

## NOTES

### *Halodule pinifolia* in the Palau Islands (Belau)

Nine species of seagrasses have been reported previously from the Micronesian region. Six species, *Halodule uninervis*, *Cymodocea rotundata*, *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila minor* and *Halophila ovalis* had been reported by various authors (Fosberg, 1955, 1961, 1976; Moul, 1957; den Hartog, 1970; Stone, 1971; Sachet and Fosberg, 1973) and three species, *Syringodium isoetifolium*, *Thalassodendron ciliatum* and *Cymodocea serrulata* were reported for the first time by Tsuda et al., (1977). The addition of *Halodule pinifolia* (Miki) den Hartog to the seagrass flora of the Palau Islands increases the total number of seagrasses reported in Micronesia to ten.

At the time Tsuda et al. (1977) evaluated the distribution of seagrasses in Micronesia, *H. pinifolia* had not been reported for any of the islands or atolls. In 1978, Joyce Vann Basilius, a Peace Corps volunteer in the Office of the Chief Conservationist for the Trust Territory of the Pacific Islands, sent me a narrow-leaved *Halodule* from the west coast of Babelthaup (Babeldaop), the largest of the Palau Islands. She reported that the seagrass was rare but occurred with *Halophila ovalis* and *Halodule uninervis* in a shallow bay. She attempted to find additional stands but her work with the Peace Corps ended shortly after the initial collection was made. John and Nancy Ogden (personal communication, 1979) studied the seagrasses in Palau, primarily in the vicinity of Malakal Channel, in June 1978 but did not find any narrow-leaved *Halodule*.

J. V. Basilius and I had collected seagrasses in various parts of the Palau Islands in March 1977. We collected *Halophila ovalis*, *Cymodocea rotundata* and *Thalassia hemprichii* at Kayangel (Ngcheangel), an atoll north of Babelthaup and *Cymodocea serrulata*, a first collection for Palau reported in Tsuda et al. (1977), on the east side of Urukthapel (Ngeruktabel) with *Halodule uninervis* and *Enhalus acoroides*. We collected *Halophila ovalis*, *Halodule uninervis*, *Thalassia hemprichii* and *Enhalus acoroides* in the vast seagrass beds of Malakal Channel and in Iwayama Bay, Koror. We observed the seagrass beds along the west coast of Babelthaup while enroute to Kayangel and noted

extensive stands of *Enhalus*. We examined the *Enhalus-Thalassia* stands on the north end of Babelthaup at Konre. In the latter part of 1977, Basilius further explored the west coast of Babelthaup where she found unreported stands of *Cymodocea serrulata* and *Thalassodendron ciliatum* as well as *Syringodium isoetifolium* (personal communication, 1978). She recognized the narrow-leaved seagrass on the west coast of Babelthaup as different from anything she had observed previously in the Palau Islands and sent the specimen to me for identification.

The Palau specimen:

Ngetpang Bay, west coast of Babelthaup, very scarce on muddy silt substrate, in estuarine bay, growing together with *Halodule uninervis* and *Halophila ovalis*, 1 December 1977, J. E. Vann Basilius 115, (TEX),

has narrow leaves 0.5–0.6 mm wide, with rounded serrulate tips typical of *H. pinifolia*. The leaves are 12–14 cm long. The herbarium specimen has been compared with living cultures of *H. pinifolia* from Thursday Island, Queensland, Australia and from Suva, Fiji and is well within the range of variation for the species. We have found that the leaf tips of *H. pinifolia* are variable in experimental cultures and that leaves on the same short-shoot can be either tridentate or serrulate (McMillan et al., in press). In contrast, the broad-leaved plants of *Halodule uninervis* from Palau have consistently produced wide leaves during more than three years in experimental cultures under growth chamber conditions. The Palau plants have continued to produce leaves that are 2.5–3.5 mm wide and tridentate leaf-tips with a rounded median tooth. These wide-leaved plants from Palau and from Thursday Island, Queensland, have isozyme systems and secondary compounds that differ from those of *H. pinifolia* from Queensland (McMillan et al., in press). Insufficient material was available for *H. pinifolia* from Palau for culture or for chemical comparisons.

The status of narrow- and wide-leaved forms of *H. uninervis* as treated by den Hartog (1970) is uncertain. Few flowers have been observed and those that den Hartog recorded were primarily for narrow-leaved plants. He stated that anthers for *H.*

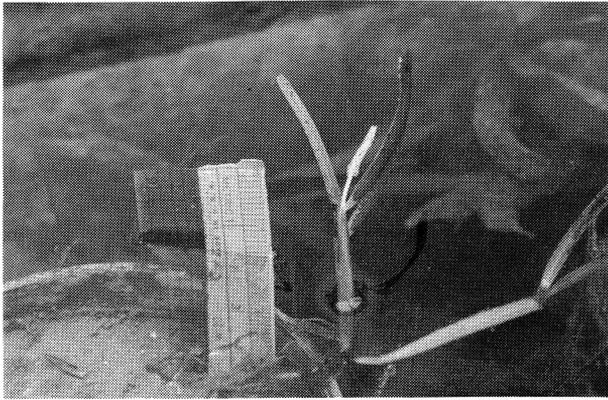


Fig. 1. Staminate flower of *H. uninervis* from Iwayama Bay, Koror, Palau. Plants had been in experimental culture for nearly three years at the time of flowering. Pollen had been released before the flower was photographed.

*uninervis* were 2–3 mm long and for *H. pinifolia* were 2.5–3 mm long. The wide-leaved plants from Iwayama Bay, Koror, Palau, flowered after nearly three years in experimental culture (Fig. 1). The staminate flower had anthers that were 9.7 mm long, greatly exceeding anything that had been recorded previously in *Halodule*. The wide-leaved plants of *H. uninervis* in Palau may be unusual, but until more flowering is observed in other populations of *H. uninervis*, their status will remain uncertain.

The distribution of *H. pinifolia* is reported by den Hartog (1970) to be Western Pacific, ranging from Formosa, the Ryukyu Islands and the Philippines through Malesia to northeastern Australia, Fiji, Tonga, and New Caledonia. Johnstone (in press, personal communication, 1980) reports its occurrence in Papua New Guinea at Port Moresby, Daru, Manus Island and Gaile. The occurrence in the Palau Islands represents an eastward extension from the Philippines into Micronesia.

Tsuda et al. (1977) have shown the attenuation of seagrass distribution in Micronesia from west (Palau) to east (Marshalls). Palau, now with 10 reported species, has the greatest number of seagrasses in Micronesia. Toward the east, Yap has 7, Truk has 5 (Kock and Tsuda, 1978), Ponape 2 and the Marshalls, 1. One species, *Halophila minor*, that has been reported for Palau is questionably present. It was reported by Tuyama (1940) but Tsuda et al. (1977) had seen no herbarium records that substantiate its presence in Palau. All of the collections of *Halophila* that we have cultured and

studied from Palau: Koror, Malakal Channel, and Kayangel or that J. V. Basilius has sent to us from Ngetpang Bay (J. E. Vann Basilius 150 TEX) show the isozyme patterns of *H. ovalis* (McMillan, 1980; McMillan and Williams, 1980) and/or the presence of sulphated flavonoids typical of *H. ovalis* (McMillan et al., 1980). Although *H. minor* occurs widely in Guam and Saipan and has been reported for Yap (Tsuda et al., 1977), its occurrence in Palau may be as narrowly restricted as that of *Halodule pinifolia*.

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#### **Biological Control of the Palau Coconut Beetle, *Brontispa palauensis* (Esaki and Chujo), on Guam<sup>1</sup>**

There are three species of coconut beetles, i.e., *Brontispa mariana* Spaeth, *Brontispa palauensis* (Esaki and Chujo), and *Brontispa chalybeipennis* (Zacher), known to occur in the Micronesian region. Their geographical distribution within Micronesia is very distinct. *B. mariana* in Saipan, Tinian, Rota, Yap, and Truk Islands; *B. palauensis* in Palau Islands (except Ngaiangl and Angaur); and *B. chalybeipennis* in Ponape, Kosrae, and Marshall Islands have been recorded (Gressitt, 1955). The primary host of these beetles is coconut palm, *Cocos nucifera* L. However, *B. palauensis* and *B. chalybeipennis* have been observed to feed on young *Pandanus* sp. and *Exorrhiza ponapensis*, respectively, in addition to coconut.

The Palau coconut beetle, *Brontispa palauensis*, is another one of the accidentally introduced pests to

Guam. This beetle is a native of Palau Islands in the Western Carolines. It was first recorded by Chujo (1937) from Palau. Detailed morphological description of this insect has been reported by Hagen and Doult (1950) and Gressitt (1955).

*B. palauensis* has been first noted on Guam in 1973 in Maite and Afame Heights. Inquiries in Maite revealed that there used to be a group of people from palau who lived in that area a few years prior to this observation. The infestation in Afame Heights, about a mile from Maite, took place probably by transferring infested coconut fronds from Maite to the solid waste dump in Afame Heights. Subsequently, the beetle has spread all over the island in about two years time. The spread of the beetle within a localized area was aided by the wind. However, its distribution to various parts of the island has been aided by the accidental transfer of infested coconut fronds from one area to the other for social events. The biology, habits, and attempts at biological control of *B. mariana* in Saipan have been reported by Lange (1950). The biology and habits of *B. palauensis* are similar to *B. mariana*. The adult beetle lays eggs in the folded tender leaves of the coconut palm. Grubs feed on the leaflets by scraping on the green tissue. Pupation takes place inside the folded leaflet or in-between leaflets that are tightly packed in the tender terminal leaf. Adults feed on the leaflets similar to their grubs.

*Biological Control:* The center of geographical distribution of the genus *Brontispa* is Austro-Malayan region (Lange, 1950). A number of indigenous parasites of *Brontispa* are known to occur in this region; however, only the larval and pupal parasite, *Tetrastichus brontispae* (Ferriere), has been widely used for biological control of *Brontispa* spp. in the Pacific region.

*T. brontispae* was introduced into South Sulawesi (Celebes) from West Java in 1932 and 1933 for the control of *Brontispa longissima celebensis* (Gestro). In 1933, the parasite was well established and a maximum of 90% parasitism was recorded. Attempts to establish this parasite against *B. longissima javana* Weise in East Java between 1932 and 1937, and Central Java in 1954, were unsuccessful (Rao et al., 1971). *T. brontispae* was introduced into Solomon Islands from Java in 1936 without significant results. Hence, it was reintroduced from Tahiti in 1968 and was successfully established (Stapley, 1971). *T. brontispae* and an egg parasite, *Haeckeliana brontispae* Ferriere, were introduced in 1948 to Saipan and Rota from Malaya and Java for the control of *B. mariana*. Of

<sup>1</sup> Contribution No. 10, Guam AES.