

IMPACT OF THE TSUNAMI (DECEMBER, 2004) ON THE LONG TAILED MACAQUE OF NICOBAR ISLANDS, INDIA

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ABSTRACT - We carried out a standard survey to assess the distribution and abundance of *Macaca fascicularis umbrosa* of Nicobar Islands (India) after the tsunami which washed the whole region in 2004 and compare them with those reported for 2000. A total of 40 groups, comprising 814 monkeys, was sighted, group size varying from 7 to 98 animals (mean \pm SD = 20.35 \pm 1.82). There was no significant change in the number of groups sighted in the interior parts of the islands before and after the tsunami, whilst the number of groups sighted in coastal areas was significantly lower after the tsunami. Also, the adults/juveniles ratio in the group varied from ca. 1:1 to 1:0.4. A fairly low ratio of immatures to adult females suggests that the tsunami also affected the population structure of the monkeys. The destruction of major coastal fruit-trees exploited by monkeys might be the reason for their lower presence in coastal areas. Future restoring of fruit plantations could enhance the human-wildlife conflict.

Key words: *Macaca fascicularis umbrosa*, group size, sex ratio, natural catastrophe

RIASSUNTO - *Impatto dello tsunami (Dicembre 2004) sul macaco delle Isole Nicobar, India.* La distribuzione e l'abbondanza di *Macaca fascicularis umbrosa* sulle Isole Nicobar (India) sono state stimate tramite campionamenti standardizzati dopo lo tsunami che ha colpito l'intera regione nel 2004 e comparate a quelle ottenute nel 2000. Sono stati avvistati 40 gruppi, formati da 7 a 98 animali (media \pm DS = 20.35 \pm 1.82), per un totale di 814 macachi. Non sono state rilevate variazioni significative del numero di gruppi presenti nelle parti interne delle isole, mentre sono diminuiti i gruppi osservati nelle foreste costiere. Il rapporto tra adulti e giovani è variato da circa 1:1 a 1:0.4. In particolare, il basso numero di giovani per femmina adulta suggerisce che lo tsunami possa aver influito negativamente sulla struttura della popolazione. La distruzione delle piante da frutto costiere, importante risorsa trofica per i macachi, potrebbe essere la causa del calo di presenza lungo le coste. L'impianto di nuove coltivazioni potrebbe inasprire la competizione tra agricoltori e fauna selvatica.

Parole chiave: *Macaca fascicularis umbrosa*, dimensione dei gruppi, rapporto sessi, catastrofe naturale.

INTRODUCTION

Isolated populations of a rare species may be disproportionately affected by

both stochastic and deterministic factors such as hurricanes, fires, changes in habitat quality, and inbreeding or genetic drift (Soulé, 1987; Burgman *et*

al., 1993). In order to conserve such species, the impact of these factors on the long-term survival of individual populations need to be assessed (Karen, 1998). An earthquake with magnitude 9.15, epicentre at 3.29°N and 95.94°E off the coast of Sumatra and focal depth 30 km, occurred on 26 December 2004 at 6.29 a.m. It triggered a tsunami that, amongst other effects, engulfed the entire low-lying coastal forests of Nicobar Islands. Water, which took several days to recede, devastated the people and wildlife of the islands (Sankaran, 2005).

Long-tailed macaques (*Macaca fascicularis umbrosa*) were the only primates that were expected to have been adversely affected by the tsunami. Long-tailed macaques are the only nonhuman primates found on Nicobar Islands (Umaphy *et al.*, 2003). Other subspecies occur in Myanmar, Cambodia, Laos, Vietnam, Thailand, Malaysia, Indonesia and the Philippines (Rodman, 1991; Tikader and Das, 1982). In 2000, a total of 88 groups, having a mean size of 36 monkeys, were recorded in Great Nicobar, Little Nicobar and Katchal islands (Umaphy *et al.*, 2003). The majority of monkey groups were found along the coastal areas (Umaphy *et al.*, 2003). Since the coastal forests of Nicobar islands were severely damaged by the tsunami (Sankaran, 2005), a survey was carried out to assess its impact on the small population of the long-tailed macaque.

STUDY AREA

Nicobar Islands (latitudes 6° 45' and 13° 41' and longitudes 92° 12' and 93° 57'), in the Bay of Bengal, arch from Andaman

Islands in the north to Sumatra (Indonesia) in the south (Saldanha, 1989; Dager *et al.*, 1991, Fig. 1).

The islands can be subdivided into three sub-groups (Sankaran, 1997). To the south lies the Great Nicobar group consisting of two major islands (>100 km²) and nine islets (>5 km²). Among them, Great Nicobar, Little Nicobar, Kondul and Pilo Milo are inhabited. Fifty-eight km northwards, the Nancowry group includes three major (>100 km²), two intermediate (36 and 67 km²) and three small islands (<17 km²), and two small islets. Except for the islets, the entire Nancowry group is inhabited. The northernmost sub-group comprises Batti Malv, uninhabited, and Car Nicobar, which lies 88 km north of the Nancowry group and has a population of >19,000 people (Sankaran, 1995). Historically, the long-tailed macaque occurs only in Great Nicobar, Little Nicobar (Great Nicobar group) and Katchal islands (Nancowry group; Umaphy *et al.*, 2003).

METHODS

In February–May 2006, all three Nicobar islands where long-tailed macaques have been reported earlier were surveyed using a standardized protocol following Umaphy *et al.* (2003). Surveys were carried out between 7.00 and 12.00 a.m. by eight people simultaneously, walking on existing trails, streams, paths and roads. Whenever a group was sighted, its exact location on the map, distance from coast and altitude were recorded using Global Positioning System. The age and sex composition of 11 groups were also estimated using the morphological features known from monkeys in captivity at Port Blair.

A total of 81 transects were laid covering an overall distance of 387.4 km. Of these, 43 transects (233.1 km) were laid in coastal forests and 38 (154.3 km) in interior forests. Mean transect length was $4.7 \pm$ (SD) 1.9 km (min-max: 2 - 12 km). Row data about the

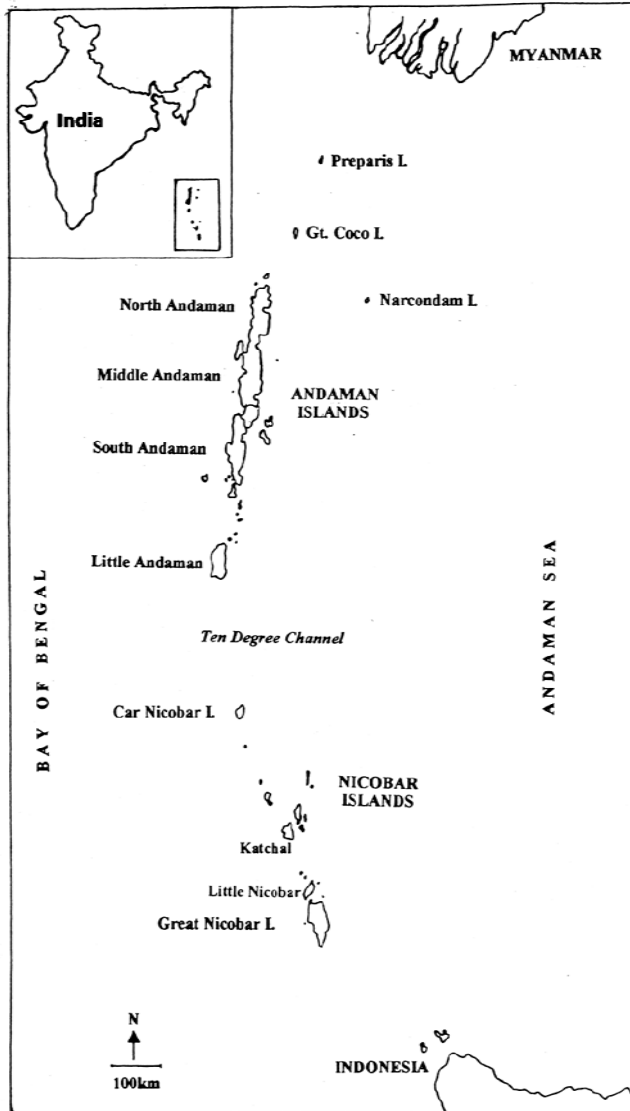


Figure 1 - Study area: Nicobar Islands of India

distribution, abundance and group composition of monkeys were compared with those obtained by the earlier survey (Umapathy *et al.*, 2003) using Kruskal Wallis test. The relative abundances of the species on the three islands (N° of groups per island / total N° of groups sighted) before and after the tsunami were compared by a

chi-square test for k-proportions (Gibbons, 1971).

RESULTS

A total of 40 groups, including 814 monkeys, were sighted. Monkey group size varied from 7 to 98 (mean \pm SD =

20.35 ± 1.82) monkeys. There was no significant change in the mean number of groups sighted in the interior parts of the islands before (in 2000) and after the tsunami (K-W test, $\chi^2 = 0.94$, d.f. = 2, N.S.), whilst the mean number of groups sighted in coastal areas was significantly lower (K-W test, $\chi^2 = 3.97$, $P < 0.05$, d.f. = 1). The relative abundance of the long-tailed macaque in the three islands did not vary ($\chi^2 = 0.01$; d.f. = 2; N.S., Tab.1) after the tsunami. In Great Nicobar Island, 473 monkeys were sighted. Group sizes varied from 7 to 47 (mean ± SD = 21.5 ± 2.8) monkeys (Fig. 2, Tab. 1). In Little Nicobar Island, a total of 142 individuals was recorded, group size varying from 8 to 26 monkeys (mean ± SD = 14.2 ± 1.8; Fig. 2). There was no difference in the number of groups sighted in coastal and interior forests of this island (Tab. 1). In Katchal Island, 199 monkeys were sighted; group size varied from 11 to 98 macaques (mean ± SD = 24.8 ±

10.5; Fig. 2). The largest group was observed near Kapanga village.

Group composition of 5, 3 and 3 groups of long-tailed macaque was analysed for Great Nicobar, Little Nicobar and Katchal islands, respectively. The percentage of adults (K-W test, $\chi^2 = 14.18$, d.f. = 1, $P < 0.001$) and immature (K-W test, $\chi^2 = 14.18$, d.f. = 1, $p < 0.001$) monkeys in the groups differed significantly before and after the tsunami. In 2000, the ratio adults/juveniles was about 1:1, whilst in 2006 was 1:0.4. The number of adult males ranged from 1 to 22 (mean ± SD = 6.08 ± 1.84), whilst that of adult females ranged from 3 to 45 (mean ± SD = 11.83 ± 3.56; Tab. 2). The adult female: male ratio increased from 1:0.22 in 2000 to 1:0.48 in 2006.

DISCUSSION

Although sampling effort was higher in 2006 than in the previous survey, (Uma-

Table 1 - Results of the surveys carried out in 2006 and comparison with previous data (Umapathy *et al.*, 2003); If = Interior forest; Cf = Coastal forest; T = Total; Tl = Total transect length; Nt = Number of transects.

Island	Number of groups							Tl (km)	Nt	Area (km ²)	Groups/km	
	2006			2000			2006				2000	
	If	Cf	T	If	Cf	T						
Great Nicobar	14	8	22	16	37	53	211.8	41	1045.1	0.104	0.23	
Little Nicobar	6	4	10	1	16	17	99.1	23	159.1	0.101	0.27	
Katchal	4	4	8	3	15	18	76.5	17	174.4	0.105	0.19	
Total	24	16	40	20	68	88	387.4	81	1378.6	0.103	0.23	

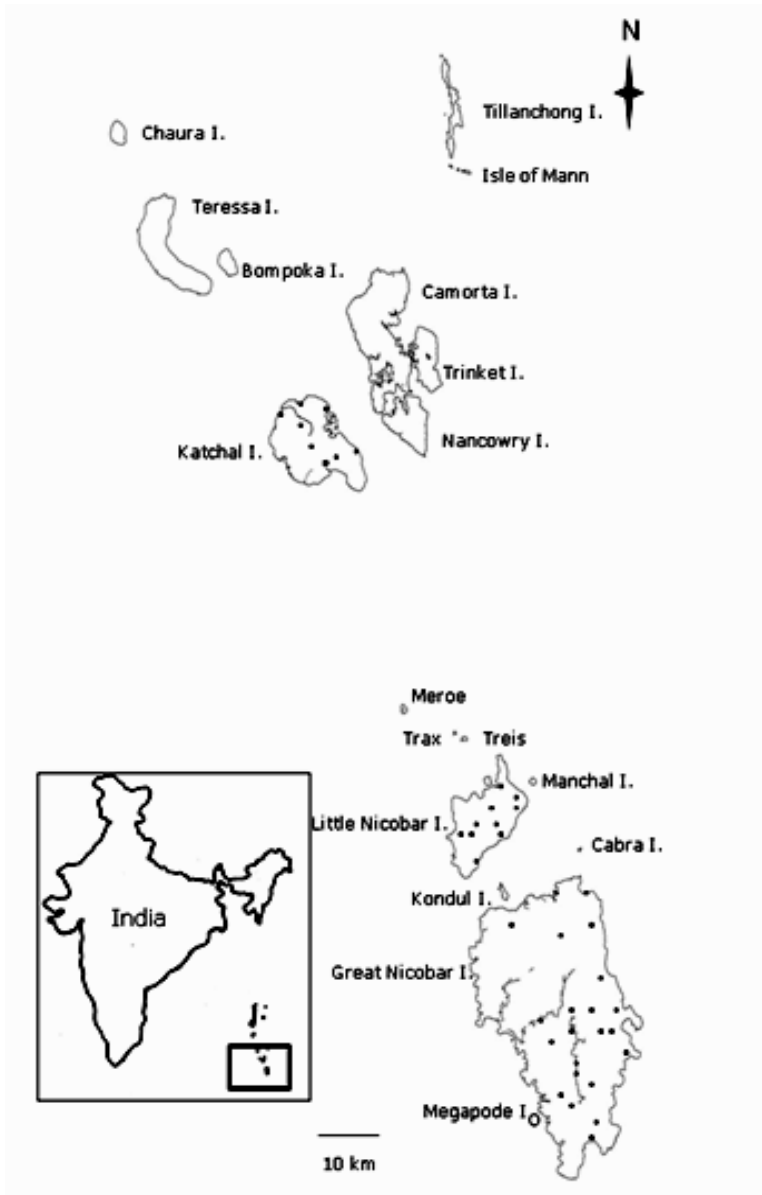


Figure 2 - Locations (black dots) of long-tailed macaque groups on Nicobar islands in 2006. Monkeys occur in Great Nicobar, Little Nicobar and Katchal islands.

pathy *et al.*, 2003), the number of groups of *Macaca fascicularis umbrosa* sighted in Nicobar Islands sharply decreased, particularly in coastal forests. The main cause of this decline may be

the disappearance of coastal trees, mainly *Pandanus* spp., *Terminalia* spp. and coconut trees, washed away by the tsunami in 2004 (Balakrishnan, 1989; Sivakumar, 2000; Sivakumar and

Table 2 - Group size and age-structure of long-tailed macaques in Nicobar Islands in 2006; ad M = adult male; ad F = adult female; j = juveniles; % ad = % adults; % j = % juveniles.

Groups	Locality	Size	Ad M	Ad F	J	% ad	% j
Great Nicobar I	Trinket Bay	8	3	3	2	75.0	25.0
Great Nicobar II	Kosingdon	34	10	16	8	76.5	23.5
Great Nicobar III	Navy Dera	12	3	7	2	83.3	16.7
Great Nicobar IV	13 KM	26	7	12	7	73.1	26.9
Great Nicobar V	35 KM	8	1	6	1	87.5	12.5
Katchal I	East of South Point	14	2	7	5	64.3	35.7
Katchal I	Near Yemkui	14	2	7	5	64.3	35.7
Katchal II	East Bay	98	22	45	31	68.4	31.6
Little Nicobar I	Near Pulo Patia	8	3	3	2	75.0	25.0
Little Nicobar II	Muhincohin	12	3	8	1	91.7	8.3
Little Nicobar III	Southern Tip	12	3	8	1	91.7	8.3
Total		246	59	122	65	73.6	26.4

Sankaran, 2003; Sankaran, 2005; Sivakumar, 2010). These species represented important food sources for macaques, which, before 2004, were more abundant in coastal regions and along rivers than in the islands' interior. Accordingly, long-tailed macaques tend to forage and lodge on trees next to water throughout their range (van Shaik *et al.*, 1996; Umaphay *et al.*, 2003). Moreover, six skulls of long-tailed macaque found near the Galathea Bay of the Great Nicobar Island confirmed that waves were also a direct cause of mortality for long-tailed macaques. A fairly low ratio of immatures to adult females indicates that the tsunami had also affected the population structure of monkeys, possibly due to food shortage for immatures.

The restoration of the original biodiversity is possible only if the natural re-

colonization is actively facilitated (Lance, 2000; Elmquist *et al.*, 2003; Thomas, 2003). The aftermath of the tsunami has left the trail of homeless families who need rehabilitation (Sivakumar, 2010). Coconut (*Cocos nucifera*) palms are the most important commercial plants of these islands, consequently their cultivation has become important for the future survival of people in this region. New crop plantation will need to take into account the long term effects of habitat alteration. It is quite possible that, in the absence of appropriate measures, the ongoing plantation of coconut and other economic fruit-bearing trees would encroach upon the majority of coastal areas, provoking, in the next future, harsh human-monkey conflict. Accordingly, habitat destruction and persecution in the coconut crops are the

major threats to the survival of long-tailed macaques, although the species is protected since 1972 by the Wildlife (Protection) Act. At present, only the monkey population of Great Nicobar Islands is protected by two National Parks (Campbell Bay National Park and Galathea National Park). Inadequate coverage of Protected Areas has already threatened several species in Nicobar Islands, including the long-tailed macaque (Sanakaran, 1997). Therefore, after obtaining the willingness from the local communities, Little Nicobar and Katchal islands should be declared 'Community Reserves' in order to enhance the protection of the long-tailed macaque and other threatened species of the region.

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