

**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 (35° 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 Streptacidae
(Gastropoda: Heterostropha)**

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The family Streptacidae 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 Streptacidae 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 m² (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/m² versus 500–7000 oysters/m² 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 m² 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 LC₅₀s could not be determined based on the low mortality rates. Juvenile EC₅₀ 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. villepini*, *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 fascioliid 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 COI 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 1m² 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*, *punguis*, 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 $x=13$, 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