

**A ZOOGEOGRAPHICAL ANALYSIS
OF THE RISSOININE FAUNA
OF THE EASTERN PACIFIC
WITH SPECIAL REFERENCE TO A COMPARISON
WITH THE CARIBBEAN FAUNA
AND WITH A CHECKLIST
OF THE EASTERN PACIFIC RISSOININAE STIMPSON, 1865
(MOLLUSCA : GASTROPODA)**

by

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SUMMARY

This paper reviews the faunal composition of the Rissoininae of the eastern Pacific. The number of rissoinine species has been estimated between 29 and 31, of which the vast majority occurs in the tropical part of the eastern Pacific. The Galapagos Islands and Guadalupe Island have a very impoverished rissoinine fauna.

Faunal affinities of the eastern Pacific Rissoininae with the Atlantic and Indo-Pacific fauna are discussed.

Key words : Rissoininae, eastern Pacific, zoogeography, checklist.

INTRODUCTION

As part of a review of the species of the Rissoininae, currently in progress, the rissoinine faunas of the eastern Pacific and the Atlantic Ocean were revised. This allows some conclusions on the distribution and species composition of the Rissoininae of the eastern Pacific and on the affinities with the Atlantic and Indo-Pacific rissoinine fauna. A systematic review of the eastern Pacific rissoinine species will be presented in a forthcoming paper.

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MATERIAL AND METHODS

The rissoinine material on which this study is based, is in the « Los Angeles County Museum », in the « Koninklijk Belgisch Instituut voor Natuurwetenschappen », Brussels, in the « United States National Museum », Washington and in the « Academy of Natural Sciences of Philadelphia ».

RESULTS

Composition of the eastern Pacific Rissoininae fauna

The number of known species, belonging to the subfamily Rissoininae from the eastern Pacific coast is estimated between 29 and 31 (cf. appendix I). Most species occur in the tropical part of the eastern Pacific from the Gulf of California to Ecuador. A group of about nine, closely resembling species occurs north of the Gulf of California. They resemble members of the genus *Schwartziella* NEVILL, 1881 in having a pyriform aperture and in the absence of the apophysis on the inner side of the operculum, but differ in lacking the typical parallel spiral threads on the outer margin of the interior side of the outer lip. No similar species are known from other parts of the world. They are tentatively assigned here to the genus ?*Schwartziella* until more information on their external morphology and internal anatomy will be available.

Geological history of the Panamanian Isthmus

From the Cretaceous to the Plio-Pleistocene, at least one, and possibly three, more or less wide seaways connected the eastern Pacific with the Caribbean Sea. Between 3.6-3.1 m.y. ago, the emergence of the Panamanian Isthmus isolated the Atlantic and Pacific biotas (JONES and HASSON, 1985). The emergence of the Panamanian Isthmus is a well documented vicariance event that may have caused the fragmentation of ancestral species ranges and, at longer term, eventually resulted in allopatric speciation. In several groups of molluscs, recent species-pairs (« cognates ») have been identified on the two sides of the Panamic Isthmus (e.g. D'ATTILIO, 1975; OLD, 1975; VOKES, 1975; VERMEIJ, 1978).

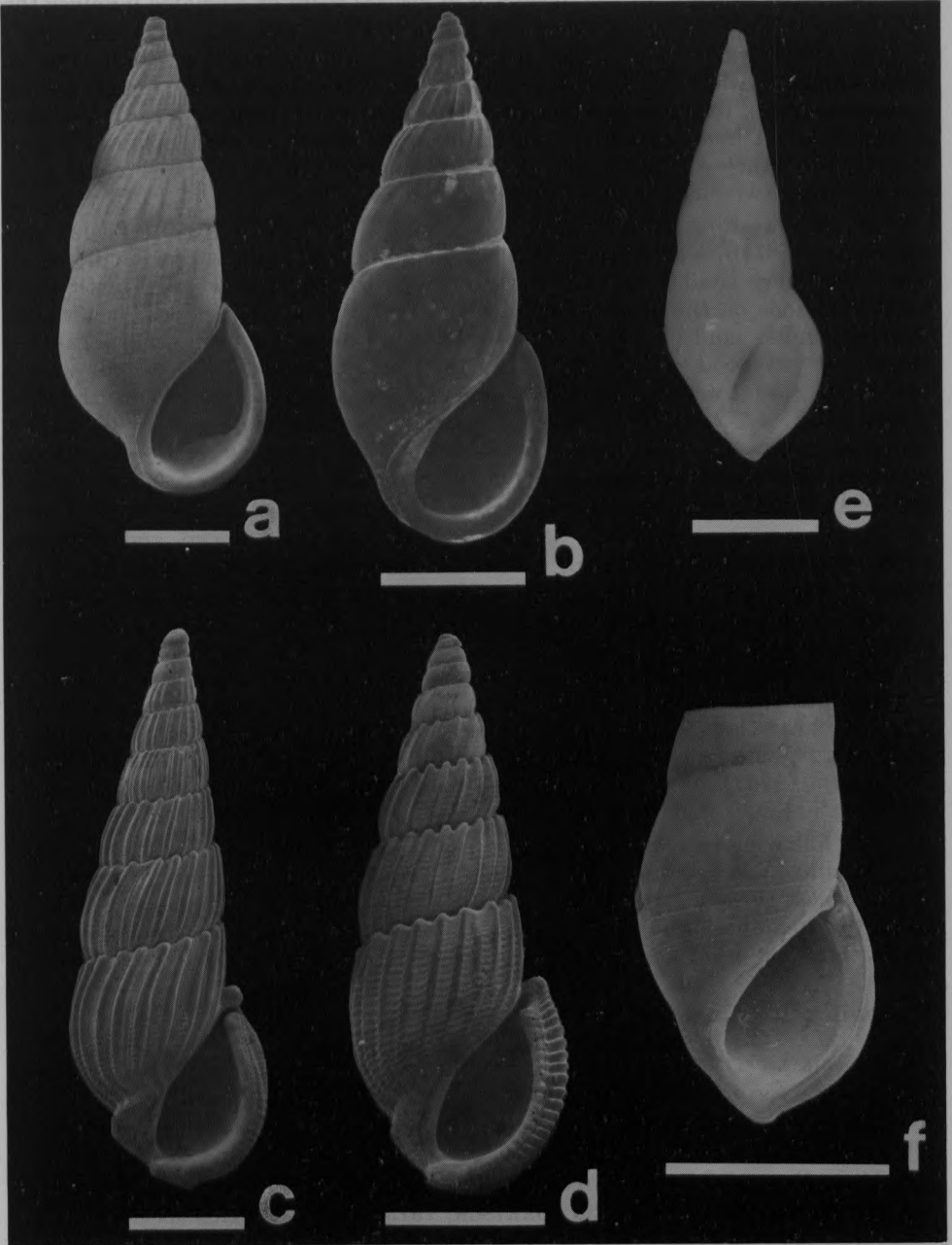
PLATE I

- a. *Zebina striosa* (C. B. ADAMS, 1850). Jamaica (USNM, 441843).
- b. *Zebina* sp. Bahia Herradura, Costa Rica (LACM, 72-52).
- c. *Mirarissolina bermudezi* (AGUAYO and REHDER, 1936). Miami (USNM, 451126).
- d. *Mirarissolina ericana* (HERTLEIN and STRONG, 1951). Golfo Elana, Costa Rica (LACM, AHF-316).
- e-f. *Mirarissolina histia* (BARTSCH, 1915). Concepcion Bay, Baja California, Mexico (KBIN) (Fig. 1f : detail of aperture).

Scale bars : 1 mm.

Atlantic-Pacific cognates among the Rissoininae on the opposite coasts of
North America

PLATE I



This plate contains six figures (a-f) of Rissoininae shells. Figures a, b, and c are lateral views of shells of varying sizes and ornamentation. Figures e and f are apical views of shells. Figure d is a more complex view, possibly showing the shell's profile and aperture. Each figure includes a white horizontal scale bar below it.

Atlantic-Pacific cognates among the Rissoininae on the opposite coasts of Tropical America

The demonstration of the existence of species-pairs or cognates involves the search for monophyletic groups of species on the Atlantic and the Pacific sides of America. The taxonomy of the Rissoininae is largely based on similarities in shell characters which are known to be very often the result of convergent evolution. Anatomical data are mostly unavailable, and even when they are, they turn out to be of little or no use for establishing phylogenetic relationships between species. Nevertheless, on the grounds of striking resemblances in shell characters, the following two species pairs are considered here :

(1) The western Atlantic *Zebina striosa* (C. B. ADAMS, 1850) (Pl. 1a) and *Zebina* sp., (Pl. 1b) a thus far underscribed species from the eastern Pacific. Both species are very similar in shell characters, viz. the thin, glossy shell with weak axial plications on the adapical spire whorls and the slightly globose last whorl. Because similar (and possible related) species are unknown from other localities, there is a very good reason to consider them sister species, i.e. a pair of species that have arisen from a single speciation event, each is the other's closest relative (LINCOLN *et al.*, 1982). The possible ancestor of both species may be *Zebina bulimina* (OLSSON and HARBISON, 1953) from the Pliocene of St. Petersburg, Southern Florida. This species strongly resembles both other species in its relatively thin shell and in its very similar shell shape.

(2) The western Atlantic *Mirarissolina bermudezi* (AGUAYO and REHDER, 1936) (Pl. 1c) and the eastern Pacific *Mirarissolina ericana* (HERTLEIN and STRONG, 1951) (Pl. 1d). Because both species are so similar in shell and apertural characters and no recent similar species are known from other localities, an inference of close relationship seems warranted. They may represent good examples of vicariance. Both species are characterized by the presence of a strongly elongate posterior channel. *M. bermudezi* has a very prominent apophysis on the inner lip, near the transition to the posterior channel; this apophysis is absent in *M. ericana*. A somewhat similar species is the « Miocene » *Mirarissolina lepida* (WOODRING, 1928), having a similar, but somewhat less prominent apophysis on the inner lip.

The following two species are listed by VERMEIJ (1978) as cognates : the eastern Pacific *Schwartziella effusa* MÖRCH, 1860 and the western Atlantic *Schwartziella fisheri* (DESJARDIN, 1949); both species are characterized by a strongly expanding inner lip near the shell base; otherwise both species are very similar to some other species from both sides of the Panamic Isthmus.

Paciphiles and Caribphiles

WOODRING (1966) introduced the terms « Paciphiles » and « Caribphiles » respectively for those species which were present in the fossil record of the western Atlantic but now extinct in that province, while still present in the eastern Pacific, and for those species which survived in the Caribbean only.

The only paciphile which could be identified without being too speculative, is the recent *Mirarissolina histia* (BARTSCH, 1915) (Pl. 1e, f). This species strongly resembles the « Miocene » *Mirarissolina xesta* (WOODRING, 1928) from Jamaica; both species are characterized by the absence of any axial and spiral sculpture apart from some spiral grooves near the shell base, which are slightly more

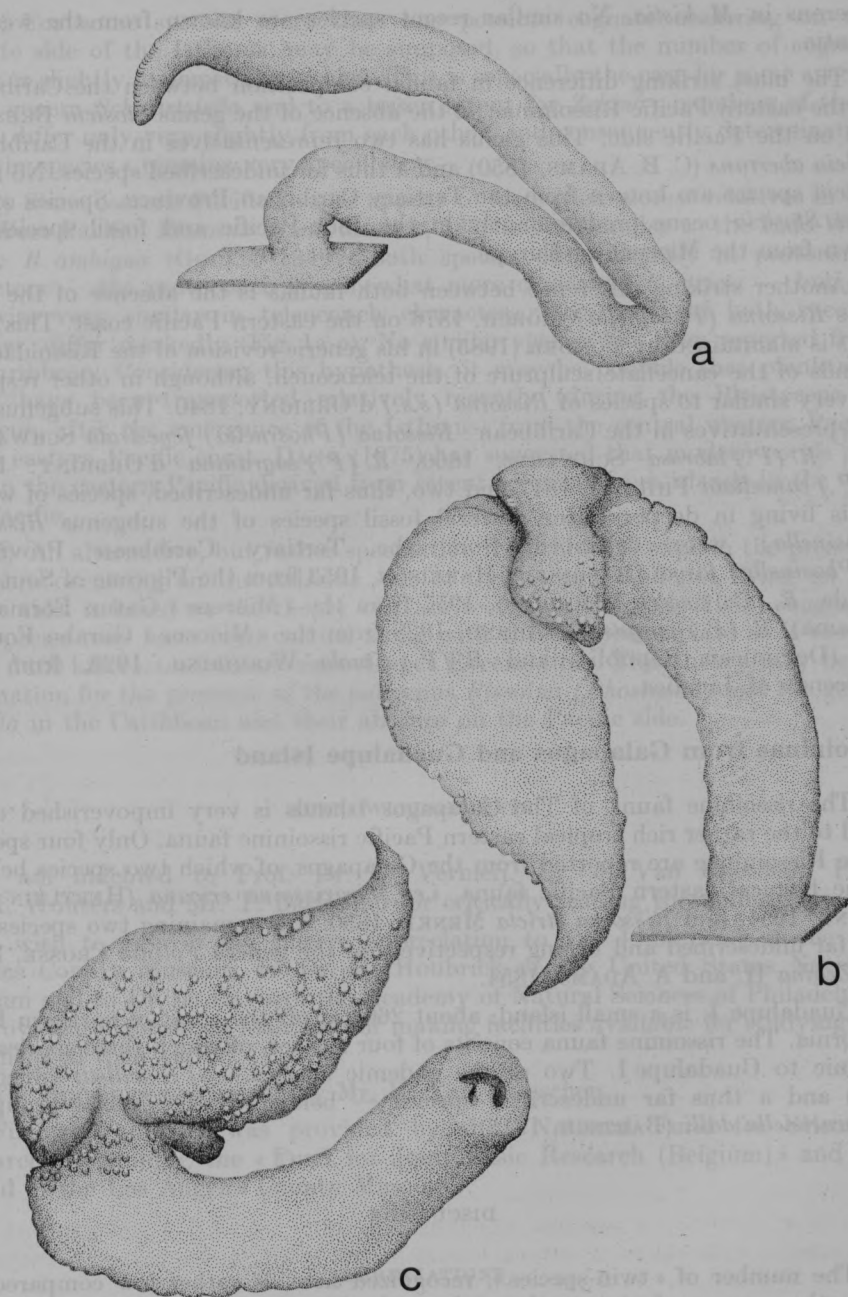


Fig. 1. — a : *Rissoina stricta* (MENKE, 1850). Penis, lateral aspect, San Carlos Bay, Mexico (ANSP, 354788) ; b-c : *Rissoina ambigua* (GOULD, 1849). Penis, dorso-lateral (Fig. 1b) and ventral (Fig. 1c) aspect, Vanuatu (AMS, 155164). Scale bar : 1mm.

numerous in *M. histia*. No similar recent species are known from the western Atlantic.

The most striking difference in faunal composition between the Caribbean and the eastern Pacific Rissoinae, is the absence of the genus *Stosicia* BRUSINA, 1870 on the Pacific side. This genus has two representatives in the Caribbean, *Stosicia aberrans* (C. B. ADAMS, 1850) and a thus far undescribed species. No fossil *Stosicia* species are known from the Tertiary Caribbean Province. Species of the genus *Stosicia* occur predominantly in the Indo-Pacific and fossil species are known from the Miocene of Europe.

Another striking difference between both faunas is the absence of the subgenus *Rissoina* (*Phosinella*) MÖRCH, 1876 on the eastern Pacific coast. This subgenus is maintained by PONDER (1985) in his generic revision of the Rissoidae, on grounds of the cancellate sculpture of the teleoconch, although in other respects it is very similar to species of *Rissoina* (*s.s.*) d'ORBIGNY, 1840. This subgenus has six representatives in the Caribbean: *Rissoina* (*Phosinella*) *fenestrata* SCHWARTZ, 1860, *R. (P.) labrosa* SCHWARTZ, 1860, *R. (P.) sagraiana* d'ORBIGNY, 1842; *R. (P.) cancellata* PHILIPPI, 1847 and two, thus far undescribed, species of which one is living in deeper water. Several fossil species of the subgenus *Rissoina* (*Phosinella*) were described from the Tertiary Caribbean Province: *R. (Phosinella)* *farqoi* OLSSON and HARBISON, 1953 from the Pliocene of Southern Florida, *R. (P.) oncera* WOODRING, 1957 from the « Miocene » Gatun Formation (Panama), *R. (P.) pyrgus* WOODRING, 1928 from the « Miocene » Gurabo Formation (Dominican Republic) and *R. (P.) rituola* WOODRING, 1928, from the « Miocene » of Jamaica.

Rissoinae from Galapagos and Guadalupe Island

The rissoinine fauna of The Galapagos Islands is very impoverished compared to the rather rich tropical eastern Pacific rissoinine fauna. Only four species of the Rissoinae are reported from the Galapagos, of which two species belong to the tropical eastern Pacific fauna, *i.e.* *Mirarissoina ericana* (HERTLEIN and STRONG, 1951) and *Rissoina stricta* MENKE, 1850. The remaining two species are thus far undescribed and belong respectively to the genera *Folinia* CROSSE, 1868 and *Zebina* H. and A. ADAMS, 1854.

Guadalupe I. is a small island, about 260 km off the coast of northern Baja California. The rissoinine fauna consists of four species, of which three species are endemic to Guadalupe I. Two of the endemic species — ?*S. willetti* (STRONG, 1938) and a thus far undescribed species — belong to the species group of ?*Schwartziella dalli* (BARTSCH, 1915).

DISCUSSION

The number of « twin-species », recognized here, is rather low compared to some other groups of gastropods, such as the Murocopsinae (VOKES, 1975), the Typhinae (D'ATTILIO, 1975), the Conidae (OLD, 1975) etc. Furthermore, rissoinine species occurring at both sides of the Isthmian barrier are unknown.

The following possible explanations can be formulated for the low number of rissoinid cognate species.

(1) For some species, more than one possible cognate occurring on the opposite side of the Isthmus, may be supposed, so that the number of cognate species is slightly underestimated here. This is especially the case for some species of the genera *Schwartziella* and to a lesser extent for *Zebina*: members of those genera differ only very slightly from each other, and consequently determination of « twin species » remains very speculative.

(2) Some eastern Pacific species appear to have their closest relatives in the Indo-West Pacific. *Rissoina stricta* MENKE, 1850 is very similar to the Indo-West Pacific *R. ambigua* (GOULD, 1849): both species differ slightly in protoconch characters — the protoconch is somewhat more conical in *R. stricta* — but are otherwise very similar in teleoconch characters. The penes of both species, however, differ markedly (Fig. 1a-c). No similar species has been reported from the Caribbean. Considering this hypothesis, it may be possible that planktonic larvae have been transported relatively recently (during the Pleistocene or Holocene, after the emergence of the Isthmus) from the central western Pacific to the eastern Pacific coast. DANA (1975) has suggested that modern corals and reefs in the eastern Pacific derived from recent colonists from islands in the central Pacific.

(3) An alternative, but rather speculative hypothesis to explain the presence of genera occurring on the Atlantic side of the Isthmus and not living on the Pacific side, is based on the theory of plate tectonics. DURHAM (1985) suggested that species may have been carried along with the Caribbean plate as it moved about 1400 km east-northeast since Upper Eocene time. This theory may be an explanation for the presence of the subgenus *Rissoina* (*Phosinella*) and the genus *Stosicia* in the Caribbean and their absence on the Pacific side.

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ABBREVIATIONS

ANSP : Academy of Natural Sciences of Philadelphia.

KBIN : Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels.

LACM : Los Angeles County Museum, Los Angeles.

USNM : United States National Museum, Washington.

LITERATURE CITED

- DANA, T. F. (1975), « Development of contemporary eastern Pacific coral reefs », *Mar. Biol.*, **33**, 355-374.
- D'ATTILIO, A. (1975), « Recent and fossil Typhinae of New World », *Bull. Am. Malac. Union* (1975), 50-51.
- DURHAM, J. W. (1985), « Movement of the Caribbean plate and its importance for biogeography in the Caribbean », *Geology*, **13**, 123-125.
- JONES, D. S. and P. F. HASSON (1985), « History and Development of the Marine Invertebrate Faunas Separated by the Central American Isthmus », in : STEHLI, F. G. and S. D. WEBB (eds), « The Great American Biotic Interchange », *Topics in Geobiology*, **4**, 325-355, New York/London.
- LINCOLN, R. J., G. A. BOXSHALL and P. F. CLARK (1982), *A dictionary of ecology, evolution and systematics*, Cambridge University Press, Cambridge/London/New York/New Rochelle/Melbourne/Sydney, 298 p.
- OLD, W. E. (1975), « Living *Conus* from the New World, with special reference to 'Twin Species' », *Bull. Am. Malac. Union* (1975), 52.
- PONDER, W. (1985), « A Review of the Genera of the Rissoidae (Mollusca : Mesogastropoda : Rissoacea) », *Rec. Aust. Mus., suppl.*, **4**, 1-221.
- VERMEIJ, G. J. (1978), *Biogeography and Adaptation*, Harvard University Press, Cambridge/Massachusetts/London, 332 pp.
- VOKES, E. H. (1975), « Eastern Pacific-Western Atlantic faunal affinities — Muricinae and Muricopsinae », *Bull. Am. Malac. Union* (1975), 54.
- WOODRING, W. P. (1966), « The Panama land bridge as a sea barrier », *Proc. Am. Phil. Soc.*, **110**, 425-433.

APPENDIX I

Checklist of the eastern Pacific Rissoininae

Superordo : Caenogastropoda COX, 1959

Ordo : Neotaenioglossa HALLER, 1882

Superfamily : Truncatelloidea GRAY, 1840

Family : Rissoidae GRAY, 1847

Subfamily : Rissoininae STIMPSON, 1865

Genus : *Rissoina* D'ORBIGNY, 1840

Rissoina allemani BARTSCH, 1931. Costa Rica - Panama.

Rissoina barthelowi BARTSCH, 1915. Baja California - Panama.

Rissoina expansa CARPENTER, 1865. Baja California - S. Mexico.

Rissoina inca D'ORBIGNY, 1840. Peru - N. Chile.

Rissoina peninsularis BARTSCH, 1915. Baja California - Ecuador.

Rissoina stricta MENKE, 1850. Baja California - Ecuador, Galapagos Is.

Rissoina (Rissolina) costata A. ADAMS, 1851. « Peru ». [= *R. turricula* PEASE, 1860]. This is a very doubtful record, as *R. costata* is a western Pacific species; possibly the specimens reported from Peru have been transported from the Pacific islands or they may represent mislocalized specimens.

Genus : *Zebina* H. and A. ADAMS, 1854

Zebina axeliana (HERTLEIN and STRONG, 1951). Baja California - N. Colombia.

Zebina (Tiphycorma) preposterum (BERRY, 1958). Baja California - Costa Rica.

Zebina sp. Baja California - Costa Rica.

Zebina sp. Galapagos Is.

Genus : *Schwartzziella* NEVILL, 1881

Schwartzziella burragei (BARTSCH, 1915). Baja California - Mazatlan.

Schwartzziella effusa (MORCH, 1860). Costa Rica - Colombia.

Schwartzziella firmata (C. B. ADAMS, 1852). Baja California - Colombia.

Schwartzziella woodwardii (CARPENTER, 1857). Baja California - Ecuador.

Schwartzziella nereina (BARTSCH, 1915). Baja California - Costa Rica.

Schwartzziella (Pandalosia) ephamilla (WATSON, 1886) [= *Rissoina porteri* BAKER, HANNA and STRONG, 1930]. « Gulf of California ». This is a very doubtful record as *S. (P.) ephamilla* is an Indo-western Pacific species.

Genus : ? *Schwartzziella*

? *Schwartzziella bakeri* (BARTSCH, 1902). S. California - Cedros I.

? *Schwartzziella californica* (BARTSCH, 1915). Santa Catalina I. - Cedros I., Guadalupe I.

? *Schwartzziella Coronadensis* (BARTSCH, 1915). Los Coronados Is.

? *Schwartzziella dalli* (BARTSCH, 1915). S. California - Cedros I.

? *Schwartzziella hannai* (SMITH and GORDON, 1948). Monterey Bay.

? *Schwartzziella newcombei* (DALL, 1897). S. Alaska - N. Canada.

? *Schwartzziella willetti* (STRONG, 1938). Guadalupe I.

? *Schwartzziella* sp. Guadalupe I.

? *Schwartzziella* sp. Channel Is. (California).

Genus *Folinia* CROSSE, 1868

Folinia signae (BARTSCH, 1915). Baja California - Ecuador.
Folinia sp. Galapagos Is.

Genus : *Mirarissoina* WOODRING, 1928

Mirarissoina ericana (HERTLEIN and STRONG, 1951). Baja California - Panama,
Galapagos Is.

? *Mirarissoina guadalupensis* (STRONG, 1938). Guadalupe I.

Mirarissoina histia (BARTSCH, 1915). Baja California - Panama.