Alien Snails Threaten Hawaiian Wetland Ecosystems

by Christopher Alpha*

1. The Alien Invasion

Exotic freshwater snails of the families Ampullariidae and Viviparidae have been known in Hawaii for a number of years. Fortunately, the biology of these early exotic introductions, or aspects of the Hawaiian environment, prevented the populations of these species from attaining high densities. Recently, additional exotic freshwater snails of the family Ampullariidae, genus *Pomacea*, have become established in the islands. The currently known distributions of these organisms has been documented (Cowie, 1993). Initially, populations have been focused in taro lo'i and their feeder streams (auwat). The warm, slow moving waters of the taro lo'i, with their abundant aquatic vegetation, mimic these snails' natural habitat quite closely. Snails are known to have been intentionally introduced to lo'i by farmers seeking to profit from their sale for food for human consumption. The snails are now expanding out through the feeder streams and further inland. Commonly called "apple snails" or "mystery snails" by the public, there are thought to be four species of Ampullariidae, and one species of Viviparidae in Hawaii. The problem is compounded due to the confusing state of the taxonomy of the Ampullariidae.

The vectors of transmission to and within the Hawaiian Islands are thought to be the aquarium trade and individuals seeking to culture them for commercial profit. Snail "farms" have been active on Maui, Oahu, and Kauai islands and there are an unknown number of smaller-scale private operations. Escapees from these projects are inevitable. Interisland exchange of snail brood stock between snail entrepreneurs is also known to have occurred. The snails enjoy popularity as a food item with Filipinos and other Asian ethnic groups. Due to this demand, the live snails are readily available in many Chinatown markets in downtown Honolulu.

The first introduced exotic, *Cipangopaludina chinensis* (family Viviparidae), was introduced from Asia by Chinese immigrants as a food item around the turn

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REEF COMBINGS

Shell Writers

Chris Alpha is a graduate student in the Botany Department at the University of Hawaii. Unfortunately, his interest in the effects of apple snails on Hawaiian taro did not translate into a dissertation project. Instead, his interest in conservation biology has led him to work with endangered plants.

Tony Swann, a director for Wheldon & Wesley, continues to reflect on his business as a book dealer. Mr. Swann, who has recently stopped smoking, has a reputation throughout the world as an honest businessman. This reputation has made Weldon & Wesley very successful.

Olive Schoenberg-Dole has traveled extensively throughout the Pacific following the tracks in the sand to some of her favorite shells. A longtime friend, Olive seemed an appropriate person to write a profile of Stu Lillico, Editor Emeritus of HSN.

Bob Purrymun is a retired construction supervisor who now resides in the San Francisco Bay area. An amateur scientist at heart, Bob used to track the movements of Terebra off Waikiki, Hawaii by marking, releasing, and recapturing shells.

The Junior Shell Club

In preparation for their nighttime reefwalk on November 13, the Junior Shell Club (JSC) listened to a presentation on reef animals and constructed underwater look boxes. JSC advisor Tina Xavier talked about the animals the children could expect to see during their reefwalk and addressed some safety and conservation issues to insure that everyone had fun and that the reef was preserved for others to enjoy.

The Junior Shell Club meets at 7 P.M. on the first Friday of every month at the Makiki Recreation Center in Honolulu. Meetings last approximately one and a half hours and include a short talk, crafts, and refreshments.

For more information, contact Vela Beckwith at (808) 682-0951 (Honolulu).

HMS president Dr. Robert Cowie presents Evelyn Gage Gerisch, HSN's first editor, with a Triton Award recognizing her outstanding service to the Society.

***

Dr. Robert Cowie to Remain Society President

Dr. Robert Cowie, malacologist at Bernice P. Bishop Museum, was (unanimously) reelected as HMS President for 1994 at the Society's annual business meeting.

The entire list of nominees presented at the November meeting was approved. Betsy Gagne (Vice President), Vela Beckwith (Recording Secretary), Trudi Ernst (Corresponding Secretary), and Bob Moffitt (Treasurer) will continue on in their positions. Olive Schoenberg-Dole and Barbara Kuenmer will join returning Directors Ron Beckwith, George Cook, Bill Ernst, Liz Kane and David "Woody" Woodman. Stu Lillico has been elected HMS Counselor.

Renewals

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Hawaiian Shell News does not intentionally carry original descriptions of species or genera, and does not wish to be cited as authority for new taxa.

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of the century. *C. chinensis* is currently found on Hawaii, Maui, Oahu, and Kauai islands, existing sympatrically with *Pomacea* spp. and *Pila conica* (Cowie, 1993).

One of the first species of Ampullariidae to arrive was *Pila conica* which is native to Asia. *Pila conica* was first collected in the wild in 1966 in Keanae, Maui (Bishop Museum collection). Asian immigrants are also thought to be responsible for the arrival of *P. conica* and *P. conica* is recorded from Maui, Molokai, and Oahu (Cowie, 1993).

*Pomacea bridgesi* is another of the early Ampullariidae introductions, first collected in Waipio valley, Hawaii in 1965 (Bishop Museum collection). *Pomacea bridgesi* originates from tropical South America where dark colored individuals predominate. The aquarium trade imported *P. bridgesi* to Florida and generated trade in yellow individuals for higher commercial appeal (Cowie, 1993). Subsequently, *P. bridgesi* has become established in the southern United States. *P. bridgesi* populations have been recorded from Hawaii, Maui, Oahu, and, most recently, Kauai (Cowie, 1993).

The most recent aliens to arrive are *Pomacea paludosa* and *Pomacea canaliculata*. *P. paludosa* is from Florida and *P. canaliculata* has origins in South America. *P. paludosa* has been recorded only from a single locality on Maui in 1990 (Bishop Museum collection). Unlike *P. paludosa*, *P. canaliculata* has quickly spread almost throughout the Hawaiian islands. *Pomacea canaliculata* has rapidly increasing populations on Maui, Oahu, and Kauai (Cowie, 1993). The earliest collection of *P. canaliculata* is from Keanae, Maui in early 1989 (Bishop Museum collection). The speed with which *P. canaliculata* has spread in the state may be attributed to the activities of large-scale culture operations and the snail's prolific nature.

II. Life History

Data on the biology and life histories of these snails in their native habitat are scarce. Similarly, life history studies of these snails in non-native habitats are fragmentary, excluding crop damage surveys from Asia. However, some generalities can be made (Mochida, 1991; Guerrero, 1989; Synder & Synder, 1970).

*P. paludosa*, *P. bridgesi* and *P. canaliculata* are present in Hawaii and are currently in the process of spreading across the state. *P. paludosa* and *P. canaliculata* are currently found on Maui, Oahu, and, most recently, Kauai islands, existing sympatrically with *Pomacea* spp.

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**III. Alien Impacts in Asia and Hawaii**

The impact of introduced *Pomacea* to Asian agriculture has been devastating. Crops affected include young rice seedlings, taro, swamp cabbage, lotus, mat rush, wild rice, water chestnuts, and azolla (Mochida, 1991). The snails have also been shown to feed on a number of terrestrial plants when these are placed in their culture ponds (Mochida, 1991). During 1982 in Taiwan, 17,000 hectares of rice were infested with *Pomacea canaliculata*, with 124,430 hectares of rice having become infested for an estimated loss of 30.9 million U.S. dollars that year alone (Mochida, 1991).

In Hawaii, the initial sites of activity have been mostly taro lo'i, a habitat similar to the native habitats of these ampullariid and viviparid snails. The snails are currently moving out of the taro lo'i, and into neighboring streams and wetland areas.

The Hawaii Department of Land and Natural Resources (DLNR) recognizes 376 perennial streams within the state (Smith, Wilcox & Edmonds, 1990). Biological information on these streams is varied and incomplete. As the snails expand their range into feeder streams and adjacent wetlands, there must be concern for native stream and riparian habitats. According to the Nature Conservancy's Hawaiian Heritage Database there are 171 rare, threatened, and endangered plants associated with streams within the state. *Pomacea* are uniquely adapted, in that they have both gills and an air breathing lung, and thus can spend extended periods out of water. It is this fact that imperils riparian vegetation. The amount of plant material consumed by populations of *Pomacea* snails in taro lo'i is tremendous. If these trends continue in native Hawaiian riparian systems, serious losses of plant cover will result. Negative impact in these areas is not yet documented, since the invasions are still in their infancy. However, the potential damage that *Pomacea* may cause to these areas is reason alone for great concern.

Stream-related plants are not the only organisms in danger as Hawaiian streams are also home to a great many endemic vertebrate and invertebrate species, including between eleven and thirteen presumed endemic fresh-
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water snail species from four families (Neritidae, Thiariidae, Lymnaeidae, and Ancylidae/Bulimidae) (Kay, 1990). The introduction of alien freshwater snails may cause competition for resources between natives and aliens. Pomacea snails have been observed feeding on green algae next to Neritina granosa in streams near Keanae, Maui (Skippy Hau, DLNR — pers. comm.) Since the native freshwater snails have evolved with minimal competition this could be disastrous.

Four gobies, one a candidate endangered species, as well as a native shrimp, and a native prawn also live in Hawaiian streams (Smith, Wilcox & Edmonds, 1990).

IV. Alien Control

Chemical molluscicides, such as metaldehyde, triphenyl-tin acetate, and alachlor, are the popular choice for control in Asia (Cheng, 1989). Although fairly effective against Pomacea, these metal-based chemicals and most others show no specificity, and are often very toxic to fish and other water life (Cheng, 1989; Mochida, 1991; Godan, 1983). Many of these compounds are not widely approved for agricultural usage worldwide. Copper sulfate has been used with success, but lacks specificity. Large kills of non-target invertebrates and vertebrates are associated with its usage, as with most metal based chemicals. Copper sulfate is most effective in still, clear waters; poor kills have been reported in flowing, muddy waters such as taro lo‘i (Acosta et al., 1989). The State Department of Agriculture has run some field tests with copper sulfate in Kauai taro lo‘i with limited success. Unapproved and illegal use of copper sulfate has been documented on Oahu and Maui (David Penn, pers. comm.).

The Hawaiian Islands have seen their share of biological controls, most of which have had undesirable consequences (Stone & Scott, 1985). The natural predators of these snails include snapping turtles, the yellow-throated cayman, and the Everglades snail kite (Snyder & Snyder, 1970). Clearly, the introduction of such species to combat the Pomacea problem is a poor idea. In Japan, the use of predatory black carp has had some limited success (Mochida, 1991). The use of ducks in Asia as a control measure in agricultural areas is recommended (Anon., 1989; Mochida, 1991). The ducks eat the young snails and help fertilize the area with their droppings. This is an appealing low-technology solution that has recently been tried in Maui, but it does not eliminate the snails totally.

The safest, least environmentally harmful method of control is the mechanical collection of snails and eggs by humans. Rice farmers in Asia take advantage of the snails' habits and place upright sticks in their paddies on which the snails lay eggs, facilitating easy collection and disposal (Anon, 1989). Another technique used by rice farmers is to dig deep trenches in the paddies; and slowly lower the water level. The snails migrate into the deeper areas, and are easily collected (Anon, 1989). At the moment there appears to be no easy solution to the problem. A promising area for future research would be sexual attractants with which to lure the snails to traps.

V. Conclusions

The full impact of Pomacea freshwater snails in the Hawaiian islands is yet unknown. With the advent of large populations of Pomacea snails in Hawaii concern for native species is obligatory. Many native species require undisturbed habitats to survive and reproduce and perpetuate
the ecosystem as a whole unit. There are no signs of factors abiotic or biotic that will limit populations of Pomacea. Direct effects most likely to be seen first would include increased competition for resources such as food and space between the native snails and the aliens. The relatively low reproductive rates of native stream fauna simply aren’t in favor of competition against the very fecund Pomacea snails. The secondary, and even tertiary effects of the presence of alien freshwater snails upon the ecology of the islands can only be darkly hypothesized. The question is: what native species will be impacted first by the Pomacea snails?

References


Joanne Lightfoot
1930 - 1993

Joanne Lightfoot, long-time Hawaiian Malacological Society member and active in the Conchologists of America, succumbed in May after a long fight against cancer at her home in Sedona, Arizona.

"Joanne possessed unusual motivation and skills," wrote Harry G. Lee in the American Conchologist in reporting her death. "She was accomplished in bridge and tennis, and an active volunteer in a number of civic organizations. Her avocation, especially in recent years, however, was conchology.

"She was captivated by tiny marine shells. This focus resulted from the diversity and beauty of this element of the fauna but, perhaps, more passionately from the challenge presented by their relative neglect in the scientific literature. Thus she became a bit of a pioneer—an unusually zealous, largely self-taught student."

Mrs. Lightfoot produced five substantial papers on the Caecidae, including one appearing in Hawaiian Shell News last year. The same year, she came to Honolulu in connection with the HNS Fiftieth Anniversary Celebration and Shell Show.

She is survived by her husband, John, three daughters and six grandchildren.

Live Rock Collecting Ban to be Discussed

Competing proposals to regulate the collecting of ‘live rock’ in U.S. federal waters of the Gulf of Mexico, the Caribbean and the South Atlantic may be thrashed out soon at a series of public meetings. The object is to either prohibit or limit the removal of the live coral substrate from reefs in the Gulf and U.S. waters of the Southeast.

Project Reefkeeper, a citizen group concerned at the continuing destruction of tropical shallow-water marine life, defines “live rock” as “coral reef substrate or rubble with attached marine life, such as sponges, anemones and soft corals.”

The South Atlantic Fishery Council and the Gulf of Mexico Fishery Council have selected “preferred management options” for live coral that differ in their time frames.

The South Atlantic body wants an immediate halt to collecting; the Gulf group would allow three more years. Project Reefkeeper backs the former.

“The collected live rock cannot be replenished on a biological time scale, as can other fishery resources,” claims Project Reefkeeper Director Alexander Stone in Miami. “The continued collection seriously disrupts— or even destroys— entire reef communities.”

The Caribbean Fishery Management Council earlier in the year considered proposed action on a corals and coral reefs fishery plan for U.S. waters in the Caribbean. It is preparing a draft plan for public comment that Project Reefkeepers says would include total protection from collection for hard corals, soft corals and live rock.

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Shell Book Collections: Building and Rebuilding

reflections by Tony Swann*

Tony Swann continues to reflect on the business of bookelling. Last month, Mr. Swann discussed the history of his company, Wheldon & Wesley. In this month's article, he talks about some of the great shell book collections his company has had the pleasure of handling.

There are few truly great shell book collections in the world, and, as a bookbuyer for Wheldon & Wesley, I have had the opportunity to see many of them. The firm's long reputation as a specialist has brought its reward in the form of opportunities to buy collections it had helped form in the past.

First among these was the mollusc library of E. R. Sykes. It was probably the finest and most complete on the subject ever formed by one man, and is the subject of an Appendix in the second edition of P. Dance's *History of Shell Collecting* (1986). In 1947 my father, Howard Swann, was summoned by letter to a beautiful old manor house in Dorset. Sykes' family had a bank which was one of those later amalgamated to form Barclay's. My father had only been in the business a couple of years but Sykes and his wife treated him like an old family friend.

Sykes took my father through all his books, the great feature of which was that Sykes had had the bibliographer Sherborn annotate many of them inside the covers. All the books were listed by my father who then returned to the office and worked out a price with his brother Charles which, in due course, was accepted. It was described as "the most marvelous library on the subject you could imagine. He had every book - except Poli". He had not only the original edition of Martini and Chemnitz in 12 volumes but also the second edition, which ran from about 1830 to 1920 in 40 volumes. Only once have we had another set of that.

As for Reeve's *Conchologia Iconica*, Sykes was on his way to the bank in London one day about 1880, and he walked along Faringdon Road where there was a book market. On one barrow he saw a volume of Reeve, so he asked the man if he had any more and was told "Oh yes, I've got a heap of them!" The man took him to the shed where he kept his stock and there was a major part of Hanley's library. Among many other things was a complete set of Reeve. For the whole library in 1948 we got about £1,200, a lot of money in those days. Apparently Sykes had bought the majority of his books from Wheldon between about 1890 and 1914 so even then we were very much in "on one barrow he saw a volume of Reeve [Conchologia Iconica], so he asked the man if he had any more and was told 'Oh yes, I've got a heap of them!" the business of "recycling" collections from old customers.

If you read Peter Dance's appendix on this library you will find it even more astonishing when you realize that many of the finest books had already been sold to our then two most important customers for the subject, the Field Museum in Chicago and the Allen Hancock Foundation. The Allen Hancock Foundation in particular bought some of the best things in Sykes's library.

Incidentally, the fine dedication copy to the Emperor of Austria of Born's *Testacea*, bound in red morocco with the imperial eagle on the covers, went to Stillman Berry in California for £15. Many books went to J. R. Tomlin, whose library is now in the National Museum of Wales. Albert Salisbury was another customer. My father describes this as his biggest education in shell books. Under his elder brother's guidance he wrote practically the whole of catalogue 67 which contained it, using also what Sykes had told

* Wheldon & Wesley Ltd., Lytton Lodge, Codicote, Hitchin, Herts., SG4 8TE, England
moved to Lytton Lodge. Salisbury used to arrive at our premises in an ancient car and was always very smart in his appearance. Again the books were in a large house, but in an extraordinary mess. My father dealt with the nephew who said, “My uncle’s wife died on their honey moon in 1900 and he never married again, although he did have a housekeeper until recently”.

One of Salisbury’s other hobbies was the organ and the drawing room had a fair size organ built into it. His study was so cluttered that he ended up with a desk on the landing outside and the latest acquisitions of shells and books were in orange boxes on the floor. In the drawing room the sofa and armchairs were piled high with the various journals he took. Some of his books went to the Royal Scottish Museum but we got the majority. My father remembers him as a charming man.

Next month, Tony Swann continues his reflections on bookselling.

This article has appeared in a different form in The Conchologists’ Newsletter.

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**The Right Shell, But Wrong Ocean**

Broward Shell Club member Mary Bukstel knew she had something unusual when, diving at 90 feet off Boynton beach last year, she spotted a large bivalve in the reef that snapped shut on her approach. Although she specializes in *Spondylus* and *Chama*, she worked to free it from the substrate and brought it ashore.

Despite appeals to fellow shellers, identification was slow in coming. Recently at a Shellers Jamboree in Largo, Florida, however, the “stranger” was recognized as a *Pinctada mazatlanica* (Hanley, 1856) — normally limited to the Pacific coast of Baja California and southward to Peru. The valves measure about six inches across.

How did such a Panamic shell from the Pacific Ocean come to make its home on a Florida Atlantic reef? asks the Shell-O-Gram of the Jacksonville Shell Club. It could have traveled through the Panama Canal either on the hull of a ship once moored on the West Coast or as a veliger in the ballast water during passage. To combat this sort of inadvertent species introduction, ships have been encouraged to exchange ballast water while on the high seas.

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**A Mysterious Greek Find**

A reader from England sent this mysterious photograph. The object, porcelain in consistancy, was found by a diver off the coast of the Greek island of Samos. Though no measurements were taken, a man’s wedding band is included in the photo for scale. Does anyone know what this is?
Stu Lillico —
Beloved HMS Busybody

by Olive Schoenberg-Dole

They popped out of the wet sand as he and his wife strolled along the people-less beach in Zanzibar, fifty-odd years ago. The two stopped to see what the strange creatures were. Shells! Shells alive! And so it all began — 'Stu Lillico's love of shells.

Born in Seattle, Washington, Stu could be called a man of the world. Early on he lived in China where he was a newspaperman, editor, and foreign correspondent during the 30's. He met his wife, Helen Inglehart, in Japan and they were married in Shanghai. He spent two years in Zanzibar when he was with the U.S. State Department. Some of the countries he's been to are South Africa, India, Singapore, China, Japan, Australia, as well as many European countries, and islands of the Pacific. Lucky for us, he chose to retire in Hawaii.

Did I say "retire"? Anything but. First thing he did was join the Hawaiian Malacological Society, and give us a slide show on Zanzibar. Next he took up scuba diving and joined a dive club. Then he became a member of Adventures Club, the Keppel Bay Shell Club, the National Capital Shell Club, and Conchologists of America.

Shortly after arriving in Hawaii in 1970, he volunteered his editorial expertise to Hawaiian Shell News, working with Ellis Cross and Ruth Fair. He inherited the editorship from Ruth early in the 70's. Around 1986 he decided he needed a "breather." Dr. Tom Burch took over as editor. When Tom wanted to quit and HMS couldn't find another person for the job, Stu came back to the rescue. He called himself "Editor Pro Tem" — waiting for someone to come along. In September Stu "retired" from his editorial position, but he has not left HSN entirely. He still offers his insight and guidance and occasional article.

Not only has Stu been HSN editor for 15 years, he has managed a shell show, been president twice, been vice-president, and a perpetual member of the board of directors. But no matter how involved, he has always found time to go shelling, whether locally or to far-away places like Vanua Levu, Ovalau, Taveuni, Malolo lae in Fiji, Tonga, Christi-

...
Anyone for Classic Shell Books?

Several classic volumes dealing with shells are among the first sale items offered to HMS members for the Society's July 15, 1994 Mail Auction, reports Auction Coordinator Trudi Ernst.

The volumes received to date include:


A 59 page supplement with 480 colored figures is bound with the original in a handsome tooled-leather volume.


One of four original accordion-fold oriental-style volumes in a set, this "book" includes 95 hand-colored woodcut figures with some occasional minor fading. Cover has been reattached. Three introductory pages in Japanese and two pages of romanized plate explanation. The volume was donated by longtime HMS member Spencer Tinker of Honolulu.

In addition to the two rare volumes, several mid-twentieth century publications of interest to collectors and researchers have been donated for the auction. They include:


The first printing of a study that has since been expanded in separate volumes. Paperback, in good condition.


This initial printing contains original descriptions of numerous Hawaiian species. Paperback, in good condition.

"We are in need of more 'auctionable' items," according to Ms Ernst. "In addition to books, we are receiving shells but we would like more specimens that will bring prices in the $50 to $500 range. As they reach us, they will be listed in future issues of Hawaiian Shell News."

The Society's Board of Directors has agreed that all proceeds from the auction will be used to initiate an endowment fund to finance the continued upgrading of the Society's monthly Hawaiian Shell News.

Offerings of shells, books, and other items suitable for auction should reach the sale committee by March 15. They will be reported in HSN as received.

Bids will be accepted until sale opening time on July 15.

Shells and other items for the sale can be mailed to:

Hawaiian Malacological Society
Attention: Mail Auction Committee
P.O. Box 22130
Honolulu, HI 96823-2130

All donations will be acknowledged by letter.

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Welcome to Hawaii

Visiting Hawaiian Malacological Society members are invited to contact the Society in advance of their arrival in Honolulu to indicate their schedule and interests. Our regular membership meetings are on the first Wednesday of each month (except December). Please keep in mind that the Society office is not open every day and that it does not have a telephone. Individual members are listed in the Honolulu telephone book. See page two of Hawaiian Shell News for the names of society officers.
Echoes of the Past
Hotcakes and Hot Shells —
Our first full Day on Majuro Atoll

by Bob Purdymin

A hurricane in the early 1980’s blew it away. The island was about 100 yards wide there and, as OK didn’t show up right away, we walked across the road to the ocean wave bench for some beach combing. The tide was well out. There were placid little pools with broken chunks of coral and lots of little sand pockets. We found shells under every rock, mostly Cypraea moneta and rock shells. There were thousands of crabbled shells, a few miters and some small cones.

OK arrived about 9 AM and canceled our trip. He had to pack fish for a mainland shipment. So instead, we obtained three scuba tanks and decided to head for the extreme western end of the atoll near the little town of Laura thirty miles away. George and Bunnie Cook of Honolulu had shelled there previously with good results.

We arrived to find that the tide was quite low, with a vast expanse of water up to one foot deep. Many sand channels ran through large patches of finger coral and we spent about 90 minutes wading as the water was much too shallow to snorkel. We also found that wading was quite difficult as the finger coral collapsed under foot. But there were many sand trails with Terebra maculata and T. crenulata at the ends. Cypraea annulus, C. moneta, C. lyra, C. rossii, and C. aurica were under slabs and chunks of coral. I found a large clean Lambis truncata in about eight inches of water.

After lunch we started back toward Rita. At the 25 mile marker we found a little turn-off heading in the direction of the lagoon. The water looked rather dirty, but we decided to give it a try. Our chart put the depth at 6 to 10 feet, so we decided to snorkel this one. About 100 yards offshore the water was clear, and there was a sand bottom with large stands of antler coral, scattered table coral, and large coral "bommies". We zig-zagged back and forth over this area and found a few nice Conus marmoratus, Lambis lambis, and Terebra. I found a tiger cowry and George collected a very clean Hippopus hippopus about 6 inches in diameter. We had seen a number of them up to one foot in diameter, but due to baggage weight limits no one wanted to collect a large one. We headed back to Rita, still with full scuba tanks.

Wes and I decided to use our tanks at the western end of the airport on the lagoon side of Rairik Island. George decided to beach walk and take a few pictures.

Just off the road was a borrow pit 10 to 15
feet deep, dredged out to make the road alongside of the airport runway. Further out was a small reef about four feet deep and 25 to 30 feet across. Finning over this reef, we were startled to find a steep slope covered with live and dead coral rubble—a sheller’s utopia. We spent a pleasant hour shelling in the rubble. Wes found his Cypraea mappa just where Emerald had waved. I found a C. elgantina and some nice Murex. Both of us filled a dirty bag full of shells to pack for home and future identification. This ended our first full day of shelling on Majuro Atoll.

Watch for Bob Purthymun’s next installment of "Echoes of the Past"

Bob Purthymun’s "Echoes of the Past" has originally appeared in the NCMS (Northern California Malacological Club) Newsletter
Up Close and Personal

Dr. Carole Hickman of the University of California at Berkley discussed some of her recent research at the November meeting of the HMS. Using Scanning Electron Microscopy (SEM), Dr. Hickman is attempting to explore some of the minute aspects of larval shell sculpture and radulae structure.

Planktonic larval shells, even magnified 100 times can appear featureless, but often, with progressively greater magnification, varying degrees of shell structure will become visible. Tubercles on grainy fields or wave lines on filamentous webbed backgrounds may be seen when the larval shell surfaces are viewed at 2,500 and even 10,000 times magnification.

"The textures cannot be predicted from taxonomy," Dr. Hickman said. "Turrids can be granular or have a mesh-like network." Nor can larval sculpture be predicted from the adult. Cowries have very ornate larval sculpture that, upon settlement from the plankton, becomes very smooth and characteristic of the adult.

"The change in sculpture at metamorphosis is very abrupt," Dr. Hickman explained. "A similar abrupt change is seen in the larval sculpture when the snail hatches from its egg case."

But do these ever-finer grain structures have a function? Dr. Hickman has noticed that wavy lines seem to decrease shell breakage, but she does not know what function some of the other microstructures might serve.

In addition to showing many SEM photographs of larval shells, Dr. Hickman also displayed some of her radulae work. Using SEM, she has been able to ascertain how radular structure reduces the likelihood of tooth breakage.

"Molluscs have solved this problem in much the same way that engineers might solve it," Dr. Hickman said. "Radular teeth are wider at the base. This distributes the shear forces that might snap the tooth off during feeding." She also showed that the teeth are highly interconnected, another way of improving tooth strength.

Radulae may have a taxonomic importance. It appears that many radula forms are maintained within groups. The genus

Calliostoma, for example, all have feathery teeth.

The radula structure can also tell a great deal about how the organism feeds. Siphonaria in Hawaii graze the tips of algae off rocks, while Cellana eats similar turf algae, but grazes it down to bare basalt rock. Siphonaria have very delicate teeth designed to snip off bits of food, while the radula of Cellana is tipped with hemotite to make it durable.

D.M.