

The Newsletter of the IUCN/SSC Mollusc Specialist Group
Species Survival Commission IUCN - The World Conservation Union

TENTACLE

Editorial

Since the previous issue of *Tentacle* went to the printers, two long-awaited publications have appeared: the proceedings of the "Symposium on Threatened Molluscs" that was held at the 1986 UNITAS Solem Memorial Symposium on the Biodiversity and Conservation meeting in Edinburgh, and the proceedings of the "Alan Solem Memorial Symposium on the Biodiversity and Conservation of the Mollusca" that was held at the 1992 UNITAS meeting in Siena. Both contain much interesting reading (summarised in notices in this issue) but they differ in one important way. The Siena proceedings seem to reflect a greater sense of urgency and indeed of willingness to actually do something proactive about conservation of molluscs. Winston Ponder's contribution tells us exactly what we can and should be doing (both generally as mollusc conservationists and specifically as the Mollusc Specialist Group). His article should be required reading, not only for those committed to doing something about mollusc conservation, but for all who feel that "ugly, slimy invertebrates" get a raw conservation deal when faced with the "furry and feathery" and the "charismatic megavertebrates".

In the USA, the Endangered Species Act (ESA) has come under intense fire from the Republican dominated Congress. The ESA is the legislation under which species are listed as endangered, critical habitat is designated, and Recovery Plans are developed—such as that put together by Mike Hadfield and colleagues for *Achatinella* (Hawaiian tree snails). In early April 1995, Congress passed a moratorium on adding animals or plants to the list or designating critical habitat. That moratorium is still in effect. In addition, funding was rescinded from the budget allocated to the listing program of the US Fish and Wildlife Service, the agency that implements and coordinates action on Endangered Species.

In order to counteract the powerful and wealthy anti-ESA lobby, conservationists have had to step up their lobbying activities. At the forefront of this activity has been the Endangered Species Coalition (ESC), of which the American Malacological Union has become a member organisation. The ESC is now run by the Environmental Information Center (1400 16th Street NW, Suite 330, Box 5, Washington DC 20036-2266, USA; tel. 1 202 797 6500, fax 1 202 797 6501, e-mail eicinfo@acpa.com). If you believe in a strong ESA, contact them, join up, and give them your support.

Also in the USA, at its 1995 annual meeting in Hilo, Hawaii, the American Malacological Union (AMU) passed a motion proposed by David Lindberg that "The American Malacological Union does not allow the selling, buying or trading of shells or shell products at its annual meeting". The discussion prior to the



passing of the motion centred on two issues: the role of the amateur in scientific discovery, and the impact (or not) of shell collecting on natural populations of molluscs (see the article by Kerry Clark in this issue).

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The AMU has traditionally maintained a strong amateur contingent and acknowledges that amateurs have in the past made major contributions to the scientific study of molluscs, and will and should continue to do so. However, as an organisation with an increasing commitment to conservation, the AMU felt that, even if the evidence for the impact of shell collecting is generally poor, supporting the dealing of shells at its meetings may present the wrong message and undermine its conservation activities. I believe that other malacological organisations around the world that profess a conservation ethic should follow this lead and play a more active conservation role.

Once again, this issue of *Tentacle* has news from many parts of the world, reminding us that it is not only North American freshwater mussels and Polynesian tree snails that are in peril. Notable nonetheless is the article by Jim Murray recounting the news about the re-introduction of *Partula* to Moorea. Sadly, the enclosures into which the snails were released (*Tentacle* 5) failed—through human fallibility rather than intrinsic failure of the technology—and *Euglandina* was able to get in. Nevertheless, the experiment demonstrated the viability of re-introduction to carefully managed areas, with the snails surviving and reproducing. While captive breeding and re-introduction to the wild will never be a major option for the conservation of most molluscs, this is a positive outcome that gives us hope that these truly fascinating snails may yet be saved. The "Pacific Island Land Snail Page" continues to broaden its scope with articles about New Zealand and, in particular in this issue, a strong call to action from Japanese scientists concerned that proposed airport construction on the pristine island of Anijima in the Ogasawara archipelago of Japan will destroy not only endangered land snails but an entire ecosystem. This particular issue may be an instance in which we can make our voices heard and influence the decisions that are being made.

The previous issue of *Tentacle* (No. 5) was delayed at the printers, so that when it eventually appeared some of the news items were not as topical as they should have been. Regrettably similar delays have affected the present issue. It was ready for printing in January 1996 but, for reasons beyond my control, it had to wait more than half a year. I apologize to authors and readers. Please continue to send me your news for inclusion in *Tentacle* 7—don't wait until I have to beg you!

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IUCN AND MOLLUSC SPECIALIST GROUP NEWS

Because of the problems encountered in production of *Tentacle* No. 5, the following notice was omitted. Apologies.

In the last triennium, Sue Wells and Philippe Bouchet co-chaired the Mollusc Specialist Group. Although Sue remains a member of the Group, due to her current job commitments, she has decided to resign from the chair. Sue put in a lot of hard work for the Group, frequently with little recognition. Philippe remains as

co-chair but wishes to stand down at the end of the current triennium (1996). Mary Seddon of the National Museum of Wales replaces Sue as co-chair.

IUCN Mollusc Specialist Group meeting, September 1995

A meeting of the MSG was held during the Vigo conference on Friday 6th September and was attended by 40 participants. The main issues were:

1. 1996 Red List (see article below);
2. Progress on the Action Plan (see article below).

Issues were raised from the floor and included dissemination of information about molluscan conservation, extending the coverage of the Action Plan, and comments on the last Red List of Threatened Molluscs. Most of these issues are addressed in the articles below.

Unitas Malacologica, 1995

Winston Ponder in the Plenary Address at the Unitas Malacologica meeting in Vigo in September drew attention to the important role played by malacologists in providing information about, and promoting the need for research on molluscan biodiversity. He called upon the entire community to make the science that is relevant to current issues more accessible to the general public and the rest of the academic community. His keynote address looked at where papers on molluscs were published, the level of funding awarded to research on molluscs, and showed that other taxonomists get a disproportionate level of funding compared to the number of species within their Phyla. Given the increased awareness of global biodiversity and new funding opportunities, he called upon the participants at Unitas Malacologica to respond to the challenge and put molluscs firmly to the forefront of public awareness.

"The Conservation Biology of Molluscs" Proceedings of the 1986 Symposium on Threatened Molluscs, Edinburgh

The proceedings of this symposium have now been published as *SSC Occasional Paper No. 9*, with the title "The Conservation Biology of Molluscs. Proceedings of a Symposium held at the 9th International Malacological Congress, Edinburgh, Scotland, 1986". The book (81 pp., soft cover) is edited by Alison Kay and includes a "Status report on molluscan diversity and a framework for conservation action" written by her. The following is taken from Dr. Kay's Foreword:

"Recognizing the importance of molluscs in the life of humankind and the significant roles they play in ecosystems, the Mollusc Specialist Group believes that continuing loss of mollusc diversity is detrimental not only to ecosystems around the world, but, in the long run, to humankind itself. In an effort to ameliorate the increasing loss of diversity suffered by molluscs worldwide, this volume has been developed to provide a resource on the conservation status of molluscs today and some suggestions for the conservation of molluscan diversity in the future. There are two parts: 1) a series of papers summarizing the current status of

molluscs presented at a Symposium on Endangered Molluscs at the 9th International Malacological Congress, held in Edinburgh, in September 1986; and 2) a status report on molluscan diversity worldwide.

"The Symposium on Endangered Molluscs was commissioned by Resolution of the 8th International Malacological Congress, held in Budapest in September 1983:

"Recognizing that all biotic diversity is changing in a dramatic manner as a result of increasing pressures of man, and recognizing the need for the enunciation of priorities if we are to develop a world strategy which will insure the survival of species and genetic diversity, be it resolved that the *Unitas Malacologica* encourage and support the activities of the Species Survival Commission on Invertebrates of the International Union for Conservation of Nature, and in particular the work of the Species Survival Commission on Mollusca.

"Be it further resolved that the *Unitas Malacologica* encourage and support a climate for research and education in such areas of concern as those of economically important species like the giant clam *Tridacna*, of endangered species such as the Achatinellid snails of the Hawaiian Islands, and of areas of high molluscan diversity such as the Madeira Islands.

"And, be it further resolved that a meeting on the conservation of molluscs be organized for the 9th International Congress in Edinburgh in 1986."

"The eight papers and five abstracts from the symposium are arranged in Section 1 in four chapters: 1) the keynote address, a synthesis of what we know and what we do not know about current pressures on molluscs; 2) a group of papers that address the pressures on especially vulnerable groups of Mollusca, namely those found in island habitats; 3) several papers dealing with the current status of molluscs on continents; and 4) a final paper representing a major statement on the economics of the shell trade, a continuing source of pressure on marine molluscs.

"Section 2 presents a report on molluscan diversity. This status report focuses on the diversity of molluscs on continents, on islands, in freshwater, on coral reefs, as economic resources, as alien species, and as model systems. Five major actions are proposed for the conservation of molluscan diversity:

- 1) the acquisition and management of threatened habitats on island, in aquatic ecosystems, on continents and on coral reefs;
- 2) the development of a data base necessary for knowledge of molluscan diversity;
- 3) the prevention of the introduction of alien species that have negative impacts on native mollusc species and control and eradication of those exotic species where such introductions have occurred;
- 4) the establishment of self-sustaining captive populations of endangered mollusc species and support of their eventual re-introduction into their native habitats;
- 5) the promotion of public awareness and concern for molluscan conservation programmes."

The book can be obtained from IUCN Publications Services Unit, 219c Huntingdon Road, Cambridge CB3 0DL, UK (Tel. 44 1223 277894, fax 44 1223 277275, e-mail iucn-psu@wcmc.org.uk); price UK£15 (US\$22.50), postage and packing add 15% (UK), 20% surface mail outside UK, 30% airmail Europe, 40% airmail elsewhere. It can also be obtained in the USA from Island Press, Box 7, Covelo, California 95428 (Tel. 1 800 828 1302 from within the continental USA, 1 707 983 6432 from anywhere else, fax 1 707 983 6414). A discount of 33.3% is available to member

organisations of IUCN (not to individual Specialist Group members).

"Biodiversity and Conservation of the Mollusca" Proceedings of the 1992 Alan Solem Memorial Symposium on the Biodiversity and Conservation of the Mollusca, Siena

This book, the proceedings of the symposium held in 1992 at the 11th International Malacological Congress in Siena, is now available. It is edited by A.C. van Bruggen, Susan M. Wells and Th. C.M. Kemperman. The book contains the invited lectures presented at the conference, some additional commissioned papers, and four of the contributed papers. Copies can be obtained from the publisher, to whom further enquiries should be addressed: Backhuys Publishers, P.O. Box 321, 2300 AH Leiden, The Netherlands. The price is Netherlands Guilders 68.00 plus postage and packing.

The following is the list of contributions:

- van Bruggen, A.C. Biodiversity of the Mollusca: time for a new approach.
 Wells, S.M. Molluscs and the conservation of biodiversity.
 Kay, E.A. Diversification and differentiation: two evolutionary patterns in the molluscan fauna of Pacific islands with consequences for conservation.
 Ponder, W.F. The conservation of non-marine molluscs in perspective.
 Emberton, K.C. On the endangered biodiversity of Madagascar land snails.
 Heller, J. & Saffriel, U.N. Setting priorities for the conservation of land snail faunas.
 Waldén, H.W. Norway as an environment for terrestrial molluscs, with viewpoints on threats against species and diversity.
 Wells, S.M. & Chatfield, J.E. Conservation priorities for European non-marine molluscs.
 Valovirta, I. Threatened land molluscs in Finland.
 Mackie, T.G. & Roberts, D. Population characteristics of *Margaritifera* in Northern Ireland.
 Seddon, M.B. Endangered land snails of Porto Santo (Madeiran Island Archipelago): monitoring change in species diversity and implications for their conservation.
 Cameron, R.A.D. Patterns of diversity in land snails: the effects of environmental history.
 Coppo, G. Vanishing Galapagos malacofauna.
 Dussart, G., Meier-Brook, C. & Flood, K. Spatial autocorrelation of diversity in freshwater molluscan communities.
 Schembri, P.J. Diversity and conservation of the non-marine molluscs of the Maltese Islands.
 de Winter, A.J. Gastropod diversity in a rain forest in Gabon, western Africa.

1994 IUCN Red List still available

Published in early 1994, this list is available from IUCN Publications Services Unit, 219c Huntingdon Road, Cambridge CB3 0DL, UK (Tel. 44 1223 277894, fax 44 1223 277175, e-mail iucn-psu@wcmc.org.uk), price UK£15 (other details of availability and prices are as for Alison Kay's "Conservation Biology of Molluscs—see above). This list will be replaced in 1996 with the revised list (see next article).

1996 Red List of globally threatened molluscs

There are 1265 mollusc species on the 1994 List plus 287 extinct species. There are many reasons why species have been placed on the at risk list, the main reasons being:

1. Habitat change/reduction/deterioration.

2. Predation (introduced molluscs/vertebrates),
3. Commercial exploitation.

Every three years the list is reviewed, and this process has now started, but with an additional difference, the adoption of revised categories as of November 1994. The need to revise the categories has been recognised for some time. New definitions have now been developed with the general aim of providing an explicit, objective framework for the classification of species according to their extinction risk. The revision has several specific aims:

1. To provide a system that can be applied consistently by different people.
2. To improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction.
3. To provide a system which will facilitate comparisons across widely different taxa.
4. To give people using the threatened species lists a better understanding of how individual species were classified.

The data for all of species on the 1994 list (name, country/range and status) have all been entered into a computer database currently held in Cardiff at the National Museum of Wales. In the period between July and August 1995 letters were sent to over 150 people throughout the world seeking information, comments on the revised status of species, and information about the application of the new Red List criteria. Notices were also placed on bulletin boards via the Internet.

Since then, data from publications, papers, and material supplied to Sue Wells in 1993 have been examined and some data on species (and subspecies) entered into the database.

So far responses and comments have been received on about 40% of the current Red List species, as well as proposals for new species to be added to the Red List. Some of these still merit Critically Endangered, Endangered or Vulnerable status, although there are some species which are more widespread and these are now recognised as being at lesser risk (Conservation Dependent, Near Threatened and Least Concern). A few species have been suggested as candidates to come off the list (where further work on their distributions has found that the habitats are sufficiently extensive) and thus, although we will keep them in our review pool, they will be removed as the degree of risk does not merit Red Listing.

The 1996 Red List is still dominated by species found in Europe, USA, Australia and the Pacific islands. This is a reflection of the relative level of knowledge not necessarily the degree of endemism, level of biodiversity or extent of risk to the fauna. We have been actively seeking to increase review of Molluscs in Africa and Asia, and some species have been placed on the Red List where they are only presently known from habitats which have been under pressure through deforestation. The publication of the list is expected to take place around the time of the next IUCN general assembly.

Mary Seddon, co-chair, Mollusc Specialist Group

Racing with conservation of molluscan races— Progress report on the Action Plan for the Conservation of Land and Freshwater Molluscs

At the *Unitas Malacologica* congress in Vigo, Spain (28 August–2 September 1995), a short but productive conservation meeting took place, dealing with both the 1996 revision of the IUCN Red List and the "Action Plan for the Conservation of Land and Freshwater Molluscs". The open-ended meeting saw the participation of many non-MSG members, thus demonstrating that conservation issues are a growing concern for many professional and non-professional malacologists. The Vigo congress was the occasion to strengthen contacts with colleagues, especially from Central and South America, as well as from Russia.

Because the basis for conservation action by administrations and agencies in countries within political boundaries, rather than natural biogeographical units, a major part of the Action Plan consists of country reports. The aim of these country reports is to outline the entire world molluscan diversity from a conservation perspective.

Such a report typically consists of:

1. brief summary of geography, extent of natural habitats (e.g., area of rainforest), and human population pressure;
2. state of knowledge of the land and freshwater mollusc fauna, areas of high diversity, levels and areas of endemism, eventually with maps;
3. threats, endangered and extinct species, local legislation;
4. targets for action.

Input has been solicited from malacologists all over the world. Contributors work in a voluntary capacity, and sign the report(s) they put together. Whenever possible, we want to involve local malacologists, either as authors or as reviewers. Although the most up to date information (including unpublished information) is obviously preferred, country reports are based on the published, sometimes outdated, literature when nothing else is available. It is precisely one of the goals of the Action Plan to identify such gaps in our knowledge.

The accompanying map shows the current progress on country reports. We have allocated countries to one of three categories:

1. Unshaded countries are those where we have not yet identified a contributor who is willing to commit him/herself. For some of these countries, contacts have been made, but no positive commitment has yet been expressed.
2. For countries shaded in grey, drafts have not been finalized yet, but things are moving forward. A number of drafts are ready (e.g., Southeast Asian countries, Philippines, Solomon Islands), but either still need to be checked or are currently being reviewed (e.g., New Zealand). This section also includes countries for which reports are currently being drafted as a result of contacts established in Vigo, e.g., Costa Rica (Zaidett Barrientos), Cuba (Gloria Pereira), countries of the former Soviet Union (Alexander Suvorov), Equatorial Guinea (Benjamin Gomez), etc.
3. Countries and states in black are those where we are satisfied that the reports are adequate. They

include such complex faunas as those of Indonesia, Australia, Hawaii and French Polynesia.

If you would like to contribute to the Action Plan and we have not already contacted you, please contact Olivier Gargominy, the research assistant for the project (see below). As the accompanying map shows, the main geographical area with unassigned countries is North, Central and South America. We urge our colleagues with expertise on the molluscan faunas of these countries to commit themselves. The Action Plan is not a futile bureaucratic exercise. Rather, it is our chance to put molluscs on the conservation agenda so that the bird and mammal people cannot say "we didn't know".

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Invasive Species Specialist Group

Aliens, the newsletter of the IUCN/SSC Invasive Species Specialist Group often contains items of interest to mollusc conservationists. It is available from its editor: Sarah Lowe, Centre for Conservation Biology, School of Environmental and Marine Sciences, University of Auckland (Tamaki Campus), Private Bag 92019, Auckland, New Zealand. E-mail sjlowe@tmknov1.auckland.ac.nz

IUCN and MSG information sources on molluscs

1994 Red List of Molluscs. The computer database used to compile the 1994 Red List of Threatened Animals is accessible through the World-Wide Web at the World Conservation Monitoring Centre. The URL address is: <http://www.wcmc.org.uk>. If you need to check on which species were given what status in the previous Red List, the links from the WCMC site will be useful to you.

SSC List. Members of the SSC Mollusc Specialist Group are entitled to register with the SSC mailing list, which disseminates information to the SSC network. At present it is restricted to members, but may become more widely available in the future. Contact Mary Seddon if you wish to get access to this mailing list.

MOLLUSCA ON THE INTERNET

The MOLLUSCA listserver is intended as an informal forum for discussions of molluscan evolution, palaeontology, taxonomy and natural history. There are over 700 subscribers. From time to time it has something of interest related to conservation. To subscribe to the list send e-mail to:

listproc@ucmpl.berkeley.edu

Then on the first line of the body of the message:

sub mollusca <your_name>

You will get a reply soon after saying that your name has been added. You will then receive anything that is posted to the list. MOLLUSCA is maintained and managed by D.R. Lindberg and R.P. Guralnick of the University of California Museum of Paleontology, Berkeley, USA.

CITES ON THE INTERNET

CITES-L is a Bulletin board restricted to trade issues for endangered species, which is managed from the World Conservation Monitoring Centre in Cambridge. The majority of information relates to mammal and bird trade, but updates to the CITES lists are posted there. To subscribe send an unsigned e-mail message to: listserv@wcmc.org.uk

CENTENARY SYMPOSIUM VOLUME OF THE MALACOLOGICAL SOCIETY OF LONDON

"Origin and Evolutionary Radiation of the Mollusca", edited by John Taylor, was published by Oxford University Press (ISBN 0 19 854980 6) on 30 November 1995. It comprises the proceedings of the Centenary Symposium of the Malacological Society of London held in September 1993. Copies, price UK£75.00, can be ordered from Oxford University Press, Walton Street, Oxford OX2 6DP, UK, or via OUP offices in many other countries.

There are 31 chapters by many well-known malacologists, and although not directly dealing with conservation issues, many of the chapters provide basic background that is important to those involved in conservation and biodiversity studies of molluscs.

The volume contains the latest ideas of how molluscs relate to other phyla, the relationships of the different molluscan classes, new phylogenies for the gastropods at all levels and reviews of bivalve and scaphopod evolution. The chapters reflect a diversity of approach including morphological and molecular studies, ultrastructure, larval development and biogeography.

MEETINGS 1996

Molluscan Conservation: a Strategy for the 21st Century

This conference is organised on behalf of the IUCN/SSC Mollusc Specialist Group and the Conchological Society of Great Britain & Ireland. It will take place at the National Museum of Wales, 20 & 21 November 1996. The conference organisers are Mary Seddon (co-chair of the Mollusc Specialist Group) and Ian Killeen (on behalf of the Conchological Society).

Sessions will include:

1. What determines the priorities for conservation funding?
2. Approaches to biodiversity or assessing conservation priorities.
3. Habitat management for molluscs: conflicts and policies.
4. Implementation of European and UK legislation for molluscan conservation.
5. Introductions and re-introductions.

Enquiries should be addressed to: Molluscan Conservation Conference, The Secretary, Department of Zoology, National Museums & Galleries of Wales, Cathays Park, Cardiff CF1 3NP, UK. Or contact Mary

Seddon direct (see list of Mollusc Specialist Group Members at the end of this issue of *Tentacle*).

BIODIVERSITY: THE UK STEERING GROUP REPORTS

On 12 December 1995 the UK government published the steering group report on implementing the UK Action Plan to meet the Biodiversity Convention signed in Rio de Janeiro in 1992. The UK Action Plan set as an overall goal:

"To conserve and enhance biological diversity in the UK, and to contribute to the conservation of global biodiversity through all appropriate mechanisms".

Within the two volumes there are 11 molluscs that are listed as Globally Threatened species (five of these are EC Habitats Directive species). These molluscs have been given a specific action plan with objectives and targets set for UK agencies to follow for the next five years. The majority of recommendations relate to a better understanding of their ecology and distributions, with specific actions proposed on safeguarding sites and encouraging water quality improvements within the catchment areas of the freshwater species.

The report also recognised important UK species such as the "near endemics", and makes suggestions for future monitoring programmes and action plans to cover these species. Whether funding will be found to support the implementation of the Action Plan remains an interesting and important question!

In addition the report emphasised the importance of disseminating information on historical collections held in the UK, and their value in assessing changing distribution patterns on a worldwide basis. In the UK alone there are large and historically important mollusc collections outside London: in Cambridge, Cardiff, Edinburgh, Glasgow, Liverpool, Manchester, Newcastle and Oxford, and significant collections in Brighton and Exeter. Only half of these collections have specialist curators, and in the next few years some of these curators will be retiring, making the potential loss of information (or at least access to it) greater. It remains to be seen how the UK government will respond to the need to make the data on these collections accessible to the wider public.

The report is available from HMSO Bookshops (fax orders 44 0171 873 8200); price UK£26 (Volume 1, Meeting the Rio Challenge) and UK£30 (Volume 2, Action Plans).

Mary Seddon, co-chair, Mollusc Specialist Group

THE EUROPEAN INVERTEBRATE SURVEY HABITATS DIRECTIVE WORK ON MOLLUSCS

The European Invertebrate Survey has been undertaking a contract for the EC on the invertebrate species in the Habitats Directive Appendices. This involved reviewing the current state of published knowledge on the 23 species of molluscs. Fred

Woodward (Unio Trust) was coordinating the Molluscan list with compilers for each data sheet from the UK and France. The overall project coordinator was Peter van Helsdingen at the University of Leiden. Although these reports have been distributed for comment to the various governments, at present we have no information on when the results will be publicly available.

Mary Seddon, co-chair, Mollusc Specialist Group

RECENT WORK ON HABITATS DIRECTIVE SPECIES IN ENGLAND

by Ian Killeen

Margaritifera margaritifera (Linnaeus, 1758)

In Summer 1995 the National Museum of Wales carried out a survey to assess the current status of the freshwater pearl mussel *Margaritifera margaritifera* in selected English rivers. The work was commissioned by the national conservation agency English Nature in response to their Species Action Plan produced in March 1995.

The Action Plan assessment concluded that the mussel was now rare in England having suffered substantial recent declines. It was considered that there were only seven English rivers that supported populations of *M. margaritifera*. Most of these conclusions were based on 1970s data and therefore there was an urgent need for current information on status and distribution within the seven priority rivers.

The new survey confirmed that populations of *M. margaritifera* are still living in all of the priority rivers. But only one of these rivers supported a substantial population. The presence of very small specimens indicated that recruitment had occurred as recently as 1992. Four rivers were found to still support reasonable numbers of mussels although at the well known (and traditionally fished) sites the numbers had declined dramatically since the 1970s. The remaining two rivers only had very small populations comprised entirely of large adults. In these rivers the status of the mussel is considered critical and it is possibly on the verge of extinction.

A programme of further work has been suggested to include further surveying, water chemistry analysis, tagging and monitoring, and setting up mussel reserves.

Vertigo moulinsiana (Dupuy, 1849)

Preparation of the entry for the European Invertebrate Survey Species Directive drew attention to the lack of recent knowledge on current status and distribution for *Vertigo moulinsiana* throughout much of north-west Europe. In Holland, Germany and Belgium for example there was evidence of significant decline. In Britain the species has a discontinuous distribution across south-east England with the greatest population densities believed to have been in East Anglia.

Recording in recent years had indicated that the species was also common in the country of Berkshire (central southern England). English Nature commissioned a survey to assess the true status of

V. moulinsiana in the Kennet and Lambourn river valleys.

The survey revealed that *V. moulinsiana* was thriving at 19 of the 33 sites examined over a wide geographical area in both river valleys. On this basis the Kennet and Lambourn valley system must be considered to support one of the greatest concentrations of the species in the country. The habitat with the largest populations was open swamp dominated by the grass *Glyceria maxima* with pools of standing water.

Ian Killeen, Malacological Services, 163 High Road West, Felixstowe, Suffolk, UK.

FRESHWATER BIVALVES IN NORTH AMERICA

Mussels in Georgia

From: *Endangered Species Bulletin* November/December 1995, p. 26.

The US Fish and Wildlife Service (FWS) Jacksonville, Florida, Field Office is sponsoring several surveys and recovery efforts by the National Biological Service (NBS) for the conservation of freshwater mussels. An on-going status survey on mussels of the Altamaha River system of central Georgia is focusing on seven species restricted to that drainage, including the Altamaha spinymussel (*Elliptio spinosa*). Recent recovery projects include NBS research on which fish species host the larvae of four mussels that are proposed for listing, and a study to determine the effects of sedimentation on mussels and fish communities within several Apalachicola River system tributaries.

In addition, the FWS Jacksonville and Asheville, North Carolina, Field Offices are cooperating to fund research projects and outreach activities. One study at the NBS Virginia cooperative research unit involves experiments on how best to feed and raise juvenile mussels in tanks for eventual placement into native habitat. The other project, which is being conducted by the NBS Tennessee co-op unit, will investigate the potential of using fish hatchery raceways to propagate mussels for reintroduction. Both research projects are using non-endangered mussels as surrogates for listed species. The outreach activities, initiated by the Asheville office in cooperation with the FWS Jacksonville and Jackson, Mississippi, Field Offices, include an exhibit at the Tennessee Aquarium in Chattanooga on the conservation of freshwater aquatic biodiversity and a traveling interactive display on mussels. Also, the Asheville office has developed a freshwater ecosystem "trunk" or container that provides educators with a variety of educational material on lesser known aquatic species.

Mussel poaching is big business in Michigan

by David Poulson

Hidden in the gravel and muck of Michigan's rivers is a multimillion-dollar resource that has made the state a target for poachers who feed the lucrative cultured-pearl industry.

In a single bust made in Indiana last August, wildlife officers found 3000 pounds [approx. 1361 kg] of mussels—a pickup-truck full—poached from Michigan's Grand River. A multistate and federal task force is investigating the sale of mussels, outlawed in Michigan in 1988.

Left alone, they might live on the river bottom 40 years, as happy as the proverbial clam. But the word is out among mussel divers that "Michigan is a gold mine", said Andy Pierce, a federal wildlife agent in Ohio.

Although not as exotic as rhino horns and elephant tusks, mussel experts say that the public should be equally outraged by the illegal trafficking in a slimy creature with no eyes and no brain. "They're kind of like living rocks", is how Don Schloesser, of the National Biological Service in Ann Arbor, describes Michigan's mussel population. "Unless a boater brings one up on an anchor, you wouldn't know it's out there."

With nearly 300 different species, the United States is the mother lode of the world's mussel population. As a family they are the largest group of endangered animals in North America. And they are prized by a \$3-billion pearl industry centered in Japan.

"Part of America's natural history is getting shipped overseas," said Tom Watters, mussel expert for the Ohio Division of Wildlife. "We ship these things over dirt cheap and they come back as expensive pearls."

Taking mussels is legal in many states, particularly those along the Mississippi River. Tennessee is the center of a legitimate domestic industry that this year will export 6500 tons of mussel shells worth \$50 million.

After leaving the United States, the shells are sliced, diced and shaped into beads. A piece of the mantle—the fleshy part inside the shell—of a live oyster is wrapped around the bead and then surgically implanted into another oyster. "Some of it's a little grisly, cutting up a live animal and shoving it into another animal", Watters said.

In 18 months to three years the oyster will put a thin layer of nacre—the substance that makes pearls and shells—around the bead. It would take decades to form the same sized pearl naturally, and it is seldom perfectly shaped. "Almost every cultured pearl in the world has a center with a piece of shell that comes from the United States", said Robert Todd, commercial musseling coordinator for the Tennessee Wildlife Resources agency.

Demand is high, and increasing. Poachers look for unharvested bodies of water because they have the largest shells, which make the largest beads and pearls.

Michigan gets about a dozen calls a year from shell buyers interested in the state's mussels, said Don Nelson, the state's commercial fisheries coordinator. The state banned mussel harvesting primarily because no one knows how many there are, where they are at and how they affect other river life. Some buyers insist that they should be allowed to harvest Michigan mussels before the state's zebra mussel invasion kills them, Nelson said.

In 1991, state and federal officials in Ohio and West Virginia successfully prosecuted a Tennessee shell buyer for purchasing more than \$200,000 worth of shells illegally taken in the Ohio River. Wisconsin, which now allows mussel harvesting only on the Mississippi River, issued 22 tickets for undersized mussels last August, said Dennis Kirschbaum, a state conservation warden. One buyer was charged for having endangered species collected from inland waters.

The price of one species almost doubled to \$4.10 a pound this year, Kirschbaum said. "There are people going out there making \$1,000 a day, \$800 a day, no problem".

In the past four years, ten people in six different cases have been charged under Michigan law with taking mussels. All but one were from Tennessee. Some were caught in broad daylight. Others were found after conservation officers followed cars with Tennessee license plates, towing boats. The highest fine any of them got was \$600. But with federal officials now checking for interstate transport of mussels, offenders face up to \$250,000 in fines and up to five years in prison.

Investigators say they are accumulating evidence of perhaps widespread poaching involving out-of-state divers in Michigan. "They're taking a huge amount of shells out of the Grand River", said Carl Wilson, a US Fish and Wildlife agent in Grand Rapids. The hot spots are between Ionia and Grand Rapids.

Within a few months, the two Tennessee men caught with 3000 pounds of Michigan mussels are expected to be indicted by a federal grand jury in Grand Rapids, Wilson said. Federal investigators estimate the value of those shells at up to \$10,000. More indictments are expected from a federal grand jury investigation based in Tennessee, Wilson said. "It will come out that the majority (of those indicted) are taking mussels from the Grand River".

As part of the Tennessee investigation, wildlife officers, including one from Michigan, seized records from the Tennessee Shell Co. last February. The company is one of the nation's leading buyers and exporters of mussel shells. In response to phone calls, Tennessee Shell President Peggy Baker released a statement written in her capacity as secretary of Shell Exporters of America (SEA), an industry trade group. It blamed pollution and habitat destruction for imperiling freshwater mussels, and said that the industry was working with regulators to "protect this renewable resource". The organization does not condone poachers, who are a very small percentage of mussel shell fisherman, she wrote. "These poachers operate as independent contractors who sell their shells to independent buyers who then sell shells in bulk to the members of SEA".

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This story can also be found on the World Wide Web at: <http://www.great-lakes.net/~glew/sections/e/stories/e951107a.html/>

From this web site you can connect to many other sites with mussel information.

Pearly mussel's only breeding population

From: *Endangered Species Bulletin* May/June 1995, p. 20: *Oryx* 29(4), pp. 237-238.

Following the recent discovery of the world's only known reproducing population of the purple cat's paw pearly mussel *Epioblasma obliquata obliquata*, in Killbuck Creek of Coshocton County, the US Fish and Wildlife Service is working with the Ohio Division of Wildlife and Ohio Department of Transportation to conduct species surveys and bridge-replacement activities in Coshocton and Wayne counties of Ohio.

SECOND LONG-LOST SPECIES OF FRESHWATER PLANORBID REDISCOVERED

by Bill Adams

The Greenfield ramshorn (*Helisoma eucosmium*) has recently been rediscovered in southeastern North Carolina, USA (*Brimleyana* 22: 23-29). This follows within a decade the rediscovery of the magnificent ramshorn (*Planorbella magnifica*) from the same region (*Nautilus* 102(3):125-126). Prior to their rediscovery, neither had been seen for decades and had been presumed to be extinct by some authors. With the discovery of these populations, long standing systematic issues surrounding these species can finally be addressed. Unfortunately, the news is not all good. Both species occur in a region which is rapidly urbanizing and their habitats are unprotected. Moreover, while both are considered candidates for listing under the Endangered Species Act, the listing process has been halted by recent congressional action [see Editorial, above].

More information or reprints of the above articles can be obtained from the author.

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DECLINE IN THE FRESHWATER GASTROPOD FAUNA IN THE MOBILE BAY BASIN, SOUTHEASTERN USA

by Art Bogan, J. Malcolm Pierson & Paul Hartfield

Reprinted with permission from: La Roe, E.T., Farris, G.S., Puckett, C.E., Doran, P.D. & Mac, M.J. (Eds.). *Our living resources: a report to the nation on the distribution, abundance, and health of US plants, animals, and ecosystems*. US Department of the Interior, National Biological Service, Washington, DC. Pp. 249-252.

The historical freshwater gastropod fauna of the Mobile Bay basin in Alabama, Georgia, Mississippi, and Tennessee was the most diverse in the world, comparable only to the diversity reported for the Mekong River in Southeast Asia. This fauna was represented by 9 families and about 118 species. Several families have genera endemic to the Mobile Bay basin: Viviparidae: *Tulotoma*; Hydrobiidae: *Clappia*, *Lepyrium*; Pleuroceridae: *Gyrotoma*; and Planorbidae: *Amphigyra* and *Neoplanorbis*. The greatest described species diversity was in the

Pleuroceridae (76 species). The pleurocerid genera *Pleurocera*, *Leptoxis*, and *Elimia* had their greatest radiation in the Coosa River drainage.

Although this extremely diverse aquatic gastropod fauna received little attention in the past 50 years, it was actively studied during the second quarter of this century (Goodrich, 1922, 1924, 1936, 1944a, 1944b). During the last 60 years, this unique gastropod fauna has declined precipitously (Table 1; Athearn, 1970; Heard, 1970; Stansbery, 1971). More recent documentation of the decimation of this fauna was presented by Stein (1976) and Palmer (1986). The endemic genus *Tulotoma* (Figs. 1 and 2), formerly widespread in the main channel of the Alabama and Coosa rivers, was presumed extinct until recently rediscovered (Hershler *et al.*, 1990). The pleurocerid genus *Gyrotoma*, restricted primarily to the shoals of the Coosa River, contained six recognized species, all of which are presumed extinct (Table 2; Fig. 3).

Status and Trends

Literature records were compiled to document the gastropod species present historically. Recent surveys of the aquatic gastropod fauna of the Coosa and Cahaba river drainages in Alabama have been conducted using standard field techniques (Bogan & Pierson, 1993a, b). Additional unpublished data (Bogan & Hartfield) are included.

Recent surveys of the aquatic gastropod fauna at about 800 sites (Table 1) have documented population declines, decreases in species' ranges, and the loss of a major portion of the gastropod diversity, especially in the Coosa River. The Coosa River drainage had at least 82 species historically (Table 1); today 26 species are presumed extinct in six genera, and four genera (*Clappia* [2 species], *Gyrotoma* [6 species], *Amphigyra* [1 species], and *Neoplanorbis* [4 species]) are presumed extinct (Tables 1 and 2). The genus *Leptoxis* has been reduced to a single species restricted to three creek tributary systems in the Coosa River.

The fauna of the Cahaba River drainage has fared much better (Table 1). Although the Cahaba River drainage does not suffer from the numerous dams and the siltation problems of the Coosa River drainage, it is heavily affected by nonpoint-source runoff, siltation, acid mine drainage, pollution from wastewater treatment plants, and water withdrawn from domestic water use. Species such as *Lepyrium*



Fig. 1. Live specimens of the endangered *tulotoma*, *Tulotoma magnifica*, from Kelly Creek, Elmore County, Alabama, 1993.

showalteri and *Lioplax cyclostomaformis*, formerly much more widespread in the basin, are now apparently restricted to one or two shoal areas in the Cahaba River main channel. The status of the pebblesnails (Hydrobiidae) is uncertain. The former diversity of the genus *Somatogyrus* in the Coosa River has probably suffered the same fate as most of the main channel shoal-dwelling pleurocerid species—extinction. Detailed information on the freshwater limpets (Ancylidae) is not available, but they appear to have suffered similar range restrictions.

The uncertainty expressed in the diversity of the historical gastropod fauna presented in Table 1 is indicative of our lack of information regarding all aspects of the historical gastropod fauna of the Mobile Bay basin. There are a lack of detailed data on the ecology and life history of all the species, and a paucity of distributional information for most of the families other than the Pleuroceridae, making estimation of gastropod diversity by drainage difficult.

Declining species diversity can be directly linked to the inundation of the shoal areas of the rivers of the Mobile Bay basin by impoundment and siltation resulting from a variety of watershed disturbances, including 33 major dams for hydroelectric generation, locks and flood control on the major rivers of the Mobile Bay basin, and numerous smaller impoundments on tributary rivers and streams. Most gastropods inhabiting shoal areas are gill-breathing species typically grazing on the rock substrate in

Table 1. Summary of the aquatic gastropod fauna of the river systems in the Mobile Bay basin.

Data*	Alabama River	Tombigbee R. drainage	Black Warrior R. drainage	Cahaba R. drainage	Coosa R. drainage	Talapoosa R. drainage	Mobile Bay basin total
Approximate total historical gastropod species diversity	19	8	17	36	82	8	118
Number of species found in recent surveys	3	3	7	24	30	4	80
Federally listed endangered species	1	0	0	0	1	0	1
Federal candidate species	4	1	6	16	43	2	70
Number of species presumed extinct	?	0	2	4	26	?	38
Percent decline in gastropod fauna	84%	62%	56%	33%	63%	50%	32%

* Data from Bogan & Pierson (1993a, b), Burch (1989), and A.E. Bogan & P. Hartfield (unpublished data).

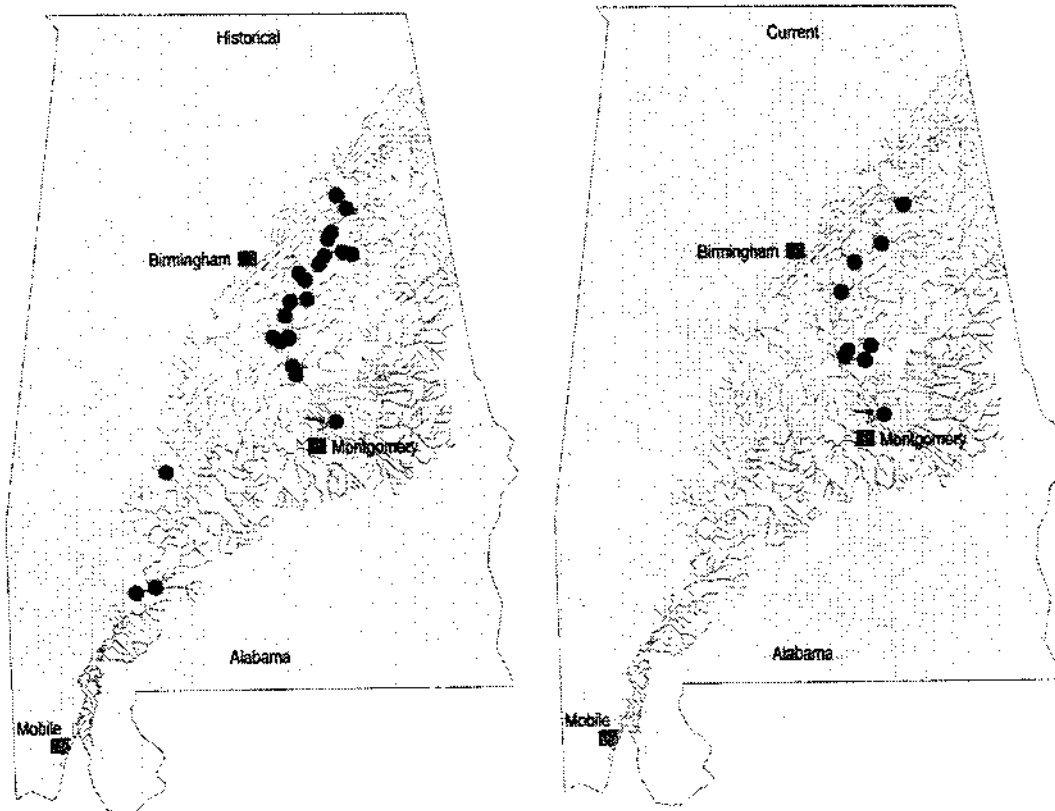


Fig. 2. Historical and current distribution of *Tulotoma magnifica*. Filled circles represent a single or two closely located collection sites (after Hershler et al. 1990). Map modified from US Geological Survey 1:500,000 scale—State of Alabama sheet (1970 ed.).

shallow riffle and shoal areas. They formerly lived on rocks in the shallow shoal areas with highly oxygenated water. The pleurocerid gastropod fauna represented a significant portion of the invertebrate biomass living on these shoal areas.

When this habitat was impounded, the snails were not able to survive the deep, cold, and often oxygen-depleted water. Many areas not impounded have suffered because of the heavy siltation of shoal areas, smothering the plant life that formed the diet of these gastropods. Major sources of siltation include poor agricultural and silvicultural practices, lack of riparian buffer zones, and generally poor land-use practices. The drastic decline in gastropod diversity is especially evident in the Coosa River main channel where numerous species formerly found on the shoals have disappeared after damming of the river (Bogan & Pierson, 1993a). Other species have had their ranges fragmented by the damming of the rivers and have become restricted to the unimpounded areas below the dams with clean current-swept gravel and bedrock outcrops.

Tulotoma magnifica (Figs. 1 and 2) is the only aquatic gastropod now federally listed as endangered; none is listed as threatened, although 104 species of aquatic gastropods from Alabama are on the federal candidate list. Most are from the Coosa and Cahaba rivers (Table 1). Conservation and recovery of the remaining diversity will require immediate action to prevent further declines and extinctions. This will necessitate action to improve water quality across the basin and to decrease the amount of silt entering the streams and rivers. In addition, the survey of the aquatic gastropod

fauna of the Mobile Bay basin is not complete, and additional fieldwork in the main channels of the larger rivers is needed, especially on the vertical limestone wall habitats.



Fig. 3. Illustration of representative species of the extinct slitshell genus *Gytotoma* from Butting Ram Shoals, Coosa River, Alabama.

Table 2. Freshwater gastropod species presumed extinct in the Mobile Bay basin.

Family Common name	Scientific name
Hydrobiidae	
Cahaba pebblesnail	<i>Clappia cahabensis</i> Clench, 1965
Umbilicate pebblesnail	<i>C. umbilicata</i> (Walker, 1904)
Pleuroceridae	
Short-spire elimia	<i>Elimia brevis</i> (Reeve, 1860)
Closed elimia	<i>E. clausa</i> (Lea, 1861)
Fusiform elimia	<i>E. fusiformis</i> (Lea, 1861)
No common name	<i>E. gibbera</i> (Goodrich, 1922)
High-spined elimia	<i>E. hartmaniana</i> (Lea, 1861)
Constricted elimia	<i>E. impressa</i> (Lea, 1841)
Hearty elimia	<i>E. jonesi</i> (Goodrich, 1936)
No common name	<i>E. lachryma</i> (Reeve, 1861)
Ribbed elimia	<i>E. laeta</i> (Jay, 1839)
No common name	<i>E. maglamertana</i> (Goodrich, 1936)
Rough-lined elimia	<i>E. pilsbryi</i> (Goodrich, 1927)
Pupa elimia	<i>E. pupaeformis</i> (Lea, 1864)
Pygmy elimia	<i>E. pygmaea</i> (H.H. Smith, 1936)
Cobble elimia	<i>E. varuxemiana</i> (Lea, 1843)
Excised slitshell	<i>Gyrotoma excisa</i> (Lea, 1843)
Striate slitshell	<i>G. lewisi</i> (Lea, 1869)
Pagoda slitshell	<i>G. pagoda</i> (Lea, 1845)
Ribbed slitshell	<i>G. pumila</i> (Lea, 1860)
Pyramid slitshell	<i>G. pyramidata</i> (Shuttleworth, 1845)
Round slitshell	<i>G. walkei</i> (H.H. Smith, 1924)
Agate rocksnail	<i>Leptoxis clypeata</i> (H.H. Smith, 1922)
Oblong rocksnail	<i>L. compacta</i> (Anthony, 1854)
Interrupted rocksnail	<i>L. formani</i> (Lea, 1843)
Maiden rocksnail	<i>L. formosa</i> (Lea, 1860)
Rotund rocksnail	<i>L. ligata</i> (Anthony, 1854)
Lirate rocksnail	<i>L. lirata</i> (H.H. Smith, 1922)
Black mudalia	<i>L. melanoides</i> (Conrad, 1834)
Bigmouth rocksnail	<i>L. occutata</i> (H.H. Smith, 1922)
Coosa rocksnail	<i>L. shoualteri</i> (Lea, 1860)
No common name	<i>L. torrefacta</i> (Goodrich, 1922)
Striped rocksnail	<i>L. uttata</i> (Lea, 1860)
Planorbidae	
Shoal sprite	<i>Amphigyrus alabamensis</i> (Pilsbry, 1906)
No common name	<i>Neoplanorbis carinatus</i> (Walker, 1908)
No common name	<i>N. smithi</i> (Walker, 1908)
No common name	<i>N. tantillus</i> (Pilsbry, 1906)
No common name	<i>N. umbilicatus</i> (Walker, 1908)

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CONSERVATION OF HONG KONG LAND SNAILS

by Wai Hoong Ho

Land snails reflect the state of the environment and they are useful in identifying important habitats for conservation. Land snails are sensitive to disturbance, low mobility, high turnover (Kerney & Stubbs, 1980) and the use of persistent pesticides (Hunter, 1980). They reflect land-use history due to their poor dispersal and recolonisation abilities (Disney, 1986).

A principal goal of conservation is to ensure the long-term survival of as many species as possible (IUCN, 1992). However, due to budgetary constraints on conservation and the competing demands of other forms of land-use, some system is necessary for identifying the areas which maximise potential benefits from conservation measures.

A simple method of determining target areas for conservation action is to identify countries with the highest number of species. The concept of "Megadiversity Countries" was introduced to highlight countries with a high number of species (McNeeley et al., 1990). Species lists of vertebrates, swallowtail butterflies and higher plants were used to identify such countries, and China is listed as one of them, with 62 species of mammals (IUCN, 1992).

The second approach is to identify areas with the greatest numbers of endemic species or species with a restricted range. Land snails are useful as "flagship" species as they have low mobility and often exist as isolated pockets of populations.

In Hong Kong, the Plants and Animals (Protection of Endangered Species) Ordinance (1990) issued by the Government of Hong Kong has highlighted some of these "flagship" species for conservation. While no local land snails are protected by law, trading and possession of the following species are prohibited by the Government of Hong Kong: *Papustyla* [= *Papuina*] *pulcherrima* (Camaenidae) (the Emerald Green Snail of Manus Island, Papua New Guinea); *Achatinella* species (Achatinellidae) and *Paryphanta* species (Rhytididae). The 1994 IUCN Red List categorised *Papustyla pulcherrima* as a rare species, existing in a restricted geographic range. However, a recent report of the Cambridge Solomons Rainforest Project suggested that the threat to *P. pulcherrima* was diminishing as indicated by the low prices of the snail (40 toea or 24 British pence each) at the local market in Manus and the fact that the snail forest habitat was almost undisturbed (Dutson, 1993). Although prices

were inflated in Port Moresby, foreign trade of the snail was apparently declining.

The malacological literature (Yen, 1939; Brandt, 1977; Chen & Gao, 1987) reports ten species of land snails as endemic to Hong Kong, and they are *Tornatellina boeningi*, *Kaliella hongkongensis*, *Microcystis schmaekeri*, *Microcystis stenomphala*, *Macrochlamys nitidissima*, *Macrochlamys discus*, *Cryptosoma imperator*, *Chloritis hungerfordiana rufopila*, *Macrocyctoides crenulata* and *Sinoennea splendens hongkongensis*. However, during a recent survey of Hong Kong land snails between September 1991 and July 1993, only four species have been found: *Cryptosoma imperator*, *Kaliella hongkongensis*, *Macrochlamys nitidissima* and *Chloritis hungerfordiana rufopila*. Two of these endemic species, *C. h. rufopila* and *K. hongkongensis* exist as small and isolated populations. The population density of *C. h. rufopila* averaged 1.3 individuals m⁻² at Nam Fung Road woodland on Hong Kong Island and only a single specimen was found at another location at Tai Mo Shan Country Park in the New Territories. Two specimens of *K. hongkongensis* were recorded from Tai Tam Country Park on Hong Kong Island and another specimen from Ho Chung valley in the New Territories. It is a matter of concern that the other six endemic species have not been found during this survey. The survey included 37 sampling sites that were previously investigated by Yen (1939) and Brandt (1977), plus some additional sites. However, Yen (1939) and Brandt (1977) did not give the exact localities of their sites, so it was not possible to locate them precisely. The species not recorded during the recent study may be extinct but may yet still be extant in very small populations.

Forty percent of the total land area in Hong Kong is designated as country parks which together cover an area of over 40,000 ha (Thrower, 1984). Many of the collecting sites for species recorded only as isolated populations in the survey are located within these nature reserves and country parks. Because development is prohibited within these areas, the populations are safe—in theory at least. In the past, these species may have had wider distributions in Hong Kong, but owing to habitat destruction, their populations have become fragmented and isolated. Such populations are destined to exist as ecological "islands" (IUCN, 1992). Examples include *Pupina pulchella*, which was only collected from Tai Po Kau Nature Reserve in the New Territories, and *Diplommatina* sp. from Pokfulam Country Park on Hong Kong Island. *Kaliella hongkongensis* is found at an unprotected site in Ho Chung valley, which has been proposed for inclusion in the Ma On Shan Country Park extension (Country Parks Department, 1993).

Some important sites where species of restricted distribution and low numbers were found were not located within country parks but within Sites of Special Scientific Interest (SSSI). These areas are recognised by the Country Parks Authority as of special interest and value by reason of their flora, fauna, geological, cultural or archaeological features (Thrower, 1984) and development of these sites is usually not possible. *Chloritis hungerfordiana rufopila* and *Bradybaena fortunei meridionalis* were found in small numbers at two locations, Tai Mo Shan Country Park and Nam Fung Road woodland. The

latter site is designated as a SSSI on the basis of its rare flora, including *Endospermum chinensis* and *Adenantha pavonina* (Richard Corlett, Department of Botany, The University of Hong Kong, pers. comm.). *Camaena xanthoderma* was found at two sites in the New Territories only, at Wong Mo Ying and Sha Lo Tung. Only one live specimen was found at Wong Mo Ying and the site is classified as private land with no impending development (District Lands Office, 1993), and Sha Lo Tung is proposed for development into a golf course. The population of *C. xanthoderma* at Sha Lo Tung is further threatened as its habitat was burned in November 1991. Because of the inability of land snails to escape burning, fires are an important threat to rare snails such as *C. xanthoderma*.

Other species found outside protected areas exist as isolated populations. *Euphaedusa lorraini elongata* is confined to one site at Tai Tau Chau (Hong Kong Island), an area which is designated as a "Green Belt" and includes coastal features which should be protected from development (Town Planning Ordinance, Hong Kong Town Planning Board, 1989). At present, this site is undeveloped due to its rugged terrain. In September 1994, drainage and sewerage work were observed at Tai Tau Chau. The site under construction was located beside the sampling site of *E. l. elongata*. Protective measures such as the erection of an enclosure to reduce disturbance (such as trampling and dumping) to *E. l. elongata* was undertaken. Another cause for concern is the impact of heavy rainstorms such as that on 8 May 1992, which resulted in the loss of *E. l. elongata* when the snails were washed into drains and drowned.

Another species with a restricted distribution is *Plectopylis pulvinaris pulvinaris*, which was recorded from two sites, Plantation Road and Mt. Austin, on Hong Kong Island. The site at Plantation Road has been designated as a residential area and the site at Mt. Austin is designated as a "Government/Institution/Community" zone (Town Planning Ordinance, Hong Kong Town Planning Board, 1988). Although both areas are low density residential developments, patches of woodland are still present and well-shaded with deep layers of leaf litter beside the footpaths. Nevertheless, the current land-use zones do allow further development of the area, and snail populations are by no means secure. Another two species occur as isolated populations and in low densities only on Lantau Island: *Cyclotus chinensis* and *Kaliella* sp. Only two specimens of *Cyclotus chinensis* have been found, at Tei Tong Tsai on Lantau Island. The site is not protected from development although the species is unlikely to be threatened due to the remote location of the site. In addition, only one specimen of *Kaliella* sp. was found at Tei Tong Tsai and another four individuals at Sunset Peak on Lantau Island. As the site at Sunset Peak lies within Lantau South Country Park, it is protected from development. Because of the unusual fauna at Tei Tong Tsai, some form of protection should be implemented, such as the designation of the site as a SSSI.

The recent survey has highlighted species that are endemic, low in density and restricted in distribution. A matter of some concern is that six endemic species known only from Hong Kong have been lost. Species become extinct due to deterministic and stochastic processes (IUCN, 1992). Deterministic processes

include anthropogenic disturbances (e.g., deforestation). Stochastic processes include such things as demographic uncertainty (random events in the survival and reproduction of individuals), environmental uncertainties (unpredictable changes in weather, food supply, disease and predation), and natural catastrophes such as droughts, fires and disease. The sites in which the two remaining endemic species, *Chloritis hungerfordiana rufopila* and *Kaliella hongkongensis*, occur, are protected under the Country Parks Ordinance and as Sites of Special Scientific Interest. Some highly localised species lie outside protected areas and are vulnerable. Moreover, none of the land snail species found during the survey are legally protected. Future monitoring of such species is needed to provide information on populations that are already small and at risk. These species should be considered for inclusion in the IUCN Red List and further protective measures implemented.

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THE ENDANGERED GIANT MEGALOBULIMUS FROM THE ATLANTIC FOREST OF BRASIL

by Dr. Maria Cristina Dreher Mansur and Prof. Dr. José Luiz Moreira Leme

In the past, the Atlantic Forest of Brasil covered a vast area close to the Ocean, extending over 5000 km from the northeast in Rio Grande do Norte State to the southeast in Rio Grande do Sul State. Now it has been reduced to isolated islands of forest restricted to high mountain regions and areas of steep topography. The land molluscs have been extirpated from the lowlands and are now confined to these islands. These habitats may be peripheral and not ideal for these species. We know little about the predators of land snails in the Atlantic Forest. However, even in protected parks like Boracéia in São Paulo State, we found many destroyed

shells, suggesting that predation has a major impact on the populations.

A number of other facts about land molluscs in Brasil should be emphasized. Species diversity and intraspecific variability are great, but population densities are in general very low. Most species live in very small areas and may depend on very special microclimatic or other environmental conditions that are in general as yet unknown. More than 20% of the described species are known only from the original publication and have never been seen or collected since. The lack of a precise type locality in many of these original descriptions, combined with the lack of observations of the snails in the field are, however, only part of the problem. Many of the taxonomic and systematic problems, even at the family level, remain unresolved because most studies have been based only on shell morphology.

Leme (1974) showed that minor differences in shell characteristics, supposed to be minor variation without taxonomic significance, hid more fundamental differences in internal anatomy. This led him to believe that the supposed convergences and parallelisms in shell characters in fact masked a higher diversity of species than was generally accepted. Leme (1973) also noted the existence of species-groups, with overlap of characters among individual species.

Intraspecific studies of polymorphism and other kinds of variation, or on the geographic distributions of species are completely lacking.

The reason for the existence of so many small populations or relict faunas of gastropods in the Atlantic Forest may also be related to climatic change during the quaternary glaciations (Ab'Sáber, 1977a, b). In the upper Pliocene to Pleistocene, climatic conditions were different. Between 12,000 to 18,000 years B.P. the climate was colder and drier than it is now, with an expansion of Araucaria Forest to the north, and a general retraction of the tropical forests, such as the Atlantic Forest. Between São Paulo and Espírito Santo States, the Atlantic Forest was reduced to discontinuous refuges, mainly on mountain tops more exposed to humidity.

According to Leme (1975), the Megalobulimidae are derived directly from the Archaeopulmonata (Ellobiidae). More usually, they are placed along with the Strophocheilidae and closely related to the Dorcacidae of Africa, constituting an ancient Gondwanian group of giant land snails. Their study is fundamental to gaining a better understanding of these interesting but divergent phylogenetic hypotheses.

The following species are relict species of *Megalobulimus* found only in the Atlantic Forest.

Megalobulimus grandis. One of the largest members of the genus. More than 15 cm long, it is found only on the island of São Sebastião, which is covered with Atlantic Forest, off the coast of São Paulo State. It is probably almost extinct.

Megalobulimus lopesi. A rare species living only in the Boracéia biological reserve in the Atlantic Forest of São Paulo, 900 m above sea level and about 12 km from the Atlantic Coast. After more than 20 years of

weekly searching, only seven samples have been collected. It is probably a relict species that, even though living in a strongly protected area, is declining because of the impacts of large numbers of predators, acid rain derived from industries in Cubatão, or possible climatic changes resulting in unusual weather such as the strong frost in 1979 (Heyer *et al.*, 1990).

Megalobulimus parafragilior. From Cubatão county at Serra de Cubatão in the Atlantic Forest, 400m above sea level, 50 km from Boracéia Station. Only 15 samples have been collected after 25 years of intensive searching in the protected area of forest. The species is endangered because of many factors including agricultural activities, the environmental impact of brick factories, and the acid rain caused by gases emanating from industries in Cubatão.

Megalobulimus fragilior. Very close to *M. parafragilior*. The type locality is in Rio Grande da Serra County, São Paulo. Despite more than 25 years of searching it is known basically from the empty and broken shells constituting the type material preserved in the collections of the Museu de Zoologia da Universidade de São Paulo. Recently, some samples were collected alive in Boracéia Station, 50 km distant from the type locality. The species is now being redescribed by one of us (Leme). It is endangered for the same reasons as *M. parafragilior*, as well as the presence of many local predators.

Megalobulimus cardosoi. Only known from five samples constituting the type material preserved in the collection of the Museu de Zoologia da Universidade de São Paulo. In nature the species has never since been found. It is probably extinct, due to the destruction of the Atlantic Forest in Alagoas State and other States of northeast Brasil, by sugar-cane cultivation.

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PACIFIC ISLAND LAND SNAIL PAGE

Pacific Island Land Snail Group annual meeting, Jersey Wildlife Preservation Trust, April 1995

A detailed report of this meeting, written by Jane Reynolds, has already appeared in *The Conchologists' Newsletter* (the newsletter of the Conchological Society of Great Britain & Ireland), No. 135 (December 1995), pp. 575-585.

The next meeting of the group will take place in London in May 1996.

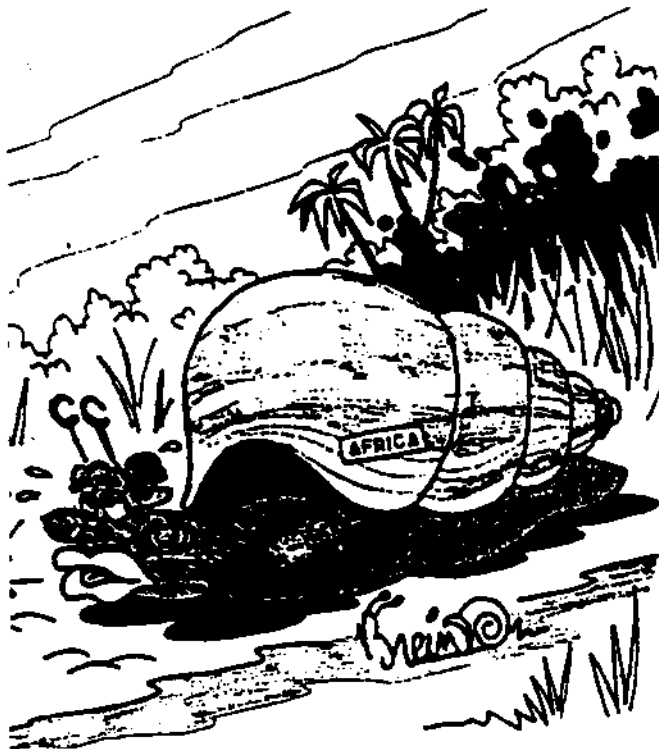
Also in this issue of *The Conchologists' Newsletter* (pp. 555-561) is an article, also by Jane Reynolds, entitled "The Conchological Society's *Partula* colony—or the problems of keeping rare snails in captivity in a domestic environment".

Partula update—Moorea, Tahiti, the Marquesas

by Jim Murray

The summer of '95 was a bittersweet one for the project for the restoration of *Partula* to the island of Moorea. The background of this work is now well known. The introduction of the agricultural pest *Achatina fulica* and the subsequent effort at biological control with *Euglandina rosea* resulted in the extinction of all the wild populations of *Partula* on this French Polynesian island. However the success of the captive breeding program has made it possible to attempt a reintroduction in a semi-natural enclosure (see *Tentacle*, issue 5).

The news from '95 is both good and bad. The worst is that a breakdown of the monitoring system had led to an invasion of the enclosure by *Euglandina* and a complete loss of the initial stocks. However judging by the empty shells the introduction was entirely successful. Many juveniles were born in the enclosure and some individuals had actually reached maturity. Thus we have clear evidence that the captive



breeding program has maintained the vigor and variation necessary for survival and reproduction under natural conditions. The enclosure was renovated and re-wired with stainless steel in preparation for a new set of stocks to be released.

The party also surveyed the populations on Tahiti and in the Marquesas. The remaining Tahitian populations are of three classes. There are a few extremely sparse ones coexisting with *Euglandina*, almost certainly doomed to early extinction. There are a few fairly healthy ones on Mt. Marau (and possibly on other mountains) at high altitudes. These are threatened by adjacent *Euglandina* populations. Finally there is a large area on the southeast coast where *Euglandina* has not yet penetrated. Although the long term prospects for these populations are not good, they are likely to survive for a few more years.

We visited the six major islands of the Marquesas and found the infestation with *Euglandina* to be well advanced. The surroundings of the principal villages on Hiva Oa and Nuku Hiva have been denuded of partulids. However the Puamau district of Hiva Oa still supports good populations, perhaps saved by the destruction of habitat that might have served as a corridor for migration. Good collections for captive breeding were also made from each of the other four islands. Fatu Hiva has been invaded by *Achatina*; given the people's mistaken faith in the efficacy of *Euglandina*, the introduction of the predator is almost inevitable. So far Tahuata, Ua Huka, and Ua Pou are free of both *Achatina* and *Euglandina*. We can hope that history will not repeat itself.

The addition of so many new stocks to the captive breeding program has placed a heavy strain on the resources of the zoos and universities now engaged in the work. New volunteers are badly needed to help out. Interested people should contact Paul Pearce-Kelly and David Clarke, Joint International Coordinators, Zoological Society of London, Regent's Park, London NW1 4RY, UK.

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Partulidae programme update

by Paul Pearce-Kelly

As Jim Murray has already provided an update on the field element of the Partulidae programme over the 1995 season I shall confine myself to a brief report on the ex situ element. Whereas the 1994 annual meeting of the Pacific Island Land Snail Group was devoted to a comprehensive review of all the species in the family Partulidae, the 1995 meeting, held at the Jersey Wildlife Preservation Trust, concentrated its energies on an analysis of the captive populations. Using the colony management and analysis database CERCI, the participants assessed the viability of the captive populations by investigating a range of indicators including fecundity patterns over time and generation. Preliminary analysis indicates that where numbers were seen to be declining it was often due to a reduction in fecundity rather than direct mortality. One area we are currently examining is the possibility of density dependence. Some of the long term data

sets showed some evidence of seasonal variation in mortality and fecundity which we are also further investigating. There is also some evidence of generation length declining over time in some of the captive populations. A further area of current investigation is the comparison between the performance of inbred and outbred lines. Where this can be measured there is evidence of the outbred lines doing slightly better than the direct line stock. A thorough review of the different maintenance systems is also being conducted. None of the above analysis could be conducted were it not for the participants following a standardised recording protocol. As a result of the field collections made during the latest set of field work (see Jim Murray's report, above) the number of taxa of Partulidae held in the programme rose to 33. As expected from previous experience, the *Samoana* species have not done well in captivity. However, the newly collected Tahitian *Partula* species are doing well. On the long term captive front we have to report the loss of *Partula turgida* (from the island of Raiatea) the last individual of which died on New Year's Day.

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Partulid habitat management study on Guam

by Barry D. Smith

A study is under way on Guam to evaluate the use of artificial canopy for conservation of species of *Partula*. Funded by a US Department of Defense Legacy Program grant, the project involves suspending industrial shade cloth over secondary growth to simulate artificial canopy in areas of the Haputo Ecological Reserve Area, where the natural forest canopy has been damaged by tropical cyclone winds. Each of eight 25 m² shaded plots on the US Naval Computer and Telecommunications Area Master Station—Western Pacific will be monitored monthly for one year by graduate students Scott Bauman and Frank Camacho to determine survival, growth, and recruitment of *Partula gibba* and *Partula radiolata* transferred to the sites. The area adjacent to the shaded plots is being monitored to determine the emigration rate of snails transferred to the plots and the survival rate of emigrant snails in forest lacking canopy foliage.

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Achatina and *Euglandina* in New Caledonia

The carnivorous land snail *Euglandina rosea* originates in the southeastern USA. Since 1955, it has been introduced to many tropical islands in the Pacific and Indian Oceans in ill-conceived attempts to control the demography of the Giant African Snail, *Achatina fulica*, itself an invasive species in many tropical, continental as well as insular, countries. Whereas *Achatina* tends to stick to agricultural and secondary vegetation, *Euglandina* has spread to remnants of native forests and is now literally eating out the endemic land snails of many Pacific islands. Hawaii and French Polynesia are particularly severely

hit, with at least 61 and 76 extinct species respectively.

Achatina fulica was first introduced to New Caledonia in 1972, probably with ornamental plants carrying eggs or juveniles imported from Tahiti. It has spread over all of the mainland and the satellite islands, and is now the most widespread land snail in New Caledonia, with stocks amounting to thousands of tons and considerable damage to crops and gardens.

At the suggestion of intergovernmental organisations, *Euglandina rosea* was introduced to New Caledonia between 1974 and 1978 for the biological control of the Giant African Snail. Because New Caledonia has a rich and highly endemic land snail fauna (ca. 400 species), and considering the ecological disaster that followed the introduction of *Euglandina* in Polynesia, a survey was carried out in 1993 to check the current status of these introduced populations. We found that two regions do have populations of *Euglandina*: (1) in the Nouméa area, there are two sites (in the city of Nouméa itself and at Plum, ca. 30 km to the south-east) with very low population densities; (2) the main focus is in the Ouégoa-Koumac area, in the North of the mainland, where well established populations exist.

We also have indications that *Euglandina* has established itself in the Loyalty Islands, but this has not yet been checked. Introductions to other sites, including localities on the east coast of New Caledonia with high rainfall, apparently failed, as no animal or shell was found during our 1993 survey. Local people confirmed this absence. It would thus appear that after 20 years in New Caledonia, *Euglandina rosea* has failed to invade native habitats from the localities where it was initially released. The threat to the native land snail fauna is still there, but is obviously not as serious as elsewhere in the Pacific.

Despite an official ban on the import of *Euglandina* to the French-administered islands of Wallis and Futuna, it has recently been introduced illegally by private individuals, lured by its erroneous reputation as an efficient agent for control of *Achatina*. Besides loss of habitat, *Euglandina* remains the single most important cause of extinction of endemic land snails in the Pacific.

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Conservation research and management of New Zealand's giant land snails

by Greg Sherley

New Zealand land snail diversity is dominated by the micro-fauna (Solem *et al.*, 1981) but conservation focuses on the research and protection of the giant species because these are perceived to be at greatest risk from habitat destruction and introduced predators. Four genera in three families receive most of the conservation effort: Bulimulidae *Placostylus*; Paryphantidae *Paryphanta*, *Powelliphanta*; Rhytididae *Wainuia* (taxonomy after Powell, 1979). Since many species of these genera occurred in lowland and

coastal forest they have been badly affected by human induced habitat loss or modification. Feral pigs, goats, deer and domestic cattle species have been responsible for habitat destruction. Introduced predators of giant snails include possums, rats, feral pigs, hedgehogs, and at least one passerine, the song thrush.

All of New Zealand's largest land snail groups (*Placostylus*, *Paryphanta* and *Powelliphanta*) are now legally "protected", though the various attempts at protection still largely reflect the interests of a few enthusiasts. Surprisingly, given their large size and conspicuous appearance, their presence has remained undetected in many areas, and new subspecies, species, and even one new genus, have recently been discovered. The purpose of this note is to review current research and management, and to list most of the important references relating to the conservation of the various species of giant land snails.

1. Bulimulidae

Placostylus

P. bollonsi. This species is the largest in the *Placostylus* genus, with its cone-shaped shell measuring up to 100 mm long. Like the other species of *Placostylus* it feeds on dead and living leaves. All four subspecies occur on the Three Kings Islands off the north of the North Island (Powell, 1979). Because these islands are a Nature Reserve and therefore are afforded the maximum legal protection for conservation land in New Zealand, and are mammal free, the snails are considered relatively safe from habitat modification and introduced predators. Management and research therefore extends only to monitoring populations using quadrat counts as often as occasional visits to the islands permit. Brook & Laurenson (1992) reported on what was known of this species' taxonomy and ecology. Apparently the populations declined in numbers as a result of human-induced habitat modifications, but are now recovering. Recent research includes a study of the shell morphology of each population in an attempt to differentiate between them (Sherley, in press).

P. hongii. This species occurs on Aorangi and Ta Whiti Rahi of the Poor Knights Islands Nature Reserve offshore of Whangarei, northeastern North Island, where it is reasonably secure from mammal pests. Remnant populations on the mainland are threatened by stock trampling and/or ship rat predation. At two mainland populations, rats are poisoned using brodifacoum (anticoagulant) baits placed in stations and restocked at about four-monthly intervals. The largest of these populations is the type locality and is being monitored annually using four 2.5 m x 12 m quadrats. The data from this monitoring are to date equivocal about whether the population is stable or not.

P. ambagiosus. There are 10 subspecies (Powell, 1979) still extant, although at least three are critically endangered. The conservation status of each subspecies is described in Sherley & Parrish (1989) and Parrish *et al.* (1995). Research has been carried out into their ecology (Penniket, 1981), taxonomy (Penniket, 1981; Triggs & Sherley, 1993; Sherley, in press), population changes following predator control

(Sherley *et al.*, in prep.), conservation by translocation (Sherley, 1995), and captive breeding and growth (Dr. Ian Stringer, Massey University, NZ, unpub.).

Management has centred on controlling predators such as rats, fencing out feral pigs (which are predators, as well as destroying habitat) and domestic stock (which trample habitat and crush snails), translocating snails to establish new populations, and captive rearing with a view to being able to create new populations in the wild with the offspring. Researchers and managers are also developing monitoring techniques. Cluster sampling methods are being designed and snails have had transponders glued to their shells to assess whether it will enable individuals to be readily found under litter using a radar-transceiver. Most of the latter has involved trialling different types of transponders (varying diode and aerial combinations) in the field.

2. Paryphantidae

Paryphanta

Paryphanta are large carnivorous snails with dark green shiny thick shells. They live in forest or scrub and are predators. Like *Powelliphanta* they lay clutches of large, white limy eggs and prefer wet, humid forest and scrub. There is one species and a subspecies: *P. busbyi busbyi* is the largest (80 mm diameter) and is reasonably widespread from Auckland to Kaitia in the northern peninsula of the North Island, while *P. b. watti* (65 mm diameter) is confined to a tiny area in the northernmost tip of the North Island.

A study has been underway for about 18 months on the ecology of *P. b. busbyi* (Richard Montifore, unpub.), while the New Zealand Department of Conservation is funding research into the ecology of the endangered *P. b. watti* (Ian Stringer, Massey University, unpub.), in particular studying dispersal, survival and growth rate.

Powelliphanta

Powelliphanta are mainland New Zealand's largest land snails (up to 95 mm) and many species are strikingly beautiful with shiny red, yellow and black striped shells. They occur from East Cape in the North Island to Fiordland in the South Island. Like *Paryphanta* they are carnivorous, largely eating worms, and lay large hard-shelled eggs.

There has been substantial research in the last 15 years into the distribution, morphology and genetics of *Powelliphanta* and consequently the taxonomy of the group is presently under review (K. Walker & R. Hitchmough, in prep.). It seems the earlier taxonomy for the larger *Powelliphanta* (Powell, 1979) will largely be reinstated, after a comprehensive "lumping" of the group in the 1970s (Climo, 1978). The total number of *Powelliphanta* species will almost double (19 species and 52 subspecies) with the discovery of many more taxa, largely within the South Island's "rossiana" series. These snails are the smallest *Powelliphanta*, and because they occur above the timberline in remote alpine grasslands in the wet western South Island, are relatively difficult to find. Conversely, their high altitude environment may have

helped their survival as fewer introduced predators survive there.

Since the early demise of several species through habitat loss during the colonisation of New Zealand, there have been no recent extinctions. However, a few subspecies are in a precarious state, and most others appear to be in gradual decline. The Department of Conservation has recently begun to monitor many *Powelliphanta* taxa so a clearer picture of the rate of decline should be available in a few years.

Widespread possum control to protect *Powelliphanta* is being carried out by the Department of Conservation, along with limited localised rat control. However, there has been no progress protecting snails from feral pigs.

There has been some work on the ecology of several species of *Powelliphanta* (K. Walker, unpub. and C. Devine, unpub.) through mark/recapture studies, and *Powelliphanta* have been successfully reared in captivity (Walker, unpub.).

3. Rhytididae

Wainuia and *Rhytida*

A study into the biology and conservation status of *Wainuia* and *Rhytida* is underway (Efford & Bokeloh, 1991). Results so far show that both genera are susceptible to predation by introduced possums, rats and hedgehogs. Unlike the larger land snails they are not legally protected, yet several species seem in a vulnerable position. The feeding behaviour and diet of *Wainuia* are possibly unique among snails. Some re-organisation of *Wainuia* taxonomy is underway (Efford, in prep.).

If readers would like addresses of researchers whose work has been mentioned in this note, please get in touch at the address below. Thanks to Kath Walker for improving the text.

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More on New Zealand *Placostylus*

The following is modified from *Re-introduction News* No. 10 [1995]: 8-9, also by Greg Sherley:

Re-introductions have occurred since 1990 and involved three subspecies of giant land snail (*Placostylus ambagiosus*). These subspecies are *P. a. whareana*, *P. a. annectens* and *P. a. paraspiritus*. The reasons for the re-introductions were to increase the number of populations to two in the case of *P. a. paraspiritus*, and to create a protected population for each of the others.

Interesting observations of *P. a. whareana* and *P. a. annectens* include transferencees attempting to return to the site they were collected from—a maximum distance of 66 m. Thus despite being removed from sub-optimal forest habitat (grazed, eroding, feral pig and rodent predation) to fenced and predator-free habitat within their known range, some snails have tried to return to their original locations—in one case three times. Neither of these subspecies have bred at the new sites, but *P. a. paraspiritus* has and there has been no sign of dispersal from its re-introduction area.

In future we hope to be able to rely on captive breeding of giant land snails for re-introduction programmes. Captive breeding affords many advantages, including being able to produce many individuals which can be transferred at the optimal time (e.g. when climatic conditions are most suitable), conducting re-introductions in an experimental manner to enable scientific study (of techniques and the ecology of transferencees), and minimising the risks of harvesting from small populations.

More on New Zealand *Powelliphanta*

The following is modified from an article that appeared in *The Papustyla* 9(2) [March/April 1995], which reprinted it from the *New Zealand Herald*.

A rare native carnivorous snail is under threat of extinction and opossums are being blamed as the main culprits. The snail, *Powelliphanta marchantii*, is found only in the high-altitude forests of the northern Ruahine and southern Kaimanawa ranges—the oldest land mass in the North Island. A Department of Conservation survey has shown an alarming destruction rate and fragmentation of the remaining population. The Department's senior officer for wildlife and fauna management in the Tongariro/Taupo Conservancy, Cam Speedy, says such fragmentation is an early warning that a species is in sharp decline. He says the survey showed the snails are being subject to heavy predation from opossums, rats, pigs, and from accidental destruction from the hoofs of deer. Eighty-two percent of empty shells showed damage characteristic of opossum predation. Speedy says the survey showed population densities were around 90 live snails per hectare. Empty shells were found at a rate of 1820 per hectare. The other important finding was that large areas of apparently suitable habitat had no snails or shells at all. He hopes the survey will spark a study to give the Department information on trends in the snail population over the next few years. In the meantime he fears the snail is becoming one more native species facing extinction because of the opossum.

Save Anijima and its unique land snails

The following is taken (slightly modified) from a message that was distributed over the Internet by Drs. K. Tomiyama and J. Suzuki.

Anijima, an untouched island in the Ogasawara archipelago, is about to be destroyed. Why? Because of the construction of a new airport planned by the Tokyo Metropolitan Government.

The Ogasawara archipelago (also known as the Bonin Islands), is situated in the north-west Pacific Ocean, south of Japan. It consists of 20 small islands, the largest of which are Chichijima (24 km²) and Hahajima (21 km²). All of the islands are uninhabited except for Chichijima and Hahajima which together have a population of about 2000 people. Anijima lies 500 m from Chichijima, easily its closest neighbour. It is said that the construction of a new airport on Anijima is more economical than on the other islands. But Anijima is the most precious and important island from an ecological point of view.

Why is Anijima important? The Ogasawaras are good examples of oceanic islands: 1) they have been isolated from any other land mass for at least several hundred thousand years; 2) they have a high endemic ratio—40% of vascular plant species and 70% of woody plants are endemic; 94.3% of the land snails are endemic, as are 30% of the 236 insect species, and there are 4 endemic birds and one native mammal, the fox bat. This high level of endemism is proof indeed of the importance of these islands but sadly most of these species are now endangered. Anijima is the only remaining island in the archipelago that has not been widely deforested.

cultivated, and destroyed by grazing goats. On Anijima, the original fauna and flora have been conserved because of the lack of water resources and hence relatively little human activity. This island still preserves, in its original state, the endemic fauna and flora of the Ogasawara archipelago, including 13 species of land snails found only on Anijima.

What will happen to Anijima? It is inevitable that the construction of the new airport will cause serious disturbance to the primaevial flora and fauna on Anijima, and increase the chance of invasion of species from the outside. The total land area of Anijima is 785 ha. The length of the planned landing strip will be 1800 m and its construction alone will destroy 11% of the total land area of the island. The construction of the airport as a whole will certainly affect a much larger part of the island area, which will increase the risk of the extinction of many endangered endemic species, and may damage irrevocably the marine ecosystem around Anijima due to soil erosion from the construction. If this fragile ecosystem is lost, we may never recover it.

What can you do? Join us. We are objecting to the construction of an airport on Anijima. Why build a new airport on Anijima when there is an abandoned airport on Chichijima? If you agree with us, please send a letter of protest to:
Mr. Yukio Aoshima, The Governor of Tokyo, Shinnjuku, Tokyo 163-01, Japan.
E-mail: SHB00924@niftyserve.or.jp
TOKYOGOV@pcvan.or.jp
Please send a copy of your letter to us (Drs. Tomiyama and Suzuki) at the addresses below.

Since the above message was posted a subsequent analysis of the situation has also been posted (10 January 1996). The following is taken (slightly modified) from this posting, which is a translation by the author of an original article that appeared in Japanese in the monthly journal of science *Kagaku Asahi* May 1995, pp. 10-13.

Nonsense-assessment by Tokyo Metropolitan Government that ignores the value of pristine forest in the Ogasawara Islands, Japan

by Yoshikazu Shimizu (Professor at Komazawa University)

The Tokyo Metropolitan Government (TMG) decided again in February 6, 1995 that they would build a large-scale airport on Anijima, in the Ogasawara Islands, Japan. Why again? Because they once nominated Anijima for the scheduled airport, in February 1989, but the Ministry of Transportation (MT) then requested TMG to re-examine the plan in view of the expected demand of passengers, conservation of nature and share of construction costs, when MT adopted the TMG's plan in the sixth 5-year Master Plan of Airport Construction (the general plan of the Japanese Government) in November, 1991. Thus TMG selected four candidate localities in the Ogasawaras for the scheduled airport: Chichijima, Hahajima, Anijima and Ototojima and carried out an environmental assessment in 1994.

Anijima is the only island in the Ogasawaras that has never been inhabited; it is covered with pristine native forest (*Distylium* dry forest which features the Ogasawaras' dry-type vegetation). Anijima supports a complete ecosystem in which native plants and

animals maintain their original relationships with each other. It also has many endangered endemic species (plants, insects, land snails, etc.), some of which are extinct on the other islands of the group. The indispensable value of Anijima is in this totality of the ecosystem. Only on Anijima is it possible to maintain the original Ogasawaran ecosystem into the future.

Manipulation to lessen the value of Anijima

The decision of TMG was made based on an "Environmental Assessment for the Airport Construction in the Ogasawara Islands", which TMG asked NIPPON KOEI (one of the leading consultancy companies in Japan) to produce in 1994. Table 1 shows the summary table: "Estimated Influence on the Valuable Plants and Animals" which was used for as explanation for the press and Ogasawaran villagers (local people). They selected valuable plants and animals such as endangered species listed in the Red Data Books of Japan and gave points to each species according to the degree of supposed impact of construction of the airport. The number in the table shows the total points of each category for each island.

If you look at this table without any annotations, you would believe their explanation: "Each island has its own value and the plants and animals of no one island will be more impacted by the airport construction than any other island" (Explanatory paper for the press by TMG). Indeed, some might gain the impression that the influence on Anijima and Ototojima is less than that on Chichijima and Hahajima simply by comparing the points in the table.

Table 1. Meaningless evaluation of the impact on nature of airport construction in the Ogasawaras (a higher score purportedly signifies greater impact).

Category	Total points			
	Chichijima	Hahajima	Anijima	Ototojima
Plants (endangered spp.)	25	24	21	17
Plants (other valuable spp.)	89	108	59	54
Plants (total)	114	132	80	71
Mammals	4	4	-	-
Birds	12	20	10	12
Amphibians/Reptiles	3	2	2	4
Insects	17	18	22	38
Land snails	30	36	67	28

However, we can find some intentional manipulation to lessen the relative value of Anijima, when we analyze the original data of the table. First, there is a biased selection of valuable species. As for plants, they selected many ferns (about 30% of the total number selected: 109 species) although there are only a small number of fern species in Anijima because of its arid environment. Thus the other islands with mesic habitat good for ferns have the advantage over Anijima. On the contrary, many endemic rare trees and herbs which feature in the dry forest of Anijima are not included in the list.

In the category of land snails they considered fossils and semi-fossils of Chichijima as "valuable species" so that the points for Chichijima increased.

The second problem is in the evaluation method of the influence of the airport construction. They adopted five grades from "Grade 1 = no influence" through "Grade 5 = serious influence on all four islands", and gave points to each species according to its grade. But why does a species on which there will be "no influence" get one point, which is added to the total points of "the influence of the airport construction"? Suppose that one species is endangered now because of the past destruction of habitat in one island like Ototojima, this species gets four points (Grade 4 = serious influence within one island), while a species with many individuals because of the intactness of the ecosystem in one island like Anijima gets only two points (Grade 2 = influence on part of the population) even though the species is endangered from the viewpoint of the Ogasawara Islands as a whole. In short, Chichijima, Hahajima and Ototojima, where destruction of nature before World War II was so severe that only a few valuable species are left in the proposed airport construction areas, get a high score for impact of construction, while Anijima, where the pristine native forest covers almost the whole area, gets a lower score because of the intactness of the ecosystem. This evaluation is really contrary to the common sense of environmental assessment!

Nonsense of the total points of evaluation

The third problem involves the survey area. According to the public document of TMG, "survey area" of assessment (supposed airport construction area) was divided into two parts: "altered area", which would receive direct destruction as a result of airport construction, and "other area" located around the altered area. They listed the distribution of valuable species found in the two areas separately. Thus, we should suppose that valuable species listed in "other area" also lived within "survey area". But, in fact, some of them were selected from outside of "survey area", which means that valuable species were selected from all over the island irrespective of "survey area", especially in Chichijima and Hahajima. Those species living far from the supposed airport and unlikely to be impacted by the airport construction were given points, and then these points were added to the total points of evaluation. If so, it is not strange that big islands like Chichijima and Hahajima with larger total area and more diversified environment than Anijima get high total points in the evaluation. In conclusion, the total points of evaluation shown in Table 1 has no meaning and therefore it is clear that the deductions based on this evaluation are unsound.

Nevertheless, the trouble is that many people believed the TMG's opinion when they explained the result of the assessment in the press conference or the villagers' conference. We find the sentence: "Anijima is the best for the airport construction because the impact on nature is less than on the other islands, even though some influence is inevitable on any island" in the resolution by the Ogasawara Village Assembly. Is it right that this kind of important decision that would determine the future of the Ogasawaras was made based on distorted grounds? It may be possible that TMG announced the distorted

result officially even though they knew the real value of Anijima. If so, they must be blamed for cheating villagers and citizens (tax payers).

It cannot be helped that this decision was made on the assumption that the scientific value of Anijima had been evaluated correctly and was fully understood by the villagers. But as researchers of nature in the Ogasawaras we cannot agree with the way TMG undertook the process.

If a place like Anijima where many endangered endemic species (some of which are Natural Monuments of Japan) are living is allowed to be developed, there would be no place that can escape from the pressure of development in Japan. Why is such a thing possible?

Here is another trick. The scheduled area of the airport construction on Anijima is designated as the only "ordinary area" in the Ogasawara National Park. The "ordinary area" is the lowest ranked land in the national park area, where development is easily permitted. Why? Because TMG had a plan to make an airport here when the Ogasawara Islands were restored to Japan in 1968 from the USA, and this place was designated "ordinary area" and available for future development when the Ogasawara National Park was established in 1972. TMG says "the scheduled area of Anijima is designated as "ordinary area" by Natural Park Law in contrast to the other candidate localities designated as higher ranking and requiring strict conservation" (Explanatory paper by TMG), but is this fair?

Invaluable nature of Anijima

Let's think about why this kind of nonsense assessment is allowed in Japan from a wider viewpoint. The main reason is that they do not see nature as a whole (ecosystem) but just look at valuable species. In addition, they take only the presence or not of the valuable species into account and almost ignore the present status of the population (number of individuals, distribution, etc.) and the circumstances (human impact in the past, environment around the habitat, etc.). Thus the kind of nonsense result can arise such that one individual of a valuable species remaining in a secondary forest has the same value as many individuals of the same species living in a pristine forest.

Even valuable species cannot live in isolation from other common species in their ecosystem. They ignore the relationships among component species in an ecosystem. For example, it is not considered that extinction of pollinator insects influences the reproduction of host-plants or invasion of alien species damages native species.

I suppose that this kind of evaluation dissecting nature must be related to the developers' excuse that they could move valuable species within the developed and destroyed area to a safer place. If they admit the value of the total ecosystem, they might even have to give up the whole development project because even they cannot say that they could move a whole ecosystem to another place.

It is a well-known principle that we should let as large an area as possible be free from human activity in order to preserve pristine ecosystems. But we must be

careful about what developers say recently about "restoration of ecosystems".

From an ecological viewpoint, almost all the area of the candidate localities, other than on Anijima, was cultivated fields before World War II and has since been covered with secondary forest. Though there are several valuable species left in isolation on ridges, steep slopes and valleys within the area, which have escaped past development, the ecological value of these places as a whole is far less than on Anijima. It is true that the valuable species left in these places also deserve protection, but that is another problem. An assessment that cannot differentiate the value of pristine forest from that of secondary forest has no meaning.

What is the aim of the "environmental assessment" that makes it possible to develop a pristine environment like Anijima? If they did the survey only to pay lip-service to having done an assessment, what a waste of our taxes! This kind of assessment is not unique in Japan to the Ogasawaras. We should not believe the analysis that developers present without checking the original data ourselves. We must exclude this kind of meaningless assessment from Japan.

For more details and to find out what else you can do, contact:
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Some publications dealing with the land snails of the Ogasawaras and their critical status are:

- Kurozumi, T. 1988. Species composition and abundance of land mollusks and factors affecting their extinction in the Ogasawara (Bonin) Islands. *Ogasawara Research* 15: 59-109.
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- Tomiyama, K. & Kurozumi, T. 1992. Terrestrial mollusks and conservation of their environment in the Ogasawara Island. *Regional Views* (Tokyo Institute for Applied Geography, Komazawa University) 5: 39-81.

These publications are all in Japanese, but they all have English summaries, species lists, maps and figures with legends in English.

MARINE MATTERS

Mollusc conservation in south and central Florida: importance of life history data in development of collection policy

by Kerry B. Clark

Florida's wildlife is under intense and continually increasing pressure, both from a growing residential population (now about 14 million), and a large tourist population (about 21 million visitors in 1994). By

official state estimates, Florida's resident population may reach 95 million in the next century. Most of this activity is concentrated in the coastal zone, and most of our coastal waters consequently show some degree of patent disturbance. It is reasonable to expect that intensive habitat management will be necessary to protect our biological resources, and that such efforts must begin now to minimize further degradation. One consideration is whether to protect molluscs against non-commercial collectors. A frequent response from both hobbyists and biologists to such proposals is "Collecting isn't the problem; habitat loss and degradation are the real problems, and sometimes commercial collection contributes to declines of some species". While this is perhaps generally true at present, the problem is rather complex, and I believe there are exceptions that should be considered in development of a policy.

Habitat degradation is undoubtedly the major problem in most cases of threatened marine species. But if we compare policies with regard to threatened terrestrial organisms, we can see that there are circumstances where "amateur" collection can be a problem. For example, highly specialized organisms usually have narrowly defined niches, and occur as small, isolated populations or as widely distributed but very low-density populations. With some experience, one can often learn how to target collection efforts, and efficiently locate such species. Thus, the native orchids of Florida are associated with specific host plants, in specific habitats, and Florida found it necessary to protect these against efforts of both professional and hobbyist collectors (the distinction can be blurred, for "hobbyists" may collect with goals of trading and propagation, and perhaps many "professional" collectors begin as hobbyists). Further, advances in collecting equipment and techniques increase the efficiency of collectors. In this example, tree-climbing equipment and technology has improved much in recent years, and for a few hundred dollars one could assemble an efficient, safe, and portable set of climbing gear for orchid collection. The problem is compounded when a species has a long life history and low reproductive success, and becomes commercially valuable (especially by rarity), is edible, or has intrinsic beauty. Each of these, excepting edibility, applies to Florida's native orchids, and has contributed to the need for regulation.

Our understanding of population and conservation biology of marine organisms is rather undeveloped in comparison with that of terrestrial biology. One major problem is that it is very difficult to conduct large areal surveys underwater; one cannot walk and scan with binoculars, and the costs of marine studies are much higher. The problems increase with habitat degradation, because visibility declines with water quality. We have recognized fairly few "keystone" species in most marine habitats, and most of the life history studies available concentrate on commercially useful, typically generalist, species of widespread occurrence. A further problem is that some widely-held attitudes on population biology of marine organisms are probably false, based on too few studies for accurate generalization. One of these, "Thorson's Rule" (Thorson, 1950), postulated that most tropical marine species have planktonic larvae, and thus should be widely distributed by ocean currents. As a corollary, tropical species should be relatively immune to local collection efforts, because distant populations supply larvae for recruitment.

This is true for many species; the larvae of spiny lobsters apparently drift long distances during an extended planktonic development. However, there are some problems with this interpretation. One is that the "rule" was based on an inappropriate data base; Thorson's tropical collection was based on Bermuda, an oceanic island, and one might reason that species with planktonic larvae are much more likely to reach Bermuda than species with limited dispersal (but conversely, non-planktonic species are more likely to colonize islands if they reach them). In fact, there are exceptions; Clark & Goetzfried (1978) showed that tropical opisthobranch molluscs have a high proportion of direct-developing species (lacking a larval stage) and brevipelagic species, a situation which holds even in Bermuda (Clark, 1994)! A further problem is that possession of a planktonic larva does not guarantee dispersal; Knowlton & Keller (1986) showed that planktonic larvae of a tropical alpheid shrimp do not disperse from parental populations, and I have presented circumstantial evidence that such a mechanism operates for some ascoglossan molluscs (Clark, 1994). However, even animals with dispersing planktonic larvae can become extinct, if they are trophic specialists (Carlton *et al.*, 1991). The degree of trophic specialization among tropical marine molluscs is poorly investigated, but probably underestimated (Clark & De Freese, 1987).

On the basis of limited knowledge of reproductive biology, marine trophic specialists appear to have disproportionate incidence of non-dispersing larvae (Clark, 1994), and probably more so in inshore waters (Clark, 1995). The incidence of non-planktonic development is probably underestimated, because development pattern is one of a suite of covariant "K"-adaptations for species with low-density, stable populations: common species are easier to collect and study, leading to an inherent bias in data collection. I have noted this bias in my own studies, in that my initial impression of Florida opisthobranchs was that Thorson's rule was correct; only after exhausting the common species did the predominance of non-planktonic development emerge.

The effects of technology and knowledge of life history on collectability of marine species parallel those of terrestrial species. Marine organisms are accessible as never before, via technology such as SCUBA and jet-ski vehicles. With increasing research, locatability of unusual marine specimens also increases; the habitats of virtually all Florida ascoglossan molluscs, for example, were unknown prior to 1971, but are now available in the literature (Clark & Busacca, 1978; Jensen & Clark, 1983; Clark & De Freese, 1987; Clark, 1994). Use of suction collectors (Clark, 1971) has also drastically increased collection efficiency of opisthobranch slugs. Such changes have the potential to amplify the effects of amateur collection (I include here scientific collection for research purposes), particularly in the context of drastically increasing human population and the popularity of marine biology as a hobby interest.

Life history characteristics (long maturation, large size, edibility, trophic specialization and level, visibility of animals in site, ecological significance, and habitat specialization) and collection value (large, particularly attractive species) should be duly considered in development of policy for collection of living animals. I have doubts whether a "dead shell"

policy can be effectively enforced, but this may represent a reasonable compromise in some cases. As an example, cassids (helmets) are trophic specialists (feed on echinoderms), reach large size and are presumably long-lived, and are highly attractive to collectors. Knowledge of the appropriate collection technique can enable highly efficient collecting; I would rather not reveal details, but a class of a half dozen graduate students, equipped with this knowledge, was able to locate about four specimens per hour of collection time per person, and we apparently found all mature specimens near one patch of reef in about a half hour. The effect of removal of cassids is potentially major, as the ecological effects of uncontrolled grazing urchin populations are significant: "Sea urchin grazing has a major impact on coral reefs, and ... unquestionably regulates the diversity and abundance of tropical marine plants and animals" (Hendler *et al.*, 1995). Removal of urchin predators thus may impact already-stressed seagrass populations in the Keys (Robblee *et al.*, 1991). Deer cowries in the Keys can also be efficiently collected with such knowledge, and the "rule" for collecting these is now common knowledge among Keys divers. In a third example, before depletion of *Strombus gigas* in the Florida Keys, we were able to locate very high densities of queen conch by noting a behavioral peculiarity that concentrates them in dense linear arrays.

Rarity does not imply non-essentiality in marine ecosystems. As opposed to common "keystone" species, which continuously regulate bulk processes in ecosystems, "vermian" species regulate, fine-tune, and stabilize populations of other species. For example, ascoglossan molluscs feed on algae avoided by most herbivores because of toxicity, and these algae are important both as limestone producers on coral reefs and as competitors to scleractinian corals (Clark, 1994). Most ascoglossans in Florida appear to have one or two generations per year, and with localized (autochthonous) recruitment, repeated collections have noticeable and long-lasting effects (several years) on populations (Clark, 1994).

In summary, consideration of life history patterns shows that some marine molluscs (and by extrapolation, other taxa) are potentially at risk from non-commercial collection, and that some life history features predispose species to overcollection. Unfortunately, knowledge of such basic life history features as developmental pattern is rudimentary, and must be collected for an informed policy for protection of marine molluscs. The most susceptible species are trophic specialists, for which the least data are available, but these species can have important roles as regulators of populations of other species. These species are unlikely to form the basis of commercial fisheries, but may attract the attention of non-commercial collectors for various reasons, and in the absence of allochthonous recruitment, such collection may have significant effects on populations.

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Sea shells in the Philippines

The following report was published in 1995:

Salamanca, A.M., Pajaro, M.G. & Alava, M.N.R. The utilization of marine resources in the Philippines (Seashells and Marine Mammals. Report to TRAFFIC-Southeast Asia. 58 pp.

It is obtainable from TRAFFIC Southeast Asia, Locked Bag 911, Jln. Sultan P.O., 46990 Petaling Jaya, Malaysia.

RECENT PUBLICATIONS RELEVANT TO MOLLUSC CONSERVATION

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- Bogan, A., Pierson, J.M. & Hartfield, P. 1995. Decline in the freshwater gastropod fauna in the Mobile Bay basin. In: LaRoe et al. (listed below). Pp. 249-252.
- Chen, R. 1994. A study on mollusc diversity and its protection near the atolls of Nansha Islands. In: *Studies on marine biodiversity of the Nansha Islands and neighbouring waters*. Pp. 51-57. [Publisher, etc. in Chinese].
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- Newton, L.C., Parkes, E.V.H. & Thompson, R.C. 1993. The effects of shell collecting on the abundance of gastropods on Tanzanian shores. *Biological Conservation* 63: 241-245.
- Ponder, W.F. 1994. Australian freshwater Mollusca: conservation priorities and indicator species. *Memoirs of the Queensland Museum* 36(1): 191-196.
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