

## Original Research

Daily Activity Budget of Nicobar Long-tailed Macaque  
(*Macaca fascicularis umbrosa*) in Great Nicobar Island, India

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## ABSTRACT:

Nicobar long-tailed macaques (*Macaca fascicularis umbrosa* Miller, 1902) are distributed in three Islands of Nicobar namely Great Nicobar, Little Nicobar and Katchal. Their insular population requires special attention from research and management perspectives. Daily activity budget of *M.f. umbrosa* in the Great Nicobar Island was studied from October 2011 to September 2013 by intensive direct observation method. Study revealed that Nicobar long-tailed macaque, undergoes most of the time for Locomotion (36.07%), followed by feeding (22.35%), resting or being inactive (15.74%), grooming (11.14%), vocalization (7.03%), playing (5.64%), sexual arousal (1.46%) and agonistic (0.56%). All daily activities have significant difference ( $\chi^2 = 1156.22$ ;  $df = 7$ ,  $P = 0.05$ ). Chi-square test demonstrated that the daily activity budget differed significantly among the behaviours. Qualitative results found that the interaction within the group was fighting and grabbing food. The significant observation of disability in their legs was noticed in Nicobar Long-tailed Macaque. The relation between their behaviour and disability is also discussed.

## Keywords:

*Macaca fascicularis umbrosa*, Daily activity budget, Great Nicobar Island

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## INTRODUCTION

Primates are maintaining the sustainable ecosystem and play as indicator for ecosystem health; hence, they help in making of conservation and management plans. Non-human primates of undisturbed areas are having great behavioural variation (Thomas, 1991) which are closely related to human beings such as eating, playing, fighting, keeping young ones etc. (Rod and Preston-Mafham, 1992). The daily activities and behaviour of primates differ between residential, non-residential and undisturbed areas (Krebs and Davies, 1993). Large group size, poor habitat quality, seasonal variation in food availability may affect their daily activity budget (Peres, 1993; Passamani, 1998). The Long-tailed macaques (*Macaca fascicularis umbrosa* Miller, 1902) are the only non-human primates found on Nicobar Islands (Umapathy et al., 2003). Other subspecies occur in Myanmar, Cambodia, Laos, Vietnam, Thailand, Malaysia, Indonesia and the Philippines (Rodman, 1991; Tikader and Das, 1985). This species varies in their behaviour, social organisations, habitat consumption, morphology and genetic variation due to wide distribution (Brent and

Veira, 2002; Hamada et al., 2008). Previous researches in Nicobar subspecies are available for population status and distribution profiling (Umapathy et al., 2003; Sivakumar, 2010; Narasimmarajan and Raghunathan, 2012) Study on ecology and behaviour are also focused in the other subspecies of Long-tailed Macaque in South East Asian countries. Reports are available on the aggressive and social behaviour of *M. fascicularis* (Nordin and Jasmi, 1981; Zamzarina, 2003; Brent and Veira, 2002; Khor, 2003; Md-Zain et al., 2003; Siti, 2003). The present study is focused on the daily activity budgets of *Mf. umbrosa* in Great Nicobar Island.

## MATERIALS AND METHODS

### Study Area

The Great Nicobar Island is about 1045.1 sq km comprises of Campbell bay National Park and Galathea National Park (Fig. 1). These two National Parks embrace Great Nicobar Biosphere Reserve (GNBR). The study site covers about 3 km<sup>2</sup> and is composed of low hills near dense semi evergreen forest, Maggar Nallah river and human Settlements at Govind Nagar (06° 59.985' N 093° 54.459' E) and it is 6 km away from Campbell Bay (Fig. 1). GNBR has richest faunal and

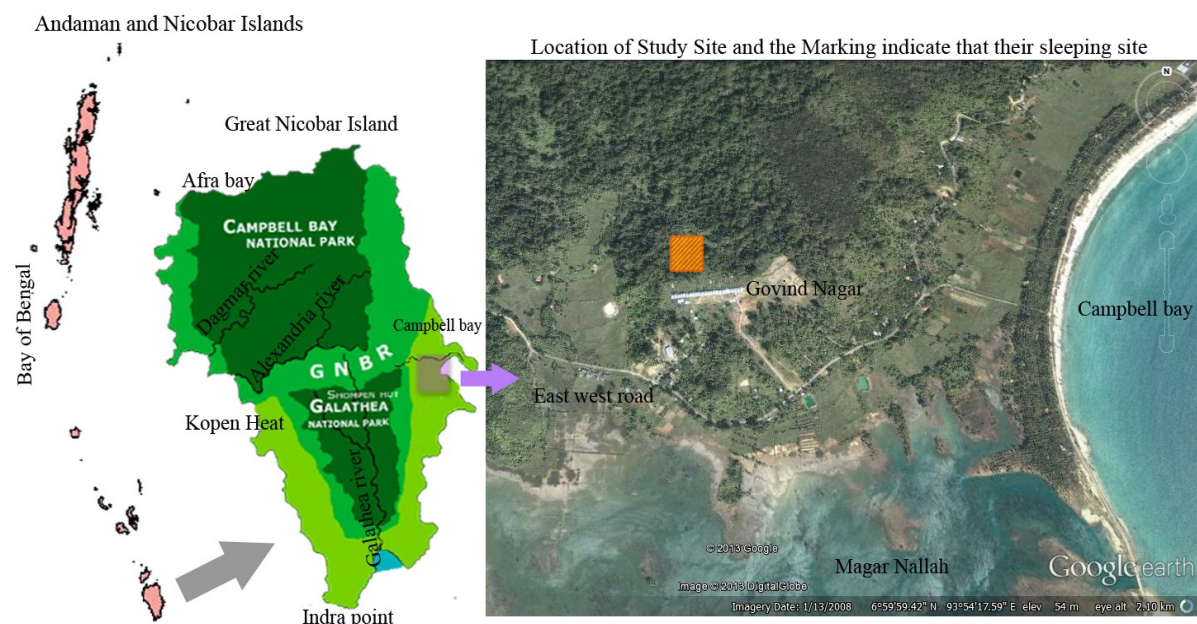


Fig 1. Study area and Study site.

floral communities. Great Nicobar is the home for plants like *Albizia chinensis*, *Albizia lebbeck*, *Artocarpus chaplasha*, *Calophyllum soulattri*, *Dipterocarpus* sp., *Pterocarpus* sp., and *Sterculia campanulatum*. In fauna, other than the long-tailed macaques, the endemic mammals recorded are Nicobar wild boar (*Sus scrofa nicobaricus*), Nicobar Tree shrew (*Tupaia nicobarica*), Nicobar shrew (*Crociodura nicobarica*) and Nicobar Flying fox (*Pteropus faunulus*).

### Behaviour Sampling Method

Following the methods of Hambali et al., (2012); Md-Zain et al., (2008b) and Brent and Veira (2002) daily activity observations of macaque were made during 2 to 3 days in a week at 0500 hours until 1630 hours for 78 days from October 2011 to September 2013 to determine the behaviour categories. A study group categories and its composition of the three consecutive years are given in Table. 1. The total number of individuals in study group increased year by year *i:e* from 37 to 51 individuals. Every year the numbers of females were more than that of males. This group was marked by their dominant male who had a distinctive large and elongated white area between the eyes and white eyelids compared to the other groups. Focal animal sampling method was adopted to collect the quantitative data at ten minutes interval (Altmann, 1974; Lehner, 1979). During torrential rain and adverse weather condition, the observation was discontinued until the weather resumes normally, because the animals were partially obscured or moved completely from the observation sites. The data on the observations of locomotion, feeding, resting,

grooming, vocalization, playing, sexual arousal and agonistic were collected during the study. Chi-square test was applied to analyse the behaviour data set obtained. The nonparametric  $\chi^2$  test was used to analyze the significance of activity budgets.

## RESULTS AND DISCUSSION

Result on the percentage of eight daily activities of Nicobar long-tailed macaques monitored is given in Table 2. Chi-square analysis upon the present study indicated that all the eight behavioural observation shows significant differences (Table 2). Jaman and Huffman (2008) observed that, activities of Japanese macaque (*M. fuscata*) in captivity varied between age-sex classes. Similarly the behavioural variation occurred in individual with different age-sex observed in the present study. The most observed daily activity for all the age group was locomotion. The locomotion is the highest portion of daily activity in long-tailed macaques compared to other activities (Hambali et al., 2012; Md-Zain et al., 2010; Sia, 2004; Suhailan, 2004). This is because of diurnal in nature as they are very active during the day as they use their maximum time in searching for food.

### Locomotion

According to Menard (2004) and Wheatley (1980) Long-tailed Macaques are the primates spending most of their time for moving as they are mainly frugivorous and occupy more space. It was also observed that the study group's moving choice is varied day by day to different location and range. When they move out

**Table 1. Year wise group composition and total number of Individuals in the study group.**

Group categories Year	Adult (Mature)			Immature			Total No. of Individual
	Male	Female	Total	Sub Adult	Juvenile	Infant	
2011 (October)	10	13	23	10	3	1	37
2012 (March)	12	15	27	12	4	2	45
2013 (August)	13	16	29	12	6	4	51

**Table 2. Percentage and Chi-square value of Nicobar long-tailed macaque's daily activity.**

Activity	Observation	Percentage (%)	Expected frequency	$\chi^2 = (O-E)^2/E$
Locomotion	518	36.07	179.5	638.34*
Feeding	321	22.35	179.5	111.54*
Resting	226	15.74	179.5	12.04*
Grooming	160	11.14	179.5	2.12*
Vocalization	101	7.03	179.5	34.33*
Playing	81	5.64	179.5	54.05*
Sexual	21	1.46	179.5	139.95*
Agonistic	08	0.56	179.5	163.85*
Total	1436	100	1436	1156.25

\* Showing significant differences ( $p < 0.05$ ), by using the chi-square test ( $\chi^2$ ).  
Degrees of freedom (df) = 7, O-Observation, E-Expected frequency.

of their home range, there was a shortage of food sources and availability of fruits. According to O'Brien and Kinnaird (1997), availability of food source significantly affects their locomotion in daily activity pattern. Sometimes these animals visit human settlement areas and raids crop land, coconuts farms and banana farms which lead to their destruction. The result indicates that the macaque spent most of the time in moving due to the insufficient food sources in their habitat. Likewise this study group also spend most of their time to visit different localities because of their diminishing natural food sources.

### Feeding

Besides locomotion, feeding was observed as one of the major activities of macaque during the study (Fig. 2 A). It resembles with the other subspecies studied by Hambali *et al.*, (2012), Md-Zain *et al.*, (2010), Suhailan (2004) and Tuan-Zaubidah (2003) who all found that feeding is the second most occurrence activity compared to other. However this finding was contradict with other macaque species. For example Southern India wild lion-tailed macaque (Kurup and Kumar, 1993) and captive Japanese macaque (Jaman and Huffman, 2008) spend the

highest proportion of time in resting rather than feeding depending on the food and weather factor. An increase in one activity may pose some influence on other activities (Jaman and Huffman, 2008). The main food sources are fruits, flowers, tender leaves, insects, crabs, beetles, butterflies, some spiders, grasshopper etc. Usually macaque feed insects in afternoon period between resting and grooming. When the food sources are less long-tailed macaque usually rest.

### Resting

Resting is the third most activity observed in our study (Fig. 2 B). The result of the study revealed that prolonged feeding activity considerably reduced the resting behaviour during the observation from macaque in Great Nicobar as noticed by Hambali *et al.*, (2012) in Malayan long-tailed macaque and Kurup and Kumar (1993) in lion-tailed macaque. Resting includes activities like sleeping, lying down and to sit idle. Macaques were observed resting on tree branches, dead woods, bushes, rocks and sometimes resting on the roads. Also they use to take a few minutes rest after walking continuously. Rainy season and unusual climate directly affect their feeding and moving activities and increase their resting



activity. During night time, macaques sleep on the top of tree branches. This behaviour indicates that the macaque protect themselves from the predators. The only known predator is reticulated python (*Broghammerus reticulatus*) as no other higher predators are found in Great Nicobar Island, but the anthropogenic activity and domestic predators like dogs also affects their normal activity.

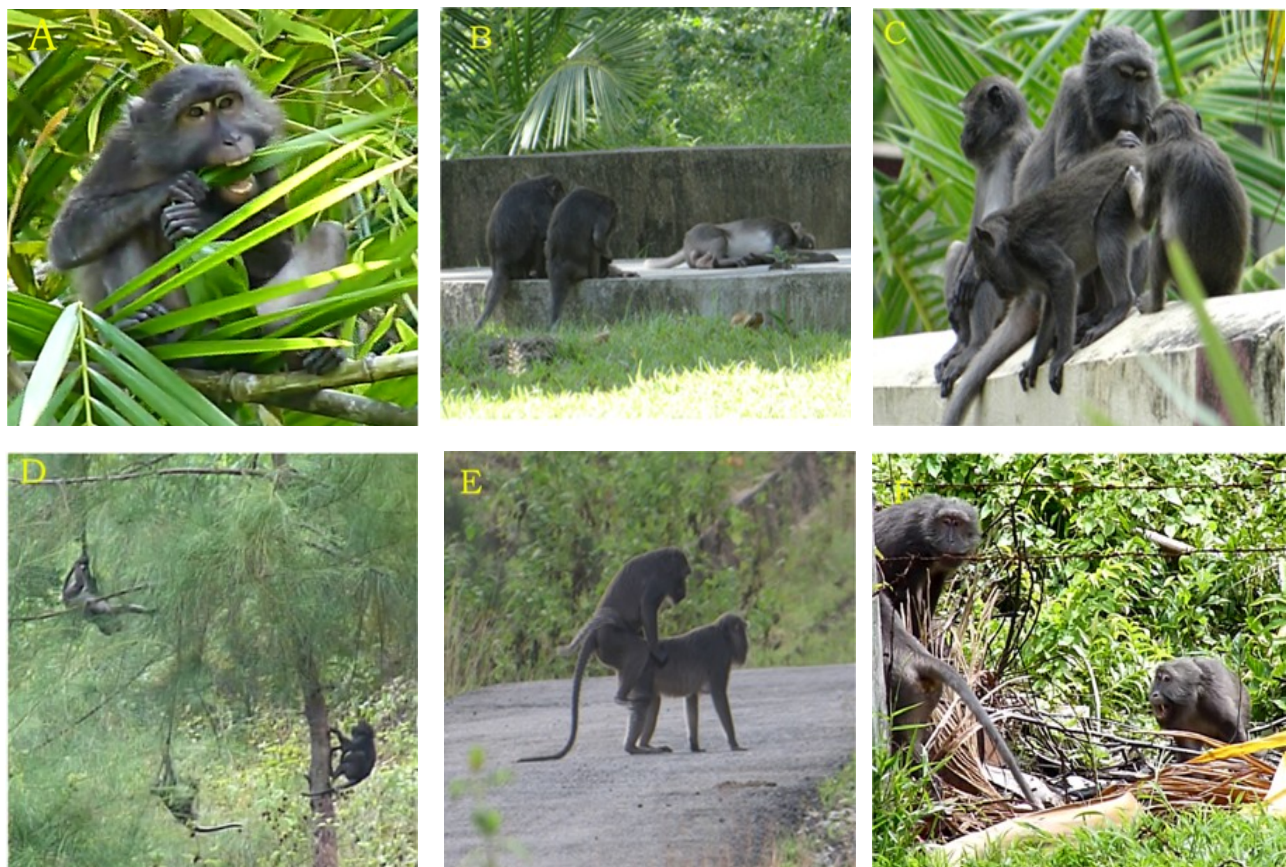
**Grooming**

Grooming is the fourth highest activity observed after resting (Fig. 2 C). This result is similar with *M. fascicularis* found in Kuala Selangor Nature Park, Malaysia (Hambali *et al.*, 2012). Most of their grooming activity occurs at the time of resting period. It was predominantly observed at late afternoon when the macaques return to the home range. At the time of grooming one monkey picks up lice from other’s body. Most of the individuals often prefer to self-groom rather

than social grooming. Social grooming highly noticed between the adult female and adult male. Observations on grooming between the adult female with infants were least due to the presence of only few infant in the group. There was a least observation on grooming between adult female and juveniles as well as sub adults. Self-grooming was also often observed in sub adults and secluded male at the time of resting. In addition, after mating, the dominant male is groomed by female. According to Lazaro-perea *et al.*, (2004) this behaviour can be a way to get protection from others while fighting and also for sharing of food.

**Vocalization**

Vocalization is the fifth behaviour that has been observed. When the agonistic interaction occurs between the group individuals, dominant adult male produce loud calls and all the other individuals sound continuously. In general, macaque produces loud calls especially for



**Fig 2. Various activities of Long-tailed Macaque in Great Nicobar Island**  
**A. Feeding, B. Resting, C. Grooming, D. Playing, E. Mating, F. Agonistic.**

grabbing and snatching food item and fighting with their group member. In addition during agonistic interaction within the group or entrance of predatory animals such as dogs in their territory, macaque used to make vocalization. Normally vocalization can be treated as a warning signal to protect themselves from predators as observed by Md-Zain *et al.*, (2010). Due to the observer's or the human's activity in their range, macaque produce different sounds and mainly the sub adults seem to be most active as they used to climb very quickly and keep other individuals alert. Members of the group after hearing the vocal call warning used to climb to higher ground to escape or hide in bushes. We observed a least number of calls produced by macaques while playing activity. Kipper and Todt (2002) and Md-Zain *et al.*, (2010) also found that the vocal call was produced by macaques while playing. In the present study the male long-tailed macaques were found to produce vocal calls while grooming after mating. No females were observed producing vocals during mating. On the other hand observation made by Md-Zain *et al.*, (2010) showed that females were found to produce vocal during and after mating. The possible reason for this behaviour can be a hormonal effect (Engelhardt *et al.*, 2005).

### Playing

Playing activity is the sixth behaviour that has been observed during the study period (Fig. 2 D). We found predictable differences in playing activity in the juveniles and sub adults. Juveniles were found to play more than sub adults. Adult macaques were not involved in playing activity. The playing behaviour may form a social competition and juveniles in their active age period will learn on social relations (Kipper and Todt, 2002). Usually, playing behaviour was observed in the late afternoon, when adult long-tailed macaques are inactive. Wrestling, chasing, tickling, swinging on the tree branches, pulling their tails to play with one another and invert hanging and jumping were the playing

categories observed during the study. It was also observed that these animals prefer playing on the selected trees like Casuarinas, Pandanus, Guava and Coconut. In the evening, all the group member moves near sleeping site and while moving many were found collecting and eating some insects in the bushy area.

### Sexual Arousal

Sexual behaviour like mating, mount, inspect copulation are the categories were observed as the seventh activity (Fig. 2 E). In our study period dominant males were actively involved in mating with adult females as this may help females in giving birth to healthy generation. Females use to live with multimale group, focused in copulating with dominant males as observed by Hambali *et al.*, (2012), Lawler *et al.*, (1995), Md-zain *et al.*, (2010) and Van Noordwijk and Van Schaik (1999). Sexual behaviour observed is only a small portion of daily activity in long-tailed macaque. Normally the adult male was found to smell or observe the adult female genitalia first to make sure that the females are ready to mate or not which is in corroborated with the report of Brent and Veira (2002), Md Zain *et al.*, (2010) and Hambali *et al.*, (2012). The long-tailed macaque takes a few seconds for mating activity.

### Agonistic Activity

The least observed activity is the agonistic behaviour (Fig. 2 F). During our study chase, grab, hit, bite and fight are the categories of agonistic behaviour observed as the eighth activity. Though these behaviours are supported by Hambali *et al.*, (2012), Md-Zain *et al.*, (2010), Suhailan (2004) and Tuan-Zaubidah (2003) they found that mating is the least observed activity. Fighting behaviour occurred while gaining foods and mates. Hambali *et al.*, (2012) found that Malay wild long-tailed macaque has a hierarchy in the group, so that they have their own way to avoid fight when looking for food together. Chasing and biting occur sometime between the males and sub adults. Adult male were more aggressive when their food was grabbed by other males, this shows



that the aggression appeared in males higher than females which is agreed with the Brent and Veira (2002) from macaque observed at Indo-China population. Significantly we observed few aggressive activities in the Nicobar long-tailed macaque against human beings especially women and children during the study period.

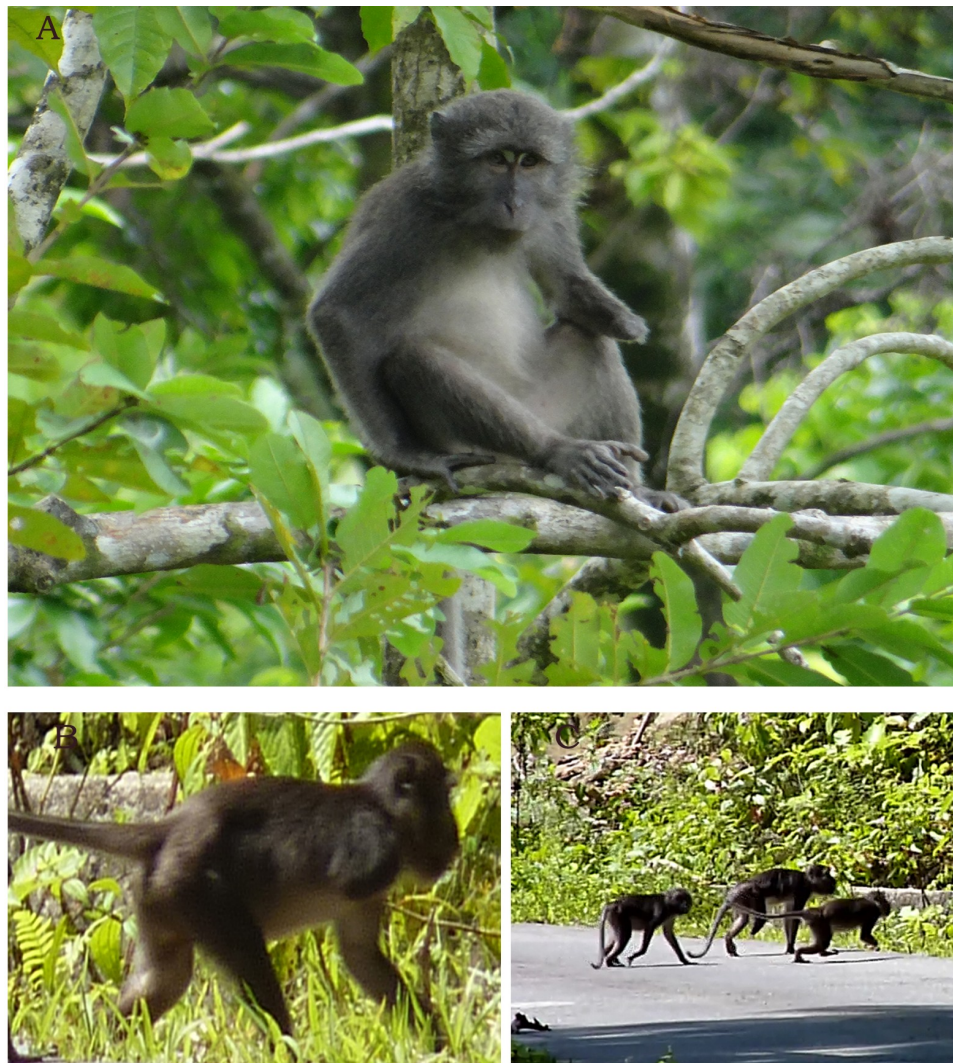
#### Disability and Behaviour

During our study period several disabled macaques were spotted (Fig 3). They were not able to move properly due to their disability. These disabilities may cause some changes in their daily activities which in turn will cause changes in their behaviour like locomotion, disability in finding mates, foraging

activities, etc. The relation between disability and behaviour is also reported in Japanese macaques (*Macaca fuscata*) by Turner et al., (2012). The possible causes of disabilities are congenital defects, dog chasing and anthropogenic activities. However, exact cause of disability was not known. But this significant observation may throw some light on the threats and their status of these monkeys.

#### CONCLUSIONS

The present study enlightened behavioural and activity patterns of the long-tailed macaque population living in the Great Nicobar Island. It is revealed that



**Fig 3. Disability in Nicobar Long-tailed macaque**  
A. Forearm partially disabled, B. Foreleg disabled, C. Hindleg partially disabled.

locomotion, feeding and resting were the most common daily activities of these monkeys. Disabled macaques spotted during our study period may give some information on the changes in their behaviour that occur due to disability as well as on the threats they use to encounter. This study also found that the aggressive behaviour against humans may raise the issue of human-macaque conflict. Further studies on the specific impact of crop raiding and feeding behaviour will derive the implication of its conservation and management strategies.

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