

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

185,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Rockbee Repellent Endemic Plant Species of Andaman-Nicobar Archipelago in the Bay of Bengal

Sam Paul Mathew and Raveendranpillai Prakashkumar

Abstract

The article concisely illustrates the vegetation dynamics and interrelationships among Man, Animal and Plant species of the insular tropical rain forests found to occur in Andaman-Nicobar Islands in the Bay of Bengal. There are two aboriginal groups known as 'Onges' and 'Shompens' living in different islands such as the Little Andaman Island and the Great Nicobar Island are mostly depends on the forest vegetation for their livelihood. The delicacy of these two ancient aboriginal groups towards wild honey in their food habits is quite time immemorial. Interestingly, it is found that the insular vegetation dynamics has a key role to gratify their needs in this regard. The two endemic plant species of the insular vegetation *viz.* *Orophea katschallica* Kurz and *Etlingera fenzlii* (Kurz) Škorničk. & M. Sabu is traditionally used by these primitive aboriginal communities for honey collection from the large wild hives of the ferocious rockbee (*Apis dorsata* Fabricius). The article also included details on chemical characterisation of *Etlingera fenzlii*.

Keywords: Andaman-Nicobar Islands, *Apis dorsata*, *Orophea katschallica*, *Etlingera fenzlii*, Onges, Shompens, Honeybee repellent endemics

1. Introduction

The Andaman-Nicobar Islands, located approximately 650 nautical miles far off from the Coromandel Coast of the Peninsular India between the latitudes 6° 45" to 13° 41" N and the longitudes 92° 12" to 94° 16" E, are characterised with enchanting seascapes bordering rocky or sandy beaches with lush green tropical rainforests. This archipelago comprises around 325 major islands and islets which offer a total insular landmass of roughly 8249sq km in the Bay of Bengal. According to periodical enumerations on flora of the Andaman-Nicobar Islands by various botanists from the Botanical Survey of India could ascertain the occurrence of 2649 plant taxa comprising 2508 species, 32 subspecies, 103 varieties and 6 forma under 1109 genera within 238 families belonging to 4 different plant groups, namely Bryophytes (mosses), Pteridophytes, Gymnosperms and Angiosperms [1–5]. The plant genetic resources (PGR) of the Andaman-Nicobar Islands have a wide range of economically significant gene pools of lesser known plant taxa and wild prototypes of several popular cultivars. Wild occurrence of popular cultivars like coconut palms, betel nut palms, betel vines were recorded since centuries ago from these islands [6–11]. The apparent wild occurrence of these popular cultivars among

several uninhabited islands over a century ago substantiate to suggest an interesting argument in phytogeographical studies on Andaman-Nicobar Islands as these islands might be a centre of origin of these species.

The tropical rainforests occurring in Andaman-Nicobar Islands is the last stronghold of pristine rainforests within the Indian territory, perhaps only exception being the slopes of the Western Ghats where it has been remarkably disturbed and degraded by human interventions (Figures 1–17). Andaman-Nicobar Islands obviously represents one of the richest repositories of insular biodiversity in the Bay of Bengal within a limited geographical area. The unique geographical location of this archipelago between the two major biodiversity



Figure 1.
Etlingera fenzlii – *Habit* (Great Nicobar Island, 2014).



Figure 2.
Etlingera fenzlii – *Inflorescence* (Great Nicobar Island, 2014).



Figure 3.
Etlingera fenzlii – Inflorescence (Kamorta Island, 2014).



Figure 4.
Etlingera fenzlii – Fruiting specimen (Great Nicobar Island, 2014).

areas (Indian Subcontinent and Malesian Islands) bestowed with an incomparable distribution of plant species with representatives of the Indian, Myanmarese, Thai, Malaysian and Indonesian floras. The flora of the Andaman group of islands shows closer affinity towards Indo-Myanmarese-Thai floras, while the Nicobar groups of islands demonstrates similarity towards the flora of Indonesia and Malaysia [2, 9].



Figure 5.
Etlingera fenzlii- single leaf (Great Nicobar Island, 2014).



Figure 6.
Orophea katschallica – Flowering specimen (Little Andaman Island, source, BSI, Port Blair 2014).

2. Materials and methods

The interrelationship between the Plant Kingdom and the Animal Kingdom is one of the intriguing subjects in vegetation dynamics, especially among isolated insular regions. The insular human population of the Andaman-Nicobar Islands



Figure 7.
Orophea katschallica – *Fruiting specimen* (Little Andaman Island, source, BSI, Port Blair 2014).



Figure 8.
Onge couple at settlement in Little Andaman Island (1994).

could be classified into ethnic tribes or original inhabitants, old settlers who came before Indian independence and the migrants after independence. The Andaman-Nicobar tribal groups (Great Andamanense, Jarawas, Sentinelese, Onges and Shompens) except Nicobarese (Nicobar Islands) could precisely be considered as the stakeholders of insular genetic diversity, since they are mostly depend on insular biodiversity for their livelihood. The native Negritude tribes of the Andaman Islands principally Jarawas, Sentinelese and Onges are rather hunter-gatherers, sustaining on wild or marine food resources and have practically no cultivation practice; Unlike the tribes of the Andaman Islands, the Nicobaries, the indigenous people of Car Nicobar, Katchal, Kamorta, Nancowry, Chowra etc. are maintaining some genetic diversity of cultivars in their native islands. The *Shompens* of Great Nicobar Island are semi-nomadic and mostly depend on wild resources for their livelihood; however, they have some crude forms in cultivation practice of wild

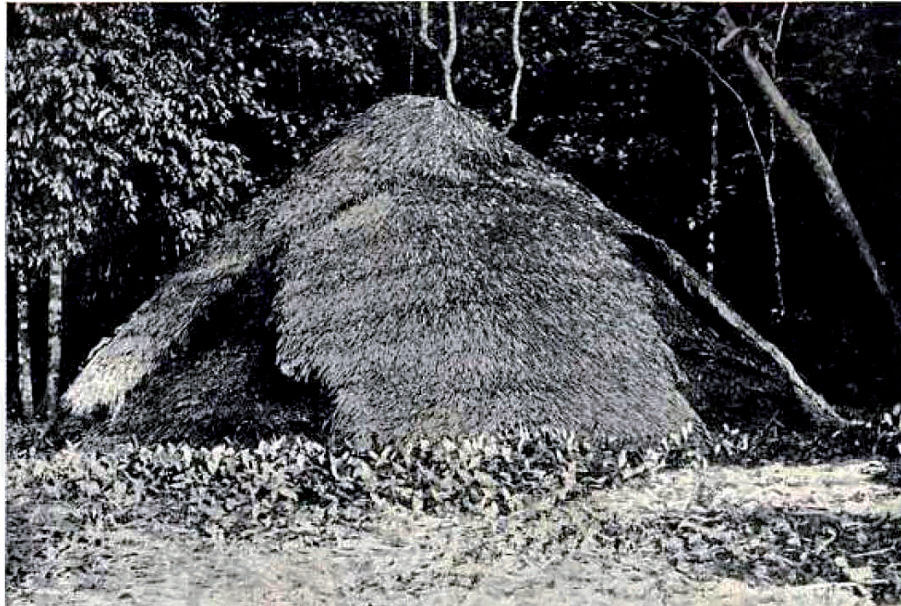


Figure 9.
An old photograph of an Onge hut (source Kloss C. Boden 1903).



Figure 10.
An Onge climbing on a tree for honey collection (source – PRD, A & N Administration 1980).

species like *Tacca leontopetaloides* (L.) Kuntze popularly known as ‘Nicobari aalu’. There are several interesting lesser known endemics used by these primitive insular aboriginals for their sustainable living. Honey bee repellent plants are one such group of insular endemics traditionally used by the insular aboriginals.

3. Insular wild honey bees: taxonomy and distribution

Apis creana Indica Fabricius, *Apis florae* Fabricius and *Apis dorsata* Fabricius are the three indigenous wild insular taxa of honey bees found to occur among the islands of Andaman-Nicobar Archipelago. The former two species usually nesting in cavities and have several combs while latter with open air single comb nesting habit generally on tall tree limbs and rock cliffs of the interior forests and rarely colonising on undisturbed building corners. *Apis creana Indica* is a subspecies of



Figure 11.
Shompen man along with a woman (Great Nicobar) source: Anthropological survey of India, Port Blair.

Apis creana spread across the Peninsular India, Sri Lanka, Thailand, Cambodia, Vietnam, Bangladesh, Myanmar, Andaman-Nicobar Islands, Indonesia, Malaysia and Philippines. This taxon is well demarcated with the smallest body size among the three. Geographical occurrence of *Apis florum* is reported from South Asia towards Southeast Asiatic regions and some warmer regions of the Middle East. This arthropod is rather frequent among the tropical forests, woods and sometimes in farming yards of Indian Subcontinent, Sri Lanka, Thailand, Andaman-Nicobar Islands, Indonesia, Malaysia and Philippines and has also been reported from Persian Gulf (warmer regions of Oman). *Apis dorsata* is a wide spread wild honey-bee species reported from South to Southeast Asian countries.

Apis dorsata is a major pollinating agent for several plant species of the Andaman-Nicobar rainforests as well as a remarkable source of natural forest honey. It is found that each colony of this species may yield 50 to 70 Kgs of honey in favourable season [12]. Forest honey has remarkable influence with the food habits of the various aboriginals of the Andaman-Nicobar Islands. Domestication of *Apis dorsata* is rather impossible owing to its aggressive nature, frequent migratory habit,



Figure 12.
Shompen lady along with her children (source – PRD, A & N Administration, 1980).



Figure 13.
Shompen hut (source Kloss C. Boden 1903).

quick temperedness etc. [13–15]. According to Koeniger [16] there are only two species viz. *A. mellifera* L. and *A. cerana* Fabricius under domesticated groups.

4. The ‘Giants’ or ‘Rockbees’: taxonomy and distribution

Apis dorsata Fabricius and *A. laboriosa* Smith are ferocious wild bees generally referred to as the ‘Giant’ or ‘Rockbee’ among the honeybees. *Apis dorsata* is with light orange brown or tawny body colour more frequent among interior insular forest habitats or infrequently establish on undisturbed shade walls and corners of old buildings in Andaman-Nicobar Islands. The nesting pattern is open air single-comb habit on tall tree limbs or rock cliffs, usually from 03 to 30 m above ground level. In Andaman-Nicobar Islands, generally the hives are nesting beneath horizontal limbs of insular tall trees such as *Dipterocarpus* spp., *Terminalia* spp., *Parishia insignis* Hook. f. etc. and sometimes more than 05 hives harbouring in a single tree. Large



Figure 14.
Apis dorsata – A Rockbee colony on building corner of BSI at Port Blair (2014).



Figure 15.
Apis dorsata – A close-up view of a Rockbee colony (2014).

hives are also being located in some islands on solitary tall trees along the open spaces (deforested areas) of the interior forests as well as along the forest edges and even at corners of buildings. One of such hives was noted by the senior author (SPM) during his tenure in Andaman's at one corner of the Botanical Survey of India building for about three years. The hanging single-comb nest may be as much as one meter in width. *Apis dorsata* is a migratory species with large hives comprising with population ranging from 25,000 to 80,000 bees [17]. The event of migration is solely correlated with seasons from rainy to winter and summer and said to be migrated towards far inter islands of the Andaman-Nicobar Archipelago up to 50 to 70 Km every year. The 'Rockbees' are extremely ferocious and well-known for its viciousness even to a minor disturbance. The huge mass of defending 'workers' can able to intruders for long distance of several kilometres through mark by their stings releasing the alarm pheromones *viz.* Isopentyl (3-methylbutyl) acetate [18]



Figure 16.
Apis dorsata – A view of a Rockbee colony formation at Mount Harriet (South Andaman, 2019).

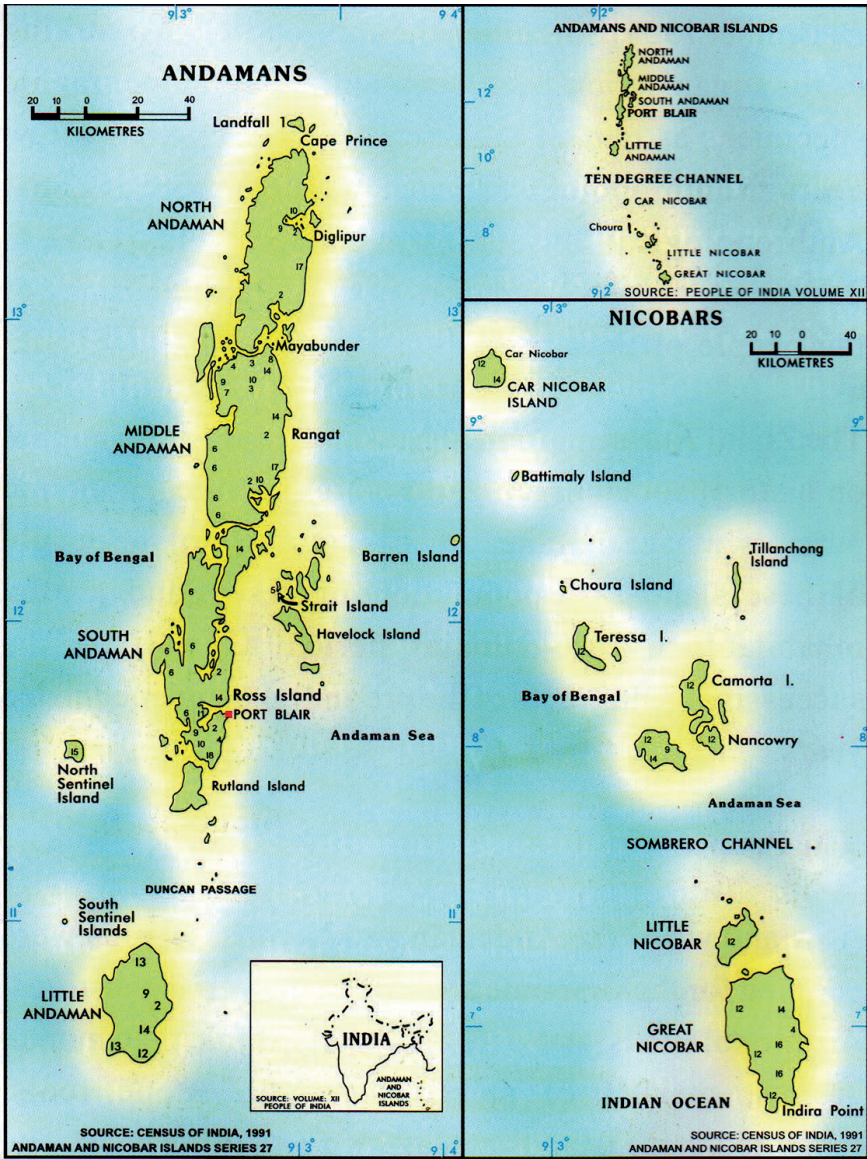


Figure 17.
Andaman–Nicobar Islands (source: Census of India, 1991).

and their massive assault may turn to be fatal for animals and even to human beings. Veith *et al.* [19] isolated a new alarm pheromone, *viz.* 2-decen-1-yl-acetate, from the stings of *Apis dorsata*. According to Veith *et al.* [19] a single sting may inject 06 μ g of this compound into the body of the prey. The worker group of *Apis dorsata* can fly even in night hours, if adequate moon light is available.

Apis dorsata is the well-known 'Giant Honeybee Proper' located along lower altitudes across South to Southeast Asia. According to one school of taxonomists, the taxonomical status of *Apis dorsata* is recognised with different subspecies, *viz.* *A. dorsata breviligula*, the Indonesian subspecies with short tongue, medium forewing length. *Apis dorsata binghami* found to occur from South to Southeast Asian regions with long tongue and long forewing [20]. *Apis laboriosa* Smith, the 'Himalayan Honeybee' found to distribute along higher altitudes from 1200 to 4000 m was originally described as a distinct species and currently treated as a subspecies of *Apis dorsata* as *Apis dorsata laboriosa* [21] based upon biological species concept. According to Arias and Sheppard [22], it is a distinct species based upon the genetic species concept with remarkable behavioural adaptations for nesting along high altitudes regardless of low ambient temperature. The organisation of Rockbee comb is similar to other species. Honey storage at the top portion of the hives, followed by pollen storage beneath and then worker brood and drone brood. The lower part of the hives generally referred to as 'mouth' of the colony where workers take-off and landing and communications on food sources by the scouts, takes place.

5. Onges and Shompens: the stakeholders of honey bee repellent plant species

The aboriginals of Andaman group of islands are Negritude race of 13 primitive tribes, mostly being extinct, and the remaining are collectively termed as 'Great Andamanese'. Currently, the indigenous people of Andaman group of islands are being classified into four groups, namely, the Great Andamanese, the Jarawa, the Onge and the Sentinelese. Interestingly, the indigenous people of Nicobar group, Nicobarese and Shompens belong to the Mongoloid race.

The Onges, presently around 100 in number on the road of extinction, are confined to within two pockets of the Little Andaman Island *viz.* Dugong Creek and South Bay. They were the semi nomadic people exclusively dependent on nature for their livelihood prior to amenities provided by the Andaman-Nicobar Administration. Even now, Rockbee honey is a delicious item in their food habits other than turtle, fish, tubers, jack fruits and screw pine fruits.

The Shompens are another primitive tribe living in Great Nicobar with two distinct divisions, the smaller division being designated as Coastal Shompens or Mawa Shompens inhabited East Coast of the island. They are very shy people; while the other group, designated as Forest Shompens, are rather hostile and are living in interior regions of Alexendra River and Galathia River areas and both groups are totally isolated with each other. According to Patnaik *et al.* [23], the segregation within the Shompen tribe as Forest Shompen and Coastal Shompen has been shown to exist on the basis of ecological analysis. The Forest Shompens are still exclusively depends on nature for their livelihood. Screw pine fruits and Rockbee honey are their staple food; while, the Mawa Shompens have a settlement provided by the Andaman-Nicobar Administration at Campbell Bay in Great Nicobar. The Forest Shompens occasionally barter Rockbee honey with East Coast Nicobarese for machetes and iron scraps useful for spear tips and knives.

6. Bee repellent insular endemic plant species

Two endemic plant taxa in Andaman-Nicobar Islands are reported as honey bee repellent species. *Orophea katschallica* Kurz, an endemic species belonging to the family Annonaceae is widely distributed from the Little Andaman Island towards the Nicobar group of Islands viz. Car Nicobar Island, Katchal Island, Kamorta Island, Great Nicobar Island. However, the natural distribution of the taxon is rather infrequent towards northern islands of the Andaman group beyond the Little Andaman. This taxon is originally described by Wilhelm Sulpiz Kurz in 1875 from Kactchal Island of the Nicobar group [24]. The type specimen is deposited at K! (Acc. No. K 000574819). Thoththari [25] was the pioneer who reported the ethno botanical use of *Orophea katschallica* by the Onges for honey collection from the wild Rockbee combs. Later Bhargava [26] stated the tranquillising property of *Orophea katschallica* on wild Rockbee. This species is known under different accents among Onges as *Toyoge* or *Tanjoge* or *Tonyoge* [27]. Interestingly, the insular honey-bee species was confirmed as *Apis dorsata* recently only in 1983 [28]. The traditional practice of Onges on gathering honey from the large Rockbee hives is very simple by chewing the leaves of *Orophea katschallica* and smears the juice mixed with their own saliva on their bodies just prior to climbing tree to get the hives. On reaching the tree limb where the hives are hanging, a coarse spray of juice mixed with saliva spits over the honey comb makes the wild bees get tranquillised and able to gather honey. Interestingly, they used to eat honey during gathering while on the trees has been observed by the authors.

As regards to the taxonomy of *Etlingera fenzlii* (Kurz) Škorničk. & M. Sabu, the species is originally described by Wilhelm Sulpiz Kurz in 1876 from Kamorta Island of the Nicobar group as *Amomum fenzlii* Kurz [7]. Later the taxon treated as *Hornstedtia fenzlii* (Kurz) K. Schum. and currently as *Etlingera fenzlii* (Kurz) Škorničk. and M. Sabu. Shompans are widely used this species for honey collection from the hanging combs of Rockbees by smearing the leaf juice over their body and chewing leaves and coarse spray of juice mixed with saliva by spits over the honey comb, as if the Onges are performing for honey collection. This species widely distributed in Great Nicobar Island and also found growing in Kamorta and Katchal Island of the Nicobar group. Recently, the extended distribution of this taxon is being recorded from the Mount Harriet Hill ranges of South Andaman's during an exploration in 2006 by the author [29].

Orophea katschallica Kurz is a small tree or a tree let with black coloured branches and oblong-lanceolate coriaceous leaves. Trimerous creamy yellowish flowers with triangular sepals and clawed petals cohering at apex. Stamens are 6 in numbers with broad connectives. Tricarpellary ovary, apocarpous. Fruits are linear beaded follicles. *Etlingera fenzlii* is around 03 m tall herbs with long linear oblong subcoriaceous to coriaceous leaflets. Inflorescence is arising from the rhizome. Flowers are light rose to deep Red in colour on maturity. The Great Nicobar specimens are with deep Red flowers while specimens from Kamorta Island are with light rose flowers. Living accessions of *Etlingera fenzlii* from Great Nicobar Island and Kamorta Island are conserving at the field gene bank of JNTBGRI as part of the studies on insect repellent species.

7. Result and discussion

The Onges and Shompens are two distinct ethnic indigenous dwindling communities of the Andaman-Nicobar Islands. The Shompens were constitutes one-sixth of the total indigenous insular population during remote past [30]. Curiously, the

present population of both communities are lower than 100 numbers of individuals and being endangered owing to various genetic and environmental reasons. Interestingly, the Shompen vernacular name of the species, *Etlingera fenzlii* has not been found in literature except in one article by Elancezhian *et al.* [31] where they referred to as 'hami'; however, the senior author during an exploration in Great Nicobar Island met with Mawa Shompens and gathered the vernacular name of the species with the help of a translator. The Shompen accent on this species name sounds like 'uijau-koaun'. In this context, it would also be relevant to mention that Shompens are also using this species for post-delivery care. This information was also collected from the Mawa Shompens during the Nicobar exploration. Rhizome and flowers are boiled with water and used to wash the uterus after child birth.

The terms 'honeybee repellent or insect repellent' is rather confusing with reality. In fact the active principles or phytochemical molecules from the plant extracts block the receptors of the insects or honeybees to detect the intruder's presence on their combs. Precisely, the phytochemical molecules act as 'bite preventing element' rather than 'insect repellent ingredient' and obviously, the efficacy varies with the quantity and quality of the active ingredients. The studies on *Etlingera fenzlii* carried out in JNTBGRI based on the traditional know-how of 'Shompen' tribe of the Great Nicobar Island unveiled that this endemic species having active components with insect 'repellent' properties towards worker bees and mosquitoes. On analysis, it is found that essential oil yield is remarkably high in leaves rather than rhizome. The chemical characterisation on essential oils of the species carried out proved that *Etlingera fenzlii* has effective 'tranquillizing' property towards insects. The essential oil extracted both from rhizome and leaves has a pungent odour obviously with quantitative and qualitative variations. The rhizome oil (0.02%) is yellowish while the leaf oil (0.4%) is colourless. Qualitative analysis by gas chromatography-out of the 98% components in the rhizome/leaf, 4 components has been identified *viz.* eugenol-14.864%, geraniol-29.41%, inalool-18.673% and methyl chavicol-41.094%. Twenty four essential oils including p-cymene, linalool and eugenol have proved to be effective repellents against worker bees and mosquitoes [32].

8. Conclusion

Insular habitats are of remarkable significance in conservation of global plant diversity, although they comprise only 5% of the total landmass of the world, approximately one quarter of all known extant vascular plants are endemic to insular habitats [33]. Apart from this, insular landmasses also have a remarkable function to the livelihood, economy and cultural diversity of 600 million islanders, approximately one-tenth of the present human population of the world [34]. The plant genetic resource (PGR) of the Andaman-Nicobar Islands ranges from sea weeds to several economically important higher plant species. It includes several endemics with promising economic values such as medicinal species used by primitive insular aborigines, wild occurrence of popular cultivars (coconut, betel nut, betel vine, etc.), wild relatives of popular cultivars (spice plants, rice, pluses, yams, aroids, fruit plants etc) landraces of cultivars (rice, coconut, betel nut, betel vine etc), timber yielding species (about 60 classified tree species), lesser known endemic insect repellent species (used by aborigines for honey collections), economically promising minor forest produce (canes, bamboos etc), endemic wild relatives of plantains (*Musa* spp.), economically important seaweeds etc. However, detailed floristic survey, evaluation and screening of economically valuable insular botanical entities of Andaman-Nicobar Islands are still remaining incomplete. Several insular medicinal species used by the aborigines of the Andaman-Nicobar

Islands for their health care have promising medicinal values and would certainly be rewarded in the field of modern medicines during the forthcoming decades. From taxonomic point of view, the geographical isolation encourages insular plants to have as much of variations as possible and exhibits remarkable degree of genetic variations within specific level. There are several insular species with minor variations on the way of become independent taxa.

Acknowledgements

The authors are thankful to all Forest officials of the Andaman Nicobar Administration at Port Blair and Great Nicobar Island for all logistic and manpower supports for exploration at Great Nicobar Island and also Dr. Rajan, Zoological Survey of India, Port Blair for all technical support during preparation of the manuscript. The authors also wish to record their sincere thanks to the Director, Anthropological Survey of India, Port Blair and Andaman-Nicobar Administration for providing rare old photographs of Onges and Shompens. The authors also would like to acknowledge Kerala State Council for Science Technology and Environment (KSCSTE) for financial assistance for the studies.

Author details

Sam Paul Mathew* and Raveendranpillai Prakashkumar
Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI),
Thiruvananthapuram, Kerala, India

*Address all correspondence to: sampmatthew@gmail.com

IntechOpen

© 2021 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Lekshminarasimhan, P. and P. S. N. Rao. A supplementary list of Angiosperm recorded (1983-1993) from Andaman and Nicobar Islands, India, Journal of Economic and Taxonomic Botany 20 (1996): 175– 185.
- [2] Mathew, S. P. A supplementary report on the flora and vegetation of the Bay Islands, India, 22 (1998): Journal of Economic and Taxonomic Botany 249 – 272.
- [3] Murugan C., S. Prabhu, R. Sathiyaseelan & R.P. Pandey. “A check list of plants of Andaman – Nicobar Islands. http://www.bsienviis.nic.in/Database/Checklist-of-Andaman-Nicobar-Islands_24427.aspx. (2016).
- [4] Pandey, R. P. and P. G. Diwakar. An integrated check-list flora of Andaman-Nicobar Islands, India. Journal of Economic and Taxonomic Botany 32. (2008): 403 – 500.
- [5] Vasudeva Rao, M. K. A preliminary report on the Angiosperms of Andaman-Nicobar Islands, Journal of Economic and Taxonomic Botany 8 (1986): 107 – 184.
- [6] Balakrishnan, N. P. & R. B. Nair. Wild populations of Areca and Cocos in Andaman Islands, Indian Journal of Forestry 2 (1979): 350-363.
- [7] Kurz, W. S. “A sketch of the vegetation of the Nicobar Islands”. Journal of Asiatic Society of Bengal. Pt 2 Nat. Hist. (1876): 45: 154. Pl. XII.
- [8] Mathew, S. P and S. Abraham: The vanishing palms of Andaman-Nicobar Islands, India. Palms 38 (1994): 100-104.
- [9] Mathew, S. P. On floristic diversity of Andaman-Nicobar Islands with special reference to insular germplasm conservation outside the islands. Abrahamia 3 (2017): 104-130.
- [10] Prain, D. The vegetation of the Coco group. Journal Asiatic Society Bengal 60 (1891) : 283-306.
- [11] Sreekumar, P. V. & J. L. Ellis. Six wild relatives of Betel vine from Great Nicobar, Journal Andaman Science Association 6 (1991):105-107.
- [12] Duta, T. R, R. Ahamed, S. R. Abbas and M. K. V. Rao. “Plants Used by Andaman Aborigines in Gathering Rock-Bee Honey Source”. Economic Botany. 39 (1985): 130-138.
- [13] Mishra, R. S, G. S. Dogra, and P. R. Gupta. An attempt to domesticate rock-bee *Apis dorsata*. Indian Bee Journal 39 (1977): 21.
- [14] Muttou, R. N. “Tree apiaries.” Indian Bee Journal 14 (1952): 87-89.
- [15] Thakar, C. V. “A preliminary note on hiving *Apis dorsata* colonies.” Bee World. 54 (1973): 24-27.
- [16] Koeniger N. “Interspecific competition between *Apis florea* and *Apis mellifera* in the tropics”. Bee World. 57 (1976): 110-112.
- [17] Reddy. Studies on the nest site selection by *A. dorsata* F. Ph.D Thesis. Bangalore University, pp: 205. (1988).
- [18] Morse, R. A, D. A. Shearer, R. Boch & A. W. Benton. “Observations on the alarm substance of the genus *Apis*.” Journal of Apicultural Research 6 (1967): 113-118.
- [19] Veith, H. J, Weiss, J and N. Koeniger. “A new alarm pheromone (2-decen-1-yl-acetate) isolated from the stings of *Apis dorsata* and *Apis florea* (Hymenoptera: Apidae).” Experientia 34 (1978): 423-424.
- [20] Gupta, R. K. Taxonomy and Distribution of Different Honeybee

- Species (in Rakesh Kumar Gupta Wim Reybroeck, Johan W. van Veen , Anuradha Gupta (eds.), DOI 10.1007/978-94-017-9199-1_2). 63-103. 2014.
- [21] Engel, M. S. The taxonomy of recent and fossil honeybees (Hymenoptera: Apidae; *Apis*). Journal of Hymenoptera Research 8 (1999):165-196.
- [22] Arias, M. C., and W. S. Sheppard. Phylogenetic relationships of Honeybees (Hymenoptera: Apinae: Apini) inferred from nuclear and mitochondrial DNA sequence data. Molecular Phylogenetics and Evolution 37(2005):25-35.
- [23] Patnaik R, G.P. Reddy and V. Sudersan. "An Ecological dimension to Ethnic identity: Forest and Coastal Shom Pen of the Great Nicobar Island." Proceedings of National Seminar on Man and Environment, Andhra University, Visakhapatnam. 1986.
- [24] Kurz, W. S. Description of new plants from the Nicobar Islands, Journal of Botany, London 13 (1875) :321-333.
- [25] Thothathri, K. "The 'tonyoge' plant of Little Andaman." Indian Forester. 92 (1966): 530-532.
- [26] Bhargava, N. "Ethnobotanical studies of the tribes of Andaman and Nicobar Islands, India. I." Onge. Economic Botany 37 (1983): 110-119.
- [27] Sharief, U. M. Plants folk medicine of Negrito tribes of Bay Islands. Indian Journal of Treditional Knowledge. 6 (2007): 468-476.
- [28] Zoological Survey of India (ZSI), Port Blair, personal communication, 2014.
- [29] Mathew, S. P, R. K Radha, P. N. Krishnan and S. Seeni. Phytogeography of Andaman-Nicobar Islands with special reference to *Hornstedtia fenzilii*. Current Science. 98 (2010): 905-907.
- [30] Das, H. H., and R. Rath. The land of coral beds: Andaman and Nicobar Islands. Aruna Printing Works, Orissa. 43-45. 1989.
- [31] Elancezhian, R, R. Rajamanickam, R. S. Kumar and M. A. Suryanarayna. "Ethnobotany of Shom Pens- A primitive tribe of Great Nicobar Island". Indian journal of Traditional Knowledge. 6 (2007): 342-345.
- [32] Garge, S, and Banerjee, A. K. Indian Perfumer. 41 (1997): 73-84.
- [33] Kreft, H., W. Jetz, J. Mutke, G. Kier, W. Barthlott. Global diversity of island floras from a macroecological perspective. Ecology Letters 11 (2008): 116-127.
- [34] Lutchman, I., B. Aalbersberg, D. Hinchley, G. Miles, A. Tiraa, S. Wells (2005): Marine Protected Areas: Benefits and Costs for Islands. WWF the Netherlands. <http://www.panda.org/coral> S.