SACON Technical Report-107

Estimation of abundance of feral elephants in Interview Island Wildlife Sanctuary, Andaman and Nicobar Islands, India

Technical Report

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and Natural History

Kumara, H.N., Manchi, S.S., Ashwin, H.P., Pethe, H. and Mane, A. (2012). Estimation of abundance of feral elephants in Interview Island Wildlife Sanctuary, Andaman and Nicobar Islands, India. Technical Report submitted to the Forest Department, Andaman and Nicobar Islands, Port Blair.

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Designing and Printing: Silotum Creations, Mysore.

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Submitted to

Department of Environment and Forest

Andaman and Nicobar Islands, Port Blair

By

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Acknowledgements

We are grateful to Mr. D.V. Negi, PCCF (WL) and Mr. Ajai Saxena, Add. PCCF (WL) for their ardent concern and sustain in the project from the initiation. We thank Mr. K. B. Singh, CF, Eco-tourism, Mr. Shaji T. Abraham, ACF (WL) for their support and help. As DFO (WL), Mayabandar keen efforts of Mr. C. R. Malik, from initiation of the project and its implementation are highly acknowledged. We also personally thank him for his great help towards smooth running of the project. The support rendered by Mr. S. K. Thomas, DFO (WL), Mayabandar during end of the project work is highly acknowledged. We thank Mr. Anil Saha, Range Officer (WL), Tugapur, Mr. S. X. Runda, Camp Officer, Interview Island and the staff members of forest department for their support during the field work. We also thank all the Forest Department Staff for their support during the work. We sincerely thank Wildlife Division, Department of Environment and Forest, Andaman and Nicobar Islands for providing funds and the opportunity to do this work.

We thank Mr. M. Y. Kamble, Scientist C, BSI, Port Blair for giving the technical inputs in floral identification.

We are thankful to Saw Loren, Saw Alexander, Justin Sumit Kumar, Mathias Lakra, Johnson, Anil Dung Dung, Mangal Singh and Kuldeep for their extra efforts during the data collection and also for keeping the working ambiance in the difficult climatic conditiond during field work without which this work wouldn't have been achieved so easily.

We express our gratitude to Director of SACON and all our colleagues in SACON for their constant support and encouragement. We are grateful to the Directors Office, Administration and Finance Division of SACON for maintaining accounts and smooth administrative processes related to the project. We thank Dr. Babu for preparing the required maps for report. We also thank Dr. Ananda Kumar for his timely suggestions and the fruitful discussion from the beginning to completion of the project.

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Introduction

Impact of feral animals on the native flora and fauna:

When an animal is introduced to new environment, its interaction with native elements of the ecosystem is towards trying to adapt in the available niche. In the process, they might start using native flora or fauna for their survival. If the non-native species is aggressive and habitat generalist then it will prevail over the native ones and thrive in the new environment. If they do not have any competitor or predator, the damage caused by such species on the native ecosystem will be very severe e.g. suppression of regeneration of three native tree species by feral rabbit at Round Island, Mauritius (North *et al.*, 1994), suppression of native wetland species by Asiatic water buffalo at Australia, many plant species were almost driven to near extinct due to feral pigs and goats at Hawaii, however, removal of these feral animals have led to the recovery of the ecosystem (Zavaleta *et al.*, 2001). Biological invasions remain to be a leading cause of species extinctions according to Gurevitch and Padilla (2004).

Feral animals in Andaman and Nicobar Islands:

Many tropical islands are rich in endemism (Gentry, 1986), Andaman and Nicobar Islands also show with rich biodiversity and high-level of endemism. Over the years along with human settlement, many domesticated animals were brought to these islands in the last century viz. goat, cat, dog, chital (*Axis axis*) and elephant (*Elephas maximus*) (Saldahna, 1989). Over time many of these animals escaped to the wilderness and become feral in these islands. The elephants are imported to the islands from mainland since the beginning of the 20th Century predominantly for timber operations. The domesticated elephants were brought to Interview Island and North Andaman by the P.C. Ray Timber Company which operated in the area in the 1950s and, which went

bankrupt during 1962. They abandoned the elephants at two different places viz. Chinapur forest at North Andaman and Interview Island (Sivaganesan and Kumar, 1994). The herd of elephants abandoned in Chainpur forest of North Andaman presumably travelled up to Diglipur Forest Division of North Andaman (Sivaganesan and Kumar, 1994) and about 40 elephants were released in Interview Island, which have become feral. The Interview Island was declared as Wildlife Sanctuary in 1985 mainly for protection of this feral population of elephants.

Estimating the abundance of Elephants:

Density estimation is vital for decisions-making process regarding the degree of protection and derivation of appropriate management techniques for the conservation of species. Population estimation either done by direct (observations) or indirect surveys (nest or fecal) is crucial to estimate abundance, density and distribution (Jathanna *et al*., 2003, Rasmussen *et al*., 2005, Varma *et al*., 2006). In case of large bodied animals such as elephants, the line transect method is commonly used to estimate density in the wild (Barnes *et al*., 1995, Sukumar 1986, Alfred *et al*., 2010), based on either direct sightings or indirect signs such as dung.

Other methods such as mark-recapture and water hole count methods have been seldom used to estimate density of wild elephants (Rasmussen *et al*., 2005, Morley and van Aarde 2007, Jennifer *et al*., 2010). In India, many studies have estimated population parameters such as density and age-sex ratios using distance sampling based on direct or indirect signs (Baskaran and Sukumar 2011, Kumara *et al*., 2012), capture-recapture, and population surveys (Sukumar 1986). Recent methods such as photographic techniques and acoustic sensors are seldom used to estimate abundance of elephants in dense forest areas (Goswami *et al*., 2007). So also the dung count method to estimate elephant densities is often limited by using known defecation rates (Kumaraguru *et al*., 2010) which are affected by factors such as season, rainfall, habitat types, size of boli etc. (Olivier *et al*., 2009, Theuerkauf and Gula 2010) or on the assumption of age-specific decay rates (Barnes and Barnes 1992) which will have impact on the estimates. In spite of which, line transect dung count and block count methods are mostly relied upon to estimate elephant densities in the forests of India (Kumaraguru *et al*., 2010).

Population monitoring is crucial to derive appropriate management and conservation of such populations and habitat. Previous studies by Sivaganesan and Kumar (1994) and Ali (2001) estimated the elephant density for Interview Island, however, current status of the elephant population was not known. We conducted the field study to estimate the elephant abundance for Interview Island during April-July 2012. In the present study, we estimated the abundance of feral elephants using dung count method (fixed width transects), photo capturing and tracking the animals for individual identification. The findings are discussed in the present report.

Study site

Interview Island is situated southwest of North Andaman Island (12° 56′17″N and 92° 42′31″ E) and is separated by 20 km of sea from Mayabunder, a town in North and Middle Andaman District (Figure 1). The island is 133 km² in area. The major vegetation types of the island include Andaman tropical evergreen, Andaman semi-evergreen, littoral and mangrove forests (Champion and Seth, 1968). The P.C. Ray Timber Trading Company operated on this island since 1950s. They have clear-felled the evergreen and semi-evergreen forests of the island for timber. They used domesticated elephants brought from mainland India (South and North Eastern India) as well as machinery like bulldozers to operate the timber company on the island. There also used to be a few small settlements on the island for the workers. Most of the island has a flat terrain except the steep hills in the southeast. The forest on the flat terrain has been logged extensively while that of the undulating rocky terrain has been left untouched because of inaccessibility and greater logistical difficulties. In 1962, the P.C. Ray Company declared bankruptcy and the timber operations, settlements and domestic elephants on the island were abandoned. The forest has been regenerating naturally in the presence of feral elephants ever since. In 1985 Interview Island was declared a Wildlife Sanctuary with the aim to protect the feral elephant population. From then on the island is uninhabited except for a police outpost on the west coast and a forest camp on the east coast of the island. Therefore, the island presents a peculiar study area with a heavily logged stand of forest allowed to naturally regenerate for the last 50 years, and undisturbed

forest also on the same island. Adding to it is the effect of the feral elephant population exploiting the same forest for sustenance.

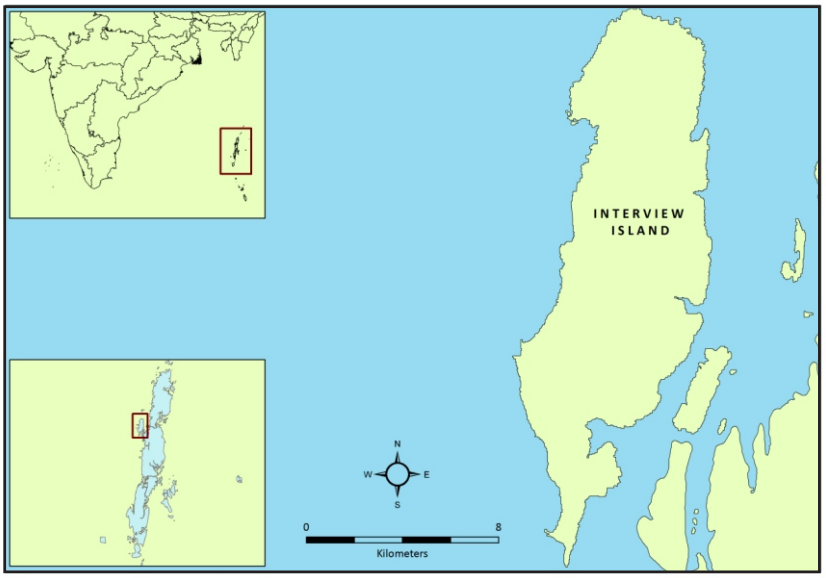

Figure 1 **Map of Interview Island Wildlife Sanctuary**

Methods

The field survey was carried out between April-July 2012. To estimate the elephant abundance in the sanctuary we used dung count method, and tracking and photo-trapping for individual identification of animals or to identify the herds.

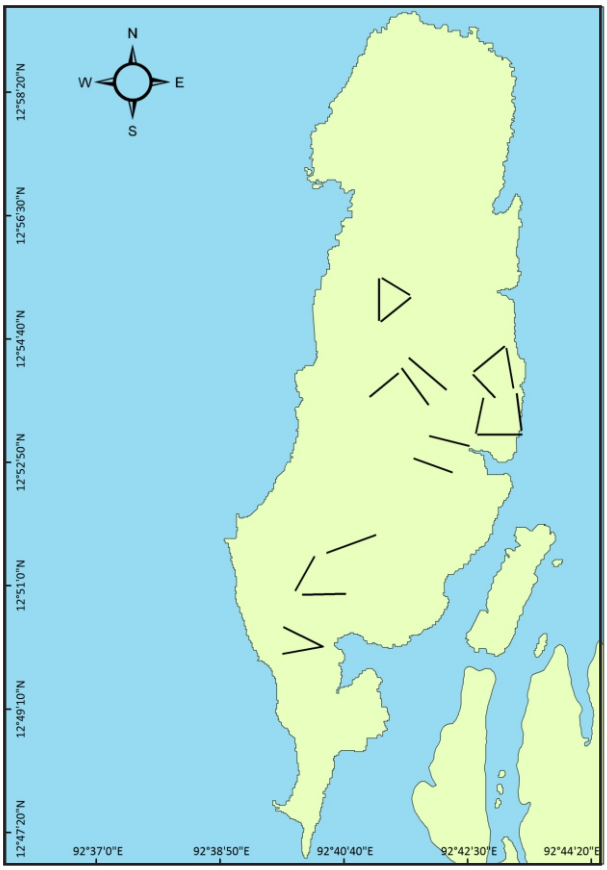

Figure 2 **Fixed widths transects used for dung count in Interview Island WLS (Transects are dark straight lines)**

Dung count method: Sivaganesan and Kumar (1994) considered rocky area, scrub forest, creek and highly undulating terrain are non-suitable habitat, and considered about 70 sq. km. as suitable habitat for the elephant. We selected the same area for sampling that Sivaganesan and Kumar (1994) projected, and placed the fixed width transects to count the dung piles (Fig. 2). In each strip, dung piles of all the varying decay stages were counted. The allocated time period did not permit the estimation of dung defecation rate and decay rate for the island.

Tracking the herd or individuals for the photo documentation and individual identification: We employed photographic techniques to record and identify the individual elephants. All fresh water bodies were identified in the park, and two teams of researchers with field assistants walked in the selected area to find out the recent movement of the elephants (along the water body and also suitable forest area). Movement of elephants was deduced based on fresh dung, foot print or feeding signs. Once the fresh signs of elephant movements were located, it was followed as possible as one could trace the signs. Photo traps were also deployed at few identified sites for the photo capturing. In addition to these methods, we kept the record of circumference of dung bolus to compare and differentiate the individuals.

We also interacted with many local people who frequented to the island and department personnel to know the frequency of sightings, frequently sighted locations, death records of elephants, herd size and visible age class in the sighted herds.

Vegetation sampling: During the fixed width sampling for elephant dung piles, we also recorded all the trees debarked and climbers that were pulled and eaten by elephants. Later separate vegetation sampling was done to estimate the abundance of food trees. About two hectare areas

were sampled in the island, within each sampling plot of 10m x10m, all the food trees with girth of more than 20 cm were counted. Species identification of trees was done using "Forest Flora of Andaman Islands" by C. E. Parkinson (1972). We also took a help of taxonomic experts from Botanical Survey of India, Port Blair to identify few plant species which we could not identify using books.

Results

A total of 7.79 km of strip with a width of 20 m and 8.3 km of strip with 13 m was covered for dung count. The total area sampled was 0.2637 sq. km., in which a total of 36 dung piles were recorded. Which provide a density of 136.52 dung piles per sq. km. We used dung density to estimate the density of elephants by using defecation rate and dung decay rate, which was estimated for wild elephants in the Western Ghats (Watve, 1992) and Interview Island (Sivaganeshan and Kumar, 1993,1994) respectively.

$$E = Y \times r / d$$

E = Estimate of elephants
Y = Density of dung piles
r = Dung decay rate
d = Defecation rate

Dung decay rate and defecation rate was considered as 0.01305 (Sivaganesan and Kumar, 1993, 1994) and 16.33 (Watve, 1992) respectively.

Which provide an estimate of 0.109 elephants per sq. km. We observed the elephants using all adjoining mangrove forests, uplifted area due to tsunami which has been in the transition of vegetation success, and part of the creek. However, some areas with thorny scrub without much vegetation, rocky plates and mangrove forests were not been used by elephants, and were considered as non-suitable habitat, thus we considered about 100 sq. km as a suitable habitat available for the elephants in the park. Therefore the estimated number of elephants (minimum population size) for the sanctuary is 10.9 individuals. We also observed group of dung piles deposited at same time with varying sizes

which include young calf and juvenile. This confirms the existence of at least one herd of elephants with a minimum of five individuals. The dung circumference made us to suspect presence of a minimum of five solitary animals. Further, our field assistants who frequented to the island and also forest department personnel revealed the sightings of solitary individuals with different shape and length of tusks, which confirms the

presence of a minimum of five solitary elephants in the island. Thus the minimum population size of feral elephant in the Interview Island Wildlife Sanctuary would be 11.

Scaffoldings were built near the water holes to record the elephants when they come to drink the water. During the study, attempt was to track the elephants using their fresh signs, and about 450 km of walk was made to locate the elephants for photo-capture. We also camped at different possible areas of elephants along the stream beds and photo-traps were also deployed at many locations to capture the elephant images. Yet we could not achieve a photo capturing of single elephant neither by walking nor by photo-traps. However, two elephants were sighted near forest camp in the midnight during the study. One Himalayan palm civet was captured in one of the photo-trap in the sanctuary.

We had an informal interaction with field assistants and department personnel on sightings, behavior, herd size, frequency of sightings, age-sex of the individuals in the herd, and their experiences with elephants. They revealed more sightings of solitary animals than the herd, sighting of herd with about seven animals in the previous year, and witnessed the death of about 15 elephants in the last 25-30 years. They took us to some of

the locations where they had sightings of recent deaths of elephants, where we also spotted the skeletal remains of elephants. They also revealed absence or no-sightings of elephants in any other neighboring islands.

Debarking and feeding on climbers:

Based on feeding signs by the elephants, we recorded 18 species as food trees/climbers belong to 14 families; among them 16 species were woody plants and two species (*Byttneria aspera* and *Calamus spp*.) were climbers in the sampled plots (Table 1). However, all the signs and debarking were very old except with the three trees/climbers. Even in most of the debarked trees had recovered and/or new bark had appeared.

Table 1 List of food plants debarked or eaten by feral elephants on Interview Island WLS

Sl. No.	Family	Scientific Name	Common Name
1	Meliaceae	*Aglaia heirnii*	Lal Chini
2	Moraceae	*Artocarpus chaplasha*	Jungli Kathal
3	Malvaceae	*Bombax insgne*	Didu
4	Sterculiaceae	*Byttneria apera*	Haathi bel
5	Palmaceae	*Calamus sp.*	Bet
6	Urticaceae	*Ficus Sp.*	Peepal
7	Ascelpediaceae	*Hopea odorata*	Tingum
8	Sapotaceae	*Manilkara littoralis*	Mahua
9	Anacardiaceae	*Odina Wodier*	Nabbe
10	Nyctaginaceae	*Pisonia excels*	Baniya
11	Lecithidaceae	*Planchonia andamanica*	Lal Bombai
12	Fabaceae	*Pterospermum acerifolium*	Makchun
13	Sterculiaceae	*Pterygota alata*	Lakkho
14	Sterculiaceae	*Sterculia campanulata*	Papita
15	Combretaceae	*Terminalia bialata*	Safed chuglum
16	Combretaceae	*Terminalia catappa*	Jungli badam
17	Datiscaceae	*Tetrameles nudiflora*	Peepok/Teepok
18	Urticaceae	*Trema amboinensis*	Bakri patti

Table 2 Number and relative abundance of food plants on Interview Island WLS (Sampled area is 26.37 ha)

Sl. No.	Scientific Name	No. of Trees Debarked	Debarked Trees / hectare	% Debarked
1	*Planchonia andamanica*	20	0.76	38.46
2	*Manilkara littoralis*	5	0.19	9.61
3	*Trema amboinensis*	4	0.15	7.69
4	*Artocarpus chaplasha*	3	0.11	5.77
5	*Bombax insigne*	3	0.11	5.77
6	*Pterospermum acerifolium*	3	0.11	5.77
7	*Sterculia campanulata*	3	0.11	5.77
8	*Hopea odorata*	2	0.08	3.85
9	*Pisonia excelsa*	2	0.08	3.85
10	*Aglaia heirnii*	1	0.04	1.92
11	*Ficus Sp.*	1	0.04	1.92
12	*Odina Wodier*	1	0.04	1.92
13	*Pterygota alata*	1	0.04	1.92
14	*Terminalia bialata*	1	0.04	1.92
15	*Terminalia catappa*	1	0.04	1.92
16	*Tetrameles nudiflora*	1	0.04	1.92

Table 3 Preference ratings of food species by elephants in the Interview Island WLS

Sl. No.	Scientific Name	Stems per Hectare (%)	Debarked trees/ hectare (%)	Preference Rating *
1	*Trema amboinensis*	0.5 (0.44)	0.15 (7.58)	17.23
2	*Hopea odorata*	0.5 (0.44)	0.08 (4.04)	9.18
3	*Manilkara littoralis*	1.5 (1.32)	0.19 (9.60)	7.27
4	*Sterculia campanulata*	1.0 (0.89)	0.11 (5.56)	6.25
5	*Planchonia andamanica*	7.5 (6.64)	0.76 (38.38)	5.78
6	*Terminalia catappa*	1.0 (0.89)	0.04 (2.02)	2.27
7	*Aglaia heirnii*	2.5 (2.21)	0.04 (2.02)	0.91
8	*Odina Wodier*	3.5 (3.10)	0.04 (2.02)	0.65
9	*Pterospermum acerifolium*	10.5 (9.29)	0.11 (5.56)	0.60
10	*Ficus Sp.*	4.0 (3.53)	0.04 (2.02)	0.57
11	*Bombax insigne*	15.0 (13.27)	0.11 (5.56)	0.42
12	*Terminalia bialata*	7.5 (6.64)	0.04 (2.02)	0.30
13	*Tetrameles nudiflora*	21.0 (18.58)	0.04 (2.02)	0.11
14	*Pterygota alata*	37.0 (32.74)	0.04 (2.02)	0.06
15	*Artocarpus chaplasha*	0	0.11 (5.56)	-
16	*Pisonia excelsa*	0	0.08 (4.04)	-

*** Preference Rating = % Debarking / % Stems available**

A total of 52 debarked food trees recorded in the sampled area (Table 2), among them *Planchonia andamanica* was observed relatively highly debarked tree (38.46), which is followed by *Manilkara littoralis* (9.61) and *Trema amboinensis* (7.69). Other important debarked trees include *Artocarpus chaplasha, Bombax insigne, Pterospermum acerifolium, Sterculia campanulata, Hopea odorata* and *Pisonia excels*. The density of these trees was varied considerably (Table 2).

We sampled an area of two hectares to assess the status of food trees in the Island. The density of food trees (stems/ha) was calculated, and that has been considered as food trees available in the island. Using the percent trees that debarked (trees used) and the relative abundance of food trees estimated (as trees available) was used to calculate the rate of preference of trees by elephants. Though the elephants frequently debarked *Planchonia andamanica*, the *Trema amboinensis* showed the highest preference (17.23). It was trailed by *Hopea odorata*, *Manilkara littoralis* and *Sterculia campanulata* with preference rating of 9.18, 7.27 and 6.25 respectively.

In sampling plots, the mature individuals of the species *Caryota mitis, Areca triandra, Calamus spp*. and *Pandanus tectorius* were absent. Young individuals of not more than 10 feet height of *Pandanus tectorius* were observed on inaccessible slopes in the island.

Discussion

Considering the findings from dung count method and recent sight record of herds/individuals, we conclude the abundance of feral elephants in the Interview Island would be 11. The estimation of population of elephants on the island has varied vastly over the years (Fig. 3). Sivaganesan and Kumar (1994) reported a release of 40 elephants to the Interview Island based on firstly,their interaction with the person called Benjamin who had been a '*mahut*' on the island at the time and had witnessed the release of elephants to the island in 1962 and secondly, also from the records of the Forest Department. After a period of more than three decades, in 1994 Sivaganeshan and Kumar estimated the density of elpephants for the island using the dung count method. They considered about 70 sq. km. as a suitable habitat in the island and projected a density of 0.99 elephants

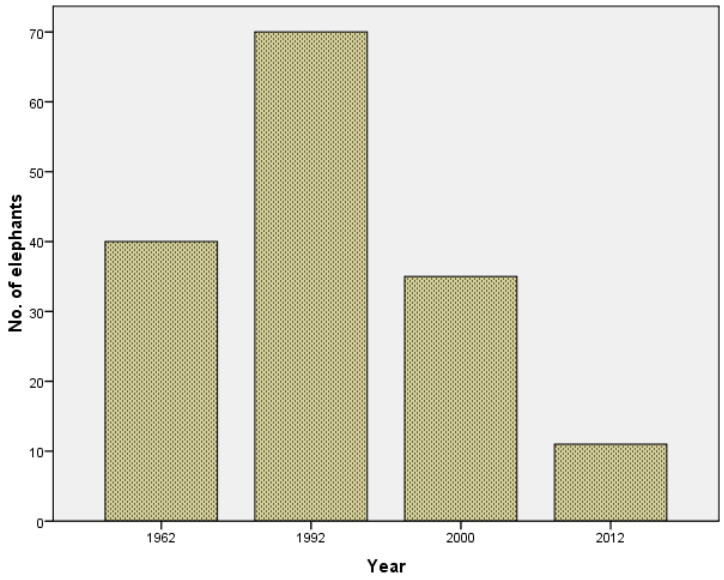

Figure 3 **The abundance of feral elephant projected by different researchers during different years for Interview Island WLS (1962: Released by P.C. Ray Company; 1992: estimate by Sivaganeshan and Kumar (1993,1994); 2000: estimate by Ali (2001); 2012: Present study)**

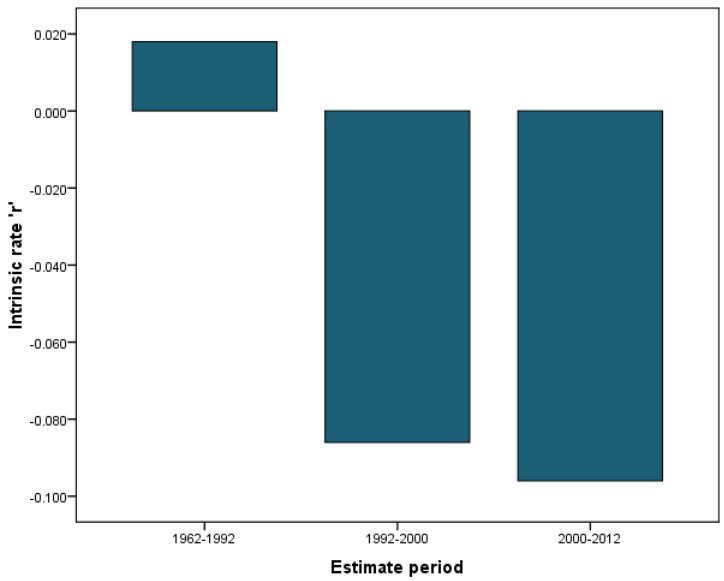

Figure 4 **Intrinsic rate of change (*r*) in the elephant population between the study periods**

Table 4 Comparitive information on trees debarked between 1994 and 2012 in Interview Island WLS

Scientific Name	1994		2012	
	Stems/ha	% Debarked	Stems/ha	% Debarked
Planchonia andamanica	3.33	20.70	7.50	38.46
Manilkara littoralis	-	-	1.50	9.61
Trema amboinensis	3.50	34.48	0.50	7.69
Artocarpus chaplasha	0.50	5.17	0	5.77
Bombax insigne	-	-	15.00	5.77
Sterculia campanulata	2.33	17.24	1.00	5.77
Hopea odorata	-	-	0.50	3.85
Pisonia excelsa	0.83	8.63	0	3.85
Aglaia hiernii	-	-	2.50	1.92
Anacardium occidentale	2.17	1.72	0	1.92
Ficus spp.	2.33	1.72	4.00	1.92
Odina wodier	0.67	0	3.50	1.92
Pterygota alata	-	-	37.00	1.92
Terminalia bialata	-	-	7.50	1.92
Terminalia catappa	-	-	1.00	1.92
Tetrameles nudiflora	-	-	21.00	1.92
Bassia butyracea	3.00	8.63	0	0
Sterculia villosa	1.17	1.72	0	0

"-"= the stem/hectare and/or % Debarked for these species might not have been counted in Sivaganesan and Kumar (1994) as they were not observed to be debarked by the elephant

per km^{-2} (i.e. 70 elephants for the island). During 2000, Ali (2001) projected about 35 elephants for the island using individual identification method.

The estimation by Sivaganeshan and Kumar (1994) was based on the dung density, defication rate and decay rate of the dung. The defication rate was calculated using domestic elephants in the North Andaman island, where they were fed on soft and boiled food, which will have greater impact on the defication rate, thus we used the defication rate calculated for the forest elepahant in the mainland by Watve (1992). However, we used the decay rate from Sivaganeshan and Kumar (1994) since it was derived from data collected on Interview Island.

The present estimate of low abundance raises question on the earlier estimates by Sivaganeshan and Kumar (1994). Ali (2001) also speculated the estimation by Sivaganeshan and Kumar (1994) may be a overestimation, since they have sampled only suitable habitat where the dung abundance would be very high. Further, one can suspect the

elephants moving to neighboring islands, but the information by the researchers from different organizations, forest department personnel and local people made us to rule out such possibility, and Ali (2001) also ruled out such possibilities. If the estimation by Sivaganeshan and Kumar (1994) is precise, then, though it is difficult to conclude and find the reasons for the decline of elephants, it is apparent that the size of feral elephant population in the Interview Island has declined sharply. Though the population initially increased at the rate of r = 0.018 (Fig. 4), later population has decreased at the rate of r = -0.092 between the years 1992 and 2012. The overall change in the population over 50 years (1962-2012) is (intrinsic rate of change) r = -0.0258. Ali (2001) claims either lack of availability of food resources or poaching of animals would be the major reason for the decline. Though the evidences of skeletal remains of elephants that we have recovered, suggest a large number of deaths as one of the driven reason for the decline in the population size, yet, the reason for the death may be a compound effect of lack of food resources and hunting.

As pointed out by earlier studies (Sivaganesan and Kumar, 1994; Ali, 2001, 2004), feeding or the damage caused by feral elephants has affected the native vegetation on the Interview Island WLS. Consequently, the changes in the vegetation community on the island has reflected in the change in the food species of the elephant. Sivaganesan and Kumar (1994) recorded 9 tree species debarked by elephants on Interview Island, while in the present study we have recorded 16 tree species debarked. They reported *Trema amboinensis* (34.48%), *Planchonia andamanica* (20.70%) and *Sterculia campanulata* (17.24%) as the most debarked species (Table 4). Other significantly debarked species were *Pisonia excelsa* (8.63%), *Bassia butyracea* (8.63%) and *Artocarpus chaplasha* (5.17%). On the other hand, we found that *Planchonia andamanica* was the most debarked (38.64%). It was followed by *Manilkara littoralis* (9.61%), *Trema amboinensis* (7.69%), *Artocarpus chaplasha* (5.77%), *Bombax insigne* (5.77%) and *Sterculia campanulata* (5.77%). Increase in the number of species debarked and shift in utilization of tree species by elephant during the current study may be on account of change in the availability of the food species that is due to the decline in the densities of the most preferred debarking species. *Trema amboinensis* was the most debarked species in 1994, its density has gone down from 3.5 stems/ha in 1994 to 0.5 stems/ha by 2012. Likewise, the density of *Sterculia campanulata* has reduced from

2.33 stems/ha to 1 stem/ha. Moreover, several debarked species of 1994 have not been found in the vegetation survey in 2012. These include *Artocarpus chaplasha*, *Pisonia excelsa, Anacardium occidentale, Bassia butyracea* and *Sterculia villosa* (Table 4).

Table 5 Density of Food tree species in Interview Island WLS

Sl. No.	Food Species	Stems/hectare	
		1994	2012
1	*Calamus spp.*	44.10	0
2	*Pometia pinnata*	8.33	10.50
3	*Trema amboinensis*	3.50	0.50
4	*Planchonia andamanica*	3.33	7.50
5	*Bassia butyracea*	3.00	0
6	*Ficus spp.*	2.33	4.00
7	*Sterculia campanulata*	2.33	1.00
8	*Anacardium occidentale*	2.17	0
9	*Endospermum chinense*	1.67	0
10	*Areca triandra*	1.30	0
11	*Pandanus tectorius*	1.17	0
12	*Sterculia villosa*	1.17	0
13	*Pisonia excelsa*	0.83	0
14	*Artocarpus lakoocha*	0.67	0
15	*Odina Wodier*	0.67	3.50
16	*Artocarpus chaplasha*	0.50	0
17	*Caryota mitis*	0.20	0
18	*Aglaia hiernii*	-	2.50
19	*Bombax insigne*	-	15.00
20	*Hopea odorata*	-	0.50
21	*Mimosops littoralis*	-	1.50
22	*Pterospermum acerifolium*	-	10.50
23	*Pterygota alata*	-	37.00
24	*Terminalia bialata*		7.50
25	*Terminalia catappa*	-	1.00
26	*Tetrameles nudiflora*	-	21.00

Apart from the debarked species, there are other food species whose density seems to have been affected by feeding or damage by the feral elephant (Table 5). The species severely affected are *Calamus spp*., *Pandanus tectorius*, *Areca triandra* and *Caryota mitis*. The increased scarcity of these species was also pointed out by Ali (2001, 2004) in his update on the issue. In addition to which, we did not find these species in our study, except for *Pandanus tectorius* young individuals found in the inaccessible slopes along streams in rocky terrain. There is a possibility that the elephants are unable to reach these places and hence the regeneration is taking place.

Recommendations

- Active management for the feral elephant population in Interview Island Wildlife Sancuary might not be necessary as the population is gradually declining without any external pressure. However, there is a requirement to constantly monitor the feral elephant population as it is showing declining trend.
- The change in the vegetation projected in the present study is may be combined effect of the chital and elephant. Which requires longterm regeneration study on food species of elepahnt and chital.
- The feral Chital (*Axis axis*) population on Interview Island also needs to be monitored at a regular basis as the changes in the ecosystem observed during this study can certainly be the composite effect of the foraging and/or damage by both the Chital and Elephant.

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