a control to test familiarity with Bornean pheasants. The questionnaires included a request for help in learning about Bornean Peacock-pheasants and a conservation message about these threatened birds. The questionnaires were perforated so the picture and conservation message could be



Figure 1. Location of Borneo and Central Kalimantan Province, Indonesia in South-East Asia.

detached from the questionnaire and saved by the respondent. Respondents could fill out the form while we were present or return it by post. The questions were multiple choice:

1. Do you know and can you name each of these birds?
The remaining questions referred to Bird No. 1 (Bornean Peacock-pheasant).
2. How often have you seen this bird (Often, rare, very rare)?
3. Have you observed this bird directly or is your information from other sources?
4. Where did you meet this bird or hear its call (near the river, in swamp forest, near lakes, in lowland forest)?
5. How many birds did you see at one time (an individual, a pair, a small group, a large group)?
6. During which season did you see this bird (rain, dry)?

Interviews

We conducted semi-structured interviews to supplement the questionnaire. Interviews were conducted by native speakers in Bahasa Indonesian to minimize

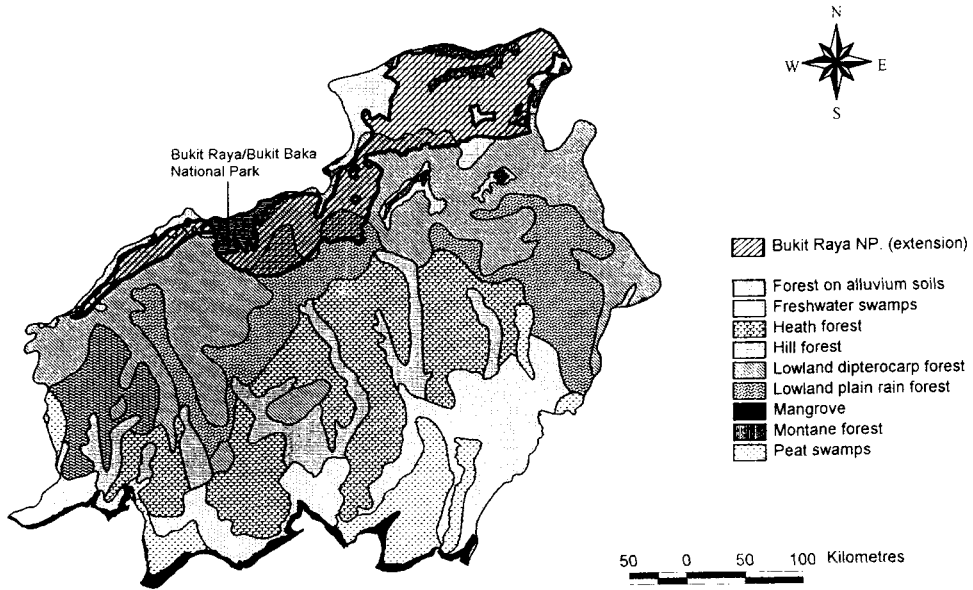


Figure 2. Distribution of forest habitat in Central Kalimantan with location of Bukit Raya National Park and proposed park extension.

Table 1. Area of different forest types of Central Kalimantan

Type	Area (km ²)
Peat swamp	9,803
Freshwater swamp	18,128
Heath forest	28,141
Forest on alluvial soil	10,689
Lowland dipterocarp forest	40,433
Lowland plain rainforest	26,586
Hill forest	15,189
Montane forest	2,151

communication problems. We asked the following questions to determine an individual's knowledge of the bird's habits:

1. What is the source of their knowledge of the bird (direct/indirect)?
2. In what type of forest do the birds occur?
3. How far from villages does the bird occur?
4. In what year were observations made?
5. How many individuals were observed?
6. During which season can the birds be found?
7. Is it more difficult to find the bird today compared with past experience?
8. What do the pheasants eat?
9. Why is the bird trapped?
10. Where can the nests be found?
11. What are nests composed of?

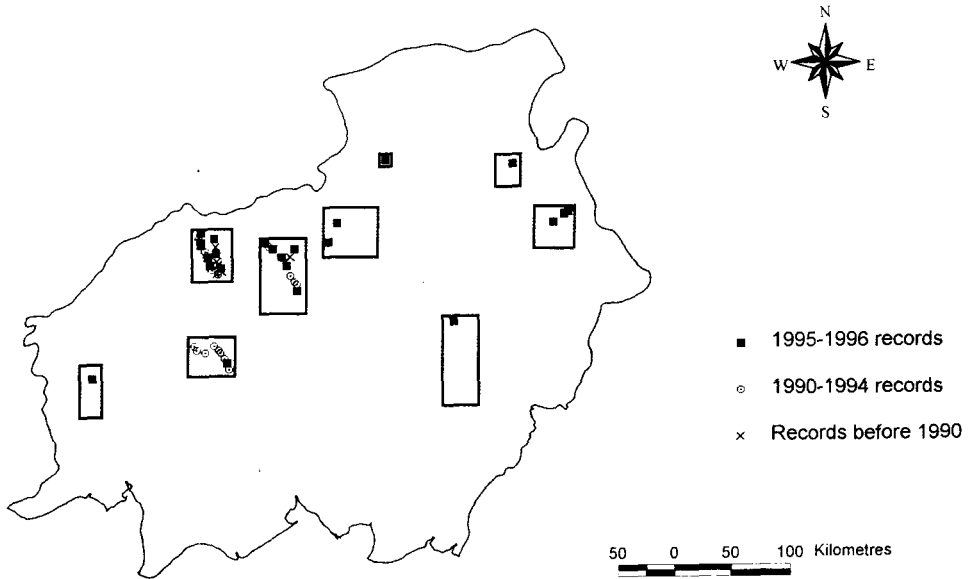


Figure 3. Distribution of records of Bornean Peacock-pheasant in Central Kalimantan by year. Blocks indicate areas where village interviews were conducted.

- 12. How many eggs are in a nest?
- 13. What colour are the eggs?

GIS

Using ARC/INFO V.2.0 and ARCVIEW V.2.0c we digitized soils, physiognomy, river drainage, forest types (RePPPProt 1990), distribution of protected areas (PHPA unpubl. data), and distribution of logging concessions (Ministry of Forestry, unpubl. data), locations of villages surveyed, and locations of villages from which positive information was obtained. We overlaid locations of Bornean Peacock-pheasants with the spatial data to answer the following questions:

- 1. In which habitat types were Bornean Peacock-pheasants most common?
- 2. How extensive are those habitat types?
- 3. What is the protected status of those habitats?

Results

Questionnaire

We distributed 950 survey forms in 97 villages and received 841 completed forms from all villages (average = 9 respondents/village, range 1–21 respondents/village). Although we hoped to treat each interview form as an independent sample, it was evident that several people would fill out a form together, or compare answers. Since we could not control this, we treated the information from each village as a single sampling unit. In some instances we used individual

Table 2. Results of questionnaire survey of 97 villages in Central Kalimantan. Percentages of respondents to questions 2 to 5 are based on the subsample of respondents who indicated knowledge of the bird (Question 1). Not all responses add to 100% as some questions were not answered by all respondents and percentages are rounded to the nearest 1%

Question	Responses	No. responses (%)	No. of villages
1 Knowledge of the bird	Yes	689 (82%)	90
	No	152 (18%)	7
2 Rarity	Very rare	114 (16%)	58
	Rare	336 (49%)	76
	Often	236 (34%)	41
3 Source of knowledge	Direct	662 (96%)	90
	Indirect	24 (4%)	16
4 Habitat	Swamp Forest	21 (3%)	14
	Near Lake	2 (0.3%)	2
	Near River	0 (0%)	0
	Lowland Forest	663 (96%)	88
5 Group size	1	402 (58%)	77
	Pair	221 (32%)	62
	Small Group	45 (6%)	21
	Large Group	17 (2%)	6
6 Season of observation	Dry	313 (46%)	61
	Rain	28 (4%)	11
	Both	345 (50%)	69

responses when we were interested in the percentage of responses to a particular question within a village. Most of the respondents (65%, 90 villages) correctly identified the Bulwer's Pheasant. Most respondents (63%, 58 villages) incorrectly identified female Hoogerwerf's Pheasant as a Bornean bird. Many of the respondents expressed confusion over the bird's identity, but most respondents identified it as a female Bulwer's Pheasant or a female Crested Fireback which it resembles. Although there was confusion over this part of the control, we felt confident that respondents were accurately identifying the Bornean Peacock-pheasant because they could describe the bird's size and thick plumage accurately, and because they used at least five names that referred to the bird's double spur, a feature not shared by other pheasants.

Only seven villages reported no knowledge of the Bornean Peacock-pheasant (Table 2). In an additional six villages, less than 50% of respondents were familiar with the bird. Of the respondents familiar with the bird, only 66% of individuals thought the bird was rare or very rare. Respondents from 28 villages believed the birds were often encountered (modal responses) whereas 58 villages considered the bird rare ($n = 46$) or very rare ($n = 12$). Most of the respondents (96% from 90 villages) familiar with the bird claimed to have observed the bird directly. We could not establish unambiguously whether this high report rate was due to captured birds being brought to villages or were direct sightings by hunters in the forest.

Most of the respondents familiar with the species (96% from 88 villages) claimed it lives in the forest. Twenty-one respondents from 14 villages said the pheasant could be found along rivers and only two respondents indicated that the bird inhabited swamp forest. The bird was most commonly observed singly or in pairs. Only 9% of respondents familiar with the bird indicated that it

occurred in small or large groups. Many respondents marked more than one category to question 5, indicating they had observed the bird on more than one occasion. Birds were observed in both the dry and rainy season, but it appears to be commoner in the dry season (Table 2).

Interviews

Semi-structured interviews revealed additional information about the distribution and natural history of the Bornean Peacock-pheasant. We interviewed 295 people in 50 villages along the Lamandau, Mentaya and Katingan Rivers. Almost all of the people interviewed claimed to have seen the pheasant; only 1% claimed second-hand knowledge (Table 3). Most respondents claimed that the bird was found within a day's walk of the village (64%) and in lowland primary forest (96%). A day's walk in the forest is usually less than 20 km (pers. obs.), but varies with terrain and density of undergrowth. The large "no response" to question three (distance from village) may reflect observations made in villages or from villagers that have forgotten details of forest encounters.

When asked if they felt that there were changes in the abundance of the bird, 85% of respondents expressing an opinion ($n = 62$) believed that the bird was less common than in the past, and no respondent felt it was more common. The overall 79% "no response" to changes in the perceived abundance may reflect a reluctance to offer an opinion when the respondent was unsure. People from 17 villages reported seeing the bird in 1995 or 1996. People from nine villages reported last seeing the bird between 1990 and 1994, and people from 17 villages said they had last seen the bird prior to 1990 (Table 3). Bornean Peacock-pheasants were most commonly observed singly or as pairs during the dry season or the fruiting season. The fruiting season can be interpreted as the transition from dry to wet season or it may refer to a supra-annual fruiting pattern common on Borneo, when unusually large fruiting events occur in response to drought. Virtually all the respondents agreed that the birds are captured exclusively by snares set for galliform birds and small vertebrates (mouse deer and muntjac). They also reported that the Bornean Peacock-pheasants were captured for food and many reported that the bird could not be kept in captivity for very long and usually died in the snare.

Few respondents were familiar with the diet or nesting habits of Bornean Peacock-pheasants. Twelve people said they had observed the birds feeding or had examined stomach and crop contents, whereas only four people gave information on nesting. One stomach contained fruit and gravel, and one crop contained fruit and ants. Three people reported that the Bornean Peacock-pheasant eats fallen fruit and rattan fruit. Three nests were reported from primary forest and one nest from recently cleared agricultural fields. All reported the bird nesting on the ground ($n = 3$) or on a rotting log ($n = 1$), but no nest is constructed. Two nests were covered with leaves. Three of the nests contained two white eggs. Finally, respondents provided peacock-pheasant feathers from four locations.

GIS analysis

Bornean Peacock-pheasants were reported from each of nine areas sampled in Central Kalimantan (Figure 3). Most records of Bornean Peacock-pheasant are

Table 3. Results of semi-structured interviews in Central Kalimantan. Percent of responses is rounded to the nearest 1%

Question	Response	Number	Percentage
1 Source of knowledge of bird	Direct sighting	292	99
	Vocalization	0	0
2 Habitat of bird	Indirect	3	1
	Near river	3	1
	Lowland forest	283	96
	Agricultural plots	0	0
	Cut forest	0	0
3 Distance from village to habitat	Hill forest	9	3
	>1 day	3	1
	1 day (6 h)	42	14
	< 1 day (>6 h)	148	50
4 Year of observations	No response	102	35
	< 1950	4	1
	1950–1960	6	2
	1960–1970	15	5
	1970–1980	27	9
	1980–1990	45	15
	1990–1994	107	36
	1995	49	17
5 No. observed	1996	51	17
	1	231	78
	2	58	20
	2–10	3	1
6 Season of observations	>10	3	1
	Dry	85	29
	Rain	18	6
	Fruit	162	55
7 Changes in encounters over time	Unknown	30	10
	None	9	3
	More	0	0
	Less	53	18
	No response	233	79
8 Diet	Fruit only	9	3
	Fruit and insects	3	1
	Insects only	0	0
	Other	0	0
	No response	283	96
9 Why do people catch bird	Food	291	99
	To sell	0	0
	For pet	0	0
	No response	4	1
10 How is the bird caught	Net	0	0
	Glue traps	0	0
	Snares	291	99
	No response	4	1

restricted to lowland plain rainforest (lowland forest not dominated by trees of the family Dipterocarpaceae) and lowland dipterocarp rainforest over soils that range from moderately fertile, weathered soils on steep slopes (dystropepts) to nutrient-poor, acidic old loam and clay soils (kandiudults). Together, lowland plain and dipterocarp forests cover 67,000 km² (44% of the land area; Table 1) of

Central Kalimantan. A single village reported the bird from an area dominated by heath forest. We received no reports of peacock-pheasants from areas where the dominant habitat type is forest on alluvial soils, hill forest, freshwater swamps or peat swamps.

Although the lowland forest habitat is extensive, most of it is contracted to logging concessions. All but three records of Bornean Peacock-pheasant were from logging concessions: two records were from the Bukit Raya National Park and the third was from the Lamandau River in the western part of the province. Logging concessions control 77% of forest land in Central Kalimantan, including most of the lowland forest habitat. Less than 660 km² of lowland forest is protected in national parks and nature reserves. A proposed 18,500-km² extension to Bukit Raya National Park would include an additional 7,590 km² of lowland forest in the protected area system and would include five more Bornean Peacock-pheasant locations.

Discussion

Status of Bornean Peacock-pheasants

The results presented here suggest that the Bornean Peacock-pheasant is more widespread in Central Kalimantan than previous data indicate, but that its distribution is patchy (Figure 3). We identified nine areas where the bird was still being trapped in 1995 and 1996. Most respondents believe the species is rare and that populations are declining. In half of the villages where people remembered seeing the pheasant, no observations have been made since 1990. The finding that the Bornean Peacock-pheasant has not been observed by local people in agricultural land or secondary forest supports the opinion that the peacock-pheasants are primary forest specialists, a potential problem as agricultural and degraded habitats become the dominant forest type of Central Kalimantan.

How much potential habitat is available for Bornean Peacock-pheasants on Borneo and particularly in Central Kalimantan? Our GIS analysis indicates that the species has highly specific habitat requirements, namely lowland plain and lowland dipterocarp forest on moderately fertile soils. The peacock-pheasant has not been recorded from swamp forest and the observation in this study from a region dominated by heath forest was from forest on alluvial soils, rather than on the infertile leached clay and sandy soils characteristic of heath forest. The question of including hill forests rests on a single record by Smythies (1981), which in turn is based on a description of the bird and its call from a local informant (as in this study). Smythies described the call as a mournful "hor hor" which P. McGowan (*in litt.* 1997) believes may be similar to a two-note whistle of the Malaysian Peacock-pheasant *P. malacense*. R. Sozer (*in litt.* 1996), however, describes two Bornean Peacock-pheasant calls: a distinctive series of "kek", and a harsh, loud "kaw" that resemble calls of the Malaysian Peacock-pheasant. Based on the lack of confirmed historical records of Bornean Peacock-pheasants' occurrence in hill forest, and the possible discrepancies in call descriptions, we conservatively exclude hill forest and mountain forest from our calculation of Bornean Peacock-pheasant habitat. The remaining lowland forest area on Borneo is approximately 150,000–200,000 km² (extrapolated from MacKinnon and

MacKinnon 1986). How much of this habitat is actually suitable for Bornean Peacock-pheasants is unknown at present.

It is well known, however, that logging and agricultural conversion continues throughout Borneo. A former collection site in Sabah has been completely logged (D. F. Bruning 1996 pers. comm.). In West Kalimantan, Holmes (1989) reported that the site where he heard pheasant vocalizations (Holmes and Burton 1987) has since been logged. A 10-year research programme at Gunung Palung National Park, near the site described by Holmes and Burton, failed to document the presence of Bornean Peacock-pheasant (Laman *et al.* 1997). The forests near Lake Sentarum are under heavy pressure from forest conversion to oil-palm plantation (S. van Balen 1996 pers. comm.). In East Kalimantan, a four-month survey of Galliformes in the Mahakam River drainage found only two sites where the birds may still exist (R. Sozer 1996 *in litt.*). Other surveys on the Berau river drainage (W. Rahardjaningtrah 1996 pers. comm.) and the Tubu River (O'Brien 1998) in East Kalimantan failed to find evidence of the bird. While new locations may yet be discovered, the data suggest that northern Central Kalimantan may be the centre of distribution for the Bornean Peacock-pheasant.

In Central Kalimantan, as in much of Borneo, most of the peacock-pheasant's remaining habitat is granted to logging concessions. Of 67,000 km² lowland forest, only 1% is currently protected. These figures must be considered conservative. Although we treat all land as forested, the figures we use are at least 10 years old, and much land has been cleared in the intervening time. If estimates of logging rates from the 1980s are extrapolated to 1997 (MacKinnon *et al.* 1997), we speculate that an additional 7,000–8,000 km² of lowland forest in Central Kalimantan has been lost to logging since 1988. Respondents failed to identify degraded forest and agricultural land as Bornean Peacock-pheasant habitat, so the actual estimate of peacock-pheasant habitat is assumed to be the amount of unlogged lowland forest in Central Kalimantan. The inclusion of the proposed extension of the Bukit Raya National Park would increase the area of protected lowland rainforest in Central Kalimantan by a factor of 10, greatly increasing the prospects for continued survival of the Bornean Peacock-pheasant and other lowland forest specialists.

Most local knowledge of the Bornean Peacock-pheasant was obtained while hunting the bird for food, suggesting that harvest pressure on the bird may be high. Hunting and logging interact to increase pressure on pheasants in three ways. First, loss of habitat forces pheasants into smaller areas and increases the density of hunters (assuming the hunters do not change their habits). Second, logging companies often employ hunters to supply meat to logging camps. Finally, logging roads increase the accessibility of forest areas to hunters. E. Bennett (1996 pers. comm.) reports that logging operations and hunting by logging company employees to supplement protein are major factors in declining wildlife populations in Malaysian Borneo. A study of hunting at 17 sites in Sarawak and Sabah failed to detect the Bornean Peacock-pheasant (E. Bennett 1996 pers. comm.).

Limitation of survey methods

Surveys and interviews that utilize local knowledge are widely used in anthropology and sociology (e.g. ethnobotany: Momberg 1993; participatory mapping:

Sirait *et al.* 1994, Momberg *et al.* 1996), but less so in tropical wildlife management. Problems with questionnaires and interviews include lack of precision and accuracy on the part of the interviewee, as well as a reliance on second-hand (or third-hand) information rather than direct observation. Our questionnaire and survey methods no doubt suffered from these problems. For example, the discrepancy between the number of people who claimed to have seen the bird, and the number who could identify how long it took to travel to the site where pheasants could be found, suggests that at least one-third of interview respondents either forgot where the birds were found or had seen captured birds in villages only. Concepts of "common" versus "rare", and "how many" often frustrate efforts to determine the status of a subject. A third of questionnaire respondents in 41 villages regarded the bird as common, a perception that a wildlife biologist would be unlikely to share. Finally, it is difficult to verify the claims independently, unless physical evidence (e.g. feathers) are presented. These limitations illustrate the need for the careful design of surveys and questionnaires to remove, as much as possible, opportunities for ambiguous responses or misinformation.

In spite of the limitations, surveys and interviews based on knowledge of local hunters may be the most cost-effective method of rapidly surveying large regions. Hart and Upoki (1997) used similar interview techniques to guide the development of forest surveys for the Congo Peafowl *Afropavo congensis* in a 125,000-km² area of lowland forest in eastern Zaire. Sozer (1996 *in litt.*) based a survey of Galliformes in East Kalimantan on information provided by local hunters. When surveying widely dispersed or extremely rare species, we argue that interview surveys are a cost-effective means of determining where to focus future efforts.

Conservation options for the preservation of Bornean Peacock-pheasant

Habitat loss may be one of the most pernicious threats to the Bornean Peacock-pheasant. The peacock-pheasant's low density and apparent absence from degraded land suggests that large blocks of primary lowland forest are needed for continued survival. The proposed extension of Bukit Raya National Park would add 7,590 km² of lowland forest to the park, potentially a major tract of habitat for the peacock-pheasant. Approval of the proposed extension will undoubtedly involve a consideration of the feasibility of economically logging the area versus the value of the forest to conservation. The fact that the Government of Indonesia has made the proposal is a hopeful sign. Detailed surveys of protected areas throughout Kalimantan and additional GIS analyses are needed to delineate further the status of peacock-pheasant habitat.

It is unlikely that people in Central Kalimantan could be persuaded to stop hunting Bornean Peacock-pheasant voluntarily. Enforcement of no-hunting zones in protected areas may be necessary to provide sanctuaries for pheasants. Most logging companies employ people to supplement meat supplies for logging camps through hunting. A requirement that logging companies prohibit hunting in their concessions would help reduce hunting pressure for pheasants and other threatened species.

Although captive breeding may complement *in situ* conservation activities, we must first ask what aspects of the conservation problem would be addressed by

captive breeding. Captive-bred birds might be used to augment natural populations or restock depleted areas. Such a programme would be feasible, however, only after the hunting problem is solved. At present, there is no market or trade in Bornean Peacock-pheasants, although private breeders and wildlife traders are interested in the commercial potential of this peacock-pheasant (D. Bruning pers.comm.). Commercialization of captive-bred Bornean Peacock-pheasants potentially could create a demand for the species with unforeseen consequences.

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References

- Beebe, W. (1922) *A monograph of the pheasants, IV*. London: Witherby.
- Brüggemann, F. (1877) Ueber eine Vögelsammlung aus Südost-Borneo. *Abhandl. A. Naturw. Veriens zu Bremen* 5: 453–466.
- Dutson, G. (1990) Birds of Barito Ulu in Borneo. *Bull. Oriental Bird Club* 12: 16–20.
- Hart, J. A. and Upoki, A. (1997) Distribution and conservation status of Congo Peafowl *Afropavo congensis* in Eastern Zaire. *Bird Conserv. Int.* 7: 295–316.
- Holmes, D. A. (1989) Status report on Indonesian Galliformes. *Kukila* 4: 133–143.
- Holmes, D. A. and Burton, K. (1987) Recent notes on the avifauna of Kalimantan. *Kukila* 3: 2–32.
- Laman, T. G., Gaither, J. C., and Lucas, D. E. (1997) Rainforest bird diversity in Gunung Palung National Park, West Kalimantan. *Trop. Biodivers.* 3: 281–298.
- MacKinnon, J. and Phillips, K. (1993) *A field guide to the birds of Borneo, Sumatra, Java and Bali*. Oxford, U.K.: Oxford University Press.
- MacKinnon, K., Hatta, G., Halim, H. and Mangalik, A. (1996) *The ecology of Kalimantan*. Singapore: Periplus Editions.
- McGowan, P. J. K. and Garson, P. J. (1995) *Status, survey and conservation action plan 1995–2000, pheasants*. Gland, Switzerland: IUCN.
- McGowan, P. J. K., Dowell, S. D., Carroll, J. P. and Aebischer, N. J. (1995) *Status, survey and conservation action plan 1995–2000, partridges, quails, francolins, snowcocks, and guinea fowl*. Gland, Switzerland: IUCN.
- Momberg, F. (1993) Indigenous knowledge systems – potential for social forestry development resource management of land-dayaks in West Kalimantan. Unpubl. M.Sc. thesis Technical University of Berlin, Berlin, Germany.
- Momberg, F., Kristianus, A. and Sirait, M. (1996) *Drawing on local knowledge: a community mapping training manual*. Jakarta, Indonesia: Ford Foundation.
- O'Brien, T.G. (1998) *Bulungan biodiversity survey*. Bogor, Indonesia: Center for International Forestry Research.
- RePPProt (1990) *The land resources of Indonesia*. Jakarta, Indonesia: ODA/Ministry of Transmigration.

Sirait, M., Podger, N., Flavelle, A. and Fox, J. (1994) Mapping customary lands in East Kalimantan, Indonesia: a tool for forest management. *Ambio* 23: 411–417.

Smythies, B. E. (1960) *The birds of Borneo*. London: Oliver and Boyd.

Smythies, B. E. (1981) *The birds of Borneo*, third edition. Kuala Lumpur, Malaysia: Malayan Nature Society.

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