

AN ANALYSIS OF GAPS AND PRIORITIES IN INDIAN ORCHIDOLOGY USING THE THIRTY FIVE YEAR OLD ARCHIVE OF THE JOURNAL OF THE ORCHID SOCIETY OF INDIA

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Abstract

An analysis was presently made to understand the impact of the Journal of the Orchid Society of India on Indian orchidology and to identify gaps in orchid research and conservation of Indian orchids. Some major questions asked were: What is the existing literature published by the journal? What are the significant areas of research? What methodological (experimental or observational) approach has been more used? How often are IUCN red-listed species studied? Analysis of research papers (from 1987 to 2021), showed 513 research articles make up the archive of the journal. Of these, 52% were experimental and 31% were field-based, and 11% were observational. The most focused areas of research were *in vitro* studies (30%) and systematic biology (17%); whereas the least focused areas were ethnobotany (1.9%) and conservation (1.9%). Studies on IUCN red-listed species were <1% and insufficient against the conservation action required (IUCN). Hence, future orchid research in India should focus on *in vitro* studies and the application of techniques for conservation and restoration of threatened species and finally give equal focus on areas other than *in vitro* studies.

Introduction

INDIA WITH its enormous diversity of orchids, Indian orchid research evolved to be a science of importance over a long period. In the post-independence era, the focus on the collection of wild orchids, a popular hobby until then, gradually shifted into sharing and publishing notes and observations on orchids in their natural habitats and gardens. This paved the way for Indian orchid science. Several books were written in this period on orchids. Ghose (1968) written a book on *Beautiful Indian Orchids and How to Grow Them?* Following this, some major books, that are still considered classics, came out including *The Orchids of Bombay* (Santapau and Kapadia, 1966), *Indian Orchids: Guide to Identification and Culture* (Vol I, II; Pradhan, 1976, 1979), *Orchids of India* (Rao, 1979), *Orchids of India* (Bose and Bhattacharjee, 1980), *Introduction to Orchids* (Abraham and Vatsala, 1981), *Orchids of Nilgiris* (Joseph, 1987), *A Catalogue of Indian Orchids* (Kumar and Manilal, 1994), *Orchids: Science and Commerce* (Pathak *et al.*, 2001), *Orchids of Himachal Pradesh* (Vij *et al.*, 2013); *Commercial Orchids* (De *et al.*, 2015), *Orchids of India: A Handbook* (Misra, 2019), and *Orchids of India: A Pictorial Guide* (Singh *et al.*, 2019).

Pioneers in orchid research published notes and articles since 1970s on various species of importance from the NorthWestern Himalayas, Western Ghats, and the NorthEastern Himalayas. GM Pradhan led the way for publishing notes on orchids in magazines/journals from 1970s as evident from his nine articles [*Paphiopedilum spicerianum* (Pradhan, 1972a), *P. villosum* (Pradhan,

1972b), *P. hirsutissimum* (Pradhan, 1972c), growing *P. venustum* from seeds (Pradhan, 1973a), *Cymbidium devonianum* (Pradhan, 1973b), habitat and growing conditions of *Vanda coerulea* (Pradhan, 1973c), *V. ceorulescens* (Pradhan, 1973d), North Indian species of *Acanthophippium* (Pradhan, 1973e), jewels to crown your collection (Pradhan, 1973f)] in Orchid Digest from 1972 to 1973. The first article by an Indian author in Orchid Digest was the article on *Paphiopedilum spicerianum* (Pradhan, 1972a). Following this, others who made significant contributions to orchid science in India such as S P Vij, S N Hegde, U C Pradhan, A N Rao, C S Kumar, K S Manilal, and Promila Pathak. Rediscovering *Paphiopedilum druryi* by Mammen and Mammen (1974), rediscovering *Cymbidium macrorhizon* by Pradhan (1975) were some of the important articles that were published during this period in the Orchid Digest. Indian journals such as *Current Science* and *The Journal of the Bombay Natural History Society* were also preferred amongst these pioneers in orchid science. The first volume of Indian Orchid Journal with their Editors as G M Pradhan and U C Pradhan though published in 1985, the journal did not survive for many years.

It was in 1987, probably inspired by the leading orchid magazines/journals, The Orchid Society of India (TOSI) established in 1984, to promote awareness and to disseminate knowledge of commercial and botanical importance of orchids; to project the importance of conservation and propagation of Indian orchids; and to further strengthen the orchid fraternity. The society launched an international Journal, *The Journal of the Orchid Society of India* (J. Orchid Soc. India) with its

editor as S P Vij (1987-2013) and later Promila Pathak (2014-till date), to fill the gap of a journal dedicated to orchid research in India. The journal published articles and communications to disseminate advances in orchid research in the country. These articles followed a scientific format similar to that of international journals. The journal is international, peer-reviewed, refereed, indexed (NAAS Rating: 4.52; T045) published annually and included in UGC Approved Care List of Journals; it focuses on scientific and commercial aspects of orchids. Being the only journal in India that focuses on orchid research in the subcontinent, it may have created a unique impact in the area of orchid research since its beginning. The trends and patterns of research in orchid science in the country may have shifted over time with the help of the journal or vice-versa. The archive with issues of the journal for 35 years thus also becomes a tool to decipher the growth of orchid science in India in the last three decades. Hence, an analysis of the journal archive was carried out to understand the gaps and priorities in Indian orchid science.

Material and Methods

Presently, a detailed analysis of the 35 year old archive of *The Journal of the Orchid Society of India*, from 1987 to 2021, was carried out to answer the following questions: What is the existing literature published by the journal? What are the significant areas of focus of the journal? What methodological (experimental or observational) approach has been more used in orchid research? What vegetative habits are mostly addressed? What tribe is mostly studied? How often are red-listed species studied as suggested by IUCN? The website of the journal allowed open online access to issues from 2015 to 2021. The volumes previous to 2015 were accessed from the library, Jawaharlal Nehru Tropical Botanical Garden and Research Institute, Trivandrum, Kerala. IUCN (2023) Red List version 2022-2 was used to verify the updated status of species and examine research and action advised by IUCN. Data on all articles in the journal from 1987 was examined in detail and patterns in them were plotted using Microsoft Excel. Articles following various methods of study have been compared and tested for significance using One Way ANOVA analysis in the software PAST 4.03.

To find articles on orchids from India in the post independence period until 1987 some journals in orchid science

were scanned. Index sorted by year of Orchid review and Orchid Digest was accessed from respective websites. The archive of the journals, Current Science (from 1981), and Australian Orchid Review (from 1939 to 2019) was also scanned.

Results

Archive of the Journal and Areas of Research

The Journal of the Indian Orchid Society published 35 issues from 1987 to 2021 (Fig. 1). The number of research articles varied from 8 to 22 with the average number of articles being 15. The total number of articles published in the journal from 1987 to 2021 was 513. The area of focus of those research articles can be categorized into *in vitro* studies, conservation, functional biology, cytology and molecular biology, ecology, systematic biology, horticultural prospects, ecology and conservation, ethnobotany, and general article on orchid research. Two articles that introduced resources overseas were excluded from the analysis. The most focused areas of research in the journal based on the number of research papers/articles, are, *in vitro* studies (30%), systematic biology (17%), ecology (13%), functional biology (11%), horticultural prospects (10%) respectively. The least focused areas of research in Indian orchid research are ethnobotany (1.9%), conservation (1.9%), ecology and conservation (4%), and cytology and molecular biology (7%) (Fig. 2)

Interestingly, all areas of focus were represented reasonably well in articles sometimes with a minimum of two and a maximum of seven in a year, from 1987 to 2021 (Fig. 3). There were significant differences between areas of focus and within each across the years (One way ANOVA, significant at $p < 0.05$). *In vitro*

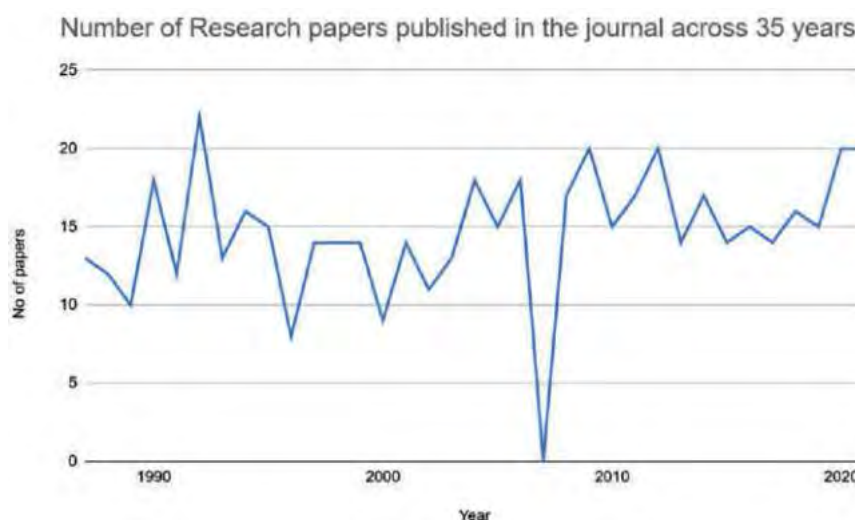


Fig.1. Research papers published in the journal from 1987 to 2021.

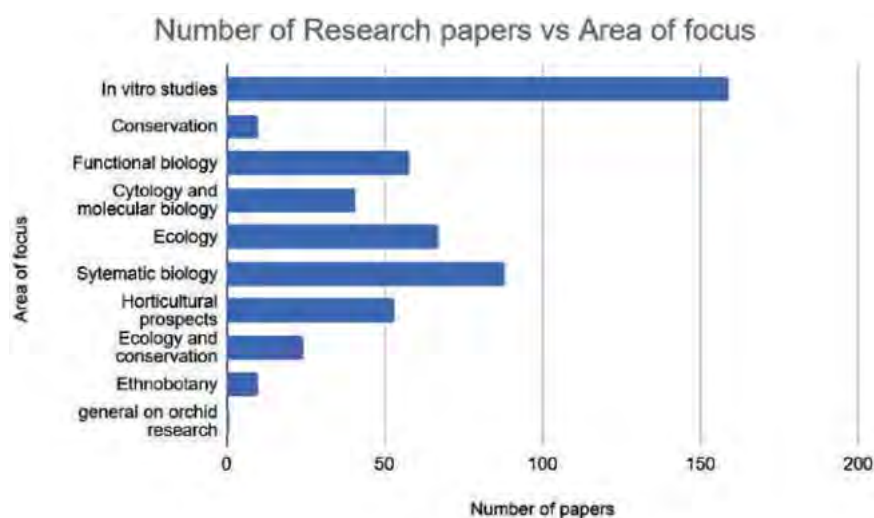


Fig. 2. Areas of focus in research papers published in the journal.

studies were the most common area of focus for the journal.

Method and Type of Research

Research articles in each area of focus were categorized based on the approach, to information, book review, field-based, review of literature, observation-based, and experimental. More than 50% of articles were of the experimental approach followed by field-based research, observations, review, and other information (Fig. 4). This explains the high number of articles being on *in vitro* studies. Other experimental articles included functional biology, cytology, molecular biology, and horticulture.

Ecology, systematic biology, and ecology and conservation make up field-based articles. The major area of focus in observation-based articles was horticulture.

In vitro studies were mostly experimental as expected (Fig. 5). Review papers in this area, effectively discussed micropropagation, seed germination in tropical orchids, and such initiatives in *Paphiopedilum*. However, contributions from observational articles were moderate. Field-based research, review, and observations in Systematic Biology indicated the progress achieved in more than three decades in the specific area. However, a very few research

articles in the area, of ecology deal with detailed ecological research and assessments. Most articles in ecology had limited field-based ecological studies and were more observational. This was again true for conservation and articles that addressed ecology and conservation together. Research papers in the areas of functional biology, cytology, and molecular biology had similar patterns in experimental and observational studies. In the area of horticultural prospects, an equal number of articles were there in both experimental and observational types. Research articles in the area of ethnobotany comprised limited field-based articles and more observations and reviews.

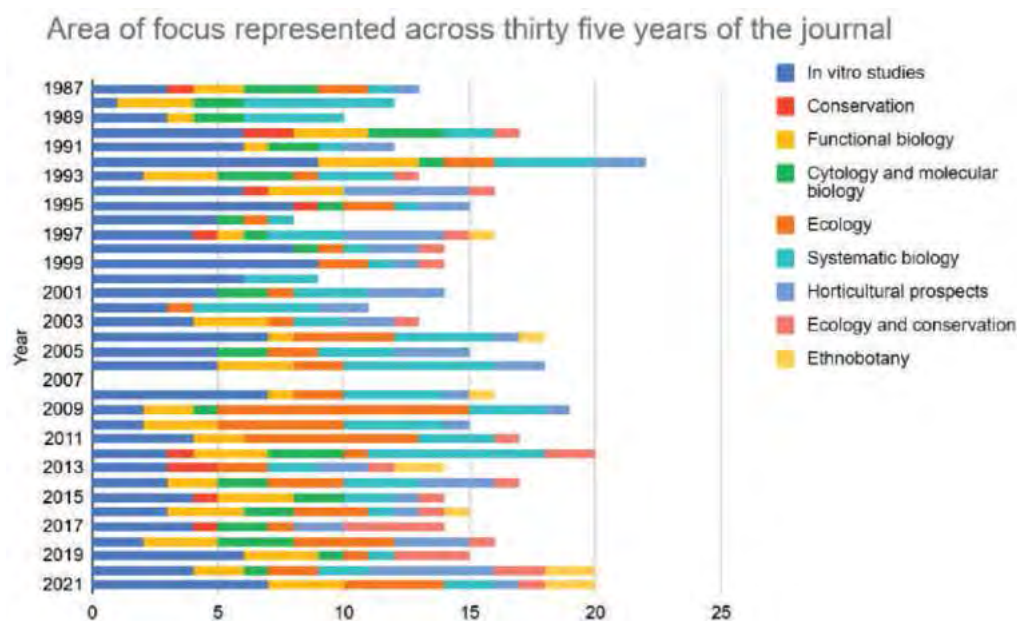


Fig. 3. The pattern of areas of focus of the journal represented from 1987 to 2021

Of all (n=513) studies, 23.6% studies focused on the tribe Vandae, making it the most studied tribe in Orchidaceae in India. Following this, other tribes with 10-20% representation included, *Dendrobieae*, *Cymbidieae*, and *Orchideae* (Fig. 6). This is because most common areas of focus such as *in vitro* studies, systematic biology, ecology, functional biology, horticultural prospects, and cytology and molecular biology almost always involved orchids like *Cymbidium*, *Vanda* etc. due to their significance in eco-

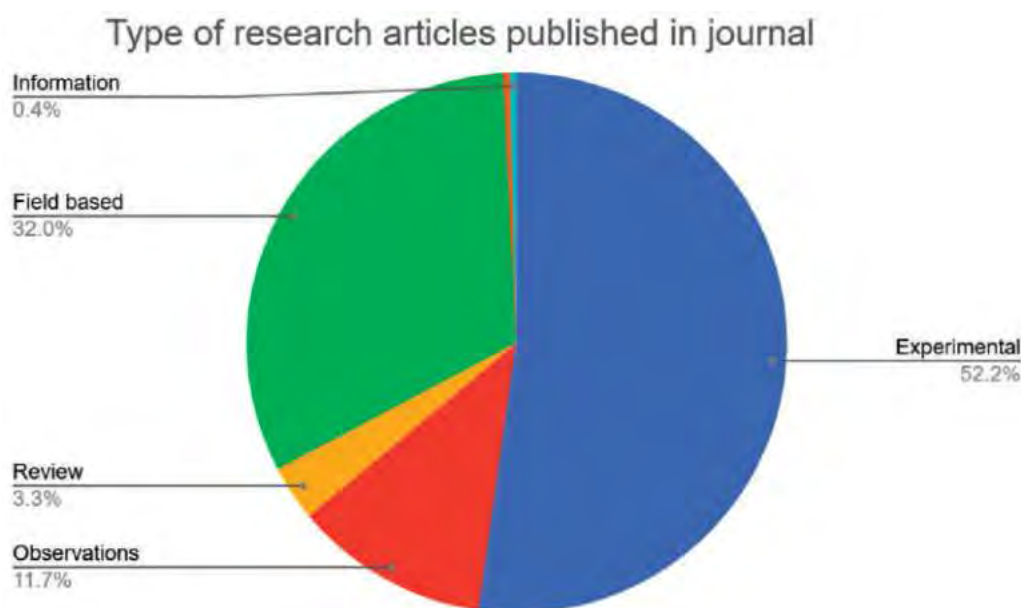


Fig. 4. Type of research articles based on research approach.

nomic and taxonomic perspectives. Other tribes such as Cranichideae, Arethuseae, Podochileae, Coelogyneae, Cyrtopodidae, Bletieae, Malaxideae, Epidendreae, and Diurideae together contributed 30%. Further, of research articles that focused on specific species or groups (n=273), 61% of studies involved orchids of epiphytic life form and 36% studied terrestrial orchids (Fig. 7). In most frequent areas of research of the journal, the focus on epiphytic orchids was nearly two times that of terrestrial orchids. This was strongly evident in areas of focus where experimental approach

was a major method of study. This is again related to the economic significance of orchids in tribes Vandeae, Dendrobieae, Cymbidieae, and Orchideae. Meanwhile, articles with a focus on saprophytic and purely lithophytic orchids were less than 1% as their number is low.

IUCN Red Listed Species

IUCN red list 2023 (version 2022-2) so far assessed the status of 73 orchids present in India. Of these, 24 fall under CR (Critically Endangered) and 11 fall under EN (Endangered), and the rest fall under LC (Least Concerned), VU (Vulnerable), NT (Not Threatened), and DD (Data Deficient). Of 513 research papers over thirty five years, only 15 articles addressed IUCN red-listed species (Fig. 8). Only one article addressed a Critically Endangered (CR) species and it was a preliminary work on the ecology of the species. In 1995, a study on the distribution, population, and habitat of the CR species, *Paphiopedilum druryi* was carried out and generated

some database, whereas nine articles included four EN orchids. The species that gathered attention as Endangered (EN) were *Cyrtopodium himalaicum*, *Dactylorhiza hatagirea*, *Eria jengingensis*, and *Paphiopedilum spicerianum*. These articles were important as they included the first report, status, ecological studies, and *in vitro* propagation attempts. However, these research works are not even close to the amount of research and conservation action required for the conservation of threatened species as

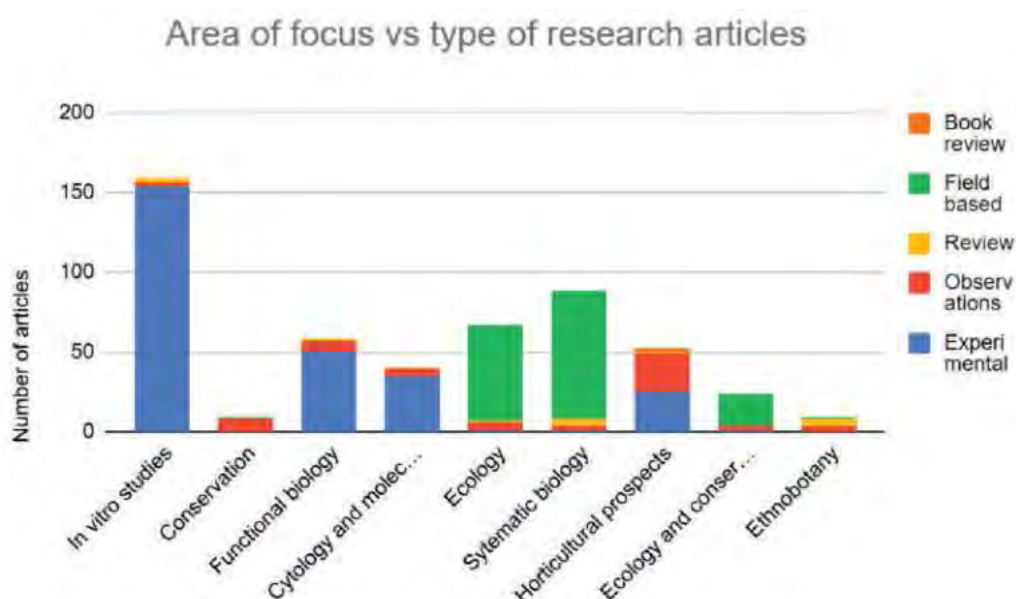


Fig. 5. Type of research articles in each area of focus by the journal.

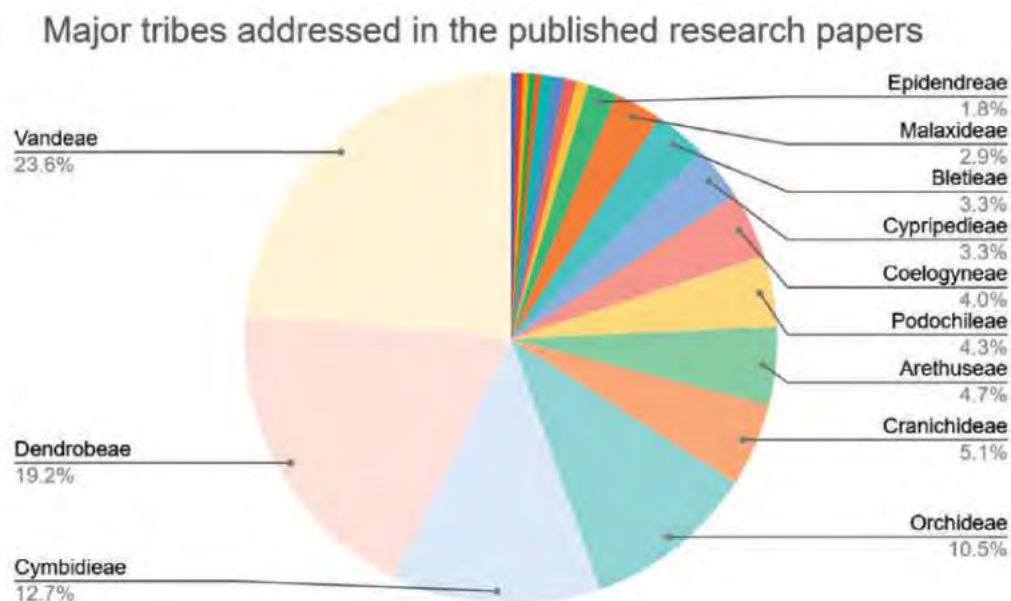


Fig. 6. Tribes studied in research papers in the journal.

per IUCN (Table 1). Further, nine articles studied Least Concerned (LC) and two addressed Vulnerable (VU) species.

Discussion and Conclusion

The Journal of the Orchid Society of India (*J. Orchid Soc. India*) created a new identity for orchid science in India over 35 years. The archive is a rich resource of articles from 1987 to 2021 that consists of research work from mainly nine areas of focus. Almost all the

the Orchid Society of India. However, this analysis solely aimed at growth, gaps, and priorities in Indian orchid science as a result of the 35 years of functioning of the Journal of the Orchid Society of India.

The archive could act as a wonderful resort for researchers working in various aspects of orchid science. Major areas of research included on *in vitro* propagation (Anuprabha and Pathak, 2019, 2020; Bhatti *et al.*, 2017; Bhowmik and Rahman, 2020; Kumari and Pathak, 2021; Laldusanga *et al.*, 2021; Lekshmi and

Decruse, 2018; Pathak *et al.*, 2017; Sembi *et al.*, 2020; Sunita *et al.*, 2021; Thakur and Pathak, 2020, 2021; Vasundhara *et al.*, 2019, 2021), systematic biology, ecology (Barman *et al.*, 2021; Hegde and Krishnaswamy, 2021a; Huda *et al.*, 2020; Jalal and Singh, 2017; Jaryal *et al.*, 2021; Kumari and Pathak, 2020; Lal *et al.*, 2021; Prakash and Pathak, 2019; Singh *et al.*, 2019), functional biology (Buragohain and Chaturvedi 2016; Gurudeva, 2019; Hegde and Krishnaswamy, 2021b; Pal *et al.*, 2019; Prakash and Pathak,

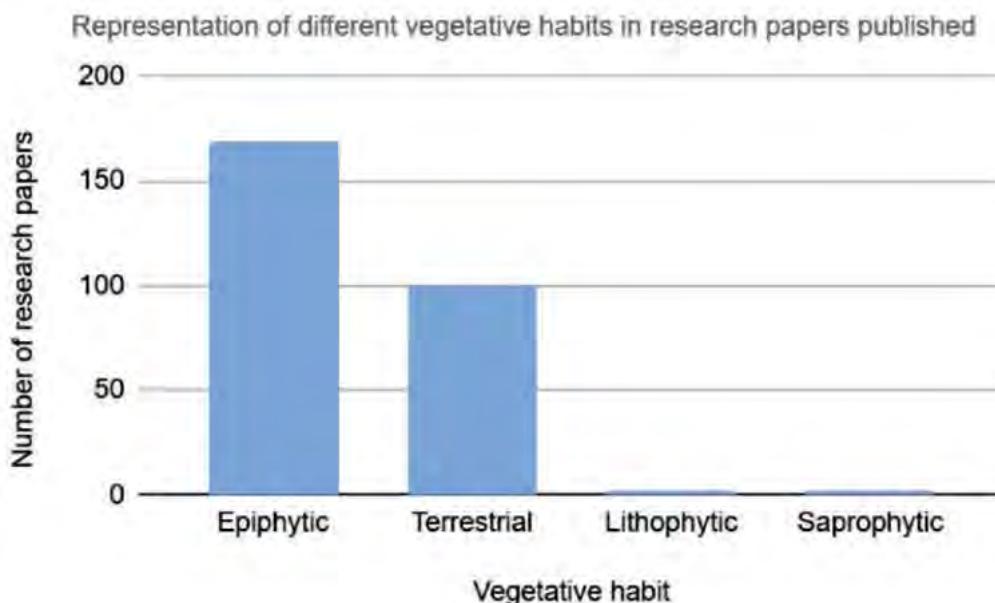


Fig. 7. Various vegetative habits in research papers published.

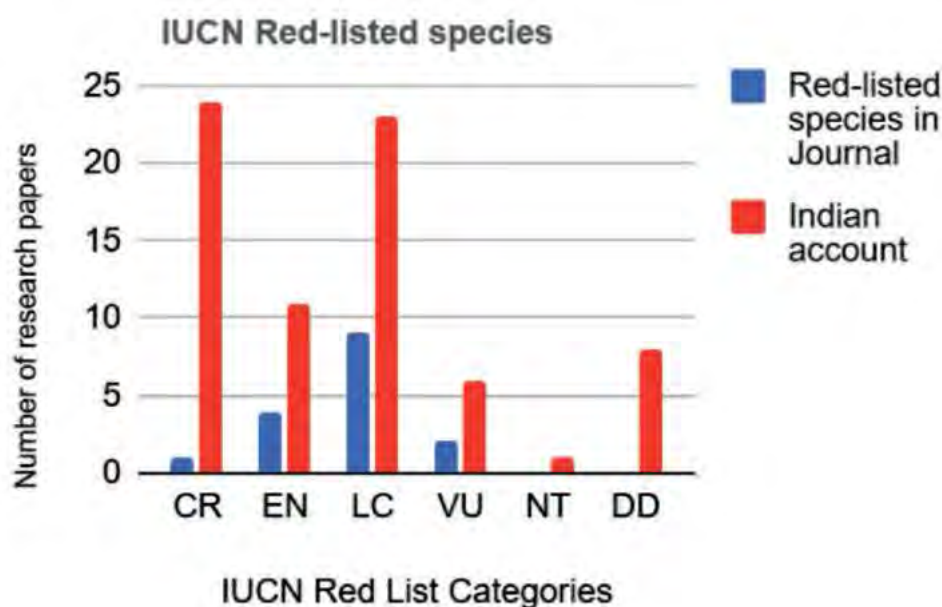


Fig. 8. IUCN Red listed species in India and their study in the journal (CR, Critically Endangered; EN, Endangered; LC, Least Concern; VU, Vulnerable; NT, Near Threatened; DD, Data Deficient).

2020a, 2022), and horticultural prospects (De and Pathak, 2020; Prakash and Pathak, 2020b; Thammasiri,

techniques, embryo culture, and asymbiotic and

2020). The journal also provided ample opportunities for publication of research paper related to orchid research conducted by students in their academic departments. This is to encourage more students to get into orchid research.

More than half of these research articles employed experimental approaches to enhance knowledge in *in vitro* research, cytological and molecular developments, and functional biology. The understanding and knowledge generated through experimental research in functional and molecular studies in the initial years have paved the way for more *in vitro* research in the later years. Most of this research, for instance, advancements in propagation

Table 1. Research papers on CR, EN species in the journal against action required as per IUCN.

Species	Status	Studies done	Action required as per IUCN
<i>Paphiopedilum druryi</i>	CR	Preliminary study on distribution, habitat and population density (Menon <i>et al.</i> , 1995)	1. Research on all aspects and trade 2. In-place protection 3. In place management 4. Species management 5. Education and awareness 6. Law and policy
<i>Cypripedium himalaicum</i>	EN	Status assessment (Maity <i>et al.</i> , 2002)	1. Research on all aspects, conservation planning and monitoring 2. In-place protection 3. In-place management 4. Species management 5. Education and awareness 6. Law and policy 7. Livelihood, economic and other incentives
<i>Dactylorhiza hatagirea</i>	EN	Study on green pod culture (Vij <i>et al.</i> , 1995); medicinal use (Lal <i>et al.</i> , 2004); preliminary study on growth, phenology, and productivity (Butola and Badola, 2006); agrotechnique for <i>ex situ</i> conservation (Shapoo <i>et al.</i> , 2020)	1. Research on different aspects, conservation planning and In place research and monitoring 2. In-place protection 3. In-place management 4. Species management 5. In place education 6. Law and policy 7. Livelihood, economic and other incentives.
<i>Eria jengingensis</i>	EN	New species record (Hegde, 1993)	1. Research on all aspects and conservation planning 2. In-place protection 3. In-place management 4. Species management
<i>Paphiopedilum spicerianum</i>	EN	Study on distribution and population (Bhattacharjee <i>et al.</i> , 2005); <i>in vitro</i> propagation (Borah <i>et al.</i> , 2015)	1. Research and monitoring 2. In-place protection 3. In- place management 4. Species management 5. Education and awareness 6. Law and policy

symbiotic seed germination has been very pioneering in orchid propagation and breeding. Experimental research also benefited the propagation and value addition of hybrid orchids in India. *Cymbidium*, *Dendrobium*, and *Vanda* hybrids have been economically important and therefore were widely used in experimental research. The large amount of attention to these tribes in turn encouraged more focus on orchids of epiphytic habit. The development of cost-effective mass propagation techniques including experiments on different nutrient media, multiplication, development of new hybrids, fertiliser effects, harvesting techniques, and post-harvest management was discussed in detail over the years. Further, articles also introduced new concepts in horticulture and floriculture from around the world with suggestions to ensure sustainable commercial utilization. This has certainly encouraged more awareness and involvement in Indian orchid horticulture. The data analysis showed that there is a gap between experimental and field research and it may be translated for Indian orchid science. Further analysis showed that researches on terrestrial orchids were comparatively less than the epiphytic orchids due probably to their comparatively low strength. A few studies carried out research focusing on propagation and conservation of threatened terrestrial orchids. However, as the terrestrial orchids are more threatened and face a greater extinction risk as compared to epiphytic orchids due to multiple threats and the climate change crisis, the focus on terrestrial orchids in their natural habitat needs to be made.

The archive reveals that only a limited number of articles addressed IUCN red-listed species that are of great concern (CR and EN). However, some others used the status due to the notion that all orchids are listed in Appendix I and II of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). It is recommended that the journal may insist that researchers shall use a single scale of assessment such as the IUCN red list or CITES with reference. The absence of reference to status could create confusion and mislead researchers about the status of species in their natural habitats. CITES itself states that Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. In CITES, the species are grouped in the Appendices according to how threatened they are by international trade not based on their actual status in their natural habitat. Hence, scientific communities that carry out detailed research on the species may better consider the IUCN status to have a common standard of status assessed. A couple of studies on threatened species like *Dactylorhiza hatagirea* and *Paphiopedilum spicerianum* threw light

comprehensively. Hence, utilization of such studies on a large-scale, multidisciplinary, and collaborative approach to aid the conservation of species is another area of concern in orchid science in the country.

Research on orchids in India has seen major developments over thirty five years of the journal. The impact, *The Journal of the Orchid Society of India* created by improving access to various aspects of orchid science and instigating discussions and research among the scientific community is highly commendable. Still, the lack of detailed understanding of orchid biology and the ecology of species of concern and, the lack of infrastructure limits the application of *in vitro* propagation techniques developed. Hence, grant opportunities for orchid researches and detailed field-based research to understand all ecological perspectives, threats, and challenges to the conservation of any species of concern is a need of the hour.

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