Chancellor, R. D. & B.-U. Meyburg eds. 2000
Raptors at Risk
WWGBP / Hancock House

Population Density, Territory Size and Habitat Use of Gurney's Eagle *Aquila gurneyi* in the North Moluccas, Indonesia

Nils Røv and Jan Ove Gjershaug

ABSTRACT

The study was carried out in 1996 as part of an environmental co-operation between Indonesia and Norway. Almost nothing is known about the biology and status of this rain-forest eagle. It is assumed that it is possibly threatened by deforestation. We studied the abundance and distribution of eagle territories within three study areas covering 439 km^2. An average density of one pair of eagles per 33 km^2 of land area was found. Mean territory size varied between 19 and 29 km^2, dependent on the forest productivity. Hunting most often took place in primary rain-forest (55 and 76 % of observed hunting time in two different areas), although that forest type covered a minor part of the eagles' habitats (12 and 34 % respectively). Our results indicate that about 800-900 pairs of Gurney's Eagles might be found in the North Moluccas, and it is concluded that at present the population is highly viable in that area. However, the species' dependence on primary forests makes it particularly vulnerable to reduction or degradation of the remaining rain-forest areas.

INTRODUCTION

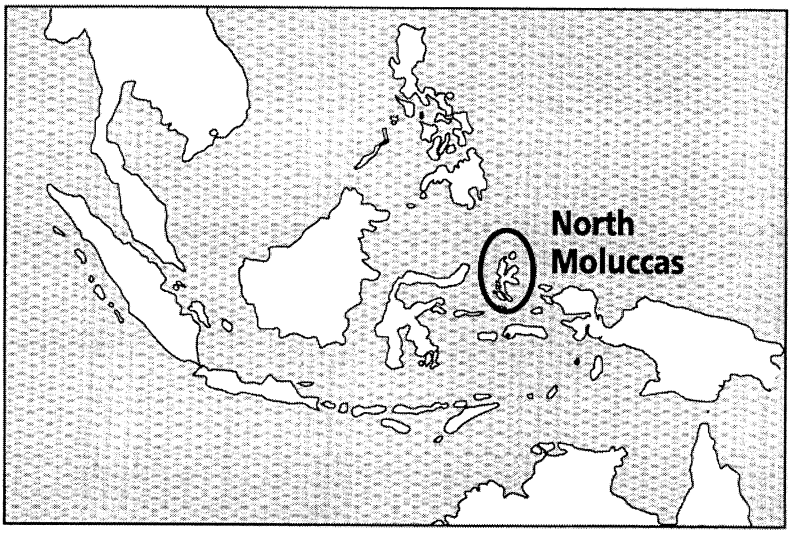
In 1990 a bilateral agreement on environmental co-operation between Indonesia and Norway was established. As part of this co-operation, a project on Conservation biology of Rain Forest Eagles in Indonesia started in 1995. The ultimate aim of the study was to obtain basic knowledge about large raptor species in the rain forest ecosystems in Indonesia so that their habitats can be managed in such a way that viable populations could be maintained in the future.

In 1996 a field study of Gurney's Eagle in the North Moluccas was carried out. This area forms a sub-biogeographic region characterised by a very special fauna of terrestrial mammals dominated by rodents, bats and marsupials. It includes the islands within Halmahera Tenga and Maluku Utara in the Maluku province (Fig. 1). Since terrestrial carnivores are absent, big raptors are the top-predators in the forest ecosystems. In order to maintain the diversity and the particular characteristics of the natural environment in this area, the preservation of those raptors might be considered as particularly important.

Gurney's Eagle is the largest top-predator in the lowland rain forest. Almost nothing has been known of its status and biology (Thiollay 1985, Burton 1989, del Hoyo *et al.* 1994). In BirdLife's

last list of the threatened bird species of the world (Collar *et al.* 1994), Gurney's Eagle is classified as near threatened, but was assumed by Burton (1989) to be threatened with extinction because of the destruction of its habitat. Meyburg (1986) has also included it in his list of threatened species. However, the fact is that very little information has been available about its population status.

Figure 1. Map of Indonesia showing the location of the North Moluccas.



The forest management authority and BirdLife International have recently proposed that a large forest area in Halmahera should be protected. It is assumed that the proposed reserve will effectively conserve a rich genetic reservoir and a unique and valuable component of the national biodiversity resource. However, the importance of the proposed protected area to large raptor species has not been considered, although those species are likely to be of particular importance. They usually need large areas for their territories and might be dependent on primary forest. It is reasonable to believe that if one can safeguard viable populations of the most area-demanding species within a protected area, the total biodiversity of the area will be conserved for future generations.

The objectives of the present study have been to obtain knowledge on population status and habitat selection of Gurney's Eagle in the North Moluccas, and to evaluate the importance of the proposed conservation of forest areas in Halmahera for the future survival of the species in the area. Fieldwork was carried out in September - October in 1996.

STUDY SITES

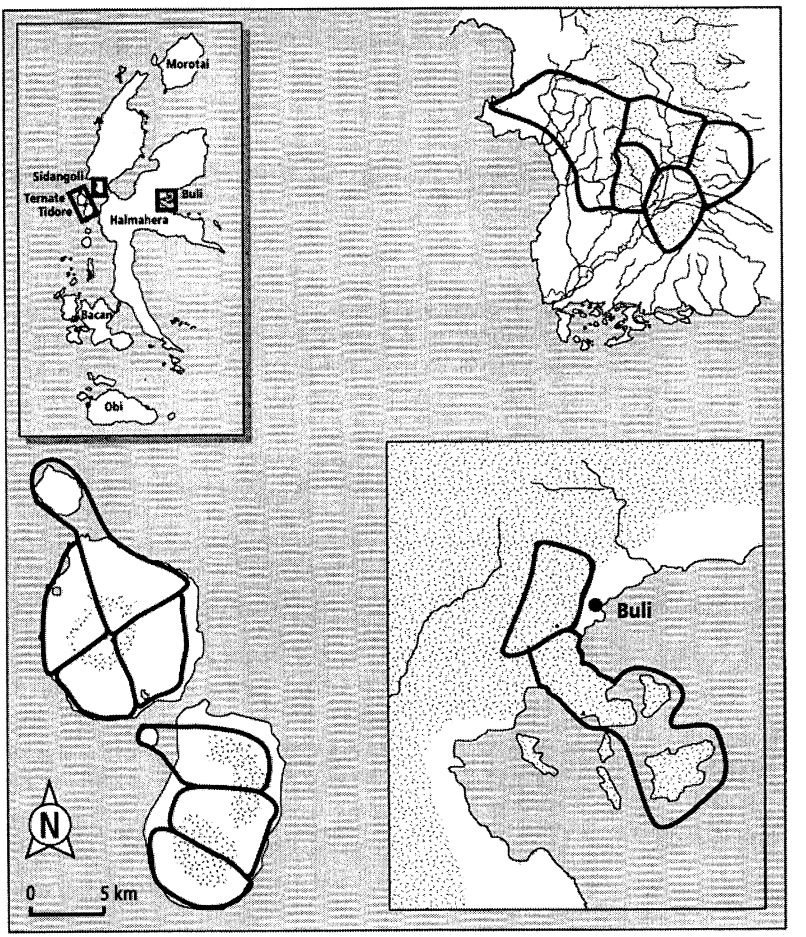
Three study areas covering 439 km^2 have been investigated, two on Halmahera mainland and one including Ternate and Tidore islands (Fig. 2). It is assumed that these areas represent common rain-forest habitats in the North Moluccas. Apandi & Sudana (1980) give the geology of the study areas on geological maps.

Ternate and Tidore islands

These volcanic islands have very fertile soil of volcanic origin. On most of the islands highly productive forests have been transformed into cultivated habitats, mostly clove, nutmeg and coconut plantations and gardens. There are considerable amounts of urban areas along the coast, including an airport on Ternate. The height above sea level of the mountains of both islands is about 1700 m and the total area of the islands is approximately 214 km^2, about 14 % of which is covered by

primary montane forest. Above the tree lines, there are narrow bands with alpine grassland, which makes the border against the bare volcanic rocks around the crater at the top of the mountains, particularly on Ternate.

Figure 2. Map of the North Moluccas showing the study areas (enlarged). The areas of primary forest are indicated (shaded).



Sidangoli area

Most of the 156-km^2-study area consists of forested hills on volcanic rocks belonging to the Bacan formation. Part of the lowland forest is situated on rich sedimentary rocks from late Tertiary belonging to the Weda formation. Near Sidangoli town, there is flat lowland on quaternary sediments (volcanic tuff and alluvial/coastal deposits). Today, most of this area is degraded grassland. The coastline limits the southern and western parts of the study area. Outside Sidangoli there is an area of mangrove forest. Most of the forest areas have been selectively logged or transformed into plantations and gardens. An estimated area of 33 km^2 of primary lowland and lower montane rain forest is found on the upper hills.

Buli

An area of 69 km² around Buli was studied during one week in September 1996. More than 84 % of the area consists of natural rain forest of lowland and lower montane types. This forest is situated on igneous ultrabasic rocks on hilly terrain. One large peninsula and two islands are found within the study area. The flat lowland around the village Buli is situated on alluvium or coastal sediments. Most of these areas are cultivated. The forests on the peninsula and the islands are partly degraded. We were informed that part of the forest has been burned some years ago.

RESEARCH APPROACH AND METHODS

Choice of investigation areas and methods was based on our own experience during visits to the study area in 1994 and 1995. The methodological approach to estimate eagle density is based on the eagles' territorial behaviour. Gurney's Eagles (usually the pair together) often soar high above the forest or perform territorial display to indicate the range of their territories. Observations were usually carried out from places with good views of the surrounding terrain. We identified the different territories by simultaneous observations of neighbouring pairs, or individual recognition on the basis of variation in plumage. Occasionally the home ranges of neighbouring pairs overlap. To calculate the average density of eagle territories, we divided the total size of the study areas by the number of recorded pairs. In the calculations, areas not used by the eagles were included, mostly plantations, gardens and grassland. Large areas of such land are found in the North Moluccas. However, on the basis of the available statistics and maps, we have not been able to estimate the areas of the different habitat types in the North Moluccas. Our population estimates are therefore based on the assumption that the study areas represent the general situation in the North Moluccas.

The seashores limit the land areas on Ternate and Tidore. In Sidangoli, the coastline limits the southern and western parts of the study area. The inland limit to the north has been defined on the basis of observations of neighbouring pairs, while to the east, the limit indicates the area which was covered by observations. In Buli, the eastern limit of the northernmost home range indicates where the eagles have been observed. Because of the high mountains we were not able to observe any neighbouring pairs in that territory. Accordingly, the size of that territory should be considered as a minimum estimate.

For each territory we calculated the total size and estimated the area of primary forest. The habitat-preference was studied by recording the forest types where hunting eagles were observed. The total time used and the frequency of observations have been compared with the estimated area of available primary forest within each territory. The area calculations were made on the basis of the available maps and a satellite spot image.

RESULTS

Population density

No significant differences in population density between the study areas were found (Table 1). On the average, one pair of Gurney's Eagle was found in each 31 km² of land area. However, one should keep in mind that in Buli, only two pairs have been studied and the home-range size of one of the pairs is a minimum estimate. Accordingly, the area requirement of eagles on igneous rocks might be more than the present results indicate.

Table 1. Abundance of Gurney's Eagle territories within the study areas.

Study area	*Total area (km²)*	*No. of pairs*	*Mean area (km²) per pair*
Ternate and Tidore	214	7	31
Sidangoli	156	5	31
Buli	69	2	34
Total	439	14	31

Territory size

On Ternate and Tidore seven pairs divided the islands in almost equal parts. Some overlap between the different home ranges was recorded. Overall, territory size varied between 9.5 and 40.5 km² (average 25.8 km²) (Table 2). In the highly fertile islands of Ternate and Tidore on the average only 4.3 km² of primary forest were available for each territorial pair, while in nearby Sidangoli a mean area of 6.5 km² of primary forest was found. In Buli, the two recorded home ranges were found in forested areas on igneous ultrabasic rocks. Although natural forests covered the entire areas of those two home ranges, they were of the same size as in the other study areas. However, part of the forest was degraded, probably because of earlier forest fires.

Table 2. Territory size and area of primary forest within the territories of Gurney's Eagles within the study areas. Means, minimum and maximum values are given in km².

Study area	*No. of pairs*	*Territory size*		*Area of primary forest within territories*	
		Mean	*Min.-Max.*	*Mean*	*Min.-Max.*
Ternate & Tidore	7	29.4	18.5-40.5	4.3	3.2-6.8
Sidangoli	5	19.4	9.5-38.3	6.5	5.0-9.3
Buli	2	28.9	25.0-32.8	28.9	25.0-32.8

Habitat use

Each time a single or a pair of eagles were observed, we recorded its behaviour and the number of minutes that particular behaviour was observed. Flying low over forest canopy or sitting on a branch of a tree obviously looking for prey were recorded as hunting. However, because of long distances, most observations of sitting eagles were recorded as unknown. Therefore, most observations of hunting behaviour were of flying birds.

Within the study areas in Ternate and Sidangoli, hunting behaviour was recorded on 93 occasions. The total duration of the hunting observations was more than four hours. Hunting birds were mostly observed in primary forest although that habitat covered a minor part of the eagles' territories (Figs. 3 and 4). This indicates that the area of primary forest is of particular importance for Gurney's Eagles.

Figure 3. Hunting time in primary forest compared to habitat availability of Gurney's Eagles on Ternate island.

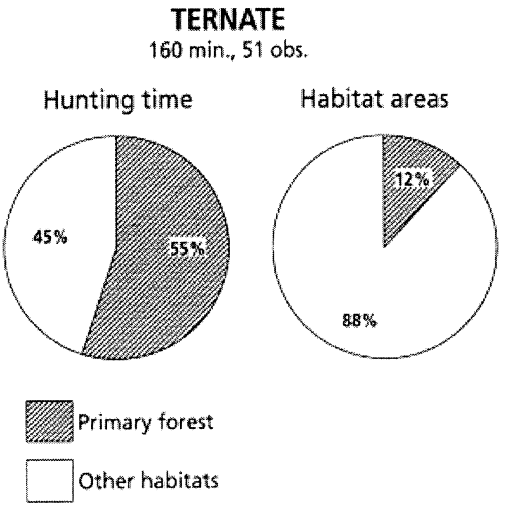
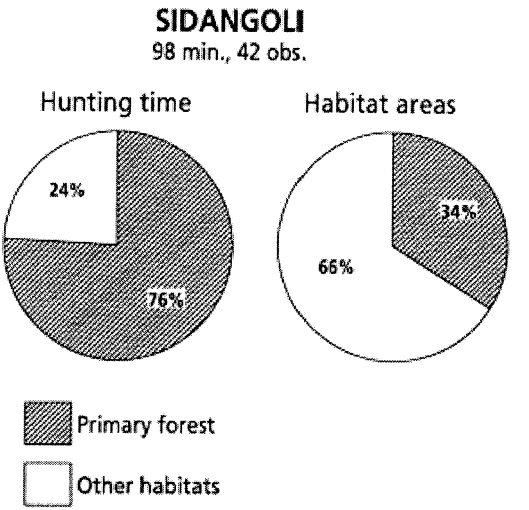


Figure 4. Hunting time in primary forest compared to habitat availability of Gurney's Eagles in Sidangoli study area.



DISCUSSION

Both population density and territory size are within the ranges of what has been found in other studies of large *Aquila* eagles, e.g. Wedge-tailed Eagles *Aquila audax* (cf. Marchant & Higgins 1993) Golden Eagles *Aquila chrysaetos* (cf. Cramp & Simmons 1980) and Verreaux's Eagle *Aquila verreauxii* (cf. Gargett 1990).

Population status in the North Moluccas

Our results indicate an average density of approximately one pair of Gurney's Eagle per 30 km^2 of forested areas on Halmahera (satellite islands included). It is known that within the North Moluccas, Gurney's Eagles are also found on the islands of Morotai, Bacan and Obi, but not in the Sula islands (Coates & Bishop 1997, White & Bruce 1986). According to the available statistics, there are approximately 27,500 km^2 of forested areas available for the eagles in the North Moluccas (areas of Sula islands subtracted). On the assumption that the average density of Gurney's Eagles within these large areas is about the same as has been found in our study areas, there would be an approximate number of 900 pairs of Gurney's Eagles in the North Moluccas. We have not been able to evaluate the reliability of the assumption on which this estimate is based. The maps of forested areas, which form the basis of the statistics, seem to represent future management plans rather that reflect the present situation. It has therefore not been possible to calculate the exact area of primary forest in the North Moluccas.

CONCLUSIONS

Our results indicate that there is a viable population of Gurney's Eagles in the North Moluccas. Moreover, the species is found in the large forests that still remain on Seram and New Guinea. A reasonable conclusion would therefore be that at present Gurney's Eagle is not a threatened species, in contrast to what has been earlier suggested.

The proposed protected area in Halmahera will encompass approximately 350,000 ha. Based on our results, an area of that size might support a minimum of 100 pairs of Gurney's Eagle. In addition, large areas of forest will probably be protected as "Hutan Lindung" (special protected forests). One might therefore conclude that if a continuous area of rain forest of the size indicated above would be protected for the future, the total biodiversity of the rain-forest ecosystems in the North Moluccas will probably be safeguarded for future generations.

ACKNOWLEDGEMENTS

We are grateful to our Indonesian sponsor, the Ministry of State for Environment (LH) for fruitful co-operation and to the Indonesian Institute for Sciences (LIPI) for permission to carry out research in the Moluccas. We are furthermore grateful to BirdLife International Indonesia Programme for their support and valuable advice during our stay in Indonesia.

REFERENCES

APANDI & SUDANA 1980. Systematic Geological Map, Indonesia, Lembar: Ternate 2516/2517, scale 1:250 000.

BURTON, P. 1989. *Birds of Prey*.. Gallery Books, New York.

COATES, B.J. & K.D. BISHOP 1997. *A Guide to the Birds of Wallacea*. Dove Publications.

COLLAR, N.J., M.J. CROSBY & A.J. STATTERSFIELD 1994. *Birds to watch 2*. The World List of threatened Birds. BirLife Conservation Series No. 4.

CRAMP, S. & K.E.L. SIMMONS 1980. *Handbook of the birds of Europe, the Middle East and North Africa*. Vol. 2: Hawks to Bustards. Oxford Univ. Press, Oxford.

GARGETT, V. 1990. *The Black Eagle*. Acorn Books and Russel Friedman Books, South Africa.

DEL HOYO, J., A. ELLIOTT & J. SARGATAL (eds.) 1994. *Handbook of the Birds of the World*. Vol. 2. New World Vultures to Guineafowl. Lynx Edicions, Barcelona.

MARCHANT, S. & P.J. HIGGINS (eds.) 1993. *Handbook of Australian, New Zealand and Antarctic Birds*. Vol. 2: Raptors to Lapwings. Oxford Univ. Press, Melbourne.

MEYBURG, B.-U. 1986. Threatened and near-threatened diurnal birds of prey of the World. *Birds of Prey Bull*. 3: 1-12.

THIOLLAY, J. M. 1985. Falconiformes of tropical rain forest: a review. In: Newton, I. & Chancellor, R.D. (eds.). *Conservation studies of raptors*. Vol. 5. ICBP Tech. Publ., Cambridge, pp. 155-165.

WHITE, C.M.N. & M.D. BRUCE 1986. *The Birds of Wallacea*. B.O.C. Check-list No. 7. British Ornithologists' Union.

Nils Røv and Jan Ove Gjershaug
Norwegian Institute for Nature Research
Tungasletta 2
N-7005 Trondheim
Norway