

New Records of Azooxanthellate Scleractinia from the Hawaiian Islands

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Introduction

This paper is essentially an updating of the checklist of azooxanthellate corals I published slightly over 20 years ago (Cairns, 1984). It is published for three reasons: 1) to correct misidentifications and changes in classification from the earlier paper, 2) to acknowledge new records for the Hawaiian fauna, some through previously published literature and 4 as the result of this paper, including one new species, and 3) to support the hypothesis suggested in 1984 that the better known a (deep-water) fauna becomes, the more widespread and less endemic it is perceived.

Since 1984 there have been 11 papers that have had a bearing on Hawaiian azooxanthellate corals and one that was overlooked by me in 1984 (i.e., Wells, 1982). As a result of those papers: 9 species have been reidentified (resulting in the loss of one fungiid species from the list), 6 species have been added, and 6 others have been placed in different genera (see annotated checklist). Four species are added to the list herein, resulting in a net gain of 9 species, increasing the known number of azooxanthellates from 54 to 63 species.

A short post-1982 history of the fauna follows. Wells (1982) described *Balanophyllia eguchii* (= *Cladopsammia eguchii*) from many Pacific localities, including Kāneʻohe Bay, Oʻahu, a location overlooked by Cairns (1984). In a series of at least 3 papers from 1985–1993 (see below), Fitzhardinge reported the incidental occurrence of an unidentified *Culicia* from shallow water, herein described as *C. rachelfitzhardingeae*. Hoeksema (1989) re-identified the 3 facultative fungiid species reported by Cairns (1984) resulting in a net loss of one species to the list. Although primarily about the New Zealand fauna, Cairns (1995) reidentified several Hawaiian records, such as *Balanophyllia hawaiiensis* (= *B. gigas*), *Eguchipsammia oahensis* (= *E. fistula*), and *Paracyathus tenuicalyx* (= *Trochocyathus rhombocolumna*), and noted range extensions for species previously thought to be endemic to Hawaiʻi. Cairns & Zibrowius (1997) also reported range extensions of “Hawaiian” species in the Indonesian region, as did Cairns (1998) for Western Australia. Although the subject was the various types of deep-water corals attached to the *Xenophora* carrier shell, Feinstein & Cairns (1998) reported 5 species from the Hawaiian Islands, including 2 new records: *Anthemiphyllia macrolobata* (previously reported as *A. dentata* by Cairns, 1984 and later officially described by Cairns, 1999), and *Placotrochides* n. sp. (herein identified as *P. minuta* Cairns, 2004b). In a paper about the corals of Vanuatu, Cairns (1999) reported *Trochocyathus patelliformis* and *Anthemiphyllia macrolobata* from Hawaiʻi. Finally, in a field guide to the corals of Hawaii, Fenner (2005) reported four new records of shallow-water azooxanthellates (*Madracis pharensis*, *Tethocyathus minor*, *Rhizopsammia verrilli*, and *Tubastraea diaphana*), illustrating them *in situ* and in color, along with several other shallow-water azooxanthellate species.

Table 1. Number of Hawaiian azooxanthellate species and percentage faunal composition found in extralimital regions. EP = number of species also found in eastern Pacific.

| | Cairns, 1984 (54 species) | Current (63 species) |
|--------------------------------|---------------------------|----------------------|
| Endemic (E) | 26 (48.1%) | 13 (20.6%) |
| Central-West Pacific (CWP) | 9 (16.7%) | 18 (28.5%) |
| Indo-West Pacific (IWP and IP) | 8 (14.8%), 1 EP | 19 (30.2%), 3 EP |
| Cosmopolitan (C) | 9 (16.7%), 4 EP | 11 (17.4%), 5 EP |
| Uncertain | 2 (3.7%) | 2 (3.2%) |
| TOTAL | 54 (100%) | 63 (99.9%) |

It is generally agreed that the Hawaiian deep-sea coral fauna is an impoverished, or attenuated, Indo-Pacific fauna, with some endemic and cosmopolitan components but little connection to the eastern Pacific (Vaughan, 1907; Vaughan & Wells, 1943; Cairns, 1984). Vaughan & Wells (1943) reported a 70% endemism component whereas Cairns (1984) calculated that component to be 48% and predicted that as the Pacific fauna becomes better known the perceived endemic percentage would continue to fall. This indeed has been the case (Table 1), the endemic percentage decreasing from 48% to 21% as various deep-water species have been found throughout the Pacific and Indian Oceans. Also, the number of species held in common with the eastern Pacific has increased from 5 to 8 (Table 1).

Abbreviations used in the text include: CD = Calicular Diameter; GCD = Greater Calicular Diameter; NMNH = National Museum of Natural History, Smithsonian Institution, Washinton, D.C.; $S_x > S_y$ = in the context of a septal formula, septa of cycle x are wider than those of cycle y; USNM = United States National Museum.

Annotated Checklist

Recent azooxanthellate Scleractinia from the Hawaiian Islands (Distribution patterns: E = endemic, C = cosmopolitan, IWP = Indo-West Pacific, IP = Indo-Pacific, CWP = central and west Pacific, a = no pattern; * may be zooxanthellate in shallow water, i.e., facultative, + = new record for Hawaiian Islands.

| | Distribution Pattern |
|---|----------------------|
| Suborder Astrocoeniina | |
| Family Pocilloporidae | |
| 1. <i>Madracis kauaiensis</i> Vaughan, 1907 | CWP |
| 2. <i>M.</i> sp. cf. <i>M. pharensis</i> (Heller, 1868) | C |
| Suborder Fungiina | |
| Family Fungiidae | |
| *3. <i>Fungia (Cycloseris) sinensis</i> Milne Edwards & Haime, 1851 = <i>Diaseris fragilis</i> sensu Cairns, 1984 | IWP |
| *4. <i>Fungia (Cycloseris) vaughani</i> Boschma, 1923 = <i>Diaseris distorta</i> and <i>C. tenuis</i> sensu Cairns, 1984 | IWP |

Family Micrabaciidae

5. *Letepsammia formosissima* (Moseley, 1876) IWP

Family Fungiacyathidae

6. *Fungiacyathus fissilis* Cairns, 1984 E

7. *F. fragilis* Sars, 1872 C
= *F. hawaiiensis* Vaughan, 1907

Suborder Faviina

Family Anthemiphylliidae

8. *Anthemiphyllia macrolobata* Cairns, 1999 CWP
= *A. dentata* sensu Cairns, 1984

9. *A. pacifica* Vaughan, 1907 CWP

Family Faviidae

*10. *Leptoseria hawaiiensis* Vaughan, 1907 CWP

Family Oculinidae

11. *Madrepora kauaiensis* Vaughan, 1907 E

12. *M. oculata* Linnaeus, 1758 C

Family Rhizangiidae

+13. *Culicia rachelfitzhardingae*, n. sp. E
= *Culicia* sp. cf. *C. tenella* sensu Fitzhardinge, 1985-93

Suborder Caryophylliina

Family Caryophylliidae

14. *Anomocora* sp. cf. *A. fecunda* (Pourtalès, 1871) a

15. *Bourneotrochus stellulatus* (Cairns, 1984) CWP
= *Deltocyathus stellulatus* Cairns, 1984

16. *Caryophyllia atlantica* (Duncan, 1873) a
= *C. alcocki* Vaughan, 1907

17. *C. hawaiiensis* Vaughan, 1907 CWP

18. *C. marmorea* Cairns, 1984 CWP

19. *C. octopali* Vaughan, 1907 E

20. *C. rugosa* Moseley, 1881 IWP

21. *C.* sp. cf. *C. ambrosia* Alcock, 1898 (sensu Cairns, 1984) C

22. “*Ceratotrochus*” *laxus* Vaughan, 1907 E

23. *Coenosmilia inordinata* Cairns, 1984 E

24. *Conotrochus funiculumna* (Alcock, 1902) IWP

25. *Crispatotrochus rubescens* Moseley, 1881 CWP

= *Cyathoceras diomedea* Vaughan, 1907

= *Cyathoceras rubescens* sensu Cairns, 1984

26. *Deltocyathus* sp. cf. *D. andamanicus* Alcock, 1898 (sensu Cairns, 1984) IWP

27. *Desmophyllum dianthus* (Esper, 1794) C
= *Desmophyllum cristagalli* sensu Cairns, 1984

28. “*Paracyathus*” *molokensis* Vaughan, 1907 E

29. *Tethocyathus minor* Gardiner, 1899 IWP

30. *Trochocyathus aithoseptatus* Cairns, 1984 CWP

31. *T. burchae* (Cairns, 1984) CWP

= *Premocyathus burchae* Cairns, 1984

32. *T. gardineri* (Vaughan, 1907) CWP

33. *T. mauiensis* (Vaughan, 1907) E

34. *T. oahensis* Vaughan, 1907 E
 35. *T. patelliformis* Cairns, 1999 CWP
 36. *T. rhombocolumna* Alcock, 1902 IWP
 = *Paracyathus tenuicalyx* Vaughan, 1907
- Family Turbinoliidae
 37. *Deltocyathoides orientalis* (Duncan, 1876) IWP
 = *Peponocyathus orientalis* sensu Cairns, 1984
- Family Flabellidae
 38. *Flabellum marcus* Keller, 1974 CWP
 = *F. deludens* sensu Vaughan, 1907
 39. *F. pavoninum* Lesson, 1831 IWP
 = *Flabellum pavoninum* var. *latum* and *distinctum* Vaughan, 1907
 40. *F. vaughani* Cairns, 1984 E
 = *F. pavoninum* var. *paripavoninum* sensu Vaughan, 1907
 +41. *Javania exserta* Cairns, 1999 CWP
 42. *J. fuscus* (Vaughan, 1907) CWP
 = *Placotrochus fuscus* Vaughan, 1907
 43. *J. insignis* Duncan, 1876 IWP
 44. *J. lamprotichum* (Moseley, 1880) IWP
 +45. *Polymyces wellsi* Cairns, 1991 C
 +46. *Placotrochides minuta* Cairns, 2004 CWP
 = *Placotrochides* n. sp. sensu Feinstein & Cairns, 1998
- Family Guyniidae
 47. *Guynia annulata* Duncan, 1872 C
- Family Stenocyathidae
 48. *Stenocyathus vermiformis* (Pourtalès, 1868) C
- Family Gardineriidae
 49. *Gardineria hawaiiensis* Vaughan, 1907 IWP
- Suborder Dendrophylliina**
- Family Dendrophylliidae
 50. *Balanophyllia desmophyllioides* Vaughan, 1907 CWP
 = *B.* sp. sensu Maragos, 1977
 51. *B. diomedea* Vaughan, 1907 E
 = *B. diomedea* var. *mauiensis* Vaughan, 1907
 52. *B. gigas* Moseley, 1881 IWP
 = *B. hawaiiensis* Vaughan, 1907
 = *B. cornu* sensu Cairns, 1984
 53. *B. laysanensis* Vaughan, 1907 CWP
 54. *Cladopsammia echinata* Cairns, 1984 E
 55. *C. eguchii* Wells, 1982 IWP
 56. *Eguchipsammia gaditana* (Duncan, 1873) C
 = *Dendrophyllia gaditana* sensu Cairns, 1984
 57. *E. fistula* (Alcock, 1902) IWP
 = *Dendrophyllia oahensis* Vaughan, 1907
 58. *E. serpentina* (Vaughan, 1907) E
 = *Dendrophyllia serpentina* sensu Cairns, 1984
 59. *Enallopsammia rostrata* (Pourtalès, 1878) C
 = *Anisopsammia amphelioides* sensu Vaughan, 1907
 = *Dendrophyllia amphelioides* var. *cucullata* Vaughan, 1907

- | | |
|---|-----|
| 60. <i>Endopachys grayi</i> Milne Edwards & Haime, 1848 = <i>E. oahense</i> Vaughan, 1907 | IP |
| 61. <i>Rhizopsammia verrilli</i> van der Horst, 1922 | IP |
| 62. <i>Tubastraea coccinea</i> Lesson, 1831 = <i>Dendrophyllia manni</i> sensu Vaughan, 1907 | C |
| 63. <i>T. diaphana</i> (Dana, 1846) | IWP |

New Records

Culicia rachelfitzhardingeae Cairns, new species

(Figs. 1A–B, 2 A–D)

Culicia sp. Fitzhardinge, 1985: 374, 376.

Culicia cf. *tenella*.—Fitzhardinge & Bailey-Brock, 1989: 570, 571.—Fitzhardinge, 1993: 35, 98–110, pl. 2, figs. A–C.

Records/Types.—Holotype: one corallite from Lilipuna Pier, Kāneʻohe Bay, Oʻahu, Hawaiʻi, 2 m, 12 April 1987, SEM stub 1096, USNM 78497. Paratypes: from same locality as holotype, about 84 corallites attached to four fragments of dead *Porites* and SEM stubs 1097–8, USNM 1073265; Kaunakaki Dock, Molokaʻi, 30 Jan 2003, 1 corallite, USNM 1073266; Port Allen small boat harbor, Kauaʻi, 13 Nov 2002, 3 corallites, USNM 1073267.

Description.—Corallites occur singly, probably the result of planulation, or as small clusters of 2–6 corallites, the latter the result of distomodaeal (Fig. 2A), or more rarely polystomodaeal, intratentacular budding, after which corallites lose their lamellar linkage but remain connected by a common basal coenosteum (Fig. 1B). Thus, there are no stolons linking corallites. Corallites cylindrical, tympanoid in shape, up to 4.1 mm in diameter, but rarely over 1.5 mm in height. Sometimes in juvenile coralla a kind of polycyclic development is seen, the first thecal ring developing at a CD of about 0.5 mm, the second at 1.1 mm, and the third and last at about 2.0 mm. Epitheca smooth, noncostate, bearing fine transverse ridges. Corallum white.

Septa hexamerally arranged in up to three and one half cycles (36 septa) according to formula: $S1 > S2 \geq S3 > S4$. Juvenile corallites of 0.5–1.0 GCD have 12 septa, those between 2.0–2.5 mm have 24 septa, and those over 2.7 mm in GCD have up to 36 septa, increasing in septal number in direct relation to calicular diameter. S1 about 0.8 mm wide, reach only about 1/3 distance to center of calice, and have an entire, highly sinuous axial margin (Fig. 2C). S2 about 0.5 mm wide but otherwise similar to the S1. Both S1 and S2 bear large blunt granules on their septal faces, the granules up to 0.16 mm in height and 0.13 mm in diameter. In small corallites, S3 are rudimentary, having an irregular axial margin, but in larger corallites some S3 are flanked by a pair of rudimentary S4, in which case the flanked S3 becomes almost as large as the S2. The upper outer edges of all septa join the theca slightly below the calicular edge producing a slight calicular rim, although the distal edges of the septa rise above the calicular edge. Small (0.20 mm in diameter), cylindrical (non-lamellar), highly granular paliform lobes occur before S1, S2 and those S3 flanked by S4, forming an elliptical palar ring surrounding the columella. P1 slightly smaller and positioned closer to columella than P2 and P3. Columella papillose, consisting of 15–10 cylindrical elements each about 0.12 mm in diameter, their upper edges slightly below that of the paliform lobes. In general the fossa is shallow.

Discussion.—This species is distinguished from the other 12–13 species of Recent *Culicia* (see Cairns, *et al.*, 1999, Cairns, 2004b; Cairns, Häussermann & Försterra, 2005) by having highly sinuous, vertical, entire axial edges of the S1–2, all other species having straight, lobate to lacinate axial septal edges. Also, the palar crown is much better developed than in any other species, and stolons are rarely if ever present.

Etymology.—This species is named in honor of Rachel Fitzhardinge, who first noted the presence of this species in the Hawaiian Islands and provided specimens to the NMNH.

Distribution.—Kauaʻi, Oʻahu, and Molokaʻi, 2 m.

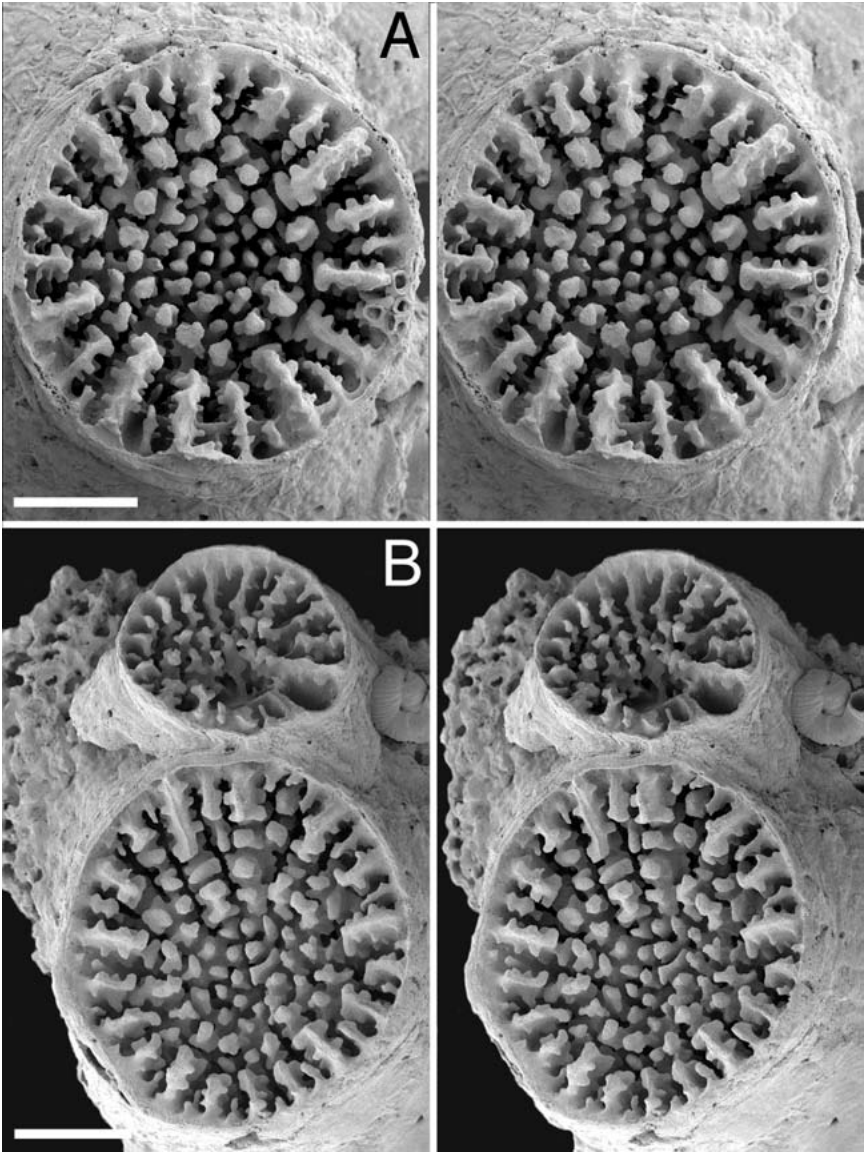


Figure 1. *Culicia rachelfithardingee*: **A**, stereo calicular view of holotype; **B**, stereo pair of parent and recently budded corallite from a topotypic paratype (USNM 1073265). Scale bars = 1 mm.

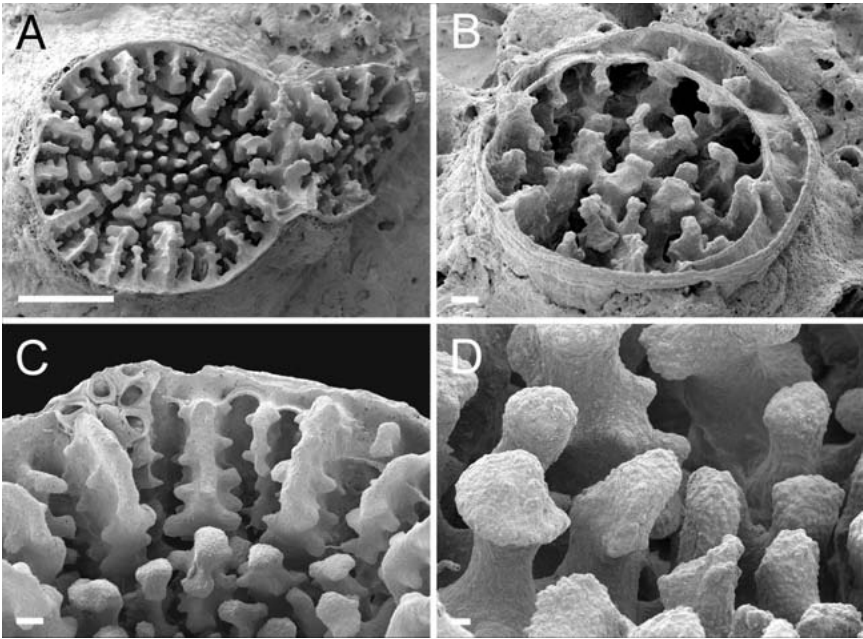


Figure 2. *Culicia rachelfitzhardingeae*, topotypic paratypes (USNM 1073265): **A**, intratentacular budding in progress; **B**, juvenile corallum showing concentric thecal rings; **C**, view of inside of calice edge showing septal granulation and some pali; **D**, view of some palmar and columella elements. Scale bars: A = 1 mm, B–C = 0.1 mm, D = 0.05 mm.

***Javania exserta* Cairns**

New island record

Javania exserta Cairns, 1999: 126–127, figs. 21 g–i.

Records.—*Pisces* 5-594, 19°47'53"N, 156°08'51"W (off Keahole Point, Hawai'i), 400 m, 16 Oct 2004, 1 corallum, USNM 1071216.

Discussion.—This species is known from throughout the western Pacific from Vanuatu to the Marshall Islands at depths of 91–455 m, thus its presence in Hawai'i is not unexpected. It is distinguished from other congeners by having only 4 cycles of septa, the S1 larger than the S2, and the S3–4 being rudimentary. The species of this genus are keyed by Cairns (2004a). The specimen reported herein is small, measuring only 6.7 mm in GCD and 16.1 mm in height.

***Polymyces wellsi* Cairns**

New island Record

Polymyces wellsi Cairns, 1991: 22, pl. 8, figs. f, i, pl. 9, figs. a–b; 2000: 7, figs. 174–175; 2004b: 308 (synonymy).

Records.—*Pisces* 5-527-8, 25°48.813'N, 173°29.802'W (seamount near Pioneer Bank), 927 m, 1 corallum, USNM 1072331; *Pisces* 5-587-6, 18°43'59"N, 158°15'44"W (Cross Seamount), 440 m, 8 Oct 2004, 1 corallum, USNM 1071236.

Discussion.—This is thought to be a cosmopolitan bathyal (355–1682 m) species, pre-

viously known from western Australia, Queensland, New Zealand, Indonesia, Vanuatu, the Philippines, the Galápagos, the western Atlantic (Cairns, 2004b), and now from the Hawaiian Islands. It is distinctive in having asymmetrically developed, contiguous basal rootlets that reinforce the pedicel, and reddish-brown color of the corallum. Both specimens reported herein were badly damaged in collection, but the salient characters are observable.

***Placotrochides minima* Cairns**

Placotrochides n. sp. Feinstein & Cairns, 1998: 81, 83, fig. 10.

Placotrochides minima Cairns, 2004b: 305–306, figs. 10E–H.

Discussion.—This species was previously known from Hawai‘i only as 4 specimens that had been attached to *Xenophora* shells, collected at depths of 119–291 m off southwestern O‘ahu and Pailolo Channel between the islands of Moloka‘i, Lāna‘i and Maui (Feinstein & Cairns, 1998). No additional specimens are reported herein. It is also known from the Banda Sea and off northeastern Queensland (Cairns, 2004b), although these specimens are free living (i.e., not attached to *Xenophora* shells).

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