Ethnobotany of Mountain Regions
Series Editors:
R. W. Bussmann · N. Y. Paniagua-Zambrana

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Ethnobotany of the Mountain Regions of Southeast Asia

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La Paz, Bolivia

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Ethnobotanical research in recent years has increasingly shifted into applied aspects of the discipline, including climate change research, conservation, and sustainable development. It has by now widely been recognized that "traditional" knowledge is always in flux and adapting to a quickly changing environment. Trends of globalization, especially the globalization of plant markets, have greatly influenced how plant resources are managed nowadays. While ethnobotanical studies are now available from many regions of the world, no comprehensive encyclopedic series focusing on the worlds mountain regions is available in the market. Scholars in plant sciences worldwide will be interested in this website and its dynamic content.

The field (and thus the market) of ethnobotany and ethnopharmacology has grown considerably in recent years. Student interest is on the rise, attendance at professional conferences has grown steadily, and the number of professionals calling themselves ethnobotanists has increased significantly (the various societies—Society for Economic Botany, International Society of Ethnopharmacology, Society of Ethnobiology, International Society for Ethnobiology, and many regional and national societies in the field currently have thousands of members). Growth has been most robust in BRIC countries.

The objective of this new series on Ethnobotany of Mountain Regions is to take advantage of the increasing international interest and scholarship in the field of mountain research. We anticipate including the best and latest research on a full range of descriptive, methodological, theoretical, and applied research on the most important plants for each region. Each contribution will be scientifically rigorous and contribute to the overall field of study.

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Editor

Ethnobotany of the Mountain Regions of Southeast Asia

With 418 Figures and 1 Table

Springer

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ISSN 2523-7489 ISSN 2523-7497 (electronic)
ISBN 978-3-030-38388-6 ISBN 978-3-030-38389-3 (eBook)
ISBN 978-3-030-38390-9 (print and electronic bundle)
https://doi.org/10.1007/978-3-030-38389-3

This Springer imprint is published by the registered company Springer Nature Switzerland AG.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Dedicated to the folk healers of Southeast Asia

Preface

Plants assume ethnobotanical importance only when they are associated with human societies. Use of plants as medicine, food, fodder, and cultural purposes all happen in specific cultural and landscape contexts. This is a major factor often ignored by biologists studying human-plant relationship. Touting a plant as an ethnobotanically important one without providing adequate information on the societies that use them, or the context of use, distorts the picture. Chapters included in this volume provide comprehensive information on the medicinal, food, cultural, and phytochemical values of selected plant species, along with the cultural context. Gleaning out these information from published literature was not an easy task as a good percentage of published articles merely mention the plant use without specifying the community and context of its use. Also, most literature do not provide an understanding on how plant use has changed over times. Our authors have taken extra care to ensure that these information are presented, wherever possible. Another highlight of this volume is that majority of our contributing authors are budding ethnobiologists. These youngsters are poised to emerge as torch bearers of ethnobiology in Southeast Asia, and the larger Asian continent. We hope that this volume would serve as an important reference material for academics, plant lovers, and members of local communities of Southeast Asia.

Acknowledgments

This volume took birth with an invitation from Rainer W. Bussmann and Narel Y. Paniagua-Zambrana, series editors of Ethnobotany of Mountain Regions. I thank both of them for providing me the opportunity to edit the volume and also the freedom to include sections on biocultural importance of the selected species.

I express my sincere gratitude to all individual authors who have contributed to this volume. However, I should specifically place on record the important role played by Anisatu Z. Wakhidah, a young ethnobiologist from Indonesia. Her entry into the project came at a time when we had suffered a major setback with a few authors dropping out. She had helped me network with other ethnobiologists from Indonesia. Without her, this project would have taken longer to complete.

For this volume, I had the privilege to work with an extremely efficient team at Springer Nature including Eric Stannard, Johanna Klute, and Sylvia Blago. The experience and patience of Johanna and Sylvia helped a lot in troubleshooting various unforeseen glitches that arose especially during the initial stages of the project.

Special thanks to D. Narasimhan, former professor of botany at Madras Christian College, Chennai, and Santhana Ganesan of Singapore Botanical Gardens for their moral support and encouragement.

I thank the Institute of Asian Studies at Universiti Brunei Darussalam for supporting me throughout this project. Though ethnobiology is an interdisciplinary subject, in Asia it is often considered as a part of the natural sciences due to the domination of a bioprospecting narrative. I am indebted to my home institute for appreciating the interdisciplinary value of this project and permitting me to work on this.

F. Merlin Franco

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Volume 2

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Cupressaceae

Ary Prihardhyanto Keim and Wawan Sujarwo

Synonyms

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Local Names

English: Papuan incense cedar; **Indonesia:** *sedar papua* (Standard Indonesian), *araum* (Karoon, Papua), *butaga* (Manikiong), *butayeka* (Manikiong), *duwak* (Kebar), *yuta* (Nairi, Watabung), *matu* (Kepauko), *nipau* (Kebar), *pomoan* (Manikiong), *sowa* (Kebar, Anjai), *sukou* (Wapi, Migote), *swa* (Anjai), *tera* (Garaina), *tuwa* (Kebar), *wonga* (arfak); **Papua New Guinea:** *ab* (Nega, Kepilam), *aiap* (Enga), *aip* (Enga), *autibo* (Kepauko), *bit* (Yogom), *dautie* (Kepauko), *dzagosa* (Asaro, Kefamo), *dzasihanini* (Asaro, Kefamo), *eis* (Karoon), *gagman* (Hagen, Togoba), *gamuga* (Hagen, Togoba), *hohoba* (Lei), *hap* (Enga, Kepilam), *iwunturra* (Manki), *kaibelkombam* (Wahgi, Minj), *kaipil* (Wahgi, Minj), *kamgenkuna* (Hagen, Togoba), *kap* (Enga, Kepilam), *mondalasap* (Mendi), *mondilasop* (Mendi), *ogeleh* (Chimbu, Masul), *oleh* (Chimbu, Masul), *ongol* (Wahgi. Minj), *urenak* (Mendi), *ye-enka* (Nauti).

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F. M. Franco (ed.), *Ethnobotany of the Mountain Regions of Southeast Asia*, Ethnobotany of Mountain Regions, https://doi.org/10.1007/978-3-030-38389-3_227

Botany and Ecology

Description: *Papuacedrus papuana* is an evergreen monoecious tree growing up to 35 to 50 m, trunk up to 1 m in diameter, tree height less than 10 m tall in subalpine scrub. Bark reddish brown and scaly at first, darkening with age. Crown pyramidal in youth but spreading, dome shaped, and with drooping branches in age. Shoots arranged in flattened, fern-like sprays with branchlets arising alternately or in opposite pairs more or less evenly on the front and rear of the parent side twigs. Lateral scale leaves up to 10–16 mm long in juveniles with the tip spreading to 3–6 mm, progressively smaller and tighter to the branchlet in more mature trees, down to 1 mm long in the most exposed adult foliage. Facial leaves much smaller and not changing as much in size with maturity, 1–3.5 mm long. Pollen cones 4–25 mm long, with 4–10 pairs or quartets of pollen scales. Seed cones 8–15 mm long, the seed scales often with fine radiating ridges extending from the bract tip. Triangular free tip of bract 1–2 mm long. Seeds 2–3 mm long, the larger wing extending straight out from the egg-shaped body by more than twice its width (Van Royen 1980; Farjon 1998, 2000, 2008; Eckenwalder 2009).

Phenology: *Papuacedrus papuana* flowers and fruits the whole year around. Keim et al. (2018) collected *P. papuana* with good seed cones and seed scales in the subalpine scrub around the vicinity of Lake Habbema at 3200 m altitude (Fig. 1).

Distribution and Habitat: *Papuacedrus papuana* is the sole extant member of the genus *Papuacedrus*. The other known species, such as *P. australis* (Tasmania; Hill and Carpenter 1991), *P. prechilensis* (Chilean Patagonia; Wilf et al. 2009), and *P. shenii* (Fossil Hill, King George Island, Antarctica; Zhou and Li 1994) are extinct. The distribution areas of *P. papuana* include New Guinea and the Moluccas, particularly Halmahera Island (Van Balgooy 1976; Van Steenis 1979; Van Royen 1980; Farjon 1998, 2000, 2008; Eckenwalder 2009). *Papuacedrus papuana* is found in the montane rainforests up to subalpine scrub mostly in highland New Guinea,

Fig. 1 Mature seed cone showing the seed scales open wide. (© Ary P. Keim)

Fig. 2 Habit of *Papuacedrus papuana* found in the vicinity of Habbema Lake, Jayawijaya at 3200 m altitude. (© Ary P. Keim)

where the species forms pure strands or mixed with other conifers and hardwoods mostly from 1500 to 3900 m altitudes (Van Royen 1980; Eckenwalder 2009). In highland New Guinea, the species is regarded as the marker of the subalpine vegetation (Van Royen 1980). In the vicinity of Habbema Lake in the Jayawijaya Range, *Papuacedrus papuana* is abundantly found in Subalpine Forest, especially in the Lower Subalpine Forest at 3200–3500 m altitudes, where the species forms widespread pure strands (Fig. 2) (Keim et al. 2018). In this vegetation type, *P. papuana* is also found cohabitant with other conifers such as *Phyllocladus hypophyllus* (Podocarpaceae), *Podocarpus brassii* (Podocarpaceae), and hardwood dicots such as *Nothofagus brassii* and *N. starkenborghiorum* (Keim et al. 2018); thus, in accordance with Van Royen (1980). The presence of the pure strand formation of *P. papuana* has also been noticed by Brass (1941a, b; see also Brass 2012) and Archbold et al. (1942). The scenery was photographed by Brass in 1938 (see De Laubenfels 1988) and is not significantly different with the situation observed by us during our visit to Lake Habbema in 2011 and 2014 (see Keim et al. 2018). Thus, at least in 2014, the pure strand formation of *P. papuana* was still generally well preserved. Keim et al. (2018) also observed the presence of *P. papuana* in the Subalpine Scrub (2400–3650 m altitudes). However, the population is mostly composed by individuals with height 3 m or lower, lower than the

population found in the Subalpine Forest, located side by side. *Papuacedrus papuana* can be found up to Subalpine Grassland at around 3200–4000 m altitudes with fairly tall individuals up to 5 m (Keim et al. 2018). The obvious presence of *P. papuana* in the Subalpine Forest of the Lake Habbema marks the species as the species marker of the subalpine vegetation in the vicinity. As the same phenomenon is also observed in many Lower Subalpine Forests in highlands New Guinea, *P. papuana* has been widely accepted as the marker species of subalpine vegetation zone throughout highland New Guinea (Hope 1976; Mangen 1993; Johns et al. 2007; Eckenwalder 2009; Kartawinata 2013; Keim et al. 2018).

Local Medicinal Uses

Indonesia: The Dani people of the Baliem Valley, Jayawijaya Range use the leaves and bark of *Papuacedrus papuana* for curing high fever, possibly caused by infection; the plant could be a potential source of antibiotic. Leaf or bark decoction is drunk, and fever is noticeably reduced by the following morning (personal observation). Although the leaves of *P. papuana* are also eaten by people in Watut and other places in the Eastern Highlands of Papua New Guinea (Powell 1976), there is no published information regarding the medicinal uses of the leaves.

Phytochemistry

Papuacedrus, together with other members of subfamily Callitroidea (genera *Libocedrus*, *Austrocedrus*, and *Pilgerodendron*), is characterized chemically by major amounts of amentoflavone and its 4"'-monomethyl ether, as well as trace amounts of hinokiflavone or its derivatives detectable by permethylation of the extract (Gadek and Quinn 1983). Being the sole member of the genus, *Papuacedrus* here refers to *P. papuana*. Markham et al. (1990) reported that *P. papuana* contains flavonoid 3-diglycosides in the form of quarcetin and myricetin. *Papuacedrus papuana* is also observed to contain other forms of flavonoids and bioflavonoids 3 and 4. The plant is also known to produce resin (Langenheim 2003). However, compared to other genera of Cupressaceae, the composition of resin from *Papuacedrus* is still largely unknown. It is suggested here that the resin of this species is likely in the form of oleoresin containing monoterpenes, the chemical substance found in majority of conifers (Springbob and Kutchan 2009). The species is also believed to contain the active compounds podophyllotoxin and deoxypodophyllotoxin, which are proven to be tumor inhibitors (Fitzgerald et al. 1957; see also Pan et al. 2009).

Fig. 3 The leaves of *Papuacedrus papuana*. (© Ary P. Keim)

Local Food Uses

Indonesia: The leaves of *P. papuana* (Fig. 3) are eaten as vegetables by the people of Watut and other places in Eastern Highlands of Papua New Guinea (Powell 1976). However, there is no such report from Baliem Valley, Jayawijaya Range. The Dani people of the valley do eat the leaves of *P. papuana*, but for medicinal and supernatural-related purposes only.

Biocultural Importance

Indonesia: *Papuacedrus papuana* is considered sacred by the Dani throughout the Baliem Valley and adjacent areas. They even consider *Papuacedrus papuana* as more sacred than *Phyllocladus hypophyllus* (the *sina* wood). This is apparently due to the conspicuous strong cypress-like aroma of the wood, rarity of the species, and sacred habitat where it is found (Lake Habbema). The timber is used for building

purposes and the bark is used for roofing (Van Royen 1980; Milliken 2006). Despite being a good source of building materials, the woods of *P. papuana* are very rarely used for building fences by the Dani people and have never been used for pigs' fences. According to the Dani, the wood of *P. papuana* is too sacred for building something that is not for humans (personal observation). The Dani also use the green wood for fuel and the smokes produced gives off little heat (Archbold et al. 1942). The smoke gives a good aroma that triggers a pleasant feeling that helps them to better sleep; thus, the smoke could act as sedatives (personal observation). The resin (see Langenheim 2003; Boer et al. 2005) is also harvested by the Dani and traditionally used as incense. It is also used in healing rituals as well as other magic. The resin is burnt and the smoke is blown over patients, accompanied with specific chants. We observed that even the Javanese who live in Wamena (the capital of Jayawijaya Regency) also use the resin in their traditional rituals (including healing rituals), possibly as a substitute for the traditional Javanese incense.

Economic Importance

Indonesia: The wood of *P. papuana* is highly prized by the Dani and mainly used for constructing houses (Purwanto and Walujo 1992; Arobaya and Pattiselanno 2007). Despite being a fairly light wood (with density of 0.37 g/cm^3; see Soewarsono 1965; Reyes 1992; Lemmens 1995), the wood of *P. papuana* is regarded as one of the highly demanded building materials in highlands New Guinea and has been massively harvested (Van Royen 1980). Fortunately, the population in the subalpine forest near Habbema Lake is still preserved well according to last exploration made in 2014 (Keim et al. 2018). Keim et al. (2018) recorded the evidence of massive illegal logging of *Papuacedrus papuana* that has followed the development of the Trans Papua highway through the vicinity of Lake Habbema. The 2013 IUCN status of Near Threatened accorded to *Papuacedrus papuana* (Thomas 2013) might have to be revised. As with many other tropical montane conifer genera, *Papuacedrus papuana* is not found in cultivation, except in some botanical collections, and no cultivar selection has taken place (Eckenwalder 2009).

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