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## Foreword

by Prince Henri of Luxembourg President, Galápagos Darwin Trust Europe

The development of a serious illustrated field guide to the marine molluscs of Galápagos started years ago thanks to Professor Cleveland Hickman of Washington and Lee University, Lexington, Virginia, USA, in an attempt to resolve a gap between the specialized molluscan literature and existing field guides to Galápagos fauna, flora, and geology. This project, begun in the 1980s, grew out of his study of intertidal and inshore macroinvertebrates, with the aim of producing a single field guide to the Galápagos marine invertebrates. He later modified this ambitious project to produce sectional guides in the Galápagos Marine Life Series, covering the common echinoderms and macrocrustaceans as well as marine molluscs.

Malacologist Yves Finet of the Museum of Natural History of Geneva, Switzerland then joined the project, bringing to it his expertise on Galápagos marine molluscs. I am especially delighted to see today the handsome result of this collaboration, which enlightens our knowledge of a fauna that is generally less familiar to the general public than the spectacular birds, reptiles or other vertebrate animals indiginous to the islands. The Galápagos Islands have always aroused worldwide interest and concern, and the present collaboration between an American professor and a scientist in Switzerland is another sign of such an international interest in this archipelago.

Years ago, I had the wonderful opportunity to visit the Galápagos for the first time. I had the immediate feeling that there was no other place on earth like this magical and still natural paradise, and that we all have to support every possible effort to study and preserve an ecosystem of such outstanding value.

Discovered in 1535, the Galápagos entered into the history of science following the visit in 1835 of the English naturalist Charles Darwin. The remarkable observations he made during his 5 -week visit contributed to his theory of evolution, later set forth in The Origin of Species (1859), one of the greatest intellectual achievements of all time. The Galápagos Islands subsequently became a National Park, and were awarded World Heritage Site status by the UNESCO. We are responsible for leaving such a legacy to our children and forthcoming generations. But if the past belongs to the future, only the present can help preserve it.

As President of the Galápagos Darwin Trust Europe and member of the Board of Directors of the International Charles Darwin Foundation, it has now become my great interest and endeavor to contribute to this task.

The Galápagos biodiversity is unique. While the isolation of the islands helped to preserve their originality for a long time, it also heightened their vulnerability to disruptions indiscriminately introduced by humans in recent

times. Should we now allow human intervention to replace this unique biodiversity by something which can already be found elsewhere in a depauperate or artificial world?

This book treats a special facet of Galápagos biodiversity. It reviews more than 250 of some 800 known species of Galápagos marine molluscs, approximately $20 \%$ of which are endemic. These species are vital links in the web of marine life, and serve as indicators of the health and equilibrium of the coastal waters of Galápagos.

Molluscan shells are creations of natural beauty. This book will convey to its readers the delight and satisfaction of studying the exquisite variety of these handsome creatures. Furthermore, books of this kind that increase our knowledge of animals and plants in threatened habitats contribute to wise environmental protection and management. Too often we find that very little is known about the fauna and flora of habitats threatened by encroaching urban and industrial development and the resulting pollution and eutrophication of coastal waters. Curiosity about molluscs and marine life in general is the kind of healthy pursuit that fosters environmental concern.

It is thus encouraging to see that both authors of the present book are working for that purpose, and the world of malacological specialists as well as those concerned with the Galápagos environment should welcome their work. It is also gratifying to see the Charles Darwin Research Station involved and taking a special interest in the project.


## Acknowledgements

Many people-scientists, students, and friends-have assisted in many ways with collection, photography, and identification. We prepared the photographs of shelled molluscs from several sources: our own collected material, the collection of Carmen Angermeyer in Puerto Ayora, Galápagos, the collections at the Charles Darwin Research Station, as well as those from various other museums. We are especially grateful to Carmen Angermeyer who on several occasions opened her extensive collection for inspection and photography. Others who helped with identifications were Jacqueline De Roy of Puerto Ayora, Galápagos, William K. Emerson, American Museum of Natural History; and Gene V. Coan and Terrence M. Gosliner, both of the California Academy of Sciences. Paul Humann and Terrence Gosliner contributed many of the fine photographs of opisthobranch molluscs; these are credited where they appear in the text. We also thank Larry Roberts and Terrence Gosliner for reviewing sections of the manuscript.

William C. Ober of Crozet, Virginia accompanied the first author on several trips to the Galápagos to assist in collecting and photography; he also prepared the drawings for the introduction. It is also a pleasure to acknowledge the cooperative assistance of the personnel of the Charles Darwin Research Station. Although many have helped in countless ways, we especially wish to thank marine biologist Rodrigo Bustamante and station director Robert BenstedSmith.

Cleveland P. Hickman Jr.
Yves Finet
March 1999


## Family Lucinidae

## Family Limidae

$\mathrm{F}^{\text {ileclams. Fileclams (or file shells) have ears like the scallops but the }}$ shell is obliquely asymmetrical with a longer anterior end and with widely gaping valves. Fileclams are able to swim but are less active than scallops. Of four species of fileclams recorded from Galápagos, only Limaria pacifica is common.

## 25. Limaria pacifica (d’Orbigny, 1846) (Syn.: Lima pacifica) <br> Pacific Fileclam

## Family Carditidae

ittle Heart Shells. These are sturdy shells with well-developed radial Lribbing and incurved beaks. Five species have been recorded from Galápagos of which only Strophocardia megastropha is common.


Lucina Clams. This is a large family of circular to ovate bivalves, mostly white in color, with an elongate anterior adductor muscle scar. We describe the three most common of five species recorded in Galápagos.

## 27. Codakia distinguenda (Tryon, 1872) <br> Elegant Lucine

Length 50 to 140 mm (2 to 5.5 in ) A beautifully white shell with saucer-shaped white valves much prized by collectors. Fine radial sculpture is crossed by spaced concentric growth lines. The hinge plate and the wide inner margin are rose-red and the center is often creamy-yellow. This lucinid is perhaps the largest species in the family. Habitat \& range: Subtidal on sand, living on tide flats at extreme low tide. Lower California to Colombia and Galápagos Islands.


## 28. Ctena galapagana (Dall, 1901)

## Galápagos Lucine

Length to 25 mm (1 in)
This small whitish lucine is easily distinguished from Codakia distinguenda by its much coarser ribbing, smaller size, and absence of coloration inside. The radial ribs are often irregularly beaded. Habitat \& range: Intertidal and subtidal on sand, down to $25 \mathrm{~m}(80 \mathrm{ft})$. Common. Mexico to Peru and Galápagos Islands.


## 10. Calliostoma jacquelinae

 McLean, 1970Jacqueline Calliostoma Height to 10 mm ( 0.4 in ) Creamy opalescent shell with distinct whorls, each composed of several finely beaded spiral cords, and with two stronger cords at the periphery. This shell was named after its collector, Jacqueline De Roy of Puerto Ayora, Galápagos. Habitat \& range: Dredging depths down to $350 \mathrm{~m}(1150 \mathrm{ft})$ in the Galápagos Islands, where it is endemic.

11. Tegula cooksoni (E.A. Smith, 1877)


Height $9 \mathrm{~mm}(0.35 \mathrm{in})$, diameter 12 mm ( 0.5 in )
A small low-spired shell with evenly rounded whorls bearing a fine spiral striation. Color brown or gray, mottled with white or pink; the umbilicus is deep, surrounded by a white umbilical area.
Habitat \& range: Extreme low water,
lower littoral on rocks. This once-common shell is less common since the 1982-83 El Niño event. Cocos and Galápagos Islands.

## 12. Tegula snodgrassi (Pilsbry

 \& Vanatta, 1902)Green-tongued Tegula Height to $15 \mathrm{~mm}(0.6 \mathrm{in})$, diameter 14 mm ( 0.55 in )
Small, high-spired conical shell with evenly rounded whorls and beaded spiral sculpturing. The umbilical area is green, sometimes intensely so. Color grayishbrown or bluish-brown flecked with white. Habitat \& range: Lower littoral, on rocks or sand under rocks. Common. Galápagos Islands, probably endemic.



## 52. Cypraea albuginosa Gray, 1825

## White-spotted Cowrie

## Length to 33 mm ( 1.3 in )

The dorsal surface of this rather elongate cowrie is distinctively colored with large dark brown circles with light grayish centers, interspersed with smaller white spots, all on a tan ground color. The aperture is wider anteriorly and the margins are rounded. The convex base is whitish lavender. Habitat \& range: Intertidal and subtidal, down to 80 m ( 260 ft ), under rocks and in crevices. Gulf of California and Revillagigedo Islands to Manzanillo, Mexico; and Cocos Island to Panama and Ecuador, including the Galápagos Islands.

Living white-spotted cowrie with its mantle partially withdrawn.


## 53. Cypraea arabicula (Lamarck, 1811)

## Little Arabian Cowrie

Length to 35 mm (1.4 in)
A wide shell with humped dorsum and central, nearly straight aperture. The numerous aperture teeth are especially sharply chiseled, an important diagnostic feature. The base is nearly flat and the margins rather sharply angulate. Color light gray to greenish blue and flecked with a net of brown coalescent worm-like patterns. Margins pink with black spots; base pinkish-yellow, with black spots near the margins. Juvenile specimens are delicate, blue-gray in color, finely speckled with brown, often with three darker broad bands. Habitat \& range: Intertidal or subtidal to 20 m ( 65 ft ), under rocks. Gulf of California south to Peru and the Galápagos Islands.


## 54. Cypraea isabellamexicana Stearns, 1893 <br> Banded Cowrie

Length to 38 mm ( 1.5 in )
This uncommon cowry is distinguished by brown trail-like streaks on a pale brown dorsum. Margins of aperture light, interior white. The ends bear a conspicuous orange and brown spot. Aperture teeth small and numerous. Habitat and range: Intertidal and subtidal under rocks. Gulf of California to Panama and the Galápagos Islands.



Left. Living banded cowrie with the two folds of the black mantle covering the shell.

## 55. Cypraea robertsi Hidalgo, 1906

Roberts Cowrie

## Length to 29 mm ( 1.15 in )

Species similar to Cypraea arabicula but less humped dorsally, wide, oval in outline and with the margins somewhat thickened by a rounded callus, not so angulate as in arabicula. Dórsum light grayish with small, irregular brown flecks or spots. Margins pinkish-brown to fleshcolored, with dark brown spots, base almost white. The aperture is narrow and the teeth are rather blunt and coarse.
Habitat \& range: Low intertidal, under rocks. Reported from Mazatlan, Mexico, south to Peru and the Galápagos Islands. Common at Panama.



## Family Terebridae

Auger Shells. These are very long, slender shells, many-whorled with short anterior canal or notch and a short aperture. Sculpturing is more strongly axial than spiral, but in many species a spiral groove below the suture, called subsutural groove, delimits a "subsutural band" between it and the suture above; there are usually one or two low folds on the columella. Auger shells prefer a fine, sandy sea floor, where they move about just under the surface, hidden under a small mound of sand. They are active at night. Some species paralyze their prey with poison injected with a harpoon-like radula.

## 148. Terebra frigata Hinds, 1844 Striated Auger

Length to 30 mm ( 1.2 in) Shell whitish with slightly concave whorls. Axial ribs are undulating and swollen posteriorly, below suture to the preceding whorl. A subsutural spiral band is outlined by a row of punctuations in the interspaces between the swollen ribs. Fine spiral striae fill the remainder of the interspaces between ribs. Habitat \& range: Subtidal to $40 \mathrm{~m}(130 \mathrm{ft})$, on sand with rock patches. Galápagos Islands (type locality), probably endemic.


## 149. Terebra jacquelinae

 Bratcher \& Burch, 1970 (Syn.: Terebra hertleini Bratcher \& Burch, 1970) Jacqueline AugerLength to 36 mm ( 1.4 in ) This shiny whitish to cream-colored auger resembles T. frigata, with concave whorls and curved axial ribs that swell into knobs at both ends, where they meet the suture. There is no subsutural spiral groove. Depressions (interspaces) between the ribs and the knobs are almost smooth and tinted yellowish. This auger is named after Jacqueline De Roy of Puerto Ayora. Habitat \& range: Subtidal below 4 m ( 13 $\mathrm{ft})$, down to $50 \mathrm{~m}(165 \mathrm{ft})$, on sandy bottoms. Endemic to Galápagos Islands.


## 150. Terebra maculata (Linnaeus, 1758) Spotted Auger

Length to 30 cm (12 in)
A robust auger, cream colored with two rows of squarish dark brown spots on each whorl, the upper row near the suture larger than the lower one. There are also fawn to light brown bands of aligned squares below periphery on the last whorl. Subsutural spiral groove apparent only on early whorls. Surface smooth and shiny, with very fine growth striae. Body whorl elongate. Habitat \& range: Subtidal. Tropical Indo-Pacific to tropical eastern Pacific, Mexico to Panama, Cocos Island, Costa Rica, and the Galápagos Islands.

151. Terebra ornata Gray, 1834 Ornate Auger
Length to 82 mm (3.2 in)
A long but slightly stubby auger, ivory beige with three rows of squarish brown spots on the spire whorls and four rows on the body whorl, the uppermost row on the subsutural band delimited by a deep spiral groove. This subsutural band is convex or moderately noded in early whorls. Surface is otherwise smooth. Body whorl short, and columella strongly recurved. Habitat \& range: Intertidal and subtidal to dredging depths, on coral sand bottom. Gulf of California to Panama and the Galápagos Islands.


## 152. Terebra plicata Gray, 1834 Braided Auger

Length to 70 mm (2.75 in)
A shiny, pinkish cream or ivory shell, sometimes covered by a natural dark brickred varnish; early whorls are tinted with violet. Axial ribs straight to wavy, thin with wide interspaces. Subsutural band very prominent, with elongate nodes that prolong the axial ribs above the subsutural spiral groove. In some specimens, finely punctate spiral lines may cross the ribs. Habitat \& range: Coral sand bottom, subtidal to dredging depths. Common by
 dredging in Galápagos (type locality), but Keen (1971) notes it is rare on the continent (Central America).

Family Chromodorididae
172. Glossodoris dalli (Bergh, 1879)

Length to 40 mm ( 1.6 in ) The background color is white or cream with scattered red, brick-red, or orange spots. The rhinophores and gills are of the background color with scattered red spots. Habitat \& range: Intertidal and subtidal rocks. Gulf of California to Costa Rica and the Galápagos Islands.

173. Glossodoris sedna (Marcus \& Marcus, 1967) (Syn.: Casella sedna) Red-tipped Sea Goddess
Length to 47 mm (1.9 in)
This dorid is transparent white, bordered by a red band and, lateral of this, a faint yellow band. The rhinophores and gills are tipped with red. As with some chromodorids, the gills are in constant motion. Habitat \& range: Rocky intertidal. Gulf of California south to Costa Rica and the Galápagos Islands.


4-1 174. Chromodoris baumanni Bertsch, 1970

## Baumann Doris

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Length to 62 mm
$(2.4 \mathrm{in})$ Dorsum covered with interspersed deep red and light brown patches. Margin of dorsum is white with red spots. The gills are white with red
 ends. Habitat \&
range: Intertidal and subtidal to 20 m ( 65 ft ), under rocks. Common. Gulf of California to Ecuador and the Galápagos Islands.
175. Chromodoris ruzafai Ortea, Bacallado \& Valdéz, 1992

Length to 20 mm ( 0.8 in )
The pale-blue body of this chromodorid is obscured with an irregular reddish band marked with small yellow spots, extended nearly the entire length of the animal. The rhinophores are a dark

reddish-brown; the gills are light pink. Habitat \& range: Galápagos Islands, endemic.

## 176. Chromodoris sphoni

 (Marcus, 1971) (Syn.: Felimida sphoni [Marcus, 1971])
## Sphon Doris

Length to 40 mm (1.6 in)
This species is recognized by the elongate band of red spotted with yellow extending from the animal's head to the posterior circlet of white gills. At body center this band extends laterally to form a crude, elongate cross. The margin of the cross is lined with bright yellow spots. Habitat \& range: Intertidal and subtidal. This species has been reported from Mexico, Costa Rica, Panama, and Galápagos Islands.


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