

Iconography of the *Haliotis* Species and Subspecies of Australia and New Zealand

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Buzz Owen and Robert Kershaw

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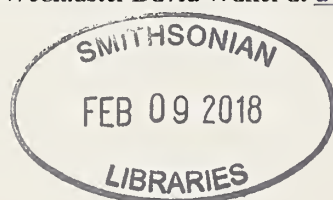
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Iconography of the *Haliotis* Species and Subspecies of Australia and New Zealand – Including Notes on Current Largest Recorded Specimens

Buzz Owen¹ and Robert Kershaw²

¹P.O. Box 601, Gualala, California 95445, USA

buzabman@mcn.org

²P.O. Box 476, Narooma, N.S.W. 2546, Australia

bob_kershaw@hotmail.com

INTRODUCTION

Approximately 82 species, subspecies, and forms of genus *Haliotis* are currently known to occur worldwide, and are distributed throughout much of the world, from as far north as central Alaska, to the subantarctic islands of New Zealand (Geiger, 1998; Geiger and Owen, 2012). Of this number, approximately 26% (21) are found in Australian waters, including 16 that are endemic to the continent. An additional seven taxa are endemic to New Zealand. They range in size from small warm water species seldom exceeding 40 mm in greatest diameter, to giant forms found in the cold waters of South Australia, which can exceed 240 mm in size. Included amongst these are some of the most diverse and strikingly beautiful species found in family Haliotidae.

The main purpose of this study is to illustrate these taxa with numerous color plates, and provide some basic information, which will be helpful in facilitating a better understanding of Australian and New Zealand abalone. A second reason for this work is to present what the authors believe is the most accurate and thorough appraisal of this area's existing taxa (species and subspecies) presented to date. With one exception, all past publications we have reviewed inevitably contain errors in the analysis and identification of these taxa and their distribution, most often due to insufficient material being available for study. To reach

some of the conclusions in this report, in excess of 3–4 million commercial shells (over both of our careers as a conservative estimate) have been examined in shell dumps in South Australia (SA) and Western Australia (WA), and many years have been spent examining other collections of Australian *Haliotis*, as well as interviewing numerous commercial divers and processors. This latter activity has brought to light several different hybrid forms which are also presented herein.

MATERIALS AND METHODS

Abbreviations of Collections: RKC: Robert Kershaw Collection; BOC: Buzz Owen Collection; PLC: Pat Lakeman Collection; MPC: Mark Payne Collection; TWC: Thora Whitehead Collection; ICC: Ian Clare Collection; ARC: Arjay Raffety Collection; JRC: Jenny Raven Collection; TGC: Tom Grace Collection; DDC: Dwayne Dinucci Collection; NHMUK: Natural History Museum United Kingdom.

Shells used in this study were selected to be in excellent condition to best illustrate details of sculpture and color. They were then hand-cleaned with small tools (such as an “Xacto” knife) and brushes to remove marine encrustations, and moistened with a light application of mineral oil to bring out natural color patterns. Excess oil was then removed from shell surfaces with a soft absorbent “terry-cloth”-type towel, to prevent glare when

photographed. Shells were photographed using Canon G6 and A650 digital cameras, having resolutions of 7.1 and 12.1 megapixels respectively. Resulting images were then processed using Adobe Photoshop CS4 on an iMac computer.

RESULTS AND DISCUSSION

The species and subspecies endemic to Australia will be treated first, followed by non-endemic taxa, and lastly the *Haliotis* of New Zealand. All are illustrated with two 8.5×11 inch photo plates, arranged so that both are visible simultaneously. Each pair of plates contains the following: 1) Photos of 13 shells, one often being a very large or even the largest known example (“World Record”). In most cases, this specimen is listed in “*Abalone Worldwide Haliotidae*” (Geiger & Owen, 2012). When the World Record shell is not available for inclusion, a very large specimen close to the same size is illustrated. 2) A brief overview of each form, covering its present known distribution, description of the shell, and a brief comment on other points of possible interest. 3) A map with a highlighted area illustrating where the species or subspecies is found, however distribution may be spotty as suitable habitat is not continuous. We feel that illustrating 13 shells, to show variations in color and sculpture is adequate to provide an understanding of each taxon. The mostly uncommon New Zealand subspecies of *H. virginea* Gmelin, 1791 will each be treated with a third photo plate containing 12 additional specimens. We felt that several of these subspecies are so uncommon that, as we were fortunate enough to have access to a fairly large amount of material, it would deepen ones knowledge to illustrate additional specimens.

Formerly Contentious Taxa: Four difficult and problematical taxa exist in eastern Australia, and two were described in 1869 (*H. brazieri* by Angas, and *H. hargravesi* by Cox), and two in

1927 (*H. melculus* Iredale, 1927 and *H. ethologus* Iredale, 1927). The first pair is found in New South Wales (NSW) from the Coff’s Harbour area south to about Eden. The second pair occurs in Queensland (QLD) from about Brisbane north to the Keppel Islands area. The two “pairs” are isolated from each other by about 425 km of sandy coastline devoid of rocky habitats. All are rare to extremely rare, with the northern pair (*H. melculus* and its form *ethologus*) being by far the rarest. Both northern and southern pairs are characterized by one of each having strong spiral ribs, with the other possessing weak to absent ribs. In the northern pair, the ribbed form (*H. melculus* form *ethologus*) is by far the most common, with the form lacking ribs (*H. melculus*) being extremely rare. The opposite situation exists with the southern pair: the ribbed form (*H. brazieri* form *hargravesi*) being much less common than the smooth form (*H. brazieri*). In addition, the ribbed form of the northern pair (*H. melculus* form *ethologus*) has much narrower ribs (often 11–15 between spire and line through tremata) than the ribbed form of the southern pair (*H. brazieri* form *hargravesi*), which averages only 7–8 ribs. (The latter taxon probably has the widest ribbing of any *Haliotis*.) The northern pair reaches a much larger size (largest known 67.5 mm), while the southern pair seldom exceeds 40 mm (largest known 51.0 mm). The sculpture of the northern taxa consists of a raised node on each of numerous very fine, folded ridges/lamellae. (Plates 1a, 1b, 2a, 2b, 8a, 8b, 9a and 9b). Prior to 2009, all four of these taxa were considered represented the same species, but examination of the animals revealed, that there are two different species (one north, one south) and both encompass ribbed and non-ribbed forms. It is our opinion that each “pair” of taxa consists of a single species exhibiting polymorphism, with a ribbed and smooth form. Similar cases are encountered with several other *Haliotis* species, most notably *H. clathrata*

Reeve, 1846 with its form *tomricei* Patamakanthin, 2002, and *H. ovina ovina* Gmelin, 1791 and its form *patamakanthini* Dekker, Regter, & Gras, 2001. Additionally, *Haliotis supertexta* Lischke, 1870, and *H. queketti* Smith, 1910, exhibit similar ribbed and smooth forms. This problem was finally resolved in August, 2009, when the first living specimen of *H. melculus* was taken near Brisbane, QLD. Close examination of this animal showed it to be vastly different than specimens of the southern pair of taxa; the QLD specimen has a smooth central area between the margins of the epipodium, while the southern pair has bulbous swollen tentacles/papillae in this region. These swollen structures were consistent with numerous specimens examined over the years and were no artifact of preservation.

Subspecies: Though the definition of what constitutes a “subspecies” is somewhat contentious (Geiger, 1998; Geiger & Owen, 2012), the definition we subscribe to is two or more populations of a given species that are geographically isolated, and differ in shell morphology. However, in several instances in the literature, subspecies of long standing and wide acceptance, whose distributions overlap (converge) where the two meet, are also accepted (Geiger, 1998; Owen, 2004a; Owen, 2004b; Owen, 2006; Owen, 2007; Geiger & Owen, 2012). Three examples of the latter (with convergence) are found in Australia, with one occurring in New Zealand, while four examples of the first (with complete isolation) are found in New Zealand on distant offshore islands and the mainland. These will all be treated similarly to full species.

Hybrids: Four Australian species are known to hybridize with one another creating four distinct hybrids (for the purpose of this discussion, the four species/subspecies are each considered single taxa). All are very rare to extremely rare (Owen and Kershaw, 2002), one cross being

known from but a single specimen (Owen and Kershaw, 2004). It is unlikely that any of these hybrids would be known were it not for a commercial fishery, in existence since approximately 1960, which has made it possible to examine vast amounts of material – literally millions of shells in commercial shell dumps in addition to live specimens in natural populations. The Australian hybrids are classic examples of hybridization between two *Haliotis* species, in that virtually all characteristics that clearly and distinctly separate two species are intermediate in the hybrid. This is not only true of the shell, but also of many characteristics of the animal as well, especially the epipodium (Cf. Owen et al., 1971). None of the hybrids could be mistaken for either parent species, and all clearly exhibit characteristics of both (Geiger & Owen, 2012). Hybridization is not known to occur between species of *Haliotis* found in New Zealand.

Commercial Fishery: A number of the larger species are fished commercially, and supply fresh and canned abalone meat to various world markets – especially in Asia. Both subspecies of *H. rubra* Leach, 1814 are taken in addition to *H. laevigata* Donovan, 1808. They are known by the following common names due to the color of the animal’s pigment: *H. rubra rubra*, “Black Lip”, *H. rubra conicopora*, “Brown Lip”, and *H. laevigata*, “Green Lip” abalone. One of the smaller species, *H. roei* J. Gray, 1826, is also taken commercially in Western Australia (WA). These fisheries exist in the colder waters of South Australia (SA), WA, Victoria (VIC), Southern NSW, and Tasmania (TAS). Diving in many of these areas is quite hazardous, as ocean conditions are often very rough, and sometimes divers have to protect themselves with a cage-like structure due to the threat of being attacked by the Great White Shark, commonly found on the south Australian coast.

We provide the scarcity on an ordinal scale of all Australian taxa and New Zealand taxa. (See Tables)

Complete List of Australian Species and Subspecies:

A) ENDEMIC TAXA:

- 1) *Haliotis brazieri* Angas, 1869. Plates: 1a & 1b. Distribution: NSW.
- 2) *H. brazieri* form *hargravesi* Cox, 1869. Plates: 2a & 2b. Distribution: NSW. (see: "Formerly Contentious Taxa").
- 3) *H. coccoradiata* Reeve, 1846. Plates: 3a & 3b. Distribution: NSW, VIC.
- 4) *H. cyclobates* Péron, 1816. Plates: 4a & 4b. Distribution: SA.
- 5) *H. diversicolor squamata* Reeve, 1846. Plates: 5a & 5b. Distribution: (Northern Territory) NT, WA.
- 6) *H. elegans* Koch in Philippi, 1844. Plates: 6a & 6b. Distribution: WA.
- 7) *H. laevigata* Donovan, 1808. Plates: 7a & 7b. Distribution: SA, WA.
- 8) *H. melculus* Iredale, 1927. Plates: 8a & 8b. Distribution: QLD.
- 9) *H. melculus* form *ethologus* Iredale, 1927. Plates: 9a & 9b. Distribution: QLD. (see: "Formerly Contentious Taxa").
- 10) *H. roei* J. Gray, 1826. Plates: 10a & 10b. Distribution: WA, SA.
- 11) *H. rubiginosa* Reeve, 1846. Plates: 11a & 11b. Distribution: Lord Howe Island, NSW.
- 12) *H. rubra conicopora* Péron, 1816. Plates: 12a & 12b. Distribution: WA.
- 13) *H. r. rubra/H. rubra conicopora* ("intergrade")*. Plates: 13a & 13b. Distribution: Elliston/Streaky Bay, SA.
- 14) *H. rubra rubra* Leach, 1814. Plates: 14a & 14b. Distribution: SA, VIC, NSW, TAS.
- 15) *H. scalaris emmae* Reeve, 1846. Plates: 15a & 15b. Distribution: SA, VIC, TAS.
- 16) *H. scalaris scalaris* Leach, 1814. Plates: 16a & 16b. Distribution: WA.
- 17) *H. semiplicata* Menke, 1843. Plates: 17a & 17b. Distribution: WA.

B) NON-ENDEMIC TAXA: (also found outside Australia / New Zealand):

- 18) *H. asinina* Linnaeus, 1758. Plates: 18a & 18b. Distribution: WA, NT.

* (Listed as a "Taxon", but actually an odd, semi-isolated population quite different from either "parent" taxa).

- 19) *H. clathrata* Reeve, 1846. Plates: 19a & 19b. Distribution: WA, NT, QLD.
- 20) *H. dissona* Iredale, 1929. Plates: 20a & 20b. Distribution: QLD.
- 21) *H. ovina ovina* Gmelin, 1791. Plates: 21a & 21b. Distribution: WA, NT, QLD.
- 22) *H. varia* Linnaeus, 1758. Plates: 22a & 22b. Distribution: WA, NT, QLD.

Complete List of New Zealand Species and Subspecies (all endemic):

- 23) *Haliotis australis* Gmelin, 1791. Plates: 23a & 23b. Distribution: N & S Island; Stewart Island, Chatham Islands.
- 24) *Haliotis iris* Gmelin, 1791. Plates: 24a & 24b. Distribution: N & S Island; Chatham Islands.
- 25) *Haliotis virginea crispata* Gould, 1847. Plates: 25a, 25b, & 25c. Distribution: N. Island.
- 26) *Haliotis virginea huttoni* Filhol, 1880. Plates: 26a, 26b, & 26c. Distribution: Campbell and Auckland Islands.
- 27) *Haliotis virginea morioria* Powell, 1938. Plates: 27a, 27b, & 28c. Distribution: Chatham Islands.
- 28) *Haliotis virginea stewartae* Jones & Owen, 2004. Plates: 28a, 28b, & 28c. Distribution: Bounty & Antipodes Islands.
- 29) *Haliotis virginea virginea* Gmelin, 1791. Plates: 29a, 29b, & 29c. Distribution: N & S Island; Stewart Island.

LIST OF HYBRID HALIOTIS (Australia)

- 30) *Haliotis rubra rubra* × *H. laevigata*. Plate: 30. Distribution: Port Lincoln, SA, to VIC; TAS.
- 31) *Haliotis rubra conicopora* × *H. laevigata*. Plate: 31. Distribution: Esperance to Albany, WA.
- 32) *Haliotis r. rubra/rubra conicopora* ("intergrade") × *H. Laevigata* (an odd semi-isolated population different from either parent). Plate: 32. Distribution: Elliston/Streaky Bay, SA.
- 33) *Haliotis laevigata* × *H. roei*. Plates: 33a & 33b. Distribution: WA to SA
- 34) *Haliotis rubra rubra* (or) *rubra conicopora* × *H. roei*. Plates: 34a & 34b. Distribution: WA to SA.
- 35) *Haliotis scalaris scalaris* × *H. laevigata* (unique). Plate: 35. Locality: Esperance, WA.

Table 1
AUSTRALIAN ENDEMIC TAXA

TAXON	AUSTRALIAN STATE							PLATE NO.
	QLD	NSW	VIC	SA	WA	NT	TAS	
<i>H. brazieri</i>	---	R	---	---	---	---	---	1a; 1b
<i>H. brazieri hargravesi</i>	---	ER	---	---	---	---	---	2a; 2b
<i>H. coccoradiata</i>	---	C	R	---	---	---	---	3a; 3b
<i>H. cyclobates</i>	---	---	R	C	C	---	---	4a; 4b
<i>H. diversicolor squamata</i>	---	---	---	---	C	C	---	5a; 5b
<i>H. elegans</i>	---	---	---	---	S	---	---	6a; 6b
<i>H. laevigata</i>	---	---	VC	VC	VC	---	C	7a; 7b
<i>H. melculus = ethologus</i>	ER	---	---	---	---	---	---	8a; 8b
<i>H. roei</i>	---	---	R	VC	VC	---	---	9a; 9b
<i>H. rubiginosa</i>	---	S	---	---	---	---	---	10a; 10b
<i>H. rubra conicopora</i>	---	---	---	---	VC	---	---	11a; 11b
<i>H. rubra conicopora "Intergrade"</i>	---	---	---	VC	---	---	---	12a; 12b
<i>H. rubra rubra</i>	---	VC	VC	VC	---	---	VC	13a; 13b
<i>H. scalaris emmae</i>	---	---	VC	VC	---	---	C	14a; 14b
<i>H. scalaris scalaris</i>	---	---	---	---	C	---	---	15a; 15b
<i>H. semiplicata</i>	---	---	---	S	S	---	---	16a; 16b

Table 1: Distribution of Taxa vs. Rarity in Australian States

ER: Extremely Rare (est. 20 specimens)

R: Rare (est. 100 specimens)

S: Scarce (est. 100–500 specimens)

C: Common (500–1000 specimens)

VC: Very Common (Fished Commercially)

(**est.**) = estimated total observed by authors

Table 2
AUSTRALIAN NON-ENDEMIC TAXA

TAXON	AUSTRALIAN STATE							PLATE NO.
	QLD	NSW	VIC	SA	WA	NT	TAS	
<i>H. asinina</i>	C	---	---	---	C	C	---	17a; 17b
<i>H. clathrata</i>	S	---	---	---	S	S	---	18a; 18b
<i>H. dissona</i>	ER	---	---	---	---	---	---	19a; 19b
<i>H. ovina</i>	C	---	---	---	S	S	---	20a; 20b
<i>H. varia</i>	C	---	---	---	C	C	---	21a; 21b

Table 2: Distribution of Taxa vs. Rarity in Australian States

ER: Extremely Rare (est. 20 specimens) C: Common (500–1000 specimens)
R: Rare (est. 100 specimens) VC: Very Common (Fished Commercially)
S: Scarce (est. 100–500 specimens) (est.) = estimated total observed by authors

Table 3
NEW ZEALAND TAXA

TAXON	LOCALITY						PLATE NO.
	North Isl.	South Isl.	Stewart Isl.	Chatham Isl.	Campbell/Auckland Isl.	Antipodes/Bounty Isl.	
<i>H. australis</i>	C	C	C	C	---	---	22a; 22b
<i>H. iris</i>	VC	VC	VC	VC	---	---	23a; 23b
<i>H. virginea virginea</i>	C	C	C	---	---	---	28a; 28b; 28
<i>H. virginea crispata</i>	C	---	---	---	---	---	24a; 24b; 29
<i>H. virginea huttoni</i>	---	---	---	---	S	---	25a; 25b; 31
<i>H. virginea morioria</i>	---	---	---	S	---	---	26a; 26b; 30
<i>H. virginea stewartae</i>	---	---	---	---	---	S	27a; 27b; 32

Table 3: Distribution of Taxa vs. Rarity in New Zealand

ER: Extremely Rare (est. 20 specimens) C: Common (500–1000 specimens)
R: Rare (est. 100 specimens) VC: Very Common (Fished Commercially)
S: Scarce (est. 100–500 specimens) (est.) = estimated total observed by authors

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ABOUT THE AUTHORS

Buzz Owen became interested in abalones in 1949, and has pursued the study of the family Haliotidae to this day. He began sport diving for the mollusk that year, and began a close examination of commercial *Haliotis* shell dumps as well. This searching of many tons of shells led to the discovery of several hybrid crosses, and began a seven year career of commercial abalone diving, to attempt to find living hybrids for confirmation. A paper on that subject was published by the Los Angeles County Museum of Natural History in 1971. He also worked in a commercial shellfish hatchery for 14 years, culturing several different hybrids, including a four-species hybrid, crossing gametes of two hybrids of dissimilar parentage. In 1979–1980, he worked on a project funded by the *Organization of American States*, investigating the feasibility of placing the red abalone (*H. rufescens*) into Chilean waters. About 1985 he began pursuing a growing interest in worldwide *Haliotis* species, aided by long-time enthusiast Katherine “Kit” Stewart. In 2002, he began writing for *Of Sea and Shore* magazine, which published over 50 of his

papers. He has described three species and four subspecies new to science. He is currently listed as the *Haliotis* specialist/expert of Guido and Philippe Poppe’s *Conchology, Inc.*, and was recently honored by being selected to be associate taxonomic editor of Haliotidae for the Muséum national d’Histoire naturelle, Paris, France. He continues to actively expand his collection of world wide *Haliotis*, which includes all described species and subspecies, plus the extremely rare hybrids – a number of which are found only in his collection.

Bob Kershaw began diving for abalone commercially in 1969 and continued until 1997 when a diving injury ended his career (he still holds a permit and quota shares in the fishery). His interest in Worldwide Haliotidae was awakening about this time, and he traveled to California to attend the Third International Symposium of Abalone Biology held in Monterey, California. There he met Buzz Owen and was exposed to large collections of worldwide *Haliotis*. From this experience, his interest turned into a passion and started his quest to assemble as complete a collection of the world’s species and subspecies as possible. He contacted shell dealers, other collectors, and found several shell auctions as well. Additionally, he traveled to distant parts of Australia to connect with commercial abalone divers, processors, and examine many tons of commercial shell, looking for gem quality specimens and hybrids. He worked with Owen and co-authored two papers exploring hybridization of Australian *Haliotis*, and stays in touch with his commercial contacts who continue to save rare material for him. Today, he is as aggressive as ever pursuing additional shells for his collection which is without doubt the most complete grouping of Australian *Haliotis* extant. In 2011, he traveled to Niue Island and discovered a new subspecies of abalone which was described as *Haliotis jacnensis kershawi* Owen, 2012.

REFERENCES

- Geiger, D. L. 1998. Recent Genera and Species of the family Haliotidae Rafinesque, 1815 (Gastropoda: Vetigastropoda). *The Nautilus* 111(3):85–116.
- Geiger, D. L. & Owen, B. 2012. *Abalone: Worldwide Haliotidae*. *Conchbooks*, Hackenheim, Germany. 361 pp., 92 pls.
- Owen, B., J. J. H. McLean & R. J. Meyer 1971. Hybridization in Eastern Pacific Abalones (*Haliotis*). *Bulletin of the Los Angeles County Museum of Natural History*. Science: No. 9.
- Owen, B. & R. Kershaw 2002. Hybridization in the South and Western Australian Abalones (Genus *Haliotis*): A Photo Study and Guide to the Identification of Shell Specimens. *Of Sea and Shore* 25:1: 55–66.
- Owen, B. & R. Kershaw 2004. A New Hybrid *Haliotis* from Western Australia. *Of Sea and Shore* 26:1: 50–53.
- Owen, B. 2004a. Proposed Revisions to *Haliotis diversicolor* Reeve, 1846, and Validation of *Haliotis supertexta* Lischke, 1870. *Of Sea and Shore* 26:2: 99–103; 105.
- Owen, B. 2004b. The *Haliotis brazieri* Angas, 1869, Complex of Eastern Australia: A Review and Photo study of a Contentious Group of Taxa. *Of Sea and Shore* 26:3: 166–172.
- Owen, B. 2006. The *Haliotis* subspecies of South and West Australia, Part 1: *H. rubra rubra* Leach, 1814, and *H. rubra conicopora* Péron, 1816. A Brief Description and Photo Study. *Of Sea and Shore* 27:3: 148–152.
- Owen, B. 2007. The *Haliotis* subspecies of South and West Australia, Part 2: *H. scalaris scalaris* Leach, 1814, and *H. scalaris emmae* Reeve, 1846. A Brief Description and Photo Study. *Of Sea and Shore* 27:4: 276–281.
- Angas, G. F. 1869. Descriptions of Twelve New Species of Land and Marine Shells from Australia and the Solomon Islands. *Proceedings of the Zoological Society* 4:45–49, pl. 2.
- Cox, J. C. 1869. On a New Species of *Haliotis* from New South Wales. *Proceedings of the Zoological Society* 4:49.
- Donovan, E. 1808. The New Cyclopaedia or Universal Dictionary of Arts and Sciences (1802–1820). (not seen)
- Filhol, H. 1880. Mollusques marins vivants sur les cotes de l'iles Campbell. *Compte Rendus des Séances Hebdomadaires de l'Academie des Sciences*, Paris, 51: 1094–1095.
- Gmelin, J. H. 1791. *Systema Naturae Per Regna Tria Naturae*, 13th edition. T1, Pars VI: 3021–3910.
- Gould, A. A. 1847. Descriptions of New Shells Collected by the U.S. Exploring Expedition under Capt. Wilkes. *Proceedings of the Boston Society of Natural History* 2: 251–253.
- Iredale, T. 1927. Colundra Shells. *Australian Zoologist* 4: 331–336.
- Jones, M. & B. Owen 2004. Description of *Haliotis virginea stewartae* New Subspecies from Subantarctic Islands of New Zealand. *Of Sea and Shore* 26:2: 81–85; 87.
- Leach, W. E. 1814. The Zoological Miscellany Vol. 1. *McMillan*, London. 144 pp.
- Lischke, C. E. 1870. Diagnose neuer Meeresconchylien von Japan. *Malacologische Blätter* 17:23–25.
- Menke, K. T. 1843. Molluscorum Novae Hollandiae. *Libraria Aulica Hahniana Hannoverae*. 46 pp.
- Péron, F. 1816. Voyages de Découvertes aux Terres Australes. *Imprimerie Impériale*, Paris.
- Philippi, R. A. 1845. Diagnoses Testaceorum Quorundam Novorum. *Zeitschrift für Malakozologie* 3: 147–152.
- Powell, A. W. B. 1938. Additions to the Recent Molluscan Fauna of New Zealand. *Records of the Auckland Institute and Museum* 2: 165–170.
- Reeve, L. 1846b. Monograph of the Genus *Haliotis*. 22 pp., 17 pls.
- Smith, E. A. 1910. On South African Marine Mollusca with Description of New Species. *Annals of the Natal Museum* 2: 175–219, 2 pls.

ADDITIONAL CITATIONS



Figure 1. Image of a live *Haliotis rubra rubra* Leach, 1814 on rocks in South Australia.

PLATE 1a

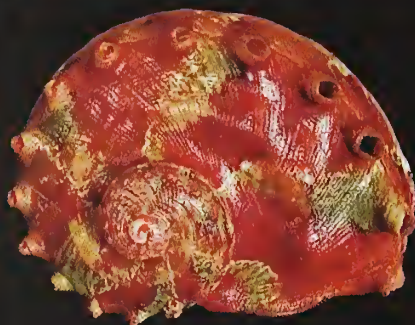
Haliotis brazieri Angas, 1869

Distribution: Northern NSW, south to approximately the Victoria border. Found under small rocks and rubble in 8-25 m.

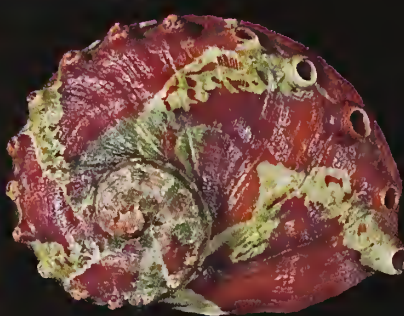
Description: Shell circular, small, seldom over 45 mm; brightly colored with red, green, cream, and purple. Interior nacre silver, and highly reflective. Spiral ribbing absent or extremely weak. 4-5 highly raised tremata. Usual adult size 35-40 mm.

Largest Specimen Measured: 51.6 mm (RKC).

Other: Far more common than the *hargravesi* form. Shells with the morphology of both forms (ribbed and smooth) exist. In the southern part of its range, often found close to *H. coccoradiata*, but seldom under same rocks and rubble.



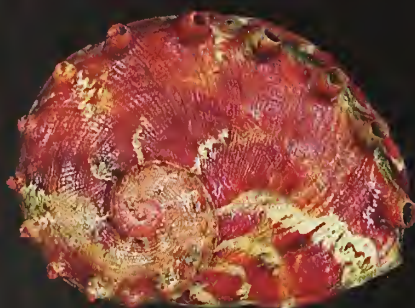
34.2 mm



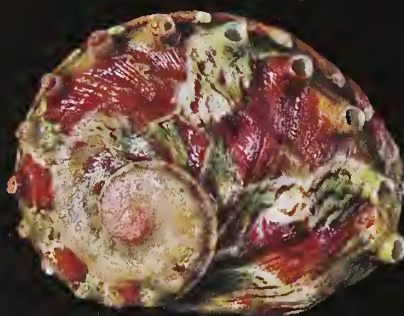
30.6 mm



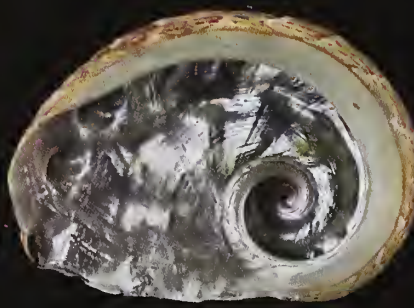
35.1 mm



33.1 mm



34.0 mm



37.0 mm

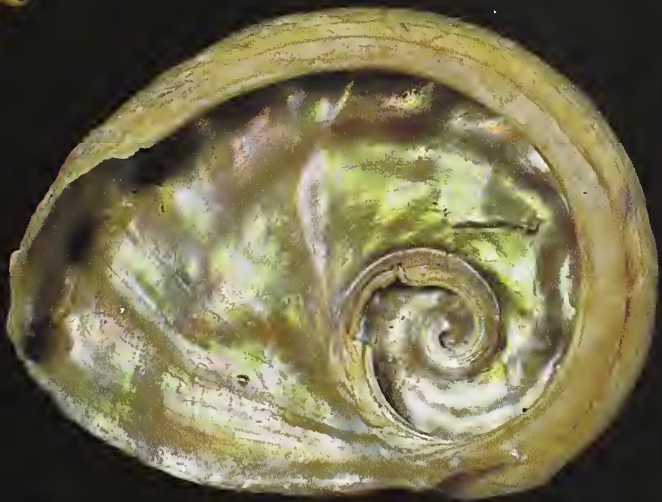
All specimens live-taken between Coff's Harbour and Eden, NSW. 15-25 m depth.

PLATE 1b

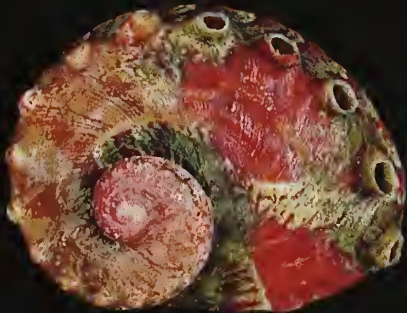
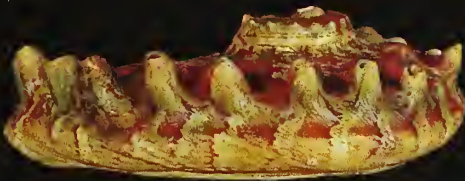
Haliotis brazieri Angas, 1869

Coff's Harbour to Eden, NSW

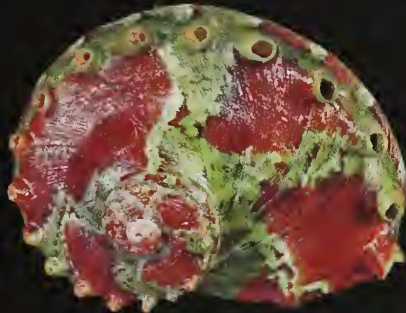
Rare



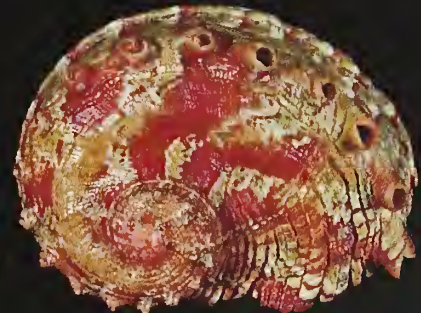
A



34.8 mm



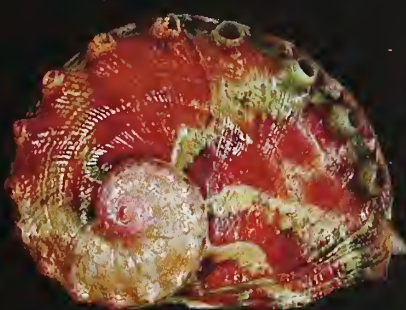
33.6 mm



32.1 mm *



31.4 mm



32.4 mm



31.6 mm

A: *Haliotis brazieri*. Largest specimen measured. 51.6 mm. Sydney Harbour, NSW, Australia. 20 m. Bottom 2 Rows: *H. brazieri*. NSW, Australia. (* Intergrade with form *hargravesi*). 20-30 m depth.

PLATE 2a

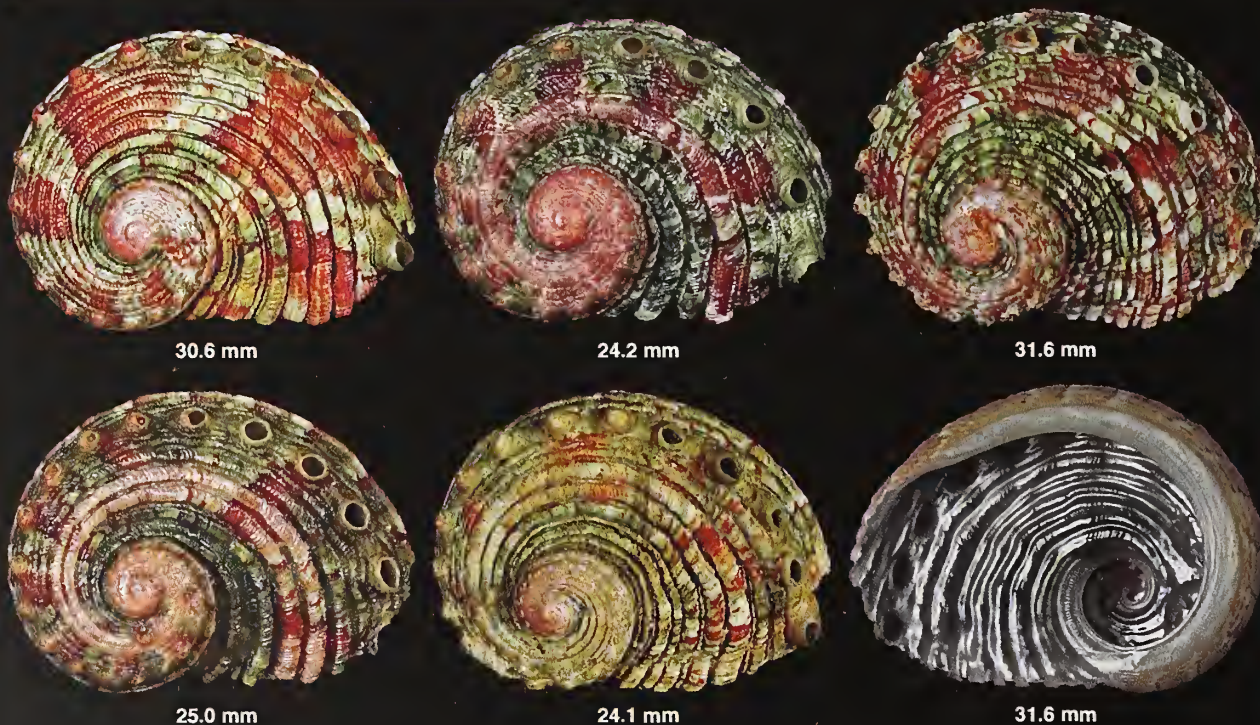
Haliotis brazieri form *hargravesi* Cox, 1869.

Distribution: Northern NSW, south to approximately the Victoria border. Found under small rocks and rubble in 8-25 m.

Description: Shell circular, small, seldom over 30 mm; brightly colored with red, green, cream, and purple. Interior nacre silver, and highly reflective. Spiral ribbing extremely strong and wide – it is this feature that separates this form from *H. brazieri*. 4-5 highly raised tremata. Usual adult size 30-35 mm.

Largest Specimen Measured: 37.5 mm (BOC). (There is little doubt that larger specimens exist).

Other: Occasional specimens will be found which are intermediate in details of spiral ribbing - partially ribbed, and partially smooth (like *H. brazieri*).



All specimens live-taken between Coff's Harbour and Sydney, NSW. 25-30 m depth.

PLATE 2b

Haliotis brazieri form *hargravesi*

Cox, 1869

Coff's Harbour, NSW, to near VIC

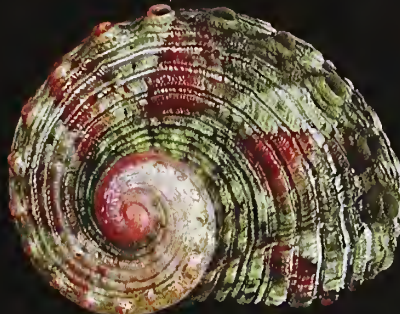
Extremely Rare



A



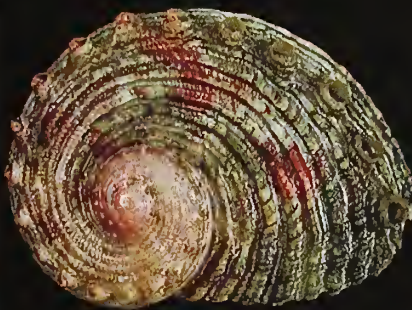
29.3 mm



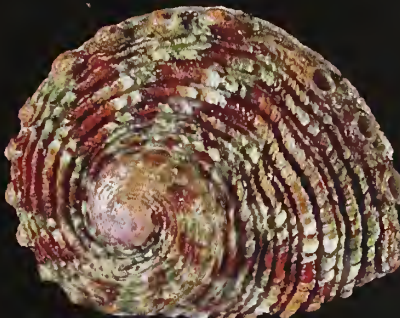
29.1 mm



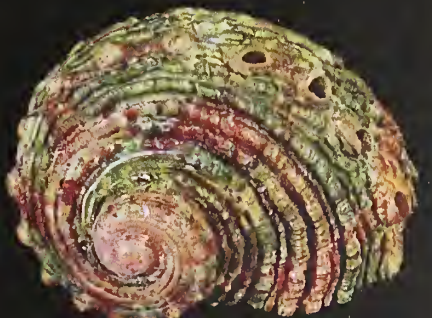
30.2 mm



28.6 mm



29.8 mm



28.6 mm

A: *Haliotis brazieri* form *hargravesi*. Large specimen. 41 mm. Coff's Harbour, NSW, Australia.
 Bottom 2 Rows: *H. brazieri* form *hargravesi*. Coff's Harbour to Sydney, NSW. 20-30 m depth.

PLATE 3a

Haliotis coccoradiata Reeve, 1846

Distribution: Found from Yamba, northern NSW, to Cape Conran, VIC, including offshore islands. Occurs intertidally north of Sydney, to ~20 m further south. Found under rocks and slabs - often in small groups up to ~12 animals. Very active when disturbed, moving quickly for cover.

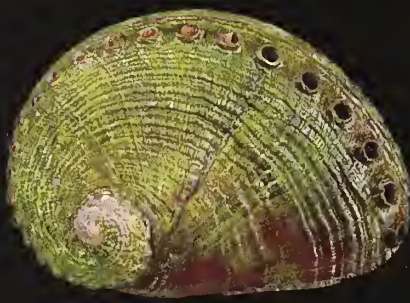
Description: Shell oval to slightly elongate. Color red-orange, to deep burgundy or green; strong, white, prosocline rays often present. Bright silver nacreous interior, with spiral ribs often visible. Fairly strong, medium width spiral ribbing generally present. Usually 5-7 slightly elevated holes open. Usual adult size 45-50 mm.

Largest Specimen Measured: 80.0 mm (RKC).

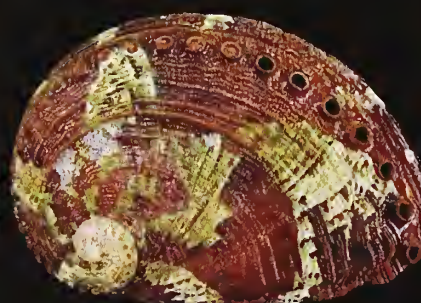
Other: A very brightly colored and variable species, often seen on the beaches of southern NSW. It has been found in great abundance at times when shifting sands have smothered large numbers of crevice protected animals.



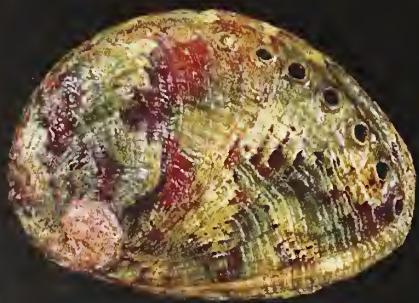
47.5 mm



40.1 mm



46.3 mm



47.4 mm



41.5 mm



75.0 mm

All specimens live-taken near Bermangui, NSW. 5-15 m depth.

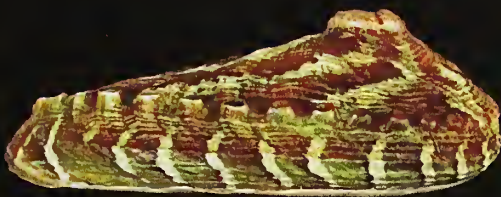
PLATE 3b

Haliotis coccoradiata
Reeve, 1846

NSW to VIC
Fairly common



A



34.3 mm



75.0 mm



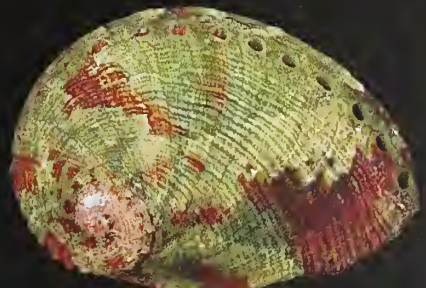
46.4 mm



37.9 mm



34.5 mm



36.2 mm

A: *Haliotis coccoradiata*.. Largest specimen measured. 80.0 mm. NSW, Australia.
Bottom 2 Rows: *H. coccoradiata*. NSW to VIC, Australia. 5-10 m depth.

PLATE 4a

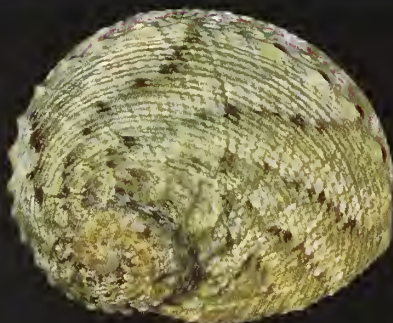
*Haliotis cyclobates* Péron, 1816.

Distribution: Esperance, WA, to Port McDonald near the SA-VIC border. Juvenile and sub-adult stages usually found on "razorfish" (*Pinna bicolor* Gmelin, 1791) in seagrass beds in sheltered areas and bays. Larger specimens found in algae covered rock ledges and around rocks. Intertidal to around 15 meters.

Description: Shell very rounded and inflated with elevated spire, located well towards center. Color light green to brown, usually with white to cream prosocline rays. Interior nacre bright silver showing spiral ribs. Spiral ribs narrow and fairly strong. Usually 4-6 slightly elevated holes. Usual adult size 50-60 mm.

Largest Specimen Measured: 97.0 mm. (RKC).

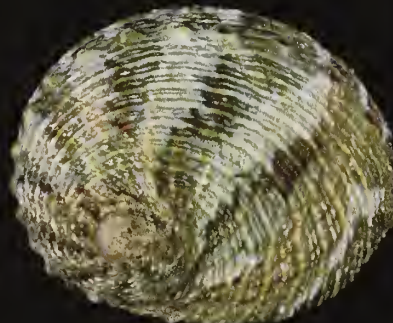
Other: Commonly preyed upon by sea birds (Oyster Catchers and gulls) at low tide.



59.3 mm



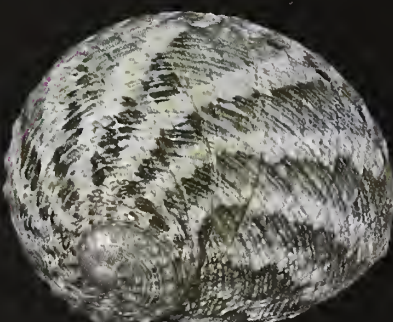
58.2 mm



35.3 mm



67.8 mm



74.2 mm



74.2 mm

All specimens live-taken from "Razorfish", Elliston, SA. 5-10 m depth.

PLATE 4b

Haliotis cyclobates
Péron, 1816

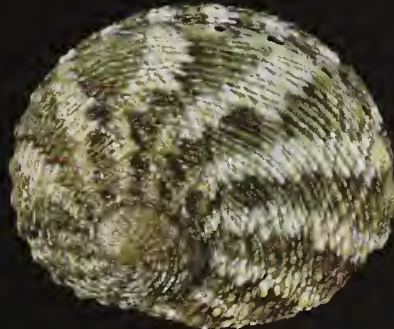
WA to near SA/VIC border

Common

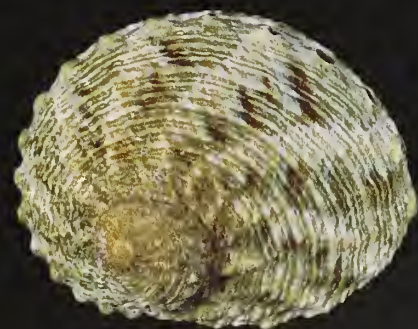
A



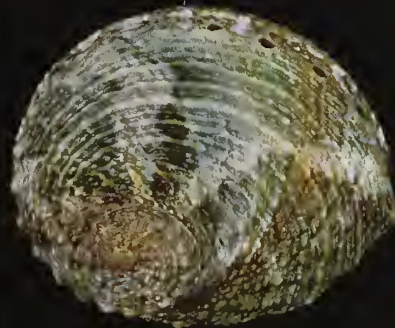
52.2 mm



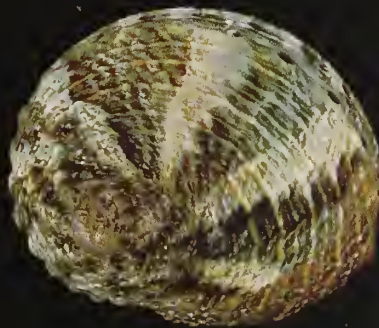
52.1 mm



51.2 mm



36.6 mm



30.1 mm



32.3 mm

A: *Haliotis cyclobates*. Largest specimen measured. 97.0 mm. Elliston, SA.
 Bottom 2 Rows: *H. cyclobates*. Elliston, SA. 5-10 m depth.

PLATE 5a

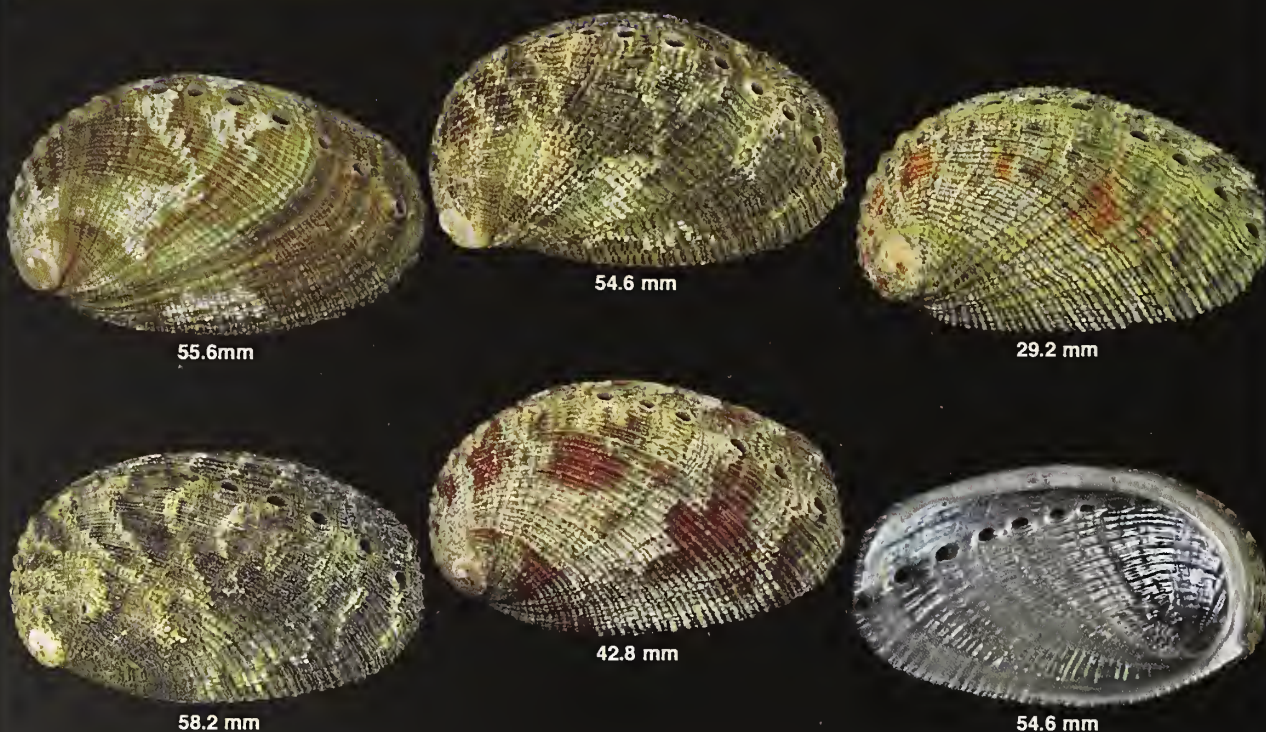
*Haliotis diversicolor squamata* Reeve, 1846.

Distribution: Shark Bay, WA, to Gulf of Carpentaria, NT. Intertidal zone to 5-10 m (shallow water). Found under rocks in dense algae growth. Most common in sheltered areas and bays.

Description: Shell very elongate, arched, spire at extreme posterior end. Color generally brown to greenish brown, often marked with strong whitish-cream chevrons. Interior nacre bright, often with bluish yellow reflections. Moderately strong and scaly spiral ribbing. Open holes usually number 6-9, and often extend closer to spire than most species. Usual adult size 55-65 mm.

Largest Specimen Measured: 82.0 mm (RKC).

Other: The Listed World Record of 97.9 mm is a specimen of *H. diversicolor diversicolor* from Java, Indonesia, which often slightly resembles the Australian subspecies. The northern ssp. attains much larger sizes, often in excess of 90 mm.

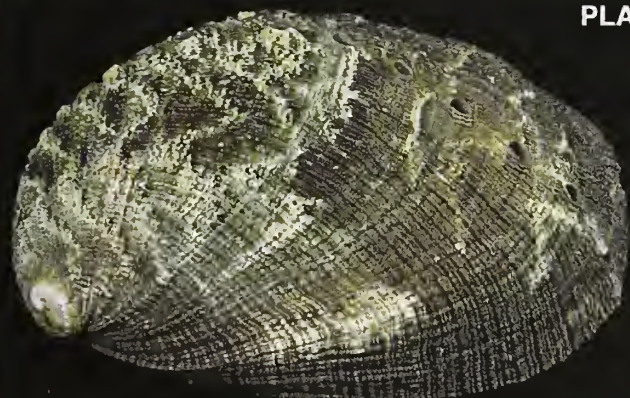


All specimens live-taken near Broome, WA. 5-10 m depth.

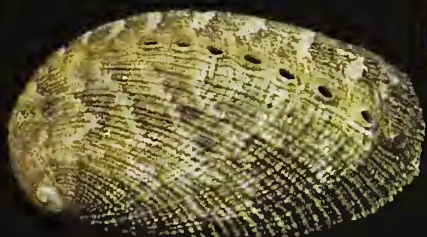
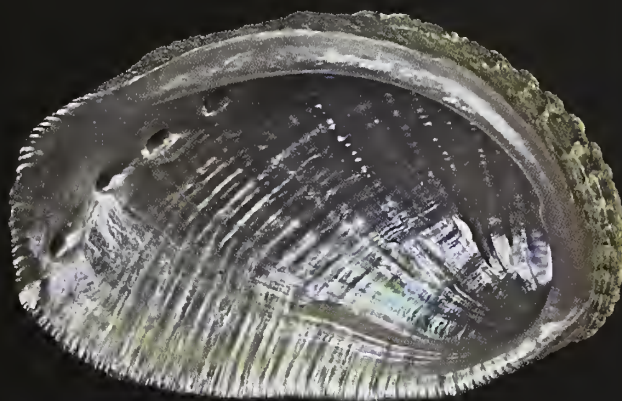
PLATE 5b

Haliotis diversicolor squamata
Reeve, 1846

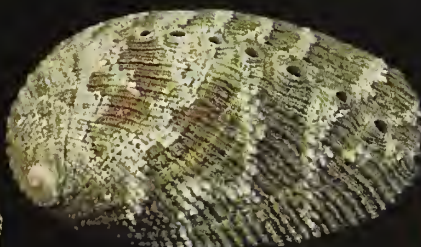
Shark Bay, WA to NT
Very common



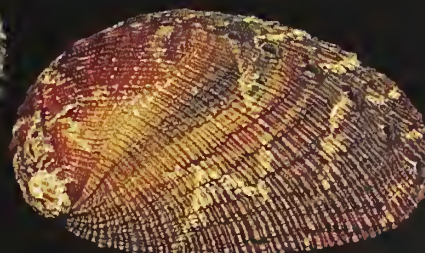
A



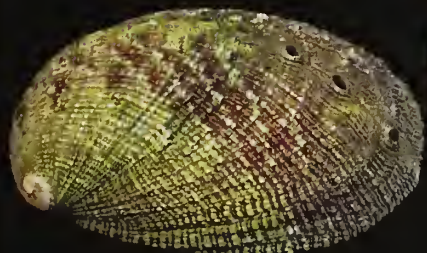
48.6 mm



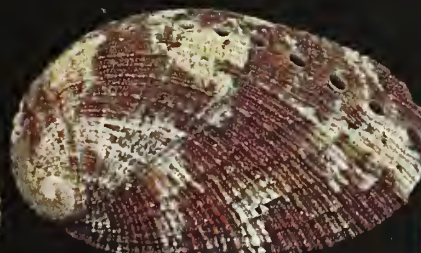
40.9 mm



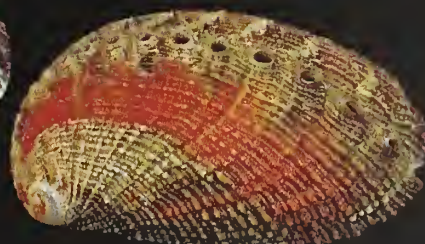
45.6 mm



59.3 mm



38.8 mm



39.2 mm

A: *Haliotis diversicolor squamata*. Large specimen. 67.5 mm. Broome, WA.
Bottom 2 Rows: *H. diversicolor squamata*. Near Broome, WA. 5-10 m depth.

PLATE 6a

Haliotis elegans Philippi, 1845.

Distribution: WA, from Esperance to Exmouth, in the extreme NW corner of the state. Very reclusive species, seldom found living; usually dead after octopus or fish predation. Occurs in somewhat deeper water, generally 10-30 m.

Description: Shell very elongate, highly arched, with spire at extreme posterior end of shell. Color usually light to dark brown, or reddish yellow to orange – sometimes with chevron or proso-cline ray markings. Interior bright silver nacre. Extremely strong and deep spiral ribbing, of varying width - perhaps strongest of any *Haliotis* species. Open holes usually number 6-12. More mature specimens often stop forming holes near anterior margin. Usual adult size 70-80 mm.

Largest Specimen Measured: 121.4 mm (RKC).

Other: *Haliotis elegans* used to be considered a very uncommon to rare species, and until fairly recently, had not been found living. This has changed in the past 10-20 years, but it still should be considered an elusive species.



All specimens live-taken between Perth and Fremantle, WA. 10-15 m depth.

PLATE 6b

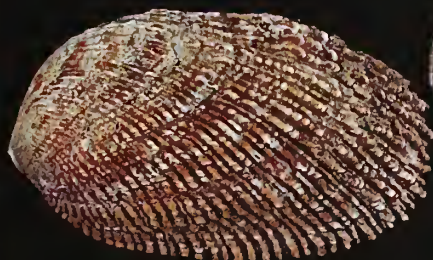
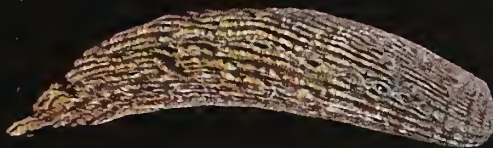
Haliotis elegans
Philippi, 1844

Esperance to Exmouth, WA

Uncommon



A



87.8 mm



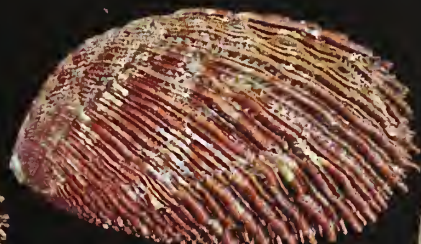
70.6 mm



68.3 mm



103.4 mm



91.3 mm



71.3 mm

A: *Haliotis elegans*. Largest measured specimen. 121.0 mm. Fremantle, WA.
Bottom 2 Rows: *H. elegans*. Fremantle to Geraldton, WA. 10-15 m depth.

PLATE 7a

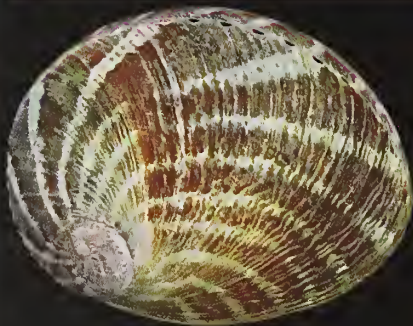
Haliotis laevigata Donovan, 1808.

Distribution: Central VIC to Geographic Bay, WA, including offshore islands; north coast of TAS. Found on open bottom, and on ledges and boulders. Prefers areas without dense bottom algae growth. Usually found in 10-30 m.

Description: Shell somewhat round, strongly inflated; often "bulbous" at spire. Color variable; bluish white to greenish brown, sometimes orange. Usually has strong prosocline ray development, sometimes of a "zig-zag" pattern. Interior nacre bright, with reflections of greenish yellow and pink. Spiral ribbing very weak to absent. Open holes generally number 8 to 12. Usual adult size 160-180 mm.

Largest Specimen Measured: 230.0 mm (RKC).

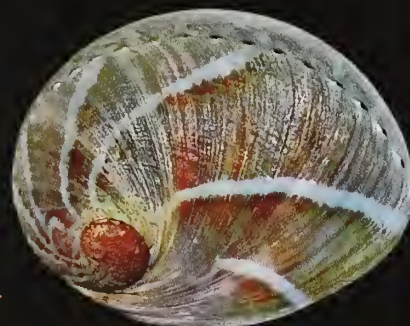
Other: Hybridizes with *H. rubra rubra*, *H. rubra conicopora*, and *H. roei*, but all are uncommon. Most prized of the commercial species, and commands the highest market price. Called the "Green Lip" abalone due to the green color of the epipodium and primary animal pigment.



166.3 mm



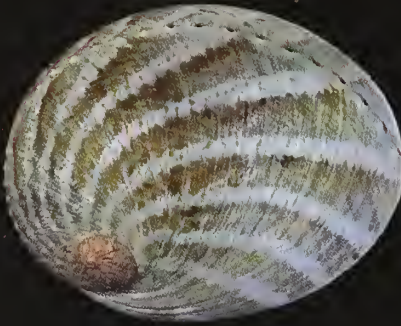
130.0 mm



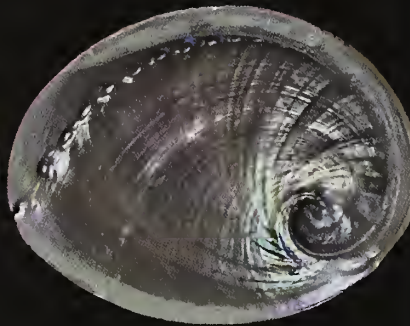
161.5 mm



198.0 mm



152.0 mm



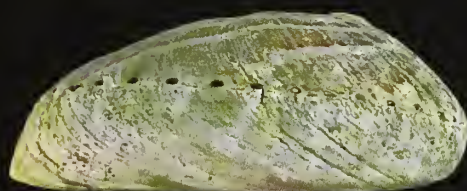
179.0 mm

All specimens taken between Port Lincoln, SA, and Esperance, WA. 10-25 m depth.

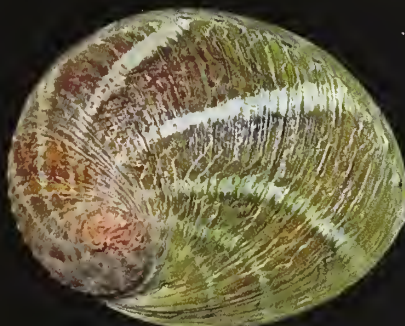
PLATE 7b

Haliotis laevigata
Donovan, 1808
WA, SA, VIC, TAS
Very Common

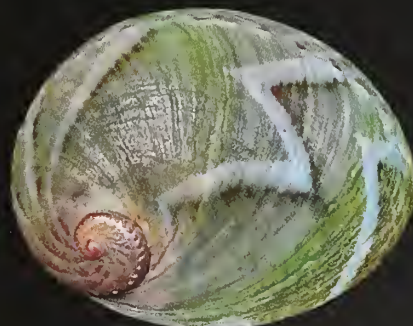
A



174.5 mm



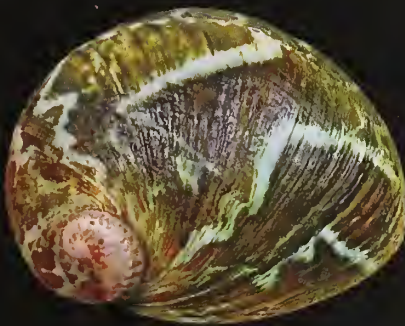
160.0 mm



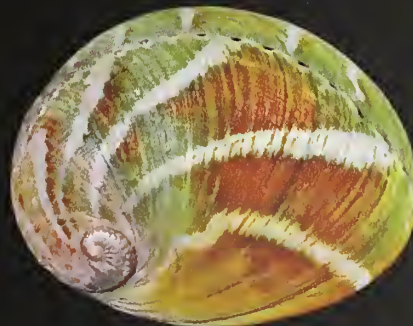
150.0 mm



179.5 mm



151.0 mm



165.0 mm

A: *Haliotis laevigata*. Largest specimen measured. 230.0 mm. Elliston, SA.
Bottom 2 Rows: *H. laevigata*. Elliston, SA. 5-15 m depth.

PLATE 8a

Haliotis melculus Iredale, 1927.

Distribution: QLD/NSW border area, inshore on reefs and around islands, to approximately Keppel Island, QLD. Found under small rocks and slabs. 8-25 m. Extremely rare.

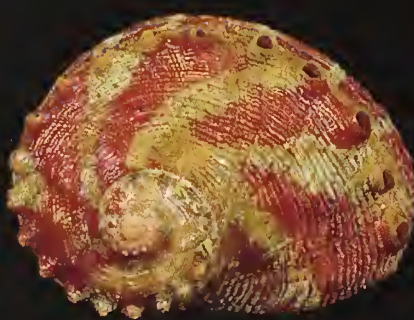
Description: Shell small, usually under 35 mm, round, spire located well towards center of dorsum. Color usually orange-red, sometimes brownish, often with yellowish prosocline rays. Interior highly nacreous, silver. Spiral ribbing weak to fairly strong; ribs are of medium width – much narrower than the extremely wide ribs of *H. brazieri* form *hargravesi*. Adult size 40-45 mm.

Largest Specimen Measured: 56.3 mm (TGC).

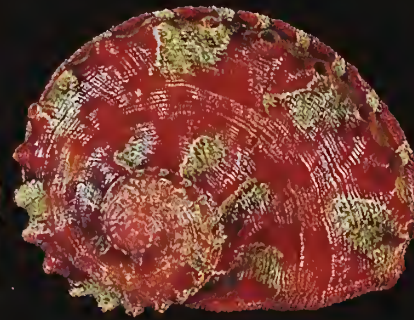
Other: Differs from *H. melculus* form *ethologus* Iredale, 1927, by the absence or near absence of pronounced wide spiral ribs. What ribbing is present is rather feeble and generally much narrower. Some specimens may also appear intermediate between the two forms.



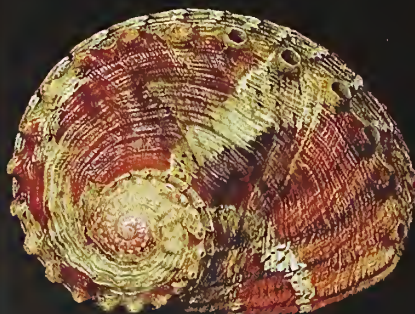
29.0 mm



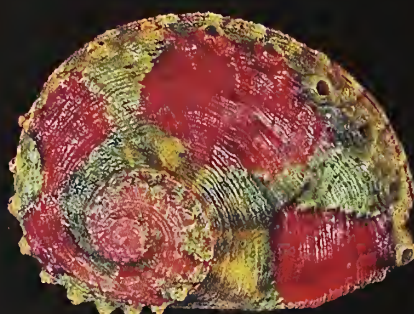
37.2 mm



42.0 mm



56.5 mm



40.0 mm



34.6 mm

All specimens live-taken between Point Cartright and Keppel Island, QLD. 15-20 m depth.

PLATE 8b

Haliotis melculus

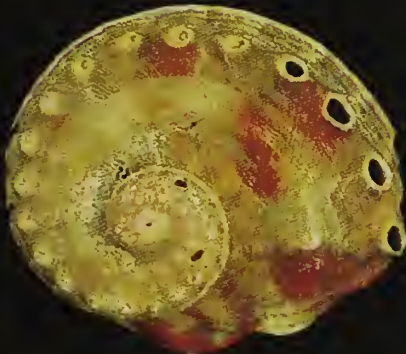
Iredale, 1927

QLD

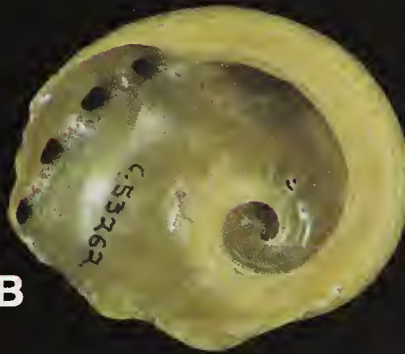
Extremely rare.



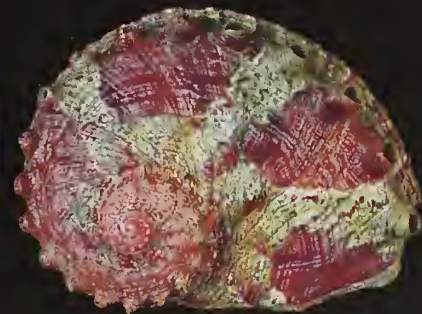
A



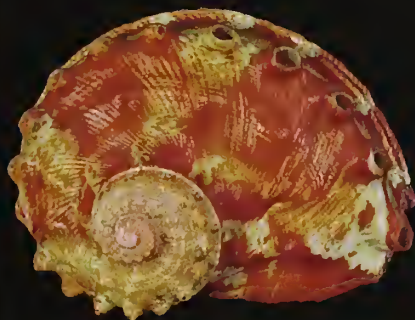
33.6 mm



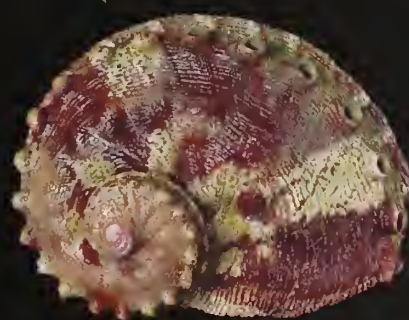
33.6 mm



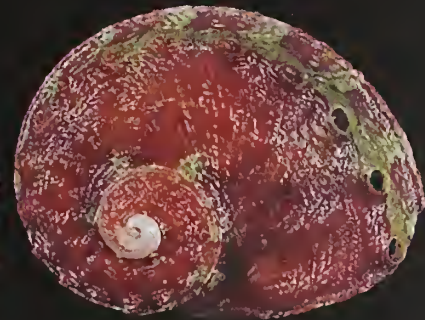
38.0 mm



32.3 mm



52.5 mm



17.0 mm

A: Mooloolabah, QLD. 42.0 mm. B: Type specimen. Near Point Cartright, QLD. All other specimens live taken between Point Cartright and Keppel Island, QLD. 12-20 m depth.

PLATE 9a

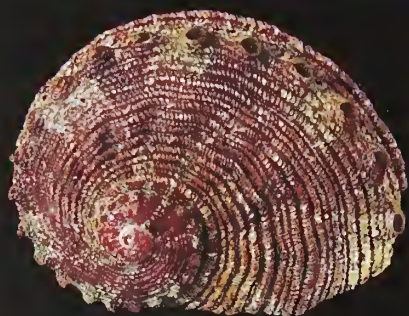
Haliotis melculus form *ethologus* Iredale, 1927.

Distribution: QLD/NSW border area, inshore on reefs and around islands, to approximately Keppel Island, QLD. Found under small rocks and slabs. 15-20 m. Extremely rare.

Description: Shell small, usually under 50 mm, round, spire located well towards center of dorsum. Color usually orange-red, sometimes brownish, often with yellowish prosocline rays. Interior highly nacreous, silver. Spiral ribbing weak to fairly strong; ribs are of medium width – much narrower than the extremely wide ribs of *H. brazieri* form *hargravesi*. Adult size 40-45 mm.

Largest Specimen Measured: 67.5 mm (RKC).

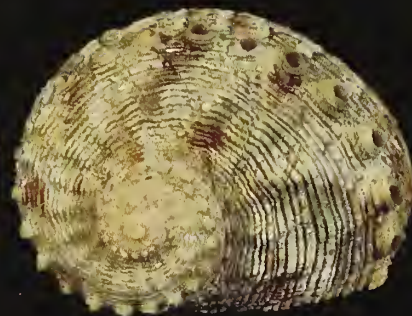
Other: *Haliotis melculus* f. *ethologus*, is a form of *H. melculus* which has stronger and more pronounced spiral ribbing. The 12 specimens on Plates 8a and 8b most closely resemble the smooth form (*H. melculus*) while the specimens on Plates 9a and 9b most closely represent the stronger ribbed form. Both forms will be found in the same habitat.



33.0 mm



41.0 mm



49.3 mm



35.1 mm



30.2 mm



33.0 mm

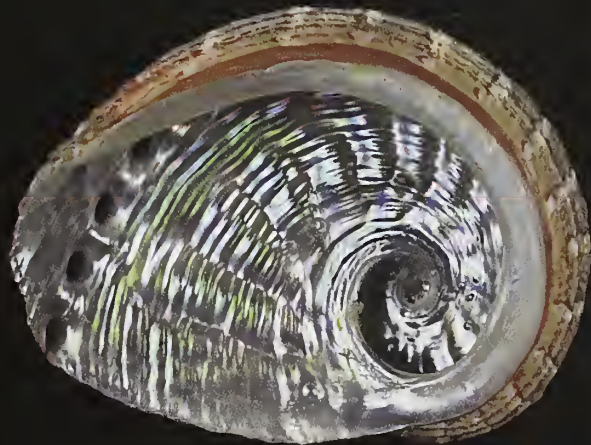
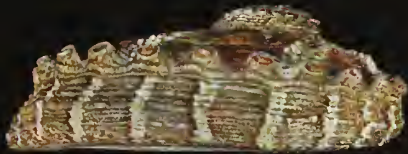
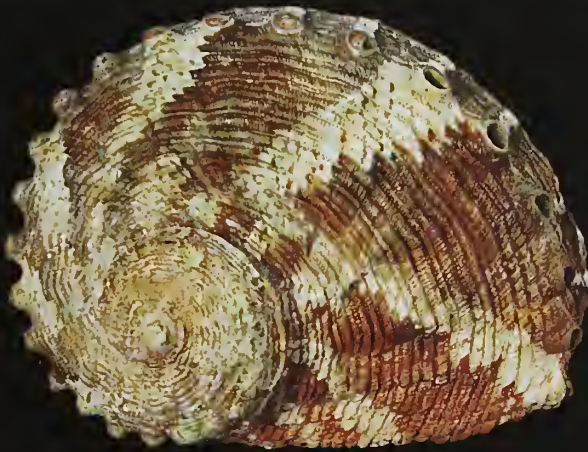
All specimens live-taken between Point Cartright and Keppel Island, QLD. 15-20 m depth.

PLATE 9b

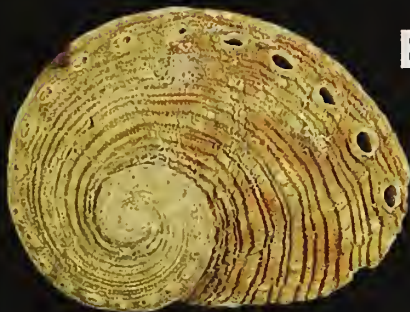
Haliotis melculus
form *ethologus*
Iredale, 1927

QLD

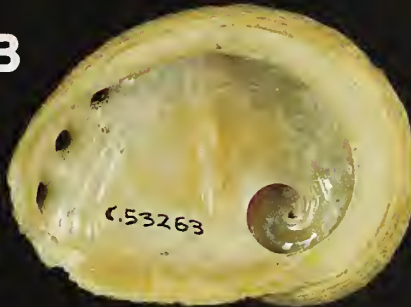
A



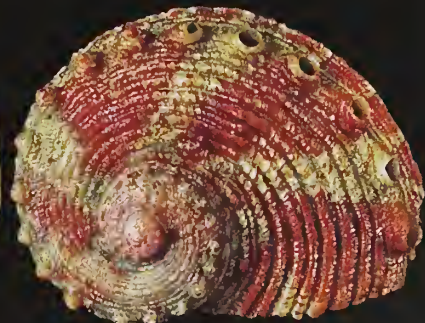
B



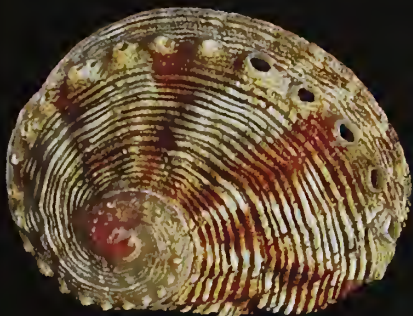
33.6 mm



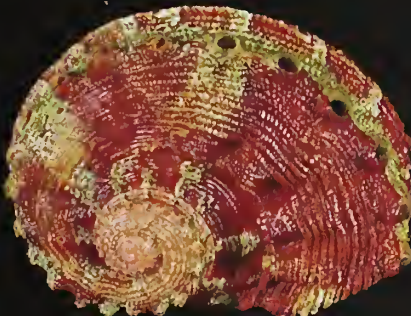
33.6 mm



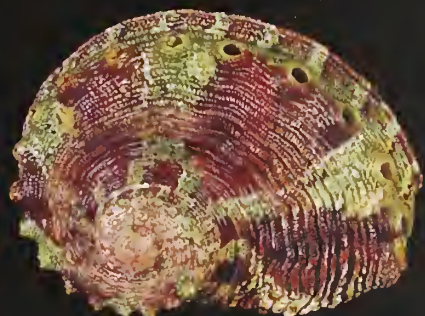
35.1 mm



51.2 mm



45.1 mm



42.1 mm

A: Coolum, QLD. 67.5 mm. B: Type specimen. Near Point Cartright, QLD. All other specimens live taken between Point Cartright and Keppel Island, QLD. 15-20 m depth.

PLATE 10a

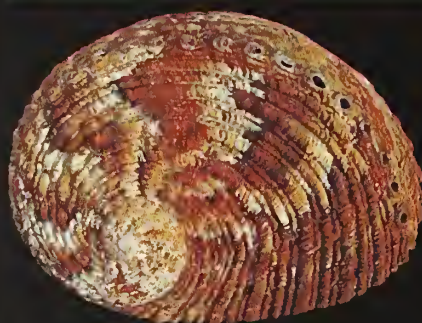
Haliotis roei Gray, 1826.

Distribution: Ranges from Port Fairy, VIC to Shark Bay, WA. Usually occurs intertidally to 5 m - in crevices, under and around boulders, and open rocky bottom. Often found living at high densities.

Description: Shell quite round and flat – of medium size (usual adult size approximately 80-95 mm). Color brick red to brown, often with whitish to cream or greenish prosocline rays. Nacreous interior, often with greenish reflections. Very strong, medium to wide, often scaly spiral ribs – also visible in interior. Usually has 6-10 slightly raised open holes. Usual adult size 70-90 mm.

Largest Specimen Measured: 132.0 mm (RKC)

Other: Hybridizes with *H. laevigata* (rare), *H. r. rubra*, and *H. rubra conicopora* (the last two very rare). *Haliotis roei* is commercially harvested and primarily canned for the Asian market.



69.3 mm



88.5 mm



87.8 mm



85.2 mm



86.6 mm



86.6 mm

All specimens live-taken between Ceduna and Freemantle, WA. 10-15 m depth.

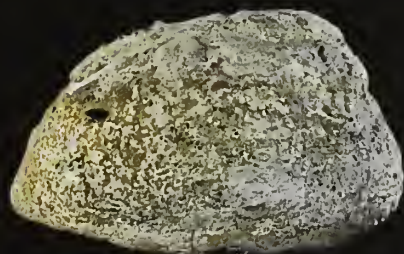
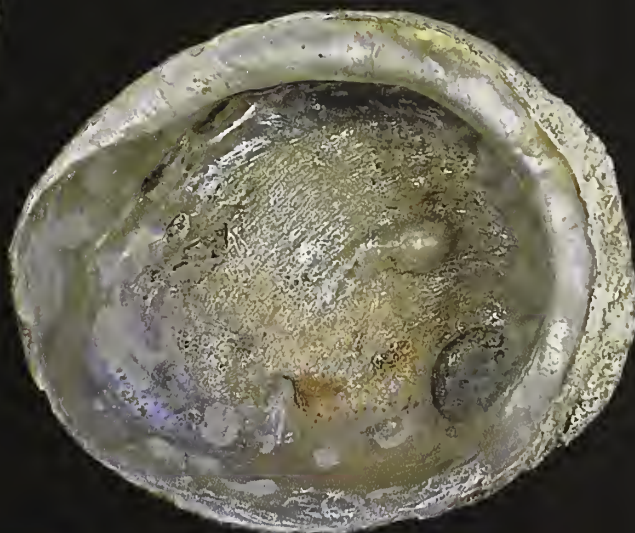
PLATE 10b

Haliotis roei Gray, 1826

WA, SA, VIC

Very Common

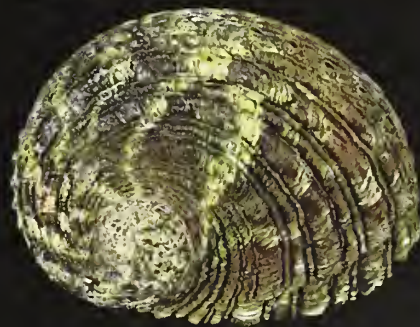
A



52.2 mm



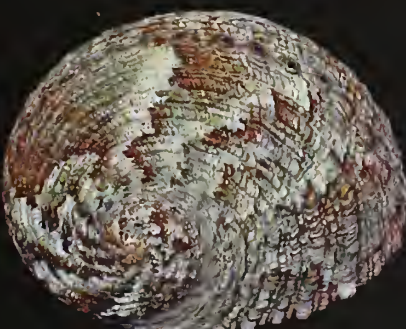
110.1 mm



51.2 mm



88.7 mm



88.5 mm



76.7 mm

A: *Haliotis roei*. Largest specimen measured. 132.0 mm. Esperance, SA.
Bottom 2 Rows: *H. roei*. Elliston, SA. 5-15 m depth.

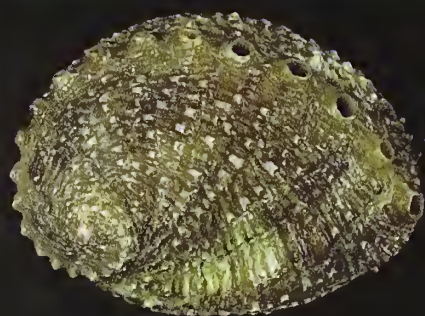
PLATE 11a

*Haliotis rubiginosa* Reeve, 1846.

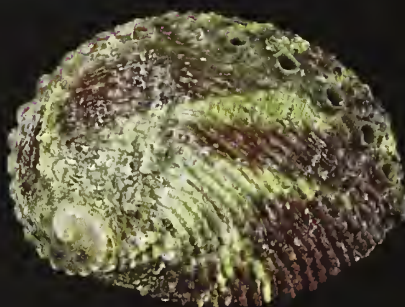
Distribution: Endemic to Lord Howe Island, NSW. (the only *Haliotis* species recorded from this locality). Found intertidally and very shallow, in urchin "pot holes" under tight crevices, stones, slabs, often in areas fairly free of excess algae growth. This is very similar to the habitat preferred by *H. varia* (from which it almost certainly evolved).

Description: Shell slightly oval, strong; fairly thick and heavy. Mostly brown with shades of cream. May also have areas of red or green, and chevrons or prosocline ray markings. Shell often overgrown with heavy, hard deposits of whitish incrustation. Interior very bright, reflective silver nacre, but often dull due to being found on beach dead (illegal to take living specimens). Very strong spiral ribbing of variable width – ribs often very "scaly" (helps separate this species from populations of *H. varia*). Usually has 5-6 moderately raised holes (beach specimens often worn smooth by surf action). Animal marked similarly to *H. varia* with pinkish-tinged epipodium.

Largest Specimen Measured: 47.5 mm (BOC). A syntype in BMNH measures >50 mm, but its identity is suspect (Owen, pers. obs.)



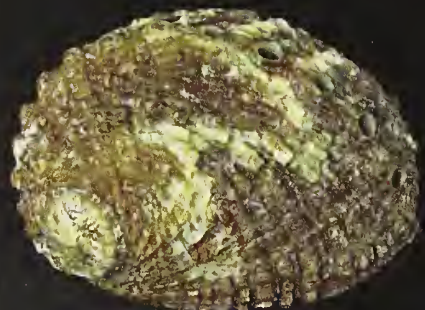
38.4 mm



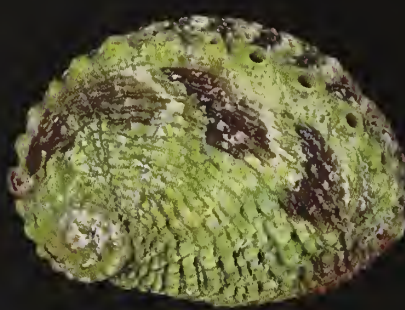
45.5 mm



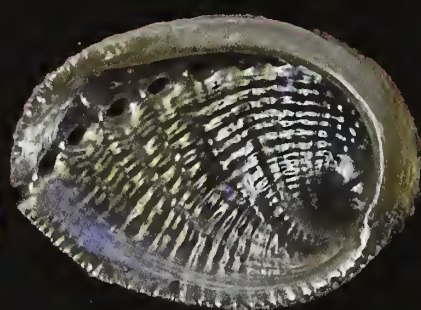
38.2 mm



39.2 mm



37.2 mm



45.5 mm

All specimens found on beach inshore from rocky reefs, Lord Howe Is., NSW.

PLATE 11b

Haliotis rubiginosa

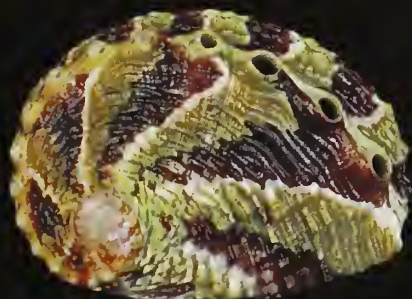
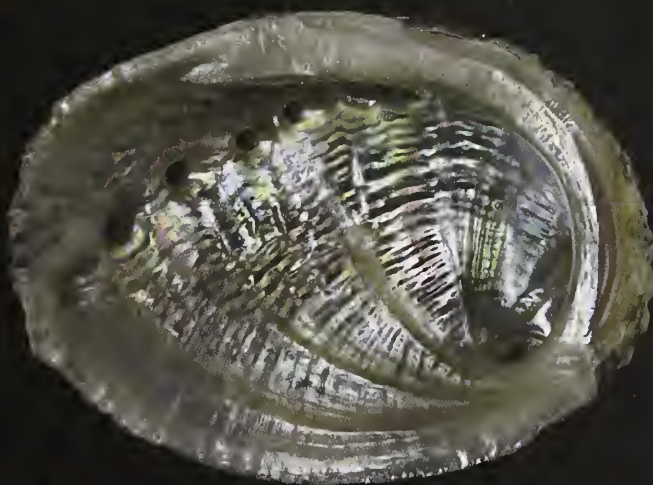
Reeve, 1846

Lord Howe Island, NSW

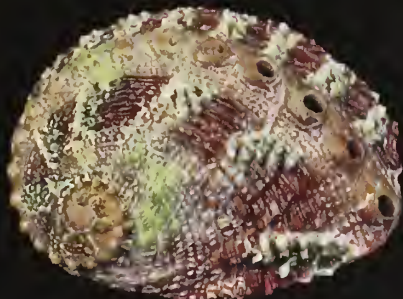
Rare



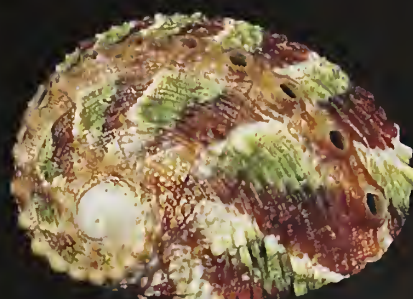
A



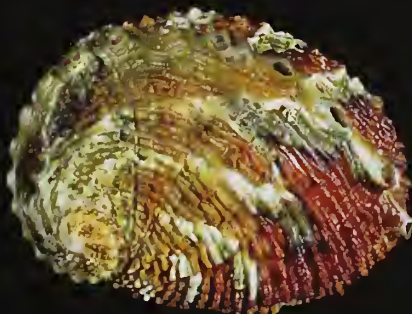
22.6 mm



21.5 mm



19.0 mm



32.5 mm



25.5 mm



32.0 mm

A: *Haliotis rubiginosa*. Extremely large specimen. 47.5 mm. Lord Howe Is., NSW.
Bottom 2 Rows: *H. rubiginosa*. Lord Howe Is., NSW. All specimens found fresh dead on beach.

PLATE 12a

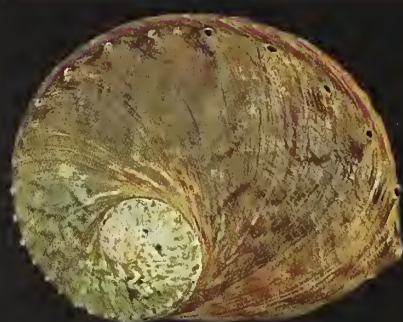
Haliotis rubra conicopora Reeve, 1846.

Distribution: Occurs from Hopetoun/Esperance area to Garden Island, south of Perth, WA; on reefs and off-shore islands. Found intertidally to approximately 30 m, around boulders and along rocky ledges and caves in areas of lush algae growth.

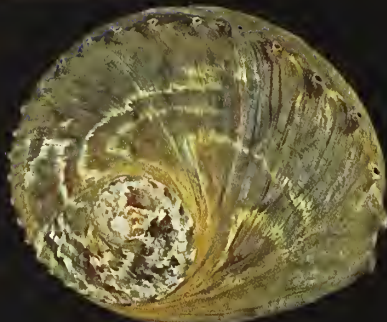
Description: Shell round, often very light in weight, and frequently very thin and flattened in sub-adult stages and young adults. Thicker and heavier when mature. Spire flattened; located well towards center of shell. Color of shell vivid brown, reddish-brown – almost red at times; also green. Diet banding not common (as it is in the eastern form *H. r. rubra*). Interior nacre bright, with yellow cream and silver reflections. Mature shells usually have areas (patches) of non-reflective brownish "clumping", especially in muscle attachment area. Spiral ribbing, if present, is often extremely fine and narrow. Nearly smooth, undulating folded ridges often present, and may be visible in interior of shell as well. Generally has 6-8 fairly well raised open holes, with narrow opening at tip. These elevated tremata appear cone-shaped and gave the subspecies its name. Attains larger size than eastern subspecies, and specimens well over 200 mm are not uncommon.

Largest Specimen Measured: 248.0 mm (ICC).

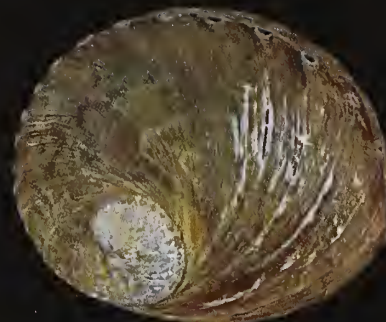
Other: Hybridizes with *H. laevigata* (fairly common), and *H. roei* (rare). Harvested commercially for both frozen and canned markets, (mostly for the latter.)



199.8 mm



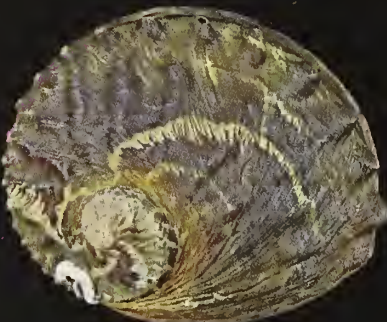
187.2 mm



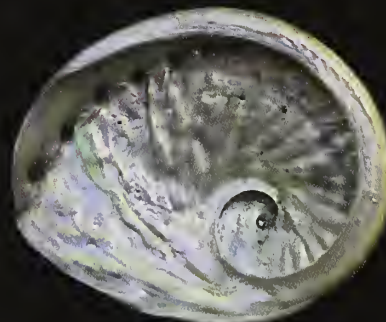
216.8 mm



158.3 mm



191.3 mm



183.8 mm

All specimens live-taken between Esperance and Hopetoun, WA. 10-15 m depth.

PLATE 12b

Haliotis rubra conicopora

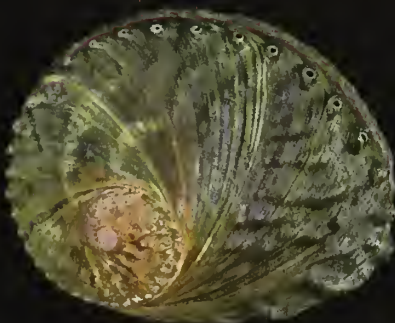
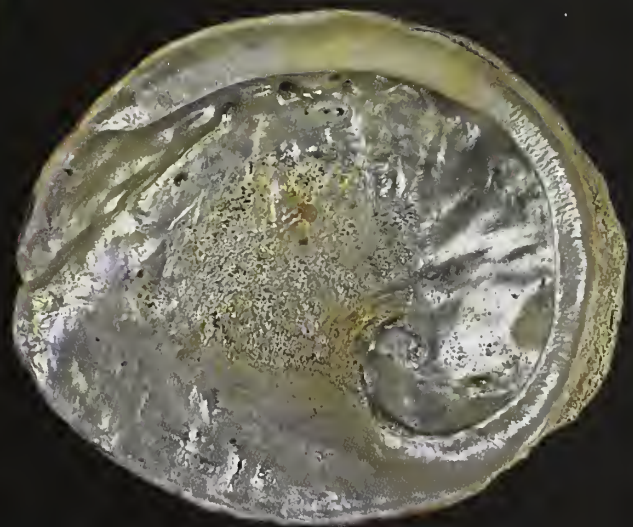
Péron, 1816

WA

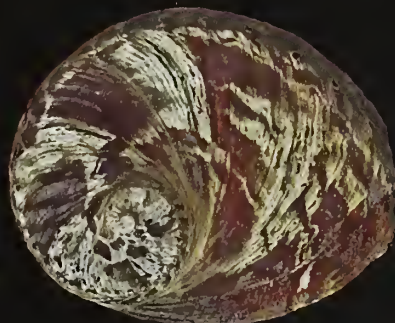
Very Common



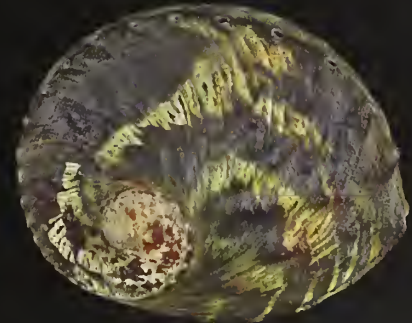
A



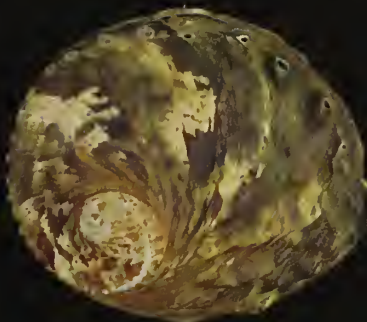
157.4 mm



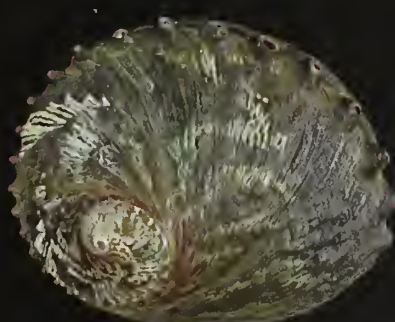
175.3 mm



155.8 mm



183.8 mm



211.5 mm



157.0 mm

A: *Haliotis rubra conicopora*. Extremely large specimen. 248.0 mm. Esperance, WA.
 Bottom 2 Rows: *H. rubra conicopora*. Esperance, WA. 10-15 m depth.

PLATE 13a

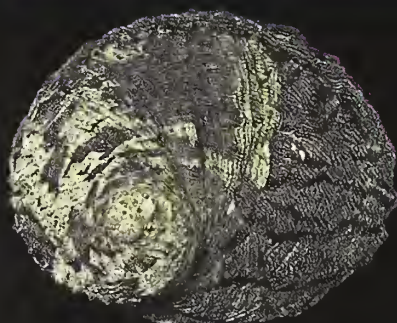
Haliotis rubra rubra/H. rubra conicopora
"Intergrade" population.

Distribution: Found in SA from Victor Harbor and Kangaroo Is., including off-shore islands, to Ceduna and Noyt's Arch (this area includes Elliston and Streaky Bay). Found on boulders and caves (rocky bottom) from Intertidal zone to 30 meters. Prefers to live in areas with heavy algae growth. In areas of high population density or where rocky substrate is limited, small animals may be found attached to the dorsal surface of larger abalones, sometimes grazing a hole through the host's shell.

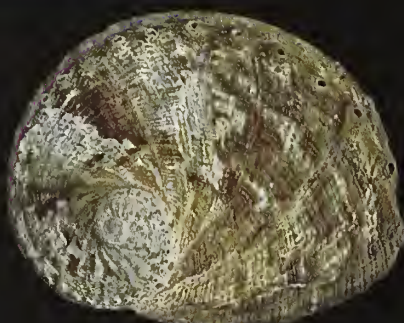
Description: Shell round, often thin; quite flat. Spire well towards center of shell (similar to both *H. r. rubra* subspecies). Color is often very dark – at times gray, to almost gray-black. Also dark brown or green. Often marked with blotchy, irregular, prosocline rays. Interior nacre bright and reflective, to dull bluish-yellow in mature specimens. Clumps of dark material often in area of muscle attachment on older specimens. Spiral ribbing variable – very strong and scaly on some specimens, and narrow and fine on others. Usually has 5-6 well elevated tapered open holes (as with *H. rubra conicopora*). Adult size often as large as 190-200 mm.

Largest Specimen Measured: 218.0 mm (RKC).

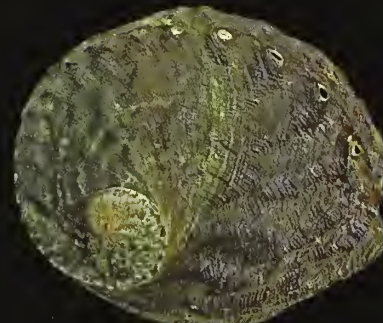
Other: In general, shell morphology leans more towards *H. r. conicopora* than *H. r. rubra* (with occasional exceptions.) Hybridizes with *H. laevigata* and *H. roei* (as do *H. r. rubra* and *H. r. conicopora*). Taken commercially for the canned and frozen market.



164.9 mm



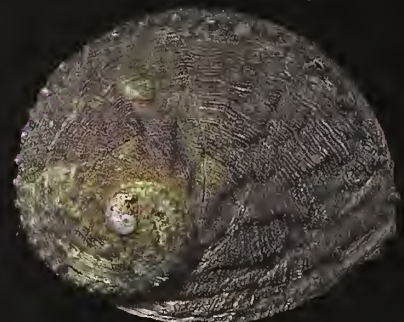
122.0 mm



181.3 mm



182.1 mm



157.5 mm



166.2 mm

All specimens live-taken between Elliston and Streaky Bay, SA. 5-15 m depth.

PLATE 13b

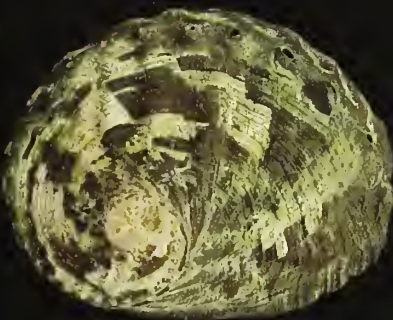
Haliotis rubra rubra/H. rubra conicopora "Intergrade"

Elliston/Streaky Bay, SA

Very Common



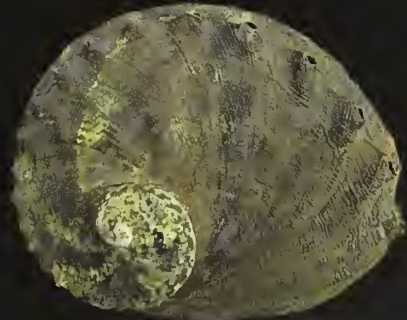
A



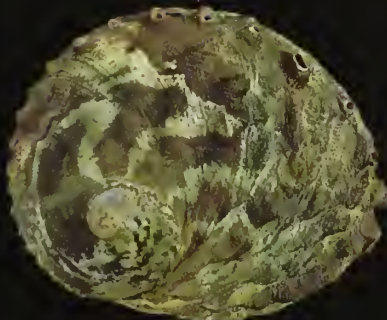
125.5 mm



164.2 mm



183.8 mm



190.2 mm



160.1 mm



166.2 mm

A: *Haliotis r. rubra/rubra conicopora* (Intergrade population). Largest specimen measured. 218.0 mm. Elliston, SA. Bottom 2 Rows: *H. r. rubra/rubra conicopora* (Intergrade population). Elliston, SA. 5-10 m depth.

PLATE 14a

Haliotis rubra rubra Leach, 1814.

Distribution: Found from extreme northern NSW, on rocky fore-shore reefs and islands, south to TAS, and continuing west to the Port Lincoln area. Found intertidally to about 30 m on boulders, and along ledges and cracks on rocky bottom. Prefers areas with dense algae growth. An "Intermediate" form between this subspecies and *H. rubra conicopora*, occurs in the Streaky Bay/Elliston area of SA. This form is different enough to be treated separately (see previous description).

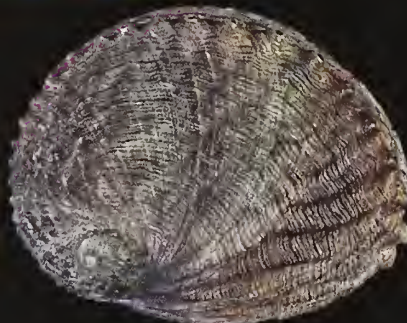
Description: Shell oval to round, somewhat flattened. Spire located well towards center of shell. Color reddish orange to brown; occasionally banded with shades of green and cream due to changes in diet. Often has strong well defined prosocline rays. Interior nacreous, with reflections of blue and pink; mature specimens often having dull brownish clumping, especially in the area of muscle attachment. Fairly strong spiral ribbing of medium width, often superimposed over radial folded ridges. Usually has 5-7 moderately raised open holes. Adult size usually 150-175 mm.

Largest Specimen Measured: 225.0 mm (RKC).

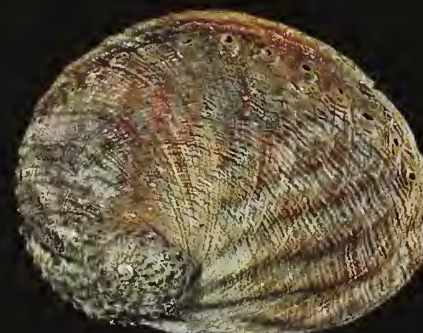
Other: Hybridizes with *H. laevigata* and *H. roei* – the latter being very rare. Commercially harvested for the fresh frozen market, and for canning – the latter in particular.



148.8mm



150.0 mm



151.3 mm



152.2 mm



147.6 mm



137.4 mm

All specimens live-taken near Maatsuyker, TAS. 5-10 m depth.

PLATE 14b

Haliotis rubra rubra

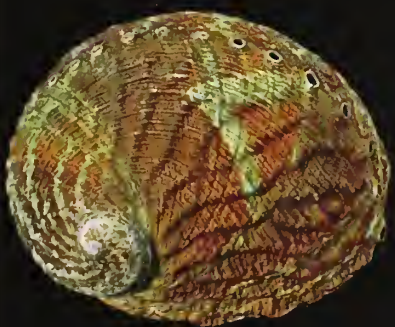
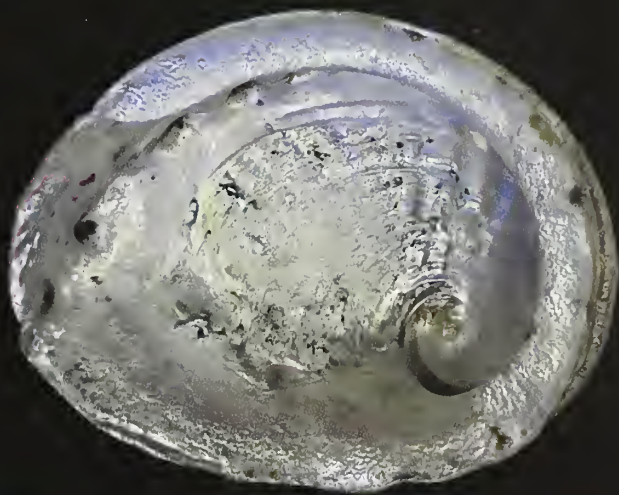
Leach, 1814

SA, VIC, NSW, TAS

Very Common



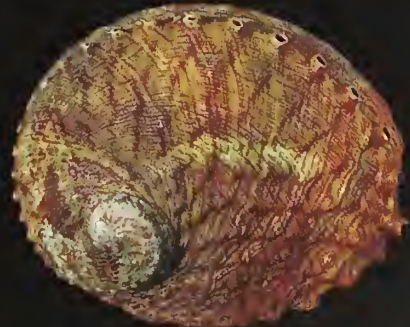
A



127.4 mm



127.1 mm



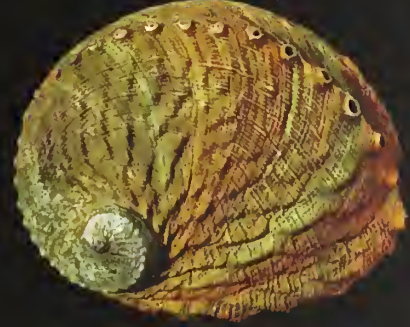
143.8 mm



136.1 mm



117.3 mm



122.5 mm

A: *Haliotis rubra rubra*. Largest specimen measured. 225.0 mm. Mallacouta, VIC.
Bottom 2 Rows: *H. rubra rubra*. Mallacouta, VIC. 5-10 m depth.

PLATE 15a

Haliotis scalaris emmae Reeve, 1846.

Distribution: Found from Ceduna, SA, to Wilson's Promontory, VIC, and the north coast of TAS. Found well hidden in crevices under rocks and ledges – usually in areas of dense algae growth. Occurs in the Intertidal zone out to 40 m.

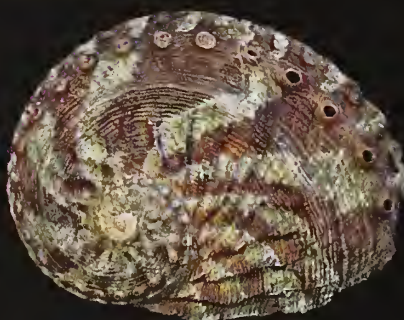
Description: Shell very round, similar to *H. s. scalaris*, except the morphology of the large tubular dorsal ridge and sharp cross lamellae are much reduced. In the extreme eastern part of its range, the rib and cross lamellae may be almost entirely absent. Color grayish brown, reddish brown to orange, often with a few whitish-cream prosocline rays. Interior nacre bright, usually showing spiral ribs and lamellae. Usually has 4-7 tapered holes, less raised than in *H. s. scalaris*. Generally, has strong, medium width spiral ribs, unlike *H. s. scalaris* which most often has no spiral ribs. Average adult size same as *H. s. scalaris* – 80-95 mm.

Largest Specimen Measured: 125.1 mm (RKC).

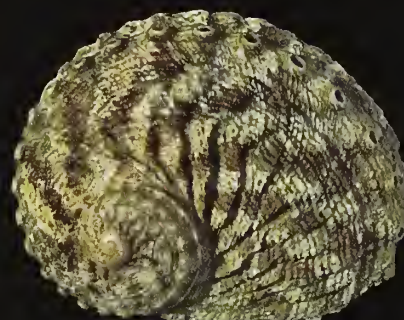
Other: A two-year commercial trial for this subspecies was unsuccessful. Originally described as a full species (*Haliotis emmae* Reeve, 1846), it is now recognized as the eastern subspecies of *H. s. scalaris*. Shells from further east demonstrate a progressively reduced central rib and sharp cross lamellae compared to *H. s. scalaris* specimens found in western SA and WA.



74.9 mm



71.0 mm



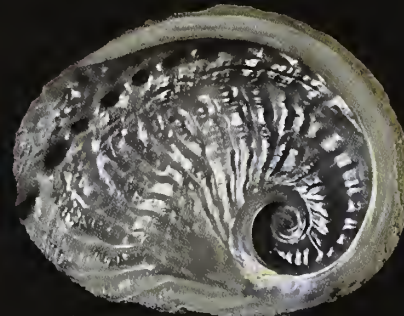
76.3 mm



62.9 mm



70.1 mm



93.6 mm

All specimens taken between Port Lincoln, SA, and TAS. 10-25 m depth.

PLATE 15b

Haliotis scalaris emmae

Reeve, 1846

SA, VIC, TAS

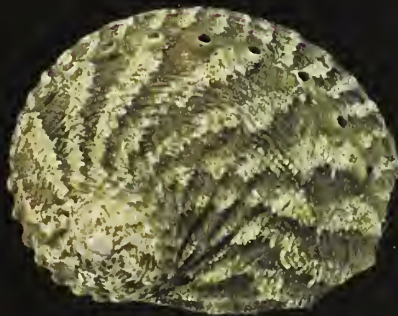
Very Common



A



83.6 mm



79.8 mm



81.1 mm



69.5 mm



82.7 mm



67.5 mm

A: *Haliotis scalaris emmae*. Largest specimen measured. 125.3 mm. TAS.
Bottom 2 Rows: *H. scalaris emmae*. TAS. 5-15 m depth.

PLATE 16a

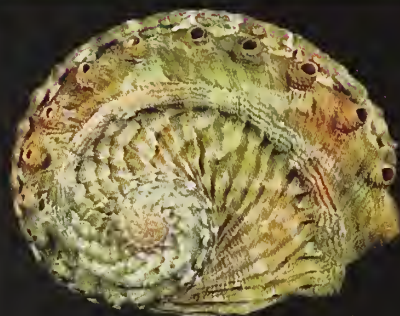
Haliotis scalaris scalaris Leach, 1814.

Distribution: Found from Ceduna, SA, to Carnarvon, WA, mostly well hidden (crevice protected) under rocks and ledges, often in areas of dense algae growth. Occurs in the Intertidal zone out to a depth of 40 m.

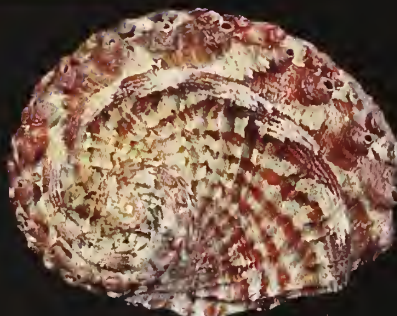
Description: Shell very round and flat, with elevated spire located well towards center of shell. Has a single extremely prominent, very rounded, raised, and scaly rib in central dorsum, running length of shell. Between rib and spire, many sharp raised cross-lamellae occur. Usually has strong, whitish, prosocline ray development. Color dark brown to orange - occasionally light green (rare). Also may be lighter brown to beige (tan). Interior nacre often extremely brilliant and reflective - almost like liquid silver, with large central rib and cross-lamellae strongly visible. Spiral ribbing extremely weak or absent, in marked contrast to *H. scalaris emmae* which has strong spiral ribs. Has 4-7 highly raised tapered holes. Average adult size 80-95 mm.

Largest Specimen Measured: 125.1 mm (RKC).

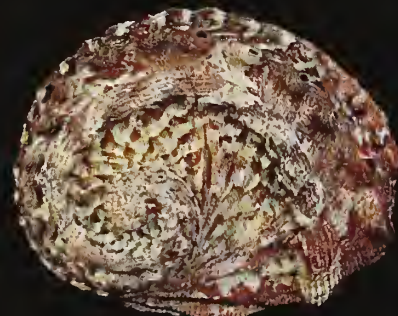
Other: Not taken commercially.



73.5 mm



81.6 mm



78.8 mm



60.0 mm



63.4 mm



76.6 mm

All specimens live-taken between Ceduna and Freemantle, WA. 10-15 m depth.

PLATE 16b

Haliotis scalaris scalaris

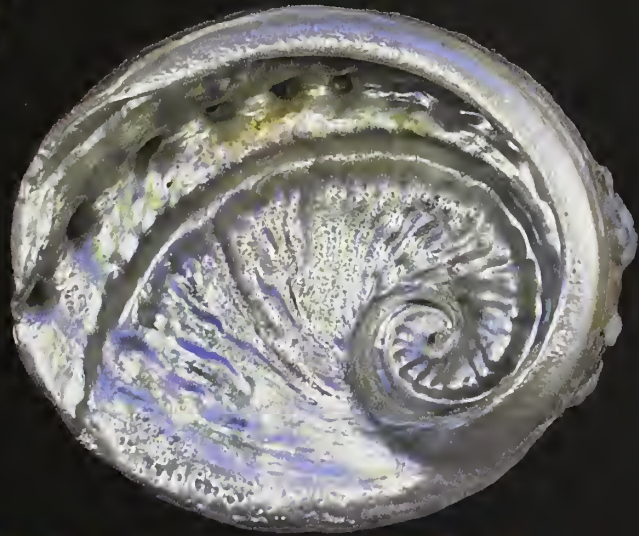
Leach, 1814

WA, SA

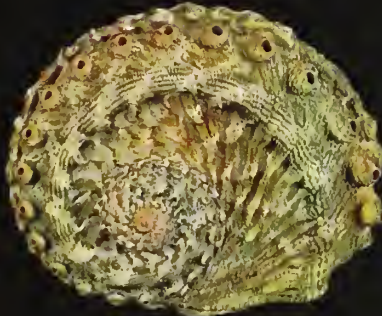
Common



A



93.5 mm



68.1 mm



91.5 mm



57.7 mm



64.2 mm



74.8 mm

A: *Haliotis scalaris scalaris*. Largest specimen measured. 125.0 mm. Jurien Bay, WA.
Bottom 2 Rows: *H. scalaris scalaris*. Albany to Esperance, WA. 5-10 m depth.

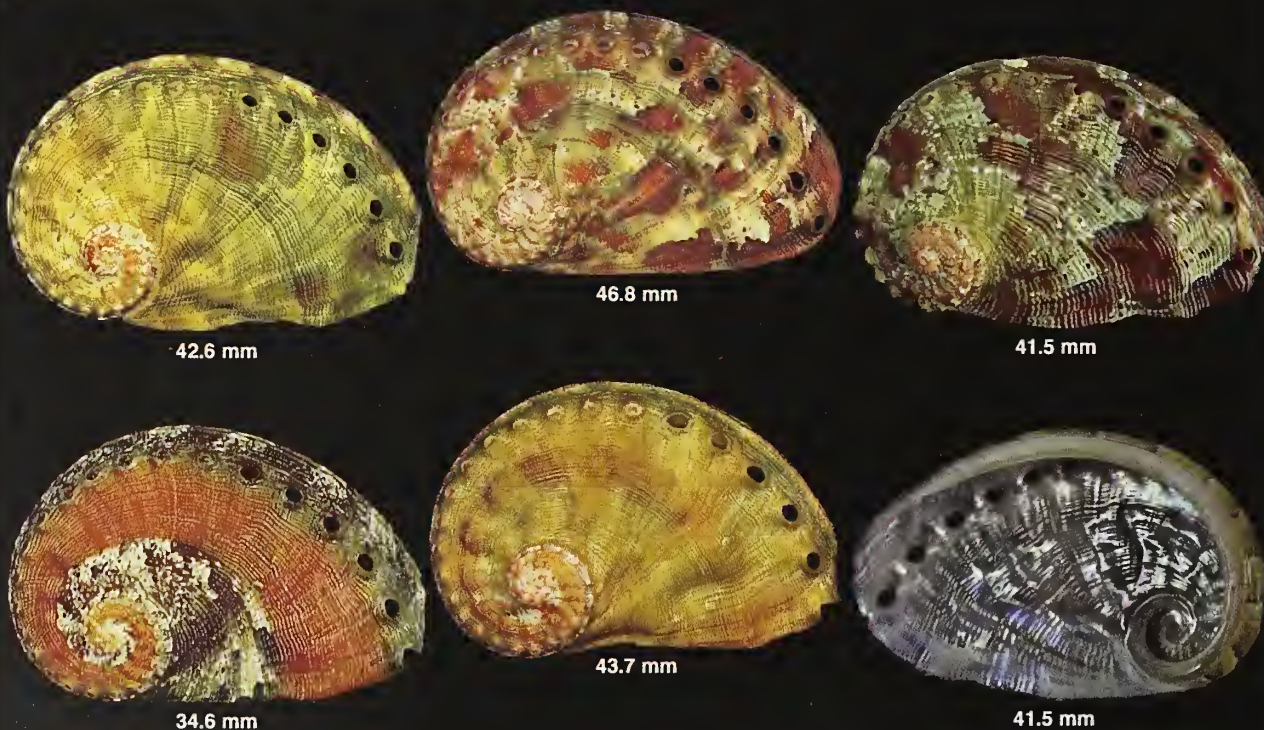
PLATE 17a

Haliotis semplicata Menke 1843.

Distribution: Has been found from just east of Esperance, to Carnarvon, West Australia. Found under rocks and ledges in 3-15 m.

Description: Shell elongate; gently raised, wide rib-like area runs entire length of shell, intersected by very low, raised, folded radial ridges. Color red-brown, often blotched with areas of cream or orange. Shells totally orange exist, as well as a genetic color phase with a striking spirally oriented orange band, similar to the band of similar color often seen in *H. k. kamtschatkana*, and *H. kamtschatkana assimilis*. Interior highly nacreous, often showing low spiral ridge and radial folds. Spiral ribbing usually weak, narrow width, nearly absent on many specimens. Usual adult size 45-55 mm.

Largest Specimen Measured: 74.5 mm (RKC)



All specimens live-taken between Perth and Albany, WA. 5-15 m depth.

PLATE 17b

Haliotis semiplicata

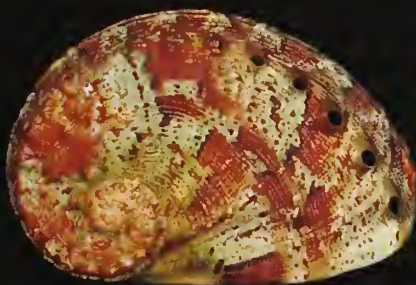
Menke, 1843

SA, WA

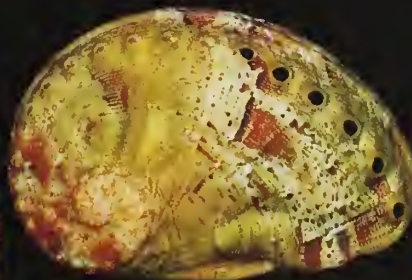
Fairly Common



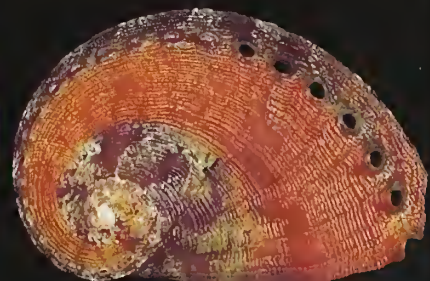
A



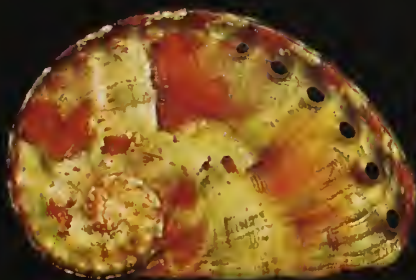
43.6 mm



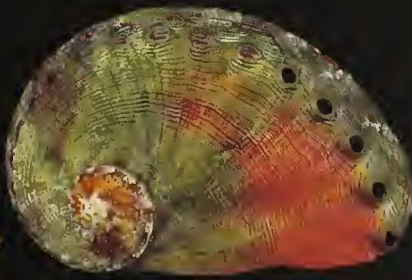
38.7 mm



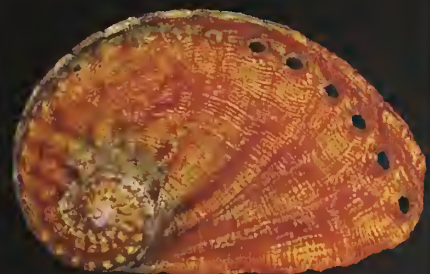
39.4 mm



42.5 mm



44.5 mm



45.6 mm

A: *Haliotis semiplicata*. Largest specimen measured. 74.5 mm. Near Perth, WA.
 Bottom 2 Rows: *H. semiplicata*. Albany, WA. 10-15 m depth.

PLATE 18a

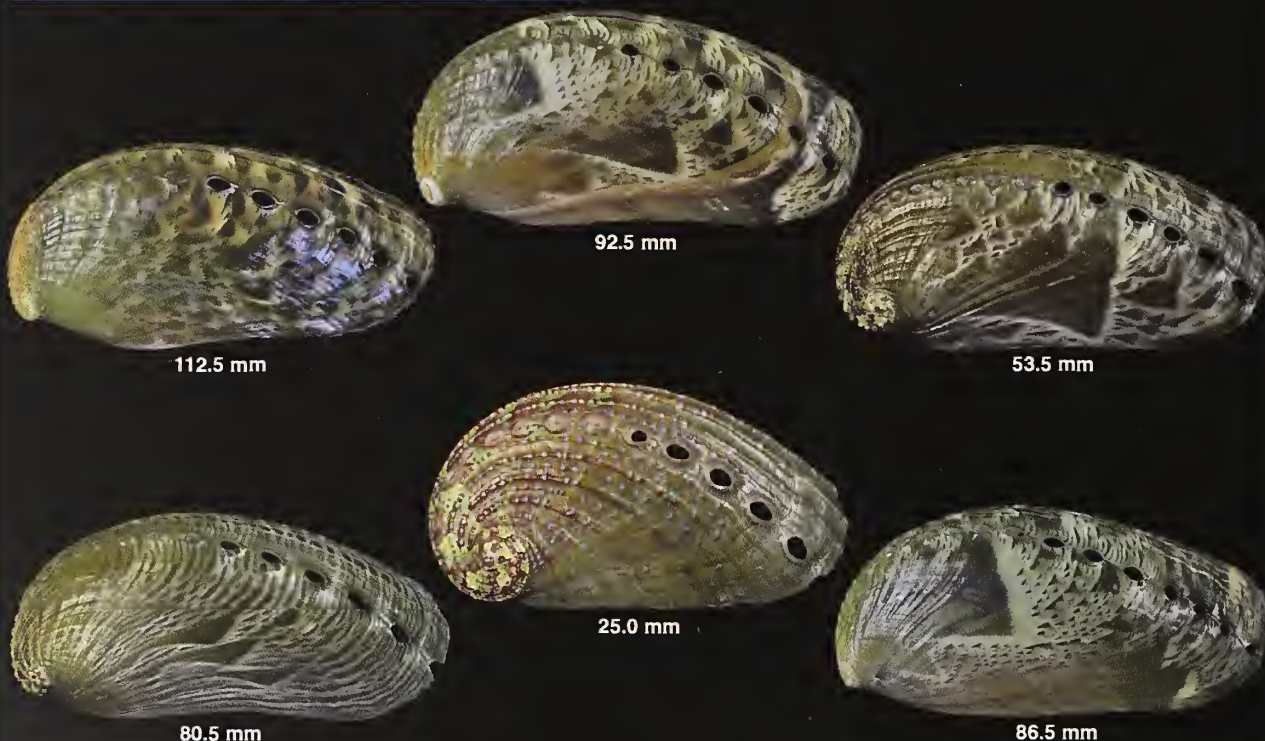
*Haliotis asinina* Linnaeus, 1758.

Range: Occurs from Bundaberg, southern QLD, and around northern Australia, to Exmouth, WA. Found intertidally to 8 m on rocks and coral reefs, often under rocks and dead coral.

Description: Shell very elongate, smooth, highly arched, spire located close to posterior margin. Color dark green to green and brown, with irregular markings (often of a "sharks tooth", or "tent pattern") and chevron patterns of cream and gray. Nacre brilliant, often showing light bluish-green tinge. Strong wide spiral ribbing in juvenile stages; absent in adult specimens. 5-7 elongate holes - not raised. Usual adult size 80-95 mm.

Largest Specimen Measured: 120.0 mm (DDC).

Other: *Haliotis asinina* is one of the most common of the world's abalone species, and is distributed throughout much of the Indo Pacific Basin. The animal has an extremely large epipodium that covers part of the dorsal side of the shell. It has been reported by a number of sources to be able to dislodge itself from the surface to which it is attached, and "glide" through the water. Taken commercially in large numbers.



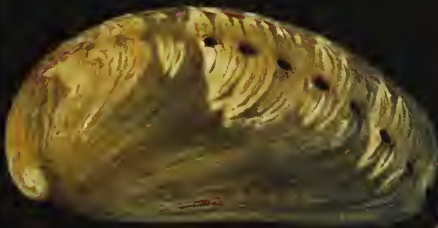
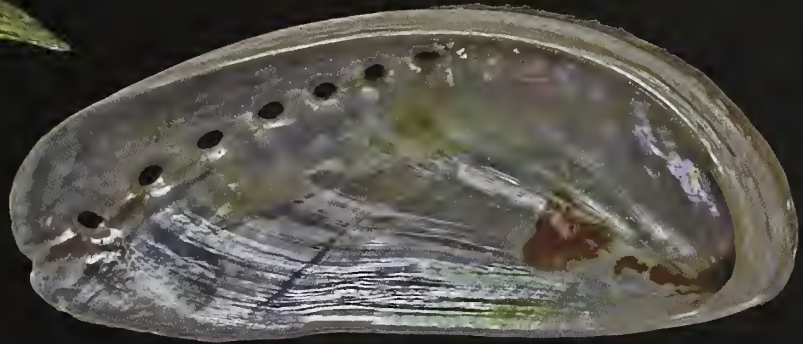
All specimens live-taken at various localities in QLD. 5-10 m depth.

PLATE 18b

Haliotis asinina
Linnaeus, 1758

QLD, NT, WA
Very Common

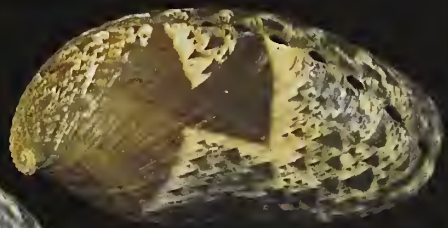
A



105.0 mm



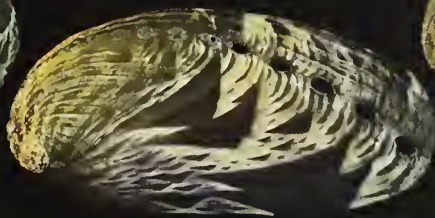
51.5 mm



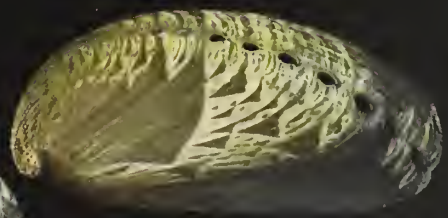
104.5 mm



92.0 mm



60.5 mm



99.0 mm

A: *Haliotis asinina*. Largest specimen measured. 120.0 mm. Indo Pacific Basin.
Bottom 2 Rows: *H. asinina*. QLD. 5-10 m depth.

PLATE 19a

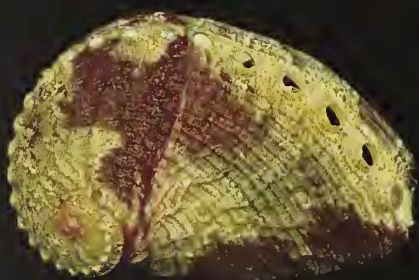
Haliotis clathrata Reeve, 1846.

Distribution: Occurs from Bundaberg, southern QLD to Exmouth, WA, on mainland and around coastal islands. Intertidal to 20 m, under rocks and slabs - often in algae growth. Frequently found living close to populations of *H. varia*.

Description: Shell oval, to slightly elongate - not round; somewhat flat. Color most often bright red-orange to light orange. Specimens for Stange Bay, QLD, often have mottled red-brown and purple colors. May be marked with cream or white chevrons/prosocline rays - often much variation in color and markings. Interior bright silver nacre, showing external sculpture details. Moderately strong spiral ribbing, frequently with sharp tight lamellae crossing ribs. Spire well towards center of shell, 4-5 slightly elevated holes. Average adult size 25-35 mm; Stange Bay specimens 40-45 mm.

Largest Recorded Specimen: 67.5 mm (identification questionable).

Other: An extremely variable *Haliotis*, having the widest distribution of any known species. Until recently, sometimes in error referred to as *H. crebrisculpta* Sowerby III, 1914, (the holotype of the latter actually being a specimen of *H. squamosa* Gray, 1826 [Owen, 2005]).



38.5 mm



31.8 mm



28.5 mm



32.6 mm



31.6 mm



33.7 mm

Live taken from Stange Bay, QLD, and the Great Barrier Reef. Intertidal to 5 m depth.

PLATE 19b

Haliotis clathrata Reeve, 1846

QLD, NT, WA

Uncommon



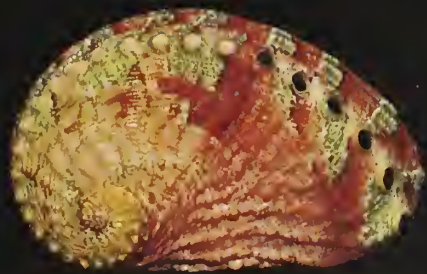
A



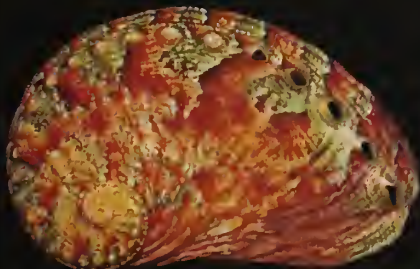
36.2 mm



34.3 mm



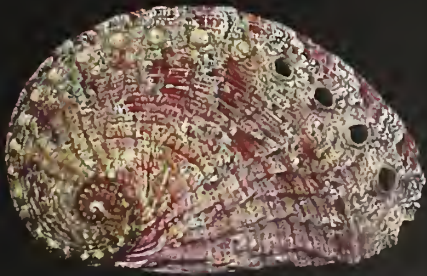
38.3 mm



36.4 mm



34.6 mm



37.8 mm

A: *Haliotis clathrata*. Very large specimen. 42.6 mm. Stanage Bay, QLD. Intertidal.
 Bottom 2 Rows: *H. clathrata*. Stanage Bay, and Great Barrier Reef. Intertidal to 5 m depth.

PLATE 20a

Haliotis dissona Iredale, 1929.

Distribution: Found in Australia only on a small section of the QLD coast in the Gould's Reef area. The type locality is "Michaelmas Cay, QLD". This species appears to be most common in Tonga and New Caledonia, and will also be found in Fiji and American Samoa.

Description: Shell very elongate, somewhat arched, with spire positioned towards posterior end. Color generally off white, with a large brownish or sepia stripe running down center of dorsum; also commonly near solid orange or brown, with mottled white to cream patches. A reverse of this pattern with a solid white background and orange to brown patches will be seen as well. Nacre is highly silvered (fresh dead specimens), with occasional steel-blue iridescence. Sculpture consists of strong, usually fairly wide, spiral ribs, which are smooth and not scaly. Usually has 4-5 fairly large open holes which are slightly elevated. Usual adult size 20-25 mm

Largest Specimen Measured: 36.4 mm (BOC).

Other: Extremely uncommon in Australia, and appears restricted to a very tiny area in northern QLD. A very difficult species to find alive - in Tonga at least (where it is relatively common). Specimens over 30 mm are very rare. Not a common species in collections, and much sought by *Haliotis* collectors.



All specimens found on beach near east end of Foa Island, Ha'Apai Group, Kingdom of Tonga.

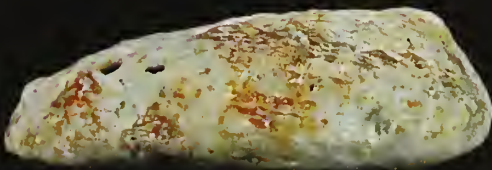
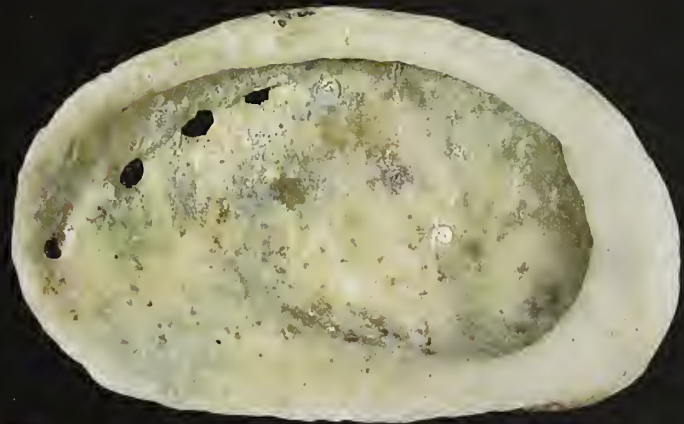
PLATE 20b

Haliotis dissona
Iredale, 1929

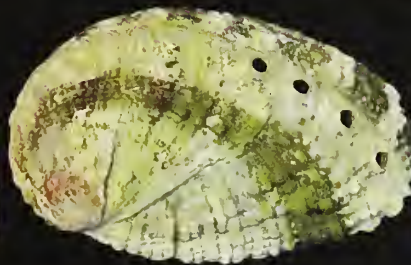
Gould Reef, QLD
Extremely Rare



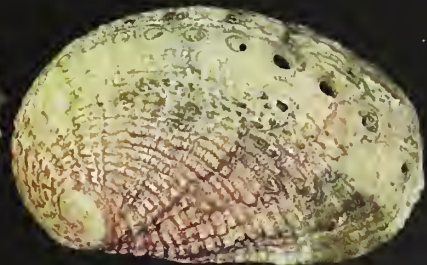
A



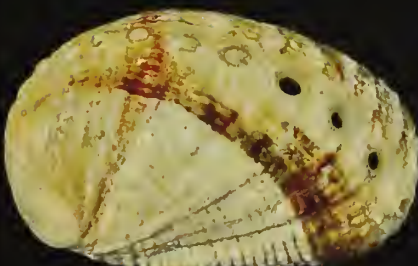
28.4 mm



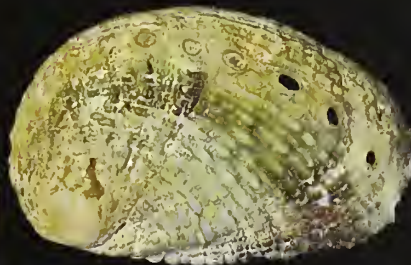
26.1 mm



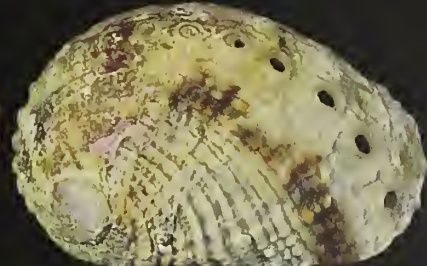
27.3 mm



31.2 mm



22.3 mm



22.5 mm

A: *Haliotis dissona*. Largest specimen measured. 36.4 mm. Ha'Apai Group, Tonga. Beach.
Bottom Two Rows: *Haliotis dissona*. Gould Reef, QLD. Intertidal and beach specimens.

PLATE 21a

Haliotis ovina ovina Gmelin, 1791.

Distribution: Found from southern QLD, Barrier Reef, and Islands around northern Australia to Exmouth, WA. Under rocks, dead coral slabs, and in rock and coral crevices. Intertidal out to 30 m.

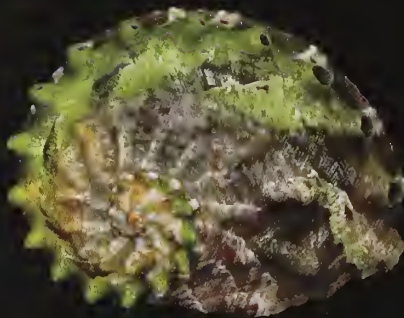
Description: Shell circular, inflated, spire located well towards center of shell. Color extremely variable, often mixture of red, green, yellow, brown, purple, orange, etc. Frequently marked with several broken patterns of prosocline rays mixing together on the same specimen. Patterns can be extremely complex. Interior highly nacreous silver, showing details of exterior sculpture. Dorsal surface very lumpy, often covered with warty protusions arranged in irregular radial folds. Spiral ribbing may be weak to virtually absent. Usually has 3-5 large, strongly elevated, round, open holes. No muscle scar. Usual adult size about 50-60 mm.

Largest Specimen Measured: 90.2 mm (BOC).

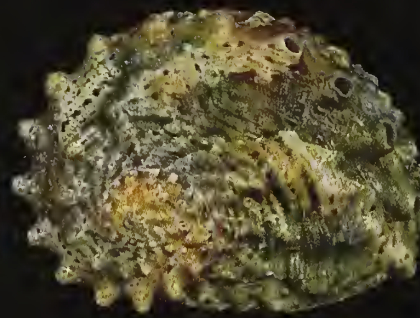
Other: Extremely common throughout much of its range in the Indo Pacific Basin, but generally much less common in Australia. An extremely complex species in regards to sculpture and coloration, with seemingly infinite variables.



57.3 mm



49.4 mm



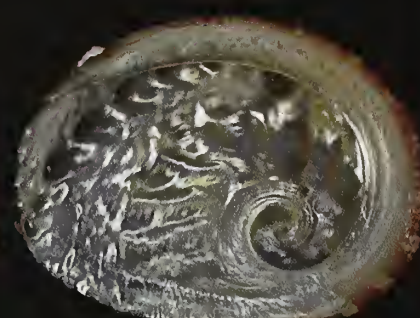
51.3 mm



54.8 mm



60.1 mm



32.0 mm

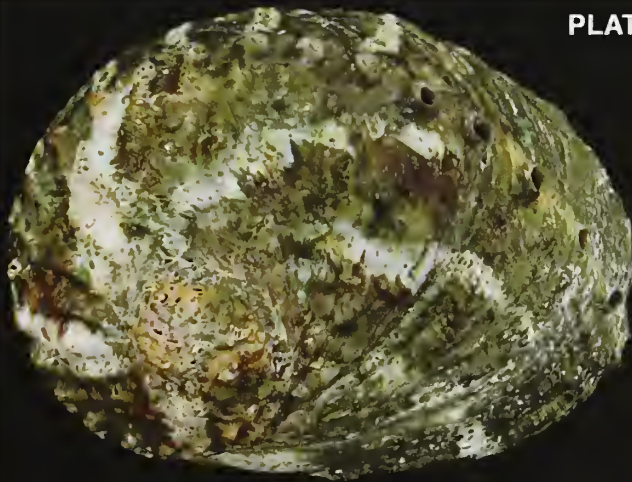
All specimens live-taken at various localities in the Philippine Islands. 5-10 m depth.

PLATE 21b

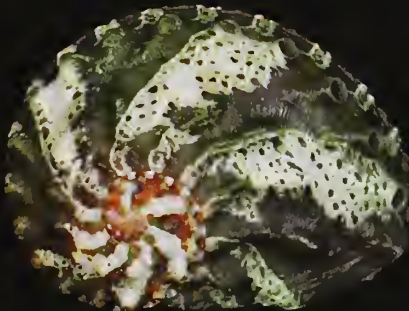
Haliotis ovina ovina Gmelin, 1791

QLD, NT, WA

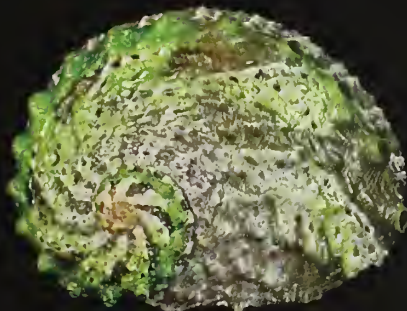
Scarce In Australia



A



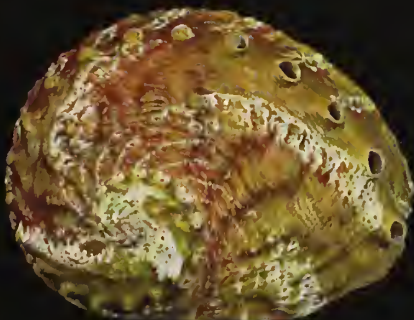
46.8 mm



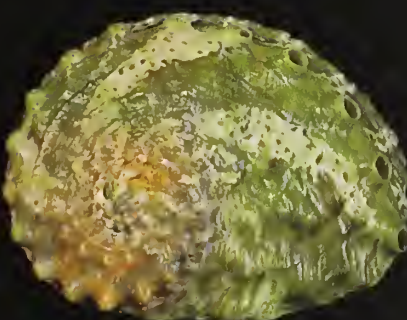
38.0 mm



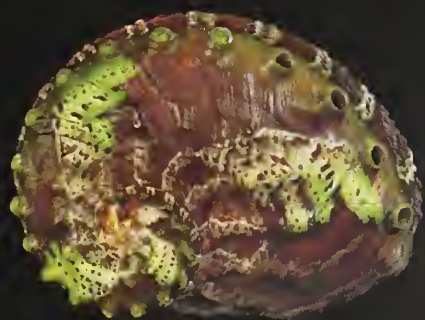
54.0 mm



61.0 mm



52.5 mm



51.5 mm

A: *Haliotis ovina ovina*. Largest specimen measured. 90.2 mm. Na Trang, Viet Nam. 5-10 m depth.
 Bottom 2 Rows: *H. ovina ovina*. Northern QLD. 5-10 m depth.

PLATE 22a

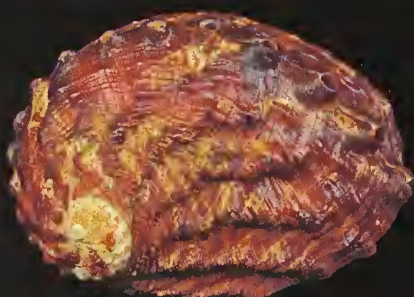
*Haliotis varia* Linnaeus, 1758.

Distribution: Found from southern QLD, inshore and around islands of Barrier Reef; then around northern Australia to Shark Bay, WA. Under rocks and dead coral slabs; in crevices, cracks, and in "popholes" on rock walls. Locally very common. Found Intertidal to 5 m, and well up near the high tide mark.

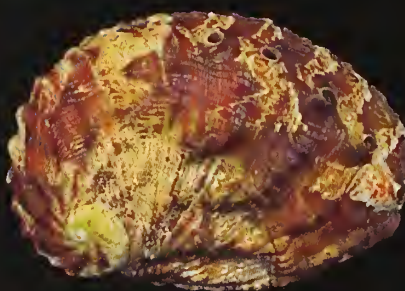
Description: Shell oval, inflated (not flat). Spire placement normal – not towards center of shell as is often the case with many Australian species. Colors brown, black, green, burgundy, with irregular cream prosocline rays. Interior highly nacreous, silver, showing details of exterior sculpture. Dorsal surface extremely variable, often quite lumpy, with or without folded ridges and spiral ribbing. A well named species (*H. "varia"*). Usual adult size 35-45 mm.

Largest Specimen Measured: 86.1 mm (RJRC).

Other: One of the world's most common species. Very closely related to *H. rubiginosa*, from Lord Howe Island, NSW.



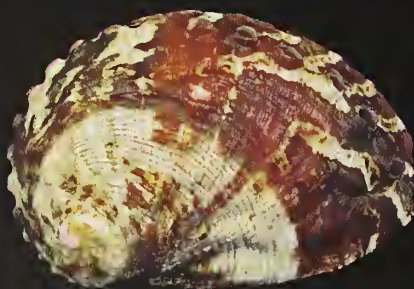
46.0 mm



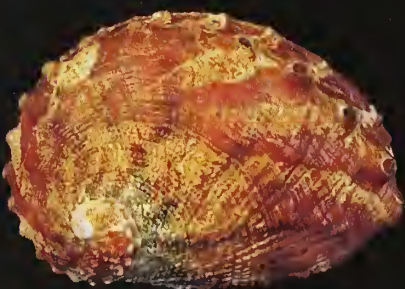
45.0 mm



43.5 mm



58.0 mm



47.5 mm



50.8 mm

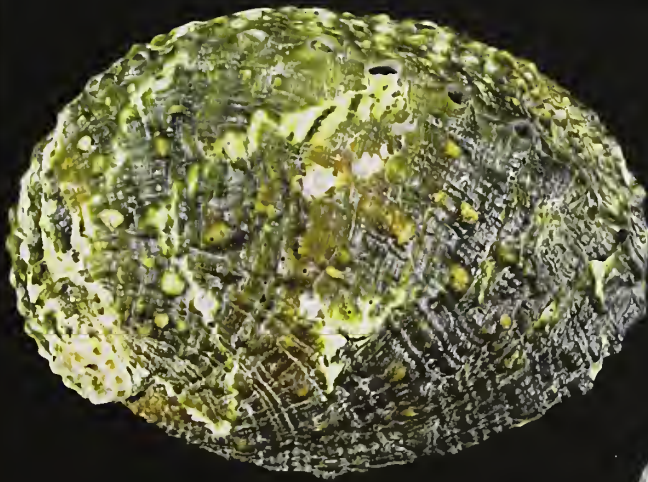
All specimens live-taken between Shark Bay and Port Headland, WA. Intertidal to 5 m depth.

PLATE 22b

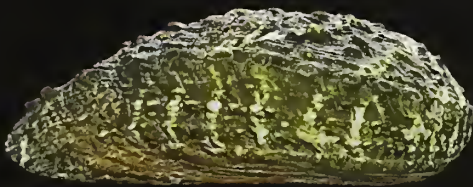
Haliotis varia Linnaeus, 1758

QLD, NT, WA

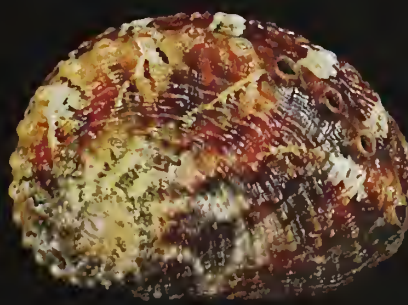
Very Common



A



36.5 mm



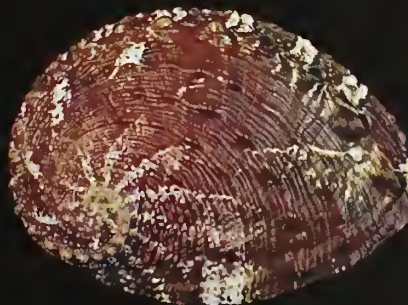
39.0 mm



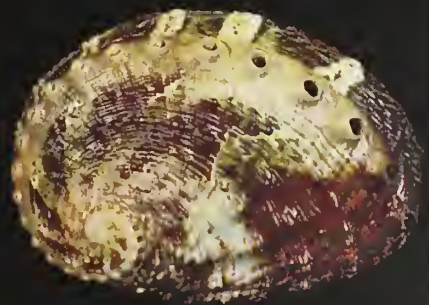
28.0 mm



36.1 mm



34.3 mm



35.0 mm

A: *Haliotis varia*. Largest specimen measured. 86.05 mm. Locality unknown.
 Bottom 2 Rows: *H. varia*. QLD. Intertidal to 5 m depth.

PLATE 23a

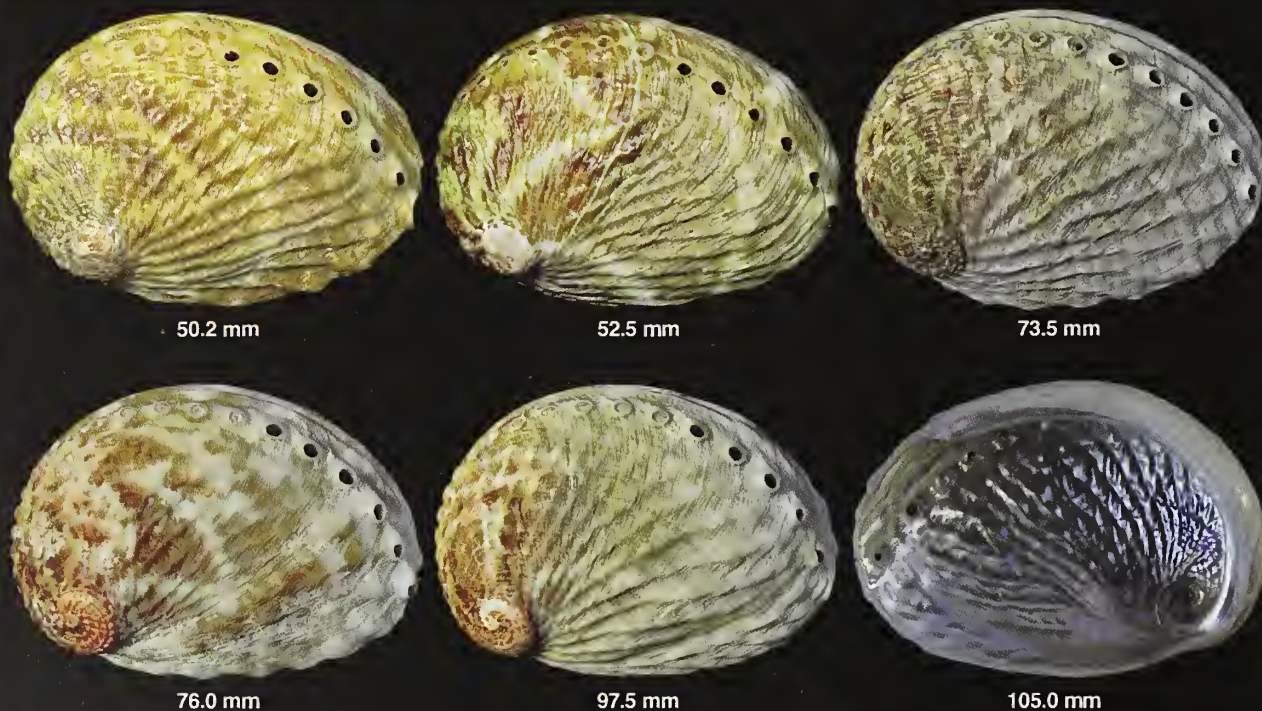
*Haliotis australis* Gmelin, 1791.

Distribution: NZ, including Stewart and Chatham Islands. Found under rocks and ledges in 5-10 m.

Description: Shell oval-elongate, arched, with somewhat elevated spire. Color usually dull white to orange, or orange-brown. Very frequently with scattered white chevron-like markings. Sometimes yellowish-green tinted due to periostracum. Dorsal surface with variable width spiral ribbing, and numerous, very prominent lamellae/folded ridges. Usually 5-7 open holes, only slightly elevated. Interior nacre bright whitish-silver. No muscle scar. Usual adult size 50-80 mm, but shells in excess of 100 mm are occasionally found

Largest Specimen Measured: 112.9 mm (RKC)

Other: Taken commercially, and known as the "Yellow Footed Abalone".



All specimens live-taken on South Island, NZ. 5-10 m depth.

PLATE 23b

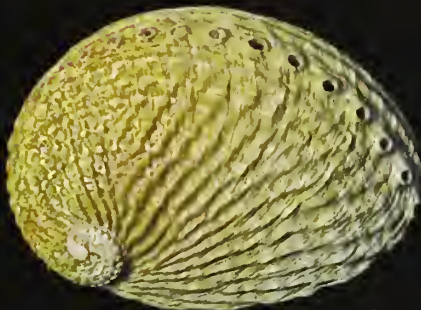
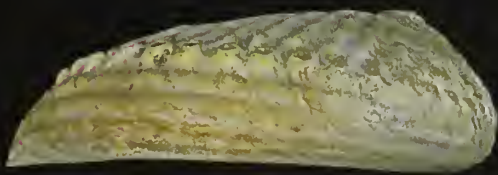
Haliotis australis Gmelin, 1791

Mainland NZ and Chatham Islands

Very common



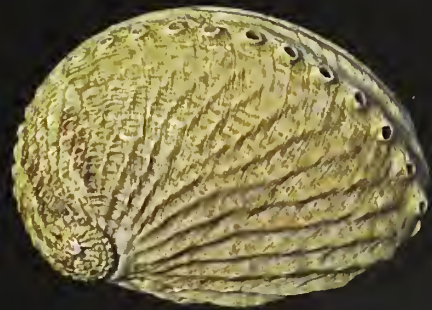
A



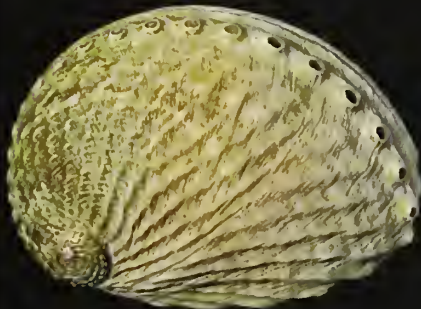
87.4 mm



75.3 mm



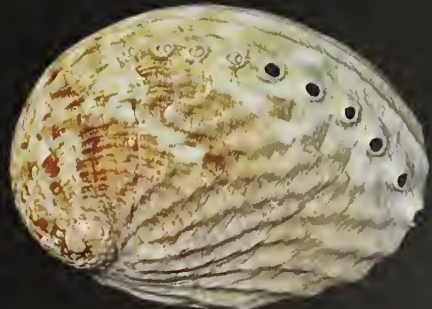
85.8 mm



89.0 mm



71.5 mm



97.0 mm

A: *Haliotis australis*. Extremely large specimen. 112.9 mm. South Island, NZ.
 Bottom 2 Rows: *H. australis*. South Island, NZ. 5-10 m depth.

PLATE 24a

*Haliotis iris* Gmelin, 1791.

Distribution: NZ, including Stewart and Chatham Islands.

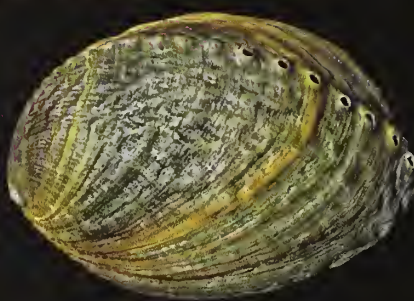
Description: Shell oval-elongate; spire low, at extreme end of shell. Usually not visible in ventral view. Color usually olive/sepia, often with blue tones. Adult shells often heavily overgrown with marine encrustations. Interior bright to dark blue-green; highly iridescent. Often has dark (black) patches of conchiolin deposits masking iridescence. Forms muscle scar in more mature specimens (~ over 80 mm). Spiral ribbing absent, but surface has regular small undulations/lamellae. Usually 4-7 open holes, slightly raised. Usual adult size 130-155 mm.

Largest Specimen Measured: 198.4 mm (BOC). Shells in excess of 200 mm probably exist, but lack confirmation (Mark Jones, pers. comm.).

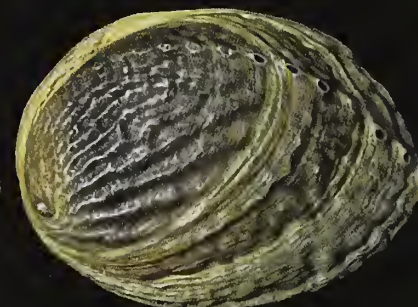
Other: An extensive commercial fishery exists for meat and shells. Divers must "free dive" (not use compressed air). Carefully selected adult specimens may "polish" with extreme care to produce a striking and popular tourist shell curiosity, several which are illustrated herein.



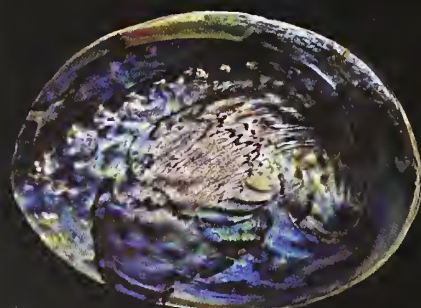
79.5 mm



103.0 mm



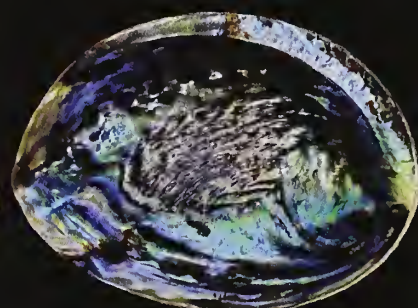
99.5 mm



154.3 mm



97.5 mm



150.6 mm

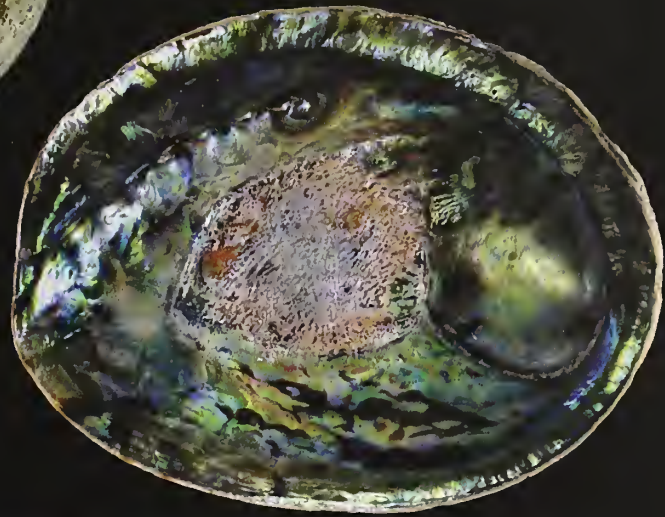
All specimens live-taken on South Island, NZ. 4-12 m depth.

PLATE 24b

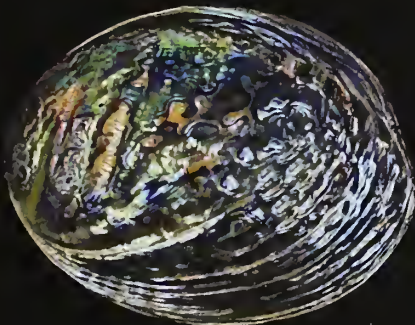
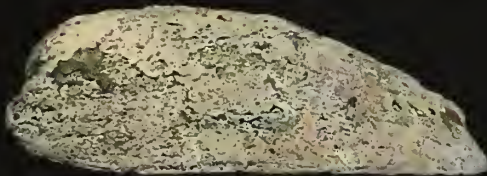
Haliotis iris Gmelin, 1791

Mainland NZ
and Chatham Islands

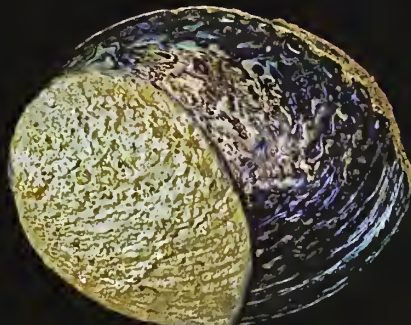
Very common



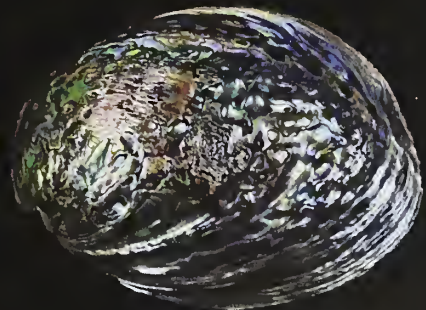
A



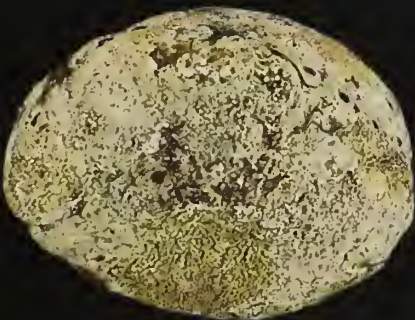
166.4 mm



173.0 mm



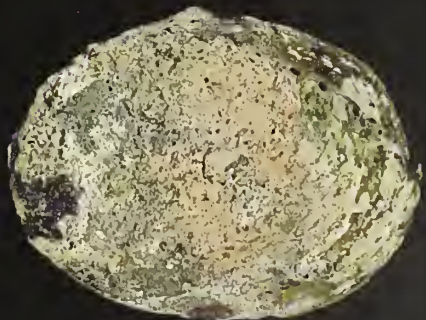
165.3 mm



185.8 mm



76.3 mm



187.8 mm

A: *Haliotis iris*. Largest specimen measured. 198.5 mm. Stewart Island, NZ.
Bottom 2 Rows: *H. Iris*. Polished shells, and heavily encrusted specimens in natural state. South Is., NZ.

PLATE 25a

Haliotis virginea crispata

A. Gould, 1847.

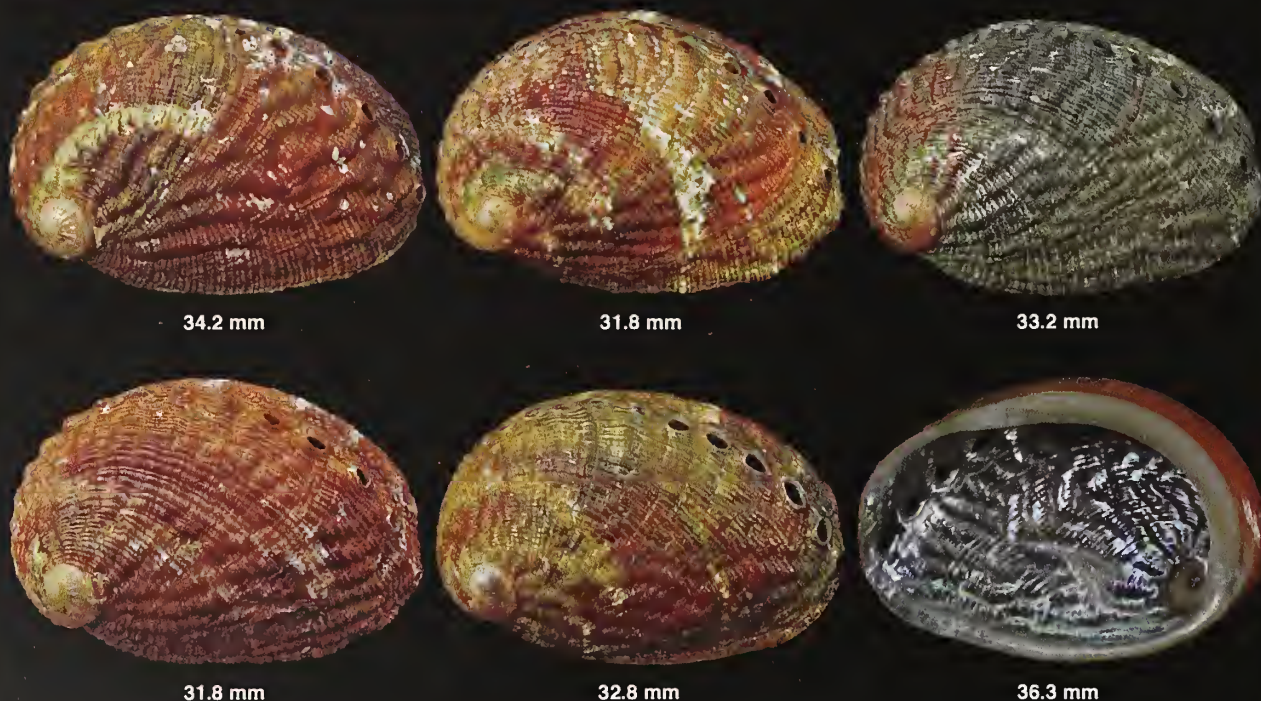


Distribution: North Island, NZ. Found under rocks and ledges in 3-15 m.

Description: Shell oval-elongate, arched; spire located a bit away from posterior end. Very highly colored, with bright shades of red, green, orange, brown, often with white chevron patterns or mottling. Interior nacre very bright, with reflections of blue or magenta, depending on exterior color. Sculpture consists of very fine spiral ribbing, usually combined with many strong undulating prosocline folds/lamellae - one of this subspecies most prominent features (though occasional shells may lack these folded ridges). Usually has 4-7 small to medium open holes, which are slightly oval and raised. Usual adult size 30-40 mm.

Largest Specimen Measured: 47.8 mm (BOC).

Other: A questionable subspecies to many, in part due to its range overlapping the nominate species, *H. v. virginea*, and the existence of specimens of intermediate morphology. Curiously, one of 6 specimens of *H. v. virginea* found at the Snares, 110 km SW of Stewart Is., is very similar to *H. virginea crispata* in several features, especially the strongly pronounced lamellae



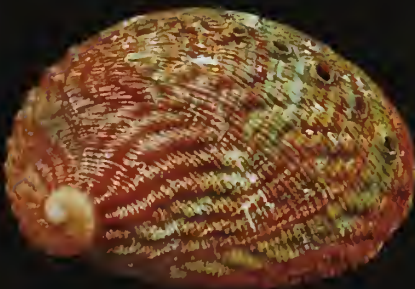
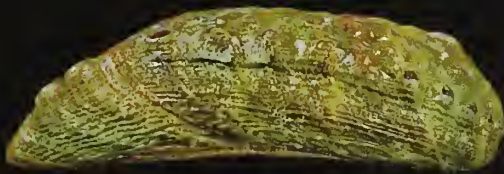
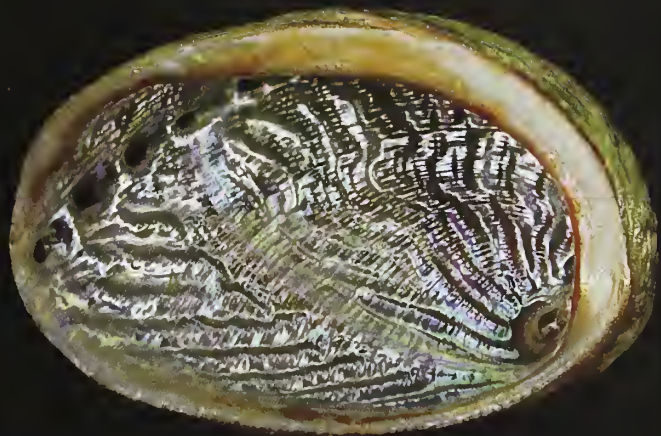
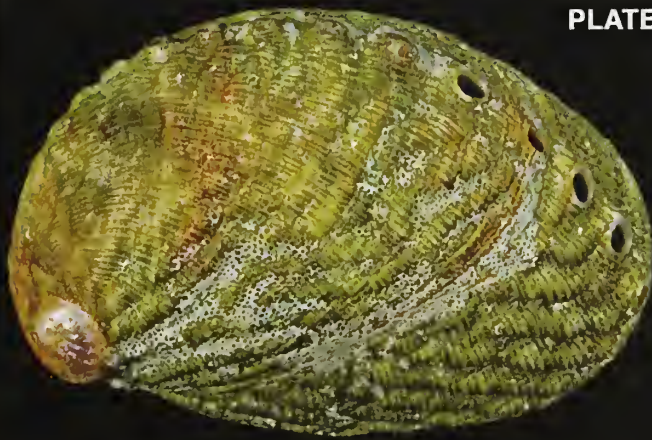
All specimens live-taken on north coast of North Is., NZ. 3-15 m depth.

PLATE 25b

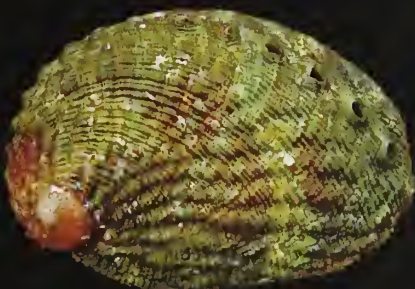
Haliotis virginea crispata
A. Gould, 1847

Northern NZ
Common

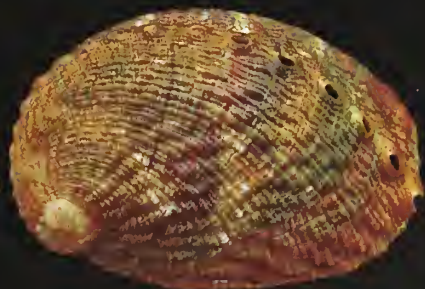
A



32.4 mm



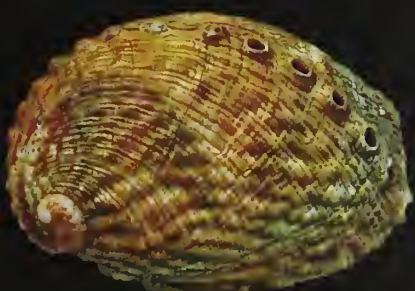
31.2 mm



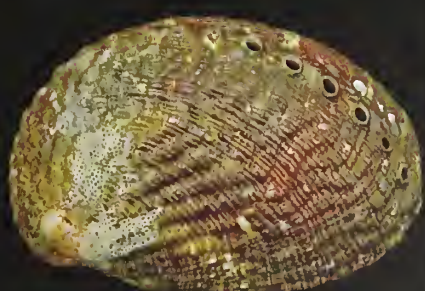
28.8 mm



41.5 mm



40.0 mm

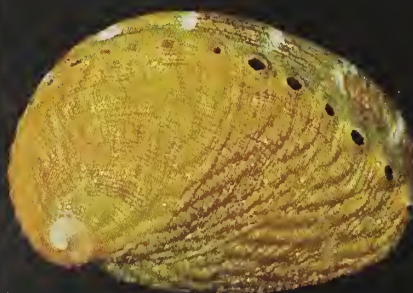


41.5 mm

A: *Haliotis virginea crispata*. Largest specimen measured. 47.8 mm. North Island, NZ.
Bottom 2 Rows: *H. virginea crispata*. North Island, NZ. 5-10 m depth.

The 5 *H. virginea virginea* subspecies of NZ

PLATE 25c. *Haliotis virginea crispata* A. Gould, 1847.



64.5 mm



59.5 mm



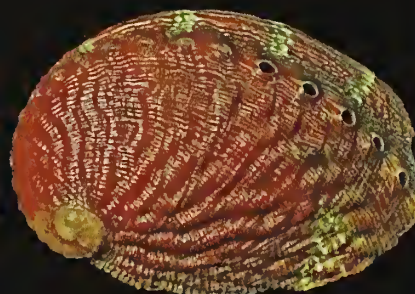
55.1 mm



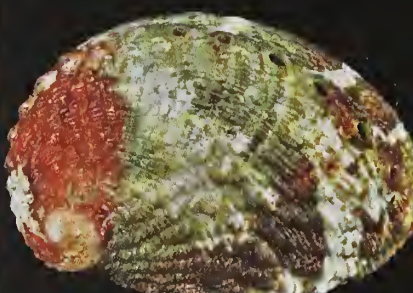
61.8 mm



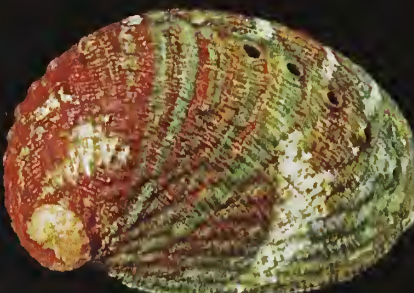
33.0 mm



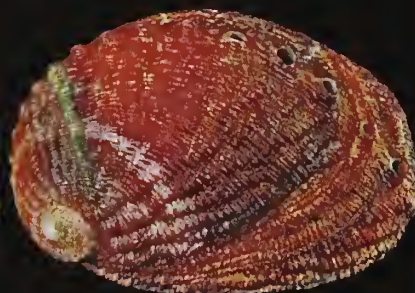
29.2 mm



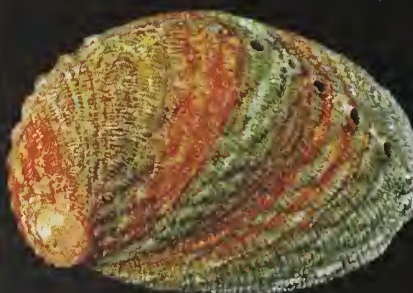
33.8 mm



37.3 mm



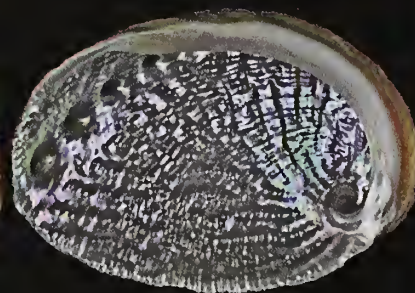
37.8 mm



43.2 mm



34.2 mm



33.0 mm

All Rows: *Haliotis virginea crispata*. NE coast of North Island, NZ. 3-10 m depth.

PLATE 26a

Haliotis virginea huttoni

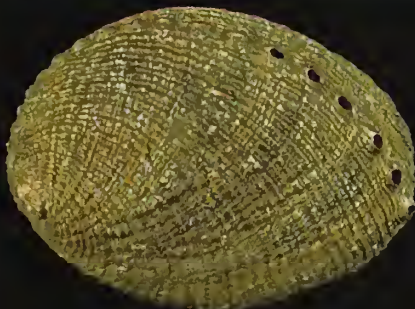
Filhol, 1880.

Distribution: Auckland and Campbell Islands, NZ. Found under rocks and ledges in 8-12 m.

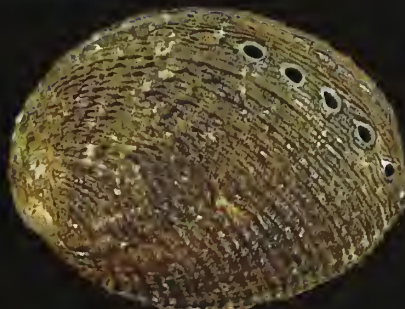
Description: Shell small, oval-elongate; light to medium weight, arched. Spire at extreme posterior end of shell. Color very dark brown to almost black. Genetic chevron-like markings totally absent. Interior nacre bright, sometimes less reflective than average. Dorsal surface consists of strong and fairly wide spiral ribs, with weak or absent prosocline folded ridges. Holes small, lightly oval and raised - usually 5-8 open. Average adult size 40-55 mm.

Largest Specimen Measured: 69.48 mm (PLC).

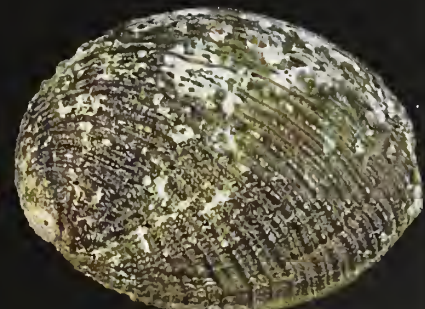
Other: Based on the examination of approximately 50 specimens from both Islands, adult shells from Auckland Island were more oval shaped (less elongate) than Campbell Island specimens. Shells from the latter locality may also be darker in color. Future studies might compare populations from the two Islands.



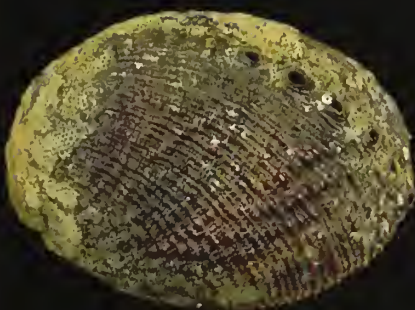
57.3 mm



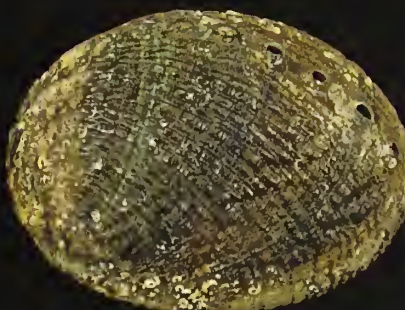
51.0 mm



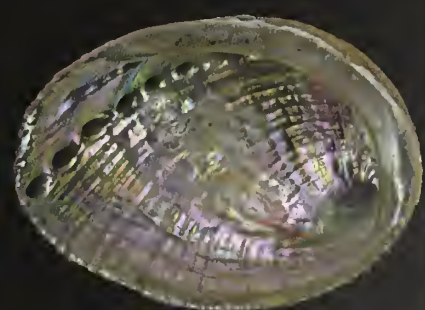
60.6 mm



52.6 mm



56.0 mm



60.6 mm

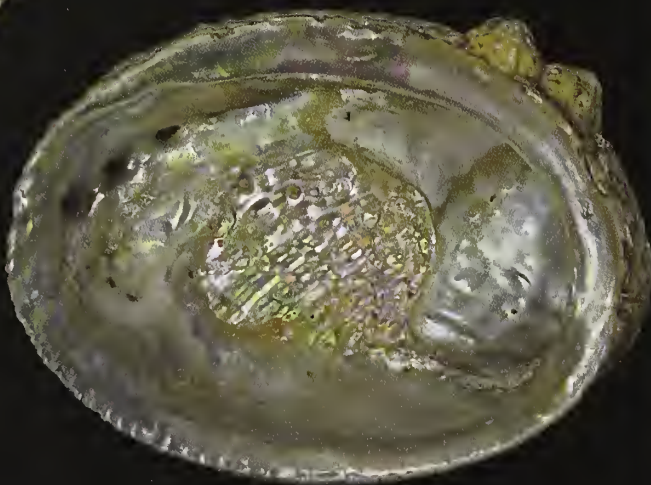
All specimens live-taken at Derry Castle Reef, Enderby Is., Auckland Is., NZ. 8-12 m depth.

PLATE 26b

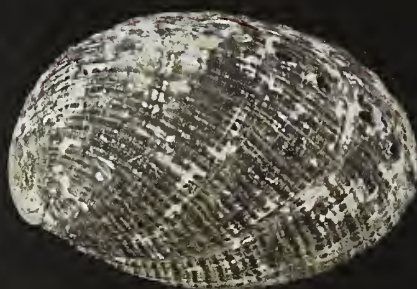
Haliotis virginea huttoni
Filhol, 1880
Campbell and Auckland Is., NZ
Common
(Rare in collections)



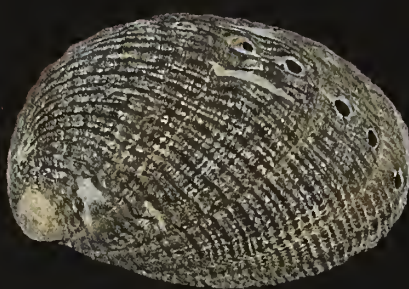
A



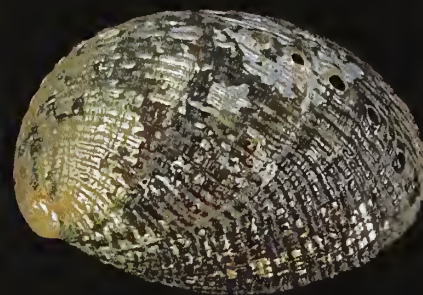
65.8mm



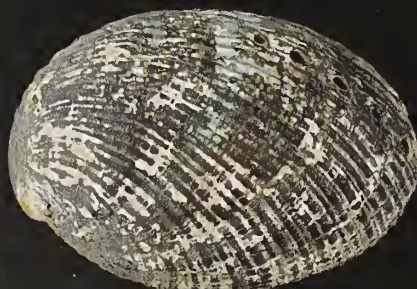
63.9 mm



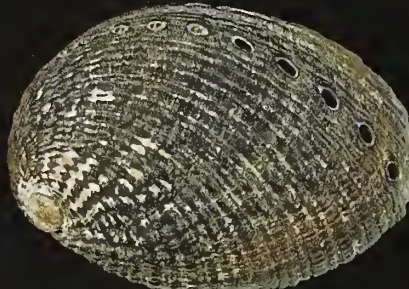
60.4 mm



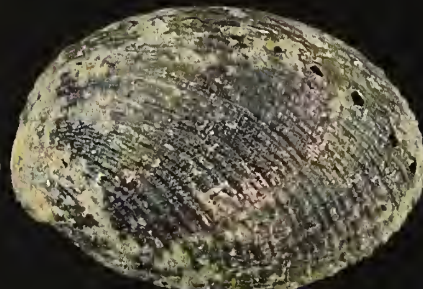
64.3 mm



64.0 mm



48.6 mm

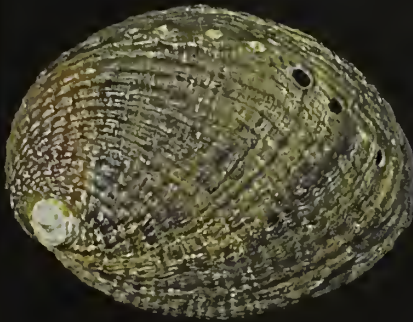


60.2 mm

A: *Haliotis virginea huttoni*. Very large specimen. 67.8 mm. Auckland Island, NZ.
Bottom 2 Rows: *H. virginea huttoni*. Perserverance Harbour, Campbell Is., NZ. Depth 5-10 m.

The 5 *H. virginea virginea* subspecies of NZ

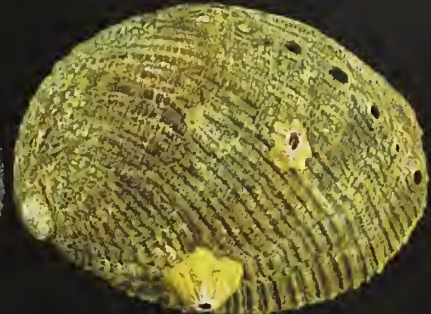
PLATE 26c. *Haliotis virginea huttoni* Filhol, 1880.



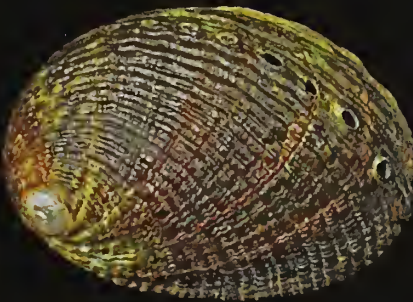
44.5 mm



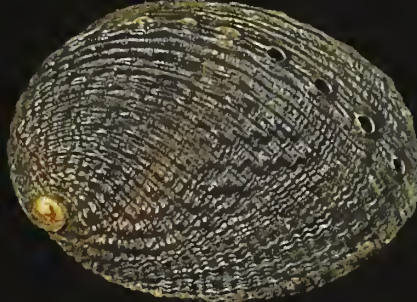
48.0 mm



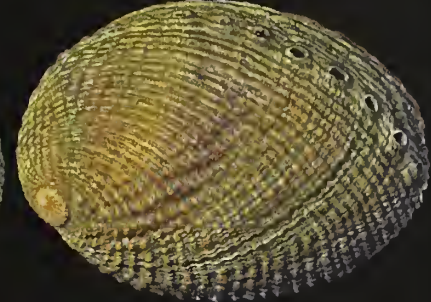
58.3 mm



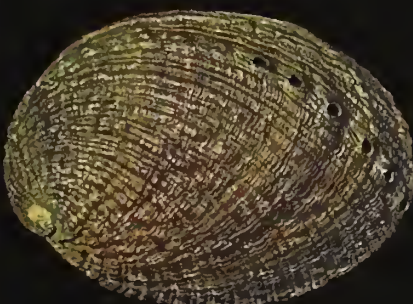
48.2 mm



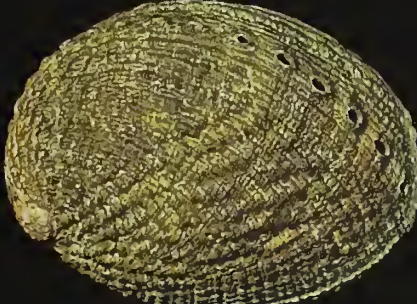
50.5 mm



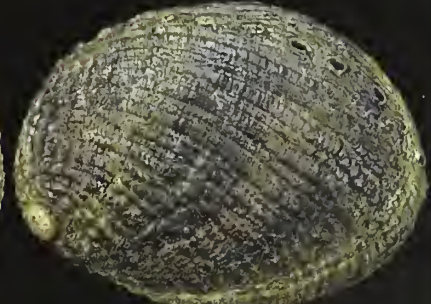
51.5 mm



47.2 mm



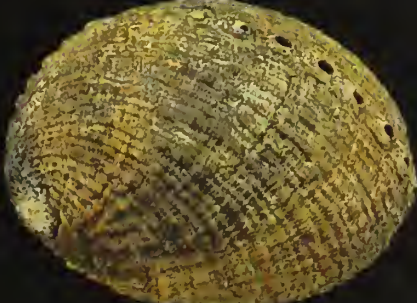
59.0 mm



62.4 mm



47.2 mm



58.1 mm



47.2 mm

All Rows: *Haliotis virginea huttoni*. Auckland and Campbell Islands, NZ. 3-10 m depth.

PLATE 27a



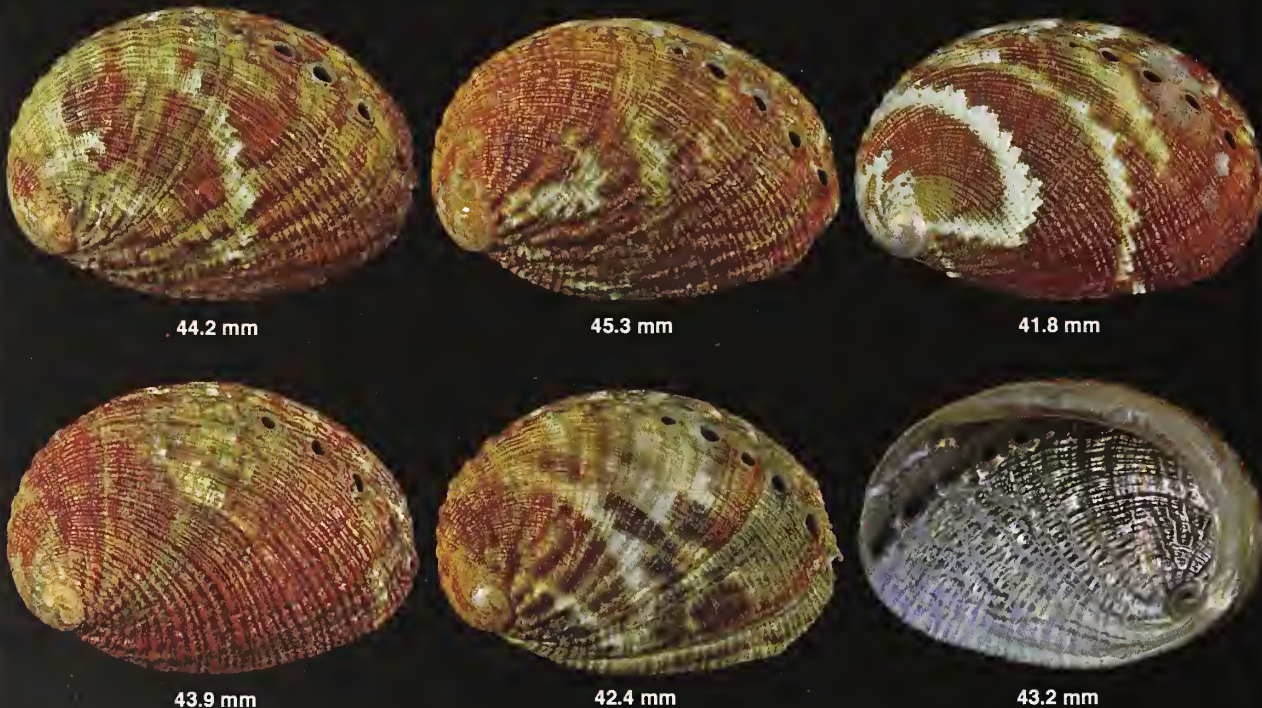
Haliotis virginea morioria
Powell, 1938.

Distribution: Chatham Island, NZ. Found under rocks and ledges in 5-15 m.

Description: Shell small to medium sized, oblong, arched. Spire slightly elevated, positioned well towards posterior end of shell. Colors include reddish-brown, red-orange, occasionally green. Whitish prosocline rays and chevron markings are extremely common, and may be observed on nearly all specimens examined. Interior nacre very brilliant, often tinged with magenta or blue sheen. Sculpture consists of fine spiral ribs, with some specimens showing moderate spiral folds. Holes oval, medium sized, slightly raised, usually 5 open. Usual adult size 40-50 mm.

Largest Specimen Measured: 75.0 mm (JRC).

Other: Somewhat resembles *H. virginea crispata*, but generally lacks the strong lamellae/folded ridges, and attains a much larger size.



All specimens live-taken at Chatham Island, NZ. 5-10 m depth.

PLATE 27b

Haliotis virginea morioria
Powell, 1938

Chatham Is., NZ

Locally common

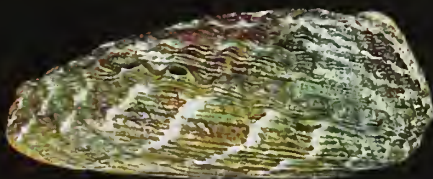


75.0 mm

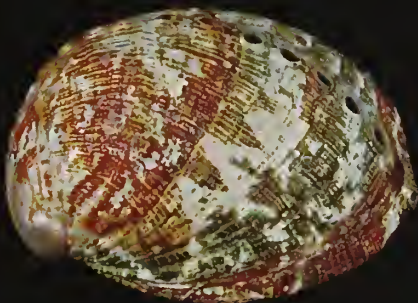
A



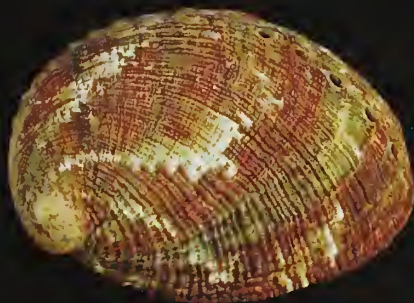
75.0 mm



58.7 mm



52.4 mm



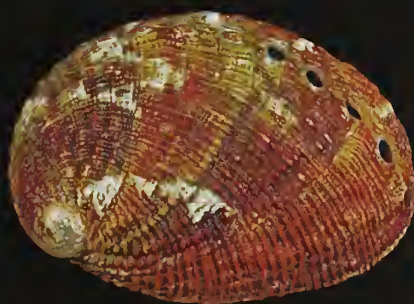
47.3 mm



50.6 mm



48.8 mm



46.3 mm

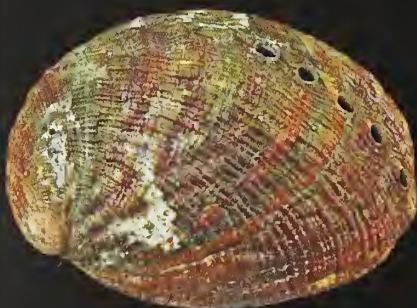


44.7 mm

A: *Haliotis virginea morioria*. Largest specimen measured. 75.0 mm (side view 58.7 mm). Chatham Is., NZ.
Bottom 2 Rows: *H. virginea morioria*. Chatham Island, NZ. 5-10 m depth.

The 5 *H. virginea virginea* subspecies of NZ

PLATE 27c. *Haliotis virginea morioria* Powell, 1938.



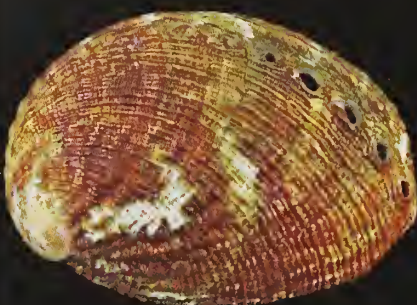
47.3 mm



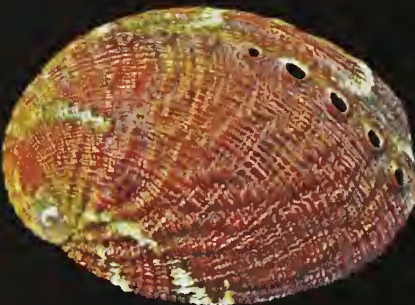
40.7 mm



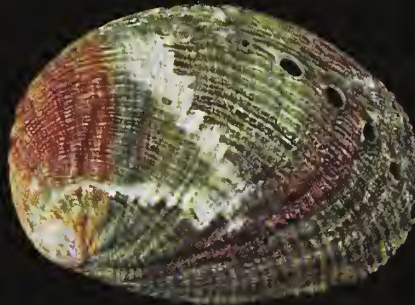
43.1 mm



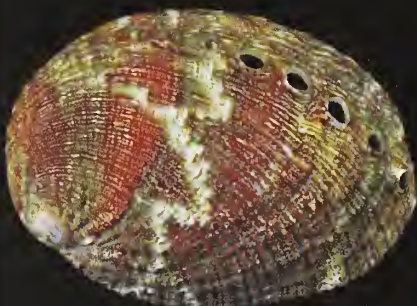
43.2 mm



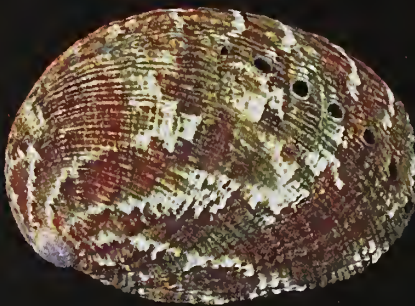
50.5 mm



38.5 mm



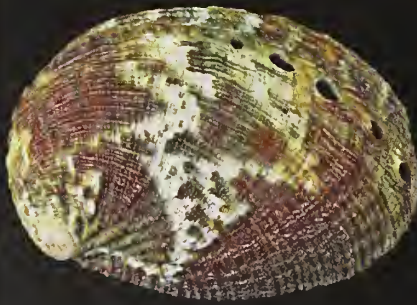
40.2 mm



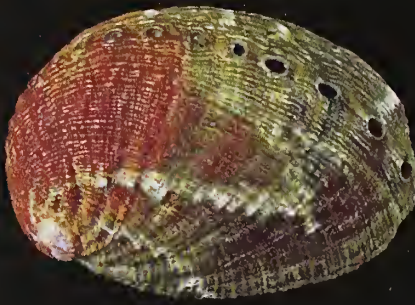
40.3 mm



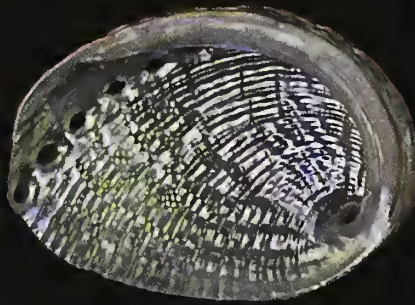
38.5 mm



40.5 mm



42.1 mm



44.2 mm

All Rows: *Haliotis virginea morioria*. Chatham Islands, NZ. 3-10 m depth.

PLATE 28a

Haliotis virginea stewartae

Jones & Owen, 2004.



Distribution: Endemic to Bounty and Antipodes Islands, ~ 1000 km southeast of NZ. Under ledges in 4-8 m.

Description: Shell small to medium size, oblong, medium weight, arched. Spire elevated, and located somewhat towards center of shell. Color red-orange to brownish-orange; less frequently brownish-tan. Occasional greenish concentric bands will indicate areas of diet change. Never observed with chevron markings, or prosocline rays. Interior nacre very bright, often with green reflections; dorsal ribs often strongly visible. Sculpture consists of strong spiral ribs, medium width, and often spaced widely apart. Prosocline folds occasionally present, but are usually weak. Usually has 4-6, fairly large, moderately elevated open holes. Usual adult size 40-50 mm.

Largest Specimen Measured: 67.2 mm (BOC).

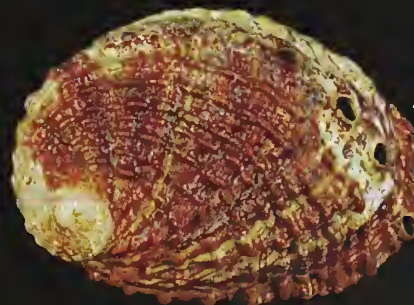
Other: Easily the most different of all the *H. v. virginea* subspecies due to its extremely strong and often widely spaced ribbing, large open holes, total lack of genetic chevron markings, and spire elevation and placement more towards center of shell. Often has a badly eroded dorsum due to severe sea conditions. Extremely rare in collections, but common in natural populations.



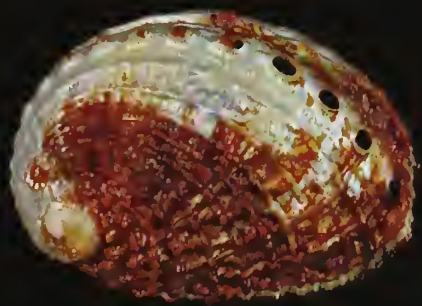
38.2 mm



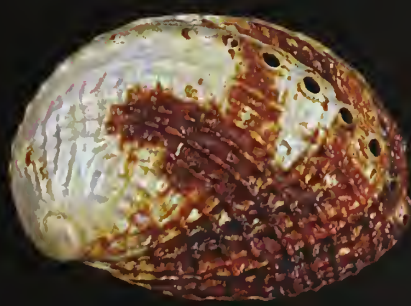
40.1 mm



44.3 mm



38.3 mm



59.8 mm



59.8 mm

All specimens live-taken at Bounty Island, NZ. 4-8 m depth.

PLATE 28b

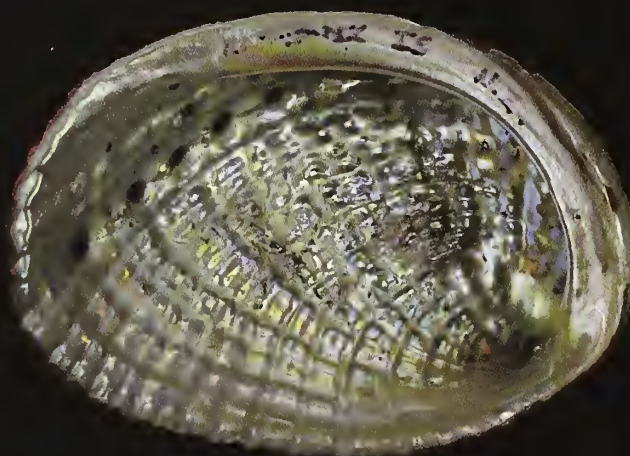
Haliotis virginea stewartae
Jones & Owen, 2004

Bounty & Antipodes Is., NZ

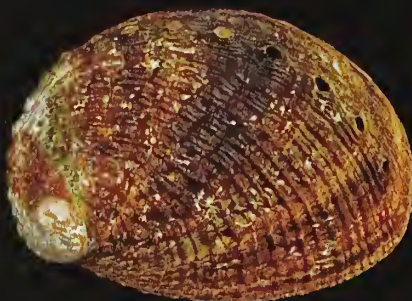
Extremely rare in collections



A



37.3 mm



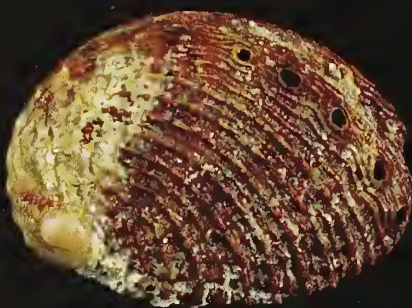
58.5 mm



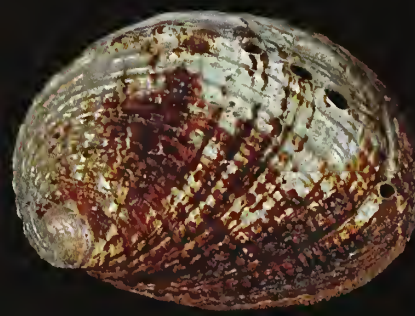
56.5 mm



56.5 mm



46.0 mm

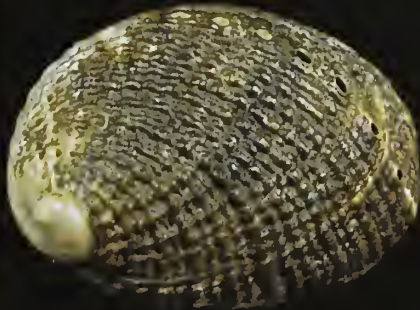


55.9 mm

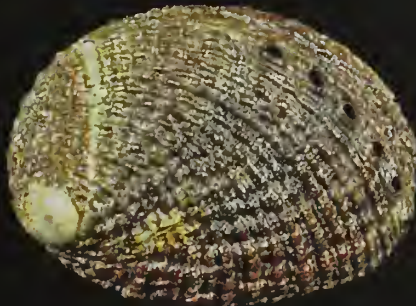
A: *Haliotis virginea stewartae*. Largest specimen measured. 67.2 mm. Antipodes Is., NZ.
Bottom 2 Rows: *H. virginea stewartae*. Antipodes Is., NZ. 4-8 m depth.

The 5 *H. virginea virginea* subspecies of NZ

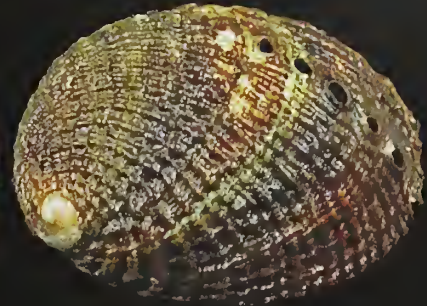
PLATE 28c. *Haliotis virginea stewartae* Jones & Owen, 2004.



64.5 mm



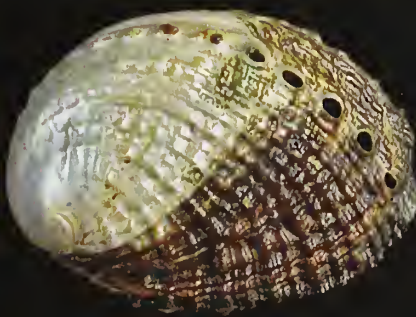
59.5 mm



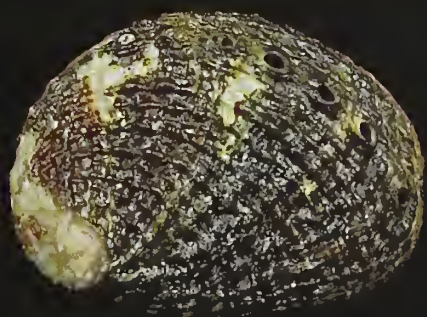
55.1 mm



61.8 mm



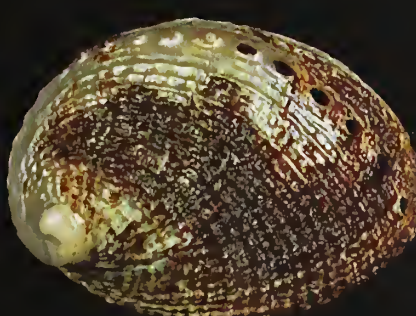
49.0 mm



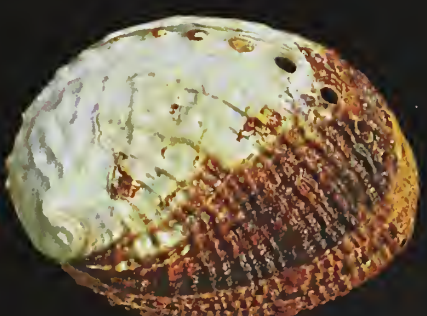
43.2 mm



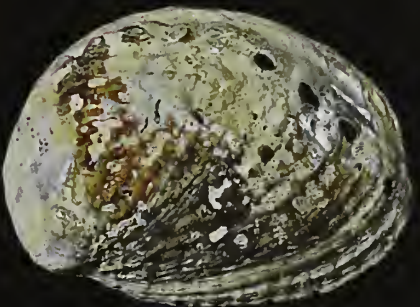
43,8 mm



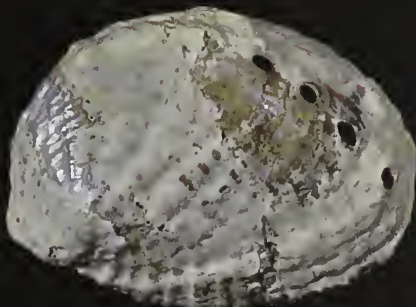
60.5 mm



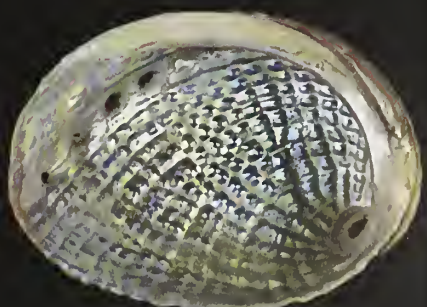
55.3 mm



38.0 mm



34.2 mm



64.5 mm

All Rows: *Haliotis virginea stewartae*. Antipodes Islands, NZ. 3-10 m depth.

PLATE 29a

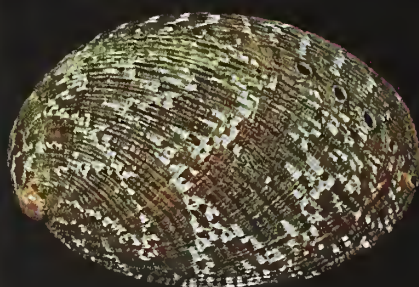
Haliotis virginea virginea Gmelin, 1791.

Distribution: South Is., South end of North Is., Stewart Is., NZ..
Under rocks and ledges in 5-10 m.

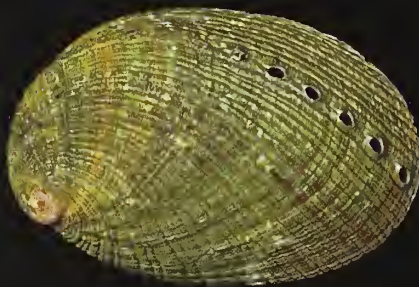
Description: Shell small, oval-elongate, arched, quite thin. Spire at extreme end of shell. Color red, green, and brown tones, often with abundant irregular white chevrons. Interior nacre brilliant, often with strong reflections of blue or magenta. Fairly narrow to medium width low spiral ribs of square to rounded profile. Lamellae/folded ridges occasionally present, but usually few in number, and weakly developed. 4-7 holes usually open, only very slightly elevated. Average adult size 45-60 mm.

Largest Specimen Measured: 68.5 mm (RKC).

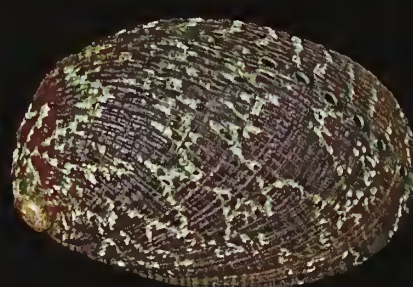
Other: *Haliotis virginea virginea* and its subspecies are too small to be harvested commercially.



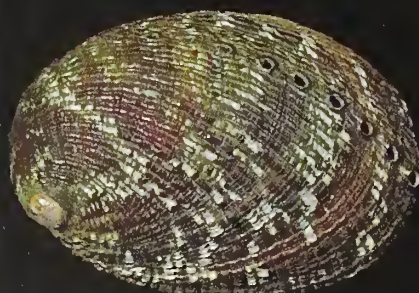
66.2 mm



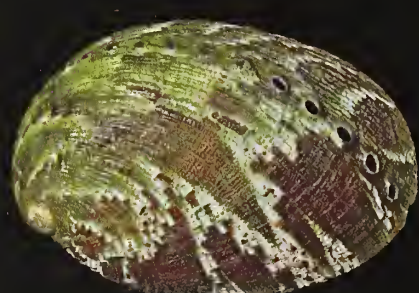
49.2 mm



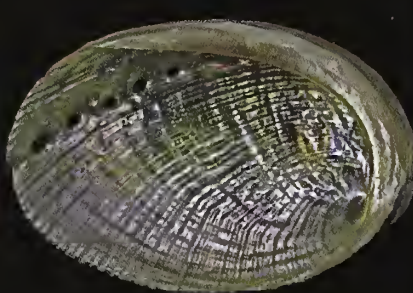
68.5 mm



48.5 mm



53.0 mm



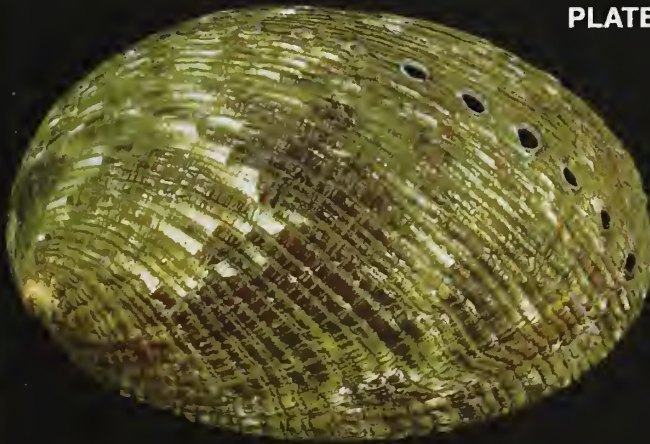
66.5 mm

All specimens live-taken on South Is. and Stewart Is., NZ. 5-10 m depth.

PLATE 29b

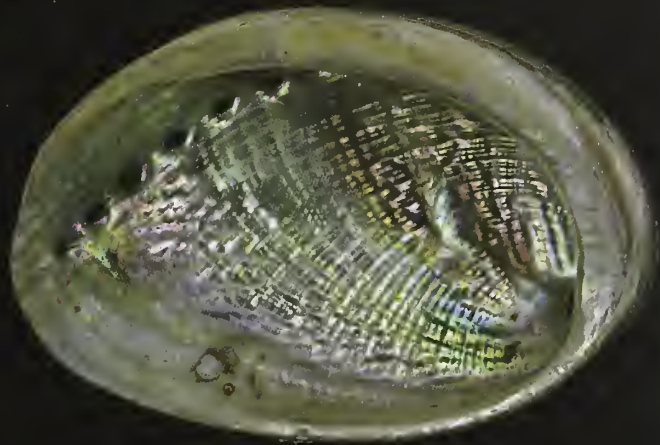
Haliotis virginea virginea
Gmelin, 1791

Southern NZ
Very common



66.3 mm

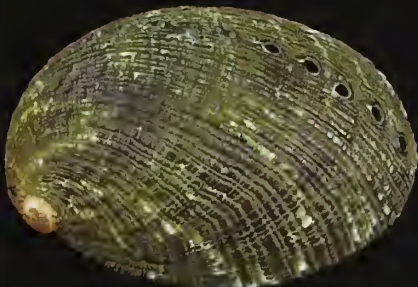
A



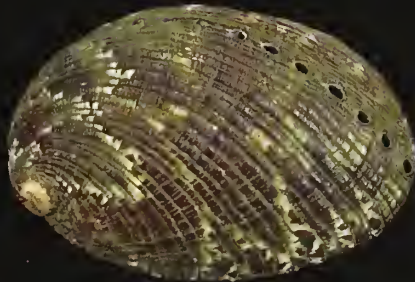
66.3 mm



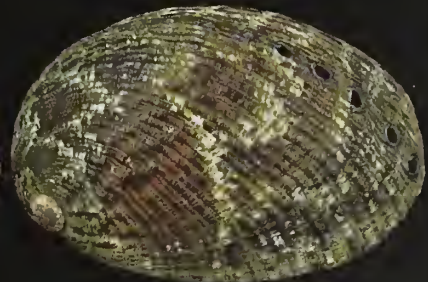
68.5 mm



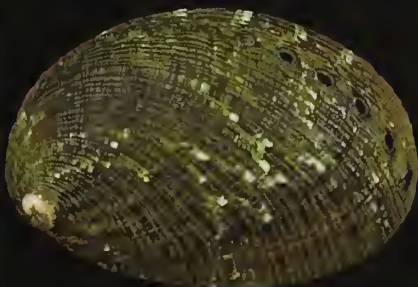
47.3 mm



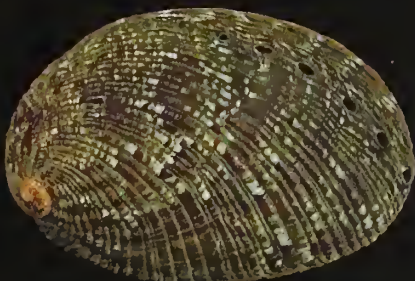
51.4 mm



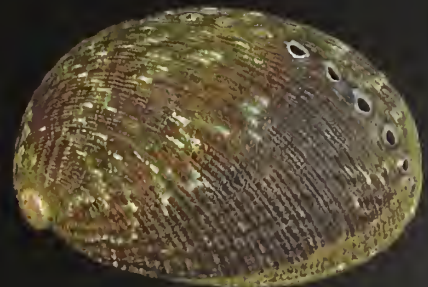
43.6 mm



44.8 mm



39.4 mm

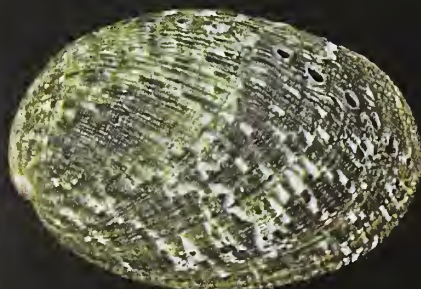


61.8 mm

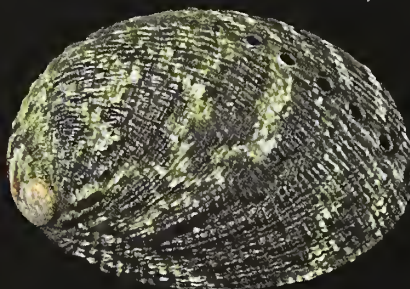
A: *Haliotis virginea virginea*. Two very large specimens. South Is. to Stewart Is., NZ.
Bottom 2 Rows: *H. virginea virginea*. South Island, NZ. 5-10 m depth.

The 5 *H. virginea virginea* subspecies of NZ

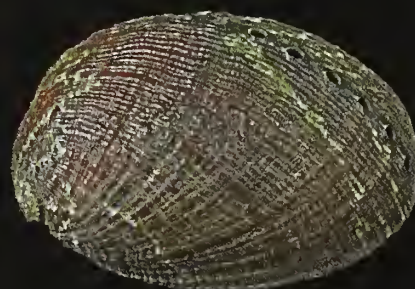
PLATE 29c. *Haliotis virginea virginea* Gmelin, 1791.



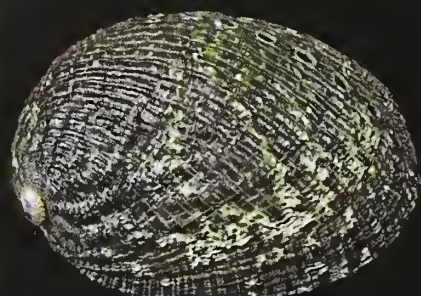
44.5 mm



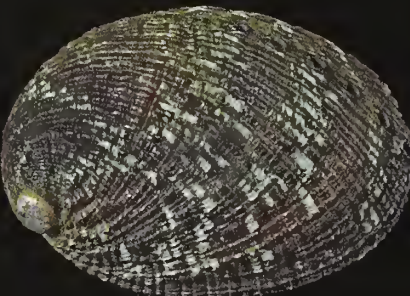
48.0 mm



58.3 mm



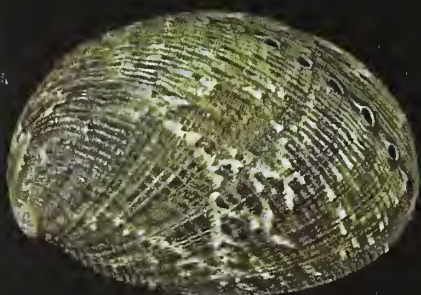
48.2 mm



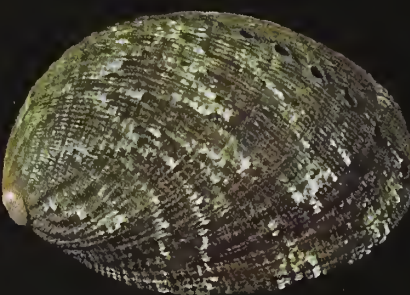
50.5 mm



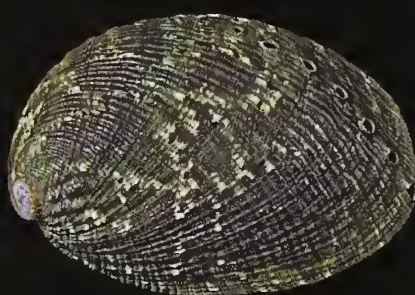
51.5 mm



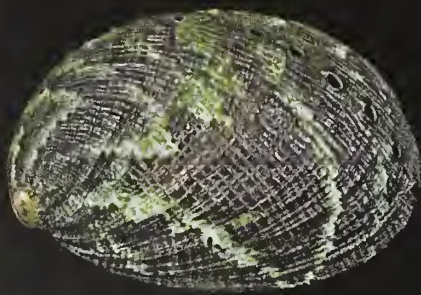
47.2 mm



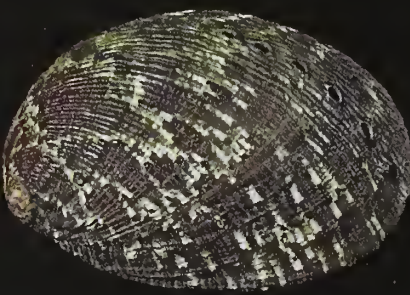
59.0 mm



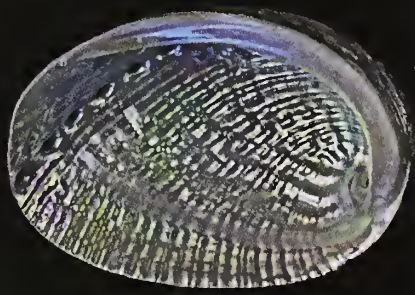
62.4 mm



47.2 mm



58.1 mm

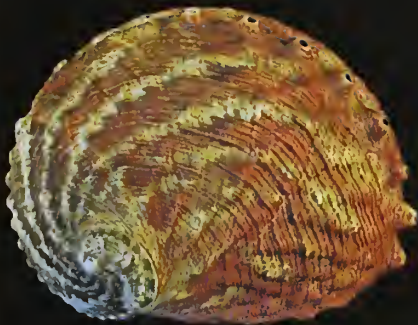


47.2 mm

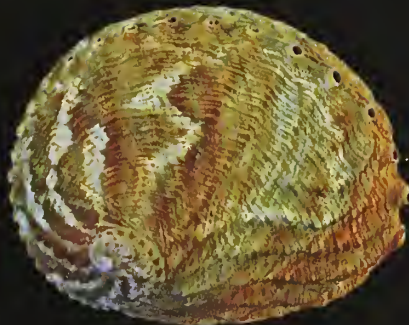
All Rows: *Haliotis virginea virginea*. South Island and Stewarts Island, NZ. 3-10 m depth.

The Hybrid *Haliotis* of Australia

PLATE 30. *Haliotis rubra rubra* Leach, 1814 x *H. laevigata* Donovan, 1808.



171.5 mm



132.5 mm



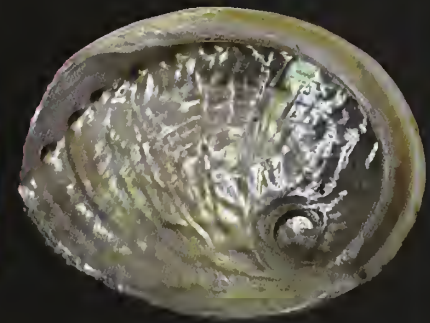
146.3 mm



143.3 mm



149.5 mm



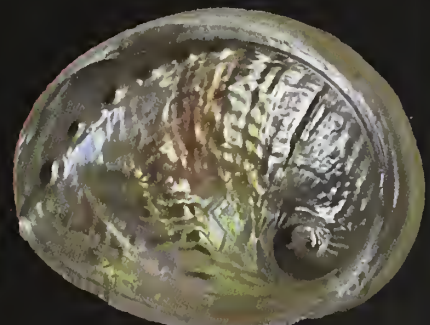
148.4 mm



162.5 mm



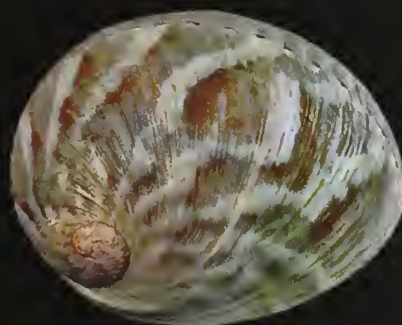
139.0 mm



154.2 mm



169.8 mm



150.0 mm

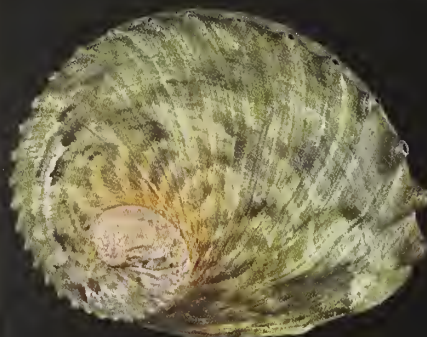


157.4 mm

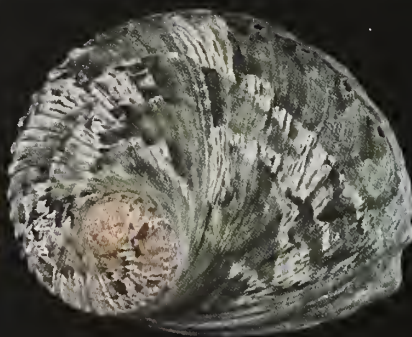
Row 1: *Haliotis rubra rubra*. VIC to NSW.
 Rows 2 & 3: *H. rubra rubra* x *H. laevigata*. Port Fairy, SA, to VIC.
 Row 4: *Haliotis laevigata*. Near Port Fairy, SA.

The Hybrid *Haliotis* of Australia

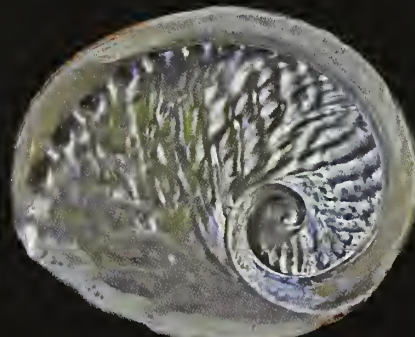
PLATE 31. *Haliotis rubra conicopora* Péron, 1816 x *H. laevigata* Donovan, 1808.



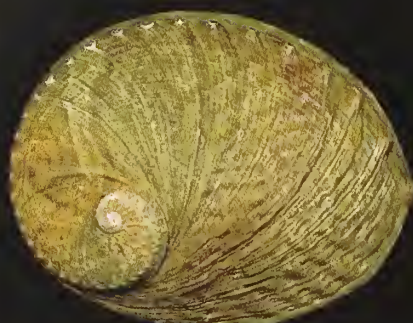
174.0 mm



164.3 mm



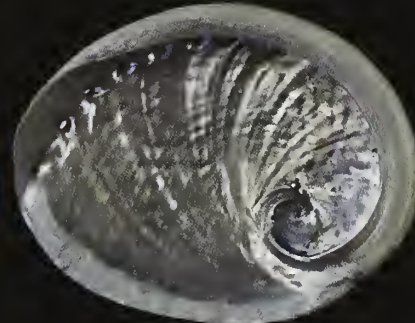
170.2 mm



166.0 mm



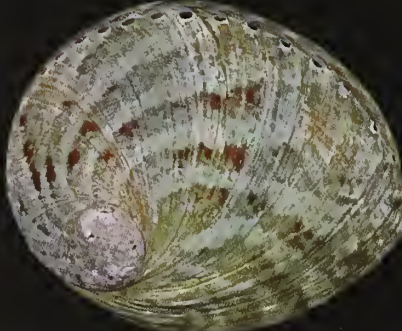
155.5 mm



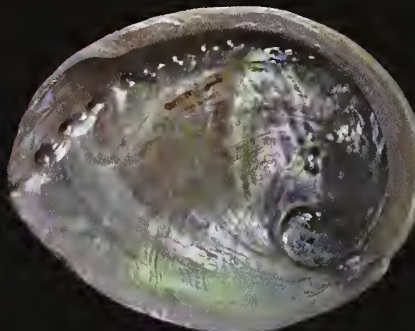
155.5 mm



166.5 mm



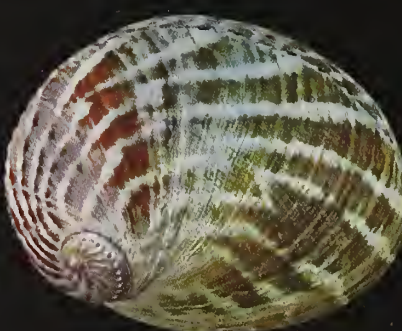
159.3 mm



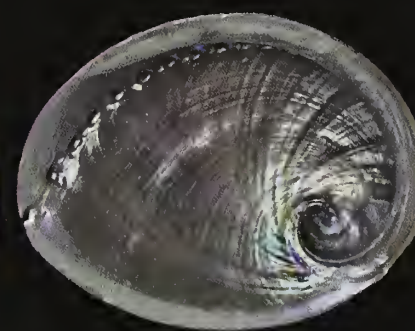
159.3 mm



164.3 mm



160.2 mm



156.3 mm

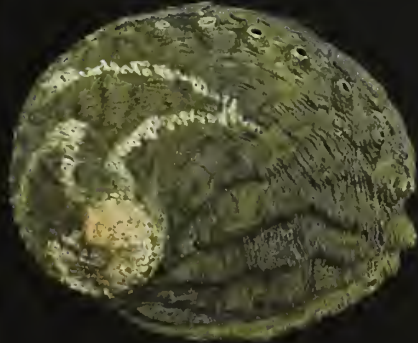
Row 1: *Haliotis rubra conicopora*. Esperance, WA.

Rows 2 & 3: *H. rubra conicopora* x *H. laevigata*. Esperance, WA.

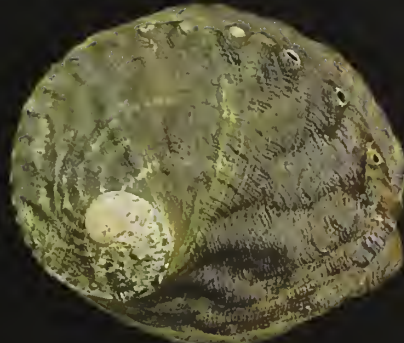
Row 4: *Haliotis laevigata*. Esperance, WA.

The Hybrid *Haliotis* of Australia

PLATE 32. *Haliotis r. rubra/rubra conicopora* "intergrade" x *H. laevigata* Donovan, 1808.



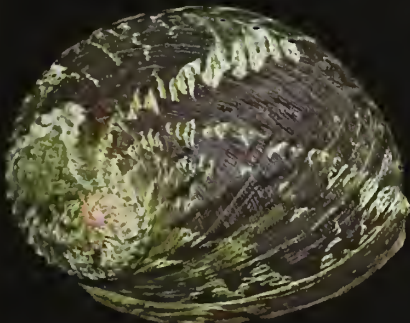
183.8 mm



164.3 mm



164.3 mm



153.2 mm



147.1 mm



156.3 mm



137.0 mm



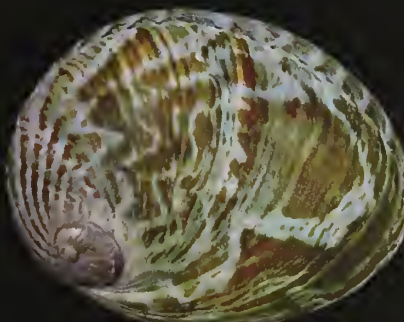
110.5 mm



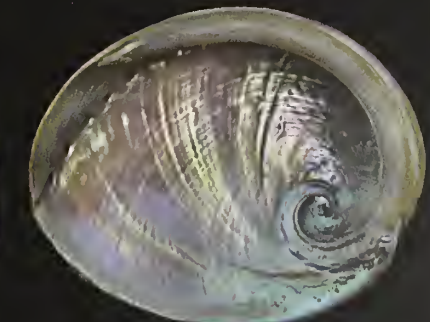
110.5 mm



188.2 mm



161.2 mm



178.3 mm

Row 1: *Haliotis r. rubra/rubra conicopora* "intergrade". Esperance, WA.

Rows 2 & 3: *H. r. rubra/rubra conicopora* "intergrade" x *H. laevigata*. Esperance, WA.

Row 4: *Haliotis laevigata*. Esperance, WA.

The Hybrid *Haliotis* of Australia

PLATE 33a. *Haliotis roei* Gray, 1826 x *H. laevigata* Donovan, 1808.



88.3 mm



85.2 mm



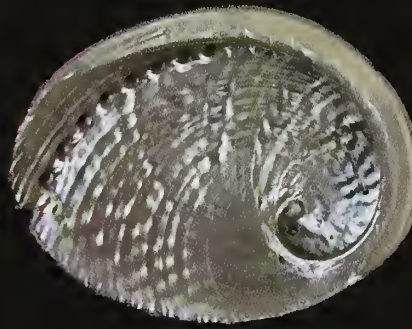
81.2 mm



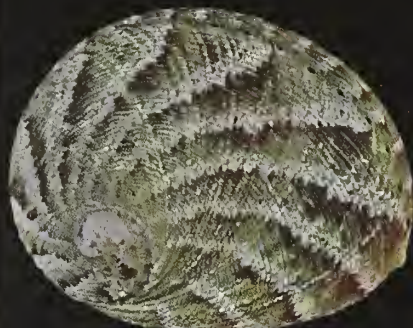
109.3 mm



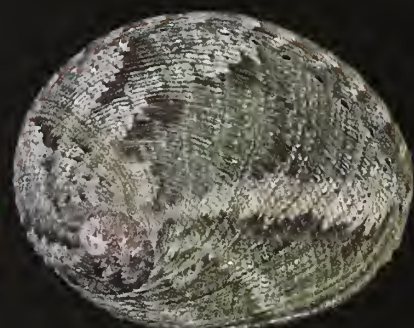
110.0 mm



108.3 mm



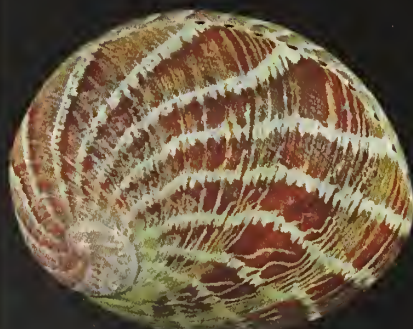
114.0 mm



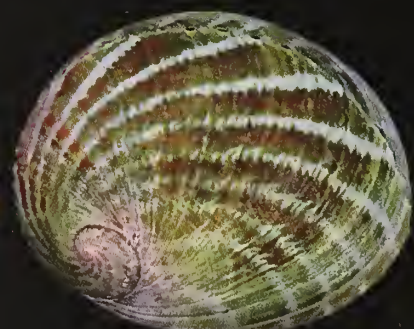
96.0 mm



88.4 mm



164.1 mm



155.6 mm

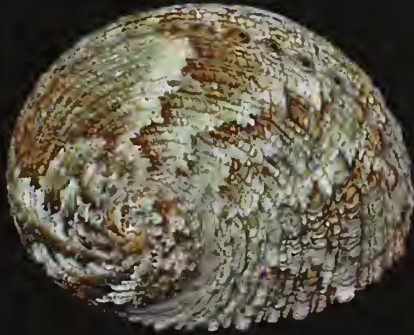


167.8 mm

Row 1: *Haliotis roei*. Taken between Albany and Esperance, WA.
 Rows 2 & 3: *H. roei* x *H. laevigata*. Taken between Albany and Esperance, WA.
 Row 4: *Haliotis laevigata*. Taken between Hopetoun and Esperance, WA.

The Hybrid *Haliotis* of Australia

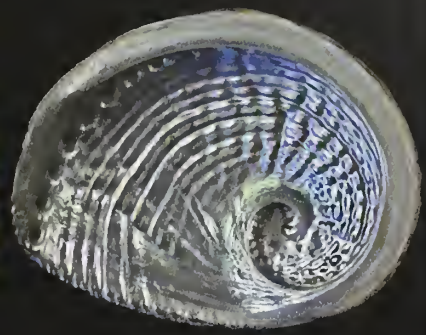
PLATE 33b. *Haliotis roei* Gray, 1826 x *H. laevigata* Donovan, 1808.



88.5 mm



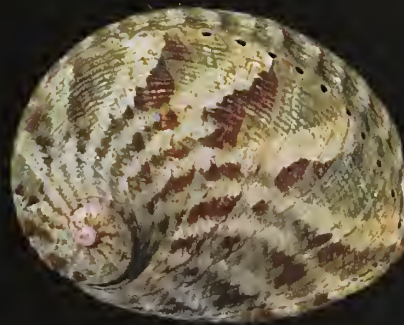
74.5 mm



91.3 mm



83.3 mm



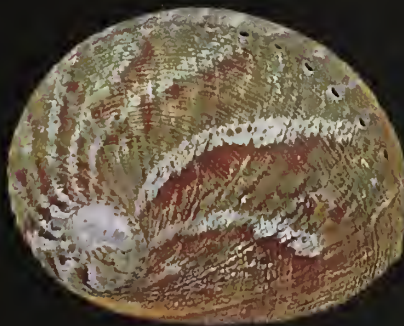
78.0 mm



105.5 mm



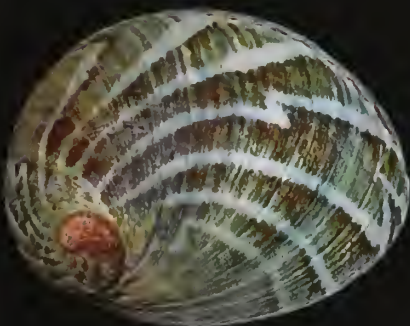
114.0 mm



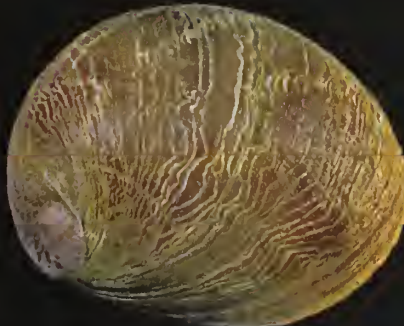
140.3 mm



97.6 mm



198.0 mm



150.0 mm



156.3 mm

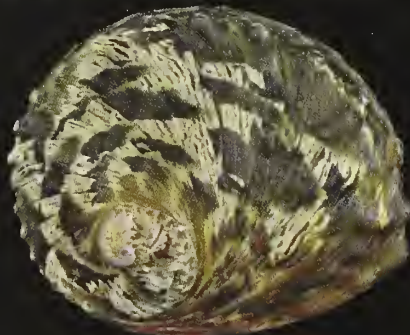
Row 1: *Haliotis roei*. Taken between Albany and Esperance, WA.
 Rows 2 & 3: *H. roei* x *H. laevigata*. Taken between Albany and Esperance, WA.
 Row 4: *Haliotis laevigata*. Taken between Hopetoun and Esperance, WA.

The Hybrid *Haliotis* of Australia

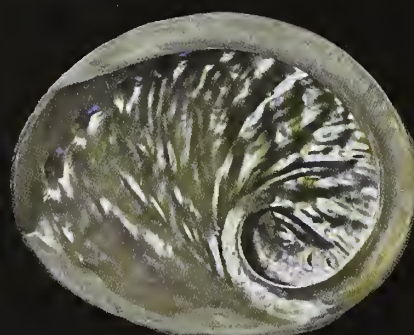
PLATE 34a. *Haliotis rubra conicopora* Péron, 1816 x *H. roei* Gray, 1826.



168.5 mm



172.5 mm



180.0 mm



119.0 mm



112.2 mm



117.0 mm



94.0 mm



123.2 mm



123.2 mm



88.0 mm



94.2 mm



78.4 mm

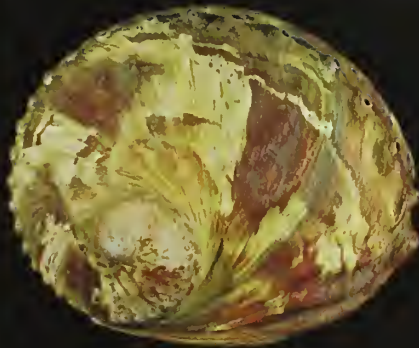
Row 1: *Haliotis rubra conicopora*. Esperance, WA.

Rows 2 & 3: *H. rubra conicopora* x *H. roei*. Esperance, WA.

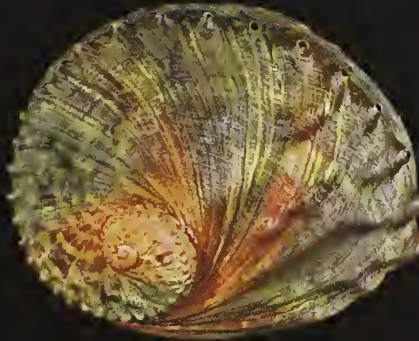
Row 4: *Haliotis roei*. Esperance, WA.

The Hybrid *Haliotis* of Australia

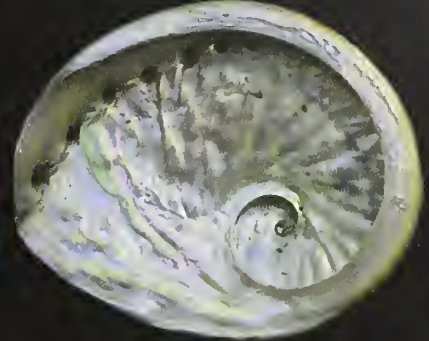
PLATE 34b. *Haliotis rubra conicopora* Péron, 1816 x *H. roei* Gray, 1826.



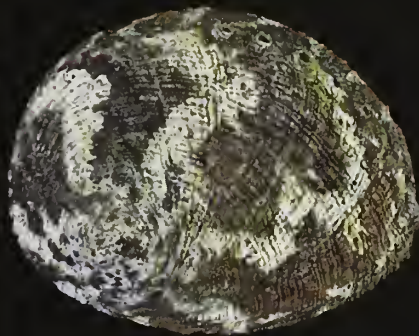
166.5 mm



180.0 mm



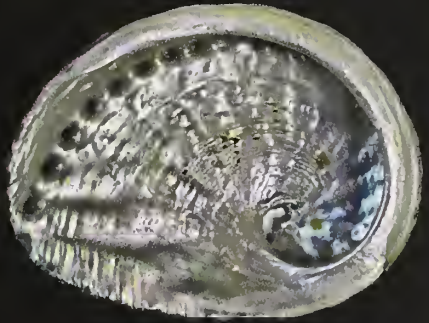
183.8 mm



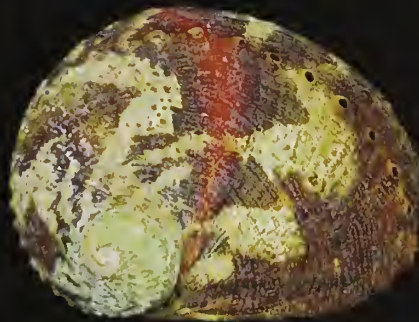
95.0 mm



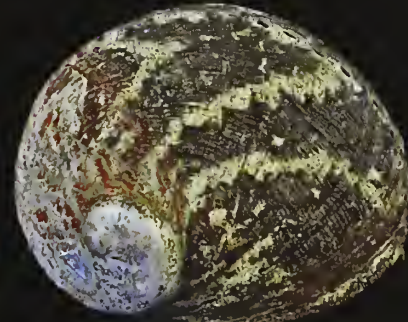
123.2 mm



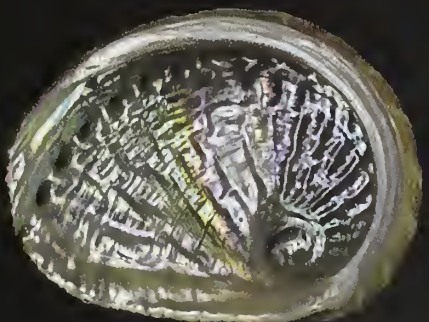
119.4 mm



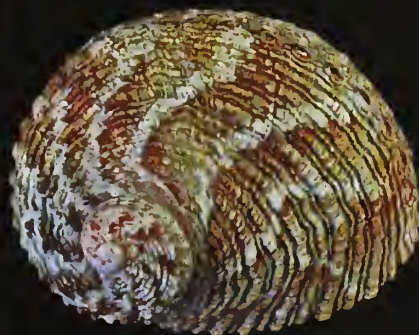
82.7 mm



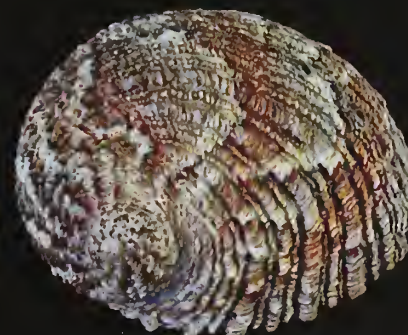
149.5 mm



82.7 mm



90.0 mm



88.0 mm



88.2 mm

Row 1: *Haliotis rubra conicopora*. Esperance, WA.
 Rows 2 & 3: *H. rubra conicopora* x *H. roei*. Esperance, WA.
 Row 4: *Haliotis roei*. Esperance, WA.

The Hybrid *Haliotis* of Australia

PLATE 35. *Haliotis scalaris scalaris* Leach, 1814 x *H. laevigata* Donovan, 1808.



74.8 mm



76.6 mm



121.1 mm



121.1 mm



164.8 mm



200.0 mm

Row 1: *Haliotis scalaris scalaris*. Esperance, WA.
 Rows 2 & 3: *H. s. scalaris* x *H. laevigata*. Esperance, WA.
 Row 4: *Haliotis laevigata*. Esperance, WA.



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