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Status and distribution of the little-known and elusive Nicobarese worm lizard *Dibamus nicobaricum* (Fitzinger in Steindachner, 1867) (Squamata: Dibamidae)

S.R. Chandramouli[1,*], G. Gokulakrishnan[2] & C. Sivaperuman[3]

[1] *Department of Ecology and Environmental Sciences, School of Life Sciences, Pondicherry University, Puducherry*
[2,3] *Zoological Survey of India, Andaman and Nicobar Regional Centre, Haddo, Port Blair*

* *Corresponding author: Email: findthesnakeman@gmail.com*

[1] urn:lsid:zoobank.org:author:73BF7214-77B1-45EA-A7FB-8CB13D15094F
[2] urn:lsid:zoobank.org:author:81676BC5-F41F-4A8A-8531-FF9CBB282843
[3] urn:lsid:zoobank.org:author:08F28A10-E80D-420C-9241-24F5CC199EB6

Abstract. Field surveys were carried out to record the elusive and little-known fossorial Nicobarese worm lizard *Dibamus nicobaricum* (Fitzinger in Steindachner, 1867) on seven of the 23 islands of the Nicobar archipelago. It was recorded from three new localities, two in Great Nicobar and the other from Teressa Island, extending the northern and southern boundaries of its distribution significantly. One of the individuals, a subadult male recorded during this study happens to be the smallest one ever recorded, measuring just 70 mm SVL. A predictive distribution model was developed based on the geo-coordinates of its occurrence with a reliable prediction of 25–100% probability on islands of the central and southern group of the Nicobar archipelago, diminishing to 12–25% on Car Nicobar, situated to the north. The Area Under the Curve (AUC) of the model was 0.907, indicating a reliable prediction. Status of *D. nicobaricum* was assessed for the first time as per the IUCN guidelines which reveal that it has to be considered as an endangered species based on its narrow distribution range.

Key words. Nicobar worm-lizard, *Dibamus nicobaricum*, distribution, status, MAXENT model.

INTRODUCTION

Dibamids are one among the oldest living group of squamate reptiles (Pyron et al. 2013). The genus *Dibamus* Duméril and Bibron, 1839 currently has 24 species (Uetz et al. 2020) of which *Dibamus nicobaricum* (Fitzinger *in* Steindachner, 1867) is one among the earliest known species. The holotype was collected by G.R. Frauenfeld from "Nicobars" during the global voyage of the Austrian Frigate "SMS Novara" and described originally by Fitzinger *in* Steindachner (1867) as *Rhinophidion nicobaricum*. In the same publication, Steindachner (1867) reported on similarities between *Rhinophidion* Fitzinger, 1967 and *Typhloscincus* Peters, 1864 resulting in the transfer of the species *nicobaricum* to *Typhloscincus*. Later Stoliczka (1873) attributed this species to the genus *Dibamus* Duméril & Bibron, 1839 where it is currently placed. Dibamids, being fossorial and small bodied organisms, have remained extremely elusive and hence, not many records of most species exist.

The Nicobar worm-lizard *Dibamus nicobaricum* has been reported only a very few times since its original description. Stoliczka (1873) considered *Dibamus nicobaricum* to be a synonym of *Typhloscincus Martensii* Peters, 1864 from Ternate Island, Indonesia (now *Dibamus novaeguineae*). Annandale (1904), Humayun Abdulai (*fide* Das 1996), Biswas and Sanyal (1977), and Das (1996) are some of the authors who recorded this species from Great Nicobar and Biswas and Sanyal (1980) recorded it from Camorta in the Central group of Nicobar Islands based on a single adult female specimen. Biswas and Sanyal (1977) reported on morphological and sexual variation within this species based on the examination of three specimens. Based on an examination of the above material and his own collection from Shompen Hut in Great Nicobar, Das (1996) resurrected *D. nicobaricum* from the synonymy of *Dibamus novaeguineae* to a distinct and valid species. Also, he considered the record from Camorta to be doubtful (Das 1996: 160). Although this species was discovered about a century and a half ago there is an apparent lack of knowledge concerning its biology, population structure and distribution within the Nicobar archipelago. This deficiency of data also results in the fact that its current status has not yet been assessed according to IUCN criteria yet. Hence, the present study was conducted to determine the status and distribution of the Nicobar worm-lizard *Dibamus nicobaricum*.

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Table 1. Morphology of two individuals of *D. nicobaricum* recorded during this study (measurements in mm).

Character	individual from Great Nicobar	ZSI/ ANRC (T)-7718 (Teressa)
SVL	70	107.6
Tail length	11	24.5
Body Width	2.9	7.4
Tail width	2.2	6.6
Head length	3.3	6.1
Head width	2.8	5.5
Head depth	2.8	4.6
Eye to nostril	2.5	3.5
Number of ventrals	218	183
Number of subcaudals	38	19
Midbody scalerows	23	25
Sex	male	male

MATERIAL AND METHODS

Visual encounter survey method (following Crump and Scott, 1994) was employed to collect data on the occurrence of the target species. Islands were selected in such a way that at least one of each subgroup of islands was represented and most of the relatively larger islands (with geographic area > 50 km^2) were included. The forests were walked by foot and surveys were conducted for one hour duration, wherein specific types of habitats such as evergreen forests, semi evergreen forests, riparian forests, coastal moist deciduous forests and plantations and microhabitats such as leaf-litter, dry stream beds, buttresses and soil under rocks and decayed fallen logs were carefully inspected for the presence of the target species. One of the specimens recorded here from Teressa Island was collected, preserved and deposited at ZSI ANRC (Zoological Survey of India, Andaman and Nicobar Regional Centre), Port Blair. Surveys were conducted both during the day and night time. Logs were turned, leaf litter was disturbed, loose soil was dug and tree buttresses were specifically examined in detail with a flash light to detect the target species. Behavior of the individuals recorded during this study was observed in situ following Altmann (1974). Photographic documentation was carried out in the natural habitat, but upon capture. Morphological characters namely, the number of scale-rows at midbody, supralabials, infralabials, number of ventrals and subcaudals were examined with a magnifying lens and the following measurements; snout-vent length (SVL), tail length, body width, tail width, head length, head width, head depth, eye-nostril distance were recorded using vernier calipers to the nearest 0.1 mm. All of the survey locations were marked with a GPS and mapped. The geo-coordinates of the survey locations were recorded with a Garmin 12 channel GPS and were pooled with those based on literature records; thereby a consolidated set of occurrence points was available to us. This set of GPS points were used in a predictive distribution modeling based on maximum entropy algorithm – MAXENT v. 3.3.3 (Phillips et al. 2006). For making predictions of occurrence of the target species, climatic data were downloaded for the relevant tile from the Worldclim database (Hijmans et al. 2005) and appropriately clipped to the area of interest with DIVA GIS ver. 7.5. Based on these predictions and the geo-coordinates of its occurrence, the possible extent of occurrence and the exact area of occupancy of *D. nicobaricum* was determined (derived from Geocat: http://geocat.kew.org/). These were then used as variables in the status assessment as per the IUCN norms version 3.1 (IUCN 2012).

RESULTS

Three individuals were recorded from new localities during this study; one from Govind Nagar, another from Galathea Bay in Great Nicobar and the third one from Kalasi in Teressa Island. *Dibamus nicobaricum* is recorded from Teressa Island in the central Nicobar Islands for the first time and this also forms the northernmost record of this species. Likewise, the one recorded from Galathea forms the southernmost record. One of the specimens from Govind Nagar (Fig. 1A) recorded during this study is the smallest one ever recorded, measuring just 81 mm, with 70 mm SVL. This specimen is described below in detail.

Fig. 1. *Dibamus nicobaricum* recorded during this study in life: A – C: Govind Nagar, D - Galathea, Great Nicobar.

(a) Morphology (Figs 1–2)

Body vermiform; head blunt; neck and eyes indistinct; nostrils located towards the snout tip, more ventral than dorsal or lateral in position; rostral large, roughly as broad as long, occupying ¼ of the head length. Frontonasal much broader than long; relatively smaller than frontal. Frontal shield pentagonal with the vertex pointing posteriorly, slightly wider and fairly longer than the frontonasal. Ocular shield horizontally elongate, situated between the edges of frontal and frontonasal shields; eyes located underneath the ocular scales but visible. Postocular single and fairly large. Two distinct supralabials visible on either sides; anterior one much elongated and wedge shaped; posterior relatively shorter and bordering ocular and postocular shields. Mental shield small, bordered by one infralabial (the first) on each side. Body scales smooth, glossy and fairly imbricate. Forelimbs completely absent; two small skin-flaps situated on either sides of the vent (immediately above), indicating the rudiments of hind-limbs. Measurements and pholidosis of the specimens examined are presented in Table 1. Dorsal body unpatterned; uniform reddish brown in colour. Ventral region more pinkish and slightly lighter than the dorsal.

(b) Distribution (Fig. 3)

Dibamus nicobaricum was recorded from three new localities during the present study, two of which are from Great Nicobar, where it is already known and a first record from Teressa Island. An adult male was recorded from Kalasi in Teressa Island, under the soil at about 5 cm depth in a coconut plantation (under exploitation) and a juvenile male was recorded from under a log in riparian habitat along the banks of a seasonal stream near Govind Nagar, Great Nicobar (Fig. 4). Both these were in dense evergreen forests under thick canopy cover. The third individual was recorded from under a log in a littoral forest in Galathea Bay, Great Nicobar, forming the southernmost record for this species.

The MAXENT model predicted the distribution of *D. nicobaricum* in Great and Little Nicobar islands with occurrence probabilities ranging from 1 to 0.25 in Great and Little Nicobar islands and islands of the Central group, which diminishes to 0.12–0.25 in Car Nicobar, the northernmost island of the Nicobar archipelago. AUC (area under the receiver operating characteristic curve) value was 0.908 with significant contributions by the following variables: precipitation of the wettest month

Table 2. Percentage contribution of bioclimatic and physiographic variables to the model.

Variable	% contribution	Permutation importance
_bio13_29_a	45.8	0
_bio16_29_a	42.5	72.6
_bio17_29_a	4.7	0
_bio6_29_a	4.1	15.7
_bio7_29_a	2.9	11.7
_bio2_29_a	0	0
_bio1_29_a	0	0
_bio19_29_a	0	0
_bio18_29_a	0	0
_bio15_29_a	0	0
_bio14_29_a	0	0
_bio9_29_a	0	0
_bio8_29_a	0	0
_bio5_29_a	0	0
_bio4_29_a	0	0
_bio3_29_a	0	0
_bio12_29_a	0	0
_bio11_29_a	0	0
_bio10_29_a	0	0
_alt_29_a	0	0

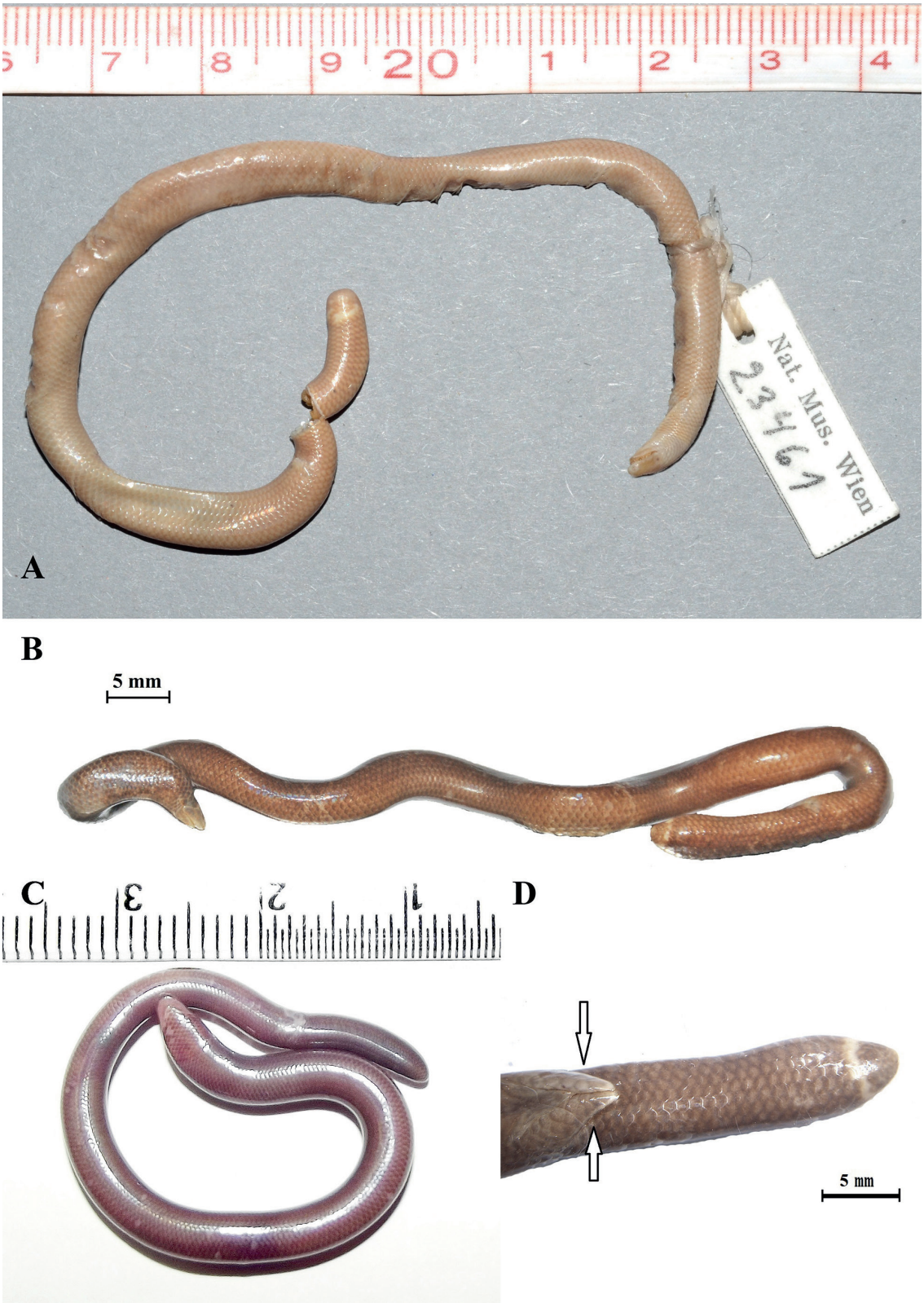

Fig. 2. *Dibamus nicobaricum*. **A**. Holotype of *D. nicobaricum* NMW 23461 (courtesy: Gernot Vogel). **B**. ZSI/ ANRC (T)-7718 collected from Teressa, central Nicobars. **C**. Ventral view of an individual from Great Nicobar, in life. **D**. Ventral view of tail, showing hindlimb rudiments (arrows).

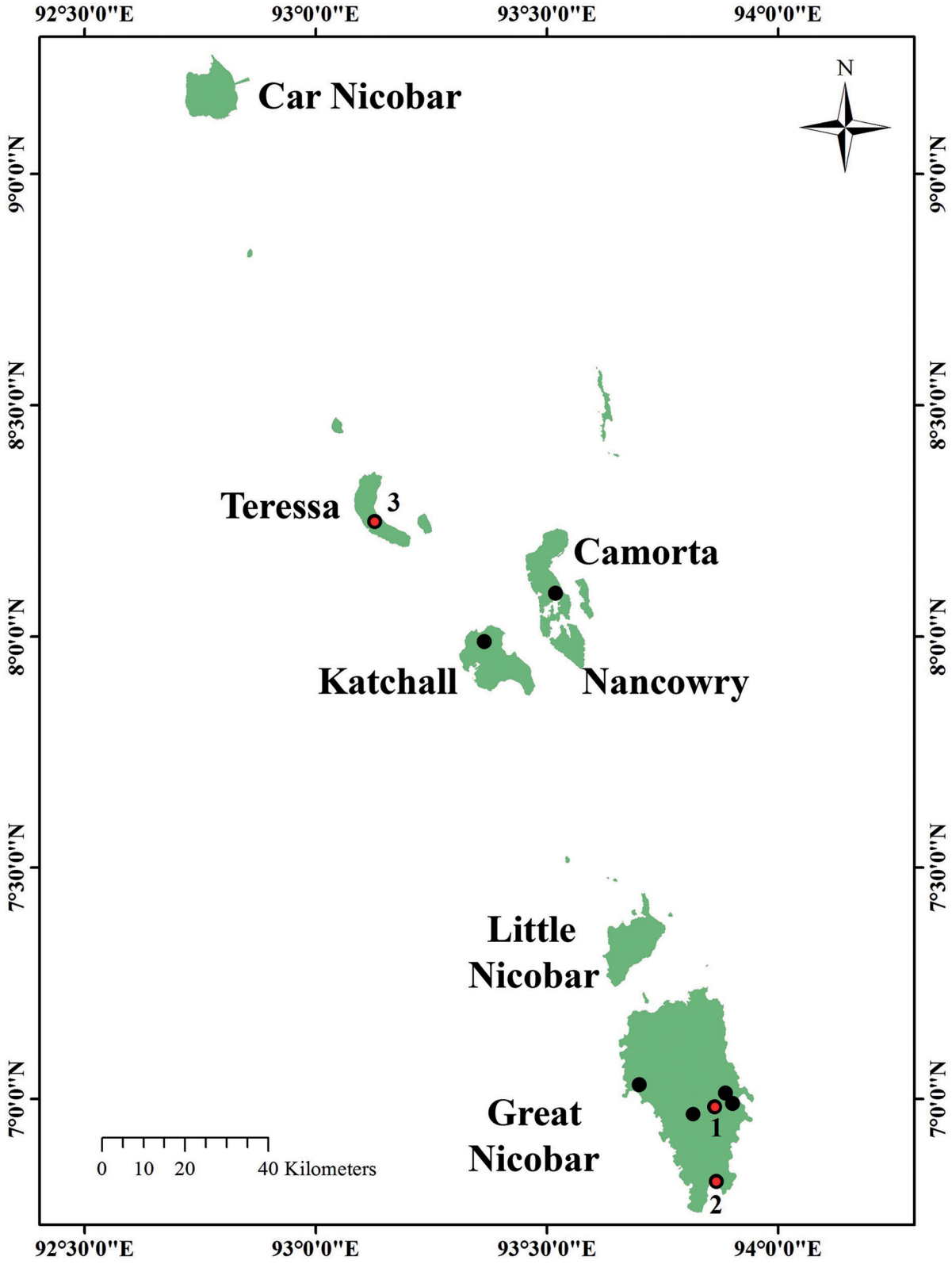

Fig. 3. Distribution records of *Dibamus nicobaricum* in the Nicobar archipelago. New records from this study marked in red.

Fig. 4. Habitat of *Dibamus nicobaricum* near Govind Nagar in Great Nicobar.

(45.8%), precipitation of wettest quarter (42.5%), precipitation of the driest month (4.7%), minimum temperature of coldest month (4.1%) and annual temperature range (2.9%). The other factors pertaining to climate and altitude did not have any influence on the prediction (Table 2, Figs 5–7).

(c) Behaviour

Behavioural observations were made on the recorded individuals of *Dibamus nicobaricum* to observe its pattern of activity in situ. The period of complete exposure of the organism was very meager when compared to the duration spent underground. Whenever the animal ventured under the soil surface, it always reached the bottom of the container, burrowing through the soil nearly 2–3 cm deep and resting underground. It voluntarily ventures out above the soil surface very rarely (during day time). This elusive behavior, its relatively small body size and cryptic colouration could chiefly be the reasons behind the very few records of this species till now. Majority of the local people were not familiar with *Dibamus nicobaricum* and could not recognize it based on the pictures shown.

(d) Status assessment of *Dibamus nicobaricum*

Based on the projected distribution maps and the number of individuals observed and reported in literature until now, it would be appropriate to regard *Dibamus nicobaricum* as an 'Endangered' species as per the norms of the IUCN criteria B1 (Extent of occurrence 3865 km^2, which is less than 5000 km^2) and B2 (Area of occupancy estimated to be 36.0 km^2, which is less than 500 km^2). However, data on population of *D. nicobaricum* and its fluctuation over a period of time are extremely difficult to establish owing to its rarity, relatively small body size, fossorial behaviour and elusive nature.

DISCUSSION

Dibamus nicobaricum has been recorded only a few times since its original description in 1867. The present study adds to the information on natural history, distribution and behavior of *Dibamus nicobaricum*. Although *Dibamus nicobaricum* was revalidated as a distinct species by Das (1996), Honda et al. (2001) questioned the validity of the Nicobarese species based on the fact

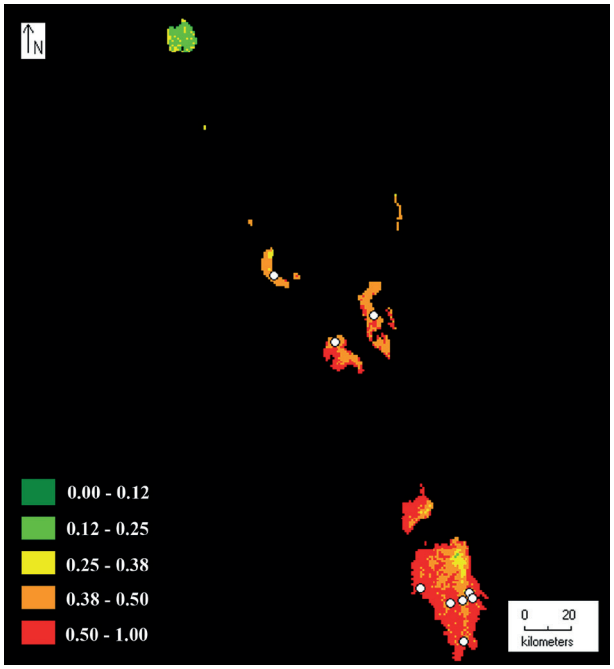

Fig. 5. Predicted distribution of *Dibamus nicobaricum* based on occurrence points. Warmer colours denote higher occurrence probability.

that Das (1996) failed to study the holotype housed at the Natural History Museum of Vienna (NMW 23461) and considered it to be a synonym of *Dibamus leucurus* (Bleeker, 1860). In addition, they pointed at certain morphological inconsistencies between the material reported by Das (1996) as *Dibamus nicobaricum* and the holotype that they have examined. Later, Das and Yakoob (2003) argued based on data from the original description of the species by Fitzinger (1867) and reinstated the specific status of *Dibamus nicobaricum*. Originally described as a member of the genus *Rhinophidion*, which is to be treated as a neuter because of its termination "*on*" the specific epithet *nicobaricum* was appropriate which is also in neuter because of its termination "*um*" and the binomial was grammatically correct according to the Art. 31.2 of the ICZN (1999). When Steindachner (1867) referred this species to the genus *Typhloscincus*, he erroneously amended the specific epithet to '*nicobaricus*'. Stoliczka (1873), who transferred *nicobaricus* to the genus *Dibamus* from *Typhloscincus* also retained the specific epithet with the masculine termination "*us*". However, Das (1996) reinstated the correct specific epithet by mentioning this species in the combination *Dibamus nicobaricum* with a masculine generic epithet and a neutral specific epithet, as per the original description. Later, Das (1999) changed it back to the name combination *Dibamus nicobaricus* (sic.) with a masculine generic as well as specific epithet. Likewise, the taxon authorship of *D. nicobaricum* has sometimes been attributed to Steindachner (1867) (e.g., Uetz et al. 2020). However, the correct representation should be Fitzinger in Steindachner, 1867, because Steindachner (1867: 53) himself credited the description of *Rhinophidion nicobaricum* to Fitzinger by mentioning it as "Fitzinger in lit".

Though Das (1996) included the Camorta locality in the distribution of the species, he was skeptical about its validity and expressed doubt on its authenticity assuming that the locality could be in error and emphasized the need for its verification. During the present study, *Dibamus nicobaricum* has been recorded from Teressa Island, located further northwest (~ 40 km) of Camorta, which endorses the earlier record from Camorta by Biswas and Sanyal (1980), thereby extending the northern boundary of its distribution range significantly. Likewise, the new record from Galathea Bay in the southern extremity of Great Nicobar Island extends its known distribution range further southwards by at least 30 km. Its confirmed presence in Camorta, Katchall and Teressa Islands in the central group of the Nicobar archipelago make its occurrence on other islands of this group such as Nancowry, Tillanchong and Bompaka highly probable. Also, there is a high probability of its occurrence in the intervening Little Nicobar Island. Records of *D. nicobaricum* have been relatively rare since its description and information on abundance of the species is hard to obtain due to its elusive and fossorial lifestyle. Hence, this species has been considered data deficient by the IUCN until now. Based on the projected distribution maps and the number of individuals observed and reported in literature and the present study, it would be appropriate to regard *Dibamus nicobaricum* as an 'Endangered' species as per the norms of the IUCN criteria B1 (Extent of occurrence less than 5000 km^2) and B2 (Area of occupancy less than 500 km^2). Several aspects of this species, such as breeding biology, feeding ecology and population estimates still remain unknown. Further studies on such specific aspects would provide us more insights about the endangered and narrowly endemic *Dibamus nicobaricum*.

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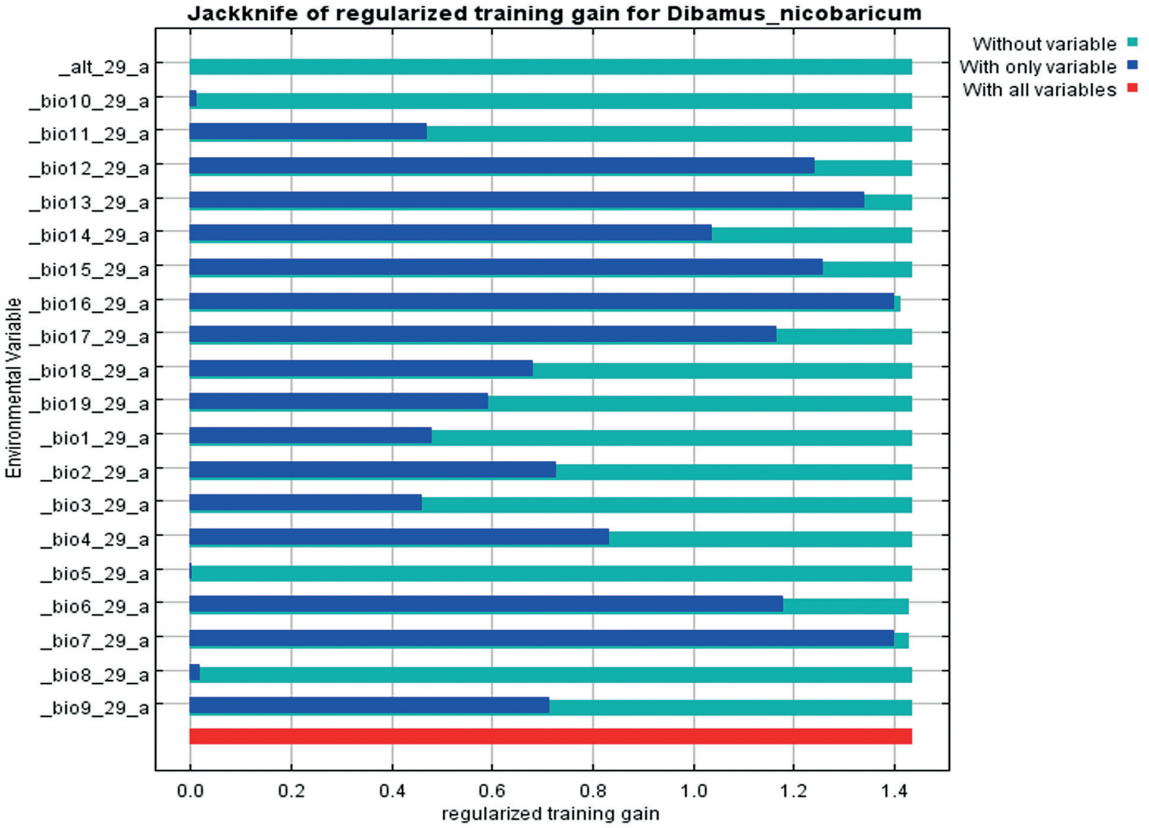

Fig. 6. Jackknife test of variable importance to the model.

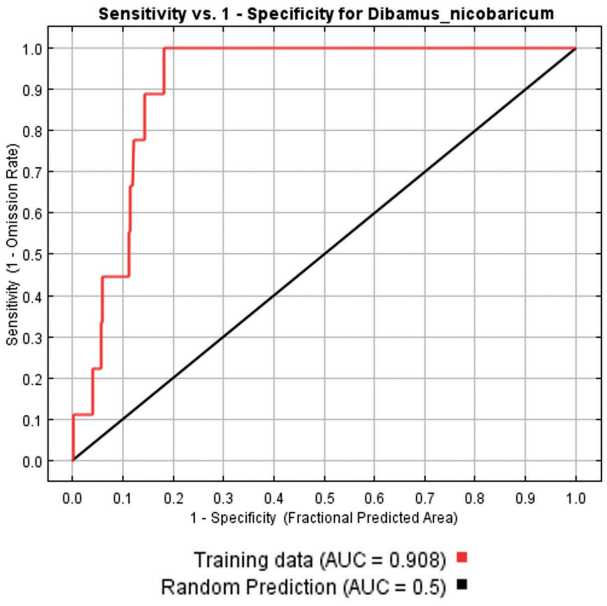

Fig. 7. Receiver operating characteristic curve for the MAXENT model predicting the distribution of *Dibamus nicobaricum*.

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