

# Associations of coral and boring bivalves: Lizard Island (Great Barrier Reef, Australia) versus Safaga (N Red Sea)

## Vergesellschaftungen von Korallen und Bohrmuscheln: Lizard Island (Großes Barriere Riff, Australien) im Vergleich mit Safaga (N Rotes Meer)

by

Karl KLEEMANN\*

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### Abstract

Associations of coral and boring bivalves from Lizard Island (Great Barrier Reef, Australia) are reviewed and compared with those from Safaga, northern Red Sea. Although certain coral and *Lithophaga* species are present in both areas, the respective associations differ regionally distinctively in *L. laevigata* and *L. simplex*.

Hosts for *L. laevigata* at Lizard include *Astreopora*, *Coscinaraea*, *Cyphastrea*, *Goniopora*, *Montipora*, *Porites*, and *Psammocora*, at Safaga, *Favia*, *Leptastrea*, *Porites*, and *P. (Synaraea)*, rarely *Cyphastrea* and *Montipora* in co-occurrence with *L. purpurea*. Hosts of *L. simplex* at Lizard include *Acanthastrea*, *Astreopora*, *Echinopora*, *Favia*, *Goniastrea*, *Lobophyllia*, and *Symphyllia*, at Safaga *Astreopora*, *Goniastrea*, and *Pavona*. At Lizard, *L. lima*, found in single or few specimens per coral colony, occurs alone or together with *L. laevigata* (in *Porites*), or *L. simplex* (in *Acanthastrea*, *Astreopora*, and *Favia*).

Most bivalve species have a variety of hosts, a few seem to be restricted to a single coral genus. Different genera of bivalves may be found in the same host specimen, e.g., *Pedum* and *Lithophaga* in *Montipora* (at Safaga, Red Sea) and *Porites* (at Lizard, GBR). At Lizard, *Pedum* was found only in *Porites*, including *P. (Synaraea)*, while it occupies at least 12 host genera in the northern Red Sea, particularly *Montipora*.

In contrast to coral rock, where several different boring bivalves can occur next to each other, rarely more than one *Lithophaga* species is found per host colony, although it happens in both areas. On the other hand, the same coral species may be inhabited by one species of *Lithophaga* in one area and (mainly) by another in the other area. In *Lithophaga*, more associations are established at Lizard than at Safaga, while in *Pedum* it is the other way round. Altogether, more different associations can be noted than equal ones.

Generally, coral-bivalve associations are regionally stable

and do not overlap. Thus, host determination should yield the bivalve identity, too.

### Zusammenfassung

Die Vergesellschaftungen von bohrenden Muscheln mit Korallen von Lizard Island im Großen Barriere Riff von Australien werden vorgestellt und mit jenen des nördlichen Roten Meeres verglichen. Obwohl bestimmte Arten von Korallen und *Lithophaga* in beiden Gebieten vorkommen, sind die jeweiligen Assoziationen mit *L. laevigata* und *L. simplex* recht unterschiedlich.

Als Wirte für *Lithophaga laevigata* dienen bei Lizard *Astreopora*, *Coscinaraea*, *Cyphastrea*, *Goniopora*, *Montipora*, *Porites* und *Psammocora*, bei Safaga *Favia*, *Leptastrea*, *Porites* und *P. (Synaraea)*, selten *Cyphastrea* und *Montipora*, in Gemeinschaft mit *L. purpurea*. Als Wirte für *L. simplex* eignen sich bei Lizard *Acanthastrea*, *Astreopora*, *Echinopora*, *Favia*, *Goniastrea*, *Lobophyllia* und *Symphyllia*, bei Safaga *Astreopora*, *Goniastrea* und *Pavona*. *L. lima*, die bei Lizard einzeln oder in wenigen Stücken in Korallen gefunden wird, kommt allein oder gemeinsam mit *L. laevigata* (in *Porites*) oder *L. simplex* (in *Acanthastrea*, *Astreopora* und *Favia*) vor.

Die meisten Muschelarten sind nicht wirtsspezifisch, doch einzelne scheinen auf eine Korallengattung beschränkt zu sein. Verschiedene Muschelgattungen können in der selben Koralle angetroffen werden (z.B. *Pedum* und *Lithophaga*). Während in totem Substrat verschiedene Bohrmuschelarten und -gattungen nebeneinander vorkommen können, ist selten mehr als eine *Lithophaga*-Art je Wirtskolonie anzutreffen, dies kommt aber in beiden Untersuchungsgebieten vor. Andererseits kann die gleiche Korallenart in dem einen Gebiet von einer *Lithophaga*-Art bewohnt werden, im anderen (vorwiegend) von einer anderen, obwohl die erste dort auch vorkommt. Insgesamt sind weniger gleiche als unterschiedliche Assoziationen feststellbar. Bei Lizard sind mehr Assoziationen mit *Lithophaga* als bei Safaga zu finden. Mit *Pedum* ist es umgekehrt.

\* Institut für Paläontologie der Universität Wien, Geo-Zentrum, Althanstr. 14, A-1090 Wien

Im allgemeinen sind die Korallen-Muschel-Vergesellschaftungen regional stabil und überlappen nicht. Die Bestimmung des Wirts sollte damit auch die Muschelidentität ergeben.

## 1. Introduction

Several organisms, mainly invertebrates, but also algae and fish, are known associates of corals. Their relationship to the hosts includes symbiosis as well as parasitism. Some associates, like fish, are mobile, others sessil or both, such as crustaceans and molluscs. Some gastropods and bivalves live on or inside live coral (epi- or endolithic). From the latter, associations from Lizard Island are compared with those from the Safaga Bay, northern Red Sea (KLEEMANN, 1992). The benefits to the associates are discussed in KLEEMANN (in press).

## 2. Methods

Observations in the field by SCUBA-diving, were carried out at Lizard Island (Fig. 1), Cairns section of the Great Barrier Reef (GBR). From the coral-bivalve associations, photographs in situ and representative samples were taken. Corals were identified according to VERON (1986), VERON & PICHON (1976, 1980, 1982), VERON & WALLACE (1984), and VERON et al. (1977).

Locations at Lizard Island mentioned in the text: BB – Boiler Bay, C – Site C, NPI – North Palfrey Island, WM – Washing Mashine (Fig. 1). Field sites at Safaga are documented in KLEEMANN (1992).

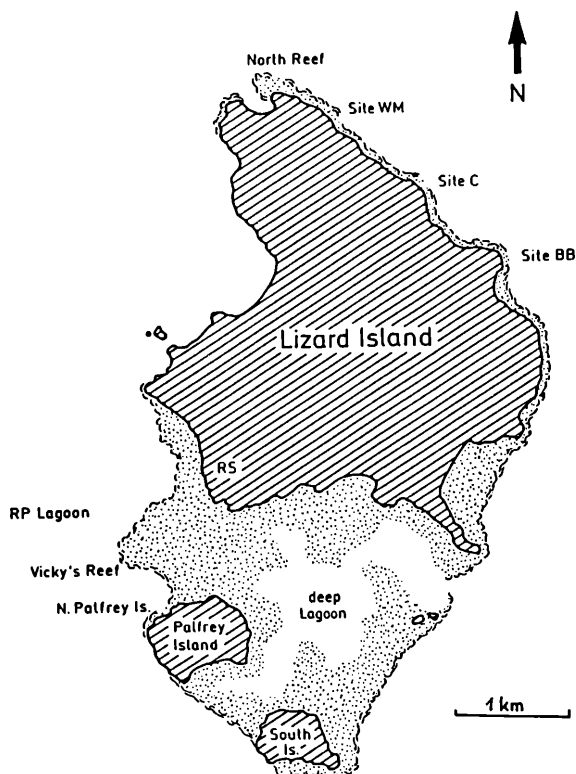


Figure 1: Sketch-map of Lizard Island group and transect sites.

## 3. Results

At Lizard, 21 coral genera, and at Safaga, 12 were noted to serve as hosts for the mytilid *Lithophaga*. Corals being used as host by the same species in both areas are few (Tab. 1), e.g., *Cyphastrea microphthalma* (LAMARCK, 1816), *Goniastrea retiformis* (LAMARCK, 1816), *Montipora* spp., *Pocillopora damicornis* (LINNAEUS, 1758), *Porites* spp., and *Stylophora pistillata* (ESPER, 1795). Corals present in both areas, but being used only in one, are: *Diploastrea heliopora* (LAMARCK, 1816), *Faviafavirus* (FORSKAL, 1775), *F. pallida* (DANA, 1846), *Leptastrea purpurea* (DANA, 1846), *Leptoria phrygia* (ELLIS & SOLANDER, 1786), and *Lobophyllia corymbosa* (FORSKAL, 1775) at Lizard, and *Echinopora gemmacea* (LAMARCK, 1816), *E. lamellosa* (ESPER, 1795), and *Favia stelligera* (DANA, 1846) at Safaga. Other corals are used by different species in the respective area, e.g., *Cyphastrea*, *Montipora* (Tab. 1).

From the identified *Lithophaga* spp. from the GBR and Red Sea, *L. kuehnelti* was found only at Lizard, and *L. purpurea* only at Safaga.

Although live *Acropora* is generally free of *Lithophaga* infestation, *A. (Isopora)* is commonly bored by *L. kuehnelti*, e.g., *A. (I.) brueggemanni* (BROOK, 1893), of staghorn morphology, at NPI (Pl. 1, Fig. 1) and semi-massive *A. (I.) cuenata* (DANA, 1846) at sites WM, C, and BB.

Several specimens of *L. laevigata* were found in *Goniopora tenuidens* (QUELCH, 1886) (Pl. 1, Fig. 2, see Discussion). Others occurred in *Montipora danae* EDWARDS & HAIME, 1851, at sites WM and NPI, in *M. grisea* and *informis* BERNARD, 1897, at site WM and NPI respectively, in *M. millepora* CROSSLAND, 1952, at site WM, in *M. monasteriata* (FORSKAL, 1775, sensu VERON & WALLACE, 1984; figs. 7, 8) at site WM and NPI, in *M. nodosa* (DANA, 1846), *M. venosa* (EHRENBERG, 1834), and *Porites australiensis* VAUGHAN, 1918, all at NPI (Tab. 1).

The rare association of *Lithophaga lessepsiana* with *Pocillopora damicornis* at Heron Island (KLEEMANN, 1980), was lately also observed at Abu Haschisch, a reef near Safaga, N Red Sea. Some pale specimens, growing at the southern side in 10–14 m depth, occupied a few to several minute bivalves, maximum length 20 mm (Pl. 1, Fig. 3).

At NPI, *L. lima* occurred in *Coeloseris mayeri* VAUGHAN, 1918, and in thin-walled *P. lobata* DANA, 1846 (sensu VERON & PICHON, 1982; fig. 10). In four hosts, *Coeloseris mayeri*, *Diploastrea heliopora*, *Leptoria phrygia*, and *Platygyra daedalea* (ELLIS & SOLANDER, 1786), only *L. lima* were found. In other corals it co-occurs with *L. laevigata* and *L. simplex* (Tab. 1).

*L. purpurea*, only known from the Red Sea (KLEEMANN, 1980, 1992; Tab. 1), is particularly common in *Montipora* and *Stylocoeniella* of the reef slope at 20–50 m. *L. simplex* was found in *Acanthastrea echinata* (DANA, 1846) at NPI, in *Echinopora mammiformis* (NEMENZO,



Figure 2: *Chlamys madreporarum* (SOWERBY, 1847) in *Acropora valida* (DANA, 1846), at site WM, Lizard Island, GBR; x 2.

1959) at sites C and NPI, and in *Favia fava*, at NPI (Tab. 1). The pectinid *Pedum spondyloideum* (GMELIN, 1791), was only found in *Porites*, including *P. (Synaraea) rus* in thin laminated growth form (Pl. 1, Fig. 4). The *Pedum-Porites* association, being very common in the lagoon, was rarely found at exposed sites (SE reef wall, 10 m). Another pectinid, *Chlamys madreporarum* (SOWERBY, 1847, determined after WALLER, 1972: pl. 3, fig. 42), was found, only once, deeply embedded in *Acropora valida* (DANA, 1846) at site WM (Fig. 2). WALLER (1972:238) noted for this bivalve of Japanese and Malaysian waters that it lives, byssally attached, deep within corals in a manner somewhat like *Pedum* (KLEEMANN, 1990a). This can be confirmed.

#### 4. Discussion and Conclusion

Usually bivalve borers are restricted to either dead surfaces or live hosts. The only exception I know of, is Caribbean *L. bisulcata* (ORBIGNY, 1842) (SCOTT, 1988a-b). Records of other *Lithophaga* species from dead and live coral are dubious (KLEEMANN, in press). Some of the coral boring bivalve associations have been noted before (GOHAR & SOLIMAN, 1963; HIGHSMITH, 1980; KLEEMANN, 1977, 1980: tab. 3, from Heron and Lizard Island, GBR, and Aqaba, northern Red

Sea, considered in Tab. 1, 1990a and cited literature re *Pedum*; WILSON, 1979, 1985; SCOTT, 1980, 1986, 1988a-b; MORTON, 1983, 1990).

Results from Lizard Island were compared with earlier results (KLEEMANN, 1977, 1980), and particularly with the situation at Safaga, northern Red Sea (KLEEMANN, 1992).

Most of the coral associated bivalves considered here, have a variety of hosts to choose from. Nevertheless, *Lithophaga kuehnelti* is exclusively found in *Acropora (Isopora)* species. It may be regarded a narrow spectrum borer (MORTON, 1983). MUSSO (1993) reported living colonies of *A. (I.) cuneata* at Lizard being extensively excavated by bivalves of the genus *Lithophaga*. These were presumably all *L. kuehnelti*, as observed in *A. (I.) palifera* (LAMARCK, 1816) at Heron Island (KLEEMANN, 1977, 1980).

For *L. laevigata*, species of *Cyphastrea*, *Montipora*, and *Porites* may serve as hosts in both geographical areas (Tab. 1). *Acanthastrea*, *Acropora (Isopora)*, *Heteropsammia*, *Lobophyllia*, *Platygyra*, *Psammocora*, *Symphyllia*, and *Turbinaria* were found to serve as hosts only at Lizard, *Pavona*, *Siderastrea*, and *Stylocoeniella* only at Safaga. Nevertheless, in the E. Pacific, *Pavona varians* VERRILL, 1864 and *P. clivosa* VERRILL, 1864 (= *clavus* (DANA, 1846)) are hosts for *L. laevigata* (KLEEMANN, 1982).

Most host colonies are used by one *Lithophaga* species, although overlapping occurs in both areas. And, what is more surprising, the same host may hold one kind of borer in one area and another in the other area, in spite of the first occurring there, too. E.g., in the Red Sea, *Astreopora* is a (favorite) host of *L. simplex* (KLEEMANN, 1992), while at Lizard, *L. laevigata* and *L. lima* can occur in it (KLEEMANN, 1980). Many *Montipora* spp. serve as hosts for *L. laevigata* at Lizard, while in the Red Sea they usually inhabit *L. purpurea*, sometimes together with *Pedum* (KLEEMANN, 1990a: fig. 5), and rarely with *L. laevigata* (Tab. 1). Some *Lithophaga* species appear only in one area, e.g., *L. purpurea* from the Red Sea, and *L. kuehnelti* from the GBR. A Caribbean example is *L. dixonae* SCOTT, 1986. *L. lima*, originally described from Donganeb, southern Red Sea, in *Coscinarea monile* (FORSKAL, 1775), was not observed at Safaga. At Lizard usually present in one or a few specimens per coral head, *L. lima* is the only species which dwells in hosts used by other *Lithophaga* species, namely *L. laevigata* (in *Cyphastrea* and *Porites*) and *L. simplex* (in *Acanthastrea* and *Favia*) (KLEEMANN, 1980; Tab. 1).

Bivalves of different genera may occur in the same host colony, e.g., *Lithophaga* and *Pedum* in *Porites* (at Lizard) or *Montipora* (at Safaga, KLEEMANN, 1990a). Although several host and bivalve species are present in both areas, less equal associations than different ones can be noted (Tab. 1).

Regionally the host spectrum may become narrow, as in *Pedum*. At Lizard, it only occurred in *Porites* and *P. (Synaraea)*, while at Safaga in further 11 host genera (including *Hydnophora*, not mentioned in KLEEMANN, 1990a).

Caribbean *Lithophaga dixonae*, found exclusively in 3 *Madracis* species, and *L. kuehnelti* from the GBR, found in 3 *Acropora (Isopora)* species (Tab. 1), appear restricted to one host genus and geographical area. Thus, it would be interesting to determine the *Lithophaga* species in *Madracis kirbi* VERON & PICHON, 1976, from the GBR (VERON, 1986:88, fig. 1, 89, fig. 2), and other corals (see Appendix).

Different *Lithophaga* species sometimes dwell the same host colony. Particularly *L. lima* shares hosts with *L. laevigata* and *L. simplex* at Lizard. When *L. lima* specimens are fully grown, they can easily be spotted by the larger borehole apertures. At Safaga, *L. laevigata* and *L. purpurea* may occur together in *Cyphastrea* and *Montipora* (Tab. 1). Determination of the respective borer by the borehole aperture is difficult. But often the posterior ends of the shells are visible within the aperture and the purple colour of *L. purpurea* helps to distinguish it from the other. The smaller *L. purpurea*, is most common on the reef slope, to 50 m, in the respective hosts, often in very high population density.

*Lithophaga laevigata* dwells in *Porites* in both areas, particularly in lagoonal habitats, which are presumably

richer in nutrient compared with the reef slope. In the Red Sea, *L. laevigata* is rarely found in host genera, which it preferably occupies at the GBR, e.g., *Montipora* (KLEEMANN, 1980, including sp. "g" in tab. 3) and *Cyphastrea*. In the Red Sea, these are mainly bored by *L. purpurea* instead (KLEEMANN, 1980, 1992), a species not known from the GBR and dwelling also in *Echinopora* and *Stylocoeniella*. These and other genera are also used as hosts at Lizard by *Lithophaga* (VERON & PICHON, 1976).

Apart from errors in determination (see below), references of certain bivalves in live coral have to be regarded with caution, when assuming a probable association, as many dead coral borers survive coral overgrowth, e.g. *Gastrochaena* (KLEEMANN, 1980: figs. 5–6), which has often led to wrong conclusions. This has led to an oblique picture of the recorded coral-bivalve associations, including dead coral borers (MORTON, 1983, 1990).

The caption for Fig. 4A in MORTON (1983), reading "The siphons of *L. lima* protruding amid the expanded polyps of the day-feeding coral *Goniopora tenuidens*", should read "*L. laevigata*" (Tab. 1). *Lithophaga obesa* (PHILIPPI, 1847) is a dead coral borer, although MORTON (1990), referring to WILSON (1979), lists it as boring *Cyphastrea*. WILSON (1979:475), reported "*L. obesa* usually burrows in coral rock", and "a single specimen was extracted from among living polyps of a large massive coral head (probably *Cyphastrea*) at a depth of 3 meters". On the next page (WILSON, 1979:476), we read "in live *Porites*" for this specimen, which explains the mistake.

*Lithophaga curta* sensu HIGHSMITH (1980), from *Montipora berryi*, represents *L. laevigata* (KLEEMANN, 1990b) as does *L. hanleyana* sensu OTTER (1937) from *Porites* (KLEEMANN, 1980), while true *L. hanleyana* (REEVE, 1857) is a dead coral borer (KLEEMANN, 1984).

*L. hanleyana* sensu GOHAR & SOLIMAN (1963) represents three species: (1) *L. lessepsiana* from *Stylophora*, (2) *L. purpurea* from *Cyphastrea* and *Montipora*, and (3) *L. simplex* from *Goniastrea*.

*L. lima* sensu GOHAR & SOLIMAN (1963) represents *L. purpurea*.

WILSON (1979) treated *L. kuehnelti* and *L. simplex* as synonyms of *L. lessepsiana*, in 1985 (p. 187), he regarded *L. kuehnelti*, *L. laevigata*, and *L. simplex* as sibling species, and considered the status of *L. lessepsiana* being less clear, probably conspecific with *L. simplex*. To me, *L. lessepsiana* appears closer related to *L. laevigata* than *L. simplex*.

In contrast to dead coral, rarely more than one *Lithophaga* species is found per live host colony, although it occurs in both geographical areas. On the other hand, the same coral species may be inhabited by one species of *Lithophaga* in one area and by another somewhere else, in spite of the first being also present.

	Great Barrier Reef (Lizard)	Red Sea (Safaga)
<i>Lithophaga kuehnelti</i> KLEEMANN, 1977	<i>Acropora (Isopora) brueggemanni</i> <i>A. (I.) cuenata</i> <i>A. (I.) palifera</i>	
<i>L. laevigata</i> (QUOY & GAIMARD, 1835)	<i>Astreopora myriophthalma</i> <i>Coscinarea columna*</i> ) <i>Cyphastrea microphthalma</i> <i>C. serailia</i> <i>Goniopora tenuidens</i>	<i>Cyphastrea</i>  <i>Favia stelligera</i> <i>Leptastrea purpurea</i> <i>L. transversa</i> <i>Montipora</i> spp. (rarely) <i>Porites</i> spp. <i>P. (Synarea) rus</i>
<i>L. lessepsiana</i> (VAILLANT, 1865)	<i>Montipora</i> spp. <i>Porites</i> spp.  <i>Psammocora contigua</i> <i>P. profundacella</i>	<i>Stylophora pistillata</i>  <i>P. damicornis</i> <i>Stylophora danae</i> <i>S. kuehlmanni</i> <i>S. mammillata</i> <i>S. pistillata</i> <i>S. subseriata</i>
<i>L. lima</i> LAMY, 1919	<i>Heteropsammia cochlea</i> <i>Pocillopora damicornis</i> (Heron I.)  <i>Stylophora pistillata</i>	
	<i>Acanthastrea echinata</i> <i>Astreophora ehrenbergi</i> <i>A. myriophthalma</i> <i>Coeloseris mayeri</i>	<i>Coscinarea monile</i> (from Donganeb, S Red Sea)
	<i>Cyphastrea serailia</i> <i>Diploastrea heliopora</i> <i>Favia pallida</i> <i>Leptoria phrygia</i> <i>Platygyra daedalea</i> <i>Porites lobata</i> <i>Porites</i> sp.	
<i>L. purpurea</i> KLEEMANN, 1980		<i>Cyphastrea microphthalma</i> <i>C. serailia</i> <i>Echinopora gemmacea</i> <i>E. lamellosa</i> <i>Montipora</i> spp. <i>Siderastrea savignyana</i> <i>Stylocoeniella guentheri</i>
<i>L. simplex</i> IREDALE, 1939	<i>Acanthastrea echinata</i>  <i>Astreopora</i> sp. <i>Echinopora mammiformis</i> <i>Favia amicornum</i> <i>F. favosa</i> <i>F. favus</i> <i>F. lizardensis</i> <i>F. pallida</i>  <i>G. retiformis</i> <i>Lobophyllia corymbosa</i>	<i>Astreopora myriophthalma</i>          <i>Goniastrea pectinata</i> <i>G. retiformis</i>   <i>Pavona maldivensis</i>
<i>Lithophaga</i> sp.**)	<i>Symphyllia</i> sp. <i>Echinopora glabra</i> <i>Montipora</i> cf. <i>edwardsi</i> <i>M. foveolata</i> <i>M. verrilli</i> <i>M. verrucosa</i> <i>Porites andrewsi</i> <i>P. mayeri</i> <i>Turbinaria</i> cf. <i>mantonae</i>	
*) for <i>Goniastrea</i> in error (KLEEMANN, 1980)		
**) specimens were too small to show specific characters for identifications		

Table 1: Live coral bored by *Lithophaga* from Lizard Island, Great Barrier Reef, and Safaga, Red Sea.



Generally, coral-bivalve associations are regionally stable and do not overlap. Thus, it can be predicted which bivalve species will be found in the respective hosts.

In the literature (e.g., VERON et al., 1977; VERON & PICHON, 1976), many figured corals have distinct or probable *Lithophaga* boreholes (see Appendix). To which species they belong is dubious when either more than one has been observed in the host, e.g., in *Cyphastrea* (Tab. 1; MORTON, 1983: tab. 3), or no appropriate reference is available. From known associations and considering regional differences, in most cases host determination should yield the bivalve identity, too.

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### Appendix 1: Additional coral-boring bivalve associations illustrated in the literature

Hosts of the following list, represented by specimens, are indicated by collection numbers of the Natural History Museum, London (BMNH). All localities, except for *Merulina scheeri* from the Red Sea, are from the GBR, Australia.

#### Hosts of *Lithophaga laevigata*

*Montipora angulata* (LAMARCK, 1816), including *M. fossae* CROSSLAND, 1952, (according to VERON & WALLACE, 1984:75), infested colonies from the latter are BMHN 1934.5.14.195, –282, –286

*M. danae* (EDWARDS & HAIME, 1851), Palm Islands (VERON & WALLACE, 1984: fig. 134)

*M. informis* BERNARD, 1897, probably from Fizroy Reef and Raine Island (VERON & WALLACE, 1984: figs. 281 and 284 respectively)

*M. monasteriata* (FORSKAL, 1775), probably from Palm Islands and Corbett Reef (VERON & WALLACE, 1984: fig. 6, respectively figs. 9–10)

*Porites lichen* DANA, 1846, represented by the syntypes of *P. purpurea* GARDINER, 1898, BMHN 1904. 10.17.22

*P. stephensoni* CROSSLAND 1952, BMNH 1934. 5.14.232, –377, –400

*Porites* sp. A, BMNH 1978.2.2.141.

#### Probable hosts of *L. laevigata*

*Goniopora norfolkensis* VERON & PICHON, 1982, holotype, from Iris Point, Orpheus Island, Palm Islands (VERON & PICHON, 1982: fig. 169)

*G. somaliensis* VAUGHAN, 1907, Great Palm Island (VERON & PICHON, 1982: fig. 152)

*Merulina scheeri* HEAD, holotype, BMNH 1981.4.1.1, paratype, BMNH 1981.4.1.2, both from Harvey Reef, North Towartit

*Montipora fimbriata* BERNARD, 1897, holotype, BMNH 1892.12.1.274, from Warrior Island, GBR

*M. australiensis* BERNARD, 1897, from Willies Island (VERON & WALLACE, 1984: fig. 226)

*M. composita* CROSSLAND, 1952, GBR, BMNH 1934.5.14.303

*M. corbettensis* VERON & WALLACE (1984: figs. 272–273), from Corbett Reef

*M. hispida* (DANA, 1846), from Sue Island (VERON & WALLACE, 1984: fig. 207)

*M. stratiformis* BERNARD, 1897, holotype BMNH 1897.6.18.1, from New Guinea

*Psammocora digitata* (VERON & PICHON, 1976: fig. 37)

*P. explanulata* (VERON & PICHON, 1976: fig. 28)

*P. haimeana* (VERON & PICHON, 1976: figs. 39–40)

*Porites* sp. 1, from Magdelaine Cay (VERON & PICHON, 1982: fig. 89)

*P. annae* CROSSLAND, 1952, from Palm Islands (VERON & PICHON, 1982: figs. 80, 83)

*P. lichen* DANA, 1846, from Britomart Reef (VERON & PICHON, 1982: fig. 65)

*P. stephensoni*, from Low Isles (VERON & PICHON, 1982: fig. 33)

*P. (Synaraea) rus* (FORSKAL, 1775), from Yorke Island (VERON & PICHON, 1982: fig. 110).

#### Probable hosts of *L. simplex*

*Favia* sp. 1, from Hazard Bay, Orpheus I., Palm Islands (VERON et al., 1977: fig. 80)

*F. favius* (FORSKAL, 1775), from Whitsunday Islands (VERON et al., 1977: fig. 419)

*F. laxa* (KLUNZINGER, 1879), Lizard Island (VERON et al., 1977: fig. 415)

*F. matthai* VAUGHAN, 1918 (VERON et al., 1977: fig. 59)

*F. maxima* VERON et al., 1977 (fig. 427), from Withsunday Islands (in my view, *Favia maxima* includes *Favites rotundata* VERON et al., 1977)

*Goniastrea australiensis* (VERON et al., 1977: fig. 179)

*Lobophyllia hemprichii* (VERON & PICHON, 1976: figs. 457, 786), from Wistari Reef

*Symphyllia recta* (VERON & PICHON, 1976: fig. 796).

#### Hosts of *Lithophaga* sp.

*Astreopora gracilis* BERNARD, 1896 (VERON, 1986: 210, fig. 2)

*Barabattoia amicornum* (EDWARDS & HAIME, 1850) (VERON, 1986:466, fig. 1)

*Echinophyllia orpheensis* VERON & PICHON, 1980 (VERON, 1986:375, fig. 3)

*Favia maritima* (NEMENZO, 1971) (VERON, 1986:464, fig. 1)

*Goniastrea palauensis* (YABE, SUGIYAMA & EGUCHI, 1936) (VERON, 1986: 487, fig. 1)

*Leptastrea transversa* KLUNZINGER, 1879 (VERON, 1986:517, fig. 2)

*Symphyllia agaricia* EDWARDS & HAIME, 1849 (VERON, 1986:424, fig. 1).

For the above mentioned associations, I would presume to find only *L. simplex* in *B. amicornum*, *F. maritima*, *G. paulensis*, and *S. agaricia*; *L. laevigata* in *Leptastrea transversa*; in *A. gracilis* three species may occur, *L. laevigata*, *L. lima*, and *L. simplex*, ranked in probability.

#### Hosts of *Pedum*

*Porites lobata* (DANA, 1846), from Mellish Reef (VERON & PICHON, 1982: fig. 9)

*Montipora venosa* (EHRENBERG, 1834), the holotype, Zoologisches Museum Berlin 952, from an unknown locality but most probably from the Red Sea, is inhabited by a specimen of *Pedum* (VERON & WALLACE, 1984: fig. 170).

Figured *M. turgescens* BERNARD, 1897, and *M. hispida* (DANA, 1846) (VERON & WALLACE, 1984: fig. 82 and 208 respectively), both from Sue Island, GBR, appear to hold *Pedum* specimens.

#### Hosts of *Chlamys*

Three *Chlamys* sp. were observed in the syntype of *Acropora syringodes* (BROOK, 1892), from Palm Islands, BMNH 1892.6.8.209 (= *A. longicyathus* (EDWARDS & HAIME, 1860, VERON & WALLACE, 1984:392).

WALLER (1972) described *C. marshallensis* from *Acropora* sp., *Porites lutea*, and *Seriatopora hystrix*, and *C. cf. irregularis* from *Porites* and *Pocillopora*, from Eniwetok Atoll.

More unidentified *Lithophaga*-coral associations are figured in VERON & PICHON (1976: figs. 13, 28, 37, 39, 40, 47, 49, 153, 155), and several unknown are likely to be found by detailed investigations in the field.

## PLATE 1

- Fig. 1. A branch of *Acropora (Isopora) brueggemanni* (BROOK, 1893), about 10 cm in length, with tiny apertures of boreholes by *Lithophaga kuehnelti* KLEEMANN, 1977, at NPI, Lizard Island, GBR.
- Fig. 2. Cleaned *Goniopora tenuidens* (QUELCH, 1886), from NPI, Lizard Island, GBR, hosting four specimens of *Lithophaga laevigata* (QUOY & GAIMARD, 1835). Note dentation of posterior shell-incrustation; x 1.8.
- Fig. 3. *Pocillopora damicornis* (LINNAEUS, 1758), infested by *Lithophaga lessepsiana* (VAILLANT, 1865), from 12 m, S side of Abu Haschisch, near Safaga, N Red Sea; x 0.8.
- Fig. 4. Thin laminated *Porites (Synaraea) rus* (FORSKAL, 1755), with *Pedum spondyloideum* (GMELIN, 1791), from 10 m, SE side of Lizard Island, GBR; x 1.2.



PLATE 1

