



RESEARCH ARTICLE

Ecology and conservation of the threatened *Pecteilis triflora* (D.Don) Tang & F.T.Wang (Orchidaceae): a new record from Odisha, India

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Abstract

Pecteilis triflora (D.Don) Tang & F.T.Wang (Orchidaceae), a terrestrial orchid categorized as Critically Endangered by the IUCN, is reported for the first time from Odisha, India. A detailed taxonomic description, type information, habitat characteristics, associated flora, photographic documentation and voucher specimen details are provided. The species was recorded during a biodiversity assessment in the Rourkela Forest Division, Sundargarh district, where three populations were observed in *Shorea robusta*-dominated forests. A total of 39 individuals were recorded across the three sites. The species occurred in partially shaded forest habitats on hill slopes and hilltops and was associated with 38 plant species. Five faunal species were also documented in the surrounding habitat and herbivory on the aerial parts of *P. triflora* by barking deer was observed. Species richness ranged from 24 to 34 species among the study sites, while the highest vegetation abundance was recorded at Site 1 and the highest diversity at Site 3. Spatial distribution patterns differed among sites, with clustered patterns at Sites 1 and 3 and an approximately random pattern at Site 2. The findings provide baseline information on the distribution, population status, habitat characteristics, associated vegetation and potential ecological pressures affecting *P. triflora* in Odisha. Based on the observed small population size and restricted habitat occurrence, habitat protection, invasive species management, long-term population monitoring and further ecological and genetic studies are recommended for its conservation.

Keywords: Biodiversity indices, Conservation, Critically Endangered, Ecology, *Habenaria triflora*, Orchid

Introduction

Orchidaceae is one of the largest families of flowering plants, comprising a remarkable diversity of species

adapted to a wide range of ecological conditions (Wang *et al.* 2026). Orchids exhibit complex ecological relationships with pollinators, mycorrhizal fungi and associated plant communities, making them sensitive indicators of habitat disturbance and ecosystem changes. However, habitat loss, fragmentation, climate change, invasive species and anthropogenic pressures have resulted in significant declines of many orchid populations worldwide (Zhang *et al.* 2026). Therefore, documentation of threatened orchid species and assessment of their ecological requirements are essential components of effective conservation planning.

The genus *Pecteilis* Raf. belongs to family Orchidaceae (subfamily Orchidoideae, tribe Orchideae and subtribe Orchidinae) and comprises approximately ten terrestrial orchid species distributed across South and Southeast Asia, including the Malay Archipelago (POWO 2026). They prefer to grow in grasslands, open forests and montane habitats between 400 and 2500 m elevation. In India, five species of the genus have been recorded; *Pecteilis gigantea* (Sm.) Raf., *P. henryi* Schltr., *P. korigadensis* Jalal & Jayanthi, *P. susannae*

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(L.) Raf. and *P. triflora* (D. Don) Tang & F.T.Wang (Jalal and Jayanthi 2019).

Pecteilis triflora (D. Don) Tang & F.T.Wang (Figure 1) was originally described as *Habenaria triflora* D. Don and is distributed in parts of South Asia, including India, Nepal and Bangladesh (Rokaya *et al.* 2013). The species is currently categorized as Critically Endangered due to its restricted distribution, declining populations and continuing habitat degradation (Kumar 2023). Previous studies have documented its occurrence in Jharkhand, Uttarakhand and Meghalaya, where it is generally associated with forest habitats dominated by *Shorea robusta* and other terrestrial orchids (Kumar *et al.* 2009, Kumar and Veldkamp 2010, Singh *et al.* 2019).

In Odisha, the genus *Pecteilis* was previously represented by only two species, *P. gigantea* and *P. henryi* (Misra 2007; Kumar *et al.* 2021). During a biodiversity assessment conducted in September 2024 in the Rourkela Forest Division, Sundargarh district, Odisha, a flowering terrestrial orchid with distinct morphological characteristics was encountered in the Bisra Range. Detailed examination of the specimens, comparison with the protologue, herbarium material and relevant taxonomic literature (Misra 2007, 2019; Kumar *et al.* 2009, 2021, 2023; Singh *et al.* 2019; Kothareddy *et al.* 2024) confirmed its identity as *P. triflora*. This represents the first confirmed record of the species from Odisha and extends its known distribution within India.

Although previous studies have focused primarily on the distribution and taxonomic status of *P. triflora*, ecological information regarding its habitat characteristics, associated vegetation, population structure and biotic interactions remains limited. Understanding plant community composition and habitat conditions is particularly important for conserving terrestrial orchids, which often depend on specific ecological conditions for successful establishment and reproduction.

In the present study, biodiversity indices were used to characterize vegetation structure and community composition in habitats supporting *P. triflora*. Spatial distribution patterns were assessed separately using Moran's Index. Such ecological assessments provide valuable baseline information for identifying suitable habitats and developing targeted conservation strategies. The objectives of the present study were to (i) document the first occurrence of *P. triflora* in Odisha, India; (ii) provide a detailed taxonomic description supported by photographic documentation and voucher specimens; (iii) characterize habitat conditions and associated floral and faunal diversity; (iv) evaluate biodiversity and spatial distribution patterns within occupied habitats and (v) propose conservation measures for the long-term survival of this Critically Endangered orchid.

Materials and methods

Study area and field survey: Field investigations were conducted during September 2024 as part of a biodiversity assessment in the Rourkela Forest Division, Sundargarh district, Odisha, India (Figure 2). The study area is situated in eastern India and represents a tropical dry deciduous forest ecosystem dominated by *Shorea robusta* Gaertn. The vegetation of the region supports diverse herbaceous, shrub and tree species, including several terrestrial orchids.

Species identification and herbarium preparation: The collected specimens were critically examined and identified through comparison with the original species description (protologue), available herbarium specimens and relevant taxonomic literature (Misra 2007, 2019; Kumar *et al.* 2009, 2021, 2023; Singh *et al.* 2019; Kothareddy *et al.* 2024). The specimens were confirmed as *Pecteilis triflora* (D. Don) Tang & F.T.Wang, representing the first authentic record of the species from Odisha. A voucher specimen was prepared following standard herbarium techniques (Jain and Rao 1977) and deposited in the Herbarium unit of Ambika Prasad Research Foundation, Odisha, India. Detailed morphological observations were recorded from fresh specimens and



Figure 1: Observation of *Pecteilis triflora* (D. Don) Tang & F.T.Wang in different locations of study areas.

TABLE 1: Biodiversity and spatial distribution indices of three study sites supporting *P. triflora*

Parameters	Collection site 1	Collection site 2	Collection site 3
GPS Coordinates	N 22°11.667' E 085°01.867'	N 22°10.360' E 085°02.224'	N 22°09.212' E 085°00.423'
Elevation	307 m	397 m	323 m
Species richness	34	24	34
Abundance	602	260	532
Shannon-Wiener diversity index	3.44	3.15	3.51
Simpson's diversity index	0.92	0.90	0.93
Evenness	0.77	0.78	0.79
Dominance index	0.08	0.10	0.07
Brillouin index	3.53	3.23	3.59
Fisher's Alpha index	20.13	14.29	20.51
Menhinick's index	2.51	2.17	2.54
Moran's index	0.45	0.01	0.51

photographic documentation was prepared during field observations.

Ecological assessment: Vegetation sampling was conducted at three sites supporting natural populations of *Pecteilis triflora* in the Bisra Range. One quadrat measuring 20 × 20 m was established at each site, resulting in three

quadrats and a total sampled area of 1,200 m². The quadrats were purposively positioned to represent the habitat occupied by *P. triflora*. All vascular plant species occurring within each quadrat were recorded and their abundance was documented. Population observations of *P. triflora* were recorded separately within the sampled quadrats. The sampling design was intended to characterize the vegetation community associated with *P. triflora* rather than to estimate herbaceous species abundance at a fine spatial scale. Biodiversity characteristics of the three study sites were assessed using species richness and abundance, together with Shannon-Wiener diversity, Simpson's diversity, Pielou's evenness and dominance indices to characterize vegetation diversity and community structure. Moran's Index was calculated separately to assess the spatial distribution patterns of vegetation within the study sites. These measures were used to provide a descriptive assessment of species composition, abundance, diversity, evenness, dominance and spatial distribution in habitats supporting *P. triflora*. Given that one quadrat was sampled at each of the three sites, the calculated values were interpreted descriptively and were not used to infer statistically significant differences among sites (Dorrough *et al.* 2019).

Taxonomic treatment

Pecteilis triflora (D.Don) Tang & F.T.Wang, Acta Phytotax. Sin. 1(1): 62. 1951. *Habenaria triflora* D.Don, Prodr. Fl. Nepal. 25. 1825. *Platanthera triflora* (D.Don) Pradhan, Indian Orchids 2: 680. 1979.

Holotype: Nepal, *s.d.*, *F. Buchanan s.n.* (BM000034548!).

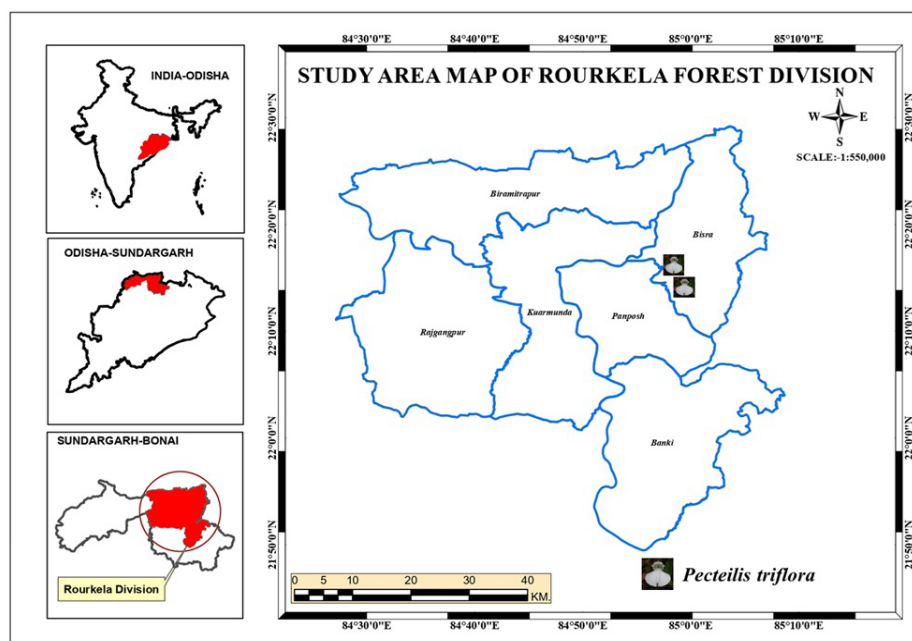


Figure 2: Geographical location of *Pecteilis triflora* (D.Don) Tang & F.T.Wang in study areas.

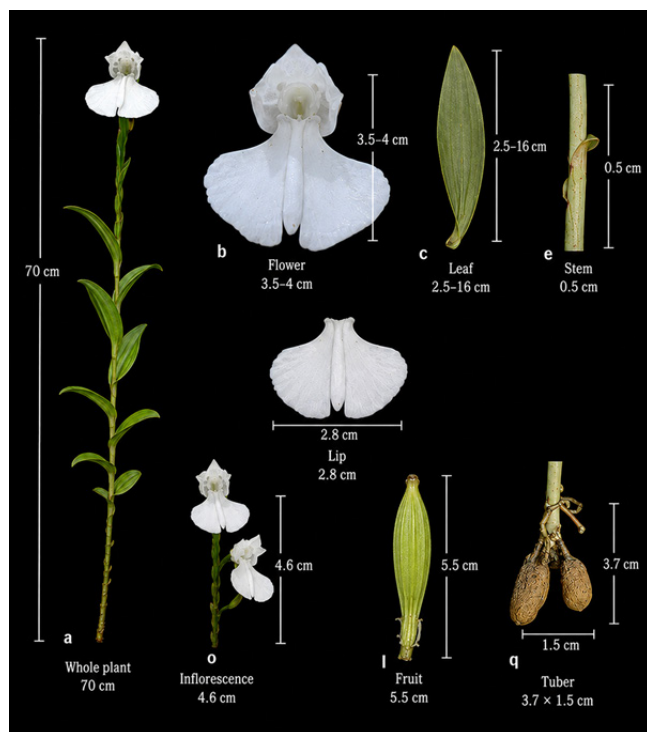


Figure 3: Morphological features of *Pecteilis triflora* (D.Don) Tang & F.T.Wang

Terrestrial herb, up to 70 cm tall. Stem stout, leafy, enclosed by leaf sheaths at the base. Tubers ellipsoid to cylindrical, solitary or paired, c. 3.7×1.5 cm, with a short neck bearing several slender roots. Leaves 5-11, arranged along the stem and forming a basal rosette, 2.5-10 cm long, fleshy, ovate-lanceolate, apex acute, base gradually narrowed, margin entire; upper leaves narrower and acuminate, middle leaves largest; adaxial surface dark green with a narrow longitudinal furrow along the midrib; abaxial surface pale whitish green. Inflorescence terminal, racemose, 1-3-flowered. Flowers showy, white and without noticeable fragrance. Floral bracts foliaceous, 3.5-4 cm long, acuminate. Sepals white, subequal; dorsal sepal c. 1.2×1.6 cm, rounded, erect, with four prominent veins; lateral sepals c. 1.1×1.5 cm, obliquely oblong-ovate, six-veined, slightly notched at the apex and reflexed. Petals linear, broader at the base, curved and shorter than the sepals; lip c. 2.8×3.5 cm, flabelliform, three-lobed; lateral lobes broad and spreading; mid-lobe linear and shorter than lateral lobes, slightly elevated along the central portion. Spur slender, funnel-shaped, cylindrical, curved, 3.8-4.2 cm long, extending beyond the ovary and bent away from the column. Column erect, c. 1.3 cm long, with wing-like appendages along the outer surface. Ovary 2.6-3 cm long, ribbed. Anther locules adnate to the sides of the column, clavate. Pollinia two, falcate, with rounded ends. Capsule oblong, up to 5.5 cm long, with five distinct longitudinal ridges (Figure 3-5).



Figure 4: Herbarium specimen of *Pecteilis triflora* (D.Don) Tang & F.T.Wang.

Flowering and fruiting
September-November.

Habitat and ecology

The species was observed in *Shorea robusta*-dominated forests, primarily occurring on hill slopes and hilltops. It was associated with several other terrestrial orchids, including *Geodorum laxiflorum*, *Habenaria commelinifolia*, *Liparis deflexa*, *Nervilia concolor*, *Odisha cleistantha* and *Peristylus lawii*. The habitat comprised partially shaded forest patches with diverse herbaceous vegetation, providing suitable conditions for the growth and establishment of terrestrial orchids.

Specimen examined

India, Odisha, Sundargarh district, Rourkela Forest Division, Bisra Range, $22^{\circ}11.667' N$, $85^{\circ}01.867' E$, elevation 307 m, 8 September 2024, Sanjeet Kumar 134 (Herbarium unit of Ambika Prasad Research Foundation).

Associated plants

Andrographis paniculata, *Asparagus racemosus*, *Biophytum sensitivum*, *Bridelia retusa*, *Buchanania lanzan*, *Byttneria*



Figure 5: Fruiting in the conserved plant of *Pecteilis triflora* (D.Don)
Tang & F.T.Wang.

herbacea, *Cajanus scarabaeoides*, *Casearia graveolens*, *Cassia fistula*, *Cayratia pedata*, *Celastrus paniculatus*, *Chlorophytum arundinaceum*, *Cissus adnata*, *Curculigo orchioides*, *Desmodium gangeticum*, *Dioscorea bulbifera*, *Diospyros melanoxylon*, *Flemingia chappar*, *Globba marantina*, *Grewia hirsuta*, *Haldina cordifolia*, *Hemidesmus indicus*, *Hybanthus enneaspermus*, *Leea asiatica*, *Lindernia ciliata*, *Lindernia crustacea*, *Lygodium flexuosum*, *Millettia extensa*, *Phanera vahlii*, *Phoenix acaulis*, *Polygala crotalarioides*, *Pterocarpus marsupium*, *Selaginella kraussiana*, *Shorea robusta*, *Spatholobus parviflorus*, *Terminalia anogeissiana*, *Uraria lagopodioides*, and *Woodfordia fruticosa*.

Associated faunal species

Barking deer, Hyena, Leopard, Wild boar and Wild rabbit.

Distribution

The species was previously reported from Bangladesh, India and Nepal (Rokaya *et al.* 2013; Kumar *et al.* 2009). It has been considered possibly extinct in Bangladesh owing to habitat loss (Rashid *et al.* 2018). In India, *P. triflora* has been documented from Jharkhand, Uttarakhand and

Meghalaya (Kumar *et al.* 2009; Kumar and Veldkamp 2010; Singh *et al.* 2019). The present record from Sundargarh district represents the first confirmed record of *P. triflora* from Odisha and extends the documented state-level distribution of the species. The geographical proximity of the present Odisha locality to previously reported localities in Jharkhand and the occurrence of similar *Shorea robusta*-dominated forest habitats suggest that these records may occur within a broader area of potentially connected habitat. However, the available distributional information is insufficient to determine whether the Odisha and Jharkhand occurrences represent distinct subpopulations or a continuous population. Therefore, the present record should be interpreted as a new state record rather than evidence of a separate subpopulation and further surveys between and around the known localities are required to clarify population connectivity and distribution extent.

Ecological significance and discussion

The ecological assessment recorded variation in vegetation composition and abundance among the three sites supporting *P. triflora* (Table 1). Species richness was 34, 24 and 34 at Collection Sites 1, 2 and 3, respectively, while vegetation abundance was 602, 260 and 532 individuals. Shannon-Wiener diversity values were 3.44, 3.15 and 3.51, with corresponding Simpson's diversity values of 0.92, 0.90 and 0.93. Evenness ranged from 0.77 to 0.79, while dominance ranged from 0.07 to 0.10. Moran's Index values were 0.45, 0.01 and 0.51, indicating clustered spatial patterns at Sites 1 and 3 and an approximately random pattern at Site 2. These results indicate variation in vegetation composition and spatial distribution among the surveyed habitats; however, the observed differences should be interpreted descriptively because the detailed number and spatial arrangement of quadrats at each site were not specified in the present sampling design. A total of 39 individuals of *P. triflora* were recorded across the three sites, comprising 22 individuals at Site 1, 11 at Site 2 and six at Site 3. Site 1 supported the highest number of *P. triflora* individuals, whereas Site 3, despite having the highest recorded vegetation diversity values, supported the fewest individuals of the orchid. This observation indicates that the local occurrence of *P. triflora* cannot be directly inferred from overall vegetation diversity alone. The present survey did not quantitatively assess the specific environmental factors responsible for these differences; therefore, factors such as soil properties, moisture, canopy conditions, disturbance and reproductive success should be considered as potential explanations rather than established determinants. Further standardized sampling and long-term population monitoring are required to evaluate the relationship between *P. triflora* abundance and habitat conditions. The occurrence of *P. triflora* within diverse forest-floor vegetation indicates that the species occupies

a structurally heterogeneous habitat in *Shorea robusta*-dominated forests. The species was recorded together with six other terrestrial orchids, namely *Geodorum laxiflorum*, *Habenaria commelinifolia*, *Liparis deflexa*, *Nervilia concolor*, *Odisha cleistantha* and *Peristylus lawii*. The co-occurrence of these orchids suggests that the forest patches provide suitable environmental conditions for a diverse terrestrial orchid assemblage; however, the present study did not evaluate direct ecological interactions among these species. Similarly, *Curculigo orchioides*, *Dioscorea bulbifera*, and *Lindernia crustacea* were frequently observed in proximity to *P. triflora*, but their occurrence should be interpreted as habitat co-occurrence rather than evidence of ecological dependence. Edaphic conditions are likely to be important in determining the establishment and persistence of terrestrial orchids. However, soil texture, pH, moisture, organic matter and nutrient status were not quantitatively assessed in the present study. Consequently, the specific contribution of these factors to the occurrence and establishment of *P. triflora* cannot be determined from the available data. Future studies should incorporate systematic assessment of soil properties together with population monitoring to identify the environmental conditions associated with successful establishment, growth, flowering and recruitment of *P. triflora*. Such information would improve the understanding of its habitat requirements and support more targeted conservation management.

The present study also recorded several faunal species, including barking deer, hyena, leopard, wild boar and wild rabbit, within the habitat of *P. triflora*. During field observations, herbivory on aerial parts of *P. triflora* by barking deer was documented. Discussions with forest watchers indicated that terrestrial orchids may be consumed occasionally by herbivorous mammals such as barking deer and wild boar. Although the impact of herbivory on population dynamics remains unknown, such interactions may represent an additional ecological factor requiring consideration in future conservation planning.

Previous studies have reported *P. triflora* from restricted localities in India and neighbouring countries. Kumar *et al.* (2009) documented its occurrence in Chotanagpur, Jharkhand and described its association with terrestrial orchids such as *Habenaria*, *Malaxis* and *Nervilia* in *Shorea robusta*-dominated forests. The present study expands this ecological association by documenting the occurrence of *P. triflora* with a broader assemblage of terrestrial orchids, including *Geodorum*, *Habenaria*, *Liparis*, *Nervilia*, *Odisha* and *Peristylus*.

Sahu and Choudhary (2022) reported the presence of *P. triflora* in Saranda Forest, Jharkhand, but provided limited information regarding population size and associated vegetation. Rokaya *et al.* (2013) recorded the species from moist open habitats in Nepal, whereas Rashid *et al.* (2018)

highlighted its probable extinction in Bangladesh due to habitat degradation. Kumar *et al.* (2023) documented populations comprising approximately 30-40 individuals across three Indian localities. The present survey recorded 39 individuals from three sites, indicating the continued persistence of small populations within suitable forest habitats. The documentation of associated plant diversity and terrestrial orchid assemblages provides baseline information on the vegetation community occurring within the habitat of *P. triflora*. However, the present study was based on field observations of species co-occurrence and did not assess direct positive, negative or neutral interactions between *P. triflora* and the associated plant species. Therefore, the recorded species should be considered habitat-associated or co-occurring taxa rather than species demonstrating a confirmed ecological relationship with *P. triflora*. Further experimental and long-term ecological studies are required to determine whether particular plant species influence the establishment, growth, flowering or persistence of *P. triflora*.

Conservation action

Considering the restricted distribution, small population size and Critically Endangered status of *P. triflora*, immediate conservation attention is required to safeguard its remaining populations and habitats. An awareness programme was conducted involving forest watchers and officials of the Rourkela Forest Division. The programme highlighted the taxonomic identity, conservation status, distribution and ecological importance of *P. triflora*. Forest personnel were also informed about the importance of protecting the species during routine forest management activities.

Special emphasis was given to the monitoring and management of invasive alien plant species that may negatively influence orchid habitats. Forest watchers were advised to regularly monitor the occurrence and spread of invasive species, particularly *Chromolaena odorata*, in areas supporting *P. triflora*. Early detection and appropriate management of invasive plants are essential for maintaining native forest floor communities. The application of the IUCN Green Status of Species framework (Grace *et al.* 2021) is recommended for evaluating conservation recovery and measuring the effectiveness of management interventions for *P. triflora*. Long-term monitoring of existing populations, identification of additional suitable habitats and systematic surveys in similar forest ecosystems are necessary to improve understanding of the species' distribution and conservation requirements.

As part of an *ex-situ* conservation initiative, six tubers and three wildlings of *P. triflora* were collected with appropriate permission and established in the Orchidarium of the State Botanical Garden, Nandankanan Zoological Park, Odisha, India. After 65 days of cultivation, fruit development was observed and documented photographically. The cultivated

individuals continue to receive regular maintenance, including irrigation and monitoring, with the aim of supporting future propagation efforts and serving as a conservation resource for this threatened orchid.

Recommendations for conservation and management Based on the small number of individuals recorded, restricted occurrence within partially shaded *Shorea robusta*-dominated forest, associated vegetation characteristics and observed herbivory, three priority management actions are recommended for the conservation of *P. triflora* in the study area.

Protect and maintain forest-floor habitat

The three recorded sites supporting *P. triflora* should be identified as priority microhabitats within the Bisra Range and protected from activities that may alter the forest-floor environment. Particular attention should be given to maintaining partial canopy cover, natural leaf litter, associated herbaceous vegetation and the undisturbed soil conditions of the occupied sites. Since only 39 individuals were recorded across the three sites, routine forest management activities should avoid unnecessary disturbance around known individuals, particularly during the flowering and fruiting period from September to November.

Site-specific monitoring and manage invasive vegetation

Permanent monitoring plots should be established around the three known sites to record individual survival, flowering, fruiting, recruitment and changes in habitat condition annually. Regular surveillance for invasive plants, particularly *Chromolaena odorata*, should be undertaken around occupied sites, with manual or other site-appropriate control measures applied where necessary while minimizing disturbance to the orchid and associated native vegetation. Such monitoring will provide an early indication of population decline and habitat deterioration and allow management interventions to be adjusted accordingly.

Monitoring of herbivory and population recruitment

Because herbivory on the aerial parts of *P. triflora* by barking deer was observed during the field survey, its potential effect on flowering, fruit production and recruitment should be assessed through repeated observations during the growing and reproductive seasons. Wherever repeated herbivory is documented at particular sites, non-invasive site-specific protection measures may be considered for vulnerable individuals. Monitoring of fruit production and natural recruitment should be integrated with population surveys to determine whether herbivory is affecting the persistence of the small local populations.

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References

- Dorrough J, Sinclair SJ and Oliver I (2019). Expert predictions of changes in vegetation condition reveal perceived risks in biodiversity offsetting. *PLoS One* **14**(5): e0216703.
- Grace MK, Akçakaya HR, Bennett EL *et al.* (2021). Testing a global standard for quantifying species recovery and assessing conservation impact. *Conservation Biology* **35**: 1833-1849.
- Jain SK and Rao RR (1976). *A Hand Book of Field and Herbarium Methods*. Today and Tomorrow's Printers and Publishers, New Delhi, India.
- Jalal JS and Jayanthi J (2019). *Pecteilis korigadensis* (Orchidaceae: Orchidoideae), a new terrestrial orchid from the northern Western Ghats, India. *Phytotaxa* **388**(2): 167-173.
- Kothareddy P, Arigela RK and Dejong B (2024). *Orchids of the Palni Hills, Tamil Nadu, a pictorial guide*. Ambika Prasad Research Foundation, Odisha, India.
- Kumar P (2023). *Pecteilis triflora*. The IUCN Red List of Threatened Species 2023: e.T186884431A186884436.
- Kumar P and Veldkamp JF (2010). *Pecteilis rawatii* (Orchidaceae), a new species from India. *Gardens' Bulletin Singapore* **61**(2): 335-341.
- Kumar P, Jalal JS and Rawat GS (2007). Orchidaceae, Chotanagpur, state of Jharkhand, India. *Check List* **3**(4): 297-304.
- Kumar P, Jalal JS and Rawat GS (2009). On the occurrence of *Pecteilis triflora* (D. Don) T.Tang & F.T.Wang (Orchidaceae) in India. *Richardiana* **9**(4): 161-171.
- Kumar S, Mishra S and Mishra AK (2021). Diversity of orchid species of Odisha state, India. With not on the medicinal and economic uses. *Richardiana* **5**: 1-26.
- Misra S (2007). *Orchids of India, a glimpse*. Bishen Singh Mahendra Pal Singh. Dehradun, India.
- Misra S (2019). *Orchids of India, a handbook*. Bishen Singh Mahendra Pal Singh. Dehradun, India.
- Mosoh DA, Prakash O, Khandel AK and Vendrame WA (2024). Preserving earth's flora in the 21st century: climate, biodiversity, and global change factors since the mid-1940s. *Frontiers in Conservation Science* **5**: 1383370.
- Rashid ME, Rahman MA and Huda MK (2018). Possibly lost orchid treasure of Bangladesh and their enumeration with conservation status. *Journal of Biodiversity Conservation and Bioresource Management* **3**(1): 65-83.
- Rokaya MB, Raskoti BB, Timsina B and Münzbergová Z (2013). An annotated checklist of the orchids of Nepal. *Nordic J. Bot* **31**: 511-550.
- Sahu RK and Choudhary AK (2022). Decline in biodiversity of orchids in Ranchi district and its adjoining areas. *RJOST* **7**(1): 61-64.
- Sharma BP, Saradar B, Choudhari SS, Sampatrao TS, Marndi S and Kumar S (2024). Orchid Diversity in Mining Impacted Forest areas of Odisha: Documentation, Restoration and Conservation Aspect. *Indian Forester* **150**(9): 876-881.

- Singh SK, Agrawala DK, Jalal JS, Dash SS, Mao AA and Singh P (2019). *Orchids of India - A pictorial guide*. BSI, Kolkata, India.
- WangM, Jiang J, Liang H, Lei L, Chen Y, Li Y, Hua Y, Ma T, Ding W, Li X andNiu Z (2026). The multichromosomal structure evolution of *Dendrobium* mitogenomes and new insights into interrelationships of recently radiated tribes in Epidendroideae (Orchidaceae). *Front. in Plant Sci.* **17**: 1864920. <https://doi.org/10.3389/fpls.2026.1864920>
- ZhangH, Tang M, Wang Y, Pan R and Deng H. (2026). Patterns of Orchid Diversity and Their Potential Habitat Under Climate Change in Chongqing, China. *Biology* **15(4)**: 351. <https://doi.org/10.3390/biology1504035>