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AN ANALYSIS OF IUCN RED LIST CATEGORY AND CRITERIA ALONG WITH TAXONOMIC IDENTITY OF *MUSA PARAMJITIANA* L. J. SINGH (MUSACEAE): AN ENDEMIC WILD BANANA SPECIES

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ABSTRACT

An analysis of IUCN Red List category and criteria of *M. paramjitiana* L.J. Singh (Musaceae) has been carried out by following the IUCN Red Listing guidelines and assessed as Extinct based on the exhaustive and systematic surveys throughout its historical range, herbarium data and distribution record. We also described the morphological taxonomic key characters of this species here in great details.

Key words: Andaman and Nicobar Islands, conservation, endemic, IUCN, red list index, threat

Introduction

The wild banana species are limiting their conservation and use because, they are not well assessed. However, it is well recognized genetic base for plant breeders to develop a high yielding, disease resistant variety of parthenocarpic edible banana (cultivars). Taxonomically banana belongs to the genus *Musa* L. of the family Musaceae which comprises ca 85 species, distributed throughout the globe mainly in the tropical Asia from Himalaya to Northern Australia (Kress, 1990; Häkkinen and Väre, 2008; Häkkinen, 2010, 2013; Li *et al.*, 2010; Roskov *et al.*, 2022; Singh *et al.*, 2020a,b, 2025; Maurya *et al.*, 2023; POWO, 2026).

In India, the genus represented by ca 32 species with restricted distribution throughout the country (Singh *et al.*, 2020a, b, 2021, 2025; Maurya *et al.*, 2023; Purti *et al.*, 2024). Singh *et al.*, (2020a) re-visited *Musa* taxonomy based on morphological and molecular data, DNA sequence data (ITS, trnL-F) and population assessment which revealed that the ANI is congenial habitat for four wild banana species viz., *M. acuminata* Colla, *M. balbisiana* Colla, *M. indandamanensis* L.J. Singh and *M. paramjitiana* L.J. Singh of them we assessed here the IUCN Red List category and criteria of *M. paramjitiana* along with taxonomic key characters based

on field and herbarium data and literatures in great detail.

M. paramjitiana is endemic to Andaman and Nicobar Islands (ANI), one of the hotspot of biodiversity and a well recognized phytogeographical region for rich and unique plant diversity with high endemism in India (Singh *et al.*, 2014, 2020a, b, 2021; Singh and Ranjan, 2021). This species is only known from its type collections. It was first collected in the year 2013 and assessed as 'Critically Endangered' (Singh, 2017). Thereafter, various workers conducted field surveys and revealed that not even a single individual of this species was recorded either in its known natural habitats or in other localities, nor in any *ex-situ* conservation sites (Singh *et al.*, 2020a, b, 2025; Purti *et al.*, 2024). They stated that the increased developmental activities including road construction in forest areas and conversion of forest land to farmland, along with over exploitation of natural resources, led to the loss of its habitats, which is strongly and evidently supported by satellite images cited in Singh *et al.*, 2020b and its IUCN Conservation Status was assessed as Possibly Extinct (Singh *et al.*, 2020b, 2025; Purti *et al.*, 2024).

It is also noticeable that, *M. paramjitiana* often confused with its closely allied species, *M. balbisiana* Colla (syn. *M. balbisiana* var. *andamanica*) by several

authors especially those by Bohra *et al.*, (2019) as briefly discussed in account by Singh *et al.*, (2020b) and more recently by Pathania *et al.*, (2026). *M. balbisiana* is distributed across the country including ANI. Although, based on vitro specimens, account by Pathania *et al.*, (2026) analyzed taxonomic status without any physical context to genetic data (images of mature individual with morphological /key taxonomic characters grown in natural habitat or at *ex-situ* sites, details of natural habitat like name of locality, G.P.S. etc.) acting as an independent source to validate the identity of *M. paramjitiana*. Apart from the type localities (after type collection, not even a single individual of this species could be located despite long search since 2014 to 2025), there is no data on the occurrence of the species in any other localities as briefly mentioned by various workers (Singh *et al.*, 2020a,b, 2005, Purti *et al.*, 2024). The Satellite images (cited by Singh *et al.*, 2020b) of type locality of *M. paramjitiana* is a strong evidence to loss of its known natural habitat.

M. paramjitiana is highly distinct from other known species of wild banana in a combination of morphology of vegetative and reproductive characters as cited in the protologue figures 1-5. We revisited and surveyed all possible localities of *Musa* habitat in the ANI between 2023 to 2025 for critical assessment of IUCN Red List category and criteria of *M. paramjitiana*. Besides, a comprehensive description along with the images of live plants (taken from protologue) and details of examined herbarium specimens of this species housed at CAL, PBL are also provided here for easy identification.

The vast genetic diversity of wild bananas is being threatened. Hence, *in-situ* as well as *ex-situ* are required not only in India, but also at a global scale (Singh, 2014, 2017; Singh *et al.*, 2020a,b, 2025; Purti *et al.*, 2024). Human induced stresses were observed one of the major causes of the decline of wild banana population in these Islands (Singh, 2017). Singh (2017) stated that the overexploitation by local people for manifold value and staple food for elephants is leading to threats, and wild Musaceae including the new taxon are locally disappearing in several relatively open disturbed areas. The findings of the present study are relevant for the strategy and management plan of *in-situ* as well as *ex-situ* conservation of important wild gene-pools of *Musa* spp.

Materials and Methods

Data were compiled from no. of literatures and personal field observation of the author. The occurrence points (GPS co-ordinates) were taken from literatures. The data on population and their threat were noted down

from the previous work done by various author working on this species. Distribution map was prepared using ArcGIS 10.2.2 software and GeoCAT mapping domain. The species assessment was carried out with the help of IUCN tools *viz.* guidelines for using the IUCN Red List Categories and Criteria “(Version 16, 2024)” and the “IUCN Red List Categories and Criteria (Version 3.1, Second Edition, 2012)”. The Area of Occupancy (AOO) and Extent of Occurrence (EOO) were calculated using GeoCAT (Geospatial Conservation Assessment Tool).

Results and Discussion

IUCN Red List category along with the morphological taxonomic key characters of *M. paramjitiana* L.J. Singh (Musaceae) is recorded in great detail as mentioned below:

Taxon data sheet with justification of Red List Assessment

Name of the Taxon

Musa paramjitiana L.J. Singh, Nord. J. Bot., 35: 77-84. 2017.

Taxonomic status: Species.

Description

Plant robust, suckering freely, with 2-3 suckers that are vertically arranged. Mature pseudo-stem 7.0-10.5 m high, 100-130 cm in diameter at the base, covered with old brown leaf sheaths, underlying colour yellowish green with blood red blotches, upper portion yellowish green; young pseudo-stem light green with silvery white appearance. Leaf habit intermediate; lamina 250-260 x 45-70 cm, obliquely subcordate at base, cuspidate at apex, green adaxially, medium green abaxially; midrib 2 cm wide, dorsally light green, ventrally yellowish green; veins in 253-278 pairs, paxillate; young lamina apex retuse or piliferous. Petiole 35-55 cm long, greenish yellow, its margins closed with imbricate and overlapping petiole bases, margins curved inwards, bases winged and clasping the pseudostem. Inflorescence a spathe; axis 75-110 cm long. Carpellate bud lanceolate, 32-45 cm long, erect, first vertical and then falling horizontally downwards with deeply imbricate sage bracts; peduncle 45-60 cm long, its base clasping the pseudostem. Sterile bracts 3-5, 30.5-70.0 x 9.5-12.5 cm, adaxially sage/grey green, yellow green towards apex, at base and margins scarlet (vivid red with a touch of yellow), abaxially vermillion, incurved, prominently striated, persistent, very long-attenuate at apex, 1.5-9.5 cm long. Fertile bract 30-55 x 7.5-14.5 cm, adaxially sage/grey green, yellow green towards apex, at base and margins scarlet (vivid red with a touch of yellow, abaxially vermillion), incurved, at apex umbulate,

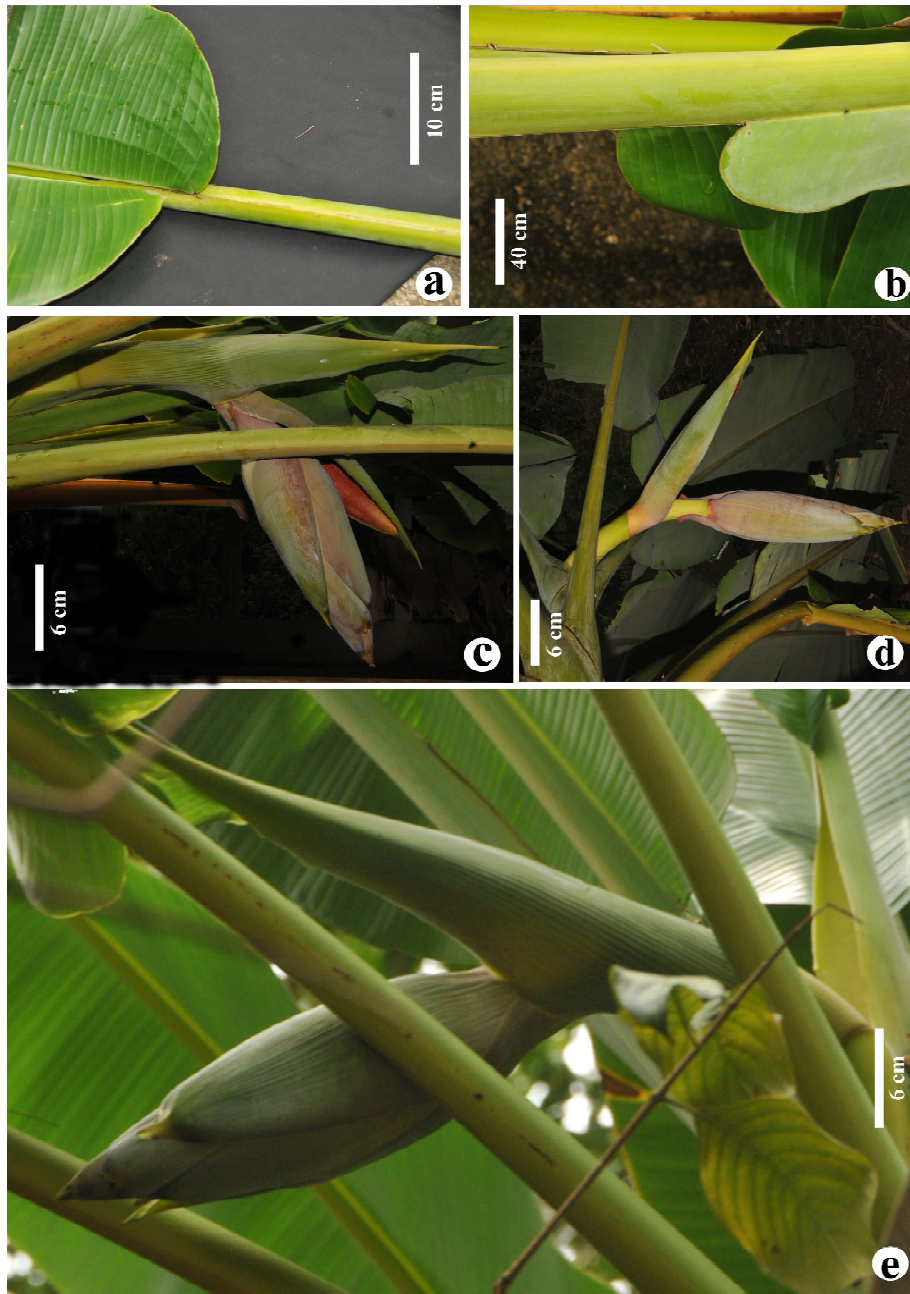


Fig. 1 (a-e): *Musa paramjitiana* L.J. Singh (Musaceae), **a- b:** A portion of petiole with overlapping margin and obliquely subcordate leaf base, **c-e:** inflorescence buds (spathe) (all after Singh, 2017).

prominently striated. Basal flowers carpellate, 16-19 per bract in 2 rows, 3.5-8.8 cm long, pedicellate; pedicel 1.8-2.0 cm long. Compound tepals 3.5-3.8 x 1.5-2.0 cm, two, pandurate glove shaped, orange with prominent striations, fringed, 5-lobed (toothed) with cuspidate lateral lobes ending in a fine thread like structure. Free tepal 2.2-2.5 x 1.2-1.5 cm, its margins curved inwards and loosely clasping with two lateral hornlike structures; horn 0.3-0.4 cm long. Stamens 5, 1.1-1.5 cm long, candle-shaped, attached at the base of style, pineyed and rather shorter than the tepals and style; anther *ca* 0.2-0.3 cm long, 2-celled, orbicular, yellowish white, linear; filament yellowish

white. Pistil 5.5-8.8 cm long; ovary *ca* 2.5-4.0 cm long, 3-celled, curved, yellow with light scarlet neck and numerous ovules in 6 rows per locule; style straight, stramineous, 2.5-3.0 cm long; stigma 0.6 x 0.5 cm, orbicular, stramineous. Staminate bud lanceolate; bract deeply imbricate, incurved, umbulate at apex, prominently striated, adaxially sage/grey green, yellow green towards apex, base and margins scarlet (vivid red with a touch of yellow, and abaxially vermillion, sometimes ferruginous rust colour), 10 x 7 cm, prominently striated. Staminate flowers averaging 14 per bract, in two rows (7 x 7), falling with bracts; compound tepal to 2.8-3.5 x 0.6-0.8 cm,

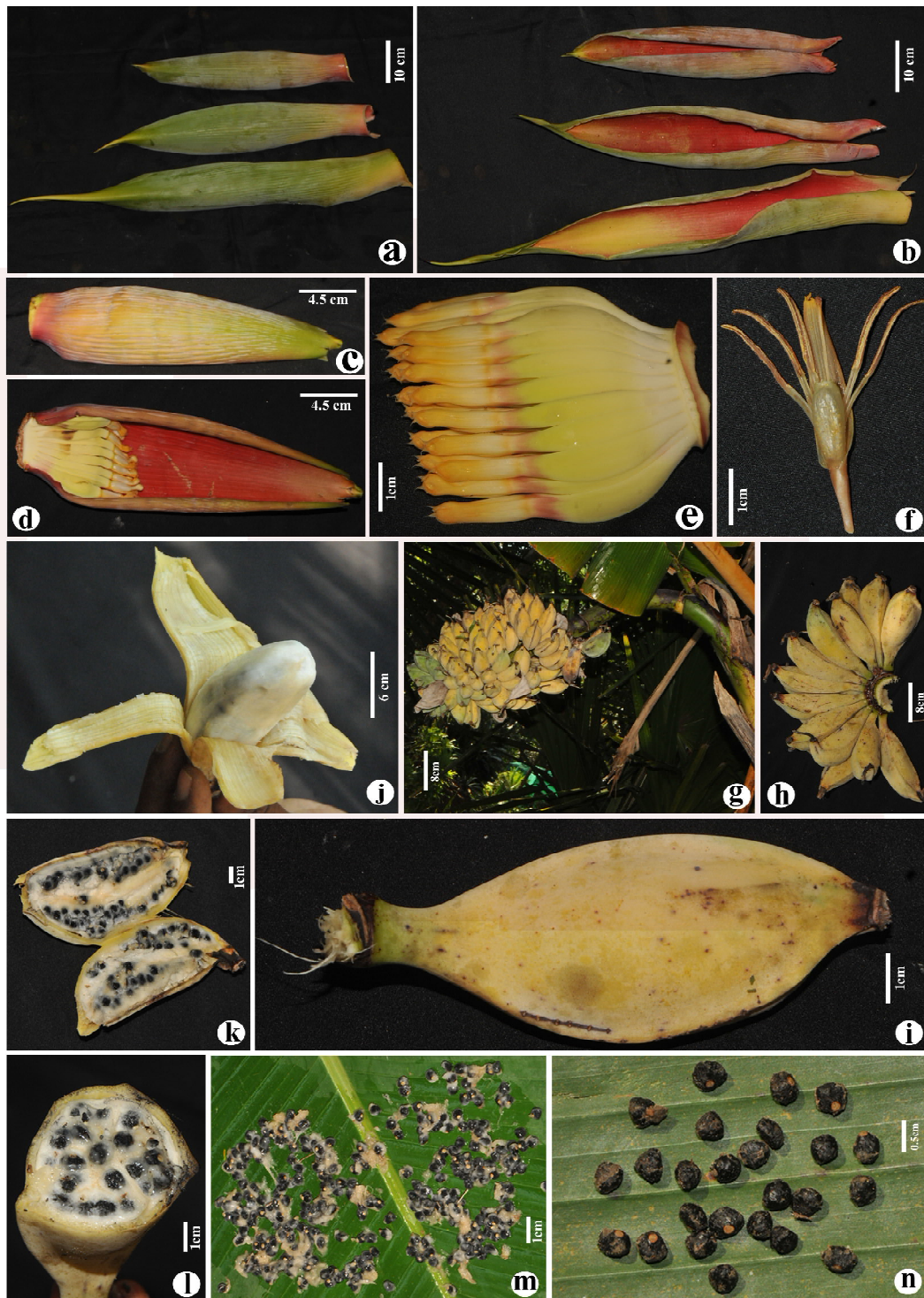


Fig. 2(a-n): *Musa paramjitiana* L.J. Singh (Musaceae), **a:** adaxial surface view of sterile bracts with very long-attenuate apex and prominent striations, **b:** abaxial surface view of sterile bracts with very long-attenuate apex and prominent striations, **c:** adaxial surface view of fertile bracts with umbulate apex and prominent striations, **d:** abaxial surface view of fertile bracts with umbulate apex and prominent striations, **e:** a bunch of carpellate flowers, **f:** staminate flower, **g:** inflorescence with persistent bracts, **h:** single fruit hand (Bunch), **i:** single fruit, **j:** Peeled open fruit, **k:** fruit in longitudinal section showing apricot, orange pink pulp with plenty of seeds, **l:** fruit in cross section showing apricot, orange pink pulp with plenty of seeds, **m- n:** fig or bulb shaped seeds (all after Singh, 2017).

fringed, 4-lobed (toothed), lateral lobes longer than middle, striated, orange; free tepal 1.6-1.8 x 1.0-1.3 cm, translucent white with praemorse cuspidate apex 0.2 cm long; stamens 5, not inserted, 3.5-4.5 cm long; filaments stramineous straw coloured to very pale dull yellow, 1.7-2.0 cm long; anther lobes stramineous straw coloured to very pale dull yellow with vermilion orange red appearance, 1.8-2.0 cm long. Pistil stramineous straw coloured to very pale dull yellow with vermilion orange red appearance; ovary to 1.2 x 0.5 cm, cream with wide orange apex, with numerous ovules in 2 rows per locule; style 3.0-3.2 cm long; stigma obovoid, 1 mm in diameter. Bunchlux axis 1.0-1.5 m long with 10-13 hands. Fruits 16-19 per hand; individual fruit 8.5-13.5 x 3.5-4.8 cm, straight, slightly ridged, obscurely 4-5-angled at maturity, apically blunt with persistent floral remains, with sweet and sour taste, boat-shaped, apically acute, 1.0-1.5 cm long; stalk 2.0-2.5 cm long, angled, slightly curved, green, immature citrine, the dull greenish yellow peel turning golden yellow with brownish red blotches and immature fruit pulp apricot, orange pink with plenty of seeds. Seeds 0.4-0.8 x 0.2-0.6 cm, numerous, with cinereous starchy pulp, irregular, bright black, brown when dry, fig or bulb shaped, angular, large, hard, *ca* 0.4-0.6 cm in diameter at base, 0.2 cm at apex, up to 250-300 per fruit, viable.

Phenology

Flowering and fruiting in October-December.

Habitat, ecology and distribution

Musa paramjitiana grows near water stream bank and low slopes of the forests of North and Middle Andaman. It was introduced at Dhanikhari Experimental Garden-cum-Arboretum (DEGCA), Botanical Survey of India, Andaman and Nicobar Regional Centre as a part of *ex-situ* conservation in 2013 but unable to establish under *ex-situ* condition. Thereafter, the exhaustive and systematic surveys since the year 2014-2025 throughout its historical range fail to record an individual neither in natural habitat nor in any *ex-situ* conservatory.

Global distribution

Endemic to Andaman group of Islands, India.

Distribution in India

Andaman and Nicobar Islands, North Andaman, Krishnapuri, Middle Andaman, Kaushalaya Nagar.

Specimens examined

India, Andaman and Nicobar Islands, North Andaman, Krishnapuri, 8 Feb 2013, Lal Ji Singh 29580 (holotype: CAL!, isotype: PBL!), Middle Andaman, Kaushalaya Nagar, 19 Oct 2013, Lal Ji Singh 29582 (PBL).

Note

This species is highly distinct from other species of the genus by having the petiole bases winged; leaf margins curved inwards and closed, imbricate, overlapping and clasping the pseudostem; leaf lamina obliquely sub-cordate at base and cuspidate at apex; lanceolate inflorescence with dimorphic bracts; sterile bract sage/grey green with very long attenuate apex; fertile bract adaxially sage/grey green, abaxially vermilion with umbulate apex, incurved, compound tepals, pandurate glove shaped, orange with prominent striations, fringed, 5-lobed (toothed) with cuspidate lateral lobes ending in a fine thread like structure; free tepals inwardly curved at margins and loosely clasping with two lateral horn like structures; fruits citrine, boat-shaped with persistent floral remains with apricot (light orange pink) pulp and plenty of viable seeds. Seeds bright black, brown when dry, fig or bulb shaped (protologue figures 1-5).

Population status

No living individual of *M. paramjitiana* are spotted, neither in natural habitat nor in any *ex-situ* conservatory. The natural habitat is disturbed substantially by the local inhabitants and converted into cultivation field.

Threat(s)

Anthropogenic activities, especially the developmental works (construction of foot path, conversion of land into cultivation, etc.) and invasive herbivory indicating loss of habitat. The known habitat associated with intervention of the local inhabitants especially by the Ranchi community and refugee settler from Bangladesh and Peninsular India residing in surrounding of that area. These local inhabitants actively involved in cultivation of banana cultivar infested by insect herbivory as recorded by Purti *et al.*, 2024.

Besides, we also recorded during the field surveys, after interviewed the village people and they stated that they have observed the wild Andaman masked palm civet, *Paguma larvata tytleri* (Tytleri 1864) eating the seeded fruit of wild banana. Parts of wild banana particularly pseudostems, leaves and inflorescence were used by the locals for decoration on various religious and ceremonial rituals.

Ex-situ Conservation

Ex-situ Conservation efforts was made at DEGCA (Lat. 11°34.296'N, Long. 092°40.259'E, *ca* 20 m elevation) by protologue author in 2013 but not succeeded (Singh *et al.*, 2020b; Purti *et al.*, 2024). Thereafter, no data is available on its *ex-situ* conservation. More recently the habitat of DEGCA has been recorded with impact of

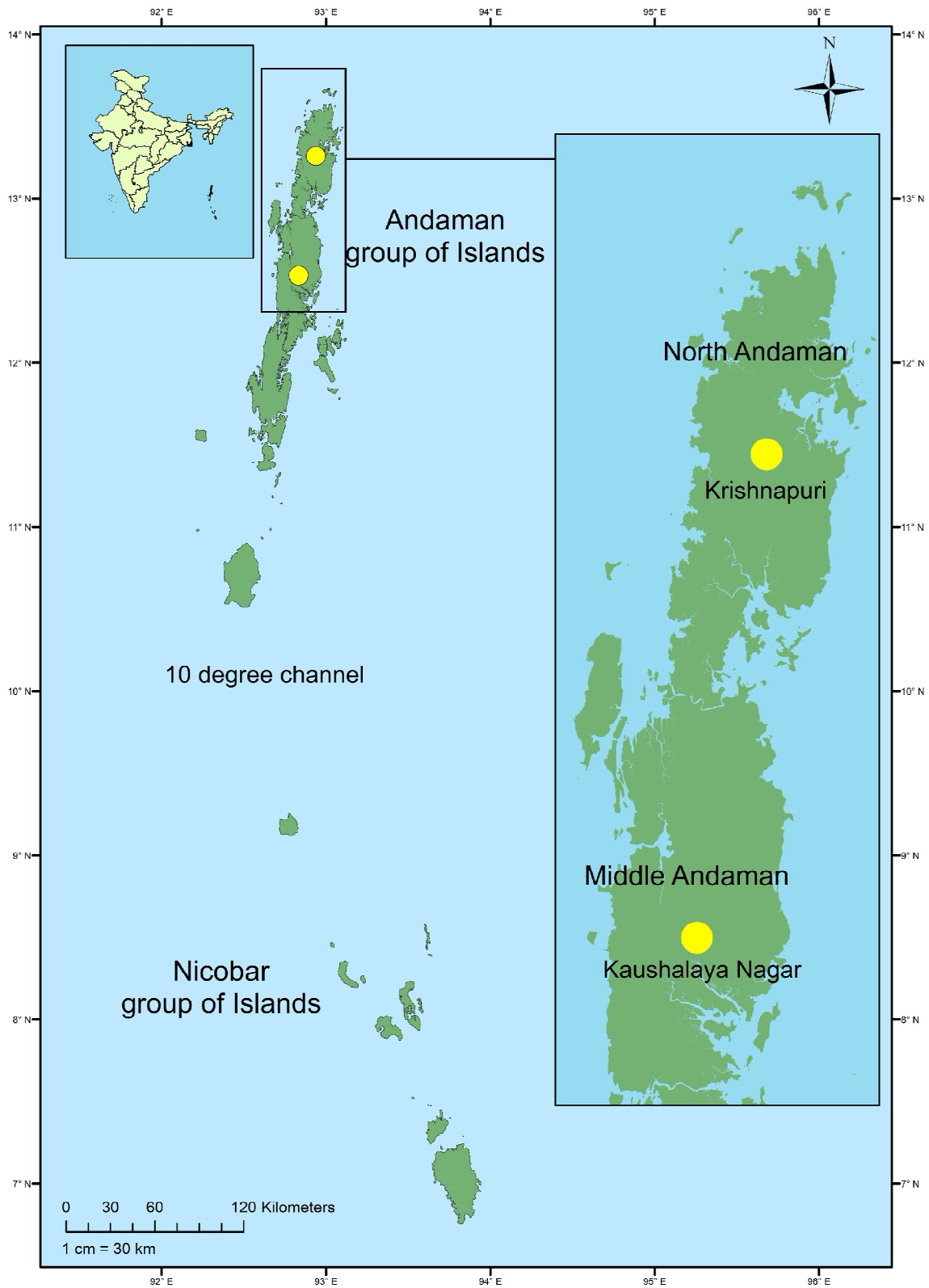


Fig.3: Map of the Andaman and Nicobar Islands showing distribution of *Musa paramjitiana* L.J. Singh (Musaceae).

insect herbivory (Banana skipper' or 'banana leaf roller, *Erionota torus* Evans, 1941 (Lepidoptera: Hesperidae) by Purti *et al.*, 2024.

Red List Assessment as per IUCN Guidelines (IUCN, 2012; 2024): Extinct

Justification

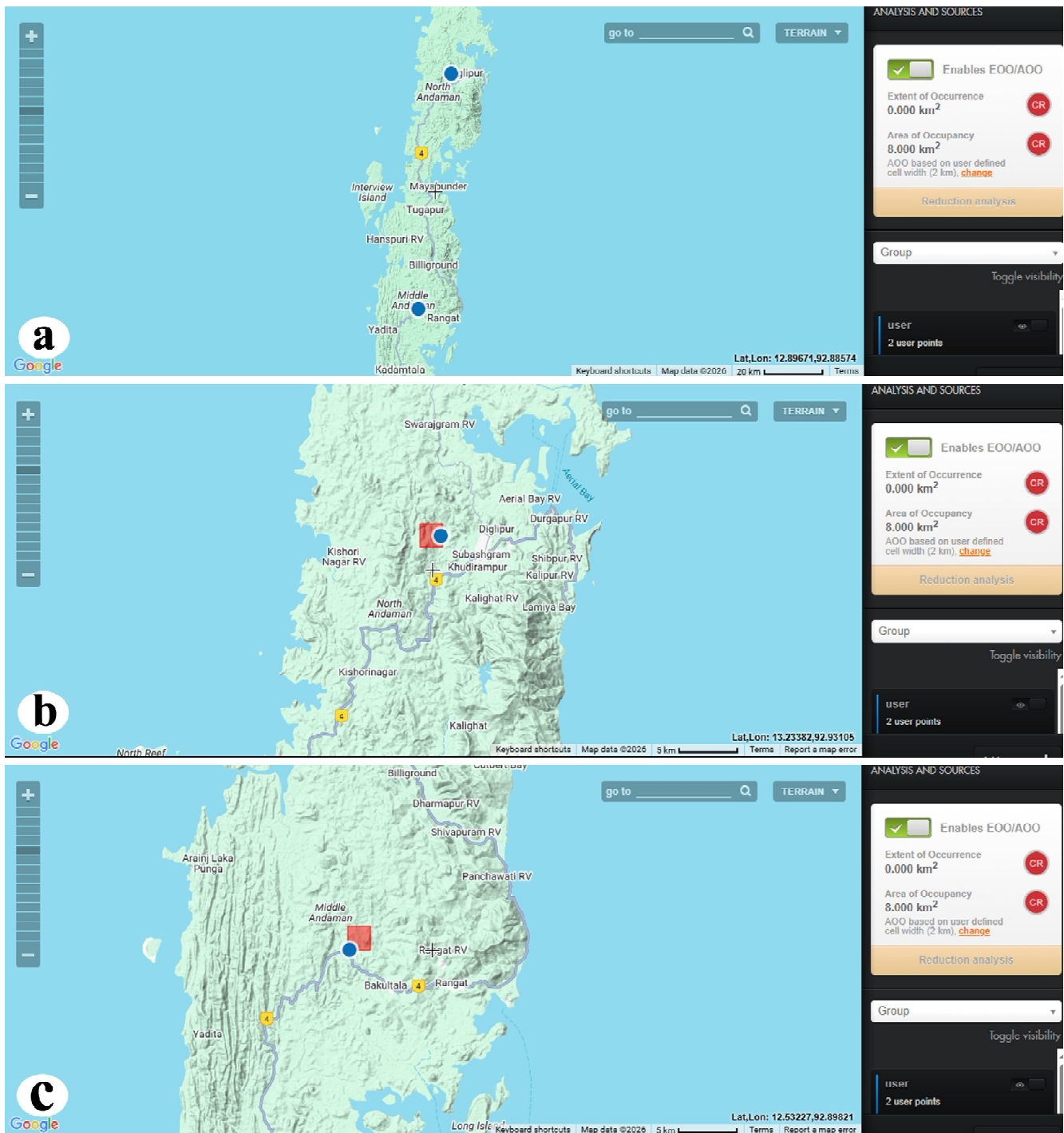


Fig. 4a-c: Google Earth imagery (Geo CAT online software) showing AOO and EOO of *Musa paramjitiana* L.J. Singh (Musaceae).

The species was firstly collected from Krishnapuri (North Andaman) in the year 2013 and its IUCN red list categories and criteria assessed as 'Critically Endangered' (Singh, 2017, 2020).

The species is known to occur in few localities of North Andaman and Middle Andaman with 2 and 1 mature individual respectively in the year 2013. As a part

of *ex-situ* conservation, the Germplasm (3 rhizomes and 23 seedlings and five rhizomes and 10 seedlings) were collected and introduced at DEGCA, in the month of February, 2013 and in the month of October, 2013 respectively but didn't succeeded under *ex-situ* conservation. All planted individuals died within January, 2014 as briefly mentioned in (Singh *et al.*, 2020b). Thereafter, surveys conducted during 2014 to 2019 found

that natural habitat disturbed substantially by the local inhabitants and no living individual of this species could be located, neither in its natural habitat nor in any *ex-situ* conservatory. Under this situation, its conservation status was assessed as 'Possibly Extinct'. More recently similar observation has been recorded by Purti *et al.*, (2024). They stated that the type localities of *M. paramjitiana* L.J. Singh is found completely lost due to anthropogenic activities. They also recorded cultivar of that area including throughout the islands was infested by arthropod herbivory; Banana Skipper, *Erionota torus* Evans, 1941.

Insect herbivory has been recorded in wild banana species of islands viz. *M. balbisiana* Colla, *M. acuminata* Colla and *M. indandamanensis* L.J. Singh at their natural population as well as *ex-situ* site (DEGCA). During study at DEGCA they documented that leaves of seedlings of *M. paramjitiana* were fed upon by this type of larvae, resulting in the death of the planted individuals of this species stated by Gardener but they were not aware about this insect herbivory as recorded in the account by Purti *et al.*, (2024). After interviewing the village people, it was revealed that, the seeded fruit of wild banana is being eaten by wild Andaman masked palm civet, *Paguma larvata tyleri* (Tyleri 1864). Wild banana was also exploited as decorative material on various religious and ceremonial rituals.

The above mentioned reasons might be the cause for disappearance of *M. paramjitiana* L.J. Singh from natural habitat. They revealed that the rapidly increasing anthropogenic pressures in these islands which include development related activities may cause other wild species of *Musa* to vanish from the ANI in near future.

Apart from the type localities, there was no data on the occurrence of the species in other localities. During field surveys we also observed that the known population is completely lost mainly due to anthropogenic interventions as shown in satellite image provided in earlier account by Singh *et al.*, 2020b. The Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated as 00.00 Km² and 8 Km² respectively from the old known GPS coordinates taken from herbarium and protologue. Since, there are no known localities for the occurrence of this species the current AOO and EOO is calculated as zero.

Earlier, this species was flagged as "Critically Endangered" and 'Possibly Extinct' in the year 2017 & 2020 respectively. Consequently, no live plant was observed in the natural habitat during field surveys conducted up to 2025. The species is not spotted from last one decade, despite the long search by various workers

including present authors. The efforts on *ex-situ* conservation of this species was not succeeded, this species is also not present in cultivation. The last mature individual of this species was spotted in the month of October, 2013 in the natural habitat (type locality). Hence, as per previous data and present evaluation it was found that this species is neither found in wild habitat nor in cultivation which reflecting the magnitude of the IUCN Red List category of this species as Extinct status.

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