70th Annual Meeting

American Malacological Society

Sanibel Island, Florida

31 July-4 August 2004

Program and Abstracts

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The logo for the 70th Annual Meeting was designed by J. H. Leal and includes a stylized rendition of *Scaphella junonia* (Shaw, 1808)

Program and Abstracts

70th Annual Meeting
American Malacological Society
Sanibel Island, Florida
30 July–4 August 2004

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Edited by:
José H. Leal, Elizabeth Grimm, and Christina Yorgey
Sanibel 2004

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Welcome to Sanibel!

Dear Colleagues,

It is a great pleasure and privilege to welcome you to the 70th Annual Meeting of the American Malacological Society on Sanibel Island, Florida. Sanibel is a world-renowned, nature-oriented travel destination that is also famous for its bountiful molluscan resources. The event is being hosted by The Bailey-Matthews Shell Museum and has as its main venue the Sundial Beach Resort. I am certain you will agree with me that these are very appropriate choices for an AMS meeting.

As indicated inside the front cover of this volume, the meeting is being co-sponsored by a number of local and national organizations. I want, however, to extend special thanks for the unlimited assistance provided by the organization I direct, The Bailey-Matthews Shell Museum. The board of trustees, its president Jon L. Thompson, volunteers, and staff of the Museum have been, in many and diverse ways, fully supportive of the choice of our organization as the host institution of this unique event.

In addition to that, I want to acknowledge the generous financial support AMS received for the full printing of this book from the Lee County Visitor and Convention Bureau. Executive Director D.T. Minich embraced our cause and acted swiftly to find the necessary funds. The Sanibel-Captiva Shell Club, Inc., liberally sponsored the bulk of the social events taking place during the meeting.

As you read through this book of program and abstracts, it will become clear that the 70th Annual Meeting covers a wide gamut of subjects and taxonomic groups in malacology. In addition to contributed papers on marine, freshwater, and terrestrial mollusks, a symposium on the Relationships of the Neogastropoda will be convened by M. G. Harasewych of the National Museum of Natural History at the Smithsonian Institution. Special sessions will include Biodiversity of Marine Mollusks (organized by Gustav Paulay, Florida Museum of Natural History); Coastal Molluscan Assemblages as Environmental Indicators (Michael Savarese, Aswany Volety, and Greg Tolley, Florida Gulf Coast University); Terrestrial Mollusks as Agricultural and Environmental Pests (David Robinson, United States Department of Agriculture/Academy of Natural Sciences of Philadelphia), and Global Marine Bivalve Database Workshop (Gustav Paulay, Florida Museum of Natural History; Paul V. Scott, Santa Barbara Museum of Natural History;

and Graham Oliver, National Museums & Galleries of Wales). In addition, a special student gathering organized by Ken Hayes, Anna Bass, and Amy Wethington, all graduate students in malacology, will focus on and discuss common issues and problems faced by soon-to-be professionals in the field. I want to acknowledge the financial or in-kind support received for these sessions from the National Science Foundation, United States Department of Agriculture, Florida Museum of Natural History, Florida Gulf Coast University, Sanibel-Captiva Chamber of Commerce, and Sundial Beach Resort.

The ever-popular malacological auction will take place on the evening of Monday, August 2. Three field trips are planned for the last day of the meeting, Wednesday, August 4: A nature-watching visit to J. N. "Ding" Darling National Wildlife Refuge on Sanibel, guided by professional ornithologist and Shell Museum volunteer Dr. Jon Greenlaw; a daylong boat trip to Cayo Costa State Park, which I will guide (located on isolated and undeveloped Cayo Costa, the park offers pristine views of the Gulf, dunes, lagoons, and opportunities for shell collecting; no live-mollusk collecting is allowed in the park or elsewhere in Lee County); and a visit to a Plio-Pleistocene fossil pit in Sarasota County guided by Roger Portell, invertebrate paleontologist at the Florida Museum of Natural History. The field trip program at this meeting benefited from in-kind help from the United States Fish and Wildlife Service (J. N. "Ding" Darling National Wildlife Refuge), Florida Park Service (Cayo Costa State Park), Florida Museum of Natural History, and Captiva Cruises.

Last but not least, I want to acknowledge the dedication and hard work of the local organizing committee for the 70th Annual Meeting of the American Malacological Society. The event could not have happened without the consistent help from Debbie Frederick, Jon Greenlaw, Anne Joffe, Pat Jones, Kim Nealon, Hal Pilcher and, especially, Shell Museum public relations manager Libby Grimm and the mainstay of this entire effort, my assistant Tina Yorgey.

I hope the meeting fulfills your highest expectations of disseminating and acquiring cutting-edge malacological information. And may your stay on Sanibel be a pleasant and unforgettable one!

José H. Leal, Ph.D.
President, American Malacological Society

The Bailey-Matthews Shell Museum

The Shell Museum has rapidly established itself as a recognized educational and research organization. Since opening in 1995, our institution has grown at a rate exceeding the best expectations, in spite of a relatively small budget and limited staff. The Museum's solid foundation of volunteers embodies its commitment to strong community participation. Community interactions of various kinds are forces that drive the Museum along the path of its mission.

The Museum's exhibits are designed to inform and educate, using shells and mollusks as their *leitmotif*, on a range of subjects broader than the topic shells/mollusks itself. In the last several years the Museum has instituted many educational projects. Through its programs, lectures and seminars, and community involvement, the Museum reaches out to schoolchildren in grades K–12, senior citizens, and underserved and minority constituencies in Lee County and Southwest Florida.

Efforts have been successful in expanding the profile of the Museum nationally and internationally. The Museum publishes *The Nautilus*, the oldest (since 1886) English-language malacological journal in the world. The Museum collaborates with research institutions and libraries worldwide. The R. Tucker Abbott Visiting Curatorship, awarded annually to an outstanding malacologist, has become one of the country's main accolades in the field. In addition, aiming for accreditation with the American Association of Museums, the Museum has undergone Museum Assessment Program (MAP) phase 1, and will have its collections reviewed later this year by the Collections Assessment Program of the Institute for Museum and Library Services.

I want to invite you on behalf of the Museum board of trustees, staff, and volunteers to take some time during the meeting to get acquainted with the Museum, its exhibits, collection, and public programs. Come and explore with us the many facets of malacology at its best!

José H. Leal, Ph.D.
Director, The Bailey-Matthews Shell Museum

Saturday, July 31	
9:30–17:00	Registration, 2nd Floor Lobby
10:00–12:00	Council Meeting (Closed Meeting), Flamingo Room
17:00–18:00	Systematics Committee Meeting (Open to all), Flamingo Room
19:00	Opening Reception, Poolside
Sunday, August 1	
8:00	Welcome Address, Keynote Speaker, The Sanibel Room
9:40	Break
10:00	Special Session I – Biodiversity of Marine Mollusks, Sundial 1
	Special Session II – Snails and Slugs, Sundial 2
12:00	Lunch on your own
13:00	Special Session I – Biodiversity of Marine Mollusks, Sundial 1
	Special Session II – Snails and Slugs, Sundial 2
15:00	Break
15:20	Contributed Session I – Marine Gastropods, Sundial 1
	Special Session II – Snails and Slugs, Sundial 2
17:20	Dinner on your own
19:00	Open House at The Bailey-Matthews Shell Museum
Monday, August 2	
8:00	Symposium – Relationships of the Neogastropoda, Sundial 1
	Special Session III – Coastal Molluscan Assemblages, Sundial 2
10:00	Break
10:20	Symposium – Relationships of the Neogastropoda, Sundial 1
	Special Session III – Coastal Molluscan Assemblages, Sundial 2
12:00	Lunch on your own
13:20	Global Marine Bivalve Database Workshop, Sundial 1
	Contributed Session II – Terrestrial Gastropods, Sundial 2
15:00	Break
15:20	Global Marine Bivalve Database Workshop, Sundial 1
	Poster Session, The Sanibel Room
17:00	Dinner on your own
19:30	Endowment Auction, The Sanibel Room
Tuesday, August 3	
8:00	Contributed Session III – Marine Mollusks, Sundial 1
	Contributed Session IV – Freshwater Mollusks, Sundial 2
10:00	Break
10:20	Contributed Session III – Marine Mollusks, Sundial 1
	Contributed Session IV – Freshwater Mollusks, Sundial 2
12:00	Lunch on your own
13:20	Student Gathering, Flamingo Room
15:20	Business Meeting (Open to all), The Sanibel Room
17:00	Group Photo Session
19:00	Closing Banquet, The Sundial Room
Wednesday, August 4	
8:00–17:00	Field Trips

Saturday, July 31, 2004

9:30–17:00 Registration, 2nd Floor Lobby

10:00–12:00 Council Meeting (Closed Meeting), Flamingo Room

17:00–18:00 Systematics Committee (Open to all), Flamingo Room

19:00 Opening Reception at Sundial Beach Resort, Poolside

Sunday, August 1, 2004
(The Sanibel Room)

Welcome Addresses

8:00–8:15 José H. Leal, AMS President 2003–2004

8:15–8:25 Jon L. Thompson, President of the Board of trustees, The Bailey-Matthews Shell Museum

8:25–8:35 Marty Harrity, Mayor, City of Sanibel

Keynote Lecture

8:35–9:40 Neogastropoda: Questions of Tempo and Mode in Macroevolution and Macroecology, by Alan J. Kohn

9:40–10:00 Break

Sunday, August 1, 2004
Special Session I – Biodiversity of Marine Mollusks
Organizers: Gustav Paulay and Christopher P. Meyer
(Chair: Gustav Paulay; Room: Sundial 1)

10:00 Gary Rosenberg
Species Discovery Curves for Marine Mollusks: No Sign of an Asymptote

10:20 Yuri I. Kantor and Alexander V. Sysoev
Biodiversity of Russian Marine Mollusks

10:40 Ángel Valdés
What is New on the Biodiversity of Opisthobranch Mollusks?

11:00 Paul Valentich-Scott
Diversity of Hosts and Form in Commensal Galeommatoidean Bivalves

11:20 Lyle D. Campbell and Sarah C. Campbell
Bivalve Diversity in a Mid-Pliocene Subtropical "Chama-Reef" Bioherm, Darlington County, South Carolina

11:40 Paula M. Mikkelsen and Rüdiger Bieler
Marine Bivalves of the Florida Keys: A Qualitative Faunal Analysis Based on Original Collections, Museum Holdings, and Literature Data

12:00–13:00 Lunch

Special Session I –Continued
(Chair: Christopher P. Meyer; Room: Sundial 1)

13:00 Taehwan Lee and Diarmaid Ó Foighil
Ribbed Mussels of the Caribbean: The Curse of the Sibling Species Complex

13:20 Marta J. deMaintenon
Biodiversity of Hawaiian Marine Mollusks: The Perspective of a Nondispersing Species

13:40 Alan J. Kohn and Thomas F. Duda, Jr.
Generic Hyperdiversity in Time and Space

14:00 Gustav Paulay, Christopher P. Meyer, and Jonathan B. Geller
Tempo and Mode of Diversification in the Indo-West Pacific

15:00–15:20 Break

Sunday, August 1, 2004
Special Session II – Snails and Slugs as Agricultural and Horticultural pests
Organizer: David G. Robinson
(Chair: John Slapcinsky; Room: Sundial 2)

10:00 Ian H. Gibbs
Distribution and Control of the Giant African Snail (Achatina fulica) in Barbados

10:20 Silvana C. Thiengo and Monica A. Fernandez
Achatina fulica in Brazil: The Current Situation

10:40 Angela Fields and David G. Robinson
The Slug *Veronicella sloanei* (Cuvier, 1817) — an Important Pest in the Caribbean

11:00 Wilfredo García
Bradybaena similaris (Rang, 1831): A Potentially Serious Pest for Citrus Crops

11:20 Frederick J. Zimmerman
The Quarantine Procedures in the Caribbean and the Potential Agricultural Impact on the United States

11:40 David G. Robinson and Angela Fields
The Cuban Land Snail *Zachrysia*: The Emerging Awareness of an Important Snail Pest in the Caribbean Basin

12:00–13:00 Lunch

12:00–13:00 Editors of Malacological Journals (Closed Meeting , Flamingo Rm)

Special Session II –Continued
(Chair: Robert Hollingsworth; Room: Sundial 1)

13:00 Stephanie A. Clark
Molluscs of Quarantine Concern: An Australian Perspective

13:20 Kenneth A. Hayes
Systematics, Phylogeography, and Evolution of Apple Snails, *Pomacea* spp.

13:40 Robert H. Cowie
Invasive Apple Snails (Ampullariidae) in Hawaii and Southeast Asia

14:00 Robert G. Howells
Current Status of Channeled Applesnail (*Pomacea canaliculata*) in Texas

14:20 Yvette R. Ogle
The Channeled Apple Snail (*Pomacea canaliculata*) in Florida and Elsewhere

14:40 Alan R. Hardy
Exotic Mollusks Intercepted or Established in California and Their Impact Upon California Agriculture

Sunday, August 1, 2004
Contributed Session I – Marine Gastropods
(Chair: Matthew R. Campbell; Room: Sundial 1)

15:00–15:20 Break

15:20 Timothy A. Rawlings, Timothy M. Collins, and Rüdiger Bieler
Mitochondrial Gene Rearrangements at a Snail's Pace

15:40 Francisco Escobar de Llata, Alejandro Zugasti Cruz, Estuardo López Vera, Elva Escobar Briones, and Edgar Heimer de la Cotera
Distribution of the Family Conidae in Shallow and Deep Waters Off the Yucatan Peninsula, Mexico

16:00 Matthew R. Campbell
Systematics and Phylogenetics of the Family Streptacididae (Gastropoda: Heterostropha)

16:20 Dianna K. Padilla
Inducible Offenses in Marine Molluscan Grazers

16:40 Deirdre Gonsalves-Jackson
Biogeographic Distribution of Developmental Types in Opisthobranch Mollusks Across the Isthmus of Panama

17:00 Janice Voltzow and Claire-Louise Martin
Unlocking the Key to Flow in Fissurellids

19:00 Open House at The Bailey-Matthews Shell Museum

Sunday, August 1, 2004
Special Session II – Snails and Slugs as Agricultural and Horticultural pests
Organizer: David G. Robinson
(Chair: David G. Robinson; Room: Sundial 2)

15:20 William Tang
Hitchhiking Mollusks on Tile Shipments from Italy

15:40 Ronald B. Hammond
Slugs as Pests of Agricultural Crops

16:00 Tim N. Stevens
Chemical Control of Invasive Snails: The Approach and Strategy Utilized by USDA, APHIS, PPQ Toward Eradication

16:20 Robert Hollingsworth
Chemical Alternatives to Metaldehyde and Methiocarb: Current Status and Prospects

16:40 John Slapcinsky
Delineating the Distributions of Alien Terrestrial Mollusks in North America

17:00 J. W. Smith and G. Fowler
Mapping the Potential Distribution of Invasive Mollusks in North America

19:00 Open House at The Bailey-Matthews Shell Museum

Monday, August 2, 2004
Symposium – Relationships of the Neogastropoda
Organizer: M.G. Harasewych
(Chair: M.G. Harasewych; Room: Sundial 1)

8:00 M. G. Harasewych
Origin and Early Evolutionary History of the Neogastropoda: Evidence from Nuclear and Mitochondrial DNA Sequences

8:20 Yuri I. Kantor
Neogastropod Sister Group: Morphological, Chromosomal, and Paleontological Evidences

8:40 Luiz Ricardo L. Simone
Phylogeny of the Neogastropoda: A Morphological Perspective Considering Its Relationship with the Caenogastropoda

9:00 Gregory S. Herbert, D. Merle, and C. S. Gallardo
Insights on Neogastropod Phylogeny from Ontogenetic Records of Shell and Radular Characters: A Case Study Using the Muricidae

9:20 Ellen E. Strong
Utility of Kidney Morphology in Phylogeny of the Neogastropoda

9:40 Guido Pastorino and Miguel Griffin
Trophon Montfort, 1810: The History of an Old Patagonian Resident

10:00–10:20 Break

Symposium – Continued
(Chair: Greg Herbert; Room: Sundial 1)

10:20 Helena Fortunato
A Cladistic Reevaluation of the *Strombina* Group (Buccinoidea: Columbellidae) Jung, 1989

10:40 Alan J. Kohn, Thomas F. Duda, Jr., and Trevor R. Anderson
Revisionary Systematics of *Conus*

11:00 M.G. Harasewych
Closing Remarks

12:00–13:20 Lunch
12:00–13:20 Land Snail Conservation (Closed Meeting, Flamingo Room)
12:00–13:20 Editorial Committee of American Malacological Bulletin (Closed Meeting, Osprey Room)

Monday, August 2, 2004
Special Session III – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency
Organizer: Mike Savarase
(Chairs: M. Savarese, G. Tolley, and A. K. Volety; Room: Sundial 2)

8:00 Mike Savarese
Opening Remarks

8:00 Jonathan S. Fajans, Patrick Baker, Shirley Baker, and Edward Phlips
Biology, Ecology, and Physiology of the Non-Indigenous Asian Green Mussel, *Perna viridis* (Mytilidae), in the Southeastern United States

8:20 Gabriel A. Delgado and Robert A. Glazer
Queen Conch (*Strombus gigas*) as an Indicator of Nearshore Environmental Degradation in the Florida Keys: Implications for Continued Coastal Development

8:40 T. D. Alphin, M. H. Posey, H. D. Harwell, and T. Molesky
Intertidal Oyster Reefs as Critical Habitat: Influence of Reef Morphology and Complexity

9:00 Michael Savarese, Aswani K. Volety, and S. Gregory Tolley
Use of Oyster Reef Communities in the Design and Monitoring of Everglades Restoration Projects

9:20 Jay R. Leverone
Analyzing Shell Deposits to Aid in Site Selection for Bay Scallop Restoration in Pine Island Sound, Florida

9:40 William S. Arnold
Rebuilding Bay Scallop (*Argopecten irradians*) Populations in Florida Waters: Success is Predicated Upon a Firm Ecological Foundation

10:00–10:20 Break

Special Session III – Continued
(Chairs: M. Savarese, G. Tolley, and A. K. Volety; Room: Sundial 2)

10:20 Loren D. Coen, Andrew Hollis, and Majbritt Bolton-Warberg
Intertidal Oyster Habitat Restoration: Scaling Up from "r" to "R", Evaluating "Success," and Using More Environmentally Friendly (BMP) Approaches

10:40 Raymond E. Grizzle, Jennifer K. Greene, and Mark Luckenbach
Measuring and Modeling Seston Uptake by Restored Oyster Reefs

11:00 Closing Remarks

Monday, August 2, 2004

12:00–13:20 Lunch

12:00–13:20 Land Snail Conservation (Closed Meeting, Flamingo Room)

12:00–13:20 Editorial Committee of American Malacological Bulletin (Closed Meeting, Osprey Room)

Global Marine Bivalve Database Workshop
Organizers: Gustav Paulay and Paul Valentich-Scott

13:20–15:00 Open to all participants, Sundial 1

15:00–15:20 Break

15:20–17:00 Global Marine Bivalve Database Workshop - Continued
Open to all participants

15:20–17:00 Poster Session, The Sanibel Room

19:30 Endowment Auction, The Sanibel Room

Monday, August 2, 2004
Contributed Session II – Terrestrial Gastropods
(Chair: Frank E. Anderson; Room: Sundial 2)

13:20 Timothy A. Pearce and Jennifer C. Olori
Land Snails from St. Elzear Cave, Gaspé Peninsula, Quebec: Antiquity of *Cepaea hortensis* in North America

13:40 Elizabeth C. Davis
Predicting Potential Distributions of Invasive Land Snails Using an Ecological Niche Modeling Program, GARP

14:00 Frank E. Anderson
Population Genetics of a Highly Restricted Endemic Species of Polygyrid Land Snail (*Euchemotrema hubrichti*) in Illinois

14:20 John Slapcinsky
Terrestrial Mollusks from the Papuan Peninsula, Papua-New Guinea

14:40 Aydin Örstan
Natural History of *Oxyloma retusa* at the Shore of a Maryland Lake

15:00–15:20 Break

15:20 Janice Voltzow, Publications Committee
(Closed Meeting, Flamingo Room)

15:20–17:00 Poster Session, The Sanibel Room

19:30 Endowment Auction, The Sanibel Room

Monday, August 2, 2004
Poster Session
(15:20–17:00: The Sanibel Room)

- James R. Cordeiro
  Range Expansion of the Chinese and Japanese Mystery Snails of the Genus *Cipangopaludina* (Gastropoda: Viviparidae) Across North America

- Nicholas W. De Nitto, Robert C. Frankis, Jr., and Robert T. Dillon, Jr.
  Extensive Mitochondrial CO1 Sequence Diversity in a Population of the Freshwater Snail, *Physa*: Admixture or Cryptic Speciation?

- Gregory P. Dietl
  Effect of Injury on Survivorship of *Mercenaria mercenaria*

- Robert H. Drennan and Robert T. Dillon, Jr.
  No Evidence of "Sperm Sharing" in the Freshwater Pulmonate *Physa acuta*

- Adriana Gracia C., Javier Reyes F., Nadiezhda Santodomingo, and Norella Cruz
  Mollusk Shells as Habitat for Anthozoans and Hermit Crabs in the Colombian Caribbean and Pacific Continental Shelves and Slopes

- Adriana Gracia C., Nadiezhda Santodomingo, and Javier Reyes F.
  Mollusks Associated with Deep-Water Coral Habitats in the Southern Caribbean Sea: Preliminary Observations

- David M. Hayes, Kathryn E. Perez, and Russell L. Minton
  Morphological Variation in *Elimia comalensis* from the Edwards Plateau

- Mark E. Hitchcox and Frederick J. Zimmerman
  Threats to Agriculture from Exotic Terrestrial Stylommatophora and Early Detection Strategies

- Wallace Holznagel, Christina M. Savarese, Steven P. Savarese Jr., Deb Kirkland, and C. Lydeard
  A Preliminary Basommatophoran Phylogeny Based on the Nuclear Ribosomal LSU Gene

- Nirmala Karnik and David C. Campbell
  Phylogeny of *Elimia caelatura* Complex of Upper Coosa Basin, Alabama

- Deborah L. Kirkland and Amy R. Wethington
  No Pre-Mating Reproductive Isolation Between *Physa acuta* and *P. pomilia*

- José H. Leal
  The Biodiversity of Shallow-Water Marine Mollusks of Southwest Florida Revisited

- Patricia Miloslavich, Juan Manuel Díaz, Ana Karinna Carbonini, and Néstor Ardila
  Spawn of *Zafrona pulchella* (Blainville, 1829) and *Anachis helenae* (Costa, 1983) (Caenogastropoda: Columbellidae) from the Colombian Caribbean

- Claudia Muniain and Guido Pastorino
  The Subfamily Lamellariinae (Gastropoda: Velutinidae) in the Magellanic and Antarctic Area

- Nicida Noriega and Patricia Miloslavich
  Protein Content of Embryos and Intracapsular Liquid of *Melongena melongena* (Linnaeus, 1758) (Caenogastropoda: Melongenidae) During Intracapsular Development

- Nelsy Rivero Paredes
  Some Nudibranchs (Mollusca: Opistobranchia) from Parque Nacional Morrocoy, Venezuela

- Carolyn Porter
  Systematics and Biogeography of the Squid Genus *Alloteuthis* (Loliginidae) Based on Morphological and Molecular Sequence Data

- Gerhard Steiner, Hermann Dreyer, and Elizabeth M. Harper
  Bayesian Inference of Anomalodesmatan Phylogeny (Bivalvia: Heterodonta)

- Jody Thompson and Michael M. Gangloff
  The Allen Archer Collections at Auburn University: A Global Portrait of Terrestrial Snail Biodiversity

- Janet Waggoner, Stephanie A. Clark, Kathryn E. Perez, and Chuck Lydeard
  Terrestrial Snail Survey of the Sipsey Wilderness Area in Northwestern Alabama

- Linda Walters, Loren D. Coen, Paul Sacks, Jeffrey Grevert, and Jennifer Stiner
  Impact of Boat Wakes on Intertidal Reefs of the Oyster *Crassostrea virginica*: A Comparison of Reefs in South Carolina Tidal Channels Versus a Florida Estuary

- John A. Wilk
  Cytochrome Oxidase I (COI) Sequence in Florida *Isognomon alatus* – Implications for Systematics and Population Genetics

Tuesday, August 3, 2004
Contributed Session III – Marine Mollusks
(Chair: Marta J. deMaintenon; Room: Sundial 1)

8:00 Luis A. Rodríguez-Gil, Joji Ogawa, and Richard S. Appeldoorn
Photoperiod Effect in the Embryonic Development of the Queen Conch *Strombus gigas* (Linnaeus)

8:20 P. E. Penchaszadeh, F. Arrighetti, G. Bigatti, M. Cledón, J. Giménez, D. Luzzatto, and C. Sanchez Antelo
Studies on Volutids in Argentina (Caenogastropoda: Volutidae)

8:40 Gregorio Bigatti and Pablo E. Penchaszadeh
Reproductive Cycle and Oviposition Events in *Odontocymbiola magellanica* (Gmelin, 1791) (Caenogastropoda: Volutidae) in Golfo Nuevo, Patagonia, Argentina

9:00 Carole S. Hickman
Molluscan Diversity and Function in Seagrass Ecosystems

9:20 Eugene V. Coan, Alan R. Kabat, and Richard E. Petit
2,400 Years of Malacology

9:40 Donna Turgeon
A Joint Venture for the American Malacological Society, American Fisheries Society, and Others — Building an Aquatic Species Inventory and Prototype Warning System for Invasive Species

10:00–10:20 Break

Tuesday, August 3, 2004
Contributed Session IV – Freshwater Mollusks
(Chair: Robert T. Dillon; Room: Sundial 2)

8:00 Marian E. Havlik
2003 Follow-Up of a 2002 Unionid Translocation, Mississippi River Mile 818.9, Cottage Grove, Minnesota

8:20 David C. Campbell
North American Unionoidean Genera: Old Names and New Evidence

8:40 Jeanne M. Serb, John L. Harris, and M. Chris Barnhart
The Utility of Molecular Phylogenetics for Unionid Conservation: Identifying New Populations of the Endangered Winged Mapleleaf *Quadrula fragosa* (Bivalvia: Unionidae)

9:00 Maria Esther Diupotex-Chong, Manuel Uribe Alcocer, and Bertha Lucía Montejo Quintero
Karyotype and "G" Band Analysis of *Pomacea patula catemacensis* (Baker, 1922) from Catemaco Lagoon, Veracruz, México.

9:20 John D. Robinson, Robert T. Dillon, Jr., Thomas P. Smith, and Amy R. Wethington
No Reproductive Isolation Between the Freshwater Pulmonate Snails *Physa virgata* and *P. acuta*

9:40 Robert T. Dillon, Jr. and Paul D. Johnson
Population Genetic Survey of the Pleurocerid Genus *Lithasia* in the Duck River of Central Tennessee

10:00–10:20 Break

Tuesday, August 3, 2004
Contributed Session III – Marine Mollusks
(Chair: Gerhard Steiner; Room: Sundial 1)

10:20 Douglas S. Jones, Irvy R. Quitmyer, and C. Fred T. Andrus
Seasonal Shell Growth and Longevity in the Variable Coquina Clam, *Donax variabilis*, from Northeast Florida: Evidence from Oxygen Isotopes

10:40 Gerhard Steiner, Martina Knapp, and Hermann Dreyer
The Mitochondrial Genomes of Two Limid Bivalves, and Their Significance for Bivalve and Molluscan Mitochondrial Evolution

11:00 Roland C. Anderson, James B. Wood, and Jennifer A. Mather
Diet and Prey Handling of *Octopus vulgaris* in the Caribbean

11:20 Janet R. Voight
Foraging by the Hydrothermal Vent Octopus, *Vulcanoctopus hydrothermalis*

12:00–13:20 Lunch

Tuesday, August 3, 2004
Contributed Session IV – Freshwater Mollusks
(Chair: Robert S. Prezant; Room: Sundial 2)

10:20 Norah M. Corrao, Philip C. Darby, and Christopher M. Pomory
Nitrate Impacts on Florida Apple Snail (*Pomacea paludosa*) Survival and Growth

10:40 Duane M. Choquette, Timothy A. Rawlings, and Timothy M. Collins
Phylogenetics and Population Structure of Native and Introduced Apple Snails

11:00 Silvana C. Thiengo and Monica A. Fernandez
Status of *Melanoides tuberculatus* in Brazil

11:20 Amy R. Wethington and Charles Lydeard
A Molecular Phylogeny of Physidae (Gastropoda: Basommatophora) Based on Mitochondrial DNA Sequences

11:40 Robert S. Prezant and Eric J. Chapman
In-Utero Responses in *Bellamya* Brood to a Potential Predator

12:00 – 13:20 Lunch

13:20 Student Gathering , Flamingo Room
Ken Hayes, Amy Wethington, Anna Bass

15:20 Business Meeting – Open to all, The Sanibel Room

17:00 Group Photo Session

19:00 Closing Banquet – Sundial Resort, The Sundial Room

Wednesday, August 4, 2004

8:00 – 17:00 Field Trips

Abstracts

**Intertidal Oyster Reefs as Critical Habitat:
Influence of Reef Morphology and Complexity**

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As American oysters continue to decline, efforts to restore oyster populations have also intensified. To date many of these efforts have focused on a presence/absence approach without consideration of landscape aspects or reef characteristics that may influence oyster health and ecosystem function. For intertidal reefs, vertical complexity and edge convolution are important landscape aspects influencing habitat quality. Vertical complexity affects spatial structure and refuge potential while varying edge characteristics may affect flow and use of boundary areas. Over the past two years we have examined the influence of edge complexity, vertical complexity, and reef fragmentation on faunal use of intertidal reefs, oyster recruitment, growth and survival, and the influence of these parameters on the adjacent sandflat community. Our approach has involved sampling a combination of artificial experimental reefs that vary complexity and edge characteristics in a blocked manner, as well as sampling natural reefs with varying surface complexity. Various biotic components respond differentially to aspects of reef architecture. Several members of the epifauna are more abundant on high surface-complexity reefs. Oyster recruitment and initial survival is greatest on low surface-complexity reefs, which possibly represents indirect interactions. Nekton exhibits limited responses to either surface or edge complexity. Influences on organic content, porewater N, sediment characteristics, and microalgal biomass in adjacent sandflat areas are affected more by reef edge characteristics than by vertical complexity. These results indicate the potential importance of landscape factors for reef habitat function and indicate the necessity of considering reef characteristics in restoration and conservation efforts.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

Population Genetics of a Highly Restricted Endemic Species of Polygyrid Land Snail (*Euchemotrema hubrichti*) in Illinois

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Recent studies have demonstrated that the limited dispersal abilities of land snails profoundly affect the geographic distribution of genetic variation in many species. Many broadly distributed land snail "species" are likely complexes of isolated, genetically divergent populations. The carinate pillsnail *Euchemotrema hubrichti* is a polygyrid land snail known only from a series of limestone outcroppings in the Larue-Pine Hills region of southwestern Illinois. The distribution of the species within this region is patchy—we have found three outcroppings where large numbers of snails (>200 individuals, estimated via mark-recapture) can be found, but they are rare in most other areas. Movement of individuals between two of these "high-abundance" sites (located on adjacent limestone outcroppings separated by less than 50 m) was not observed during three field seasons, suggesting that gene flow among outcroppings may be limited. To test the hypothesis that *E. hubrichti* populations are genetically isolated from one another, a region of the mitochondrial cytochrome c oxidase subunit I (COI) gene was sequenced from >15 snails from each of the "high-abundance" sites and one "medium-abundance" site, along with smaller numbers of specimens from several "low-abundance" sites throughout the known range of the species. Analyses of these data demonstrate that, while levels of sequence divergence among COI haplotypes are low (< 2%), COI haplotype frequencies differ significantly among sites. These results suggest that, while *E. hubrichti* does not appear to comprise multiple highly divergent populations, gene flow among some sites is limited.

Contributed Session II – Terrestrial Gastropods

Diet and Prey Handling of *Octopus vulgaris* in the Caribbean

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The diet of *Octopus vulgaris* was studied in the field by recovering 517 midden items from the dens of 29 octopuses on the island of Bonaire in the southern Caribbean. Prey consisted of 34 species of gastropods, 21 species of bivalves, and 18 species of crustaceans for a total of 75 different species. Although most individual octopuses were generalists, some specialized in only one type of prey or even a single species of prey. Individual differences in octopuses in environment and temperament are discussed to explain these differences. The octopuses used different methods to access different prey species. Although some were pulled apart and some were drilled and presumably envenomated, we could not predict what method would be used on a single prey species. Only one crab carapace was drilled. However, several crab chelae of *Calappa* were drilled on the inside, probably to release the muscle attachments of the claw and allow the octopus to pull the meat out through the small opening at the joint. The ecological role of octopuses as a generalist marine predator is discussed.

Contributed Session III – Marine Mollusks

Rebuilding Bay Scallop (*Argopecten irradians*) Populations in Florida Waters: Success is Predicated Upon a Firm Ecological Foundation

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Effective restoration of marine populations requires a sound ecological basis. This is exemplified by bay scallops (*Argopecten irradians*), which historically occupied nearshore habitats between West Palm Beach and Pensacola. In recent decades many of the local populations that comprise that scallop metapopulation have collapsed. Analysis of adult distribution and juvenile recruitment patterns during the 1990s revealed that substantial recruitment was only recorded at those sites where adult scallops were abundant, despite the existence of apparently suitable habitat at other sites that previously supported an abundance of scallops. These observations were interpreted to indicate that larval retention predominates in Florida scallop populations and that the number of larvae that do disperse to other sites is not adequate to replenish those populations. Thus, efforts to rebuild local populations rely upon the premise that local larval supply must be increased. To accomplish this, management regulations were modified by eliminating harvest at depleted sites in an effort to increase the survival and resultant spawning success of the few reproductively viable scallop patches that did exist at those sites. A restoration program also was implemented in an effort to increase egg production and fertilization success. That program involved concentrating large numbers of cultured scallops at multiple stations within each of several targeted restoration sites in the closed harvest area. The overall success of this rebuilding strategy, and the relative success of the management and restoration approaches, is discussed within the context of a documented two-order-of-magnitude increase in scallop abundance within the closed harvest area.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

Reproductive Cycle and Oviposition Events in *Odontocymbiola magellanica* (Gmelin, 1791) (Caenogastropoda: Volutidae) in Golfo Nuevo, Patagonia, Argentina

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The volutid snail *Odontocymbiola magellanica* is distributed from off Rio de la Plata (35º S) to Chiloé Island in Southern Chile. In Atlantic waters, *O. magellanica* is part of the *Zygochlamys patagonica* community in depths between 100–110 m off the Province of Buenos Aires and inhabits shallow waters (5 to 10 meters depths) in the Patagonian littoral. Spawning sampling was performed from September 2000 to December 2003 by SCUBA diving at the locality of Playa Paraná-Punta Loma. Females spawn white, spherical, calcareous egg capsules attached to small rocks and hard flat surfaces. Spawn occurs from July to November, showing two peaks of oviposition, in coincidence with an increase in water temperature after the winter and with the maximum water temperature in summer. Egg capsules in different stages of embryonic development were found from July to March. *Odontocymbiola magellanica* is the only species in the family Volutidae known to have an external calcium layer on the egg capsule. The egg capsule is secreted by a gland located in the anterior portion of the snail foot. It is spherical, with a mean diameter of 30 mm. The uncleaved egg diameter varies between 212–240 µm. A total of 4–8 embryos develop in each egg capsule, consuming nutritive substances in the intracapsular liquid. Hatching occurs at the crawling stage, with a shell length of 8–11 mm. Observations of histological slides shown an oocyte diameter increasing from 55.5 µm in June to 150 µm in November. Copulation starts approximately one month before the first oviposition event.

Contributed Session III – Marine Mollusks

North American Unionoidean Genera: Old Names and New Evidence

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Although some 19th-century workers described all unionoideans as "*Unio*", others recognized multiple genera. Unfortunately, some of the most prolific namers of new taxa failed to provide clear descriptions, indications of type species, or other critical information. In addition to creating confusion about their genera, this has led to further confusion when later authors have based genera on their species. Several 20th century authors have added additional generic names. During the past decade, molecular studies have highlighted problems with the current generic assignments of freshwater mussels, making it necessary to reinvestigate forgotten names and even to create a few new ones. Type designations may be needed for some groups. Recent molecular analyses include representatives of all currently recognized U.S. genera of the Ambleminae. Within Ambleminae, three major clades are evident, corresponding to the tribes Pleurobemini, Lampsilini, and Quadrulini. However, some taxa do not clearly group with any of these. The results suggest that most genera, as currently recognized, are polyphyletic; some include members of more than one tribe. Some monotypic genera can be synonymized, but others may be needed. All genera with more than six recognized species probably require revision, as do many smaller genera.

Contributed Session IV – Freshwater Mollusks

Bivalve Diversity in a Mid-Pliocene Subtropical "*Chama*-Reef" Bioherm, Darlington County, South Carolina

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Dragline operations in Darlington County, South Carolina, provided access to a *Chama congregata*-dominated, semi-consolidated hard-ground biota of mid-Pliocene age, approximately 3.2 mya. Bioclastic materials date from at least four different ages: a bone, tooth, and phosphate pebble lag deposit containing Cretaceous reptile and shark teeth; broken, abraded and chalky shell from an earlier Pliocene transgression; and blackened Pliocene shell reflecting burial in a marsh during a low stand or regression. The youngest assemblage shows minimal taphonomic degradation, the shells are fresh, frequently paired; exceedingly fragile sportellids are often unbroken, and some paired arcids preserve traces of the original ligament. The molluscan fauna contained 117 bivalves among 320 documented species, doubling the species richness of the *Chama congregata* bioherms of the warm-temperate Yorktown faunas near Williamsburg, Virginia. Epibenthic and nestling species predominated. Epibenthic taxa included *Chama, Plicatula,* and oysters, and a variety of arcids. Nestlers included mytilids, *Cumingia, Pleiorytis*, and *Hiatella.* Montacutid and sportellid commensal species reflect a variety of host species; the occurrence of *Pythinella* suggests the presence of Sipunculid worms. Exceptional species include the rugate *Glycymeris americana abberans*, a form previously known only from older strata; a pair and single valve of *Macoma cookei* Gardner, previously known only from the holotype from Yorktown, Virginia, and a pair and single valves of *Spheniopsis,* a genus represented by minute species only once documented in the Western Atlantic. *Cardiomya* species shows the greatest abundance the authors have encountered in any Atlantic Coastal Plain fossil deposit. The scarcity of shallow sublittoral elements, and the relatively high incidence of *Cardiomya* suggest mid-shelf conditions.

Special Session – Biodiversity of Marine Mollusks

Systematics and Phylogenetics of the Family Streptacididae (Gastropoda: Heterostropha)

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The family Streptacididae is among the earliest families in the subclass Heterostropha, one of the most abundant and ubiquitous Recent molluscan subclasses. The family includes 64 well-described species and four genera, and is characterized by a heterostrophic protoconch, small size (0.4 to 14 mm), sinuous growth lines, and an anomphalous base. The genus *Streptacis* Meek, 1871, has a very elongate shell and a lack of spiral sculpture. The genus *Donaldina* Knight, 1933, has radial lirae and most species are less elongate than species of *Streptacis*. The genus *Laxella* Pan and Erwin, 2002, is 0.4 to 2 mm long, lacks spiral sculpture, and has disjunct teleoconch whorls. The genus *Jiangxispira* Pan, Erwin, and Nützel, 2003, is 0.9 to 1.6 mm long, lacks spiral sculpture, and has a fusiform shape. The three Paleozoic genera survived the Permo-Triassic extinction. *Streptacis* and *Donaldina* are known from the Mississippian of Australia, the Pennsylvanian of the United States, the Permian of the United States and China, and the Triassic of China. *Donaldina* is also known from the Mississippian and Triassic of Europe. *Laxella* is known from the Pennsylvanian of the United States and China and from the Permian and Triassic of China. *Jiangxispira* is known from the Triassic of China. Cladistic analyses identify the Streptacididae as a basal member of the superfamily Pyramidelloidea, and place *Streptacis* as paraphyletic to *Ebala*, *Jiangxispira*, and *Laxella*.

Contributed Session I – Marine Gastropods

Phylogenetics and Population Structure of Native and Introduced Apple Snails

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The native Florida apple snail, *Pomacea paludosa*, is an important component of food webs within the wetland marshes and rivers of Florida and has been designated a key indicator of the health of freshwater ecosystems. An understanding of the native apple snail's population structure may help in determining the historical structure of the Everglades, a key parameter for restoration models, and in addressing the threats that urbanization and the introduction of several non-native apple snail species have for the future of *P. paludosa* and the animals that rely upon it. We analyzed the population structure of the native apple snail based on mitochondrial DNA sequence data using phylogenetic and nested cladistic analyses. We sampled more than 75 individuals across the Florida peninsula for an approximately 2.5 kilobase contiguous region of the mitochondrial genome. We found well-supported geographically structured populations, with branch lengths and topologies indicative of recent range expansion over a large portion of the current range of the species. We also used DNA sequences to evaluate competing scenarios concerning the origins and biogeography of *P. paludosa*. Our results do not support either of the current hypotheses of native apple snail origins, and suggest instead phylogenetic propinquity to introduced apple snails. This suggests the potential for hybridization between native and introduced populations. We discuss the implications of these results.

Contributed Session IV – Freshwater Mollusks

Molluscs of Quarantine Concern: An Australian Perspective

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As global trade increases so does the risk of exotic species being transported both intentionally and accidentally around the world. There is a large number of animal species of quarantine concern including a number of mollusks such as the giant African snails (Achatinidae) and the applesnails (Ampullariidae). Similarly to the United States, Australia has a large number of established non-native, mainly freshwater and terrestrial species of mollusks (more than 50 species in both cases). Like what happens in the United States, many more species are intercepted on commodities entering Australia from all over the world — some of which are considered serious pests although not currently established in Australia. The steps taken by both countries to the problems of "traveling species" are essentially the same; the species of primary concern are in most cases similar but there are a number of differences, due to factors such as geographic position, trading partners, range of environments present, and the range of products being imported.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

2,400 Years of Malacology

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A new on-line resource under the auspices of the American Malacological Society provides a comprehensive catalog of biographical and bibliographical publications for an estimated 5,000 or more malacologists, conchologists, paleontologists, and others with an interest in mollusks, from Aristotle to the present. For each person, the birth/death years and nationality are given (when known), followed by bibliographic citations to the literature about that person, his/her collections, and publications. Appendices provide citations to (1) publications on expeditions, primarily before 1900, that resulted in the collection and description of mollusks; (2) general histories of malacological institutions and organizations, or of malacological programs at universities; and (3) the histories and dates of publication of malacological journals and journals that are frequently cited in malacological publications, such as those of the Zoological Society of London. Links are provided to Internet resources, such as online versions of rare early works.

Contributed Session III – Marine Mollusks

Intertidal Oyster Habitat Restoration: Scaling Up from "r" to "R", Evaluating "Success," and Using More Environmentally Friendly (BMP) Approaches

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Intertidal oyster habitats are critical to healthy estuaries in the southeastern United States. Because of this and the decline of oysters across much of the United States, restoration projects are increasing exponentially. In South Carolina, we have been expanding our restoration/enhancement research efforts at sites slated for shell planting. Our approach included mesh for stabilization, evaluating several shell types, and two planting depths. In 2002, more than 3000 m^2 (12000 bushels) were planted with whelk, local, or Gulf oyster shell at seven sites. Roughly half of the areas were covered with mesh to minimize shell loss due to boat traffic or wind waves. We also investigated the suitability of three "biodegradable" or "non-photo-stabilized" meshes, as alternatives to a "stabilized" mesh currently in use. One initial problem was that contractors had problems planting shell as required by our initial design. Shell depth changed significantly in the first three months after planting, with siltation and shell "subsidence" also significant problems. Interestingly, recruitment to planted shell was low relative to adjacent "substrate collectors," with mean densities ranging from 219–557/m^2 versus 500–7000 oysters/m^2 over a similar time frame. Under controlled conditions, the three non-stabilized meshes broke down under UV after only four months. In the field, however, meshes generally showed little, if any "exposure" damage, with damage in the field most attributable to wave/current action. Water/mud appear to also act as significant UV filters extending mesh life. In 2003, more than 8000 m^2 of shell (27000 bushels) were planted at eight sites. Monitoring and evaluation of the 2002–03 oyster restoration sites are continuing.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

Range Expansion of the Chinese and Japanese Mystery Snails of the Genus *Cipangopaludina* (Gastropoda: Viviparidae) Across North America

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The introduction of exotic species constitutes a serious threat to native aquatic biota. The Chinese and Japanese mystery snails, *Cipangopaludina chinensis* (Gray, 1834) and *Cipangopaludina japonica* (von Martens, 1861) (both recently placed in the genus *Bellamya*), are two Asian invasive freshwater snails spreading throughout North America. Both have been implicated in aquatic vegetation decline, competition with native species, and are hosts for certain helminth parasites. Sailors returning from Yokohama, Japan, introduced the Chinese mystery snail as a food item into San Francisco's Chinatown in the 1890s. By the turn of the century, the species was securely established in the West Coast and Hawaii. The first East Coast population was collected in Massachusetts from the Muddy River, Boston, in 1914. The species has since spread throughout all of New England and New York and into 37 United States states and four Canadian provinces. The Japanese mystery snail was introduced into an irrigation ditch in Hanford, California, in 1911, and later in Mountain Lake, San Francisco. The first East Coast population appeared in 1929 in the Boston Public Gardens. Other populations include Sandusky Bay (Lake Erie), Ohio; Lake Tiorati, New York; and in Connecticut. Literature and museum records exist for Florida, Idaho, Michigan, and Oklahoma. Recent introductions in Virginia, Nebraska, and South Carolina bring the total distribution to 12 United States states. These species were originally spread intentionally for human consumption, as food for fish aquaculture, and as biologic control for mosquito larvae (also accidentally with goldfish for the same purpose). Current populations are spread through the aquarium trade or on ornamental aquatic plants. The current status in North America is presented.

Poster Session

Nitrate Impacts on Florida Apple Snail (*Pomacea paludosa*) Survival and Growth

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Nitrate pollution in first magnitude springs in Florida has been suggested as a possible reason for declining Florida apple snail (*Pomacea paludosa*) populations. Based on other nitrate toxicity studies, we hypothesized that survival and growth would not be affected at nitrate concentrations typically seen in springs (0–25 ppm nitrate). Laboratory studies were performed to examine nitrate impacts on snail survival and growth. Field data were used to determine if there was a correlation between spring snail density and spring nitrate concentration. Adult and juvenile LC_{50}s could not be determined based on the low mortality rates. Juvenile EC_{50} values were determined to be 587.35 and 617.65 ppm nitrate, for two trials, respectively. No correlation was found between snail density and spring nitrate concentration. Elevated nitrate concentrations do not seem to affect apple snail survival in the laboratory. We suggest that other factors, including habitat structure and invasion of exotic plants, help determine the distribution of Florida apple snails.

Contributed Session IV – Freshwater Mollusks

Invasive Apple Snails (Ampullariidae) in Hawaii and Southeast Asia

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Apple snails (Ampullariidae) were first introduced to Southeast Asia around 1980, initially probably from Argentina to Taiwan. The species introduced is usually referred to as *Pomacea canaliculata*. The purpose of the introduction was to develop aquaculture of the snails both for local consumption and as gourmet export items. Since 1980 and for the same purposes, apple snails have been introduced to most countries in Southeast Asia. However, they were not eagerly consumed locally and the export market did not develop. The number of introductions to Southeast Asia is unknown, but there have been suggestions that more than one *Pomacea* species have been introduced. Molecular genetic research is addressing this possibility. Four Ampullariidae species have been recorded from Hawaii, as follows. A South American species, *Pomacea bridgesii*, was first recorded in 1962 and is now locally established; *P. paludosa*, native to the southeastern USA and first recorded in 1990, may not be established; both were probably introduced via the aquarium trade. *Pomacea canaliculata*, first recorded in 1990, has spread rapidly throughout the islands. *Pila conica*, from Southeast Asia, was first recorded in 1966 but remains only locally distributed. In Southeast Asia, *Pomacea canaliculata* (and perhaps other species), has become established in the wild and is now the top pest of wetland rice. In Hawaii, this species is a major pest of wetland taro. Control measures have been implemented, but with little success. Other areas in southern Asia, as well as Australia, are not yet infested but are at great risk.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Predicting Potential Distributions of Invasive Land Snails Using an Ecological Niche Modeling Program, GARP

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I will use GARP (Genetic Algorithm for Rule-Set Prediction) to predict the potential distribution of two invasive snails, the giant African land snail, *Achatina fulica,* and the rosy wolf snail, *Euglandina rosea.* GARP models a species ecological niche based upon known occurrence data and environmental data coverages. The ecological niche can be projected onto a map to show where a species is expected to occur. The GARP model is a set of algorithms that operate in an iterative artificial-intelligence-based framework. The results can be used to predict a species distribution in both its native range and in introduced areas. The potential distribution of the giant African snail, *A. fulica,* will be predicted for the United States and the rest of the world. *Achatina fulica* is not currently established in the United States and can be an invasive agricultural pest. The models will be created using localities from the native East African range of *A. fulica*. *Euglandina rosea*, the rosy wolf snail, is a predatory snail that was introduced as a biocontrol agent for *A. fulica* in Hawaii and other locations outside the continental United States. As a biocontrol agent *E. rosea* was commonly found to attack non-target species. The potential worldwide distribution of *E. rosea* will be predicted based upon its distribution in the continental United States. These models will identify which geographical areas are currently most at risk for invasion.

Contributed Session II – Terrestrial Gastropods

Distribution of the Family Conidae in Shallow and Deep Waters Off the Yucatan Peninsula, Mexico

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There are approximately 500 species of predatory cone snails within the genus *Conus* and they constitute what is the largest single genus of marine gastropods. Cone snails envenomate their prey with a complex mixture of neuropharmacologically active compounds that have been the subject of intense investigation as pharmacological tools. Although not nearly as diverse as in the Indo-Pacific region, the marine waters of Mexico harbor as many as 40 species of *Conus.* We have initiated a careful evaluation of their distribution and ease of collection. Using SCUBA and biological dredging of the waters off the Yucatan Peninsula, we have collected common species such as *C. spurius* and *C. delessertii,* as well as the less-common *C. mazei*, *C. sennottorum*, *C. stimpsoni*, *C. villepinii*, *C. austini,* and *C. granulatus.* In all, we can account for most of the *Conus* species previously reported for this area of Mexico and biochemical work with them is in progress. Supported by CONACYT-41477Q, PAPIIT IN224503 and Ciencia Básica SEP-CONACyT 2002 Code 40158.

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Contributed Session I – Marine Gastropods

Queen Conch (*Strombus gigas*) as an Indicator of Nearshore Environmental Degradation in the Florida Keys: Implications for Continued Coastal Development

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The queen conch, *Strombus gigas*, population in the Florida Keys once supported commercial and recreational fisheries. Despite a ban on harvest since 1985, the conch population has been slow to recover. Our observations in the laboratory and field suggest that the prolonged recovery may be attributed, in part, to limited recruitment and declining environmental conditions from anthropogenic impacts. At our experimental hatchery we demonstrated that water quality has a direct effect on larval conch; growth rates more than doubled and densities were increased by a factor of 20 after incoming water was ozonated to remove dissolved organic chemicals, heavy metals, and pesticides. We also found that the pesticides used for mosquito eradication in the Keys had a significant toxicological effect on embryos and larvae. Furthermore, our field studies have shown that most adult conch located in nearshore habitats are physiologically incapable of spawning due to gonadal deficits, although reproduction does occur offshore. However, the gonadal condition of nearshore conch translocated to offshore breeding aggregations improved, and these animals began spawning after six months offshore. This suggests that some component of the nearshore environment disrupts reproduction in conch. There are a variety of compounds introduced into the environment that have the potential to be endocrine disruptors. We plan on using enzyme linked immunosorbent assays (ELISAs) to determine what chemical(s) is(are) negatively impacting reproductive development in nearshore conch. Our results, coupled with the long history of inadequate sewage treatment, mosquito pesticide application, and other sources of anthropogenic discharges in the Florida Keys provides compelling evidence for a link between coastal development and decreased reproductive output in conch.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

**Biodiversity of Hawaiian Marine Mollusks:
the Perspective of a Nondispersing Species**

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The Hawaiian archipelago is one of the most isolated tropical island archipelagos in the world, with about 32% endemic marine species based on faunal lists. However, the genetic structure of Hawaiian marine species is almost entirely undocumented. The shallow-water marine fauna of the Hawaiian Islands is often considered to be undifferentiated, though the island chain is 1600 miles long, with permanent, deep channels between many islands. The objective of the present study is to investigate population structure and insular phylogeography in a benthic marine gastropod species lacking a pelagic larval stage, to examine how much differentiation is present in a species with little or no dispersal ability. Sequences from the mitochondrial cytochrome oxidase c subunit I (COI) gene were obtained from specimens of *Peristernia chlorostoma,* a small nearshore fasciolariid gastropod found in intertidal and high subtidal rocky habitats. The results of this study suggest that populations of this species from different islands are highly differentiated, with genetic distances between populations roughly correlated with geographic distance. This implies that marine diversity and endemism in the Hawaiian Islands, and other island archipelagos, is likely to be higher than is typically indicated by faunal listings alone.

Special Session – Biodiversity of Marine Mollusks

Extensive Mitochondrial CO1 Sequence Diversity in a Population of the Freshwater Snail, *Physa*: Admixture or Cryptic Speciation?

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By virtue of its behavioral plasticity, ease of culture, and cosmopolitan distribution, the pulmonate snail *Physa* has become a model organism for the study of reproductive biology. Wethington and colleagues (in review) have recently reported the discovery of two strikingly divergent haplotypes in a sample of *Physa* from a single pond in Charleston, South Carolina, differing in mitochondrial cytochrome c oxidase subunit I (COI) gene sequence at 24–27% of nucleotide bases. We established isofemale lines from a random sample of 22 Charleston snails, then isolated DNA and applied PCR and cycle sequencing techniques to determine an approximately 650 bp fragment of the CO1 gene. Breeding studies are planned to determine whether the haplotype diversity observed by Wethington is attributable to admixture of two conspecific populations, or whether a pair of cryptic species may be coexisting in this single pond.

Poster Session

Effect of Injury on Survivorship of *Mercenaria mercenaria*

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Unsuccessful attacks by predators that damage the edge of a bivalve shell are thought to increase susceptibility to other causes of death, especially other predators. To test this hypothesis, I conducted a field experiment with artificially damaged and undamaged individuals of the hardclam *Mercenaria mercenaria*. Ten $1m^2$ replicate plots (five damaged and five undamaged), each containing ten *Mercenaria* (55–65 mm shell length), were scattered randomly, independently within and between treatments, across an intertidal flat near Masonboro Island, North Carolina. Deaths within plots, mainly from naturally foraging whelk predators, were noted every two weeks during a three-month period. Survivorship analysis of recovered animals indicates that early survival patterns are significantly ($p<0.001$) different between the two treatments, with injured *Mercenaria* having a lower probability of surviving than undamaged individuals. Within the first two weeks survivorship declined to only 64% for damaged *Mercenaria*, while 92% of undamaged individuals were still alive. The probability of survival afterward, however, was not different between treatments. A few experimentally damaged individuals that were killed by whelk predators late in the study period or were still alive at the time of censoring had begun to repair, or had completely repaired, their injury. A low capacity to isolate injured or exposed soft tissues from the outside world likely explains the initial steep decline in survival probability for damaged individuals.

Poster Session

Population Genetic Survey of the Pleurocerid Genus *Lithasia* in the Duck River of Central Tennessee

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Three species of *Lithasia* have traditionally been recognized in the Duck River: *L. duttoniana*, *L. jayana*, and *L. geniculata* (with subspecies *fuliginosa*, *pinguis*, and *geniculata* sensu stricto). Recently, Minton and Lydeard have synonymized this entire group under *L. fuliginosa* on the basis of 19 mitochondrial CO1 sequence data, simultaneously suggesting that a previously unrecognized *Lithasia* species may inhabit the adjacent Buffalo River. We sampled more than 30 individuals from each of the nominal *Lithasia* taxa present at six sites down the length of the Duck River, as well as from the Buffalo River, and examined allozyme variation using horizontal starch gel electrophoresis. We uncovered no genetic variation at 13 of the 16 enzyme loci resolved. But analysis of gene frequencies at three polymorphic enzyme loci, Mpi, Odh, and Hexdh, unambiguously confirmed reproductive isolation between sympatric populations of *L. duttoniana* and *L. geniculata*. Putative *Lithasia jayana* populations were not detectably different from *L. duttoniana*, nor did the *Lithasia* population of the Buffalo River differ from typical Duck River *geniculata*. We suggest that two biological species inhabit the study region, *duttoniana* and *geniculata*, the latter with zonal genetic differentiation that rises to subspecific level.

Contributed Session IV – Freshwater Mollusks

Karyotype and "G" Band Analysis of *Pomacea patula catemacensis* (Baker, 1922) from Catemaco Lagoon, Veracruz, México

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The mitotic chromosomes from gill tissue of 60 specimens of the freshwater snails *Pomacea patula catemacensis* were analyzed through the special "G" band technique. The diploid number of chromosomes in this species is 2n=26, the base number 0 x=13, and the fundamental number FN=52. Its karyotype is constituted by nine metacentric and four submetacentric pairs and characteristic "G" bands. No sex chromosomes were found. According to the form and architecture of chromosomes, this species shows homogeneous chromosomes regarding the relative longitude and centromeric index. The value of chromosome numbers used as a character for phylogenetic systematics in the *Pomacea* genus is discussed.

Contributed Session IV – Freshwater Mollusks

No Evidence of "Sperm Sharing" in the Freshwater Pulmonate *Physa acuta*

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Monteiro and colleagues (1984) described the phenomenon of "sperm sharing" in stocks of *Biomphalaria* marked with the recessive gene for albinism. Here we report an attempt to replicate these results using albino and pigmented lines of *Physa acuta*. A total of 18 sets of three snails were mated serially, P-A1-A2; the embryos of snail A2 were collected and examined for pigmented progeny weekly for 70 days. Although no evidence of sperm sharing was obtained, all A1 snails bore albino progeny at frequencies ranging from 3.3% to 13.4%, providing additional evidence of mixed mating or multiple insemination in this primarily outcrossing hermaphrodite.

Poster Session

Biology, Ecology, and Physiology of the Non-Indigenous Asian Green Mussel, *Perna viridis* (Mytilidae), in the Southeastern United States

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The first report of *Perna viridis* in North America came from Tampa Bay in 1999, when specimens were found clogging the intake pipes of a power plant. Since that time the mussels have spread south along the west coast of Florida and established new populations along the northeast coast of Florida and into Georgia. *Perna viridis* reaches high densities and large size in a short period of time while out-competing native fouling organisms on most artificial substrates. Tolerance studies have demonstrated the ability of *P. viridis* to withstand almost the full range of Florida's coastal habitats with regard to temperature and salinity. Additionally, native *Crassostrea virginica* reefs seem to be negatively affected by *P. viridis* settlement. The mussel's high ammonia output may provide enough nutrients to Tampa Bay waters in such a way that phytoplankton communities may experience no net loss from the increased grazing. High densities combined with high clearance rates may lead to an increase in benthic sediment around artificial substrate. Pilings, buoys, bridges, piers, jetties, and bottom debris appear to first recruit *P. viridis* to an area. Evidence of recreational harvest in some areas has been noted.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

The Slug *Veronicella sloanei* (Cuvier, 1817) — an Important Pest in the Caribbean

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Veronicella sloanei (Cuvier, 1817) is believed to be native to Jamaica, but has spread to a number of the Greater and Lesser Antilles, as well as Bermuda. We have documented its presence in Grand Cayman, the Dominican Republic, Barbados, Dominica, and St. Lucia, and it has been introduced recently into St. Vincent. It is the largest of the veronicellid slug species found in the eastern Caribbean, reaching an extended length of 12 cm. The colour of the notum is highly variable and can be a pale cream, brown, or grey with varying degrees of mottling. *Veronicella sloanei* is an aggressive, phytophagous, opportunistic pest and will attack a wide range of horticultural and agricultural crops including varieties of *Hibiscus*, *Bougainvillea,* leafy vegetable crops such as cabbage, spinach and lettuce, papaya, citrus, bean (*Phaseolus*), and peanut. In addition to leaf damage, this slug can "debark" sections of stem of plants such as *Datura* and gardenia, and will attack the corms and cormels of tannia, dasheen, banana, and plantain. Control methods used in the islands include the use of table salt, tobacco dust, Vydate®, methaldehyde powder, and Sluggit® in liquid or pellet form.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

A Cladistic Reevaluation of the *Strombina* Group (Buccinoidea: Columbellidae) Jung, 1989

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The *Strombina* group has been used as a model system to document patterns of geographic and temporal changes in species composition, evolution at species level, and adaptive trends related to the closure of the Panamanian gateway. They were also used to evaluate the contribution that factors such as environmental conditions versus predation may have in shaping life histories. Part of the gastropod family Columbellidae, the *Strombina* group has more than 100 fossil and living species classified in five genera (*Strombina*, *Cotonopsis*, *Clavistrombina*, *Sincola*, *Bifurcium*) proposed in 1989 by P. Jung after an extensive revision. Nevertheless, the group never received a formal taxonomic assignment and the relations of these genera to other columbellids and to each other is poorly known. Cladistic analyses based on 69 (205 states) characters, including shell and radular morphology, as well as gross anatomy of the alimentary and reproductive tracts, were used to reconstruct the phylogenetic relationships of these taxa and evaluate their monophyly. Thirty-six most parsimonious trees were obtained and the majority consensus tree supports the monophyly of the whole *Strombina* group. Of the five taxa analyzed, only *Strombina* does not keep its traditional constituency and results paraphylectic. The results seem to agree with some patterns of evolution seen in tropical mollusks such as the heightened extinction rates in the Caribbean during the closure of the Panamanian seaway followed by a pulse of origination in the eastern Pacific.

Symposium – Relationships of the Neogastropoda

Bradybaena similaris (Rang, 1831): A Potentially Serious Pest for *Citrus* Crops

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The Asian tramp snail, *Bradybaena similaris* (Rang, 1831), originated probably in eastern Asia, but has spread throughout the tropics and subtropics worldwide. In the United States, it is established in the Hawaiian Islands, Puerto Rico, and several southern states, including Florida, Mississippi, Alabama, Louisiana, and Texas. Although it has long been known as a pest of coffee, it is also reported as a serious pest of grape (*Vitis*) and a wide variety of tropical fruits, especially longan (*Dimocarpus longan*) and mango (*Mangifera indica*) in Taiwan, as well as *Citrus* in Louisiana. In Puerto Rico, the Asian tramp snail is now reported as causing feeding damage to three economically important citrus crops, *Citrus medica*, *C. paradise,* and *C. sinensis*. Further research is required to determine whether this snail represents a potentially serious threat to the citrus industry in the United States.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Distribution and Control of the Giant African Snail (*Achatina fulica*) in Barbados

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The giant African snail *Achatina fulica* Bowdich (Pulmonata: Achatinidae) was first found in Barbados in September 2000, near the Bridgetown Port. To date it has only been recorded feeding on wild plants of no economic importance. It has spread to four of the 11 parishes of the island and attempts to control it focus mainly on the use of the molluscide metaldehyde. Successes and problems encountered with its control, a public awareness campaign for this pest, and its potential threat to the agricultural and public health sectors are discussed.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Biogeographic Distribution of Developmental Types in Opisthobranch Mollusks Across the Isthmus of Panama

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The developmental pattern of invertebrates is a significant component of life history, influencing population distribution, recruitment, genetic variation, and extinction. Existing data suggest that in opisthobranch gastropods, planktonic development dominates in the eastern Pacific and aplanktonic development dominates in the western Atlantic. This dichotomy could result from differing environmental parameters, phylogenetic relationships, or sampling bias. This hypothesis was tested through collections of five major groups of opisthobranchs from the Pacific and Atlantic coasts of Panama. Specimens and their egg masses deposited in the field laboratory provided data for determining developmental mode and comparing proportions of developmental types between Atlantic and Pacific faunas. Of the 67 species that spawned in the laboratory, all 39 Pacific species (100%) and 23 of 28 (82%) Atlantic species released planktonic larvae in the laboratory or were inferred as such using other factors. Mean egg size was larger for Atlantic than Pacific species. Analysis of developmental types indicates that even though the Panamanian opisthobranch fauna was predominately planktonic on both coasts, there was a significant relationship between ocean and developmental type. The occurrence of both larger eggs and aplanktonic development in the Atlantic supports the dichotomous theory of development for opisthobranchs of Panama. The occurrence of aplanktonic development on the Atlantic coast could be related to substratum and low primary productivity. The Pacific coast of Panama experiences higher primary productivity levels, and presumably can more reliably support planktonic larval feeding.

Contributed Session I – Marine Gastropods

Mollusk Shells as Habitat for Anthozoans and Hermit Crabs in the Colombian Caribbean and Pacific Continental Shelves and Slopes

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Some mollusk species worldwide are known as habitats for several invertebrate species, such as sea anemones, stony corals, sipunculans, and hermit crabs. Most of these associations have been described from shallow water environments. However, in extensive continental shelf and slope sedimentary plains these associations are not well documented. During an extensive biodiversity survey carried out by INVEMAR in both Pacific and Caribbean Colombian continental shelves and slopes (20–500 m depth) several associations of mollusks + sea anemones, mollusks + stony corals, and hermit crabs + empty mollusk shells + sea anemones were documented. In the Pacific, more than 90% of the live-collected specimens of *Nassarius miser* alive were associated with the sea anemone *Hormathia* sp. The muricid *Pteropurpura centrifuga* was associated with the transisthmian azooxanthellate scleractinian *Tetocytahus prahli*. It is noteworthy that *T. prahli* specimens found in the Caribbean were associated with another muricid species, *Siratus beauii*. Additionally, the gastropod *Polystira* sp. was found associated with the azooxanthellate scleractinian *Heterocyathus* sp.; this coral genus was previously recorded only from the Western Pacific. While in the Pacific most of the mollusk-sea anemone individual associations were collected alive, in the Caribbean the sea anemone *Monactis vestita* was found attached to empty shells of gastropods and scaphopods; these in turn were often inhabited by hermit crabs of the genus *Pagurus*. These results are new evidence of interesting ecological relationships displayed by mollusks, which represent a hard microhabitat that makes possible the presence of some species of azooxanthellate corals, sea anemones, and hermit crabs on soft bottoms of the shelf and upper slope.

Poster Session

Mollusks Associated with Deep-Water Coral Habitats in the Southern Caribbean Sea: Preliminary Observations

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During marine biodiversity surveys carried out by INVEMAR between 1998 and 2002 in the Colombian continental shelf and margin, three azooxanthellate coral banks were discovered. The corals *Madracis myriaster* and *Cladocora debilis* were the main builders of the bank matrix. These formations were located off La Guajira (70 m depth), off Santa Marta (200 m) and off San Bernardo Islands (150 m). The sampled fauna was composed mainly of hard bottom dwellers; the main groups found were anthozoans, mollusks, echinoderms, sponges, and other sessile invertebrates. Mollusca was the richest group (125 species), followed by echinoderms (75 species), crustaceans (68 species), cnidarians (62 species), and fishes (47 species). Among the mollusks collected, 85 species were gastropods, 35 bivalves, three cephalopods, and two scaphopods. La Guajira was the most mollusk-rich coral bank formation with 85 species; *Arca zebra, Chlamys munda*, *Pecten chazaliei*, *Diodora cayennensis, Vermicularia spirata,* and *Petaloconchus erectus* were the most abundant species in that bank. At Santa Marta, 13 species were found; *Coralliophila squamosa, C. caribaea, Babelomurex dalli, Pseudosimnia vanhyningi, Sthenorytis pernobilis,* and *Limaria* sp. were typical dwellers of those coralline and other hard substrates. At San Bernardo, 35 species were found; including *Calliostoma* sp.*, Eudolium crosseanum, C. caribaea, Barbatia candida*, but in low abundances. There is published evidence of the ecological interactions between some of the collected mollusks and zooxanthellate coral colonies. Nevertheless, associations among mollusks and azooxanthellate corals in the southern Caribbean were not previously reported and they are far from being understood; future studies will provide new knowledge about the ecology of these particular ecosystems.

Poster Session

Measuring and Modeling Seston Uptake by Restored Oyster Reefs

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A typical goal of oyster restoration projects is to enhance water quality because of increased water filtration rates by the oysters. However, the literature on the topic indicates that this is not always the case. There is a need to develop practical methods for predicting the impacts of restored molluscan shellfish populations on water quality. We developed a simplified, spreadsheet-based model to predict the percent of the total water column cleared of seston by suspension-feeding bivalve mollusks:

$$\% \text{ Water Clearance} = (A \times B \times C)/(D \times E) \times 100$$

where A = mean bivalve density (# ind/m^2), B = mean individual clearance rate (m^3/individual/hr), C = bottom area of reef (m^2), D = cross-sectional area of water column (m^2), and E = mean water flow speed (m/hr). The variables typically can be easily measured (or estimated), except mean clearance rate, which is based on literature values. The major simplifying assumption is a completely mixed water column. Field tests over oyster reefs, mussel reefs, and hard clam aquaculture beds thus far indicate reasonably good agreement with model predictions when the major assumptions are met.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

Slugs as Pests of Agricultural Crops

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Slugs are known to cause severe injury to field crops on many continents, including Europe, Australia, and North and South America. The problem is an increasing concern when conservation tillage practices, those that leave previous crop residue on the soil surface, are used. Slugs have become a major impediment to the continued adoption and acceptance of these practices in the United States, most notably in the eastern Corn Belt and eastern states. The major slug species damaging to field crops is *Deroceras reticulatum*, more commonly known as the gray garden slug. This slug can cause significant injury to most crops, including corn, soybean, legume and grass forages, and cotton. *Deroceras reticulatum* usually has a single generation per year, with newly hatched juveniles causing injury in the spring, and full-grown adults more damaging in late summer or fall plantings. Management for slugs includes sampling for the presence of adult slugs in the fall and eggs in the spring, and taking preventive measures involving various cultural tactics. When injury becomes severe, the grower must take curative action, which usually is the application of molluscicide bait. Most bait currently in use in the United States contains metaldehyde. Future tactics being examined include the use of pathogenic nematodes and alternative baits.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Origin and Early Evolutionary History of the Neogastropoda: Evidence from Nuclear and Mitochondrial DNA Sequences

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The Neogastropoda comprise a diverse and extremely successful group of predatory marine gastropods that appear abruptly in the fossil record during the Albian (100 mya) with nearly all of families present in essentially modern form by the end of the Cretaceous. While neogastropods are easily recognized by their distinctive shell morphology, radular morphology, and anatomical features, their relationships to other gastropods are poorly understood. Hypotheses of origins have included "archeogastropod" or lower caenogastropod ancestors, and enigmatic fossil groups such as the Subulinidae. Other authors have proposed various higher caenogastropod groups including Littorinimorpha, Cypraeoidea, Tonnoidea, and Ficoidea as sister taxa. Relationships among the many lineages within Neogastropoda have also been difficult to discern because of high rates of homoplasy and high incidence of highly derived, autapomorphic features. It has been speculated that Neogastropoda have arisen by polyploidy, as they have twice the chromosomes and twice the DNA per cell of most caenogastropods. Thus, it may be possible that the homoplasies that have confounded resolution of phylogenetic relationships are the products of differences in expression of paralogous or orthologous nuclear genes. Phylogenies based on DNA sequences from nuclear as well as mitochondrial genes are compared, and the various genes and genomes evaluated for their utility in resolving the origin and early evolutionary history of the Neogastropoda.

Symposium – Relationships of the Neogastropoda

Exotic Mollusks Intercepted or Established in California and Their Impact Upon California Agriculture

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Intercepted and introduced exotic mollusks in the state of California are briefly discussed. These include both terrestrial and freshwater genera. The economic and environmental issues for some species are mentioned. The most economically significant, established species is the brown garden snail, *Cryptomphalus aspersa*. Molluscicide usages for production of citrus and in the nursery industries are given. State and local governmental programs for detection and identification of introductions are briefly discussed.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

2003 Follow-Up of a 2002 Unionid Translocation, Mississippi River Mile 818.9, Cottage Grove, Minnesota

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In May 2003 we conducted the follow-up of a 2002 unionid translocation. The 52258 m^2 project area extended from the Left Descending Bank to the Mississippi River main channel. The translocation, done prior to burial of a wastewater pipe, yielded a density of 0.38/m^2 (23 living species, 19630 unionids); 7.33% represented two Minnesota endangered and five Minnesota threatened species. In 2003, 609 live unionids (18 species) were recovered; 515 were numbered or hash-marked; 53.9% were Minnesota endangered species (most measured and aged). Of 232 individuals of *Quadrula nodulata,* 98.3% survived; 98.7% of *Arcidens confragosus* survived. One each of *Tritogonia verrucosa, Obovaria olivaria*, and *Ligumia recta* were recovered alive. The survival of all Minnesota special status unionids was 98.36%, most of which were recovered from an area <1 meter deep. Most numbers on T & E unionids were legible. A total of 12.6% of the numbered unionids had disturbance rings, as evidenced by uneven periodicity of rest rings; 3% of the numbered unionids showed little or no growth. Five additional species were represented by sub-fossil shells. The substratum was mostly mud with woody debris. Immediately upstream of Site 1, the substratum became sandy; no numbered unionids moved into that area. Slightly more *Dreissena* were found in 2003, with one to several on a unionid. Three PVC pipes marking the area remained in place in 2003; therefore construction impacts were unlikely to have extended past the project area. Translocation was successful with 97.2% survival of all marked unionids after one year, in both deep and shallow habitats.

Contributed Session IV – Freshwater Mollusks

Morphological Variation in *Elimia comalensis* from the Edwards Plateau

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Elimia comalensis (Pilsbry, 1890) (Gastropoda: Pleuroceridae) occurs in springs and spring-fed systems on and along the Edwards Plateau in Texas. The species represents the southwestern-most distribution of the genus, and is disjunct from the geographically nearest species by hundreds of miles. As part of a project examining the ecology and systematics of *E. comalensis*, we studied morphological variation in the species across its range. We identified and digitized ten shell landmarks in four populations from the plateau proper (Leakey Creek and Guadalupe River) and the Balcones Fault (eastern edge of the plateau; Comal River and Del Rio springs). Geometric morphometric analysis on Procrustes distances indicated that while the plateau populations did not differ significantly (Goodall's F-test, $p>0.6$) from each other, they did differ significantly from the Comal and Del Rio populations ($p<0.001$). The Comal and Del Rio populations also differed significantly ($p<0.05$). Our data suggest that *E. comalensis* is comprised of three distinct morphological groups. Future research employing ecological and DNA sequence data will test whether these morphotypes represent distinct evolutionary units.

Poster Session

Systematics, Phylogeography, and Evolution of Apple Snails, *Pomacea* spp.

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The freshwater apple snail genus *Pomacea* (Ampullariidae) has a native range covering most of South and Central America and the southeastern United States. Species of *Pomacea* have been introduced widely in southern and eastern Asia, Hawaii and other Pacific islands, and in the mainland United States. In their introduced ranges they have become major pests of wetland crops, notably rice and to a lesser extent taro. The taxonomy of *Pomacea*, including the identity and precise geographic origins of the pest species, is poorly understood. This lack of understanding has implications for research on many aspects of ampullariid biology, including development of effective pest management programs. Ampullariids are a major component of freshwater diversity throughout the tropics and subtropics. *Pomacea*, with 117 recognized species, is the largest genus. Species of *Pomacea* are therefore important from various perspectives, including ecosystem and human health (as vectors of human parasites). They also offer a valuable model for investigating Neotropical biogeography. As part of a systematic revision of the genus *Pomacea*, DNA sequence data are being used to develop a phylogenetic basis for hypotheses of the evolution of Neotropical freshwater biodiversity. So far, 56 individuals of five putative *Pomacea* species have been analyzed. Snails from Hawaii, numerous locations in southeastern Asia, and Argentina cluster together and are probably *Pomacea canaliculata*. Snails from introduced populations in Sri Lanka and Australia are *Pomacea bridgesii*. Snails intercepted by quarantine in Hawaii cluster with specimens from Venezuela and Thailand and are probably *Pomacea lineata*, a species native to northern South America.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Insights on Neogastropod Phylogeny from Ontogenetic Records of Shell and Radular Characters: A Case Study Using the Muricidae

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The Cenozoic radiation of the neogastropod family Muricidae resulted in extraordinary morphological diversity. Significant components of muricid morphology, however, remain too superficially defined by traditional descriptive methods to begin documenting this radiation using cladistic tools. Spiral cords on the body whorl and cusps on the rachidian tooth, for example, are often counted without being precisely identified. Major morphological transformations between early and late ontogenetic stages are also rarely considered in character construction. Our study examines muricid morphology more closely by investigating structural homologies of the shells and radulae using ontogenetic data. Cord homologies on the adult whorls are identified by tracing cords to their origin at the protoconch-teleoconch transition, where cord morphology and position are presumably at their most evolutionarily conservative and primitive states. Even muricids that differ greatly in cord number and morphology as adults often have similar, if not identical, cord arrangements as early post-larvae. Ontogenetic analyses of radulae for representatives of six muricid subfamilies show a similar pattern. Species that are now assigned to different subfamilies based on radular features of adults are shown to have similar rachidian teeth as early post-larvae. Characters constructed using ontogeny are then tested by a cladistic analysis. Tree topologies are highly congruent with independent cladistic analyses based on anatomical and molecular data. This implies that morphological characters previously assumed to be unreliable may carry substantial phylogenetic signal when described from an ontogenetic perspective. This method may have bearing on studies of early fossil neogastropods, where only shell morphology is available.

Symposium – Relationships of the Neogastropoda

Molluscan Diversity and Function in Seagrass Ecosystems

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Seagrasses are remarkable in their ability to form dense meadows of high standing crop and productivity in shallow marine environments in both tropical and temperate settings throughout the world. Marine angiosperms originated during the Cretaceous Period and had achieved broad geographic distribution in shallow marine environments by the Eocene Epoch. Because the plants are seldom preserved in the fossil record, inference of the ecosystem is based primarily on the mineralized skeletons of associated invertebrate indicator taxa. Mollusks are among the most abundant invertebrates in modern grass beds, living within the rhizosphere (*e.g.* lucinid and solemyid bivalves) as well as on blades and in leaf axils (*e.g.* trochoidean gastropods, chitons, and patelloidean gastropods). Although very few molluscan species occur exclusively on marine angiosperms, their density in grass beds, coupled with distinctive structural and anatomical traits, suggests an evolutionary response to the physical, chemical, and biological peculiarities of these ecosystems. Infaunal bivalves have exploited reduced sulfur as an energy substrate via endosymbiotic bacteria in their gills, while epifaunal gastropods and chitons have altered their geometry relative to blade morphology and hydrodynamic parameters. Life history traits of seagrass mollusks and the flow regimes in these systems act in concert to prevent dispersal away from grass beds as well as to promote settlement and metamorphosis of molluscan larvae from outside the bed.

Contributed Session III – Marine Mollusks

Threats to Agriculture from Exotic Terrestrial Stylommatophora and Early Detection Strategies

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Many species of terrestrial snails and slugs (Stylommatophora) are spread globally through human activity, and cause economic impact on agriculture. Exotic helicid and hygromiid snails such as *Theba pisana* (Müller), *Cernuella virgata* (da Costa), and *Cochlicella barbara* (Linnaeus) are pests on small grain and seedling production. The brown garden snail, *Cryptomphalus asperses* (Müller) (=*Helix aspersa*) is a recognized pest of tree fruit orchards and vineyards, downgrading the quality of fruit through feeding damage and the transmission of plant pathogens. Giant African land snails (Achatinidae) cause damage to many crops. These species and others are frequently intercepted at United States ports of entry, and in some cases have established populations in North America. Through the Cooperative Agricultural Pest Surveys (CAPS), the USDA Animal and Plant Health Inspection Service (APHIS) works cooperatively with federal, state and local authorities to detect and identify, eradicate or manage new introductions of high-risk invasive species. The APHIS Safeguarding, Intervention and Trade Compliance program (SITC) has recently discovered *Achatina fulica* Bowdich in retail pet stores, and at least one breeding operation in the United States. Populations of *A. fulica* in Hawaii and in the Caribbean Islands also pose a significant threat to the United States mainland. The APHIS Mollusk Working Group is currently developing guidelines to aid in early detection and eradication of introduced achatinid snail populations in the U.S. and neighboring territories.

http://www.aphis.usda.gov/ppq/ep/gas.html

Poster Session

Chemical Alternatives to Metaldehyde and Methiocarb: Current Status and Prospects

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Slugs and snails are important pests of agriculture, yet few toxicants are available for their control. Most chemical treatments applied against slugs and snails use metaldehyde or methiocarb as the active ingredient. Despite the usefulness of these toxicants, there are many situations in which products containing these chemicals are inappropriate, ineffective or unavailable. Inexpensive, safe chemical alternatives that can be used in food baits or applied to foliage are needed. A bait product marketed as "Sluggo®" contains 1% iron phosphate and appears to be a viable substitute for metaldehyde baits under certain circumstances. Although this product has no adverse environmental effects, its higher cost and lower efficacy may limit its use to homeowners and organic growers. Copper sulfate has been used in solution to control aquatic snails, and as an ingredient in latex paint to repel slugs and snails and to prevent them from gaining access to the canopy of tree crops. Many other alternative mollusk controls are derived from plants, including the toxicants uscharin (from the latex of an Egyptian desert plant), vulgarone-B (an extract of mugwort), and caffeine (extracted from coffee or tea). Repellents such as myrrh, neem, and yucca are effective but expensive and must be reapplied frequently. Major obstacles to the use of alternative chemicals include the costs of the active ingredient, development of effective formulations, and registration requirements.

A Preliminary Basommatophoran Phylogeny Based on the Nuclear Ribosomal LSU Gene

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In order to test the monophyly and determine the sister family-group of Physidae, a member of the pulmonate order Basommatophora, a molecular study of this order was undertaken. Most studies to date have focused on particular families within the order (e.g. Physidae and Planorbidae) using short fragments of mitochondrial genes with limited success. To examine the relationships of Basommatophora we investigated the utility of the nuclear ribosomal LSU gene. We present a preliminary phylogeny based on a 3000 bp portion of the LSU gene.

Poster Session

Current Status of Channeled Applesnail (*Pomacea canaliculata*) in Texas

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South American applesnails, considered to be *Pomacea canaliculata*, were discovered in a rice irrigation canal in southeastern Texas in 2000. Because this site was centrally located in the Texas rice belt, concerns arose at both the state and federal level. Since that time, the species has been documented in five counties in the Houston-Galveston area, as well as in one pond in northern Texas near Fort Worth. In late 2003, particularly large population increases were noted in eastern Galveston and southern Waller counties. Because of potential economic and ecological threats this snail poses, in 2001, Texas Parks and Wildlife Department moved to legally prohibit *P. canaliculata* as a harmful exotic shellfish. However, despite legal restrictions, this species continues to regularly appear in the aquarium trade in Texas. Although both adults and juveniles have been found in area rice fields, no significant crop damage has been reported to date. Presumably local rice farming methods, water level manipulations, and pesticides have limited negative agricultural impacts thus far. In 2004, expanded state regulations were proposed and research initiatives developed.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Seasonal Shell Growth and Longevity in the Variable Coquina Clam, *Donax variabilis*, from Northeast Florida: Evidence from Oxygen Isotopes

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The variable coquina clam, *Donax variabilis*, is a familiar inhabitant of sandy beaches from Virginia to south Florida and west to Texas. Extensive archaeological shell-midden deposits along the northeast Florida coast confirm that coquina clams were heavily exploited by pre-Columbian people since the Middle Archaic (ca. 5700 YBP). We examined the accretionary records of modern and archaeological *Donax variabilis* shells to assess seasonal shell growth and longevity in this species, and to determine if there was a seasonal component to shellfish harvest during the middle to late Holocene. Year-round collections of living clams and seawater data from Matanzas Beach, Florida, were made at monthly intervals and combined with historical temperature data to establish an environmental framework. The stable oxygen isotopic variation in two serially sampled, modern shells closely tracks the water temperature variation during spring and summer, the seasons of most rapid shell growth. In fact, the $\delta^{18}O$ profiles are completely explained by seasonal water temperature variations. Shell edge isotopic values correspond with water temperatures at the time of collection. Similar $\delta^{18}O$ profiles in four archaeological specimens from four different sites representing two distinct time periods indicate shell growth in late spring–summer, with harvest in autumn. Average longevity was 3–4 months. Paleotemperatures derived from two Preceramic Archaic specimens (ca. 5700 YBP) and two Orange Period specimens (ca. 3500 YBP) indicate temperatures warmer than modern by about 3.5 °C, perhaps reflecting the mid-late Holocene thermal maximum in this region.

Contributed Session III – Marine Mollusks

Neogastropod Sister Group: Morphological, Chromosomal, and Paleontological Evidences

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Neogastropoda can be generally considered as predators. Transition from herbivory to carnivory requires complex biochemical transformations. Therefore it is logical to search the sister group of Neogastropoda among carnivorous or omnivorous Caenogastropoda. On the other hand, nearly all Neogastropoda are characterized by larger number of chromosomes when compared to lower Caenogastropoda (2n=56–72 and 16–36 respectively). Among other Caenogastropoda, equivalent number of chromosomes was so far found only in three families: carnivorous Ranellidae (70), omnivorous Cypraeidae (52–72), and omnivorous Capulidae (62). Ranellidae and other Tonnoidea have long proboscis superficially similar to that of some Neogastropoda with terminal buccal mass. Nonetheless, anatomical and embryological data suggest that the neogastropod ancestor had a very short proboscis with basal buccal mass. The oldest palaentological record of Neogastropoda is probably represented by a member of the family Ptychatractidae. Recent representatives of this latter family retain the primitive foregut anatomy (short proboscis with basal buccal mass and odontophore retractors passing through the nerve ring). In addition, Tonnoidea appeared later than Neogastropoda in the paleontological record. Therefore, Tonnoidea is unlikely to be a sister group of the Neogastropoda. Capulidae is a highly specialized family with head and foregut modified for suspension feeding. This leaves the Cypraeidae, an omnivorous and carnivorous family, as a possible sister group of the Neogastropoda.

Symposium – Relationships of the Neogastropoda

Biodiversity of Russian Marine Mollusks

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Russia has a very long coastal line, and connects well-studied faunas of Europe and Japan. A catalogue of marine and non-marine mollusks of Russia and adjacent territories is being compiled. Currently, 3645 species of mollusks have been recorded from Russia. A total of 1734 species of six molluscan classes were recorded in the seas of Russia (including the low-salinity Black [235 species] and Caspian [185 species] seas). The richest areas are the Japan Sea (503 species) and southern Kurile Islands (414 species). In comparison, the fauna of Japan consists of 5106 species. The low diversity of marine mollusks results both from impoverishment of high latitude faunas as well as from insufficient study. To estimate the relationship between the number of faunal studies and the size of studies mollusks, the size structure of 1016 species of shelled gastropods and bivalves from the Russian Far-Eastern seas was compared with that of the regions with well studied faunas (Japan, Great Britain, tropical west America, Hawaii, and New Caledonia [Koumak site]). Analyses demonstrate that the percentage of small mollusks (<10 mm) studied is a function of the degree of faunal investigations rather than from latitudinal gradient. Thus in boreal well-studied British fauna the micromollusks comprise 47.25%. That is comparable to the extremely well-studied fauna of the Koumak site in New Caledonia (53.29%). In the Russian Far-Eastern seas the known percentage of micromollusks is 20.08%, leading to the conclusion that micromollusks are understudied in Russia and values from 14% to 44.5% of the total fauna are likely to be found.

Special Session – Biodiversity of Marine Mollusks

Phylogeny of *Elimia caelatura* Complex of Upper Coosa Basin, Alabama

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Numerous freshwater mollusks are threatened from habitat destruction or elimination. One such imperiled group is represented by the freshwater gastropods in the family Pleuroceridae. Pleuroceridae is the most diverse family of freshwater gastropods and have their greatest diversity in the southeastern United States. Many of the pleurocerids are currently considered extinct, endangered, or threatened. One aspect hindering the conservational efforts is that their evolutionary relationship is unclear because it is solely based on shell morphology. The taxonomy of this group is based on late 19th- and early 20th-century studies. Many previous and ongoing studies have shown that they do not correspond to the real evolutionary species. In this study, we conducted a phylogenetic analysis of the *Elimia caelatura* complex and related species including *Pleurocera* using morphological and mitochondrial cytochrome c oxidase subunit I (COI) gene sequences. Preliminary molecular analysis suggests that they do not correspond to the species and subspecies and also do not seem to match with the geographical distribution in the Upper Coosa Basin, Alabama.

Poster Session

No Pre-Mating Reproductive Isolation Between *Physa acuta* and *P. pomilia*

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Within a physid species, there is no pre- or post-mating reproductive isolation as reported in previous behavioral trials. However, a breakdown does occur in the ability to outcross between physid species. We performed a series of mating trials between one population of *P. pomilia* and one of three different populations of *P. acuta*. We looked for evidence of size-assortative mating and species-assortative mating, and attempted to correlate behaviors that affected mate decision choices. We found that in pairings between species, *P. acuta* served as male significantly more often than *P. pomilia*. In addition, *P. pomilia* exhibited significantly more instances of rejective behavior when paired with *P. acuta* than with other *P. pomilia*.

Poster Session

Generic Hyperdiversity in Time and Space

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Several mainly tropical marine prosobranch gastropod genera are hyperdiverse, containing more than 200 extant species. With well more than 500 species, *Conus* is pre-eminent among these, and it is the most diverse genus of marine animals. We address (but do not answer all of) the following questions: (1) This richness of very similar species and the geologic youth of the genus (~55my) indicate very rapid rates of speciation. When, where, and how did all these speciation events take place? (2) What molecular, anatomical, ecological, developmental, and environmental attributes might foster rapid diversification? (3) In addition to high general species richness (γ diversity), many species co-occur at finer spatial scales (α diversity: up to 36 species on a single coral reef). Do these species avoid competition by partitioning resources, and if so, how? (4) Recently, molecular techniques have enabled the recognition of widespread sympatric sibling species in the Indo-West Pacific and explosive radiation of a species flock resulting in many narrowly distributed similar species in the Eastern Atlantic. How do these discoveries affect estimates of diversity and hypotheses of speciation? (5) How are species-level phylogenetic hypotheses, also available only recently from gene sequence data, affecting our understanding of evolutionary history and past and present geographic distribution patterns?

Special Session – Biodiversity of Marine Mollusks

Neogastropoda: Questions of Tempo and Mode in Macroevolution and Macroecology

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Traditionally considered an order (following Thiele), Neogastropoda contains some 5000 species usually grouped in 15–20 families in 4–5 suborders or superfamilies. Despite its species richness and taxonomic diversity, the Neogastropoda is a rather conservative group in its homogeneity of anatomy, habits, and habitats. The most conspicuous gastropods in many marine habitats, neogastropods are almost exclusively marine, benthic, and carnivorous. A very few species have invaded fresh water and are herbivorous; some are scavengers and some parasites. I will briefly explore some broad themes of macroevolution and macroecology in the Neogastropoda, because these are still poorly known and disputed but are active and promising fields of research. Macroevolution concerns spatial and temporal patterns of speciation and extinction, how structures and functions evolve in lineages, and the shapes of clades or how lineages diversify. Salient macroevolutionary themes in neogastropods that need to be better understood include questions of ancestry and monophyly of the group, the relationship of phylogenetic patterns to the evolutionary history and diversification, and why some families and genera are much more diverse than others. Macroecology concerns broad spatial and temporal patterns of resource use among species and species diversity and abundance. Macroecological themes to be addressed include ecological diversification and disparity, with emphasis on exploitation of habitats and food types that may have been inaccessible to their ancestors.

Keynote Speaker – Symposium – Relationships of the Neogastropoda

Revisionary Systematics of *Conus*

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We report initial progress on three fronts of a project designed to improve and modernize the classification and systematics of *Conus*, the most diverse marine molluscan genus, to enhance understanding of its evolutionary history, and to facilitate broad access to the results. (1) We have established The *Conus* Biodiversity Website[1]. Its first completed component is a catalogue of all available species-group names in *Conus* published from 1758 that have come to our attention. It incorporates previously published and computerized catalogues as well as subsequently published names, and earlier names omitted by previous catalogues. At present the catalogue contains 3157 species-group names, and it is periodically updated. Currently we are adding a gallery of photographs of type specimens to the site. (2) We have been adding to the molecular and morphological taxonomic bases. The next component to be incorporated in the Website will be an entry for each valid species, including descriptions and illustrations in a format similar to the Indo-Pacific *Manual of Living Conidae* by Röckel et al. but focusing on the Western Atlantic and Caribbean *Conus* fauna. (3) We are developing species-level molecular-based phylogenetic and phylogeographic hypotheses. Phylogenetic reconstructions presently based on sequences of one mitochondrial and one nuclear gene from 138 species indicate that extant species of *Conus* descend from two major clades that diverged between the origin of the genus 55 mya and 33 mya, and that these clades differ strikingly in diversity and in the proportions of their species from different geographic regions.

[1]http://faculty.washington.edu/kohn/

Symposium – Relationships of the Neogastropoda

The Biodiversity of Shallow-Water Marine Mollusks of Southwest Florida Revisited

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The southwest coast of Florida, including Sanibel and Captiva islands, possibly represents one of the best-sampled areas in the world for shallow-water (intertidal to shallow subtidal depths) mollusks. Hobbyists and amateur malacologists have been consistently collecting there for many decades. Perry and Schwengel (1955, *Marine Shells of the Western Coast of Florida*), published an earlier inventory for the area but since then no other work has updated their findings. The Bailey-Matthews Shell Museum houses about 3500 dry and preserved lots of pertinent material, most of which were obtained through bequeathed collections. Curatorial work led museum staff to recognize the relevance of this material as the foundation for a much-needed, updated inventory of local shallow-water mollusks. The ongoing project started as a Web identification guide and aims to generate biodiversity and taxonomic data at the regional level. Literature data and records from other institutions are being used to substantiate and supplement collection information. Material is being critically reviewed to prevent inclusion of specimens of questionable origin. The presence of multiple lots of less-common species confirms their occurrence in the area and warrants their inclusion. Taxa that have not been recently collected in the area are included. In addition, the museum is engaged in sampling Sanibel and Captiva for micromollusks with help from local collectors and museum docents. At present, selected specimens of 220 species of Gastropoda, Bivalvia, Polyplacophora, and Cephalopoda have been illustrated in iconographic format[1]. Collection data for about 3000 regional records already catalogued are also available online[2].

[1]http://www.shellmuseum.org/sanibel_shells.html
[2]http://www.shellmuseum.org/collection.html

Poster Session

Ribbed Mussels of the Caribbean: The Curse of the Sibling Species Complex

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The intertidal scorched mussel *Brachidontes exustus* (Linnaeus, 1758) is nominally distributed continuously along the coast from North Carolina to Venezuela and is also present on nearby continental (Greater and Lesser Antilles, Bahamas) and oceanic islands (Bermuda). This regional evolutionary landscape has experienced a dynamic recent geological history that has reconfigured continental and oceanic interfaces. We were interested in establishing what imprint these events may have had on the cladogenesis of the Caribbean Basin scorched mussel. We present mitochondrial and nuclear gene trees based on hundreds of individuals sampled throughout the Caribbean and incorporating potential geminate species from the eastern tropical Pacific. Gene tree topologies consistently recovered three stem Caribbean lineages and six well-differentiated terminal clades, which represent six regional sibling species. The cladogenic origins of the stem lineages pre-date the closure of the Isthmus of Panama, whereas those of at least four of the six sibling species occurred after the closure. Caribbean sibling species have an intriguing pattern of within-basin distribution characterized by distinct geographic areas of ecological dominance adjoining those of sister taxa. However, species are not restricted to their core distributional areas and may be found (often co-occurring in low frequency with the local dominant) in other parts of the Caribbean Basin. These observations, coupled with the maintenance of genetic cohesion among geographically disjunct populations, imply that the distributional limits of sibling species are maintained by ecological factors rather than by barriers to larval-mediated gene flow. Our data are consistent with a history of geographically partitioned within-Basin cladogenesis that has been largely maintained by environmental exclusion.

Special Session – Biodiversity of Marine Mollusks

Analyzing Shell Deposits to Aid in Site Selection for Bay Scallop Restoration in Pine Island Sound, Florida

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A recreational bay scallop (*Argopecten irradians*) fishery existed throughout Pine Island Sound, southwest Florida, until the late 1980s. Since then scallops have disappeared from the area, except for a small relict population in the northern part of the Sound. The loss of this important resource and the potential for its reintroduction through restoration play a role in critical water management decisions related to the estuary. Thirty-six sites in lower Pine Island Sound and San Carlos Bay were sampled for shell deposits. In addition, scallop shells were placed in the field to determine shell dissolution rates. Maps of shell deposits revealed a high density of shells centered inside York Island (immediately west of St. James City) and spreading into the shallow grass flats to the north and east. Two other foci of lower density, but equally broad scallop shell distributions, were identified: one near the mouth of the Caloosahatchee River and the other at the opening to Tarpon Bay. Average scallop shell dissolution rates ranged from 1.01 to 1.32 percent annually, suggesting that the shells had been buried in the sediments for roughly 100 years. If water quality becomes suitable to support bay scallops again, these areas may offer the most optimal locations for future restoration efforts.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

Are Taxonomists Needed in a Molecular World?

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In the wake of the current biodiversity crisis and advances in molecular systematics, some researchers have suggested that DNA taxonomy can supplant traditional taxonomy. Proponents of this "DNA barcoding" envision that a short fragment of mtDNA can be used to diagnose taxa, increasing the speed, objectivity, and efficiency for circumscribing species. This suggestion has been met with strong opposition from both the systematic and taxonomic communities. However, most debate has remained philosophical and little empirical evidence has been put forth to test the barcoding approach because of a lack of sufficiently sampled, comprehensive phylogenetic datasets. Herein, I present evidence from three independent datasets (Cypraeidae, the *Astralium rhodostomum* complex, and the *Patelloida profunda* complex) to place error rates on barcoding. While the four commonly recognized sources of error are each relatively low (~2%), they are compounded, resulting in an overall error rate of approximately 10%. Most significantly, however, I identify a fifth source of error using a novel phylogenetic approach: the preponderance of false negatives if a threshold difference (e.g. 3% divergence value) is employed. These results demonstrate that at least 20% of recently derived taxa would be artificially lumped with closely related species, and indicate that up to 40% of global diversity falls within this recent window. Only through careful traditional taxonomy or extensive intraspecific molecular sampling can these units be differentiated.

Special Session – Biodiversity of Marine Mollusks

Marine Bivalves of the Florida Keys: A Qualitative Faunal Analysis Based on Original Collections, Museum Holdings, and Literature Data

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Marine bivalve diversity in the Florida Keys was studied from original collections plus critically reviewed museum specimens and literature data. The 12000-record dataset representing 389 species resulted in a 139% increase compared to the 1995 Florida Keys National Marine Sanctuary checklist. Using multivariate non-metric statistics and *a priori* geographic groups along and across the island chain, the data showed distinct differences in benthic community structure across several spatial gradients. No northeast-to-southwest gradient was found along the oceanside fauna of the island chain, but this was pronounced within Florida Bay. The shallow-water communities of bayside and oceanside were significantly different, but resulted from different percentages of the same species. In contrast, the deeper oceanside community differed substantially from both shallow-water groups in supporting a different set of species. A comparison of this bivalve fauna with other well-documented faunas of the western Atlantic grouped the Florida Keys closer to the Gulf of Mexico and Cuba than to eastern peninsular Florida, Yucatan, and the Bahamas. Aspects of the heterogeneous (live/dead/literature) nature of the dataset are discussed and compared to analyses based on live-only data (the latter resulting in less resolution but the same general patterns). Rapid assessment methods contrasted against the long-term results show effectiveness when based on a range of sample types and habitats. The importance of data-rich gray literature sources is emphasized, and the discrepancy between the "all-species-ever-recorded" list and the results of original project collections is explored.

Special Session – Biodiversity of Marine Mollusks

Spawn of *Zafrona pulchella* (Blainville, 1829) and *Anachis helenae* (Costa, 1983) (Caenogastropoda: Columbellidae) from the Colombian Caribbean

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We describe the egg capsules and embryos of *Zafrona pulchella* and *Anachis helenae* collected at the Colombian Caribbean between 20-160 m depth. *Zafrona pulchella* had one layer of 24 egg capsules attached to the shell. *Anachis helenae* was completely covered by several layers of egg capsules; only the external layer of capsules, however, contained embryos; the rest had their escape apertures open. Egg capsules of both species were translucent, dome-shaped, with an oval escape aperture at the center of the dome top; the surface was smooth with no ridges nor sutures; egg capsules were attached to the shell by an oval basal membrane which was surrounded by a thin, irregular flange. Egg capsules of *Z. pulchella* measured 2 mm in diameter and contained six embryos/capsule; egg capsules of *A. helenae* measured 1 mm in diameter and contained 25 embryos/capsule. Embryos of *Z. pulchella* were all at the gastrula stage and measured 750–900 µm in length. Uncleaved eggs of *A. helenae* measured 150 µm in diameter; the veliger had an operculum, a transparent shell measuring 188–219 µm in length, and a small velum. No nurse eggs were observed in the two species, but late cannibalism among sibling embryos may occur in *A. helenae.*

Poster Session

The Subfamily Lamellariinae (Gastropoda: Velutinidae) in the Magellanic and Antarctic Area

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Most of the Lamellariinae species from the Magellan and Antarctic regions were described as results of classic expeditions from the last century. Since then, there has not been a comprehensive revision of Lamellariinae gastropods. Around 30 species names were proposed for this area under the genera *Lamellaria* Montagu, 1815, and *Marseniopsis* Bergh, 1886. These species were described mostly based on external morphology. Several works also included the descriptions of internal shell, radulae, and basic anatomical information. Both genera are largely distributed around the Magellanic and Antarctic regions, probably because of their long planktonic larval life. This work is a first approach to the study of the anatomy of these prosobranchs, including data on living specimens (color patterns and ecological aspects). Specimens used in this study are deposited in the collections of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" and Museo de La Plata. Type material of most of the species from European museums was revised. The anatomy, radulae, and jaws (including SEM micrographs of the latter two) of several species of *Lamellaria* and *Marseniopsis* are described. In addition, a preliminary list with the taxonomic status of the species described under these genera is included.

Poster Session

Protein Content of Embryos and Intracapsular Liquid of *Melongena melongena* (Linnaeus, 1758) (Caenogastropoda: Melongenidae) During Intracapsular Development

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Eggs of *M. melongena* develop inside round, flat egg capsules that contain a gelatinous intracapsular fluid. To determine whether this gel represents a nutritional source for the developing embryos, we measured the amount of proteins of the embryos throughout development from egg to the hatching stage, as well as the protein content of the intracapsular liquid at the same stages of development. Egg capsules of *M. melongena* were collected at Golfete de Cuare, Venezuela, between 1–2 m depth. Uncleaved eggs measured 352–480 µm and each contained 8-15 µg of protein. This amount of protein was not significantly different at the trochophore, veliger, and pediveliger stages; however, it decreased significantly at the hatching stage to 6 µg/hatchling (hatchlings are pediveliger larvae measuring around 720 µm in shell length). The protein concentration of the intracapsular liquid was 0.18 µg/µl at the egg stage and it reached 0.13 µg/µl at the prehatching stage, however, the total amount of protein in the intracapsular fluid was not significantly different throughout development from one stage to the other. Results indicate that embryos of *M. melongena* do not use the intracapsular liquid as an extraembryonic food source; furthermore, about 2–5% of the eggs do not develop and remain intact without being ingested as nurse eggs by the developing embryos.

Poster Session

The Channeled Apple Snail (*Pomacea canaliculata*) in Florida and Elsewhere

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The channeled apple snail is an emerging concern in Florida. This paper will present information on this snail, including: basic biology, known distribution, impacts, and implications of the species as a vector for the rat-lung trematode *Angiostrongylus cantonensis*. An overview of its status in the world and in the United States will be discussed.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Natural History of *Oxyloma retusa* at the Shore of a Maryland Lake

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The land snail *Oxyloma retusa* (Lea) lives on cattails (*Typha* sp.) and on wet soil along the shores of Lake Churchill, a small artificial lake in Germantown, Maryland. Microscopic examinations of the feces of snails collected in April and June indicated that the snails feed almost exclusively on dead plant matter. The generation cycles of the snails in the field were monitored for two years. The snails spend the winter as juveniles and then start growing rapidly and mating in the early spring. The cohort that survives the winter reaches its maximum shell size in June, and then dies off. The first generation offspring grows through the summer and is replaced by the second generation offspring by September. This last cohort survives the winter. The two years (2002–2003) during which the populations were monitored differed in monthly temperature and precipitation means, but similar generation cycles were observed in both years.

Contributed Session II – Terrestrial Gastropods

Inducible Offenses in Marine Molluscan Grazers

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Several species of gastropod grazers have been demonstrated to express morphological plasticity in their radula. The adaptive value of these inducible offenses (traits that enhance the abilities of consumers or competitors) can be limited because of long lag times between when an individual receives environmental cues and when the new morphologies can be used. Behavioral plasticity associated with dispersal potential and food preference could work to minimize this adaptive limitation if individuals disperse less from food substrates/habitats they have been exposed to most recently, and disperse readily from alternate habitats. This type of behavioral response could act to increase the amount of time an individual resides in a given habitat, minimizing the consequences of morphology-habitat mismatches because of the long lag time. Detection of and response to local predation risk could also enhance the adaptive value of such plasticities. Two sympatric species of littorinids in the genus *Lacuna* have radular morphologies that are inducible by food and environmental cues, and relatively long lag times (20–28 days) between when they sense a new environment and new teeth are ready to use. In experiments, snails disperse less frequently from food/environments in which they have been reared, and more frequently from alternate foods they have not recently experienced. Although these two species co-occur and are closely related, they show differences in dispersal behavior with one species dispersing much more readily than the other. Dispersal is also enhanced by chemical detection of predators, especially visual predators.

Contributed Session I – Marine Gastropods

Some Nudibranchs (Mollusca: Opistobranchia) from Parque Nacional Morrocoy, Venezuela

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Between January 2003 and March 2004 nudibranch gastropods were collected in different areas of Parque Nacional Morrocoy (10°52' N, 69°16' W) to determine their diversity. A total 16 nudibranchs, representing eight species and four families (Discodoridae: *Discodoris evelinae;* Scyllaeidae: *Scyllea pelagica;* Bornellidae*: Bornella calcarata;* Chromodoridae: *Hypselodoris bayeri, Hypselodoris rutae, Chromodoris binza, Dendrodoris krebsii,* and *Tyrinna evelinae*) were collected from four areas: Cayo Muerto (10º55'40"–10º50'52" N, 68º15'40"–68º15'54" W), Cayo Sal (10º56'17"–l0º57'20" N, 68º15'22"–68º16'03" W), Varadero (10º54'47" N, 68º14'49" W) and Punta Mayorquina (10º53'45" N, 68º13'48" W). Individuals from all these species were found living on different substrata, ranging from coral reefs and rock platforms, to algal and *Thalassia testudinum* beds.

Poster Session

Trophon Montfort, 1810: The History of an Old Patagonian Resident

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Species undoubtedly belonging to the genus *Trophon* have been recorded in marine rocks exposed in southern South America and dated as far back as the late Oligocene. Earlier records are doubtful and based on poorly preserved material. The origin of this genus seems to have taken place somewhere along the coast of Patagonia, where its extant members include 11 species ranging from Chile around Cape Horn as far north as Uruguay. Although a large number of nominal species have been described from other areas, mainly Antarctica, but also from as far away as New Zealand, all of these have proven to belong to different genera. Anatomic characters allow differentiating these species from true *Trophon*. Despite the fragmentary nature of the fossil record in the Cenozoic of Patagonia, it is clear that *Trophon* was well established and fairly common in the shallow shelf environments that prevailed there throughout the Cenozoic. Its absence in the richly fossiliferous Cenozoic marine rocks in Antarctica may reflect the fact that a barrier between Antarctica and South America was already in place prior to the Oligocene. This barrier was surely related to paleogeographic changes involving the opening of Drake Passage and the consequent interruption of shelf conditions connecting Antarctica and Patagonia. This probably played a more decisive role than the inception of the Circum-Antarctic Current and the establishment of cooler temperatures in the southern oceans, as the genus seems to be adapted to cold waters — and possibly was so also in the past — as indicated by the sharp interruption of its range toward the north, where it does not extend beyond the edge of the southbound, warm Brazilian Current.

Symposium – Relationships of the Neogastropoda

Tempo and Mode of Diversification in the Indo-West Pacific

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Although the statement that the Indo-West Pacific harbors the greatest marine diversity has become a cliché, not all taxa show high diversity in the region. While some families include hundreds of regional species, others are monospecific. Some groups are diverse both at the local and regional levels, while others have modest local, but high regional diversity. What conditions facilitate or impede the development of megadiversity? Intensive biodiversity surveys at several Pacific locations combined with molecular phylogenetic studies reveal varied patterns of diversity and modes of diversification. Speciation can occur at a variety of locations, across a wide range of spatial and temporal scales, driven by varied mechanisms. Although allopatric speciation can occur almost anywhere in the region, speciation events strongly cluster in some areas that serve as diversity pumps. The geographic scale of allopatric speciation varies over orders of magnitude from inter-island to inter-regional scales, and this is substantially correlated with dispersal ability. Nevertheless, even taxa with exceptional dispersal ability can speciate allopatrically within the region. The temporal dynamics of speciation are also highly variable. While sufficient isolation to allow secondary sympatry takes >10 million years in many groups, others diversify much more rapidly. Evidence supports the importance of founder speciation in addition to vicariance, and selection is a powerful force in generating diversity. We will review numerous examples to illustrate these points and explore what combinations of these factors are most conducive for the development of megadiversity.

Special Session – Biodiversity of Marine Mollusks

Land Snails from St. Elzear Cave, Gaspé Peninsula, Quebec: Antiquity of *Cepaea hortensis* in North America

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The land snail *Cepaea hortensis*, common in Europe, was once considered introduced into North America. However, archaeological evidence indicates that *C. hortensis* was in North America before the arrival of Columbus. Could Vikings have brought the species to North America, or was it present in North America before the Vikings explored 1000 years ago? The St. Elzear Cave on the Gaspé Peninsula, Quebec, has a 13 m vertical drop at the entrance, which was effective at trapping organisms. The cave entrance opened to the surface after the most recent glaciation, about 12000 years ago. The 168-cm-deep cave sediments were excavated from 1977–1979. We identified ten species of land snails from the sedimentary deposits in the cave. Five species were abundant enough to allow for evaluation of their presence through the layers. Four native species (*Discus catskillensis, Zonitoides arboreus, Anguispira alternata,* and *Neohelix albolabris*) were present throughout the excavation. *Cepaea hortensis* was present in only the upper 84 cm of the cave sediments. Two lines of evidence from St. Elzear Cave suggest that *C. hortensis* has been in North America for at least 6000 years. The first appearance of *C. hortensis* halfway up the 168-cm sediment column suggests it appeared halfway through the 12000 years that the cave has been open, or 6000 BP. Second, extrapolation from a radiocarbon date on wood higher in the section provides a similar estimate of 6460 BP. Both of these estimates indicate that *C. hortensis* was present in North America longer before the Vikings.

Contributed Session II – Terrestrial Gastropods

Studies on Volutids in Argentina (Caenogastropoda: Volutidae)

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Adelomelon brasiliana (Lamarck, 1811) specimens were captured monthly in the Mar del Plata area (15m depth) during three consecutive years. The reproductive season extends from September to April. The mature oocytes reach 200 μm in diameter before spawning. In autumn, a resting phase begins, and non-spawned oocytes undergo reabsorption. Among the Volutidae, *Adelomelon brasiliana* is the only species known to lay free egg capsules. The distribution of egg capsules is aggregated due to bottom currents. Egg capsules are often stranded on the beach after strong storms; there they die or suffer predation by shore birds. Gonad development of *Zidona dufresnei* (Donovan, 1823) (Caenogastropoda: Volutidae) was studied over a period of two consecutive years. The reproductive season in this species in the sampled locality off Mar del Plata extended from October to March. Size at first gonadic maturity in females was 12.8 cm shell length and in males 12.0 cm shell length, but size at which 50% of the population was mature was 15.7 cm in females and 15.0 cm in males. The record of stable isotopes ratio ^{18}O deposited in the shell calcium carbonate of *Z. dufresnei* that reflects seasonal oscillations in water temperature was used to infer size-at-age. Three years of sampling of *Odontocymbiola magellanica* (Gmelin, 1791) and *Adelomelon ancilla* (Lightfoot, 1786) by scuba diving in depths of 6–10 m were performed in Golfo Nuevo, Patagonia, in order to study the spawning seasons, the diet and imposex occurrence. Imposex was registered in individuals of *Adelomelon beckii* (Broderip, 1836) off Mar del Plata (50–60 m depth); thus *A. beckii* is the deepest-occurring species where imposex was observed in the southwestern Atlantic.

Contributed Session III – Marine Mollusks

Systematics and Biogeography of the Squid Genus *Alloteuthis* (Loliginidae) Based on Morphological and Molecular Sequence Data

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Alloteuthis comprises three nominal species of small (~10–15 cm dorsal mantle length) slender squids found in the eastern Atlantic Ocean and Mediterranean Sea. These squids are objects of minor fisheries, and they are abundant members of the neritic cephalopod fauna in European and West African waters. Recent morphometric analyses have suggested that two *Alloteuthis* species — *A. media* and *A. subulata* — actually represent arbitrary divisions of a gradual range of variation in body shape, and hence should be synonymized under the name *Alloteuthis media*. To address this question, and to investigate phylogeographic patterns within this group, we have sequenced a region of the mitochondrial cytochrome c oxidase subunit I (COI) gene from several specimens from each of the three nominal *Alloteuthis* species (*A. media*, *A. subulata,* and *A. africana*) from throughout their ranges, as well as several specimens of *Afrololigo mercatoris*, the sister taxon of *Alloteuthis*. Preliminary analyses suggest that (1) specimens assigned to *A. subulata* and *A. media* based on morphometric comparisons are very similar genetically and (2) there is very little haplotype variation across the ranges of these species. Our findings thus appear to support the suggestion that *A. media* and *A. subulata* should be synonymized.

Poster Session

In-Utero Responses in *Bellamya* Brood to a Potential Predator

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The live-bearing gastropod *Bellamya (Cipangopalidina) chinensis* is an excellent test organism to address questions of environmental influence on reproductive potential. A member of the Viviparidae, *B.* (*C.) chinensis* gives birth to fully developed juveniles. In brooding adults, all stages of development are found simultaneously *in utero*, from newly fertilized ova to large juveniles. Thus a single brooding female contains all ontogenetic stages, each essentially exposed simultaneously to the same environment as the parent. This could mean that changes in parental environment could be reflected in biochemical, physiological, and/or morphological changes in the developing young. A previous author's results in finding changes in adult snail shell in the presence of predators led us to ask if brooded juveniles might also modify shell form or if total reproductive output might change in viviparid snails under similar "threat." We tested this with *B. (C.) chinensis*. When brooding adults of this snail were placed in the presence of a crayfish, we found that juveniles released were 91% the size of control offspring and total release of offspring essentially doubled. Thus, more and smaller juveniles were released in this brooding gastropod in the presence of a predator. It is possible that these changes reflect an adaptation for "protection in numbers" and/or an increased ability of the juveniles to hide in smaller crevices.

Contributed Session IV – Freshwater Mollusks

Mitochondrial Gene Rearrangements at a Snail's Pace

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Given that animal mitochondrial (mt) gene order tends to be extremely conserved even at high taxonomic levels, the arrangement of mt genes within the phylum Mollusca appears exceptionally variable. Representatives of three classes of mollusks share remarkably few gene boundaries, with gene order varying extensively even within the class Gastropoda. Here we present further evidence of an unusually labile gastropod mitochondrial genome: numerous gene order changes have occurred within the Vermetidae, a family of sessile, uncoiled, suspension-feeding gastropods that radiated from a basal caenogastropod stock in the early Cenozoic. Demonstration of major gene order changes within such a young taxonomic group is exciting for a number of reasons. First, vermetid mt genomes may help to understand more fully the mechanics of gene order changes, since the telltale vestiges of gene duplications and translocations, typically erased or overwritten with time, may still be present within these genomes. Second, vermetid mt genomes offer the opportunity to study putative mechanisms accounting for gene order homplasy and tRNA gene remolding at a fine taxonomic level. Finally, gene order changes can provide compelling phylogenetic markers that can supplement or contradict primary sequence data, and provide resolution for deeper nodes that are often weakly supported in sequence-based phylogenies. We have found four mitochondrial gene order changes that are phylogenetically informative within the Vermetidae. These markers should allow us to improve our phylogenetic hypothesis for the enigmatic Vermetidae and to investigate the conditions under which sequence-based phylogenies lack resolution or prove misleading.

Contributed Session I – Marine Gastropods

The Cuban Land Snail *Zachrysia*: The Emerging Awareness of an Important Snail Pest in the Caribbean Basin

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Three species of the terrestrial snail genus *Zachrysia* are confirmed as established outside of Cuba. Their shells are often difficult to differentiate from one another, although anatomically they are quite distinct. *Zachrysia trinitaria* (Pfeiffer, 1858) appears so far to be restricted to the Miami-Dade area of Florida. Although shells matching those of this species in institutional collections date back more than fifty years, this is the first report of this taxon outside of Cuba. *Zachrysia auricoma havanensis* (Pilsbry, 1894) is reported in Panama and the Yucatán Peninsula of Mexico and is a widespread pest throughout synanthropic environments in Puerto Rico, but seems not to have spread further into the Caribbean. *Zachrysia provisoria* (Pfeiffer, 1858) is an aggressive, polyphagous plant pest in southern Florida, and is spreading with horticultural exports: molluscan pest surveys over the last five years have detected its presence in Barbados, Saint Croix, Jamaica, and most recently, Mustique and Nevis. It has also been found in horticultural shipments from the Bahamas and Costa Rica. Immature *Zachrysia* sp. has also been detected in horticultural exports from Haïti, the Dominican Republic, and Guatemala, although the genus has not been reported as established or even introduced in those countries. Most nations seem unaware of the potential consequences to their agricultural and horticultural industries should *Zachrysia* be inadvertently introduced with horticultural imports, or be allowed to spread. Rather than being a pest of emerging importance, *Zachrysia* is actually an important and widespread pest but there is only a slowly emerging awareness of its potential significance.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

No Reproductive Isolation Between the Freshwater Pulmonate Snails *Physa virgata* and *P. acuta*

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Mate choice tests uncovered no evidence of prezygotic reproductive isolation between a population of *Physa virgata* (Gould, 1855) collected from its type locality in the Gila River of Arizona and *Physa acuta* (Draparnaud, 1805) from a control site in Charleston, South Carolina. Ten outcross *virgata* × *acuta* pairs initiated reproduction at approximately the same age as *virgata* × *virgata* and *acuta* × *acuta* controls. The mean 10-week fecundity of the outcross pairs was slightly but not significantly less than either pure-line controls, and the viability of F_1 hybrids was slightly but not significantly greater. We detected no evidence of reduction in F_1 fertility. Thus *P. virgata* should be considered a junior synonym of *P. acuta.*

Contributed Session IV – Freshwater Mollusks

Photoperiod Effect in the Embryonic Development of the Queen Conch *Strombus gigas* (Linnaeus)

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This scientific investigation aims to describe basic biological mechanisms involved in the culture of *Strombus gigas* and the main objective was to determine the direct effect of photoperiods during embryonic development until hatching. Seven egg masses of the queen conch, *Strombus gigas,* still in their first cell divisions, were subjected to six different photoperiod treatments in two phases. The first phase involved three egg masses and had a 5-hour advanced photoperiod and the second involved four egg masses with a 7-hour advanced photoperiod. The photoperiods were advanced with respect to 18:00 hours (the normal time of sunset at the collection areas in Mexico). The experimental apparatus consisted of six wooden boxes, each containing five receptacles in which portions of each egg masses were placed. Seawater flow was 200 ml/min at a controlled temperature of 27.8 ± 0.2ºC. The number of larvae that hatched was counted in all treatments in intervals of one hour, from the beginning of ecclosion in whichever treatment took the longest to complete hatching, with the objective of observing if embryos responded to the different photoperiods. The results indicated that ecclosion depended on the alternation of light/dark, such that light could be programmed to advance up to seven hours and that three cycles of artificial light/dark were enough to show enough endogenous control suggesting that this sequence can be compared to a biological clock regulated by photoperiod.

Contributed Session III – Marine Mollusks

Species Discovery Curves for Marine Mollusks: No Sign of an Asymptote

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Species discovery curves were plotted for Western Atlantic marine gastropods and Indo-Pacific marine species based on the data in Malacolog 3.3. <http://data.acnatsci.org/wasp/> and the Biotic Database of Indo-Pacific Marine Mollusks <http://data.acnatsci.org/obis/>. Year of naming was used as a proxy for year of discovery, with each species currently considered valid assigned the year that the oldest available name for it was introduced, thereby correcting for artifacts introduced by homonymy. For both faunas, the curves are almost linear since the 1840s, meaning that species have been discovered at a relatively constant rate since that time. The 1840s marked a shift from works that attempted to document all known mollusks, to monographic works at the genus and family level, with a concomitant increase in rate of discovery. The lack of clear asymptotes means that it impossible to estimate how many species these faunas contain, but the true number is likely more than twice the number currently known. The curves suggest accelerating discovery since World War II, but whether this is a true increase in rate or merely lag time to synonymy is unknown. Global databases of known mollusk species, online interactive identification keys, and DNA technology will further increase rates of discovery for mollusks.

Special Session – Biodiversity of Marine Mollusks

Use of Oyster Reef Communities in the Design and Monitoring of Everglades Restoration Projects

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Greater Everglades restoration in South Florida is the largest ecosystem restoration project in United States history, and concerns both terrestrial and estuarine habitats. Restoration is governed by a federally legislated partnership through multi-agency consensus following a strict protocol. For estuarine projects, the American oyster, *Crassostrea virginica,* is being used as a bioindicator of estuarine health, as a tool for establishing restoration targets, and as a measure of restoration effectiveness. The purpose of this presentation is to illustrate the utility of oyster biology and reef ecology in the restoration planning process. The protocol adopted for Everglades restoration consists of nine steps: (1) defining restoration goals, (2) characterizing current conditions, (3) establishing the pre-alteration state, (4) designing alternative restoration scenarios, (5) establishing performance measures and targets, (6) modeling to evaluate each scenario, (7) designing an effectiveness monitoring plan, (8) implementing a restoration scenario, and (9) initiating adaptive management. Oysters and their reef communities are being used in steps 2, 3, 5, and 7. Oyster growth, standing stock, recruitment, susceptibility to disease, living density, aerial extent of reefs, and the diversity and richness of the reef community serve as bioindicators of estuarine health (step 2). Step 3 is achieved either by comparing the present distribution of oyster reefs with pre-alteration, historical surveys or by comparison with neighboring pristine estuaries. The same aspects of physiology and ecology are used to define targets and performance measures (step 5). Finally, the restoration project's success can be gauged (step 7) by how close the system approaches a given target.

Special Session – Coastal Molluscan Assemblages as Environmental Indicators and Monitors of Restoration Efficiency

The Utility of Molecular Phylogenetics for Unionid Conservation: Identifying New Populations of the Endangered Winged Mapleleaf *Quadrula fragosa* (Bivalvia: Unionidae)

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Members of the freshwater mussel genus *Quadrula* are known for their conchological diversity and apparent phenotypic plasticity. For this reason, the taxonomy and validity of many *Quadrula* species have been controversial. One such species is the federally endangered winged mapleleaf, *Quadrula fragosa*, which historically occurred widely in the Mississippi, Tennessee, Ohio, and Cumberland river drainages. The species was believed to be extinct until a living population was rediscovered in 1985 in the St. Croix River between northwestern Wisconsin and east-central Minnesota. Recently, several *Quadrula* specimens have been found outside of the St. Croix River that appear morphologically similar to *Q. fragosa*. We used DNA sequence of the mitochondrial ND1 gene to determine the genetic distinctiveness of *Q. fragosa* from other *Quadrula* species and its phylogenetic placement in the genus. In addition, we tested the identification of putative *Q. fragosa* from Arkansas, Missouri, and Oklahoma using molecular phylogenetic methods. Our results indicate that *Q. fragosa* is a genetically distinct species and extant populations of this species exist in at least two localities outside of the St. Croix River.

Contributed Session IV – Freshwater Mollusks

Phylogeny of the Neogastropoda: A Morphological Perspective Considering Its Relationship with the Caenogastropoda

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During a decade the anatomy of almost 300 species of gastropods have been studied in detail. The first step of the project was to analyze representatives of each family of all superfamilies of the Caenogastropoda, defining phylogenetically each superfamily. The second step was to analyze the Caenogastropoda as a whole, having the superfamilies as terminal groups. The final result of these two phases of the project was to portray cladograms of each superfamily and another single cladogram with the superfamily ground plans as terminal taxa. A set of Patellogastropoda, Vetigastropoda, Neritimorpha, and Heterobranchia was used as outgroups. Based on this, Caenogastropoda can be defined by 39 morphological synapomorphies (from which six undergo reversions) and the cladogram arrangement has successively the following superfamilies: (1) Cyclophoroidea, (2) Ampullarioidea; (3) Viviparioidea; (4) Cerithioidea; (5) Rissooidea; (6) Stromboidea; (7) Calyptraeoidea; (8) Naticoidea; (9) Cypraeoidea; (10) Tonnoidea; (11) Conoidea; (12) Muricoidea; and (13) Cancellarioidea. Representatives of some of the presently considered caenogastropod superfamilies, not mentioned here, were actually mixed with these taxa. Neogastropoda resulted as a monophyletic taxon, supported by seven synapomorphies. The main goal is to focus on the neogastropod superfamilies. Some aspects will be explored, such as the present concept on the Conoidea taxonomy, in particular, which must be reanalyzed. The Cancellarioidea and the Muricoidea share at least three synapomorphies, and most probably they can be considered as a single superfamily. However, because of the high diversity and large number of included families, Muricoidea is still under analysis in the present level. The analysis of the Muricoidea itself is considered as large as the remainder of the project. The present phase aims at analyzing a set of each muricoidean family, which varies from 12 to 16 (according to different authors), defining phylogenetically each family and, at the end, to analyze the superfamily as a whole, with the family ground plan as terminal taxa. Some provisional results are given in the form phylogenetic analyses of the Pseudolividae, Marginellidae, Olividae, and Muricidae.

Symposium – Relationships of the Neogastropoda

Delineating the Distributions of Alien Terrestrial Mollusks in North America

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Many alien species of terrestrial mollusks are established in North America. With expanding world trade, the opportunity for the introduction of new alien species continues to increase. The potential costs of these alien species on agriculture or the environment are largely unknown, but potentially immense. Despite the possible risks posed by alien snails and slugs it is unclear in many cases which species are established in North America, especially among closely related species of slugs. While the distribution of native species in eastern North America is well known, the distribution of alien species is not. The USDA, through the Cooperative Agricultural Pest Survey (CAPS) program, is surveying anthropogenic and natural habitats to detect newly introduced snail and slug species and better delineate the distributions of previously reported alien species in North America. Preliminary results are reported for New York, Rhode Island, and West Virginia.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Terrestrial Mollusks from the Papuan Peninsula, Papua-New Guinea

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Surveys during 2002−2003 have uncovered remarkable radiations of terrestrial snails on the geologically complex and poorly sampled Papuan Peninsula, Papua-New Guinea. The eastern end of the peninsula includes the Cloudy Mountains to the south, and the disjunct terminus of the Owen Stanley Range to the north, separated from the main Owen Stanley uplands by extensive lowlands west of Mount Suckling. Many species appear to have distributions limited to particular mountain groups on the extreme eastern terminus of the Papuan Peninsula. Species in close proximity or sympatry share unique shell, genital, and radular characters, which suggests local speciation and poor dispersal ability. Diversity in eastern Papua-New Guinea has been underestimated and it is likely that there are many species yet to be discovered with narrow geographic and ecological ranges in the under-explored mountains of New Guinea.

Contributed Session II – Terrestrial Gastropods

Mapping the Potential Distribution of Invasive Mollusks in North America

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The Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine, of the United States Department of Agriculture is charged with protection in the United States of agriculture and environment from threats of exotic invasive pests, including mollusks such as *Achatina fulica* (giant African snail), *Monacha cartusiana* (cartusian snail), *Pomacea canaliculata* (channeled apple snail), and *Xerolenta obvia* (no common name). One of the management tools APHIS uses is predictive climatic mapping using Geographic Information Systems (GIS) to create maps. Such climatic maps assist in management and eradication strategies for invasive exotic mollusks.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Bayesian Inference of Anomalodesmatan Phylogeny (Bivalvia: Heterodonta)

Gerhard Steiner[1], Hermann Dreyer[1], and Elizabeth M. Harper[2]

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The morphologically heterogeneous and often highly aberrant Anomalodesmata became firmly established in recent molecular phylogenetic studies as one of the basal lineages of the Heterodonta. The relationships of the 14 anomalodesmatan family-level taxa have hitherto been assessed by 18S rRNA sequences only. Although several robust monophyla could be identified, e.g. that of Lyonsiidae + Pandoridae + *Brechites* and Thraciidae + Myochamidae, the basal nodes of the anomalodesmatan tree were found unstable. To improve resolution and branch support, we assembled a dataset of three ribosomal markers, 18S, 28S, and 16S rRNA, and morphological data. Separate and combined analyses of the molecular data using maximum parsimony, maximum likelihood, and Bayesian inference yielded similar topologies. Tree resolution and robustness, however, increased with combined data. Laternulidae is the well-supported sister taxon to the lyonsiid-pandorid clade, and this clade is sister group to the remaining anomalodesmatans. The thraciid-myochamid clade is confirmed, now including *Thraciopsis*. The relationships of the septibranchs remain unresolved although the monophyly of Poromyidae, Verticordiidae, and Lyonsiellidae is better supported than by 18S data alone. The identity and relationships of two *Myonera* species are enigmatic: They are not monophyletic, and neither clusters with the Cuspidariidae. Plotting morphological data on the molecular tree indicates extensive convergent evolution in several character complexes such as, for example, hinge morphology and shell microstructure.

Supported by the Austrian Science Fund (FWF) project P14356-BIO, and the Royal Society, London.

Poster Session

The Mitochondrial Genomes of Two Limid Bivalves, and Their Significance for Bivalve and Molluscan Mitochondrial Evolution

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Mitochondrial genome organization has become a valuable marker for phylogenetic reconstruction in Metazoa. In contrast to the highly conserved mitochondrial gene order in Arthropoda and Vertebrata, Mollusca are extremely variable in this aspect. Of the 15 presently available molluscan mt-genomes, those of the polyplacophoran *Katharina* and the squid *Loligo* most closely resemble that of other invertebrates. The Bivalvia contribute significantly to the variability sharing only few gene junctions with *Katharina*. The high rate of gene rearrangements and the small taxon sample for bivalves make it difficult to use of the mt-genome data for phylogenetic inference. To better assess the phylogenetic signal in mt-gene order we sequenced the mt-genome of two species of the pteriomorph family Limidae, *Limaria hians* and *Lima inflata*. In both species, all genes are encoded on the same strand and the gene for the ATPase-8-subunit is missing. *Limaria hians* possesses multiple tRNA genes for Val, Phe, Cys, and Gln, whereas *Lima inflata* features two tRNA-Pro genes. A putative origin of replication is located between *nadh6* and *cox1*. The two limids have similar gene arrangements differing only in the position of *nadh5* and the relative position of *cox3* + *nad3* to *rrnS* + *rrnL* (disregarding tRNAs). Comparison with other molluscan mt-genomes shows the two limids less similar to other bivalves than to the polyplacophoran *Katharina tunicata*. This result indicates that high gene rearrangement rates is not a common bivalve feature but may have originated independently several times in their evolutionary history.

Supported by the Austrian Science Fund (FWF) project P16954-B12.

Contributed Session III – Marine Mollusks

Chemical Control of Invasive Snails: The Approach and Strategy Utilized by USDA, APHIS, PPQ Toward Eradication

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Three sites for quarantine of invasive snails at different stages of chemical eradication efforts are located in Sunny Point, North Carolina; Detroit, Michigan; and Chicago, Illinois. Six invasive species targeted include *Monacha syriaca* (Ehrenberg, 1831), *Monacha cartusiana* (Müller, 1774), *Cernuella virgata* (Da Costa, 1778) *Trochoidea pyramidata* (Draparnaud, 1801), *Xeropicta* sp., and *Xerolenta obvia* (Menke, 1828). Site evaluation forms the foundation of the eradication process. By factoring population size, obstacles, and environmental parameters (including impacted parties) a grid can be set for treatment. A treatment plan may also include countermeasures for problematic snail host material and terrain. Mini-pelletized metaldehyde bait has proven to be the chemical of choice thus far in eradication. The Sunny Point site initiated the search for an appropriate formulation and the need to address product labeling issues. For more than sixty years, the chemical metaldehyde has been at the forefront of molluscicides and has proven effective when applied according to label instructions. Invasive species eradication requires planning that is adaptable and receptive to innovative and changing conditions.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Utility of Kidney Morphology in Phylogeny of the Neogastropoda

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Ever since the landmark study by Rémy Perrier on the anatomy and histology of the kidney of "prosobranch" gastropods published in 1889, it has been recognized that neogastropods possess kidneys with two distinct lobes of lamellae of separate structure and function. Although this fact was acknowledged many decades ago, few investigators since that time have examined organization and circulation patterns of neogastropod kidneys in detail. Typically, only degree of interdigitation of the primary lamellae (supplied by the ventral branch of the afferent renal vessel) and secondary lamellae (supplied by the dorsal branch of the afferent renal vessel) has been indicated in descriptions of the kidney — an attribute that has been shown to vary within some neogastropod families. Thus, this organ system has remained relatively poorly known. More importantly, existing descriptions have not been placed into a comparative framework with specific hypotheses of homology. The result has been that, with rare exception, neither gross nor fine structure of the renal organ has been used as a potential resource for characters in phylogenetic analyses of the Neogastropoda, nor in hypotheses of sister-group relationship to the latter. However, recent studies have revealed a number of new characters relating to renal organization and circulation. These characters will be reviewed in a broad comparative context, including interpretations of homology to other caenogastropod kidneys and the potential relevance of these characters in assessing the relationships and affinities of neogastropods.

Symposium – Relationships of the Neogastropoda

Hitchhiking Mollusks on Tile Shipments from Italy

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Snails are frequent hitchhikers in Italian tile shipments entering the United States. Italian tile products, including ceramic tile, limestone, granite, and other quarry products are imported into the United States in large quantities and thus represent a major pathway of entry for snails of agricultural concern. Miami, Florida, receives the largest quantities of any seaport in the United States, with more than 12000 containers a year. An analysis of Italian tile mollusk interceptions by federal inspectors in Miami from 1997−2003 indicate that they are concentrated around two months: November and May. This bimodal pattern of occurrence may be associated with seasonal aestivation and/or dispersal behavior of the snails commonly found: *Cernuella cisalpina, Hygromia cinctella*, and *Xerotricha conspurcata* (Hygromiidae) and *Cryptomphalus aspersus* and *Eobania vermiculata* (Helicidae). Pallets of tile awaiting shipment are often stored in or adjacent to weedy fields and it is hypothesized that snails seeking aestivation and new hiding sites preferentially crawl into these pallets most frequently during these times of year.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Achatina fulica in Brazil: The Current Situation

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The giant African snail *Achatina fulica* Bowdich, 1822, was introduced into Brazil, for commercial purposes ("escargot" farming), probably in the state of Paraná, in the 1980s. It is now widespread in at least 15 of the 26 Brazilian states, including the Amazonian region and some islands, such as Ilha Grande in the state of Rio de Janeiro. Among the reasons for the rapid dispersal of *A. fulica* is its high reproductive capacity and the tendency for people to release specimens into the wild. *Achatina fulica* generally occurs in dense populations in urban areas where it attacks ornamental gardens, vegetable gardens, and small-scale agriculture. Also of concern is the damage caused to the environment, and the effects on native terrestrial mollusks, as seen in other countries where the snail has been introduced. In addition to its importance as an agricultural and environmental pest, its role in the epidemiology of the transmission of helminthoses of medical and veterinary interest should be considered. It may act as intermediate host of *Angiostrongylus cantonensis* (Chen, 1935), a nematode that can cause meningoencephalitis in humans, reported in some Asian countries and Pacific islands. It is also considered potential host of another congeneric species *Angiostrongylus costaricensis* Morera and Céspedes, 1971, causing abdominal angiostrongylosis, a zoonosis that occurs from the southern United States to northern Argentina.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

Status of *Melanoides tuberculatus* in Brazil

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The first record of the Afro-Asiatic *Melanoides tuberculatus* (Müller, 1774) in Brazil was in 1967 in Santos, state of São Paulo. Since then, it has been recorded in the states of Ceará, Distrito Federal, Minas Gerais, Paraíba, Rio de Janeiro, Paraná, Santa Catarina, Bahia, Espírito Santo, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Pernambuco, Piauí, Rio Grande do Norte, and Tocantins. This species has been studied as intermediate host in helminthoses of medical and veterinary interest and is known to displace native species. The alarming spread of *M. tuberculatus*, the lack of any control or monitoring, and the relatively little amount of information available on Brazilian freshwater mollusks indicate that serious damage to the ecosystem and probable implications to public health are to be expected.

Contributed Session IV – Freshwater Mollusks

The Allen Archer Collections at Auburn University:
A Global Portrait of Terrestrial Snail Biodiversity

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Allen Frost Archer authored about 26 scientific papers and described a number of terrestrial snail taxa in a malacological career that spanned more than 30 years. When the Auburn University Natural History Learning Center and Museum (AUNHLCM) acquired the collection of Dr. John C. Hurd (LaGrange College, Georgia) in 2002 it also received approximately 1600 lots of terrestrial snails comprising the personal collection of Allan Archer. This material includes representatives of at least 60 presently recognized land snail families. Many specimens predate Dr. Archer's collecting career and were presumably obtained by trades with museums. One of Dr. Archer's many areas of interest was polygyrids of southeastern North America, and his collection includes 216 lots, 21 genera, and 84 species of polygyrids. Camaenids are the second most diverse group in the Archer collection with 133 lots, 70 species and 19 genera represented. Dr. Archer's collecting activities were not restricted to southeastern North America; during the later years of his life he made collections from throughout North and South America, Europe, Asia, and many Pacific and Caribbean Islands. The AUNHLCM invites malacologists to use this historic resource.

Poster Session

A Joint Venture for the American Malacological Society, American Fisheries Society, and Others — Building an Aquatic Species Inventory and Prototype Warning System for Invasive Species

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Managers need to know when a species is introduced to their region and where they can get information on whether it will become invasive to help them formulate response strategies. With a warning system, managers will be better prepared to prevent alien species and mitigate impacts. To meet the needs of living resource managers, the National Ocean Service, the United States Geological Survey, the Smithsonian Institution, the American Fisheries Society (AFS), and many others initiated in Fiscal Year 2002 a project that will produce:

- An up-to-date inventory of United States and Canadian aquatic species
- A reporting and verification system for species not on the inventory
- Timely warnings for species new to aquatic ecosystems
- Risk assessments/information on alien species

That project, implemented through *A Hawaiian Pilot Inventory and Warning System,* is now being tested. Data from other regions will be added in Fiscal Year 2004, including monitoring data and species lists from the Gulf of Mexico and Alaska that are being gathered to prepare the third edition of the *Names of Mollusks* (an AMS and AFS partnership since 1983). A draft United States and Canadian species inventory and warning system could be ready as early as Fiscal Year 2008. Visitors to the Web site will be able to check new collections against a baseline inventory of United States and Canadian species, map distributions, and get in-depth information on invasive species. If a species not on the inventory is confirmed as alien, a warning will be posted automatically to managers.

Contributed Session III – Marine Mollusks

What is New on the Biodiversity of Opisthobranch Mollusks?

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Understanding the origins and causes of the Recent diversity of opisthobranch mollusks has been hampered by the absence of comprehensive inventories, reliable phylogenetic hypotheses, and information management tools. In recent years, the availability of comprehensive databases on the Internet (Clemam, Malacolog), has provided malacologists with new tools to access and analyze large amounts of distributional information. Analyses of these data have produced interesting new evidence on dispersal patterns with broad implications for addressing regional biodiversity questions. Additionally, new available phylogenetic hypotheses have revealed repetitive patterns in different clades of opisthobranchs that indicate strong evidence for major vicariant events that would have shaped the evolutionary history of this group. Finally, intensive deep-sea collecting in the tropical Indo-Pacific (MUSORSTOM Expeditions) has revealed an unexpectedly rich opisthobranch deep-sea fauna, and produced a wealth of distributional and bathymetric data. The analysis of these data in the framework of phylogenetic systematics has provided a new interpretation on the processes involved in the evolution of deep-sea opisthobranchs. This presentation discusses some of these new findings and suggests hypotheses that attempt to explain global and local biogeographic patterns within some opisthobranch clades.

Special Session – Biodiversity of Marine Mollusks

Diversity of Hosts and Form in Commensal Galeommatoidean Bivalves

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Most, if not all, of the species represented in the Galeommatoidea (Bivalvia) live in association with an invertebrate host or assemblage. The galeommatoids are found in all oceans and embody an impressive array of shell and body forms, often reflecting their host relationships. Recent molecular and reproductive studies have suggested that many species are difficult to discriminate using traditional morphological methods, and thus indicate a far more diverse galeommatoid fauna than previously assumed.

Special Session – Biodiversity of Marine Mollusks

Foraging by the Hydrothermal Vent Octopus,
Vulcanoctopus hydrothermalis

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Octopuses of *Vulcanoctopus hydrothermalis* appear to be endemic to hydrothermal vents on the East Pacific Rise. During DSV ALVIN dive 3939, I observed a dozen individuals of this species of octopus on sulfide spires adjacent to a giant tube worm (*Riftia pachyptila)* cluster at Parigou, a vent near 13° N. Three swarms of the vent amphipod, *Halice hesmonectes*, which can reach densities of up to 1000 individuals per cubic liter, were positioned near the base of the spires, over the tube worms. The octopuses repeatedly opened their arm crown and extended their web to sweep the immediate area, including the amphipod swarm. The octopuses then closed their web, beginning at the arm tips with the contraction moving toward the mouth. To determine whether the octopuses, which had been reported to prey on crabs, were foraging on amphipods, the pelagic sampler of the ALVIN sampled the swarm and its multi-chamber suction sampler collected four octopus specimens. The specimens were preserved after the submersible emerged, roughly two hours later. Dissection of the octopuses revealed amphipods *H. hesmonectes* in their digestive tract. The use of tactile feeding by this species living at more than 2600 m depth is not surprising, as light would appear to be limited in this habitat. Speculative hunting that targets the water column rather than the sediment or rock has to my knowledge never been previously reported.

Contributed Session III – Marine Mollusks

Unlocking the Key to Flow in Fissurellids

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Most fissurellids, or keyhole limpets, are characterized by a cap-shaped shell with an apical opening. Their mantle cavities contain paired organs, including a large pair of gills, which are believed to represent the primitive condition for gastropods. The apical opening has been proposed to function to prevent incoming clean seawater from mixing with waste-laden excurrent water. This is supported by the pattern of flow in these animals; water enters at either side of the head, passes through the gills, and exits through the apical opening. Some species of keyhole limpets, however, lack an apical opening. We compared the patterns of flow and morphology of fissurellids that have apical openings with those that do not. The Australian fissurellid *Amblychilepas negrita* and the North American *Diodora aspera* have apical openings and the expected flow-through pattern of mantle circulation. The Australian fissurellids *Scutus antipodes*, *Clypidina rugosa*, and *Tugali parmophoidea*, which lack apical openings, formed siphons at the central anterior regions of their mantles through which the water exited their mantle cavities. In addition, they brought their gills together in a point above their heads, thus using the gills to manipulate the flow.

Contributed Session I – Marine Gastropods

Terrestrial Snail Survey of the Sipsey Wilderness Area in Northwestern Alabama

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A survey of terrestrial gastropods was conducted from August 2003 to the spring of 2004 in the Sipsey Wilderness area of northwestern Alabama, which is located within Bankhead National Forest. Snails were collected by hand and from samples of leaf litter from 13 sites. To date, 50+ species have been found representing ~14 families of snails. The findings revealed several species that were not reported in previous surveys conducted in the 1960s by L. Hubricht. These results indicate a need for more detailed survey work of terrestrial snails.

Poster Session

Impact of Boat Wakes on Intertidal Reefs of the Oyster C*rassostrea virginica:* A Comparison of Reefs in South Carolina Tidal Channels Versus a Florida Estuary

Linda Walters[1], Loren D. Coen[2], Paul Sacks[1], Jeffrey Grevert[1], and Jennifer Stiner[1]

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Resource managers are increasingly concerned that huge increases in recreational boating activities may be negatively impacting intertidal reefs generated by the Eastern oyster, *Crassostrea virginica,* now viewed as an economically and ecologically important species. Using a variety of hull designs, engine profiles (trim angles) and velocities, we experimentally evaluated the impact of recreational boating on reefs from two of the dominant habitat types in the southeastern United States: (1) narrow tidal channels in South Carolina with 1–2 m tidal range, and (2) shallow estuaries in Florida with small tidal amplitudes. In replicated trials, we have been measuring shell dispersal (as it is an excellent proxy for oyster recruitment success) using painted surfaces, turbidity, wind speed, and flow rates generated after each replicated boat pass. Wind alone rarely moved shells. However, significant shell movement and turbidity spikes were associated with boat-generated wakes. The results were especially dramatic on the sheer slopes of SC tidal channels and on reefs in Florida estuaries where prior activity (harvesting or die-offs) created steeply sloped, unstable accumulations of disarticulated shells along the seaward edges of the oyster reefs. Specifically, for Florida, when reef-wake distance was maximized, very few shells were dispersed, even at high speed, whereas in South Carolina, all vessels tested moved shells in large numbers. Implications are discussed for restoration and shellfish resources.

Poster Session

A Molecular Phylogeny of Physidae (Gastropoda: Basommatophora) Based on Mitochondrial DNA Sequences

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The family Physidae (Pulmonata: Basommatophora) is a group of freshwater hermaphroditic snails that have a Holarctic distribution with extension into Middle and South America. Despite considerable literature justifying various taxonomic schemes and groupings, no classification has been proposed using modern phylogenetic methods. In an effort to expand what is known concerning the evolutionary relationships of Physidae, we examined a portion of the mitochondrial 16S rRNA and cytochrome c oxidase subunit I (COI) genes from 66 specimens representing 28 taxa. The molecular phylogeny based on mitochondrial sequences supports the monophyly of the family Physidae, with the Planorbidae+Ancylidae clade representing the closest related basommatophoran families. There were six major Physidae clades uncovered in the analysis, which corresponded to penial morphology. These six groups include the following recommended phylogenetic species and species groups: *Aplexa* (*Aplexa*) *elongata* (Say), *Aplexa*-1 group; *Physa* (*Stenophysa*) *marmorata* Guilding, *Aplexa*-3 group; *P*. (*Physa*) *fontinalis* (Linneaus), *P*. (*Physa*) *jennessi* Dall, and *P*. (*Physa*) *vernalis* Taylor and Jokinen, *fontinalis* group; *P*. (*Physella*) *gyrina* Say and *P*. (*Physella*) *ancillaria* Say, *gyrina* group; *P*. (*Alampetista*) *acuta* Draparnaud, possibly *P*. (*Alampetista*) *billingsii* Heron, *P*. (*Alampetista*) *spelunca* Turner and Clench, *P*. (*Alampetista*) sp. (John's Island) and *P*. (*Alampetista*) *zionis* Pilsbry, *acuta* group; and *P*. (*Costatella*) *pomilia* Conrad and *P*. (*Costatella*) *hendersoni* Clench, *pomilia* group.

Contributed Session IV – Freshwater Gastropods

Cytochrome Oxidase I (COI) Sequence in Florida *Isognomon alatus* – Implications for Systematics and Population Genetics

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Samples of *Isognomon alatus* were taken from the shoreline of Florida, with the northernmost populations being found in Clearwater on the western side of the peninsula and near Fort Pierce on the eastern side. Partial COI sequences were isolated from individuals sampled from these populations using the primers developed by Matsumoto. These sequences are then compared to existing sequences from other species within the family to form a rudimentary phylogenetic tree and compared among each other using both AMOVA and Bayesian clustering techniques to show population boundaries along the coastline of Florida.

Supported by NSF-PEET DEB-9978119.

Poster Session

The Quarantine Procedures in the Caribbean and the Potential Agricultural Impact on the United States

Frederick J. Zimmerman

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Agricultural quarantine procedures were reviewed in the Lesser Antilles and serious quarantine issues were identified that could jeopardize the agriculture of neighboring islands in the Caribbean and the United States. Problems included: minimal inspection of agricultural cargo, little training of agricultural employees, customs officials making agricultural decisions, extreme financial stress and frequent lack of access to computers, microscopes, and other equipment. Some islands are located in close proximity to islands infested with one or more species of giant African snails, but do not have adequate cargo inspection procedures to prevent their introduction. Some airport customs declarations did not require travelers to declare snails or slugs upon entry to the islands and baggage inspections were rare to minimize the inconvenience to tourists. Increasing mollusk identification fees in remote locations, the lack of local malacology taxonomists, and few recent local mollusk surveys indicate a tremendous need for malacologists that could identify newly introduced and already present mollusks. While trade and tourism continues, the potential threat of invasive pests entering or spreading in the Lesser Antilles and ultimately to the United States, becomes even greater as more islands become infested with mollusk, noxious weed or insect pests, or infected with plant or animal diseases.

Special Session – Snails and Slugs as Agricultural and Horticultural Pests

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Papers scheduled for the next issue include:

High levels of mitochondrial DNA sequence divergence in isolated populations of freshwater snails of the genus *Goniobasis* by R. T. Dillon, Jr. and Robert Frankis, Jr.

Leopold von Buch's legacy: Treating species as dynamic natural entities, or why geography matters by M. Glaubrecht

Intraspecific competition and development of size structure in the invasive snail *Potamopyrgus antipodarum* by D. C. Richards and D. C. Shinn

Morphology and phylogenetic relationships of genera of North American Sphaeriidae (Bivalvia, Veneroida) by T. Lee

Behavior, morphology, and the coexistence of two pulmonate snails with molluscivorous fish: A comparative approach by C. M. Mower and A. M. Turner

I look forward to receiving your manuscripts!

Janice Voltzow
AMB Editor
Department of Biology
University of Scranton
Scranton PA 18510-4625
voltzowj2@scranton.edu

THE AMERICAN MALACOLOGICAL SOCIETY

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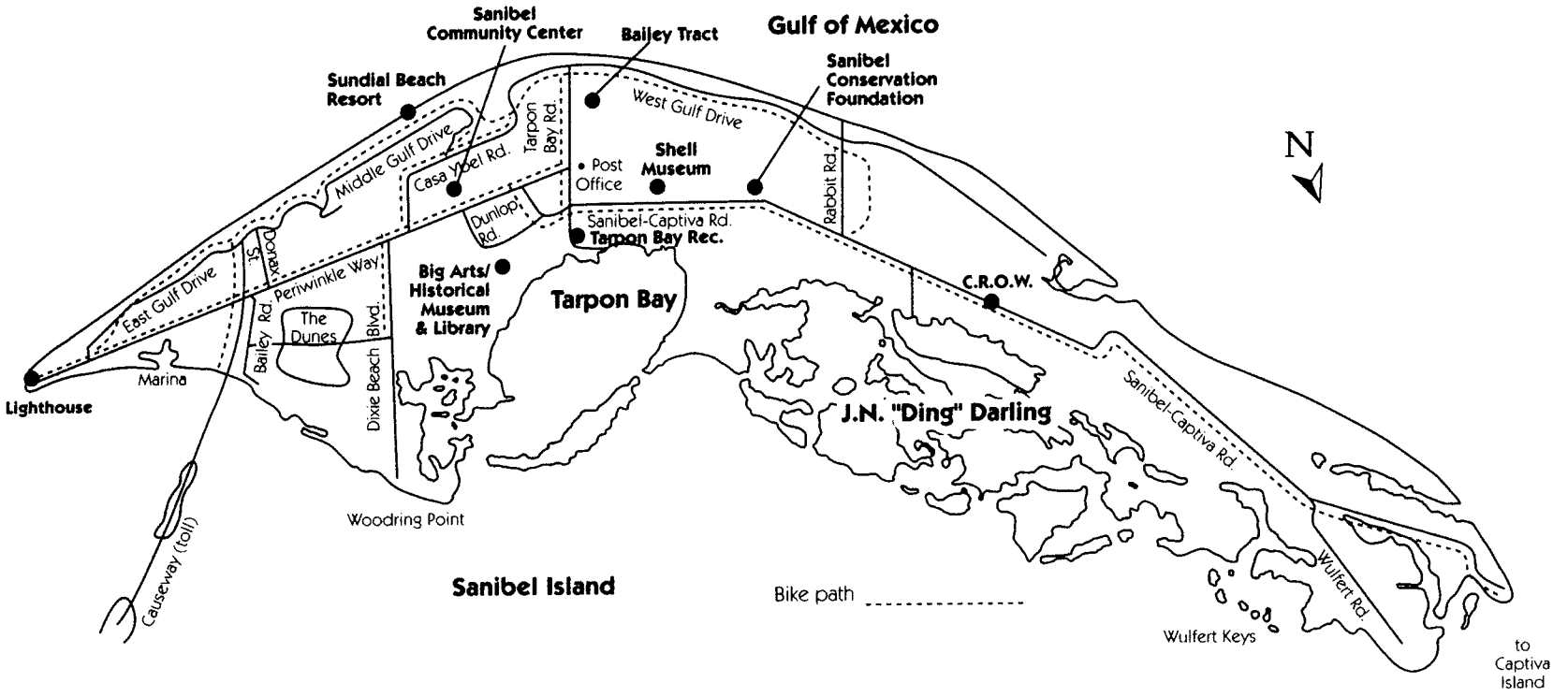
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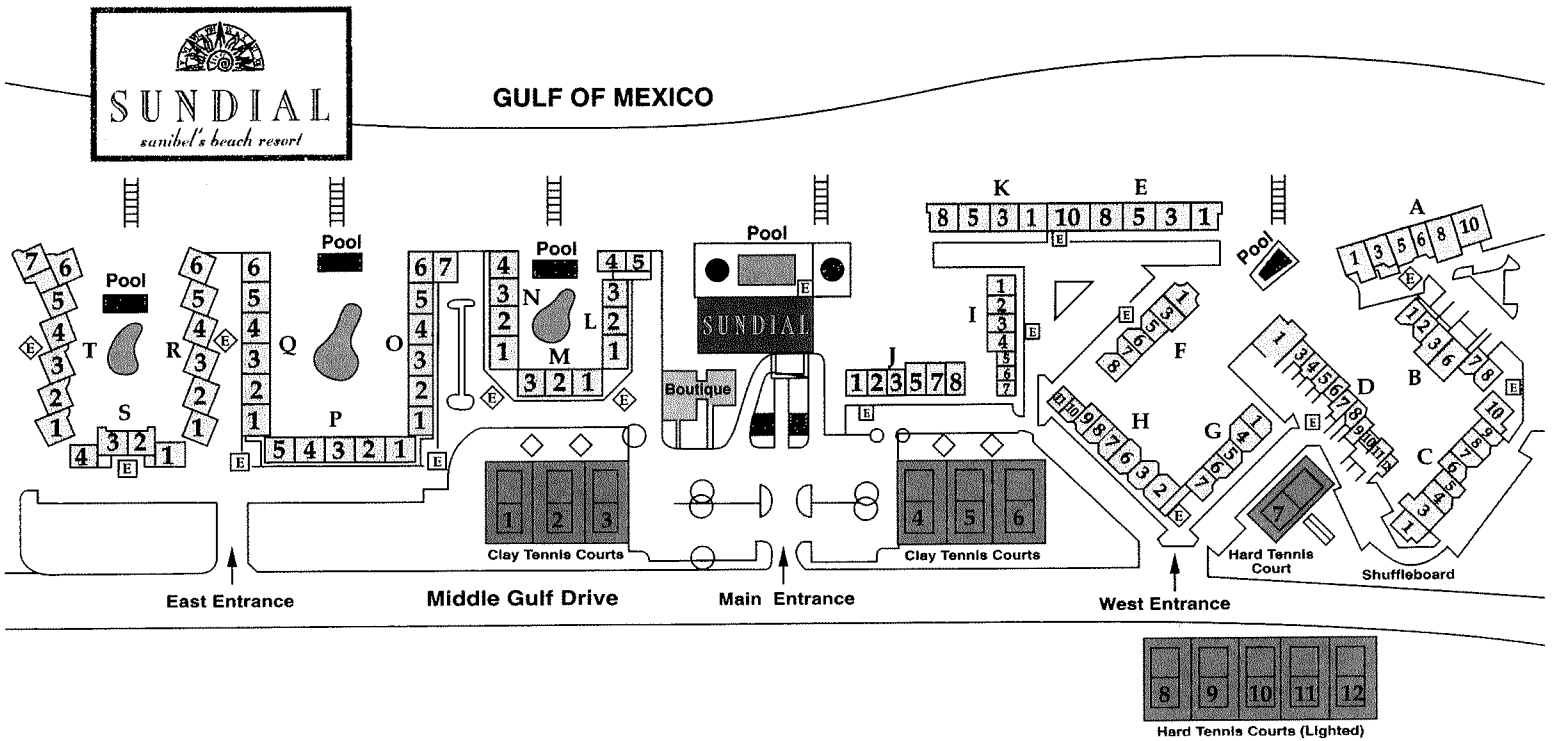
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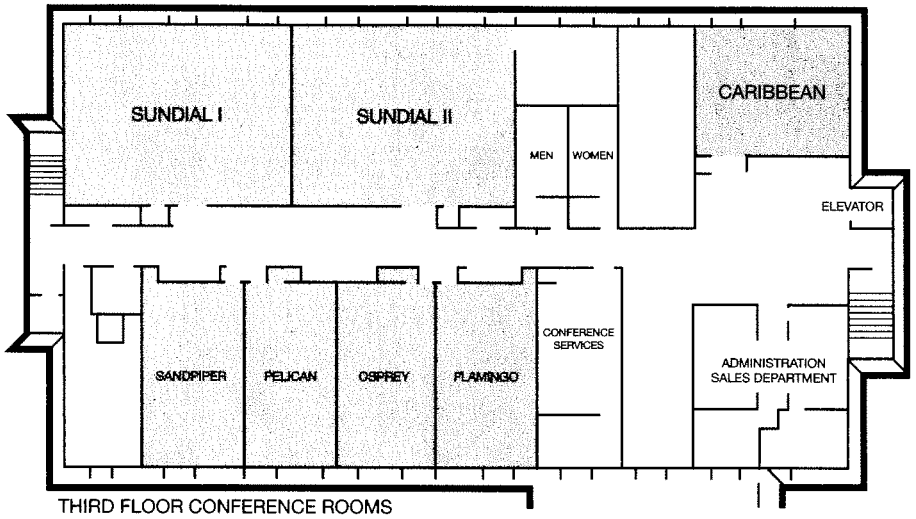

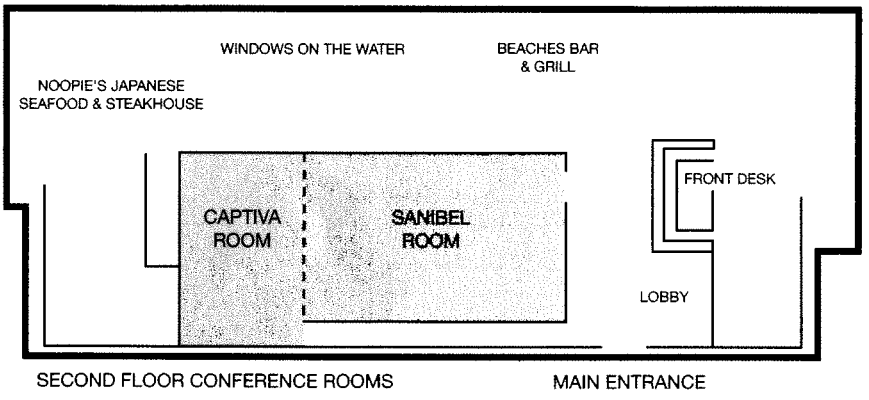

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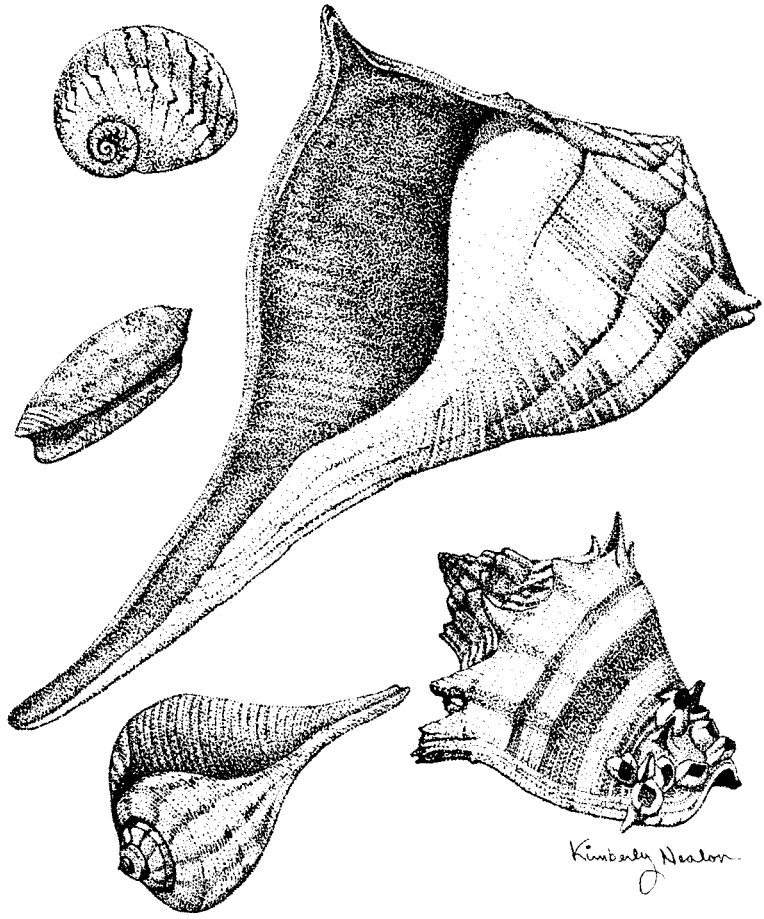

"Seashells of Sanibel", by Kimberly Nealon

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Sanibel Island, Florida

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