



DEVELOPING CONSERVATION HORTICULTURE AND CONSERVING THREATENED HIBISCUS SPECIES IN THE ASIA-PACIFIC ISLANDS REGION

PENGEMBANGAN KONSERVASI HORTIKULTURA DAN KONSERVASI SPESIES HIBISCUS YANG TERANCAM DI KEPULAUAN ASIA-PASIFIK

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Dikirim: 13 Oktober 2020; Disetujui : 02 November 2020; Diterbitkan: 10 Desember 2020

DOI: [10.47039/ish.2.2020.125-134](https://doi.org/10.47039/ish.2.2020.125-134)

Abstract

The objective of this study is to ensure the conservation of iconic Hibiscus species in the Asia-Pacific Islands region through collaborative action. Almost all of the 23 species of Hibiscus in section Lilibiscus are rare and restricted or critically endangered in nature. The study focussed on establishing the status of horticulturally important and newly discovered Hibiscus species in Indonesian New Guinea and Vanuatu through field surveys. The species have been conserved in ex situ conservation collections and capacity has been built within local partners to collect, propagate and conserve Hibiscus species. Field surveys and ex situ conservation activities will inform the development of conservation action plans for Indonesian and Pacific Islands Hibiscus species by regional stakeholders.

Keywords : ex situ conservation, *hibiscus rosa-sinensis*, lilibiscus, Manokwari, parental species, vanuatu.

Inti Sari

Tujuan dari studi ini adalah untuk memastikan konservasi spesies ikonik Hibiscus di kawasan Asia-Pasifik melalui aksi kolaboratif. Hampir semua dari 23 spesies Hibiscus di bagian Lilibiscus langka dan terancam punah di alam. Studi ini difokuskan pada penetapan status penting secara hortikultura dan spesies Hibiscus yang baru ditemukan di Indonesia dan Vanuatu melalui survei lapangan. Spesies telah dikonservasi dalam koleksi konservasi ex situ dan kapasitas telah dibangun dengan mitra lokal untuk mengumpulkan, memperbanyak dan mengkonservasi spesies Hibiscus. Survei lapangan dan kegiatan konservasi ex situ akan menginformasikan pengembangan rencana aksi konservasi untuk spesies Hibiscus Indonesia dan Kepulauan Pasifik oleh pemangku kepentingan regional.

Kata Kunci: Konservasi ex situ, *hibiscus rosa-sinensis*, Lilibiscus, Manokwari, parental species, Vanuatu.

I. INTRODUCTION

There are approximately 23 species of Hibiscus in section Lilibiscus (Linnaeus, 2008), they are mostly found on mid-ocean islands in the Indian and Pacific Oceans (Bates, 1965). Almost all of the Lilibiscus species are rare and restricted in nature and/or critically

endangered (IUCN Standards and Petitions Committee, 2019). The study aims to identify wild populations and target conservation of the following species in the Asia-Pacific Islands region: *Hibiscus rosa-sinensis* (Papua, Indonesia), 'Santo Hibiscus' (an undescribed species from West Coast Santo, Vanuatu), and Fijian Hibiscus species in Section Lilibiscus,

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including *H. bennettii*, *H. bragliae*, *H. macverryi* and *H. storckii* (larger islands in the Fiji Archipelago). The wild origins of the highly ornamental *H. rosa-sinensis* and *H. cooperi* are still unknown (Sampath, 2014; Van Houtte, 1845). The earliest known illustration of *H. rosa-sinensis* is from 1609 in Japan (Figure 1).



Figure 1. *H. rosa-sinensis*. From Mouri Umezono Gardens 1798-1851 "Umezono bushiki flower". From Fuso (bush gauge) 1609 which was Presented to Sunpu from Shimadzu Kamihisa

It is widely considered that the ancestors of Polynesians - known as Lapita people - originated in Taiwan, and migrated through Southeast Asia into the South Pacific. Lapita people likely collected *H. rosa-sinensis* during their migration and transported it throughout the Pacific Islands more than 3,000 years ago. Based on several lines of evidence, including botanical specimens from Indonesia, it is considered that both *H. rosa-sinensis* and *H. cooperi* are native to eastern Indonesia (Teijsmann, 1876). Both species are almost certainly rare and restricted in nature. As pure species in cultivation, *H. rosa-sinensis* and *H. cooperi* are disappearing due to cultivation of hybrids, and they are urgently in need of ex-situ conservations measures in botanic gardens.

Fiji has only recently been identified as a centre of diversity for Lilibiscus in the South Pacific Islands, with four species (three new) being recognised (Ash, 1987; Thomson & Braglia, 2019). Recently an apparently undescribed species of Hibiscus has been found in a garden on Santo, and the Vanuatu, forest botanist has confirmed this species occurs naturally on the West Coast of Santo (Figure 2). The new Vanuatu species appears to be involved in the ancestry of three of the Fijian species.

The study works, in the Pacific regions, i.e. Papua and Vanuatu, to identify and prioritise Hibiscus species for conservation action, build Hibiscus conservation capacity and secure threatened Hibiscus species from the threat of extinction. Also, to raise awareness of Hibiscus conservation needs amongst local populations. The objectives of this study are contributing new knowledge on the status of wild Hibiscus species in the SE Asia-Pacific Islands region, creating ex situ conservation collections and encouraging in situ conservation of threatened Hibiscus species in botanic gardens and protected areas, developing a conservation action plan for Pacific Hibiscus incorporating in situ and ex situ conservation strategies.



Figure 2. *Santo Hibiscus* sp. Nov.

II. METHOD

The areas surveyed were the Papua (Manokwari, Sorong, Sentani, and Jayapura), and Vanuatu (Santo, and the southern islands of Tanna and Erromango). The Vanuatu study area is also identified in the Critical Ecosystem Partnership Fund as key biodiversity hotspot land areas. The range elevation of the study area is between 10 and 700 m altitude.

Rapid inventory using the road transect method, where we observed and took photos of the several Hibiscus species, and collected some cuttings (Jarvis, 2007). We also consulted with local partners to gather information on wild Hibiscus in Papua, Vanuatu and other Pacific

Islands. The obtained data were analysed using quantitative descriptive approach and presented in tables and figures.

III. RESULTS AND DISCUSSION

A. Encouraging In situ and Ex situ Conservation of the Species in Native Habitats

a) Papua

Surveys were conducted on the island of Papua, Indonesia to locate Hibiscus species and assess the status in the wild, particularly of *H. rosa-sinensis*. We surveyed in Manokwari, Sorong, and Sentani, Jayapura using the road transect method. The study documented 26 Hibiscus taxa (Table 1), including potential hybrids, and collected more than one hundred cuttings (for each taxon 12 cuttings were made). The Hibiscus species which was found in front of local people's house in Manokwari, is suspected to be parental of *H. rosa-sinensis* based on petals' dimensions and colour (Figure 3), further study is needed, i.e. DNA analysis. To the best of our knowledge and based on information obtained from the local people, these Hibiscus do not grow wild in the forests (personal observations), the people of Papua cultivate Hibiscus spp. in front of their houses, home gardens and backyards as an ornamental plant.

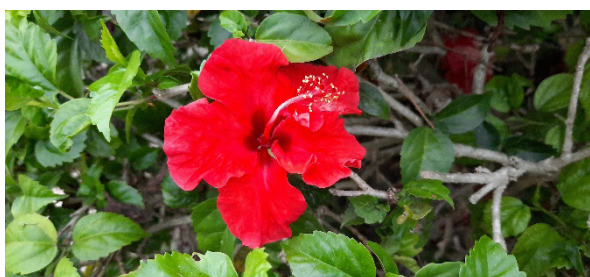


Figure 3. Hibiscus Found in Manokwari Suspected to be Parental Linage of *H. rosa-sinensis*

b) Vanuatu


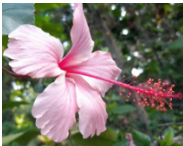

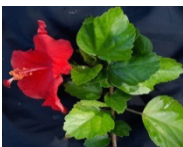

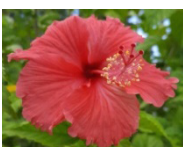
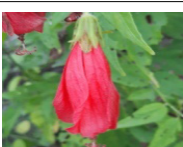


We also visited Vanuatu to meet with our local partner, Chanel Sam (forest botanist), to liaise about planned fieldwork on West Coast Santo. The aim of the fieldwork in Santo was to further document a wild species of Hibiscus that Sam had seen during a botanical expedition in a remote and unrecorded location





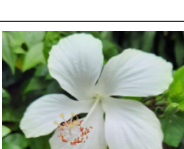
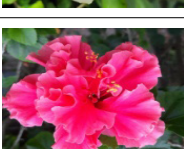
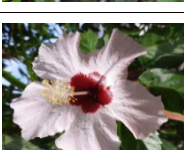
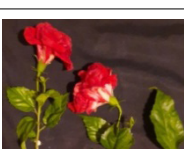
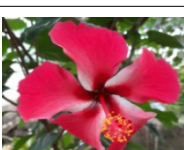
of West Coast Santo many years previously. The Hibiscus was growing in a remote and unrecorded location of West Coast Santo, and a specimen was not collected because all plants were sterile, and Sam had been under the impression that Hibiscus in this section were all introduced into the Pacific Islands. As part of this study, Sam surveyed along West Coast of Santo between Linduri and Vunavai villages. The limited time, expansive area to cover and recent impact by Tropical Cyclone Rita greatly impacted the ability to thoroughly survey for the 'Santo' species. The surveys revealed three types of Hibiscus that the Santo villagers refer to as "local" in the West coast Santo. These are Hibiscus 'Pysche' (a common hybrid in all villages) (Figure 4), Hibiscus 'El Capitolio' (a Melanesian selection of *H. rosa-sinensis*; present in a few villages) (Figure 5), and *H. rosa-sinensis* (double-petal form found at Tasmate and Luganville) (Figure 6). No specimens of the putative new species of West Coast Santo Hibiscus were found growing in the villages visited, which indicates the species is rare in the wild and will be difficult to locate without further major effort. The assessment result showed three types of Hibiscus that the Santo villagers refer to as "local" in the West coast Santo (Figures 2, 3, 4).



Figure 4. Hibiscus 'Pysche' (a common hybrid in all villages)

Table 1.
Hibiscus Taxa Documented in Papua

No.	Names		Pictures	Plant material	Location	Habitat and GPS
	Genus	Species				
1	Hibiscus	Hybrid 'Pysche' (<i>H. rosa-sinensis</i> x <i>H. schizopetalus</i>)		12 cuttings	Manokwari	Open area -0.865461, 134.060195 Elev. 16 m asl.
2	Hibiscus	Hybrid 'albolacinatus' (<i>H. arnotiannus</i> x <i>H. schizopetalus</i>)		12 cuttings	Manokwari	Open area -0.856971, 134.071769 Elev. 9 m asl.
3	Hibiscus	<i>rosa-sinensis</i> 'double'		12 cuttings	Manokwari	Open area -0.856971, 134.071769 Elev. 9 m asl.
4	Hibiscus	Unknown hybrid		12 cuttings	Manokwari	Open area -0.856971, 134.071769 Elev. 9 m asl.
5	Hibiscus	Hybrid 'Sprinkle rain' (<i>H. cooperi</i> x <i>H. schizopetalus</i>)		12 cuttings	Manokwari	Open area -0.856971, 134.071769 Elev. 9 m asl.
6	Hibiscus	Hybrid 'Pysche' (<i>H. rosa-sinensis</i> x <i>H. schizopetalus</i>)		12 cuttings	Manokwari	Open area -0.864904, 134.077259 Elev. 40 m asl.
7	Hibiscus	Hybrid (<i>H. cooperi</i> x <i>H. rosa-sinensis</i>)		12 cuttings	Manokwari	Open area -0.864904, 134.077259 Elev. 40 m asl.
8	Malvaviscus	Arboreus		12 cuttings	Manokwari	Open area -0.876555, 134.085353 Elev. 12 m asl.
9	Hibiscus	Schizopetalus		12 cuttings	Manokwari	Open area -0.876555, 134.085353 Elev. 12 m asl.
10	Hibiscus	Unknown hybrid		12 cuttings	Manokwari	Open area -0.876555, 134.085353 Elev. 12 m asl.

No.	Names		Pictures	Plant material	Location	Habitat and GPS
	Genus	Species				
11	<i>Hibiscus</i>	Unknown hybrid		12 cuttings	Manokwari	Open area -0.898407, 134.043278 Elev. 36 m asl.
12	<i>Hibiscus</i>	Hybrid with <i>H. cooperi</i> as the ancestor		12 cuttings	Manokwari	Open area -0.898407, 134.043278 Elev. 36 m asl.
13	<i>Hibiscus</i>	sp. 'Java Pink'		12 cuttings	Manokwari	Open area -0.898407, 134.043278 Elev. 36 m asl.
14	<i>Hibiscus</i>	Unknown hybrid		12 cuttings	Manokwari	Open area -0.900511, 134.038087 Elev. 4.5 m asl.
15	<i>Hibiscus</i>	Hybrid 'white dainty' (<i>H. schizopetalus</i> x Hawaiian white species)		12 cuttings	Manokwari	Open area -0.931255, 134.007124 Elev. 25 m asl.
16	<i>Hibiscus</i>	Hybrid complex 'lander-sii' or 'Pride of Hankins'		12 cuttings	Manokwari	Open area -0.931255, 134.007124 Elev. 25 m asl.
17	<i>Hibiscus</i>	<i>rosa-sinensis</i>		12 cuttings	Manokwari	Open area -0.890736, 134.051458 Elev. 34 m asl.
18	<i>Hibiscus</i>	<i>bennettii</i> 'pale'		12 cuttings	Manokwari	Open area -0.890736, 134.051458 Elev. 34 m asl.
19	<i>Hibiscus</i>	<i>rosa-sinensis</i> 'double'		12 cuttings	Manokwari	Open area -0.837533, 133.994498 Elev. 52 m asl.
20	<i>Hibiscus</i>	'Pink versicolor'		12 cuttings	Sorong	Open area -0.891184, 131.315568 Elev. 6 m asl.

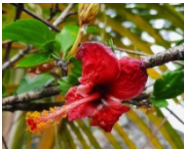





No.	Names		Pictures	Plant material	Location	Habitat and GPS
	Genus	Species				
21	<i>Hibiscus</i>	<i>rosa-sinensis</i>		12 cuttings	Sentani Jayapura	Open area -2.567681, 140.522570 Elev. 98 m asl.
22	<i>Hibiscus</i>	Hybrid complex 'lander-sii' or 'Pride of Hankins'		12 cuttings	Sentani Jayapura	Open area -2.608166, 140.623560 Elev. 82 m asl.
23	<i>Hibiscus</i>	Hybrid complex 'lander-sii' or 'Pride of Hankins'		12 cuttings	Sentani Jayapura	Open area -2.675287, 140.587258 Elev. 98 m asl.
24	<i>Hibiscus</i>	Unknown hybrid with <i>H. schizopetalus</i> as parent		12 cuttings	Sentani Jayapura	Open area -2.602821, 140.527445 Elev. 81 m asl.
25	<i>Hibiscus</i>	<i>bennettii</i> 'pink'		12 cuttings	Sentani Jayapura	Open area -2.580122, 140.551842 Elev. 81 m asl.
26	<i>Hibiscus</i>	sp. 'Java Pink'		12 cuttings	Sentani Jayapura	Open area -2.520368, 140.732795 Elev. 13 m asl.



Figure 5. *Hibiscus* 'El Capitolio' – a Melanesian selection of *H. rosa-sinensis* (present in a few villages)



Figure 6. *H. rosa-sinensis* (double-petal form found at Tasmate and Luganville)

The survey was timed to coincide with a sandalwood meeting, as which we also met with sandalwood cutters and growers from throughout the Vanuatu archipelago (including Santo and the southern islands of Tanna and Erromango). Sandalwood cutters are invariably the best sources of local information on wild Hibiscus in Vanuatu (and other Pacific Islands) as they scour more open forests in remote areas in search of sandalwood, i.e. these include areas away from tracks that are distant from villages and gardens. We further consulted with local sandalwood cutters to gather information on wild Hibiscus in Vanuatu and other Pacific Islands. In addition to gathering information on cultivated individuals of Hibiscus from Fiji (e.g. *H. bennettii* and *H. macverryi*) in Vanuatu, discussions revealed the occurrence possibly of wild *H. cooperi* growing on the island of Erromango. This may be the first record of *H. cooperi* in the wild and provides valuable information about the species and its potential connection to other Hibiscus species and hybrids in the region (Coiffier, 2012).

We visited several villages along the west Coast of Tanna from Lenakel to the northern tip of the islands. We also met with the High Chief Willy Lope (for Tanna, local name Tanouta) and other community leaders. Chief Willy said he described that there were native red-flowered Hibiscus (having seen them in his youth) growing in remote locations on Tanna: He tried to organise collections but this was not possible in the short time available. During the field visit to Tanna, we observed two of the endemic Fijian Hibiscus species (*H. bennettii* and *H. macverryi*, Figures 7 and 8, and two early cultivars Figures 9 and 10). We were informed that they had been growing these Hibiscuses for a very long time and think it likely that these are ancient, pre-European introductions from Fiji to Vanuatu (Florence, 2004).

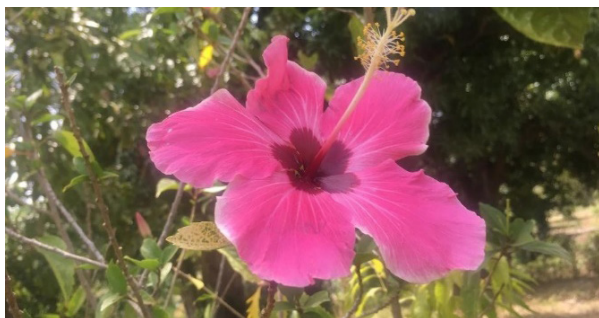


Figure 7. *H. bennettii* (Village garden, Tanna). An Ancient Introduction from Fiji where it is an Endemic Species



Figure 8. *H. macverryi* (Village garden, Tanna). An Ancient Introduction from Fiji where it is an Endemic Species



Figure 9. *H. rosa-sinensis* (flore pleno) (Village garden, Tanna). Likely a Prehistoric Hybrid between *H. cooperi* and *kaute* Hibiscus

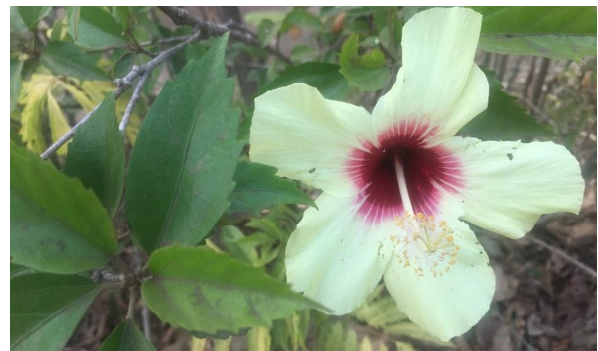


Figure 10. Hibiscus 'Fiji Tiare' (Village garden, Tanna). Most Likely a Prehistoric Hybrid from Vanuatu or Fiji, involving *H. cooperi* and *H. bragliae*, but Further Research may Prove it to be a Wild Species

We also observed plants of *H. cooperi* (Figures 11 and 12) growing in several village gardens, and two of the sandalwood cutters from Erromango informed that this species was wild in remote, interior parts of Erromango.

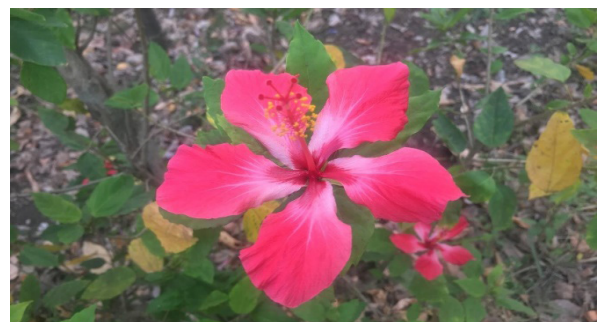


Figure 11. *H. cooperi* – Village Garden, Tanna



Figure 12. *H. cooperi* – Showing Developing Fruit Village Garden, Tanna

Our local partner, Mr. Joe Rungu, ventured into the interior forests near Port Narvin, Erromango and photographed the endemic nendrap (*H. cooperi*) for the first time (Figure 13). Joe stated that ‘I do not know how and why but some grow even deeper inland and much higher up the mountain where the Digicel tower is’. We sometimes come across this nendrap deeper inland in darker forests. There is another one similar to the one we posted but more red in colour. It appears that in pre-European times that Hibiscus species were exchanged between Fiji and Vanuatu (Coiffier, 2012; Thomson and Braglia, 2019). A pink form of nendrap likely came from Vanuatu to Fiji in prehistoric times and is known as ‘Naselai Pink’. This form went to Hawai’i and then to Royal Botanic Gardens Kew where it was wrongly named as *H. storckii* and creating considerable confusion amongst Hibiscus growers (Phillips, 1990).

B. Creating Ex situ Conservation Collections of Rare and Threatened Hibiscus in Botanic Gardens

1) Collection of Propagation Material

The cuttings of Hibiscus collected during the field trips in Papua were propagated at three Indonesian Botanical Gardens: Bali BG, Cibodas BG, and Purwodadi BG. Herbarium vouchers for each collection were deposited at Purwodadi BG. These individuals will become part of the conservation collections at these gardens. After several months in the nursery

the individuals are growing new leaves and thriving in the nurseries (Figure 14).



Figure 13. The First Images of *H. cooperi* Photographed in the Wild, Near Port Narvin, Erromango



Figure 14. Hibiscus Cuttings after Several Months’ Growth in the Nursery

Cuttings of Hibiscus growing on West Coast Santo were made and are being grown by Mr. Oliver Joshua, a Hibiscus grower in Port Vila. Future observation of the flowers will allow confirmation of the identity of the species and comparison with the species of “local” Santo, Vanuatu Hibiscus types described above.

2) Propagation Trials and Conservation Collections

The cuttings collected in Papua have been propagated very easily. Seeds were not available for collection at the time of the survey however, seeds of Hibiscus species should be collected

during future fieldtrips, and deposited in seed banks of the Indonesian Botanic Gardens. Hibiscus species are very popular ornamental plants in Indonesia, especially in the eastern parts of the country. The flower of Hibiscus has a strong cultural value, for example in ceremonial use, etc. (Sujarwo et al., 2020). Due to the ease of propagation via cuttings, the species. To develop conservation collections of threatened species of Hibiscus in the future, genetic representation and collection of seed should be key priorities. Bali and Cibodas Botanic Gardens are now housing Hibiscus collections of diverse species and hybrids collected as cuttings during the field surveys. These collections can be used for conservation research and education.

We have had success selfing the form of *H. rosa-sinensis* known as 'Fulgens'. The propagation of this form is providing information about the lineage of this species. The seedling leaves are rather elongated and with no or very few small teeth which suggests it is throwing back towards *H. cooperi*, one of the putative parents of *H. rosa-sinensis* (Braglia et al., 2010; Hochreutiner, 1900).

C. Contributing New Knowledge on the Status of Wild Hibiscus Species in the SE Asia - Pacific Islands Region

IUCN Red List conservation assessments were drafted for three species: *H. bragliae*, *H. bennettii* and *H. macverryi*. The species were assessed using data from recent and up-to-date field work, under the IUCN Red List criteria (IUCN, 2016). In collaboration with the BGC Red List team, we have reviewed the assessments and they have been submitted to the IUCN. These assessments will be used to highlight the urgent conservation needs and address priorities for the future conservation action of these species. Assessments for other project target species will be completed as more information on origin, wild distribution and status become available through additional field surveys and genetic study.

Hibiscus bragliae (Critically Endangered): The known population of *H. bragliae* is predicted to be less than 250 mature individuals and the species is highly restricted to a single island, Ovalau in Fiji. The species' habitat is

increasingly threatened by extreme climatic events, especially severe tropical cyclones and invasive species as well as infrageneric hybridization threaten the species.

Hibiscus bennettii (Critically Endangered): The very small population of only four individuals (likely now only two remain post Cyclone Winston) of *H. bennettii* is known from a single location on Vanua Levu in Fiji. The species is threatened by increasingly intense and frequent weather events such as cyclones which will impact its habitat and the existing mature individuals.

Hibiscus macverryi (Critically Endangered): The species is assessed as Critically Endangered due to its small population size (likely < 250 mature plants in the wild), restricted distribution— known with certainty from only four localities, two each on Taveuni and on Vanua Levu - and with major threats from extreme climatic events, especially severe tropical cyclones and flash flooding, invasive weeds, and from hybridization with other Hibiscus species.

IV. CONCLUSION

Discussions with local partners have identified that training in the conservation of Hibiscus and other woody species is a key future activity. Delays in developing a conservation action plan for Asia-Pacific Hibiscus have occurred as a lack of understanding of the origins, distributions and status of species in the region limit the ability to identify clear action plans for threatened species. Further clarification of the status of these species in the wild and their conservation needs as well as identification of regional expert leaders in Hibiscus conservation will help to move towards the development of conservation action plans. The future workshop planned will be an important opportunity to develop and implement plans in Indonesia for conservation with key conservation partners.

ACKNOWLEDGEMENT

The authors would like to thank to the Keidanren Nature Conservation Fund (KNCF) for financing this study. Also, we would like to thank to the people in our study areas and all team members for their support, assistance during the surveys, and anonymous reviewers.

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