AVIFAUNA OF THE ANDAMAN ISLANDS: PRELIMINARY INVENTORY AND DISTRIBUTIONAL PATTERNS¹

Priya Davidar^{2,5}, K. Yoganand³, T. Ganesh⁴ and K. Geetha Nayak^{2,6}

The distribution of 78 species of resident birds from 27 families was recorded during a survey of 45 islands in the Andamans. The species richness of birds in each site was recorded by repeated walks along transects until the species accumulation curve reached an asymptote. Species restricted to larger islands were not recorded on smaller islands. The number of species in the different islands groups such as the North, Middle, South and Little Andaman islands, did not differ appreciably. Frugivores and omnivores tended to have a wider distribution than raptors, which tended to be restricted to larger islands. This database will provide a baseline with which to compare species distributions in the future.

Keywords: Andaman islands, avifauna, biodiversity assessment, island biogeography, species distribution

INTRODUCTION

Species on islands are more vulnerable to extinction than those on continents because besides factors such as the small population size of island species and lower chances for immigration or recolonisation of islands, they have usually evolved in isolation in a less complex ecosystem (e.g., with fewer predators, diseases and competitors), and therefore cannot face the multiple threats caused by humans. Many birds endemic to islands have gone extinct due to habitat loss, introduced diseases and introduced species (Pimm *et al.* 1995). Developing biodiversity inventories and monitoring changes in fauna can help to identify rare and threatened species, and those with declining populations.

The Andaman and Nicobar Islands, which lie off mainland India, have a rich biota which is facing serious threats due to increasing human pressure and developmental activities (Whitaker 1985; Saldanha 1989; Pande *et al.* 1991; Davidar *et al.* 1995). Therefore, documentation of the distributional patterns of species will provide information that can be used for immediate conservation action and for monitoring species over time. In this study, we provide information on the patterns of bird distribution in the Andaman Islands and interpret the results in the light of conservation priorities.

Pioneering surveys conducted by Abdulali (1964, 1981) on the avifauna of Andaman and Nicobar Islands helped to set up the foundation for more detailed assessments. Ripley and Beehler (1989) analysed the avifauna from an ornithogeographical perspective and listed 104 species of breeding birds. These include 18 endemic species and 86 endemic races.

Davidar *et al.* (1995, 1996, 2001 and 2002) and Devy *et al.* (1998) conducted ecological surveys of forest birds and butterflies in the Andaman group in the 1990s. They showed that there is a latitudinal gradient in habitat diversity, with the southernmost islands in the Andaman group having a higher proportion of evergreen forests than the northern islands. They demonstrated that island size and the presence of evergreen forests significantly influenced species richness. The larger islands had more species, and rarer species, than did small islands. The avifauna of smaller islands was a nested subset of those on larger islands. Therefore, they suggested that conservation efforts should be focused on protecting forests on large islands, and evergreen forests in particular should be prioritised for conservation efforts.

An ornitho-geographic analysis on the Andaman and Nicobar avifauna was conducted by Ripley and Beehler (1989), who concluded that the avifauna of the Andamans were predominantly allied to that of Myanmar, whereas the Nicobar avifauna was a subset of the avifauna of the Andaman Islands. In this study, we present a preliminary island-wise inventory of the avifauna of the Andaman Islands, with particular emphasis on forest birds. We assessed the proportion of islands on which each species was distributed with regard to island size, location and the smallest island on which it was recorded. We also assessed whether the distribution patterns of foraging guilds differed with regard to island size and location.

STUDY AREA

The Andaman Islands lie between 10° 30'-13° 41' N and 92° 12'-93° 57' E, off the coast of south-east Asia in the

¹Accepted August 30, 2007

²Department of Ecology and Environmental Sciences, Pondicherry University, Kalapet, Pondicherry 605 014, India.

³Wildlife Institute of India, Post Bag # 18, Chandrabani, Dehradun 248 001, Uttarakhand, India. Email: k.yoganand@gmail.com

⁴ATREE, 659, 5th A Main, Hebbal, Bengaluru 560 024, Karnataka, India. Email: tganesh@atree.org

⁵Email: pdavidar@yahoo.com

⁶Email: nayakkg@gmail.com

Bay of Bengal. The northernmost islands are about 285 km from Myanmar, and the southernmost is Little Andaman Island, located between the Andaman group and the Nicobars. Most of the land area of the Andamans consists of five large and contiguous islands, North Andaman Island, Middle Andaman Island, Baratang, South Andaman Island and Rutland. The Little Andamans, another large island is about 100 km south of South Andaman island and is separated from the Nicobars, which lie further south by the 140 km wide 10 degree channel.

The climate is tropical and oceanic with rainfall from both the Southwest and Northeast monsoon winds. The average annual rainfall is about 3,000 mm (Pande et al. 1991), increasing from the northern to the southern islands (Ellis 1989). This results in a north-south vegetation gradient with predominantly drier forests in the northern islands and wetter forests in the southern islands (Davidar et al. 2002). Evergreen forests are usually confined to large and medium sized islands, except towards the south where some small islands have evergreen forest; otherwise most small islands have dry forests (Davidar et al. 1995, 2002).

METHODS

Bird survey

The sampling was focused on forest birds, and therefore the sampling effort was concentrated within inland forested habitats, and therefore mangroves, swamps, mudflats and inland waterways, and nocturnal species were under sampled. However, we are including all records in this paper as a database for future reference.

A bird list for each island was compiled based on sightings along line transects. The number of transects depended on the size of the island, and several sites were sampled on the large islands, whereas the entire area was covered in case of small islands. In each site, the number of habitats was assessed and transects were walked in each habitat type in the mornings starting at dawn. A species list for each island was compiled based on the transect walks. All birds seen and heard were recorded and identified using Ali and Ripley (1987), and King *et al.* (1975). Casual sightings of birds were also used to compile the species list of each island.

We placed species in a foraging guild, i.e. insectivore, frugivore, raptor, based on observations and field notes from Ali and Ripley (1987) and Davidar *et al.* (1996). We classified birds of prey as raptors rather than carnivores based on the conventional usage of the term raptors to describe carnivorous birds.

Islands sampled

Forty-five islands in the Andaman group were surveyed during the dry season, from February to May in 1992 and 1993 and in February of 1994. A list of islands surveyed along with their area in sq. km is given in Table 1. This survey covered all the large islands, from North Andaman Island in the north to Little Andaman Island in the south, and most islands in the associated archipelagos (Davidar *et al.* 1995). For details of the survey methodology see earlier publications (Davidar *et al.* 1995, 1996, 2001, 2002).

The South Andamans and the Labyrinth Archipelago were surveyed from February to May 1992. Baratang, Ritchie's archipelago and seven islands off the North Andamans were surveyed from February to May 1993, and North Andaman Island and eleven associated islands were surveyed in February 1994. Little Andaman Island was surveyed in 1992 and 1994.

To facilitate data analysis we categorised the islands by location: the North Andamans, Middle Andamans and Baratang, South Andamans and Little Andaman island. Each island was classified as large (>20 sq. km), medium (10 to 19 sq. km), small (0.1 to 9 sq. km) or very small (<0.1 sq. km). There were 8 large islands, ranging from Peel (23 sq. km) to South Andaman island (>1000 sq. km), 7 medium islands ranging from Tarmugli (11.5 sq. km) to Long (14 sq. km), 25 small islands, ranging from Jolly Buoy (0.12 sq. km) to Paget (4 sq. km), and 5 very small islands (Table 1). We looked at the proportionate occurrence of species on island groups, and different island size categories. The smallest island on which a species tended to occur was noted, and the minimum area requirements for all species were estimated. The species recorded on all island sizes were categorised as "all". We looked at the distribution of species in different foraging guilds with regard to island location and island size.

RESULTS

Our inventory included 78 species of birds belonging to 27 families from 45 islands of different size categories (Appendices 1-3). Thirty of these species were not included in our earlier publications (Davidar *et al.* 1995, 1996, 2001, 2002) because our survey had focused on diurnal forest birds and these additional species were nocturnal species, were not primarily forest dwelling or were wetland avifauna. Some of the rare records were on the North Andaman group of islands.

The species distribution of birds on islands indicated that 20 species were found in fewer than 5 islands, and fewer than 5 species were found on over 40 islands (Fig. 1). Twenty-seven species (34%) were recorded on islands of all size

Table 1: Area in sq.km of the islands surveyed

Island	Area (sq. km)	Island size category
South Andamans	1,348	L
North Andamans	1,128	L
Little Andamans	675	L
Baratang	230	L
Rutland	116	L
Havelock	92	L
John Lawrence	35	L
Peel	23	L
Long	14	M
Wilson	14	M
Landfall	13	M
North Passage	13	M
Sound	12.7	M
Neil	12.6	M
Tarmugli	11.5	M
Paget	4	S
Alexandria	3.6	S
North Reef	3.4	S
Red Skin	3.3	S
East	3	S
Nicholson	1.8	S
North Cinque	1.6	S
Inglis	1.4	S
Guitar	1	S
Point	0.8	S
Malay	0.7	S
Reef	0.6	S
Hugh Rose	0.6	S
Delgarno	0.5	S
Twins	0.44	S
Middle Button	0.4	S
Excelsior	0.4	S
Ross(NA)	0.3	S
Ross(SA)	0.28	S
Pocock	0.25	S
Aves	0.25	S
North Button	0.25	S
Snob	0.23	S
Turtle	0.13	S
Jolly Buoy	0.13	S
Chester		VS
Curlew	0.09	VS VS
	0.07	
Temple	0.06	VS
Egg	0.06	VS
Grub	0.03	VS

L-Large, M-Medium, S-Small, VS-Very small

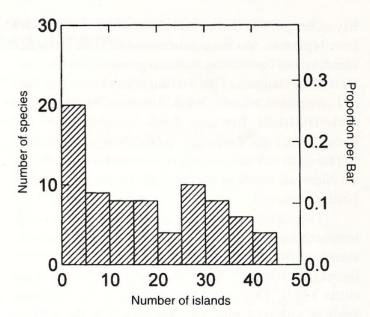


Fig. 1: Bird species distributions on islands

classes (Table 3). The majority of species were restricted to islands of particular size classes (Table 3). Fifty species (64%) were not found on islands <0.1 sq. km in area. Five species (6%) were recorded only on islands >10 sq. km and 11 species (14%) on islands >20 sq. km in area.

The distribution of guilds was strongly influenced by island size rather than by island location (Tables 2 and 4). Similar numbers of species were recorded in the different island groups, but Little Andamans had slightly fewer species than the other island groups, probably because of its isolation. Frugivores and omnivores tended to occur on islands of all sizes (Table 4), whereas raptors tended to be restricted to larger islands. A few species of insectivores and piscivores tended to occur only on large islands (Table 4).

DISCUSSION

Our assessment of bird distributions in the Andaman Islands indicates that the majority of species were restricted to larger than smaller islands. This supports our earlier observations that bird distributions in the Andaman Islands are strongly influenced by island size (Davidar *et al.* 2001). Ripley and Beehler (1989) stated that the avifauna of the Andamans is a subset of that of Myanmar and consists predominantly of widespread colonising species with high dispersal ability. Our study shows that many species do not

Table 2: Number of species of each feeding guild in the four island groups

Island group	Frugivore	Granivore	Insectivore	Nectarivore	Omnivore	Piscivore	Raptor
North	10	4	29	1	5	5	9
South	13	3	29	1	5	6	9
Middle	12	5	29	1	5	6	7
Little	11	2	23	1	4	5	8

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Table 3: Percentage of birds of each species recorded on 45 islands of different size classes and minimum area requirements of species

			Island size ca	ategory		
Family/Scientific name	Common name	Large (>20 sq.km) (N=8)	Medium (10-19 sq.km) (N=7)	Small (0.1 sq.km) (N=25)	Very Small (<0.1 sq.km) (N=5)	Minimum Island area requirements (sq.km)
Accipitridae						
Accipter nisus	Eurasian Sparrow-Hawk	37.5	0	0	0	>20
Accipter virgatus	Besra Sparrow-hawk	100	42.86	12	0	>0.1
Aviceda leuphotes	Black Baza	87.5	42.86	4	0	>0.1
Haliaeetus leucogaster	White-bellied Sea Eagle	100	85.71	44	0	>0.1
Spilornis cheela	Crested Serpent-Eagle	100	71.43	28	0	>0.1
Spilornis elgini	Andaman Serpent-Eagle	100	100	36	12.5	All
Spizaetus cirrhatus	Changeable Hawk-Eagle	87.5	57.14	24	0	>0.1
Alcedinidae	3					
Alcedo atthis	Common Kingfisher	37.5	0	8	0	>0.1
Todiramphus chloris	Collared Kingfisher	100	100	28	12.5	All
Halcyon coromanda	Ruddy Kingfisher	0	0	24	12.5	All
Halcyon pileata	Black-capped Kingfisher	12.5	0	8	0	>20
Halcyon smyrnensis	White-throated Kingfisher	100	100	84	50	All
Pelargopsis capensis	Stork-billed Kingfisher	100	28.57	24	0	All*
Anatidae	Otork-billed Kirigiisilei	100	20.07	24	U	Oil Oil
	Andomon Tool	50	0	4	0	- 0 1
Anas albogularis	Andaman Teal	50	0	4	0	>0.1
Dendrocygna javanica Apodidae	Lesser Whistling-duck	25	0	4	0	>0.1
A COLUMN TO THE PARTY OF THE PA	Brown-throated Needletail	100	85.71	20	0	>0.1
Hirundapus giganteus Artamidae	Brown-timoated Needletali	100	05.71	20	U	>0.1
	Mhite by a stad Mandaus IIau	07.5	100	4.4	0	. 0 1
Artamus leucorhynchus	White-breasted Woodswallow	87.5	100	44	0	>0.1
Burhinidae	0			40	•	0.4
Esacus recurvirostris	Great Thick-Knee	0	0	12	0	>0.1
Campephagidae						1.12
Coracina dobsoni	Andaman Cuckooshrike	37.5	0	4	0	>0.1
Coracina macei	Large Cuckooshrike	100	85.71	52	25	All
Pericrocotus speciosus	Scarlet Minivet	100	57.14	28	0	>0.1
Pericrocotus cinnamomeus	Small Minivet	100	85.71	76	12.5	All
Caprimulgidae						
Caprimulgus macrurus	Large-tailed Nightjar	100	14.29	12	12.5	All
Eurostopodus macrotis	Great Eared Nightjar	0	14.29	0	0	>10
Columbidae						
Caloenas nicobarica	Nicobar Pigeon	0	0	4	0	>0.1
Chalcophaps indica	Emerald Dove	100	85.71	48	12.5	All
Columba palumboides	Andaman Wood Pigeon	62.5	42.86	8	0	>0.1
Ducula aenea	Green Imperial Pigeon	100	85.71	68	12.5	All
Ducula bicolor	Pied Imperial Pigeon	50	0	4	0	>0.1
Macropygia rufipennis	Andaman Cuckoo Dove	100	28.57	28	0	>0.1
Streptopelia decaocto	Eurasian Collared-Dove	25	0	0	0	>20
Streptopelia tranquebarica	Red Collared-Dove	12.5	28.57	0	0	>10
Treron chloropterus	Andaman Green-Pigeon	100	100	56	0	>0.1
Coraciidae	Andaman Green-Figeon	100	100	50	U	>0.1
Eurystomus orientalis	Dollarbird	87.5	71.40	16	0	>0.1
Corvidae	Dollarbiid	07.5	71.43	16	0	>0.1
	Larga billad Craw	05	00.57	10	0	-01
Corvus culminatus	Large-billed Crow	25	28.57	16	0	>0.1
Dendrocitta bayleyi	Andaman Treepie	87.5	14.29	4	0	>0.1
Pachycephala grisola Cuculidae	Mangrove Whistler	100	100	88	12.5	All
Cacomantis sonneratii	Banded Bay Cuckoo	12.5	0	0	0	>20
Centropus andamanensis	Andaman Coucal	100	100	68	0	>0.1
Chrysococcyx	Violet Cuckoo	50	14.29	0	0	>0.1
xanthorhynchus		50			•	- 10
Cuculus micropterus	Indian Cuckoo	100	42.86	4	0	>0.1
Eudynamys scolopacea	Asian Koel	100	85.71	40	0	All*
	, wat i tool	100	00.71	40	· ·	7.111
Dicaeidae						

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Table 3: Percentage of birds of each species recorded on 45 islands of different size classes and minimum area requirements of species (*contd.*)

			Island size	e category		
Family/Scientific name	Common name	Large (>20 sq.km) (N=8)	Medium (10-19 sq.km) (N=7)	Small (0.1 sq.km) (N=25)	Very Small (<0.1 sq.km) (N=5)	Minimum Island area requirements (sq.km)
Dicruridae						
Dicrurus andamanensis Dicrurus paradiseus Irenidae	Andaman Drongo Greater Racket-tailed Drongo	100 100	57.14 100	28 64	0 50	>0.1 All
Irena puella Laniidae	Asian Fairy Bluebird	100	100	80	12.5	All
Lanius cristatus Meropidae	Brown Shrike	50	0	0	0	>20
Merops leschenaultii	Chestnut-headed Bee-eater	100	100	60	25	All
Merops philippinus Monarchinae	Blue-tailed Bee-eater	12.5	0	0	0	>20
Hypothymis azurea	Black-naped Blue Monarch	100	100	80	25	All
Terpsiphone paradisi Muscicapidae	Asian Paradise-Flycatcher	50	14.29	4	0	>0.1
Copsychus malabaricus	White-rumped Shama	75	57.14	4	0	>0.1
Copsychus saularis	Oriental Magpie Robin	100	100	92	37.5	All
Muscicapa dauurica Nectarinidae	Asian Brown Flycatcher	12.5	14.29	4	0	>0.1
Cinnyris jugularis Oriolidae	Olive-backed Sunbird	100	100	96	62.5	All
Oriolus xanthornus	Black-hooded Oriole	62.5	0	0	0	>20
Oriolus chinensis Picidae	Black-naped Oriole	100	100	92	12.5	All
Dryocopus hodgei	Andaman Woodpecker	100	71.43	20	0	>0.1
Dryocopus javanensis Dendrocopus macei	White-bellied Woodpecker Fulvous-breasted Pied Woodpecker	100 100	71.43 100	24 60	0	>0.1 All*
Ploceidae	Woodpecker					
Lonchura striata Psittacidae	White-rumped Munia	37.5	28.57	0	0	>10
Loriculus vernalis	Vernal Hanging Parrot	100	100	80	50	All
Psittacula alexandri	Red-breasted Parakeet	100	100	32	12.5	All
Psittacula eupatria	Alexandrine Parakeet	100	85.71	64	12.5	All
Psittacula longicauda Pycnonotidae	Long-tailed Parakeet	100	85.71	60	0	>0.1
Pycnonotus atriceps	Black-headed Bulbul	87.5	42.86	4	0	>0.1
Pycnonotus jocosus Rallidae	Red-whiskered Bulbul	100	100	96	62.5	All
Amaurornis pheonicurus Rallina canningi	White-breasted Waterhen Andaman Crake	25 12.5	0	0	0	>20 >20
Strigidae	Brown Houde Oct	F0	0	0	0	- 20
Ninox scutulata Tyto alba	Brown Hawk Owl Barn Owl	50 25	0	0	0 12.5	>20 >20
Sturnidae	Asian Glossy Starling	100	05 71	56	0	>0.1
Aplonis panayensis Gracula religiosa	Asian Glossy Starling Common Hill Myna	100 100	85.71 85.71	56 56	0	>0.1
Sturnia erythropygia Sylviinae	Andaman White-headed Starling		100	72	12.5	All
Cettia pallidipes Turdinae	Pale-footed Bush-Warbler	62.5	14.29	4	0	>0.1
Saxicola torquatus	Common Stonechat	0	0	4	0	>10
Zoothera citrina Zosteropidae	Orange-headed Thrush	75	71.43	56	ō	>0.1
Zosterops palpebrosus	White-eye	100	100	92	12.5	All

^{*}Species recorded in casual sightings on all islands (Davidar pers. obs.)

Table 4: Smallest island size (sq. km) in which the different feeding guilds were recorded

Feeding		Island	size	
category	>20 sq. km	>10 sq. km	>0.1 sq. km	All islands
Frugivore	0	0	7	6
Granivore	1	2	1	1
Insectivore	4	3	17	9
Nectarivore	0	0	0	1
Omnivore	0	0	2	2
Piscivore	3	0	5	5
Raptor	3	0	5	1

occur on smaller islands, probably due to the absence of their preferred habitat. The avifauna on the small and very small islands tends to consist of vagrants that are widely distributed across all habitat types (Davidar *et al.* 1995, 2001, 2002; Yoganand and Davidar 2000).

The restricted distribution of many species might be due to low dispersal ability or the inability of smaller islands to support viable populations of certain species. The raptors that are at the top of the food chain, and occur at lower densities, were less common on smaller islands (Thiollay 1997). It is quite possible that small islands are not able to support viable populations of raptors, whereas frugivores that depend on a resource that is spatially and temporally

unpredictable were widely distributed on islands of all sizes. Frugivores tend to be very mobile and fly over large distances in search of fruiting trees.

Certain species were only recorded on large islands, regardless of feeding category. These species might be specialised to particular habitats found predominantly on larger islands, such as the wet evergreen forests. We found that many species, such as *Columba palumboides*, *Macropygia rufipennis*, *Treron pompadora* and *Gracula religiosa* were associated with wet evergreen forests (Yoganand and Davidar 2000), and are therefore not likely to be recorded on smaller islands that tend to have scrubby or dry vegetation.

In conclusion, assessing the distributions of birds on islands can provide insights into the factors that govern their distribution. This database can provide baseline information with which to record changes in species distributions in the future, and thus has enormous importance for conservation.

ACKNOWLEDGEMENTS

This study was funded by a grant from the Ministry of Environment, France. We thank Dr. J.M. Thiollay for guidance and help with the avifaunal surveys, and Niraj Joshi for help with field work. The French Institute of Pondicherry provided logistical support and facilities.

REFERENCES

- ABDULALI, H. (1964): The birds of the Andaman and Nicobar islands.

 J. Bombay Nat. Hist. Soc. 91: 483-571.
- Abdulali, H. (1981): Additional notes on Andaman birds. J. Bombay Nat. Hist. Soc. 78: 46-49.
- ALI, S.A. & S.D. RIPLEY (1987): Handbook of the Birds of India and Pakistan. 2nd Compact Edn. Oxford University Press, New Delhi.
- Davidar, P., M.S. Devy, K. Yoganand & T. Ganesh (1995): Reserve size and the implications for the conservation of biodiversity in the Andaman islands. Pp. 287-303. *In*: (Eds: Boyle, T.J.B. & B. Boontawee). Measuring and monitoring biodiversity in temperate and tropical forests. CIFOR, Jakarta.
- DAVIDAR, P., K. YOGANAND, T. GANESH & N. JOSHI (1996): An assessment of common and rare forest bird species of the Andaman Islands. *Forktail 12*: 135-142.
- Davidar, P., K. Yoganand & T. Ganesh (2001): Distribution of forest birds in the Andaman islands: Importance of key habitats. *J. Biogeography* 28: 663-671.
- DAVIDAR, P., K. YOGANAND, T. GANESH & S.M. DEVY (2002): Distribution of forest birds and butterflies in the Andaman Islands: Nested patterns and processes. *Ecography* 25: 15-17.
- Devy, M.S., T. Ganesh & P. Davidar (1998): Patterns of butterfly distribution in the Andaman Islands: Implications for conservation. *Acta Oecologica* 19: 527-534.
- Ellis, J.L. (1989): Project document of North Andaman Biosphere

- Reserve in Andamans. Botanical Survey of India, Port Blair. Unpublished.
- KING, B., M. WOODCOCK & E.C. DICKINSON (1975): Collins Field Guide to the Birds of South-East Asia. The Stephen Greene Press, Lexington, MA. 480 pp.
- Pande, P.A., A. Kothari & S. Singh (1991): Directory of National Parks and Sanctuaries in Andaman and Nicobar Islands. IIPA, New Delhi. 171pp.
- PIMM, S.L., M.P. MOULTON & L.J. JUSTICE (1995): Bird extinction in the Central Pacific. Pp. 75-87. *In*: (Eds: Lawton, J.H. & R.M. May) Extinction Rates. Oxford University Press, Oxford.
- RIPLEY, S.D. & B.M. BEEHLER (1989): Ornitho-geographic affinities of the Andaman and Nicobar Islands. J. Biogeography 16: 323-332.
- Saldanha, C.J. (1989): Andaman, Nicobar and Lakshadweep. Oxford and IBH, New Delhi, India.
- THIOLLAY, J.M. 1997. Distribution and abundance patterns of bird community and raptor populations in the Andaman archipelago. *Ecography* 20: 67-82.
- WHITAKER, R. (1985): Endangered Andamans. Environmental Services Group, WWF-India and MAB India. Department of Environment, New Delhi.
- Yoganand, K. & P. Davidar (2000): Habitat preferences and distributional status of forest birds in Andaman Islands. J. Bombay Nat. Hist. Soc 97: 375-380.

Appendix 1: Distribution of avifauna in the North Andaman island group. Islands are arranged in a descending order of size, from left to right

							_	Jorth Ar	idaman Is	North Andaman Island Group						
Family / Scientific name	North Andaman	Landfall	Sound	Paget	North Reef	East	Point	Reef	Delgarno	Excelsion	Ross (NA)	Pocock	Aves	Turtle	Curlew	Temple
Accipitridae																
Accipter nisus	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accipter virgatus	-	0	0	-	0	0	-	-	0	0	0	0	0	0	0	0
Aviceda leuphotes	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haliaeetus leucogaster	-	-	-	0	-	-	-	0	0	0	0	0	0	0	0	0
Spilornis cheela	-	-	C	-	C	,	-	0	C	0	-	0	0	0	0	0 0
Spilornis elaini	,	. ,-	· -		0 0			0 0	· -	0 0	- C	0 0	0 0	0 0	0 0	· -
Spizaetus cirrhatus	-	0	0	-	0	0	-	0	. 0	00	0 0	0 0	0 0	0 0	0 0	· c
Alcedinidae					,	,		,	,))))	,))
Todirhamphus chloris	-	-	-	C	C	C	C	C	C	C	C	C	C	0	C	C
Halcyon smyrnensis	- ,-			·	·	·	·	· -	· -) -) -	- C	·	o -	·	·
Halcyon capensis		- c	- c	- c	- c	- c	- c	- c	- c	- c	- c	- c	- c	- c	- c	- c
Anatidae		•	•))))))))	0	0	0	0	>
Anas alboqularis	-	C	C	C	C	C	C	C	C	C	C	C	0	0	0	C
Dendrocvana iavanica	-	0	0	0	0	0	0	0	0	0	00	0 0	0	0 0	0	0 0
Apodidae													,		,	,
Hirundapus giganteus	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artamidae																
Artamus leucorhynchus	0	-	-	0	0	-	-	0	0	0	0	0	0	0	0	0
Campephagidae																
Coracina macei	-	-	-	-	0	-	-	-	0	0	0	0	0	0	-	-
Pericrocotus cinnamomeus	-	-	0	0	-	-	-	0	-	0	-	-	-	0	0	0
Pericrocotus speciosus	-	0	0	0	0	0	-	0	-	0	0	0	0	0	0	0
Caprimulgidae																
Caprimulgus macrurus	-	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0
Eurostopodus macrotis*	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Columbidae																
Chalcophaps indica	-	0	-	-	0	0	-	-	0	0	0	0	0	0	0	0
Ducula aenea	-	-	0	-	0	-	-	0	-	0	-	-	0	0	0	0
Ducula bicolor	-	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Macropygia rufipennis	-	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0
Streptopelia decaocto	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Treron chloropterus	-	-	-	-	0	-	-	0	-	0	-	-	0	0	0	0
Eurystomus orientalis	-	C	C	C	C	C	-	C	c	C	C	c	C	c	C	C
Corvidae		,))))))	•	•	>))))
Dendrocitta bayleyi	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pachycephala grisola Cuculidae	-	-	-	-	-	-	-	-	-	-		-	0	-	0	0
Cacomantis sonneratii	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centropus andamanensis	-	-	-	-	-	0	-	-	-	-	0	0	0	0	0	0
Chrysococcyx																
xanthorhynchus	- ,	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuculus micropterus	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eudynamys scolopacea Dicaeidae	-	-	0	-	0	0	-	0	-	0	-	0	0	0	0	0
Dicaeum minullum	-	-	•													

Appendix 1: Distribution of avifauna in the North Andaman island group. Islands are arranged in a descending order of size, from left to right (contd.)

							_	North A	ndaman I	North Andaman Island Group							
Family / Scientific name	North Andaman	Landfall	Sound	Paget	North Reef	East	Point	Reef	Delgarno	Excelsior	Ross (NA)	Pocock	Aves	Turtle	Curlew	Temple	Egg
Dicruridae	,						,				C	,					(
Dicrurus paradiseus		o	o -	o -	00	o -		o -	o -	o c	o c	- c	o c	o c	o -	00	O -
renidae)					•	ò)))	-	•	•
Irena puella	-	-	-	-	0	-	-	-	-	-	-	-	0	0	0	0	0
Meropidae Merops Jeschenaultii	-	-	-	-	C	-	-	-	-	-	c	C	C	c	c	c	C
Merops philippinus Monarchinae	-	. 0	0	0	0	0	0	0	0	0	00	0	0	00	00	00	00
Hypothymis azurea	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	-	0
Copsychus saularis	-	-	-	-	-	-	-	-	-	-	0	0	-	-	-	0	0
Muscicapa dauurica* Nectarinidae	-	0	-	0	0	0	0	0	-	0	0	0	0	0	0	0	0
Cinnyris jugularis	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
Oriolus chinensis	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0
Oriolus xanthornus	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Picidae	,		,	c	((((c	C	C	•	(((((
Dryocopus nouger		o c		0 0	0 0	00	o -	00	o c	0 0	o c	o c	o c	0 0	o c	0 0	0 0
Dendrocopos macei	. ,-	· -	-	-	0	0	-	·-	· -	· -	0	0	0	0	0	0 0	0
Ploceidae														,		,	
onchura striata*	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psittacidae	,		,	,	,	,	,	,	,	,	,	,	c	,	,	,	,
Controlle Vellialis	- +	- +	-, +	- c	- c		- +	- <	- c	- c	- c	- c	o c	- c	- +	- c	- <
Psittacula eupatria		- 0		- c	00	- 0		00	, -	00	o	o	o	o -	- c	o	0 0
Psittacula longicauda	-	· —	0	-	0	-	-	-	-	0	0	0	0	0	0	0	0
Pycnonotidae																	
Pycnonotus jocosus	-	-	-	-	-	-	-	-	-	-	- -	-	-	0	-	-	_
Pycnonotus atriceps Strioidae	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ninox scutulata	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tyto alba⁴	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sturnidae																	
Aplonis panayensis	-	-	0	-	0	0	-	0	-	-	-	0	-	0	0	0	0
Gracula religiosa	-	-	0	0	0	-	-	-	-	0	-	-	0	-	0	0	0
Sturnia erythropygia	-	-	-	-	-	-	-	-	-	-	0	-	-	0	-	0	0
Turdinae																	
Saxicola torquata	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0
Zoothera citrina	-	0	0	-	0	0	-	-	-	-	0	0	0	0	0	0	0
Zosteropidae Zosterops palpahrosus		+	-	-	•	+	+	-		•	,	•	+	٠	c	+	C
usier ups parpentusus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>	_	0

^{* -} Species recorded during casual sightings on all islands (Davidar pers. obs.)

Appendix 2: Distribution of avifauna in the South Andaman island group. Islands are arranged in a descending order of size, from left to right

Family / Scientific name	South Andamans	Little Andaman	Rutland	Tarmugli	Alexandra	Redskin	North Cinque	Malay	Twins	Ross (SA)	Snob	Jolly Buoy	Chester	Grub
Accipitridae														
Accipter nisus	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Accipter virgatus	-	-	-	-	0	0	0	0	0	0	0	0	0	0
Aviceda leuphotes	-	-	-	0	0	0	0	0	0	0	0	0	0	0
Haliaeetus leucogaster	-	-	-	-	-	-	0	-	0	-	0	0	0	0
Spilornis cheela	-	-	-	0	0	-	0	0	0	0	0	0	0	0
Spilornis elaini	-	-	-	-	-	-	-	-	0	0	0	0	0	0
Spizaetus cirrhatus	-	-	-	-	-	-	-	0	0	0	0	0	0	0
Alcedinidae								,	,	1	,	,		•
Alcedo atthis	-	0	-	0	-	0	0	0	0	0	0	-	0	0
Todirhamphus chloris	-	-	-	-	-	-	0	-	-	-	0	0	-	0
Halcvon coromanda	0	C	C	C	-	-	0	-	-	-	-	C	-	0
Halcvon pileata	0	0	0	0	0	-	0	0	0	0	-	0	0	0
Halcvon smyrnensis	-	-	-	-	-	-	C		,	-	-	-	-	C
Halcyon capensis				- 0			- (· c			· C		0
Anatidae			•)))))	,)
Anas alboqularis	-	0	0	0	0	-	0	0	0	0	0	0	0	0
Dendrocygna javanica	-	0	0	0	0	-	0	0	0	0	0	0	0	0
Apodidae														
Hirundapus giganteus	-	-	-	-	-	-	0	0	0	0	0	0	0	0
Artamidae														
Artamus leucorhynchus	-	-	-	-	-	0	-	0	-	-	0	0	0	0
Campephagidae														
Coracina macei	-	-	-	-	-	-	-	-	0	0	-	0	0	0
Coracina dobsoni	-	0	-	0	-	0	0	0	0	0	0	0	0	0
Pericrocotus cinnamomeus	-	-	-	-	-	-	-	0	-	-	-	-	0	-
Pericrocotus speciosus	-	-	-	-	-	-	0	-	0	0	0	0	0	0
Caprimulgidae														
Caprimulgus macrurus	-	-	-	0	-	-	0	0	0	0	0	0	0	-
Caloenas nicobarica	0	0	0	0	0	0	0	0	0	0	0	-	0	0
Chalcophaps indica	-	-	-	-	-	-	-	0	0	-	-	-	-	0
Columba palumboides	-	0	-	-	-	0	0	0	0	0	0	0	0	0
Ducula aenea	-	-	-	-	-	-	-	-	-	0	-	0	0	-
Ducula bicolor	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Macropygia rufipennis	-	-	-	0	-	-	-	-	0	0	-	0	0	0
Treron chloropterus	-	-	-	-	-	-	0	-	0	0	-	0	0	0
Coraciidae														
Eurystomus orientalis	-	-	-	-	-	-	0	0	0	0	-	0	0	0
Corvidae														
Corvus culminatus	0	0	0	0	-	-	0	0	0	0	0	-	0	0
Dendrocitta bayleyi	-	1	-	0	-	0	0	0	0	0	0	0	0	0
Destruction of the second														

Appendix 2: Distribution of avifauna in the South Andaman island group. Islands are arranged in a descending order of size, from left to right (contd.)

					South Andaman Island Group	man Island	Group							
Family / Scientific name	South Andamans	Little Andaman	Rutland	Tarmugli	Alexandra	Redskin	North Cinque	Malay	Twins	Ross (SA)	Snob	Jolly Buoy	Chester	Grub
Cuculidae														
Centropus andamanensis	-	-	-	-	-	-	-	-	0	-	-	-	0	0
Chrysococcyx xanthorhynchus	nus 1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuculus micropterus	-	-	-	-	-	0	0	0	0	0	0	0	0	0
Eudynamys scolopacea	-	-	-	-	-	-	0	-	0	-	-	0	0	0
Dicaeidae														
Dicaeum minullum	-	-	-	-	-	-	0	-	0	0	-	-	0	0
Dicruridae														
Dicrurus andamanensis	-	-	-	-	-	-	-	0	0	0	-	0	0	0
Dicrurus paradiseus	-	-	-	-	-	-	-	-	0	-	-	-	-	-
Irenidae														
Irena puella	-	-	-	-	-	-	-	0	-	-	-	0	-	0
Laniidae														
Lanius cristatus	-	-	-	0	0	0	0	0	0	0	0	0	0	0
Meropidae														
Merops leschenaultii	-	-	-	-	-	-	-	0	-	-	-	0	-	-
Monarchinae														
Hypothymis azurea	-	-	-	-	-	-	-	-	0	0	- -	-	-	0
Terosiphone paradisi	-	0	-	0	-	0	0	0	0	0	0	0	0	0
Muscicapidae)		•		,	•							
Consider and	-	-	-	-	-	c	c	c	0	c	c	c	c	0
Copsychias marabancus	- •	- •	- •	- •	- ,) T) +	> +) +	· ·				
Copsychus saularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nectalillaae						,	,			,	,	,	,	,
Cinnyris jugularis Oriolidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oriolus chinensis	-	-	-	-	-	_	-	-	-	-	-	-	-	0
Oriolus xanthornus	-	C	-	C	C	C	C	0	0	C	0	0	0	0
Picidae		ò		•)	•	,	,	,		•	,	,	
Dayocopus hodgei	-	-	-	-	-	-	C	-	C	C	C	-	C	C
Drygonis iayanasis		. ,-			٠,) C		0 0	0 0	0 0	-	0 0	0 0
Discopus javanerisis	- •		- 1	- •	- •) 1	- +	0 0) +) T	- 0	0 0	0 0
Dendrocopos macei	-	-	-	-	-	-	-	-	0	-	-	0	>	0
Ploceidae														
Lonchura striata*	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Psittacidae														
Loriculus vernalis	-	-	-	-	-	-	-	-	0	0	0	-	-	0
Psittacula alexandri	-	-	-	-	-	-	-	0	0	-	-	0	0	0
Psittacula eupatria	-	_	-	-	-	-	-	-	-	0	-	0	0	0
Psittacula longicauda	-	-	-	-	-	-	C	-	-	C	0	0	0	0
Pycnonotidae)			,	,	,		
Pychonoty income	-	-	-	-	,	-	-	-	-	-	-	-	-	-
Distriction officers	- +	- +	- +	- c	- (- (- c	- c	- c	- c	- c	- c	- c	
Pychonolus arriceps	-	-	-	>	Þ	>	Þ	>	>	>	>	>	>	>

Appendix 2: Distribution of avifauna in the South Andaman island group. Islands are arranged in a descending order of size, from left to right (contd.)

				- •	South Andaman Island Group	nan Islanc	d Group							
Family / Scientific name	South Andamans	Little Andaman	Rutland	Tarmugli	Tarmugli Alexandra	Redskin	North Cinque	Malay	Twins	Ross (SA) Snob	Snob	Jolly Buoy	Chester	Grub
Rallidae														
Amaurornis pheonicurus	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Rallina canningi*	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Strigidae Nipox seutulata	,		c	c	c	c	c	c	c	c	c	c	c	(
MINUX SCUIDIBIA	-	-	0	>	0	0	>	0	0	0	0	0	0	0
Tyto alba* Sturnidae	-	0	0	0	0	0	0	0	0	0	0	0	0	-
Aplonis panayensis	-	-	-	-	-	-	-	0	0	-	-	0	0	0
Gracula religiosa	-	-	-	-	-	-	-	-	0	0	-	0	0	0
Sturnia erythropygia Sylviinae	-	-	-	-	-	-	-	0	0	0	0	0	0	0
Cettia pallidipes Turdinae	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Zoothera citrina Zosteropidae	-	0	-	-	0	-	-	-	-	0	-	-	0	0
Zosterops palpebrosus	-	-	-	-	-	-	-	-	-	0	0	-	0	0

^{* -} Species recorded in casual sightings on all islands (Davidar pers. obs.)

Appendix 3: Distribution of avifauna in the Middle Andaman island group. Islands are arranged in a descending order of size, from left to right

Family/Scientific name Baratang Havelock John Lawrence Peel Long Wilson North Lawrence North Passage North Passage						~	Middle An	Middle Andaman Island Group	d Grou	d					
Accipitridae Accipitridae Accipitridae Aviceda leuphotes 1 1 1 1 1 0 <t< th=""><th>Family/Scientific name</th><th>Baratang</th><th>Havelock</th><th>John Lawrence</th><th>Peel</th><th>Long</th><th>Wilson</th><th>North Passage</th><th>Neil</th><th>Nicholson</th><th>Inglis</th><th>Guitar Button</th><th>Sir Hugh Rose Button</th><th>Middle</th><th>North</th></t<>	Family/Scientific name	Baratang	Havelock	John Lawrence	Peel	Long	Wilson	North Passage	Neil	Nicholson	Inglis	Guitar Button	Sir Hugh Rose Button	Middle	North
Accipter vigatus 1 1 1 1 1 1 1 0	Accipitridae														
Aviceda leuphotes 1 1 0 1 0 1 0 0 1 0 0 1 0 0 1	Accipter virgatus	-	-	-	-	-	0	0	-	0	0	0	0	0	0
Haliaeetus leucogaster 1 1 1 1 1 1 0 1 1 1 0 1 1 1 1 0 0 1 0 0 1 0	Aviceda leuphotes	-	-	-	0	-	0	-	-	0	0	-	0	0	0
Spilornis cheela 1 0	Haliaeetus leucogaster	-	-	-	-	-	0	-	-	-	0	-	0	-	-
Spilornis elgini 1 1 1 1 1 1 1 1 1 1 0	Spilornis cheela	-	-	-	-	-	-	-	-	-	0	0	-	0	0
Alcedinidae Alcedinidae 1 1 0 1 0	Spilornis elgini	-	-	-	-	-	-	-	-	0	0	-	0	0	0
Alcedinidae Alcedinidae Alcedonidae Alcedonidae Alcedo athis 0	Spizaetus cirrhatus	-	-	-	0	-	0	-	-	0	0	0	0	-	0
Alcedo athis 0 1 0 <t< td=""><td>Alcedinidae</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Alcedinidae														
Todirhamphus chloris 1 1 1 1 1 1 1 0 1 0	Alcedo atthis	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Halcyon smyrnensis 1 1 1 1 1 1 1 1 0	Todirhamphus chloris	-	-	-	-	-	-	-	-	0	-	0	-	0	0
Halcyon capensis 1 1 1 1 1 1 0	Halcyon smyrnensis	-	-	-	-	-	-	1	-	-	0	-	-	0	0
Anatidae Anas albugularis 1 1 0	Halcyon capensis	1	-	-	-	-	0	0	-	0	0	0	-	0	-
Anas albugularis 1 1 0	Anatidae														
Hirundapus giganteus 1 1 1 1 1 1 1 0 1 1 0 0 0 0 0 0 0 0 0	Anas albugularis Apodidae	-	-	0	0	0	0	0	0	0	0	0	0	0	0
	Hirundapus giganteus	-	-	-	-	-	-	-	-	0	-	-	-	0	0

Middle Appendix 3: Distribution of avifauna in the Middle Andaman island group. Islands are arranged in a descending order of size, from left to right (contd.) Sir Hugh Rose 000000 Button Guitar Button 0000 Inglis 0000 Nicholson Middle Andaman Island Group Neil Passage North Wilson Long Peel Lawrence John Baratang Havelock Chrysococcyx xanthorhynchus Pericrocotus cinnamomeus Streptopelia tranquebarica Centropus andamanensis Artamus leucorhynchus Eudynamys scolopacea Dicrurus andamanensis Pericrocotus speciosus Family/Scientific name Saprimulgus macrurus Pachycephala griseola Columba palumboides Macropygia rufipennis Streptopelia decaocto Eurystomus orientalis Esacus recurvirostris Cuculus micropterus Dicrurus paradiseus Treron chloropterus Chalcophaps indica Corvus culminatus Dendrocitta bayleyi Dicaeum minullum Soracina dobsoni Campephagidae Caprimulgidae Coracina macei Ducula bicolor Ducula aenea Columbidae Burhinidae Coraciidae Dicruridae Artamidae Cuculidae Dicaeidae Corvidae

North

000

Merops leschenaultii

anius cristatus

Meropidae

Irena puella

renidae

Laniidae

Appendix 3: Distribution of avifauna in the Middle Andaman island group. Islands are arranged in a descending order of size, from left to right (contd.)

Family/Scientific name	Baratang	Havelock	John Lawrence	Peel	Long	Wilson	North Passage	Neil	Nicholson	Inglis	Guitar Button	Sir Hugh Rose Button	Middle	North
Monarchinae														
Hypothymis azurea	-	-	-	-	-	-	-	-	-	-	-	_	-	0
Terpsiphone paradisi	0	-	0	0	0	0	0	-	0	0	0	0	0	0
Muscicapidae														
Copsychus malabaricus	-	-	-	0	-	0	-	-	0	0	0	0	0	0
Copsychus saularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nectarinidae														
Cinnyrus jugularis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oriolidae														
Oriolus chinensis	-	_	-	-	-	-	-	-	-	-	-	-	-	-
Oriolus xanthornus	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Picidae														
Dryocopus hodgei	-	-	-	-	-	-	-	0	-	0	0	0	0	0
Dryocopus javanensis	-	-	-	-	-	-	-	0	-	0	0	0	0	0
Dendrocopos macei	-	-	-	-	-	-	-	-	-	-	-	0	-	0
Ploceidae														
Lonchura striata*	0	0	0	-	-	0	0	-	0	0	0	0	0	0
Psittacidae														
Loriculus vernalis	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Psittacula alexandri	-	-	-	-	-	-	-	-	0	-	0	0	0	0
Psittacula eupatria	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Psittacula longicauda	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pycnonotidae														
Pycnonotus jocosus	-	-	-	-	-	-	_	-	-	-	-	-	-	-
Pycnonotus atriceps	-	-	-	0	-	-	-	0	0	0	-	0	0	0
Strigidae														
Ninox scutulata	0	-	0	0	0	0	0	0	0	0	0	0	0	0
Sturnidae														
Aplonis panayensis	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Gracula religiosa	-	-	-	-	-	-	-	-	-	0	-	0	0	0
Sturnus erythropygius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sylviinae														
Cettia pallidipes	-	-	-	-	-	0	0	0	-	0	0	0	0	0
Turdinae														
Zoothera citrina	-	-	-	0	-	-	-	-	-	0	0	0	-	-
Zosteropidae														
Zostorone nalpohrocus	-	•			-	-		•	-		•	•	•	•

* - Species recorded during casual sightings on all islands (Davidar pers. obs.)



Davidar, Priya et al. 2007. "Avifauna of the Andaman Islands: Preliminary Inventory and Distributional Patterns." *The journal of the Bombay Natural History Society* 104, 298–310.

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