

***Acanthophora spicifera* (Rhodophyta: Rhodomelaceae)
in the Marshall Islands**

ROY T. TSUDA, STEVE L. COLES
Natural Sciences, Bishop Museum
1525 Bernice Street, Honolulu, HI 96817
e-mail: roy.tsuda@bishopmuseum.org

ERIC B. GUNTHER
AECOS, Inc., 45-939 Kamehameha Hwy, Suite 104
Kane'ohe, HI 96744

R. ANDREW O. FINLAY
Land and Coastal Management Department
Environmental Protection Authority
P.O. Box 1322, Majuro, MH 96960

FRANKIE L. HARRISS
Science and Liberal Arts Department
College of the Marshall Islands
P.O. Box 1258, Majuro, MH 96960

Abstract—In May 2007, large stands of *Acanthophora spicifera* (Vahl) Børgesen were observed and photographed on the shallow lagoon reef flats overgrowing and killing corals, mostly *Montipora digitata* (Dana) and some *Psammocora contigua* (Esper), off the south side of Majuro Atoll, the capital, business center and main port of the Republic of the Marshall Islands. In early November 2007, the stands had disappeared and three sprigs, each less than 6 cm long, were collected at the same lagoon site. These voucher specimens (BISH 726487) represent the first documented record of *A. spicifera* in the Marshall Islands. *A. spicifera* was also previously observed on the shallow lagoon reef flat in mid-October 2006 and in deeper lagoon waters (6–12 m) in August 2004. It is not possible to ascertain whether *A. spicifera* is a recent invader to or a long-time resident of Majuro Atoll, since the 65 marine algal species previously recorded from this atoll do not reflect its expected algal biodiversity. *A. spicifera* is considered the most successful invasive marine plant in the main Hawaiian Islands and should be monitored as a potentially invasive species in the marine waters of Majuro Atoll.

Introduction

In May 2007, S. L. Coles and E. B. Guinther observed and photographed large stands of the red alga, *Acanthophora spicifera* (Vahl) Børgesen [= *Acanthophora orientalis* J. Agardh], in the shallow and nearshore lagoon reef waters of Majuro Atoll (7° 04' N Lat., 171° 16' E Long.), Republic of the Marshall Islands (RMI). Majuro Atoll, the capital, business center and main port of the RMI with a population of approximately 25,400, has a land area of 9.7 km² which encloses a 295 km² lagoon. The eastern and southern land sectors are contiguous, and the major flushing of the lagoon is from the north and west passes.

The photographs were later substantiated with voucher specimens (BISH 726487), three sprigs all less than 6 cm long, collected on 12 November 2007 by R. A. O. Finlay. The large stands previously observed in May 2007 on the southern lagoon reefs off the west end of Amata Kabua International Airport had disappeared. Under normal circumstances, the occurrence of *A. spicifera* on a Micronesian reef would be considered the norm except that *A. spicifera* has never been previously documented via a specimen from any of the 29 coral atolls or five coral islands in the vast expanse (2.56 million km²) of the Marshall Islands. In his FAO seaweed identification guide, Trono (1998) included the Marshall Islands in his distribution map for *A. spicifera*. In the study of Hong Kong red algae, Tseng et al. (2002) cited the Marshall Islands in the geographical distribution of *A. spicifera*. Both publications, however, did not cite a reference nor a specimen for the Marshall Islands record of *A. spicifera*.

The history of the invasiveness, distribution and competitiveness of *A. spicifera* in Hawai'i encourages the close scrutiny of this alga on the reefs of Majuro Atoll as well as surveys on other atolls and coral islands in the Marshall Islands. *A. spicifera* is suspected to have invaded the waters of Pearl Harbor in Honolulu, Hawai'i in February 1950 via a heavily fouled barge, *Yon 146*, towed 6,113 km from Guam (Doty 1961). Forty-two years after its suspected introduction, Russell (1992) considered this species the most widespread and successful alien alga in Hawai'i based on surveys in nearshore marine waters around Kauai, Oahu, Molokai, Lanai and Maui. Russell (1992) did not observe *A. spicifera* around the island of Hawai'i, the easternmost and largest of the Hawaiian Islands. Smith et al. (2002), however, observed *A. spicifera* at two of 15 surveyed sites on the island of Hawai'i. O'Doherty & Sherwood (2007) have found that Inter-Simple Sequence Repeats analysis showed highly structured Hawaiian populations of *A. spicifera* forming discrete clusters based on collection location. According to Alison R. Sherwood, University of Hawaii Department of Botany (Personal Communication), the study has been expanded to include specimens of *A. spicifera* from other Pacific sites.

The proliferation of this species in Hawai'i was aided by its multiple reproductive strategies, i.e., the occurrence of both tetrasporophytic plants and carpospore-producing female gametophytes (Smith et al. 2002) throughout the year, and its potential to grow from vegetative apical fragments as small as 0.5

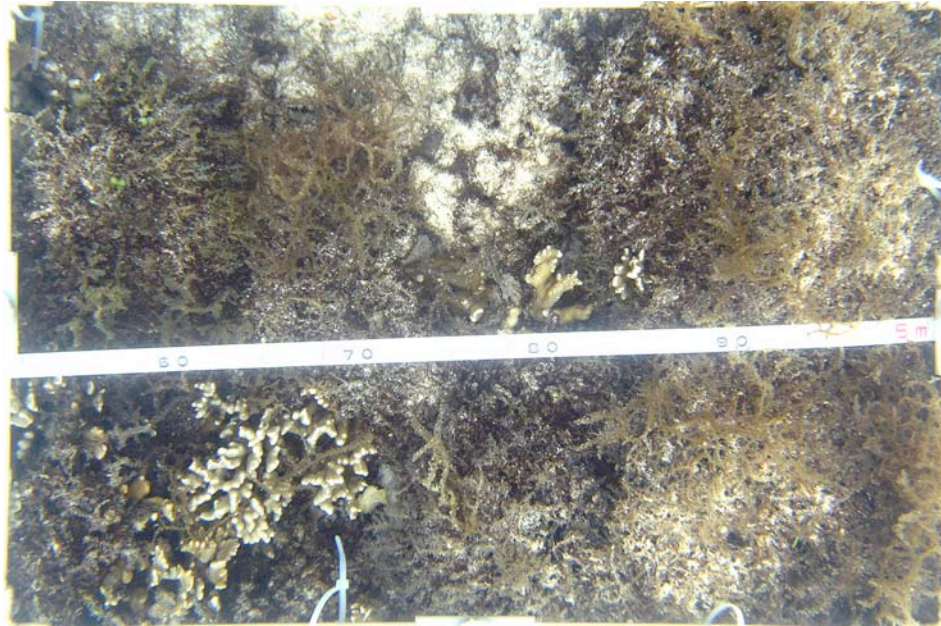


Figure 1. *Acanthophora spicifera* overgrowing the corals *Montipora digitata* (center and far left bottom) and *Psammocora contigua* (left bottom) on shallow lagoon reef flat (<0.5 m deep at MLLW) in May 2007 located west of Amata Kabua International Airport, Majuro Atoll, Republic of the Marshall Islands. Photo by S. L. Coles, May 2007, tape ca. 50 cm across.

cm long (Kilar & McLachlan 1986, Smith et al. 2002). The seasonal peak of *A. spicifera* during the summer months and low population during the winter months, as observed in Majuro Atoll, had previously been observed in Hawai'i (Russell 1992). E. B. Guinther had previously observed small scattered thalli of *A. spicifera* the previous winter (mid-October 2006) on the shallow lagoon reef flat at the east sector of the airport runway. F. L. Harriss also had observed fairly abundant stands of *A. spicifera* in the lagoon, 6-12 m deep, 8 km west of the airport in late summer (August 2004). Voucher specimens, however, are not available from these two observations. The seasonality of *A. spicifera* was, likewise, observed in the Atlantic Ocean, i.e., its appearance in late spring and early summer in Bermuda (Bernatowitz 1952).

The negative aspect of the invasiveness of *A. spicifera* on selected Pacific reefs is its competition with the indigenous marine algae and, at times, the overgrowth and killing of live corals. Russell (1992) found *A. spicifera* outcompeting native algae, e.g., *Laurencia* spp. and *Hypnea cervicornis* J. Agardh, for substrata in Hawai'i. In May 2007, S. L. Coles and E. B. Guinther clearly observed *A. spicifera* (Figure 1), as well as the brown alga *Dictyota bartayresiana* Lamouroux, overgrowing and killing corals, mostly *Montipora digitata* (Dana) and some *Psammocora contigua* (Esper), on the southern reef flat

Table 1. Earliest published records and recent compilations of the occurrence of *Acanthopora spicifera* [= *A. orientalis*] from western and central Pacific high (volcanic) islands.

Island Group	Island	References
Mariana Islands	Not Specified	J. Agardh 1851-1863
	Guam	Safford 1905
	Rota	RT2764 (GUAM), III-14-69
Caroline Islands	Saipan	Okamura 1904
	Palau	Okamura 1904
	Yap	Tokida 1939
	Chuuk (Truk)	Tsuda 1972
	Pohnpei (Ponape)	Okamura 1916
Hawaiian Islands	Kosrae (Kusaie)	Trono 1969
	Oahu, Kauai, Lanai	Doty 1961
Solomon Islands	Gizo, New Georgia, Russell, Guadalcanal	Womersley & Bailey 1970
Fiji	Ovalau	Grunow 1874, South & Skelton 2003
Samoa	Upolu	Grunow 1874, Skelton & South 2002
Tonga	Tongatapu	Grunow 1874
Society Islands	Tahiti, Moorea	Payri & N'Yeurt 1997

and reef margin of Majuro lagoon. On a favorable aspect, *A. spicifera* comprised 20% of 754 samples from mouth, stomach or fecal pellets of the threatened green sea turtle *Chelonia mydas* Linnaeus in Hawai'i (Russell & Balazs 1994).

Recent Marine Invader or Long-Time Resident?

Why has it taken so long to record *Acanthopora spicifera* from the Marshall Islands? This red alga is normally a conspicuous macroalga on the shallow reef flats, i.e., in water less than 0.5 meter deep at mean lower low water (MLLW), around Pacific islands. Stands of *A. spicifera* do exhibit seasonal highs during the summer months and lows during the winter months; however, it is still present on Pacific reefs throughout the year. Does it occur on other coral atolls and islands in the Marshall Islands?

A total of 361 marine algal species (Tsuda 2002) has been reported from the Marshall Islands; however, only 65 species of marine benthic algae are reported from Majuro Atoll. In the 1940's and 1950's, large-scale biological surveys related to nuclear bomb tests were conducted in the Marshall Islands. The marine algae reported by Taylor (1950) from Bikini, Rongerik, Rongelap and Enewetak Atolls were collected from March to August 1946 when *A. spicifera*, if

present, should have been among the collections. All algal collections reported by Dawson (1956) from Majuro Atoll were made in early winter (October 1954); however, his algal collections from Arno Atoll were made during the summer months (June to August 1951).

Dawson (1957) reported marine benthic algae from Enewetak Atoll mainly collected in late summer, i.e., August and September 1955. The absence of *A. spicifera* on Enewetak Atoll seems real when one considers that none of the more than one thousand scientists, assistants and graduate students conducting research at the Mid-Pacific Research Laboratory from 1954 to 1984 ever reported *A. spicifera* (Tsuda 1987). R. T. Tsuda did not find *A. spicifera* in a survey on the seaward reef flat in the southeast sector of Majuro Atoll in August 1975; this survey was conducted over an eight-day period in a localized area.

The published distributional pattern of *A. spicifera* around Pacific islands reveals this species to inhabit reef areas around both volcanic islands (Table 1) and coral islands and atolls. Aside from its presence in Majuro Atoll, *A. spicifera* has been reported from three other Pacific atolls, i.e., Tarawa Atoll in the Gilbert Islands, Kiribati collected in June and July 1962 (Tsuda 1964), Neoch (Kuop) Atoll in Chuuk State, Federated States of Micronesia (FSM) collected in July 1969 and June 1970 (Tsuda 1972) and Ngcheangel (Kayangel) Atoll in the Republic of Palau where it was reported “common around pier” (Ohba et al. 2007). South et al. (2001) did not record *A. spicifera* from the low coral islands of the Phoenix Islands, Republic of Kiribati, based on collections made in June and July 2000.

A search through the Bishop Museum’s Herbarium Pacificum revealed three specimens of *A. spicifera* from an atoll and a coral island which were not reported in the literature. BISH 525888 was collected by E. G. Meñez from Puluwat Atoll in Chuuk State, FSM on 7 August 1960. Two specimens were collected from Kiritimati (Christmas) Island in the Line Islands, Kiribati, by S. Adjak on 16 April 1977 (BISH 525912) and by C. L. Hunter on 31 January 2001 (BISH 772662). Based on the presence of *A. spicifera* on six atolls or coral islands, the geologic framework of the Marshall Islands should not serve as a deterrent for *A. spicifera* to inhabit the Marshall Islands.

Conclusions

It is not possible to determine whether *Acanthophora spicifera* is a recent invader or long-time resident of Majuro Atoll. One could say that *A. spicifera*, if a long-term resident, should be among the 65 algal species previously reported from Majuro Atoll since it inhabits both the shallow reef flat and subtidal lagoon waters, and is easily collectible during the summer months. The 65 algal species reported from Majuro Atoll, however, probably represent about two-thirds of the algae which inhabit this atoll. Arno Atoll, a larger atoll which lies 20 km to the east, is credited with 105 marine algal species. Since baseline information on the diversity of marine algae in Majuro Atoll is incomplete, it is not possible at this

time to speculate which species should be considered native or alien in this commercial port center of the RMI.

The presence of *A. spicifera* on other atolls of the Marshall Islands can be ascertained; however, this will be a time-consuming proposition which will be best left to the local government biologists to undertake, in association, with routine field trip visits aboard ships.

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