PROGRAM AND ABSTRACTS

FIFTY-THIRD ANNUAL MEETING

Marriott's Casa Marina Resort 19-23 July 1987

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AMERICAN MALACOLOGICAL UNION

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1986-1987

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Shell Club Program	Walter E. Sage, III

PROGRAM SUMMARY

Note: Please check the bulletin board at the registration table for additional information and program changes.

Sunday, July 19

Monday, July 20

Tuesday, July 21

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Thursday, July 23

Maude N. Meyer Student Paper Award

An award is given annually for the best paper delivered by a student at the AMU meeting. The recipient of the award is selected by a team of judges who evaluate scientific content, adequacy of research approach, organization of the presentation, quality of visual aids, and the manner in which the presenter handles questions and answers. The twelve papers entered in this year's competition are indicated by asterisks on the session schedules.

The 1987 award of $500.00 is given in memory of Mrs. Maude N. Meyer, Captiva Island, Florida, a member of the American Malacological Union for many years, an enthusiastic shell collector, and an ardent conservationist.

REGISTRATION

The registration table will be open for those wishing to register or arrange tickets for the field trips or banquet. Tables for sales of AMU publications and T-shirts will be adjacent to registration. The tables will be located in the Plantation Key Room (a section of the ballroom) on Sunday-Tuesday but will move to the Sunrise/Sunset Room downstairs on Wednesday afternoon.

ACTIVITIES

President's Reception

All registrants and their families are invited to the poolside reception Sunday evening. Mixed drinks, soft drinks, and snacks will be provided. Come and renew old acquaintances or make new ones. In case of inclement weather, the reception will be moved to the Keys Ballroom.

Sales and Exhibits

Exhibits Chairman Edward C. Nieburger has arranged for a special Dealers' Exhibits and Sales Area in the Sunrise-Sunset Room on the lower concourse (below the first floor) on Monday, July 20 (1:30 to 5:30 p.m.) and Tuesday, July 21 (9:00 a.m. to 5:00 p.m.). Shell exhibits and representatives for malacological publications will be present in the Coral Reef and Seabreeze Rooms, also on the lower concourse, from Monday through Thursday.

Conch Train Tour

All registrants and their families are invited to participate in the Conch Train Tour following the presentation of papers on Monday afternoon, July 20. There is no charge for this special AMU activity. The Conch Train is scheduled to depart from the Casa Marina at 5:30 p.m. and return by 7:00 p.m. Don't miss this opportunity for a guided tour of historic Key West, the capital of the Conch Republic.

Shell Club Program

The Monday evening program will include brief talks by representatives of the many shell clubs present, followed by several slide shows. Organizer Walter E. Sage has put together a program featuring fascinating presentations by a shell collector, a dealer, and a professional malacologist.

Field Trip Previews

If you're going on one of the field trips, don't miss the previews Tuesday evening. This is where you'll learn where you're going and what you can expect to see. Brief presentations will be made by trip leaders Billy Causey (Sanctuary Manager, Looe Key National Marine Sanctuary), Kerry Clark and Kevan Sunderland (nearshore marine) and Jane Deisler (terrestrial and freshwater).

Auction

The annual auction of books and malacological paraphernalia is one of the highlights of every AMU meeting. Many interesting and valuable items will be on the block this year, according to auctioneer extraordinaire Dick Petit. All auction proceeds go the the symposium endowment fund which provides support for speakers at symposia of the annual meeting. Don't miss this opportunity to improve your library while supporting a vital function of AMU.

Business Meeting

The annual business meeting will commence following the close of contributed papers on Thursday afternoon. This is where the dollars and sense of the AMU are established. Members are encouraged to come and participate in deciding the future of your organization.

Social Hour and Banquet

A marvelous way to unwind after the week's activities. Thursday evening will begin with a social hour (cash bar) followed by a buffet dinner featuring a menu of delicious local cuisine.

Salad Bar, with all the fixings
Marinated Cucumbers and Tomato with Oregano and Goat Cheese
Shell Macaroni with Gulf Seafood
Fresh Tropical Fruit Salad

Conch Fritters
Oysters on the Half Shell

Baked Catch of the Day
Cuban Style Roast Pork
Arroz con Pollo
Black Beans
Fried Plantains in Brown Sugar Syrup
Red Potatoes
Fresh Garden Vegetables

Garlic Bread

Key Lime Pie
Rum Cake

Coffee, Tea, Brewed Decaffeinated

Banquet tickets will be available at the registration table until 5:00 p.m. on Wednesday, July 22.

We hope the weather will cooperate; if it doesn't, Thursday evening's events will move indoors to the Keys Ballroom.

Monday Morning, July 20

SYMPOSIUM: CENOZOIC MOLLUSCAN COMMUNITIES OF THE AMERICAS. Convener: Emily H. VOKES, Dept. of Geology, Tulane University, New Orleans, Louisiana.

8:00 **WELCOME**

8:20 **NORTH AMERICAN PALEOGENE MOLLUSCAN BIOGEOGRAPHY: AN OVERVIEW.** Charles R. GIVENS, Dept. of Earth Science, Nicholls State University, Thibodaux, Louisiana.

8:40 **EOCENE FAUNAS OF TEXAS.** Richard J. ERICKSON, Tulsa, Oklahoma.

9:00 **THE FAUNA AND ECOLOGIC AREAS IN THE CHIPOLA FORMATION, NORTHWESTERN FLORIDA.** Emily H. VOKES, Department of Geology, Tulane University, New Orleans, Louisiana.

9:20 **BIVALVE PALEOECOLOGY AND THE PALEOENVIRONMENT OF THE MIOCENE CHIPOLA FORMATION OF FLORIDA.** George E. MOLLYN, Dept. of Geology, Tulane University, New Orleans, Louisiana.

9:40 **BREAK**

10:10 **EVOLUTION OF THE PATELLOGASTROPODA FAUNA OF THE CARIBBEAN SEA DURING THE NEOGENE.** David R. LINDBERG, Museum of Paleontology, University of California, Berkeley, California.

10:40 **STRATIGRAPHIC DISTRIBUTION OF THE NEOGASTROPOD FAMILY TURRIDAE IN THE DOMINICAN REPUBLIC NEOGENE.** Matthew J. JAMES, Dept. of Geology, Sonoma State University, Rohnert Park, California.

11:00 **NEOGENE FAUNAS OF NORTHWESTERN ECUADOR.** William D. PITT, Dept. of Geology, California Academy of Sciences, San Francisco, California; and Lois J. PITT, Sacramento, California.

11:20 **PALEOECOLOGY OF MIOCENE-PLIOCENE HYOTISSA HAITENSIS (SOWERBY) ASSEMBLAGES (BIVALVIA: GRYPHAEIDAE), TAMIAMI FORMATION, SOUTHWEST FLORIDA.** John F. MEEDER, National Audubon Society, Abbeville, Louisiana.

11:40 **GASTROPOD FAUNA OF THE PLIOCENE EVERGLADES ATOLL.** Edward J. PETUCH, Dept. of Geology, Florida Atlantic University, Boca Raton, Florida.

12:00 **LUNCH**

DEDICATION

This paper was scheduled to be presented by Mr. R. Jerry Britt, Jr., a Ph.D. candidate in the Department of Geology at the University of Florida. Regrettably, Jerry drowned on Friday, June 5, 1987, while collecting shells off Lido Beach, Sarasota, Florida. His untimely death has deprived the fields of malacology and paleontology of a brilliant and dedicated scholar, who, despite his youth, has made significant contributions to science. The Symposium on Cenozoic Molluscan Communities of the Americas is dedicated to his memory.

BIOSTRATIGRAPHY AND PALEOECOLOGY OF AN UPPER PLIOCENE CHOWAN RIVER FORMATION EQUIVALENT UNIT FROM ELIZABETHTOWN, NORTH CAROLINA.

BRITT, Jr., R. Jerry, Florida State Museum, Gainesville, FL 32611

A Neogene shell bed near Elizabethtown, North Carolina, which has yielded a specimen of the microtine rodent Pliopotamys cf. P. meadensis (Hibbard, 1938) about 2.5 MY old, contains demonstrably upper Pliocene mollusks in a Chowan River Formation equivalent unit. The locality lies temporally and geographically between putative classic Duplin and Waccamaw sites. The upper Pliocene molluscan fauna is dominated by shallow-water sand and mud dwellers. The deposition of the shallowing-upward upper Pliocene shell bed sequence (Type IV concentration) reworked lower Pliocene lower Duplin Formation sediments, which had themselves reworked upper Cretaceous Black Creek Formation sediments during deposition. The concurrent occurrence of the mollusks Noetia limula (Conrad, 1832) and Glycymeris subovata (Say, 1824) corroborates an upper Pliocene (M4) age for most, if not all, of the section. A lower biostromal oyster unit corresponding to a shallow bay deposition may be correlated with either slight regression or prograding fluvial deposition. Most of the mollusks from the upper part of the section seen to be classic r-strategists who rapidly invaded and/or evolved to invade a suddenly available vast shallow-water shelf.

Abstracts

NORTH AMERICAN PALEOGENE MOLLUSCAN BIOGEOGRAPHY: AN OVERVIEW.

GIVENS, Charles R., Department of Earth Science, Nicholls State University, Thibodaux, LA 70310

The distribution of North American Paleogene shallow marine mollusks defines three broad provinces: Gulf-Atlantic shelf, Pacific shelf, and Caribbean. These provinces were established during early Paleocene (Danian) time, following mass extinction of indigenous Cretaceous faunas. Immigration from the western Tethys province played a significant role in establishing the initial Paleogene faunas of the Caribbean and Gulf-Atlantic provinces. During the late Paleocene through middle Eocene interval of warm and equable climate, the shelf provinces experienced several additional episodes of immigration from the Caribbean and Tethyan regions. The provincial barriers at these times functioned as filter bridges, with the Pacific province receiving the majority of the Tethyan elements. These barriers were probably boundaries between water masses of different temperature, salinity, and turbidity, although competitive exclusion may also have been an important factor. In the Gulf-Atlantic shelf province, immigration events generally (1) coincided with marine transgressions resulting from eustatic rises in sea level and (2) followed episodes of extinction correlated with constriction and/or subaerial exposure of shelf habitats during eustatic low stands of sea level.

EOCENE FAUNAS OF TEXAS.

ERICKSON, Richard J., Post Office Box 690955, Tulsa, Oklahoma 74169

The systematics and ecology of Eocene molluscs of Texas are not as thoroughly studied as the Eocene faunas of Mississippi and Alabama. Although many of the eastern species are present in Texas, a recent survey of Eocene gastropods from a locality on the Little Brazos River, Brazos County, Texas, found about 150 species, of which 4 represent new genera and over 30 are new species. For species found in Texas and in the eastern Gulf region, the Texas specimens tend to be smaller. Some interesting ecological oddities were found in this survey. A single specimen of the genus Lippistes, which is now found only in high-latitude, cold-water seas, was found in a warm-water gastropod community.

THE FAUNA AND ECOLOGIC AREAS IN THE CHIPOLA FORMATION, NORTHWESTERN FLORIDA.

VOKES, Emily H., Department of Geology, Tulane University,New Orleans LA 70118

The Chipola Formation of late Early Miocene (Burdigalian) age outcrops only in the vicinity of Blountstown, Calhoun County, in northwestern Florida. The area of outcrop is found along the Chipola River, and two of its tributaries, Tenmile Creek, from the west, and Farley Creek, from the east. In all, about 7 linear miles of outcrop gives a remarkable access to a number of different ecologic situations, ranging from shoreline to back-reef flat, to coral-reef. As a result of this ecologic diversity, the molluscan fauna is extremely large. Using the percent increase seen in certain families monographed since Gardner's (1926-1950) original monograph and extrapolating to the entire fauna, a total of 1100 molluscan species is not unreasonable.

BIVALVE PALEOECOLOGY AND THE PALEOENVIRONMENT OF THE MIOCENE CHIPOLA FORMATION OF FLORIDA.

MOLLYN, George E., Department of Geology, Tulane University, New Orleans, La.

The Miocene Chipola Formation of the Florida panhandle has a very well-preserved and an extremely diverse marine invertebrate fauna. The distribution and abundance of 165 species of bivalves were determined from bulk sediment samples. The data were statistically analyzed and grouped using both Q- and R-mode cluster and discriminant analyses. The samples grouped into ten biotopes, based on their bivalve assemblages, indicating at least ten distinct paleoenvironments. The bivalve species were found to group into eight biofacies or groups of similarly distributed species.

The Tenmile Creek and northern Chipola River samples, which represent the basal three meters of the formation, are interpreted to have been deposited in a quiet embayment, 15 to 30 meters deep, with a soft muddy to a firmer mud/sand substrate.

The samples from Farley Creek and the southern part of the Chipola River are indicative of shallower and higher-energy environments, with depths of two to 15 meters. These samples represent a diverse array of shallow-water environments including: fore-reef, reef, reef flank, back-reef lagoon, lagoonal coralline patches, near shore meadow, and unstable sandy areas. The great faunal diversity of these areas, and the formation in general, is undoubtedly largely due to the large number of paleoenvironments present.

EVOLUTION OF THE PATELLOGASTROPODA FAUNA OF THE CARIBBEAN SEA DURING THE NEOGENE.

LINDBERG, David R., Museum of Paleontology, University of California, Berkeley, CA 94720

Tertiary fossils from the Dominican Republic and the South American mainland reveal a diverse Patelloida fauna in the Caribbean Sea during the Neogene. Limpets from the Dominican Republic are divisible into two groups. The first group, from the Rio Gurabo region, appear to have been associated with corals and their gross morphologies resemble the Recent lottiid species that inhabit the region today; included in this group is Patelloida pustulata which is extant. The second group, from the Rio Cana, consists of species that were associated with marine plants and this fauna resembles that of the Paris Basin during the Eocene. Before the closing of the Panamic portal, the region was invaded by members of the Lottiinae. Also during this period all but one species of Patelloida became extinct. All known Pleistocene fossils belong to Lottiinae with the exception of P. pustulata.

STRATIGRAPHIC DISTRIBUTION OF THE NEOGASTROPOD FAMILY TURRIDAE IN THE DOMINICAN REPUBLIC NEOGENE.

JAMES, Matthew J., Department of Geology, Sonoma State University, Rohnert Park, California 94928

The Neogene Yaque Group of the Dominican Republic has yielded a diverse, abundant, and well-preserved fauna of the neogastropod family Turridae. Material from four formations (the Baitoa, Cercado, Gurabo, and Mao) was used to reevaluate the taxonomic status of 51 species in seven subfamilies.

The stratigraphic distribution of turrid species reveals a marked concentration in the upper half of the Cercado Fm. and the lower to mid portion of the Gurabo Fm. Very few specimens were recovered from the Mao Fm. In the Rio Gurabo section, species occurrences are concentrated between 100 m and 425 m, with numerical predominance in the Gurabo Fm. Ranges of individual taxa are sharply truncated at the Miocene-Pliocene boundary in the Rio Gurabo section. In the Rio Cana section, almost complete truncation occurs at the Gurabo-Mao boundary. There appears to be no relationship between protoconch morphology and stratigraphic range or geographic distribution. The longest ranging taxon in both river sections is the highly variable Pleuroliria (Polystira) albida (Perry, 1811).

NEOGENE FAUNAS OF NORTHWESTERN ECUADOR.

PITT, William D., Field Associate Department of Geology, California Academy of Sciences, San Francisco, CA 94118

PITT, Lois J., Sacramento, California.

An overview of the molluscan faunas of northwestern Ecuador from Punta Sua to Rio Santiago, Esmeraldas Province, Ecuador. Although these faunas have long been known there have been few papers on this important area of study. The purpose of this paper is to discuss the past works, the faunas and what is in progress at this time. 1) Past publications including oil company reports, many of which are not readily available in this country. 2) Problems that exist with formational names, (Angostura, Esmeraldas Onzole), localities not previously reported and localities not well described that must be relocated in order to correlate the faunas with the formations. 3) A look at some of the localities today, their faunas and their relationships to the recent faunas as well as to the Miocene? Gatun Formation of Panama and the Miocene? Zorritos and Tumbez formations of Peru.

PALEOECOLOGY OF MIOCENE-PLIOCENE HYOTISSA HAITENSIS (SOWERBY) ASSEMBLAGES (BIVALVIA:GRYPHAEIDAE), TAMIAMI FORMATION, SOUTHWEST FLORIDA.

MEEDER, John F., National Audubon Society, Rt 6, Box 610, Abbeville, LA 70510.

Hyotissa haitensis assemblages were offshore, stenohaline, softbottom communities. Fossil and sediment analyses document the development of Hyotissa shell concentrations. Associated fossils are subdivided into the dominant epifaunal and minor infaunal components. Epifauna are encrusting organisms(barnacles, bryozoans, corals, molluscs and serpulids) and soft bottom recliners (Anomia, Hyotissa, pectens and Plicatula). Boring organisms (Cliona, a sponge and Lithophaga, a mollusc) are also very abundant trace fossils. Encope and Mellita (sanddollars)fragments are also common. Associated fauna indicate an open marine condition.

The documentation of an open marine environment is important in interpreting many Miocene-Pliocene sections because the presence of "oysters" to many workers is indicative of nearshore and/or shoaling euryhaline conditions. Continuous coring along transects, in addition to outcrop work in Florida, reveals fossil sequences and sediment texture patterns which further support open marine conditions.

In some deposits Hyotissa are found "floating" in their matrix (Jackson Bluff), approximating their life association. In most outcrops and cores, however, shells are disarticulated, packed and concentrated into meter-thick beds. The life history of Hyotissa and the developmental stages of the shell deposits are documented.

GASTROPOD FAUNA OF THE PLIOCENE EVERGLADES ATOLL.

PETUCH, Edward J., Department of Geology, Florida Atlantic University, Boca Raton, FL 33431

The shallow subsurface of southern Florida is shown to contain a large atoll reef feature of Pliocene age. When buried, this ring of zonated reefs produced the foundations for the Recent Everglades region. The swampy Everglades, itself, formed within the infilled atoll lagoon. Excavations and core sampling on the fossil reef tracts have yielded the richest-known American Pliocene gastropod fauna, with over 400 species collected. Unique to the Everglades Atoll were species radiations of the muricid genera Trossulasalpinx (7 spp.) and Acantholabia (3 spp.), and the ovulid genus Cyphoma (7 spp.). Paciphiles such as Parametaria, Jenneria, Trochita, Malea, and Pusula, also formed endemic species complexes. Of special importance were the findings of the first-known Floridian fossil Bursa and Scabricola species, a reef-dwelling Ecphora species, and the first-known American fossil Virgiconus species.

Monday Afternoon, July 20

SYMPOSIUM: CENOZOIC MOLLUSCAN COMMUNITIES OF THE AMERICAS. Convener: Emily H. VOKES, Dept. of Geology, Tulane University, New Orleans, Louisiana.

1:30 **SEQUENCE OF TERTIARY MOLLUSCAN ASSEMBLAGES FROM THE SALISBURY EMBAYMENT OF MARYLAND AND VIRGINIA, MIDDLE ATLANTIC COASTAL PLAIN.** Lauck W. WARD, U.S. Geological Survey, Reston, Virginia.

2:00 **NATICID PREDATION WITHIN CENOZOIC MOLLUSCAN COMMUNITIES.** Jennifer A. KITCHELL, Museum of Paleontology and Department of Geological Sciences, University of Michigan, Ann Arbor, Michigan.

2:20 **MIDDLE PLIOCENE MOLLUSCAN FAUNA OF TEARCOAT BRANCH, SUMTER COUNTY, SOUTH CAROLINA.** Sarahlu C. CAMPBELL, Division of Sciences, University of South Carolina, Spartanburg, South Carolina.

2:40 **MIDDLE PLIOCENE CHAMA REEF IN SOUTH CAROLINA.** Lyle D. CAMPBELL, Division of Sciences, University of South Carolina, Spartanburg, South Carolina.

3:00 **FIRST DUPLIN RECORD FOR TRIGONOSTOMA (EXTRACTRIX) HOERLEI (MOLLUSCA: GASTROPODA).** David C. CAMPBELL, Spartanburg High School, Spartanburg, South Carolina; and Matthew R. CAMPBELL, McCracken Junior High School, Spartanburg, South Carolina.

3:20 **BREAK**

3:40 **COMMUNITY REPLACEMENT IN TWO MOLLUSK-DOMINATED FOSSIL SEQUENCES, PLEIOSTOCENE OF NORTH CAROLINA.** William C. MILLER, Dept. of Geology, Humbolt State University, Arcata, California.

*4:00 **PALEOECOLOGY OF CREPIDULA (GASTROPODA) BEDS, JAMES CITY FORMATION, NORTH CAROLINA.** Diane M. WOODS, Dept. of Geology, Tulane University, New Orleans, Louisiana.

*4:20 **PALEOECOLOGY OF THE MARINE PROSOBRANCH GASTROPODS OF THE MOIN FORMATION (EARLY PLEISTOCENE) OF COSTA RICA.** David G. ROBINSON, Dept. of Paleontology, Tulane University, New Orleans, Louisiana.

*In competition for best student paper

SEQUENCE OF TERTIARY MOLLUSCAN ASSEMBLAGES FROM THE SALISBURY EMBAYMENT OF MARYLAND AND VIRIGNIA, MIDDLE ATLANTIC COASTAL PLAIN.

WARD, Lauck W., U.S. Geological Survey, Reston, VA 22092

The Tertiary beds deposited in the Salisbury Embayment of Maryland and Virginia contain an excellent record of molluscan assemblages for the last 66 million years. Various basin configurations, sea level fluctuations, and climatic trends combined to produce a habitat increasingly provincial in nature, in which an essentially temperate assemblage evolved.

Paleocene and Eocene molluscan assemblages closely resemble those in the Gulf states such as Alabama and Mississippi. Lower Oligocene beds in the Salisbury Embayment are known to occur only in several deep boreholes, but upper Oligocene beds crop out. These beds contain mollusks that become the dominant taxa during the Miocene and most of the Pliocene. Some of the taxa, such as *Glossus*, *Ecphora*, *Chesapecten*, and *Marvacrassatella*, were extremely successful in the temperate Miocene-Pliocene embayment but became extinct during the post-Yorktown (late Pliocene) sea-level fall. That event, during which both sea level and temperatures dropped, resulted in the apparent extinction of approximately 55% of the Yorktown species. The Chowan River Embayment, which followed in the late Pliocene, lacked many of the previously abundant taxa and was inhabited principally by subtropical forms, which migrated northward as temperatures rose.

NATICID PREDATION WITHIN CENOZOIC MOLLUSCAN COMMUNITIES.

KITCHELL, Jennifer A., Museum of Paleontology and Department of Geological Sciences, University of Michigan, Ann Arbor MI 48109

Temporal patterns of naticid predation, prey selection, and ontogenetic prey switching are robust (i.e. repeated and persistent) within Cenozoic molluscan community assemblages. Despite considerable taxonomic turnover of both naticid and molluscan prey species, the predatory 'strategy' persists through time. Three general hypotheses of naticid 'strategy' are considered: random selection of prey, selection of prey governed by time-minimization criteria, selection of prey governed by energy-maximization criteria. The latter hypothesis is supported empirically by (i) an allometric function that differs in detail for each species but conforms in general for all species to a sharply declining cost-benefit function with increasing (prey) size, and (ii) copious evidence of size-selectivity within each prey species. A modeling simulation shows that larger naticid predators should be more highly selective than smaller-sized naticids, given the same suite of prey species and size classes.

MIDDLE PLIOCENE MOLLUSCAN FAUNA OF TEARCOAT BRANCH, SUMTER COUNTY, SOUTH CAROLINA.

CAMPBELL, Sarahlu C., Division of Sciences, University of South Carolina at Spartanburg, Spartanburg, SC 29303

Although fossils have been sporadically documented from Sumter County in South Carolina since 1838, researchers after 1917 relied upon earlier collections or auger holes until particularly heavy rains and local flooding during the winter of 1973-1974 exposed a diverse molluscan fauna along Tearcoat Branch, six miles southeast of Sumter, South Carolina. The stream bank immediately south of County Road 255 was scoured, and the material redeposited as an unusually rich fauna of 204 gastropods, 105 bivalves, 3 scaphopods, and 2 polyplacophorans. These species combine elements from the temperate Yorktown Formation to the north with the tropical Pinecrest beds of south Florida and represent a subtropical shallow shelf province of Middle Pliocene age.

Tearcoat Branch is the single richest Middle Pliocene locality in South Carolina. This fauna unifies the scattered and disparate reports of fossiliferous materials from Mayesville, and the Pee Dee and Darlington districts.

MIDDLE PLIOCENE CHAMA REEF IN SOUTH CAROLINA

CAMPBELL, Lyle D., Division of Sciences, University of South Carolina at Spartanburg, Spartanburg, SC 29303

Middle Pliocene Chama reefs, known from the warm-temperate Yorktown Formation of Tidewater Virginia, are here documented from the Carolinas. Recent dragline operations near Lynchburg, South Carolina exposed a unique example of this biofacies in the subtropical Duplin Formation beds. The Yorktown and Duplin assemblages exhibit low faunal diversity and similar dominant taxa. Both have abundant Chama congregata and common Glycymeris subovata, G. americana, Mercenaria tridacnoides, Ostrea sculpturata, O. compressirostra, Chione latilirata, and Carditamera arata. Noetia incile is very common in the Virginia reef deposits while N. incile and the similar species, N. trigintenaria, are common at the Lynchburg site. Rarer species at both sites were recruited from the adjacent non-reef faunas. Vermicularia woodringi, a reef-forming worm snail typical of the south Florida Pinecrest beds, represents a unique record in the Lynchburg fauna. This tropical reef component has not been previously reported from the Carolina Duplin Formation.

FIRST DUPLIN RECORD FOR TRIGONOSTOMA (EXTRACTRIX) HOERLEI (MOLLUSCA: GASTROPODA).

CAMPBELL, David C. and Matthew R. CAMPBELL
Spartanburg High School, Spartanburg, SC 29302
McCracken Junior High, Spartanburg, SC 29302

Trigonostoma (Extractrix) hoerlei Olsson, 1967 was originally described from the Middle Pliocene age (planktonic zone N.20) Pinecrest beds at Acline and Kissimee in southern Florida. It has subsequently been collected at two additional Pinecrest sites (Miami and Sarasota, Florida). T. hoerlei has also been reported from the time equivalent Yorktown Formation at Chuckatuck, Virginia. Specimens attributed to T. hoerlei from the early Pliocene Punta Gavilan Formation of Venezuela represent a distinct but closely related species.

Single specimens discovered at Tearcoat Branch, six miles east of Sumter, South Carolina in June, 1984 and April, 1987 add to the stratigraphic and geographic distribution of this rare gastropod subgenus. This new site consists of a Duplin shelly fauna in a sand matrix redeposited by floods in 1973 and 1974.

T. hoerlei is found as a rare element of a particularly varied shallow shelf faunas. These South Carolina finds are the first records of this species from the Carolinas and from the subtropical Duplin Formation.

COMMUNITY REPLACEMENT IN TWO MOLLUSK-DOMINATED FOSSIL SEQUENCES, PLEISTOCENE OF NORTH CAROLINA.

MILLER, III, William, Department of Geology, Humboldt State University, Arcata, CA 95521

Compositional changes observed in two mollusk-rich fossil deposits in two different Pleistocene formations in the Neuse River valley are attributable to community replacement. This poorly understood, fundamental synecologic process involves abrupt to gradual substitution of one assembly of species for another owing to sustained, directional changes in habitats over "subevolutionary" time. This study focuses on alternate pathways of such faunal transitions, using examples from the middle Pleistocene Flanner Beach and early Pleistocene James City formations.

Although depositional settings in both formations were similar (coastal lagoons and bays), faunal transitions clearly were different. In the Flanner Beach replacement appears to have involved species-abundance reorganization, or reshuffling of rank order of taxa without wholesale additions or deletions of species, yielding a series of slightly different fossil associations dominated by Mulinia lateralis. By contrast faunal transition in the James City resulted from species turnover, involving disruption and disappearance of an extensive Crepidula fornicata biostrome and replacement by a more diverse paleocommunity with many infaunal bivalves, oyster clumps, and carnivorous/scavenging gastropods. Different replacement pathways are related to differences in ecologic properties of benthos as well as to variations in quality, intensity and rate of forcing factors.

PALEOECOLOGY OF CREPIDULA (GASTROPODA) BEDS, JAMES CITY FORMATION, NORTH CAROLINA.

WOODS, Diana M., Department of Geology,
Tulane University, New Orleans LA 70118

Outcrops of the James City Formation (Pleistocene) in eastern North Carolina contain dense, discontinuous shell beds composed mainly of stacked valves of the marine gastropod Crepidula fornicata (Linnaeus). A paleoecologic study of these units indicates that they are primarily biogenic in origin, although a reduced rate of sedimentation in the depositional setting may have abetted their formation. High shell density in the Crepidula beds is attributable to episodes of resurgence in C. fornicata populations, due to increased nutrient levels in the open bay environment. Periodic activation of tidal inlets through natural disturbances probably catalyzed the resurgence events.

The original Crepidula bed communities are thought to have been "low grade" or physically controlled communities. The taxonomic compositions of the beds reflect an environment in which substrate and other physical parameters graded in a continuous fashion. Growth and mortality within the C. fornicata populations were also influenced by conditions in the physical environment. Differences in size-frequency data between sampled populations may be related to differences in environmental stability during the periods when the populations were living on the sea floor.

PALEOECOLOGY OF THE MARINE PROSOBRANCH GASTROPODS OF THE MOIN FORMATION (EARLY PLEISTOCENE) OF COSTA RICA.

ROBINSON, David G., Department of Paleontology,
Tulane University, New Orleans, LA 70118

The prosobranch gastropod fauna of the early Pleistocene Moin Formation of Costa Rica consists of a rich assemblage of species, which are derived from a variety of different habitats, ranging from the rocky intertidal environment to a muddy substrate of the middle neritic zone. The shallower elements of the fauna reached the site of deposition on the continental shelf by gravity flow, often associated with large blocks of coral, falling from the fore-reef zone into deeper water. The species composition of this fauna proves to be an interesting mixture of widespread extant Caribbean species, endemics of a relict nature restricted to the western Caribbean of today, paciphilic taxa, and Pliocene elements which became extinct during the Pleistocene glacial events.

Monday Afternoon, July 20

CONTRIBUTED PAPERS: MARINE MOLLUSKS. Presiding: Janet R. VOIGHT, Dept. of Ecology and Evolutionary Biology, University of Arizona, Tuscon, Arizona.

1:30 **REPRODUCTION AND ECOLOGY OF THE SANDY BEACH GASTROPOD PRUNUM PRUNUM (MARGINELLIDAE) IN VENEZUELA.** A. RINCON and Pablo E. PENCHASZADEH, Intecmar, University Simon Bolivar, Caracas, Venezuela.

*1:50 **REPRODUCTIVE BIOLOGY OF VERMETUS SP. AND DENDROPOMA CORRODENS: TWO CARIBBEAN GASTROPODS (VERMETIDAE).** Patricia MILOSLAVICH, Intecmar, University Simon Bolivar, Caracas, Venezuela.

*2:10 **REPRODUCTIVE ASPECTS OF PHYLLONOTUS MARGARITENSIS (ABBOTT, 1958) GASTROPODA: MURICIDAE) IN VENEZUELA.** Roberto CIPRIANI, Intecmar, University Simon Bolivar, Caracas, Venezuela.

*2:30 **ONTOGENY OF BEAK ROSTRA IN JUVENILE CEPHALOPODS AND ITS RELATION TO FEEDING.** Susan M. CANDELA, Division of Biology and Living Resources, University of Miami, Miami, Florida.

*2:50 **POPULATION BIOLOGY OF OCTOPUS DIGUETI.** Janet R. VOIGHT, Dept. of Ecology and Evolutionary Biology, University of Arizona, Tuscon, Arizona.

3:10 **BREAK**

3:30 **BIOCHEMICAL GENETICS OF SQUID FROM THE NORTHEASTERN SEABOARD OF THE UNITED STATES.** Carl J. BERG, Florida Dept. of Natural Resources, Bureau of Marine Research, Marathon, Florida; and Ronald L. GARTHWAITE, Dept. of Zoology, University of California, Santa Cruz, California.

3:50 **ALTERNATIVE DIETS FOR REARING OCTOPUSES IN CAPTIVITY.** Randal H. DeRUSHA, John W. FORSYTHE, and Roger T. HANLON, Marine Biomedical Institute, University of Texas, Galveston, Texas.

4:10 **THE MASS CULTURE OF APLYSIA CALIFORNICA.** Thomas R. CAPO, Susan E. PERRITT, and John PAIGE, Howard Hughes Medical Institute, Aplysia Resource Facility, Woods Hole, Massachusetts.

4:25 **VERTICAL DISTRIBUTION PATTERNS OF ATLANTID HETEROPODS IN WATERS OFF HAWAII.** Roger R. SEAPY, Dept. of Biological Science, California State University, Fullerton, California.

4:45 **NEW DATA FOR SCAPHOPOD TAXONOMY.** Victor SCARABINO, Instituto Nacional de Pesca, Montevideo, Uruguay.

5:30 **CONCH TRAIN TOUR OF KEY WEST.** All are invited!

*In competition for best student paper.

Abstracts

REPRODUCTION AND ECOLOGY OF THE SANDY BEACH GASTROPOD Prunum prunum (MARGINELLIDAE) IN VENEZUELA.

RINCON, A. and P. E. PENCHASZADEH, Intecmar, University Simon Bolivar, Apartado 80659, Caracas 1080, Venezuela.

Prunum prunum reproduces throughout the year with a peak in June and this is related to a maximum in the water temperature (29 C). Egg capsules are deposited generally on living Tivela mactroides. Densities up to 56 egg-capsules per sqm. were recorded. Adult P. prunum were maintained in aquaria and several hundred egg-capsules were obtained. Development takes 50-60 days at 26 C. The egg-capsule contains a single large egg of 895-1075 microns of diameter. Hatching takes place at a crawling stage and the embryo utilizes extra vitelline supplementary food resources found in the intra capsular liquid as proteins and carbohydrates.

The distribution of egg-capsules in the field is related to the availability of living Tivela, but the density of the bivalve do not relate to an increase of the reproductive activity of Prunum. This marginellid is a predator of other mollusks mainly Donax denticulatus and D. striatus.

REPRODUCTIVE BIOLOGY OF Vermetus sp. AND Dendropoma corrodens: TWO CARIBBEAN GASTROPODS (VERMETIDAE)

MILOSLAVICH, Patricia, Intecmar, University Simon Bolivar, Apartado 80659, Caracas 1080, Venezuela.

Vermetus sp. lives attached to hard substrates up to 5 m. depth at densities decreasing from 30 ind. per sqm. to 9 ind./sqm with depth. Dendropoma corrodens lives encrusted on calcareous rocks in colonies (mean density 13 ind./10 sqcm.).

Vermetus sp. broods up to 54 egg-capsules (avg. 21) in the mantle cavity; the capsules are 2.3 mm in diameter (SD=0.4) and contains 289 eggs (SD= 114), each measuring about 240 um in diameter (SD= 14). An average of 188 embryos (SD=87) develop, the rest are ingested by the formers. The hatching larvae is a free swimming veliger measuring about 454 um (SD=20) with a well developed velum and a small foot. The larva settle after few hours of planktonic life.

D. corrodens incubates up to 8 egg-capsules (avg.= 4) in the mantle cavity; each ovoid shaped capsule is about 771 um (SD=113) in length and contains 8 eggs (SD=1.13) which measure 276 um (SD=25) in diameter. It has been demonstrated that disintegration of one egg occurs within each egg-capsule, being its yolk ingested by the developing embryos. At hatching, the crawling juveniles are about 512 um. (SD=59) and are characterized by having a well developed foot and no velum.

REPRODUCTIVE ASPECTS OF Phyllonotus margaritensis (ABBOT, 1958) (GASTROPODA: MURICIDAE) IN VENEZUELA.

CIPRIANI, Roberto, Intecmar, University Simon Bolivar, Apartado 80659, Caracas 1080, Venezuela.

Twelve specimens of P. margaritensis were captured at 2-3 m. depth on sandy bottoms near turtle grass areas at Mochima Bay and kept in aquaria at 19-23 C.

Three egg masses were deposited on the aquarium walls forming large clusters (111 to 160 egg-capsules per mass). The egg-capsules were tongue-shaped and they were arranged with its convex part outside the cluster. They averaged 6.18 (SD= 0.54) milimeters in height, 6.61 (SD= 0.33) mm in lenght (at the base) and 1.92 (SD= 0.21) mm. in width (N= 10 capsules).

The number of eggs per capsule was 419 (SD= 127) (N= 27 capsules) and the egg diameter averaged 226 (SD= 9) um (N= 140). Nurse eggs were found at a relation of 70:1 nurse eggs per developing embryo.

Development is completed after 51 days. Hatching takes place at a crawling stage and 6.8 (SD= 1.5) (N= 10 capsules) juveniles scape through a preformed hole in each capsule. Shell size at the hatching stage is 1.66 (SD= 0.38) mm. (N= 8) with 1 1/2- 2 whorls.

ONTOGENY OF BEAK ROSTRA IN JUVENILE CEPHALOPODS AND ITS RELATION TO FEEDING.

CANDELA, Susan M., Division of Biology and Living Resources, University of Miami, 4600 Rickenbacker Cswy., Miami FL 33149

The cutting edges of the beak rostra of adult cephalopods are usually smooth, but those of many young animals bear rows of teeth. In most cases, these teeth are worn or chipped away at mantle lengths of 5 to 10 mm, and are therefore present only in the first weeks of life. It is assumed that the teeth, like the teeth of vertebrate predators, are used to seize and kill prey. The size and persistence of these teeth are thought to be related to the life-mode of the young cephalopod, crawl-away hatchlings having no teeth or smaller teeth than planktonic young.

To test this theory, the beaks of selected species with different modes of life were examined with a scanning electron microscope. Benthic hatchlings do generally have smaller teeth than planktonic hatchlings; however, teeth of different planktonic groups disappear at different stages of development. For example, Heteroteuthis dispar loses most traces of teeth by 2mm ML, while bolitaenids retain their teeth throughout life. Other pelagic octopods and squids fit between these two extremes. Clearly, other factors beside habitat are involved. This study indicates that teeth may persist until the arms, tentacles, suckers, and musculature are sufficiently developed that teeth are no longer needed to help kill prey.

Abstracts

POPULATION BIOLOGY OF OCTOPUS DIGUETI.

VOIGHT, Janet R., Department of Ecology & Evolutionary Biology, University of Arizona, Tucson 85721

Octopus digueti is a pygmy octopus which ranges throughout the Gulf of California. The species has large eggs and young, which are benthic at hatching. An inhabitant of sandy areas, O. digueti uses vacant gastropod and bivalve shells as shelter. To sample the octopus population, artificial shelters were placed in the intertidal zone of Choya Bay, Sonora, Mexico. In a one year period, 800 octopuses were collected without apparent sex or size bias, except at the smallest size classes. Each individual was measured, weighed and its reproductive maturity noted.

The weights of captured octopuses ranged from 0.6 to 43 g. Cohorts in the field grew at nearly the same rate as did conspecifics in a lab growth study. The population completed two generations a year, with individual life spans ranging from 5 to 9 months. Gravid females were present throughout the year, but were most common in spring, coincident with warming temperatures. No evidence of iteroparity was found. Enlarged suckers were restricted to males of the largest size classes. Suckers probably enlarge in the terminal phase of growth, and may be reliable indicators of the fully adult age classes of male O. digueti.

BIOCHEMICAL-GENETICS OF SQUID FROM THE NORTHEASTERN SEABOARD OF THE UNITED STATES.

BERG, Carl J., Florida Dept. of Natural Resources, Bureau of Marine Research, 11400 Overseas Highway, Marathon, FL 33050; and Ronald L. GARTHWAITE, Dept. Zoology, University of California, Santa Cruz, CA 95062

Starch-gel electrophoresis was performed on 8 population samples of the squid Loligo pealei collected from Georges Bank to Cape Hatteras along the eastern seaboard of the United States of America. Techniques were developed for 21 biochemical loci, but only 3 were polymorphic enough to be useful for statistical analysis. There was great homogeneity in gene frequencies observed, but the enzyme system PGM was useful for differentiating populations. The species Loligo plei and Lolliguncula brevis occurred infrequently in the samples and could be identified readily by the enzyme system GOT.

ALTERNATIVE DIETS FOR REARING OCTOPUSES IN CAPTIVITY.

DeRUSHA, Randal H., FORSYTHE, John W. & HANLON, Roger T., Marine Biomedical Institute, University of Texas Medical Branch, Galveston, TX 77550

Traditional use of live marine prey species for octopus mariculture has restricted its practicality for inland research laboratories, commercial enterprises and home aquarists. We have evaluated the acceptability and resultant growth of the following alternative diets: frozen and freshly-killed shrimp (Penaeus spp.), live and frozen marine polychaete worms (Nereis virens), and live freshwater fish (Tilapia sp.) and crayfish (Procambarus sp.). The diets were presented for periods of 1 - 7 weeks to individually cultured octopuses and results were compared to control diets of live shrimps and crabs.

Experiments using octopuses 3-1/2 months old and older yielded encouraging results. Among the live food alternatives, growth of O. maya adults was best on crayfish, followed by polychaete worms and fish. Octopus maya, O. bimaculoides and O. briareus all grew well on frozen shrimp, which proved to be the best overall alternative diet tested. Attempts to rear O. maya hatchlings and juveniles (up to one month of age) on dead foods resulted in high mortality and little growth. These experiments indicate that post-hatch octopuses in the exponential growth phase require live food to survive and grow. As the exponential growth phase ends, non-living foods can be incorporated into the diet and produce acceptable growth.

THE MASS CULTURE OF APLYSIA CALIFORNICA.

Capo, Thomas R., Perritt, Susan E. and Paige, John, Howard Hughes Medical Institute, Aplysia Resource Facility, Woods Hole, MA 02543.

We have developed laboratory techniques for the reliable mass culture of Aplysia californica in natural seawater. Specific focus has been given to solving previously encountered culture problems. These include larval entrapment at the air-water interface, disease, the difficulty of obtaining a reliable source of metamorphic substrate and the production of large numbers of larval and juvenile sea hares.

A surfactant is added during the larval transfer to reduce surface tension and facilitate handling. A Parafilm seal eliminates the air-water interface and prevents entrapment during incubation. Buffered polyvinylpyrrolidone iodide complex and chloramphenicol are used to control epibionts and pathogens. By applying these techniques, over 45,000 larvae are mass cultured through the obligatory planktotrophic phase to metamorphic competency in one year. Mass settlement and metamorphosis are induced by the use of a laboratory culture of the alga, Agardhiella subulata (Strain A1). As the sole postmetamorphic food, this macroalga provides the nutrition necessary for subsequent growth through the early juvenile stages. Four opisthobranch species - Aplysia californica, Aplysia brasiliana, Bulla gouldiana and Hermissenda crassicornis - have been cultured using these techniques, with only slight modifications.

Abstracts

VERTICAL DISTRIBUTION PATTERNS OF ATLANTID HETEROPODS IN WATERS OFF HAWAII.

SEAPY, Roger R. Department of Biological Science, California State University, Fullerton, Fullerton, CA 92634.

The vertical distributions of ten species of atlantid gastropods off Hawaii were assessed from day and night series of opening-closing plankton net samples. Five species (Oxygyrus keraudreni, Atlanta turriculata, A. fusca, A. plana, Protatlanta souleyeti) were captured between the surface and 150 m. The latter two of these species were more abundant in the upper 50 m at night. Three species (A. lesueuri, A. inflata, A. helicinoides) ranged down to 200 m during the day, with only the latter species migrating toward the surface at night. Two species (A. peroni, A. cf. gibbosa) were distributed down to 300 m during the day, and both species migrated into the upper 150 m at night. No atlantids were captured below 300 m.

NEW DATA FOR SCAPHOPOD TAXONOMY.

SCARABINO, Victor. Instituto Nacional de Pesca Constituyente 1497, Montevideo, Uruguay

Even if the greatest part of this paper was presented at the last Unitas Malacologica meeting (1986), I consider it timely to submit it to the AMU members in order to give it wide difusion as a contribution to the knowledge of the Class.

The Scaphopoda has been the subject of several taxonomic arrangements over the past 10 years. The major source of characters were extracted from the shell and due to diverse convergences, some taxa were placed under erroneous categories. Latter, some were clarified by the study of soft parts, although entire groups are still undefined. The examination and comparaison of shells and anatomic structures of all genera described thus far, including a number of undescribed bathyal and abyssal taxa, enabled me to submit a selection of defining characters for classification in high categories and others for lower ones (in some cases even reaching species). Exclusive characters for Order, and other for family and genus level are here identified. Those, after correlation with shell data make further studies unnecessary, except for specific analysis. This fact makes the proposed classification also useful for fossil representatives, providing that the shells be collected in good condition.

New data, specially radular and anatomical, will surely help to rearrange the classification, attempting to base it under a real biological significance.

Tuesday Morning, July 21

SYMPOSIUM: BIOLOGY OF THE POLYPLACOPHORA. Convener: Robert C. BULLOCK, Dept. of Zoology, University of Rhode Island, Kingston, Rhode Island.

8:00 **WELCOME AND OPENING REMARKS**

8:15 **IS THERE A SUBPHYLUM ACULIFERA?** Amelie H. SCHELTEMA, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

8:40 **PHYLOGENETIC PATTERNS AMONG CHITONS.** Douglas J. EERNISSE, Museum of Zoology and Department of Biology, University of Michigan, Ann Arbor, Michigan.

9:05 **THE POSITION OF THE POLYPLACOPHORA IN THE GENERAL SCHEME OF THE MOLLUSCAN RADULA.** Klaus KERTH, Institut fur Zoologie, Universitat Wurzburg, Wurzburg, Federal Republic of Germany.

9:35 **THE GILLS OF CHITONS (POLYPLACOPHORA), AND THEIR SIGNIFICANCE IN MOLLUSCAN PHYLOGENY.** W.D. RUSSELL-HUNTER, Dept. of Biology, Syracuse University, Syracuse, New York.

10:00 **BREAK**

10:20 **THE DORSAL SENSE ORGANS OF CHITONS (POLYPLACOPHORA).** Franz P. FISCHER, Institut fur Zoologie, Technische Universitat Munchen, Garching, West Germany.

10:45 **SENSORY ORGANS IN THE HAIRY GIRDLES OF SOME MOPALIID CHITONS.** Esther M. LEISE, Dept. of Zoology, University of California, Davis, California.

11:15 **RESPIRATORY PATTERNS OF MOPALIID CHITONS.** R.S. COX, Museum of Paleontology and Dept. of Biology, University of Michigan, Ann Arbor; Douglas J. EERNISSE, Museum of Zoology and Dept. of Biology, University of Michigan, Ann Arbor; G. KARDON, Museum of Paleontology, University of Michigan, Ann Arbor, Michigan; and N.D. PENTCHEFF, Dept. of Zoology, University of California, Berkeley, California.

11:40 **POPULATION DYNAMICS OF THREE NORTHWESTERN ATLANTIC CHITON SPECIES (MOLLUSCA: POLYPLACOPHORA).** Paul D. LANGER, Dept. of Biology, Gwynedd-Mercy College, Gwynedd Valley, Pennsylvania.

12:00 **LUNCH**

IS THERE A SUBPHYLUM ACULIFERA?

SCHELTEMA, Amelie H., Woods Hole Oceanographic Institution, Woods Hole, MA 02543

The earliest mollusk had a small elongate body with a sole set off by a groove and separated from a head provided with cerebrally innervated sensory organs; a mucoid integument containing calcium carbonate bodies secreted extra-cellularly; a through gut with a paired, non-rasping radula and salivary glands; a triploblastic organization with paired, replicated heart, kidneys, gonads, spacious pericardium, and dorsoventral muscles, a ladder-like nervous system; and a trochophore that developed into a larva within a cellular test.

This archimollusk evolved from a pre-annelid and gave rise first to the shelled monoplacophorans and subsequently to the polyplacophorans; the Monoplacophora gave rise to all other shelled mollusks. The Aplacophora are formed by two closely related taxa, neither having a cerebrally innervated pedal surface; they arose independently from the earliest molluscan stem at an undetermined time, not necessarily before the Monoplacophora or Polyplacophora.

The concept Aculifera provides no insight into the polyphyletic origins of the early mollusks Aplacophora, Monoplacophora, and Polyplacophora.

PHYLOGENETIC PATTERNS AMONG CHITONS.

EERNISSE, Douglas J., Museum of Zoology and Department of Biology, University of Michigan, Ann Arbor, MI 48109

Numbering nearly 800 species worldwide, the chitons or polyplacophorans are a distinctive molluscan taxon. Yet phylogenetic relationships among chitons are not well understood. Here, previous attempts to postulate higher-level phylogenetic relationships among chitons are contrasted and a variety of often- or seldom-used morphological characters are evaluated for usefulness. Certain characters are of limited value because they are more indicative of a particular species' habitat, diet, or size than they are of ancestry. These include the shape of the major lateral cusps of the radula, the posterior valve sinus in some species, and the number of gills. Certain other characters are likely synapomorphic (i.e. are shared-derived) for particular higher taxa, but the alternative character state(s) are of no use for diagnosing the "left-over" species. For instance, it is not valuable to diagnose a taxon according to plesiomorphic characters such as "lack of slitted insertion teeth in valves" or "lack of pectinated insertion teeth." Such practices result in groups that are grades, not clades. Finally, certain characters not emphasized by previous authors are argued to be informative at higher taxonomic levels. Examples from comparative studies in progress include patterns of egg hull sculpturing, as imaged with SEM, and some, but not all, gill or gill position characters.

THE POSITION OF THE POLYPLACOPHORA IN THE GENERAL SCHEME OF THE MOLLUSCAN RADULA.

KERTH, Klaus, Institut für Zoologie, Universität Würzburg, 8700 Würzburg, Federal Republic of Germany

The anterior part of the polyplacophoran radula is fixed to the odontophore by the alary cuticles like in other groups of mollusks. Due to the permanent replacement the radula parts move forward continuously but are, nevertheless, firmly attached to the stationary alary cuticles. This fact raises a serious problem of understanding.

The initial stages of radula development show in 4 Pacific species of chitons that radula formation starts with the secretion of the 2nd, 5th and 8th pairs of laterals which are the main functional teeth of adults. Juveniles are therefore equipped with an efficient feeding instrument as soon as radula secretion begins. As juveniles mature new laterals are added between existing ones. The sequence in which new laterals are inserted deviates from the gastropod scheme. The initial radula development elucidates an important step in the branching off of the Juvenichitoninae from the Ischnochitonidae. The central region of the Juvenichitoninae radula persists in an early postmetamorphic stage and therefore omits to complete the general morphogenesis in the other Ischnochitonidae.

THE GILLS OF CHITONS (POLYPLACOPHORA), AND THEIR SIGNIFICANCE IN MOLLUSCAN PHYLOGENY.

RUSSELL-HUNTER, W. D., Department of Biology, Syracuse University, Syracuse NY 13244

It was demonstrated in 1965 that gills of chitons are not paired structures but can show asymmetry. More recent studies, largely on Chaetopleura, confirm the broad homologies of each chiton gill with the aspidobranch ctenidium retained in several stocks of Archaeogastropoda. In particular, similar organization is found of afferent and efferent blood vessels in the gill axis; of alternating ctenidial leaflets; and of lateral, frontal, and abfrontal cilia. In addition to like ciliary functions, both gills show similar neuromuscular reflexes in cleansing mucus-bound sediment. One difference, due to the functional organization of each row of chiton gills into a pallial curtain, is the occurrence of Velcro-like ciliary junctions. Unlike junctions in mytilid and other "filibranch" bivalves, which are modified lateral cilia linking adjacent filaments on the same gill, these ciliary junctions link leaflets on adjacent gills and probably represent modified frontal cilia. Otherwise, chiton gills are little altered from "archetypic" molluscan ctenidia.

Data on gills and other replicated structures in chitons (like data on Neopilina, and on molluscan capacity for degrowth) appear to exclude hypotheses involving metameric segmentation from models of ancestral molluscs.

Abstracts

THE DORSAL SENSE ORGANS OF CHITONS (POLYPLACOPHORA).

FISCHER, Franz P., Institut für Zoologie, Technische Universität München, D 8046 Garching, West Germany

The outer shell layer of the Polyplacophora (investigated species: Lepidopleurus cajetanus, Chiton olivaceus, Acanthochiton communis) contains numerous sense organs, the esthetes. These show five different cell types. A few photoreceptor cells (rhabdomeric or rarely ciliary type) lie laterally. Products of tall secretory cells pass through a perforated apical cap to the outside. During the process of secretion there is a slow rhythmic change in the electrical potential under the cap. "Central cells" are probably chemoreceptors. Lateral branches, the micresthetes, end with unperforated caps at the shell surface. There are some indications that these are pressure receptors. "Wall cells" form the periphery to the calcareous shell substance.

The mantle epithelium also contains sensory organs. Each of these papillae forms a calcareous spicule with an organic stalk. This stalk originates at the tip of a "spicule cell," which surrounds one other cell. This cell possesses a cilium which runs to the stalk. Both cells act as mechanoreceptors; they are surrounded by secretory cells. In some species photoreceptor cells can be present.

Both the esthetes and the mantle papillae are derived from primitive epithelial papillae similar to those found in the species L. cajetanus.

SENSORY ORGANS IN THE HAIRY GIRDLES OF SOME MOPALIID CHITONS.

LEISE, Esther M., Department of Zoology, University of California, Davis, CA 95616

Chitons in the family Mopaliidae have hairs on the dorsal surface of the girdle. These hairs may be microscopic, as in Katharina tunicata, or stout bristles, as in Mopalia muscosa. Hairs of at least seven species are innervated, and they may be innervated in all of the Mopaliidae. Hairs on animals in the genus Mopalia first arise at metamorphosis; the initial sensory neurons are formed at that time. More neurons are added as the animal grows, as well as new hairs. Hairs in chitons of the genus Mopalia contain multiple clusters of sensory neurons whose dendrites occur in discrete bundles within the chitinous hair shaft. The dendrites end distally in a bulbous nodule and each nodule is in turn capped by a calcareous spicule. The oldest dendritic bundle extends to the hair tip, with younger bundles being progressively shorter. Similar clusters of sensory neurons occur proximal to the large marginal spicules in at least four genera of this family and above the ventral spicules in species from at least five of the chiton families. This type of sensory structure, the stalked nodule or "morgenstern", which is believed to be mechanosensory, is thus widespread throughout the chitons. Thus, the girdle, often considered to contain insensitive armature, provides the animal with a large surface area for tactile sensory reception.

RESPIRATORY PATTERNS OF MOPALIID CHITONS.

COX, R.S.[1,2]; Eernisse, D.J.[1]; Kardon, G.[2] and Pentcheff, N.D.[3] 1. Dept. of Biology, U. of Michigan, Ann Arbor. 2. Mus. of Paleontology, U. of Michigan, Ann Arbor. 3. Dept. of Zoology U. of California, Berkeley

Previous models for respiration in chitons with abanal ctenidia have proposed a fairly simple system: fluid is drawn into the pallial groove through raised portions of the anterior girdle and is propelled unidirectionally posteriorly by ctenidial cilia, exiting the animal through a raised portion of the girdle at the posterior median end. We have applied flow visualization techniques to studies of living and model chitons in flow tanks to assess their respiratory fluid patterns. Our model for mopaliid respiration proposes that exhalant currents are most commonly produced directly by ciliary pumping, while inhalant currents are generated only indirectly by a pressure differential set up through evacuation of fluid through the excurrent canal of the pallial groove. Mopaliids are also observed to increase the rate of ventilatory flow through rapid muscular contractions of the pallial cavity walls. Evidence for passive fluid dynamic augmentation of respiratory flow (e.g., Bernoulli effect, inertial ramming) remains equivocal, but circumstantial evidence from field and flow tank observations suggests that it may occur. Comparative studies of respiratory fluid dynamics in different chiton clades may ultimately yield clues to their differential success in different environments.

POPULATION DYNAMICS OF THREE NORTHWESTERN ATLANTIC CHITON SPECIES (MOLLUSCA: POLYPLACOPHORA).

LANGER, Paul D., Department of Biology Gwynedd-Mercy College, Gwynedd Valley, PA 19437

Three sympatric chiton species, Tonicella rubra, Tonicella marmorea and Ischnochiton albus, inhabit the rocky subtidal in northeastern New England. Chitons were sampled for 24 months along a subtidal transect in Cobscook Bay near Eastport, Maine. The investigation identified the chiton population densities, patterns of dispersion, size relationships and major chiton predators.

Total chiton density peaked at $1000/m^2$ at a depth of 6 meters. The depth-dependent pattern of dispersion differed for each species. Seasonal fluctuations in density reflected larval recruitment in late spring and increased mortality in winter. The largest individuals of each species occurred in shallow water and the mean size decreased with increasing depth. The seasonally occurring winter flounder selected for large chitons in deeper water, whereas, the asteroid, Leptasterias littoralis, selected for small chitons. The dominant zone of predation of this small asteroid extended to a depth of 4.5 meters.

Tuesday Morning, July 21

CONTRIBUTED PAPERS: FRESHWATER MOLLUSKS. Presiding: Virginia VAIL, Florida Dept. of Natural Resources, Division of Marine Resources, Tallahassee, Florida.

9:10 **ALLOMETRIC GROWTH OF SIX PLANORBID SNAIL SPECIES.** Eileen H. JOKINEN, Institute of Water Resources, University of Connecticut, Storrs, Connecticut.

9:30 **STATUS REVIEW OF PLANORBELLA MAGNIFICA (PILSBRY)(MOLLUSCA: GASTROPODA).** William F. ADAMS, U.S. Army Corps of Engineers, Wilmington, North Carolina; and Andrew G. GERBERICH, Division of Fishes, National Museum of Natural History, Washington, D.C.

9:40 **SPRINGSNAILS (GASTROPODA: HYDROBIIDAE) OF ASH MEADOWS, AMARGOSA BASIN, CALIFORNIA-NEVADA.** Robert HERSHLER, Dept. of Invertebrate Zoology, National Museum of Natural History, Washington, D.C.

10:00 **BREAK**

10:20 **THE ENDANGERED AND THREATENED LAND AND FRESHWATER MOLLUSKS OF NORTH CAROLINA.** Andrew G. GERBERLICH, Division of Fishes, National Museum of Natural History, Washington, D.C.; and William F. ADAMS, U.S. Army Corps of Engineers, Wilmington, North Carolina.

10:40 **DYNAMICS OF FILTER-FEEDING IN MUSCULIUM TRANSVERSUM.** Carl M. WAY, Dept. of Ecology and Evolutionary Biology, Northwestern University, Evanston, Illinois, and USAE Waterways Experiment Station, Vicksburg, Mississippi.

11:00 **HOMOLOGIES AND HETEROCHRONY: ARE THEY SEPARABLE?** Louise R. RUSSERT-KRAEMER and Marvin GALLOWAY, Dept. of Zoology, University of Arkansas, Fayetteville, Arkansas.

11:20 **THE VALUE OF A STOCHASTIC MODEL IN PREDICTING UNIONID-CORBICULID INTERACTIONS (BIVALVA).** Arthur H. CLARKE, ECOSEARCH, Inc., Portland, Texas.

ALLOMETRIC GROWTH OF SIX PLANORBID SNAIL SPECIES.

JOKINEN, Eileen H., Institute of Water Resources, U-18, University of Connecticut, Storrs CT 06268

Allometry is used (1) to compare shell shape proportions (shell height/diameter) of mature specimens of six planorbid snail species, and (2) to measure changes in shell shapes during growth from approximately 1mm diameter to maturity. Five species have similar shell proportions as adults and fall into a predicted pattern of transpositional allometry where larger species have higher initial y-intercepts (shell heights) for a given diameter. Quadratic growth models illustrate three different growth patterns: convex curvilinear for the three largest species, concave curvilinear for the two smallest species, and linear for the intermediate sized species.

STATUS REVIEW OF PLANORBELLA MAGNIFICA (PILSBRY) (MOLLUSCA : GASTROPODA).

ADAMS, William F., U.S. Army Corps of Engineers, P.O. Box 1890, Wilmington, N.C. 28402

GERBERICH, Andrew G., Division of Fishes, National Museum of Natural History, Washington, D.C. 20560

Planorbella magnifica was first described from the lower Cape Fear region of North Carolina by Pilsbry in 1903. This species is of particular interest as it is the largest member of family Planorbidae. The only recorded locale for the species, Greenfield Lake in Wilmington, N.C., has been seriously degraded by urbanization and the species can no longer be found there. Having been unrecorded for many years, it has been considered extinct by some authors.

We have discovered a reproducing population of the species in Orton Pond, approximately 16 km away from Greenfield Lake. The habitat provided by Orton Pond is unusual for the area as it contains a wide variety of aquatic macrophytes and has a circumneutral pH. Many other ponds and lakes in the region have been searched and the species has not been located elsewhere. Orton Pond may therefore represent the only remaining habitat for this species. At present, Orton Pond and its surrounding lands are managed as a refuge by their owner, therefore the status of this species appears secure for the near future.

SPRINGSNAILS (GASTROPODA: HYDROBIIDAE) OF ASH MEADOWS, AMARGOSA BASIN, CALIFORNIA-NEVADA.

HERSHLER, Robert, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

Aquatic snails of the family Hydrobiidae were sampled from numerous springs in Ash Meadows, California-Nevada, during 1985-6. The fauna of this lush oasis is represented by at least three lineages and composed of 11 species (nine new) in two genera, Pyrgulopsis Call and Pilsbry, 1886 and Tryonia Stimpson, 1865. Nine species are locally endemic, including three single spring endemics, while the remaining two are restricted to Amargosa River drainage. Faunal affinities lie with taxa of the Death Valley System and Colorado River drainages. Distributional evidence suggests that local differentiation of snails has primarily occurred within narrow ranges of altitude, in contrast to patterns documented for local fishes.

THE ENDANGERED AND THREATENED LAND AND FRESHWATER MOLLUSKS OF NORTH CAROLINA.

GERBERICH, Andrew G., Division of Fishes, National Museum of Natural History, Washington, D.C. 20560

ADAMS, William F., U.S. Army Corps of Engineers, P.O. Box 1890, Wilmington, N.C. 28402

Since the publication of the first paper on North Carolina mollusks of concern some ten years ago, much additional information has been brought forth in the form of publications and necessary field work. We have reviewed all species of land and freshwater mollusks known to occur in North Carolina, and have determined those that we consider endangered, threatened or of some special concern. The species accounts are presented along with pertinent biological information and useful characters for specific indentification. In addition, we provide a list of terrestrial gastropods with rather restricted known ranges and a summary of all freshwater mollusks thought to be limited to single drainage basins. The remarkably highly endemic nature, along with the species richness of this resource, make its future protection of paramount importance.

DYNAMICS OF FILTER-FEEDING IN MUSCULIUM TRANSVERSUM

WAY, Carl M., Dept. of Ecology and Evolutionary Biol., Northwestern Univ., Evanston, IL and USAE Waterways Experiment Station, Vicksburg, MS

The dynamics of filter-feeding were studied in Musculium transversum. Filter-feeding rates were measured using latex microspheres and natural particles at concentrations spanning the range of suspended solids encountered by the clams. Filter-feeding rates were sensitive to changes in suspended particle concentration and were highest at average ambient levels. Pseudofeces production was observed for all sizes of clams at particle concentrations > 30 mg/l. Clams were also sensitive to particle size; maximal ingestion occurred with particles < 5 μm. There was no significant difference between feeding rates using similar-sized latex microspheres and natural particles. SEM analyses of natural particles demonstrated that small (< 2 μm^3), inorganic clay particles were the primary source of ingested material. These particles were colonized by bacteria and other microflora. SEM analyses of the gill and mathematical models of the dynamics of particle removal demonstrated that only particles < 5 μm in diameter can be effectively retained by the ciliary filtering mechanism. These results suggest that: 1) clams can effectively filter particles < 1 μm in diameter and 2) an alternative mode of feeding (e.g. deposit feeding using the foot) is responsible for the ingestion of particles > 5 μm in diameter.

HOMOLOGIES AND HETEROCHRONY: ARE THEY SEPARABLE?

RUSSERT-KRAEMER, L.R. and GALLOWAY, Marvin, Department of Zoology, University of Arkansas, Fayetteville, AR 72701

We have argued (Kraemer and Galloway, 1986) that heterochrony, difference in timing of developmental events between related species, can profoundly affect ecological relationships of those species. We were concerned to show that retention of an elaborate sequence of marine-like developmental stages within marsupial gills, etc. of Corbicula fluminea, the introduced Asian clam, contrasted strongly with evident truncation and/or repression of such stages in development of its putative pisidiid (sphaeriid) relatives, the pill clams and fingernail clams. More recently we have found (Kraemer and Galloway, 1987) that not only are there extreme differences in timing of embryological events betweem C. fluminea and some pisidiid bivalves, but that the events themselves, the gametogenic and larval stages, are so different we are prompted to question the basis for the traditional view that the Corbiculidae and the Pisidiidae are related! Must we abandon too, the explication of heterochronous events as they help us to understand ecological associations of the Asian clam and the Pisidiidae? While the concept of heterochrony has heretofor been advanced to explain evolutionary change and separation of related groups, could heterochrony not also be employed to account for ecological adaptations of unrelated or of distantly related groups? We argue that heterochrony, when separated from a strictly comparative/homologous context, becomes a more powerful concept.

THE VALUE OF A STOCHASTIC MODEL IN PREDICTING UNIONID - CORBICULID INTERACTIONS (BIVALVIA).

CLARKE, Arthur H., ECOSEARCH, Inc. 325 East Bayview, Portland, Texas 78374

Use of a stochastic trophic model of freshwater benthic communities indicates that some predictability is possible about the outcome of species-specific interactions between Unionidae and Corbicula fluminea (Muller). Critical variable elements in the model include unionid feeding selectivity (as evidenced by morphology and heterozygosity), feeding habits of unionid fish hosts, rates of nutrient recycling, and other biological and physical parameters. Observed cases of vigorous coexistence of unionids and Corbicula in certain communities, and of apparent exclusion of unionids by Corbicula in others, are consistent with the model.

Tuesday Afternoon, July 21

SYMPOSIUM: BIOLOGY OF THE POLYPLACOPHORA. Convener: Douglas J. EERNISSE, Museum of Zoology and Dept. of Biology, University of Michigan, Ann Arbor, Michigan.

1:30 **ON THE NEED FOR A POPULATION APPROACH TO THE TAXONOMY OF CHITONS (POLYPLACOPHORA).** Allan M. JONES, and John M. BAXTER, Dept. of Biological Sciences, University of Dundee, Dundee, Scotland.

1:50 **MECHANICAL WEAR OF THE RADULAR DENTICLE CAP OF ACANTHOPLEURA GRANULATA (GMELIN)(POLYPLACOPHORA: CHITONIDAE).** Robert C. BULLOCK, Dept. of Zoology, University of Rhode Island, Kingston, Rhode Island.

2:15 **A REEVALUATION OF THE SUBORDER CHORIPLACINA WITH REFERENCE TO ITS SOLE LIVING MEMBER CHORIPLAX GRAYI (MOLLUSCA: POLYPLACOPHORA).** Karen L. GOWLETT-HOLMES, South Australian Museum, Adelaide, South Australia.

2:40 **CHITONS (MOLLUSCA: POLYPLACOPHORA) FROM THE COASTS OF OMAN AND THE ARABIAN GULF.** Piet KAAS, Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; and Richard A. VAN BELLE, Koninklijk Belgisch, Instituut van Natuurwetenschappen, Brussels, Belgium.

3:05 **BREAK**

3:25 **CARIBBEAN ACANTHOCHITONIDAE (POLYPLACOPHORA): ANOTHER TAXONOMIC PERSPECTIVE.** William G. LYONS, Florida Dept. of Natural Resources, Bureau of Marine Research, St. Petersburg, Florida.

3:50 **CONCLUDING REMARKS**

4:05 **GROUP DISCUSSION: THE STATE OF POLYPLACOPHORAN SYSTEMATICS.**

Abstracts

ON THE NEED FOR A POPULATION APPROACH TO THE TAXONOMY OF CHITONS (POLYPLACOPHORA).

JONES, Allan M., and BAXTER, John M., Department of Biological Sciences, University of Dundee, Dundee, Scotland, DD1 4HN

The common practice of describing species of chitons from a single, or often only a very few, individuals can and has led to considerable confusion when species differences are founded upon potentially variable parameters: this is further compounded if keys are produced which quote ranges of a character determined from only small samples. This paper will illustrate such problems using examples from the British chiton fauna and will present data on variability of characters in Lepidochitona cinereus, Tonicella marmorea and Acanthochitona spp. Recommendations for improvements in the basic procedures for describing species will be given.

MECHANICAL WEAR OF THE RADULAR DENTICLE CAP OF ACANTHOPLEURA GRANULATA (GMELIN) (POLYPLACOPHORA: CHITONIDAE).

BULLOCK, Robert C., Department of Zoology, University of Rhode Island, Kingston, RI 02881

The radular ribbon of the West Indian Acanthopleura granulata (Gmelin, 1791) consists of about 72 rows of teeth, each with a pair of major lateral teeth that possess a conspicuous denticle cap made black by the presence of the iron compound magnetite. The major lateral teeth are the major scraping elements of the polyplacophoran radula. As the teeth wear out, they are sloughed off at the anterior end; new teeth are formed at the posterior end of the radular ribbon.

Studies utilizing light and scanning electron microscopy document mechanical wear of the denticle caps. Anteriorly, about the first eleven pairs of the caps show signs of wear. As the cap is used, the distal back surface becomes worn at an oblique angle, thereby maintaining a sharp cutting edge of magnetite. The prominent black tab of magnetite on the otherwise unprotected back surface disappears as wear obliterates the orange-red lepidocrocite portion of the cap. Greatly worn caps, which show increased chipping of the cutting edge, consist only of a front surface of magnetite and a clear base.

It appears that some chitonids that live on hard substrates, where mechanical wear would proceed more quickly, compensate by producing a more elongate denticle cap than those individuals living on softer substrate.

A REEVALUATION OF THE SUBORDER CHORIPLACINA WITH REFERENCE TO ITS SOLE LIVING MEMBER CHORIPLAX GRAYI (MOLLUSCA:POLYPLACOPHORA).

GOWLETT-HOLMES, Karen L., South Australian Museum, North Terrace, Adelaide, South Australia, 5000.

The suborder Choriplacina was erected by Starobogatov & Sirenko in 1975 for 2 families, Glyptochitonidae and Choriplacidae, both of which have been regarded by recent authors as synonyms of Afossochitonidae (suborder Lepidopleurina). The Afossochitonidae thus contained 4 genera, Glyptochiton (Carboniferous), Afossochiton and Lirachiton (both Tertiary) and Choriplax (Recent). The inclusion of Choriplax was based solely on shell characters, the animal being then unknown. The recent discovery of several complete specimens of C. grayi has provided the opportunity to fully redescribe this species and reexamine its systematic position and the status of the suborder Choriplacina.

C. grayi has the following combination of characters which preclude it from any of the three recognised suborders in the Neoloricata:- large unslit insertion plates in all valves, very reduced tegmentum and holobranchial gills. I therefore consider the recognition of Choriplacina justified and redefine it as a fourth suborder of the order Neoloricata.

The types and other material of all species of Afossochiton and Lirachiton were also examined. Afossochiton has features characteristic of the Acanthochitonidae (suborder Acanthochitonina) and Afossochitonidae is regarded as a synonym of this family. Similarly, Lirachiton is regarded as a synonym of Notoplax (Bassethullia) in the same family.

Glyptochitonidae is provisionally recognised as a second family in Choriplacina pending a detailed examination of Glyptochiton.

The above study has raised some doubts as to the validity of recognising suborders within the Polyplacophora.

CHITONS (MOLLUSCA: POLYPLACOPHORA) FROM THE COASTS OF OMAN AND THE ARABIAN GULF.

KAAS, Piet, Rijksmuseum van Natuurlijke Historie, Leiden, P.O. Box 9517, 2300 RA, Leiden, The Netherlands; and VAN BELLE, Richard A., Koninklijk Belgisch, Instituut van Natuurwetenschappen, Vautierstraat 29, 1040 Brussels, Belgium.

The Polyplacophora of the Arabian Gulf have been only poorly investigated up till now. The only reports of chitons from this region are those of Glayzer, Glayzer and Smythe (The marine Mollusca of Kuwait, 1984), mentioning 5 species, of which only one proves to be correctly identified, and Kathleen R. Smythe's book on the Seashells of the Arabian Gulf, 1982, in which 8 species are mentioned and very poorly illustrated, of which at best 4 have been named correctly.

We are grateful to Mrs. Barbara Glayzer and to Mrs. Kathy Smythe, who entrusted us almost all their chiton material, including the many specimens from Qatar, mostly collected by Mr. Anthony Woodward, and from the Oman coast, where Dr. Bosch, a well-known physician and shell-collector on the island of Masirah, provided Mrs. Smythe with many chiton specimens. Furthermore the junior author (VB) received many specimens through the courtesy of Mr. F. Hinkle from Kuwait.

All in all we can establish the occurrence of some 15 species in the area, of which several are new to science.

Abstracts

CARIBBEAN ACANTHOCHITONIDAE (POLYPLACOPHORA): ANOTHER TAXONOMIC PERSPECTIVE.

LYONS, William G., Fla. Dept. Natural Resources, 100 8th Ave. S.E., St. Petersburg, FL 33701-5095.

Nomenclature of Florida and Caribbean Acanthochitonidae has been confused by misinterpretation of often simplistic descriptions and illustrations and confounded by uncritical comparisons and mathematical wizardry. Characters useful in identifying species frequently have not been described. Recent revisers have tended to combine taxa, reducing the recognized species from 9 to 6 in two revisions since 1980.

Dissected material was examined using SEM to re-evaluate taxonomic status of about 1,000 specimens, principally from Florida and the Bahamas. Specimens of different sizes and from widely separated sites were examined for ontogenetic change and local variation. Types of 7 named species were examined, as were many specimens previously cited by others. Most reliable identification characters include valve, tegmentum, and tegmental pustule morphology. Species superficially similar are easily separable with SEM.

Taxa recognized here are: Choneplax lata, Cryptoconchus floridanus, Acanthochitona andersoni, A. astrigera, A. balesae, A. bonairensis, A. hemphilli, A. interfissa, A. pygmaea, A. rhodea, and 4, perhaps 5, undescribed Acanthochitona spp., for a total of 14-15 species. Many of the species live in close association (12 at Grand Bahama Island). Four species of Acanthochitona described from Brazil are distinct from Caribbean taxa; three others reported there but described from the Caribbean need re-examination and confirmation.

Tuesday Afternoon, July 21

CONTRIBUTED PAPERS: FRESHWATER MOLLUSKS. Presiding: Steve A. AHLSTEDT. Tennessee Valley Authority, Norris, Tennessee.

1:30 **TAXONOMIC PROBLEMS OF SELECTED GULF COAST UNIONIDAE.** Paul D. HARTFIELD, Mississippi Museum of Natural Science, Jackson, Mississippi; and Walter R. HOEH, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

*1:50 **BIOCHEMICAL SYSTEMATICS OF SOME NORTH AMERICAN ANODONTA (BIVALVIA: UNIONIDAE).** Walter R. HOEH, Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

2:10 **HISTOCHEMISTRY AND ULTRASTRUCTURE OF OOGENESIS IN THREE UNIONID SPECIES (BIVALVIA: UNIONIDAE).** M. Bowie KOTRLA, Dept. of Biological Science, Florida State University, Tallahassee, Florida.

2:30 **SHELL MICROSTRUCTURE IN THE THREE RIDGE MUSSEL AMBLEMA PLICATA; INTERPRETATIONS OF BIOMINERALIZATION THROUGH STATIC WINDOWS.** Robert S. PREZANT and Antonieto TAN TIU, Dept. of Biological Sciences, University of Southern Mississippi, Hattiesburg, Mississippi.

2:50 **UNEXPLAINED FRESHWATER MUSSEL DIE-OFFS IN THE MAINSTEM TENNESSEE RIVER.** John J. JENKINSON, Tennessee Valley Authority, Knoxville, Tennessee.

3:10 **BREAK**

3:30 **THE UNIONID FAUNA OF THE EASTERN TRIBUTARIES TO THE MISSISSIPPI RIVER (MOLLUSCA, BIVALVIA, UNIONIDAE).** Arthur E. BOGAN, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, Pennsylvania; Paul D. HARTFIELD, Mississippi Museum of Natural Science, Jackson, Mississippi; and Cynthia M. BOGAN, Sewell, New Jersey.

3:50 **DISTRIBUTION AND ABUNDANCE OF POTAMILUS CAPAX AND OTHER FRESHWATER MUSSELS IN THE ST. FRANCIS RIVER SYSTEM, ARKANSAS AND MISSOURI.** Steve A. AHLSTEDT and John J. JENKINSON, Tennessee Valley Authority, Norris and Knoxville, Tennessee.

4:10 **FISH HOSTS FOR FIVE UNIONID MUSSELS IN THE UPPER TENNESSEE RIVER DRAINAGE.** Bruce L. YEAGER and Charles F. SAYLOR, Tennessee Valley Authority, Norris, Tennessee.

4:25 **FEASIBILITY OF USING TELEMETRY TECHNIQUES ON FRESHWATER MUSSELS (UNIONIDAE).** Richard J. NEVES, Fred A. SERVELLO, and Rebecca K. WAJDA, Dept. of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, Virginia.

*In competition for best student paper.

Abstracts

TAXONOMIC PROBLEMS OF SELECTED GULF COAST UNIONIDAE.

HARTFIELD, Paul D. and HOEH, Walter R.,
Mississippi Museum of Natural Science,
Jackson, MS 39202 and Museum of Zoology, University of Michigan, Ann Arbor, MI 48109

The Gulf Coast unionid fauna is notorious for morphological variability and the large number of species designations based on ecoforms. The majority of these ecological variants are recognized as such, but there is still dissension over the taxonomic status of a number of Gulf Coast forms, with the most controversial of these closely resembling Mississippi River drainage species. Distinctions between related Gulf Coast and Mississippi drainage species are based on shell characters such as color, presence of rays, shell shape, size, and corrugation. Changes in these characters have been shown in some species to be associated with latitude, water quality, or substratum. Since the Gulf Coast species are geographically isolated from their Mississippi drainage analogs, it is difficult to assess whether such characters are environmentally or genetically determined and the degree of genetic differentiation that has occurred. This paper presents an overview of the taxonomic problems of Gulf Coast unionids and, using morphometric, electrophoretic, and ecological data, attempts to evaluate the environmental and genetic components of shell variation in the Quadrula pustulosa complex in Mississippi.

BIOCHEMICAL SYSTEMATICS OF SOME NORTH AMERICAN ANODONTA (BIVALVIA: UNIONIDAE).

HOEH, Walter, R., Museum of Zoology,
University of Michigan, Ann Arbor, MI 48109

Due to high levels of phenotypic plasticity and a relative paucity of morphological characters, species limits and relationships among species within the genus Anodonta are problematic. Some clarification of these problems will likely result from the use of molecular techniques such as protein electrophoresis. In this study, 13 taxa of Anodonta from 16 populations were examined electrophoretically for 20+ loci. Relationships among species were assessed using phenetic and cladistic methods. Preliminary data analysis suggests that 1) A. "marginata" from the Upper Great Lakes region is specifically distinct from A. grandis, 2) an undescribed species, morphologically similar to species within the subgenus Utterbackia exists in the lower Apalachicola River, 3) little divergence exists between A. imbecilis and A. peggyae in Lake Talquin, and 4) A. couperiana is more closely related to A. suborbiculata than it is to A. peggyae and A. imbecilis. The results of this study suggest that protein electrophoresis is a useful tool for assessing phylogenetic relationships within Anodonta.

HISTOCHEMISTRY AND ULTRASTRUCTURE OF OOGENESIS IN THREE UNIONID SPECIES (BIVALVIA: UNIONIDAE).

KOTRLA, M. Bowie, Department of Biological Science, Florida State University, Tallahassee, Florida 32304-2043

The seasonality of oogenesis has been described for many unionids, but the morphological and histochemical aspects rarely have been examined. Unionid oogenesis is of interest because fertilization and development occur internally and there is interspecific variation in the duration of larval incubation. Anodonta imbecilis, Elliptio icterina, and Villosa villosa were selected for study because they are bradytictic, tachytictic, and horotictic, respectively.

There are no qualitative morphological or histochemical differences between the species. Previtellogenic oocytes are distributed among follicle cells at the acinar periphery. Growth of these oocytes is a result of organelle proliferation and accompanies formation of microvilli and cellular elongation. The onset of vitellogenesis, which is primarily autosynthetic, is marked by the appearance of Golgi-derived yolk precursor vesicles. The vitellogenic oocyte consists of a small basal portion connected by a stalk to a larger apical portion containing the nucleus.

Mature gonadal oocytes are spherical, average 110 µm in diameter, and are at the germinal vesicle stage. The cytoplasm contains yolk bodies, lipid droplets, and an extensive endomembranous network but lacks cortical granules. A vitelline coat surrounds the oocyte.

SHELL MICROSTRUCTURE IN THE THREE RIDGE MUSSEL AMBLEMA PLICATA; INTERPRETATIONS OF BIOMINERALIZATION THROUGH STATIC WINDOWS.

PREZANT, Robert S. and TAN TIU, Antonieto, Department of Biological Sciences, University of Southern Mississippi, Hattiesburg, MS 39406-5018.

Many hypotheses try to account for biomineralization processes in molluscs using static views of shell microstructure obtained by electron microscopy. Organic components are intricate in most processes proposed and nowhere can we find molluscs better suited for examination of these processes than the unionid bivalves. Unionids have thick organic matrices clearly exposing calcification events leading to primitive prismatonacreous shells. Can we, however, use static views to interpret dynamic events? Deposits along the shell edge of Amblema plicata reveal calcareous nuclei embedded between multiple organic layers. Growth and emergence of prisms within and beyond individual organic layers occurs so that tall prisms transcend several layers. Surficial erosion of organic layers above individual forming prisms appears to allow continued vertical deposition. Prismatic growth lines, in conjunction with conchiolin erosive pits, support these contentions. Keeping genomic restrictions and environmental plasticity of shell in mind, shell microstructure serves well as a static view of biomineralization.

UNEXPLAINED FRESHWATER MUSSEL DIE-OFFS IN THE MAINSTEM TENNESSEE RIVER.

JENKINSON, John J., Tennessee Valley Authority, Knoxville, TN 37902

In both June 1985 and January 1986, mussel fishermen reported die-offs of native freshwater mussels in the mainstem Tennessee River not far downstream from Pickwick Landing Dam, in southwestern Tennessee. On both occasions Tennessee Valley Authority biologists confirmed some mussels were fresh-dead (shells empty but nacre still lustrous) or were dying. In 1986, there were a few dead or dying snails (genera Leptoxis, Lithasia, and Pleurocera) and Asiatic clams (Corbicula sp.), but aquatic arthropods and fish were not killed. The 1986 die-off ended by early summer and did not recur in 1987. Mussel populations in the Watts Bar Dam tailwater (300 miles upstream) gave no indication of similar die-offs.

Temperature, dissolved oxygen, pH, and conductivity indicated no abnormal conditions during the die-offs. Metal ion concentrations in dying animals were not obviously different from live animals 50 miles upstream. Histopathological examinations revealed normal glycogen deposits adjacent to the digestive tract but heavy growths of common bacteria in decaying tissues.

Industrial effluents, pesticides, diseases, acid rain, and general environmental degradation have been suggested as possible causes of these and similar die-offs; however, none of these suggestions is clearly supported by field or laboratory investigations.

DISTRIBUTION AND ABUNDANCE OF POTAMILUS CAPAX AND OTHER FRESHWATER MUSSELS IN THE ST. FRANCIS RIVER SYSTEM, ARKANSAS AND MISSOURI.

AHLSTEDT, Steve A. and JENKINSON, John J., Tennessee Valley Authority, Norris, TN 37828 and Knoxville,TN 37902

The Memphis District, U.S. Army Corps of Engineers contracted with the Tennessee Valley Authority to conduct a survey of freshwater mussels in the St. Francis River and Floodway system, Arkansas and Missouri, primarily to document the occurrence and abundance of Potamilus capax, a federally-listed endangered species. The survey included qualitative sampling at 144 mainstem and tributary (ditch) sites in selected reaches totaling approximately 250 river miles and quantitative sampling at 17 of these sites.

Thirty-seven mussel species were found alive in the system. Potamilus capax was found in two areas: in adjacent reaches near the mouth of the river and in a variety of habitats near Marked Tree, Arkansas. Most specimens of the species were found in a mixture of sand, mud, and clay. Quantitative sampling yielded 0.02 P. capax per square meter in mainstem sites and 0.01 per square meter in ditch sites.

The survey extended the known distribution of P. capax in the St. Francis system and demonstrated that the newly-discovered populations are at least as dense as those previously studied. Additional extensions of the species range in the drainage seem likely to occur when other tributaries are searched.

THE UNIONID FAUNA OF THE EASTERN TRIBUTARIES TO THE MISSISSIPPI RIVER (MOLLUSCA, BIVALVIA, UNIONIDAE).

BOGAN, Arthur E.,Department of Malacology, Academy of Natural Science, Philadelphia, PA 19103 HARTFIELD, Paul, Mississippi Museum of Natural Sciences, Jackson, MS 39205 BOGAN, Cynthia M. 36 Venus Way Sewell, NJ 08080

The unionid fauna of the eight major eastern tributaries to the Mississippi River, south of the mouth of the Ohio River is documented. The fauna of these rivers has been radically altered by channel modification, bank clearing and siltation from the loess and alluvial soils of the area. Information on the unionid fauna in this region has been published only recently. The freshwater bivalve fauna of the Yazoo River is known from a few archaeological specimens collected by C.B. Moore. We present new archaeological evidence for a formerly diverse fauna in the lower Yazoo River. The distribution of Gulf Coast, Ohioan and Ozarkian faunal elements in these eastern tributaries to the Mississippi River is compared. We report the first documented occurrence of an Ozarkian speceis east of the Mississippi River.

FISH HOSTS FOR FIVE UNIONID MUSSELS IN THE UPPER TENNESSEE RIVER DRAINAGE.

YEAGER, Bruce L. and SAYLOR, Charles F., Division of Services and Field Operations, Biological Resources, Tennessee Valley Authority, Norris, TN 37828

Fish hosts for Epioblasma brevidens, E. capsaeformis, E. triquetra, Quadrula cylindrica and the endangered Q. intermedia were identified from laboratory-induced infestations. Thirty-one and 55 potential fish host species were tested for Epioblasma spp. and Quadrula spp., respectively. Seven riffle-dwelling perciform species of the genera Etheostoma (6) and Cottus (1) were identified as hosts for Epioblasma spp., while five species of cyprinids, three in the genera Hybopsis and two in Notropis (subgenus Cyprinella), were hosts for Quadrula spp. The stenotopic host usage demonstrated for these five mussel species corroborates the generally narrow host requirements characterized for other, previously studied, members of their respective unionid subfamilies.

FEASIBILITY OF USING TELEMETRY TECHNIQUES ON FRESHWATER MUSSELS (UNIONIDAE).

NEVES, Richard J., SERVELLO, Fred A., and WAJDA, Rebecca K., Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061

Magnetometry and radio telemetry techniques were tested using freshwater mussels to determine whether tagged specimens could be relocated periodically in a stream. Magnets were attached to the valves of muckets (Actinonaias carinata) which were liberated at a site; a portable magnetometer was then used in attempts to relocate these mussels. Specimens of Tennessee pigtoes (Fusconaia barnesiana) were tagged with two types of radio transmitters, released at a site, and then sought using a radio receiver and loop antenna. Magnetometry was not a suitable technique, due primarily to the short detection distances (<0.5 m) and the occurrence of background electromagnetic fields. Conversely, relocation of radio-tagged mussels, using triangulation, was readily achieved to within 1 m at distances of at least 200 m away. With further technological developments to reduce transmitter size and increase battery life, radio telemetry offers a suitable means of locating and monitoring most species of mussels.

Wednesday Afternoon, July 22

CONTRIBUTED PAPERS: TERRESTRIAL MOLLUSKS. Presiding: Kenneth C. EMBERTON, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, Pennsylvania.

2:20 **SYMPATRIC CONVERGENCE BETWEEN TWO LAND SNAIL SPECIES (PULMONATA: POLYGYRIDAE).** Kenneth C. EMBERTON, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, Pennsylvania.

2:40 **VERTICAL SEGREGATION BY SIZE CLASSES OF THE SOUTHERN APPALACIAN LAND SNAIL MESODON ANDREWSAE NORMALIS.** Bradley A. FOSTER, Ecology Curriculum, University of North Carolina, Chapel Hill, North Carolina.

3:00 **THE NINGBING RADIATION OF CAMAENID LAND SNAILS - OR MAXIMUM IN THE MINIMUM.** Alan SOLEM, Dept. of Zoology, Field Museum of Natural History, Chicago, Illinois.

3:20 **BREAK**

3:40 **PRELIMINARY STUDIES OF THE REPRODUCTIVE SYSTEM MORPHOLOGY OF THE PHILOMYCIDAE (GASTROPODA: PULMONATA).** H. Lee FAIRBANKS, Dept. of Biology, Pennsylvania State University, Monaca, Pennsylvania.

4:00 **INTRODUCED LAND SNAILS AND SLUGS IN NUECES AND SAN PATRICIO COUNTIES, TEXAS.** Jane E. DEISLER, Corpus Christi Museum, Corpus Christi, Texas.

4:20 **FUNCTIONAL ADAPTATION IN THE RADULA OF HELISOMA TRIVOLVIS (SAY).** David A. SMITH, Dept. of Biology, Wabash College, Crawfordsville, Indiana.

4:35 **INTRINSIC BIOMETRY IN THE RADULA OF HELISOMA TRIVOLVIS (SAY).** David A. SMITH, Dept. of Biology, Wabash College, Crawfordsville, Indiana.

SYMPATRIC CONVERGENCE BETWEEN TWO LAND-SNAIL SPECIES (PULMONATA: POLYGYRIDAE).

EMBERTON, Kenneth C., Department of Malacology, Academy of Natural Sciences, 19th & the Parkway, Philadelphia, PA 19103

Collections at 40 sites in the southern Appalachians showed that Neohelix major (Binney, 1837) and Mesodon normalis (Pilsbry, 1900) are conchologically more similar to each other where they occur together than where they occur apart. Virtually all of this sympatric convergence is correlated with four environmental measures: latitude, elevation, aspect (north-facing to south-facing), and topographic shelteredness (exposed hilltop to deeply shaded valley). Whether this reflects direct environmental effect on shell growth or some degree of adaptation through natural selection remains to be determined. There is no evidence of character displacement, mimicry, or any other form of species interaction.

THE NINGBING RADIATION OF CAMAENID LAND SNAILS - OR MAXIMUM IN THE MINIMUM.

SOLEM, Alan, Department of Zoology, Roosevelt & Lake Shore Drive, Chicago, IL 60605-2496

The Ningbing Ranges of Western Australia are low limestone hills interrupted by snail-free plains. Three Camaenid genera have radiated into at least 27 endemic species, all with very short ranges; 0.3 - 6.0 km (median 1.6 km). The species are mostly allopatric, with some sympatry.

Sympatric species show major differences in terminal genitalia, and usually have abvious to subtle shell differences. Allopatric species show less striking genital differences, and often very minor shell alterations.

A genus occurring mostly on large and continuous masses of limestone has sympatric species that show striking shell and genital differences, but electrophoretically are barely at species level; a genus living on scattered small hills has allopatric species, slight shell or anatomical differences, but biochemically are very highly differentiated.

VERTICAL SEGREGATION BY SIZE CLASSES OF THE SOUTHERN APPALACHIAN LAND SNAIL MESODON ANDREWSAE NORMALIS.

FOSTER, Bradley A., Ecology Curriculum, University of North Carolina, Chapel Hill, NC 27514

Populations of the southern appalachian endemic land snail Mesodon andrewsae normalis were sampled using three methods: 1) walking tours through rectangular plots, visually inspecting both foliage and leaf litter, 2) detailed visual examinations of foliage from ground to 2m high, 3) leaf-by-leaf examinations of litter transects. Shell diameter, substrate, and height from ground were recorded. The three methods gave similar results, with the first method possibly biased against finding small juvenile snails.

Shell diameter and height from ground were negatively correlated in most samples. Adults were proportionally more abundant and juveniles proportionally less abundant in the litter than in the foliage. Between habitat variation in the moisture regimes and in food resources used were inadequate explanations of the data. A differing predation pressure hypothesis between the two micro-habitats is proposed. Size-limited arthropod and small mammal predators dwelling in the litter should select against small snails in the litter. Large non-size-limited avian predators should select most strongly against the most conspicuous snails, large adults on green foliage.

PRELIMINARY STUDIES OF THE REPRODUCTIVE SYSTEM MORPHOLOGY OF THE PHILOMYCIDAE (GASTROPODA: PULMONATA).

FAIRBANKS, H. Lee, Department of Biology, Pennsylvania State University, Monaca, PA 15061

Species descriptions of some Philomycidae lack detailed information concerning reproductive system anatomy. Accordingly, specimens of Pallifera varia, Philomycus venustus and P. bisdosus were collected from their type localities. Specimens of Philomycus carolinianus, P. togatus and P. flexuolaris were also collected. All specimens, except P. togatus, were collected during the same week, and all were dissected two weeks later. Specimens used in this study were reproductively mature.

Based upon the size of the dart sac and dart, two groups were apparent. Philomycus carolinianus and P. togatus in one group, P. venustus, P. flexuolaris and P. bisdosus in another. Pallifera and Megapallifera have no dart sac or dart. However, Pallifera varia does have a "pouch", a dart sac like structure that lacks a dart. During this study four apparent Megapallifera were collected, and all had a "pouch". All three species of Megapallifera have been dissected by others, and none were reported to have a "pouch".

In studies by Webb and Tompa it was concluded that Philomycus does not lose its dart during mating. They also demonstrated that dart formation begins early in the development of the reproductive system. These preliminary data support a conclusion that these "pouched" specimens were from a previously undescribed species of the Philomycidae.

INTRODUCED LAND SNAILS AND SLUGS IN NUECES AND SAN PATRICIO COUNTIES, TEXAS.

DEISLER, Jane E., Corpus Christi Museum, 1900 North Chaparral, Corpus Christi, TX 78401

Surveys of cultivated areas and of the Corpus Christi Museum collections show that 10 different foreign land mollusks have been introduced into Nueces and San Patricio Counties, Texas. Species now established in the area include Helix aspersa, Otala lactea, Eobania vermiculata, Limax flavus, Polygyra septemvolva, Euglandina rosea, Opeas pumilum, Angustipes ameghini, Lamellaxis gracilis, and Rumina decollata. Interviews with property owners and examination of historical records show that R. decollata and H. aspersa have been present for at least two decades, while O. lactea and L. flavus have been present only two to three years. The remaining species are of uncertain date of introduction to the area, but may have been in the area at least 10 years on the basis of museum specimens. The major mode of introduction of H. aspersa was nursery stock from Houston brought to Nueces County in the early 1960's. This is the most probable mode of introduction of the other species as well. Nursery stock and transplanting of ornamental plants are currently the mode by which these species are spread within the area now. Observations and interviews indicate that the slugs and the large helicids cause moderate to severe damage to gardens, while homeowners do not notice the presence of the other species.

FUNCTIONAL ADAPTATION IN THE RADULA OF HELISOMA TRIVOLVIS (SAY).

SMITH, David A., Department of Biology, Wabash College, Crawfordsville IN 47933.

The mechanism of the molluscan buccal apparatus has historically evoked controversy. Specifically, it has been unclear whether the odontophore (the radula ribbon and underlying odontophoral cartilage) functions as a rope-and-pulley (dynamic radula, stationary cartilage), as a true rasp (stationary radula, dynamic cartilage), or as a moving conveyor-belt (dynamic radula, dynamic cartilage). Results from highspeed cinematography and from videomicrography showed that the radula of Helisoma trivolvis moves independently of the dynamic cartilage during feeding.

Individual snails from five populations of Helisoma trivolvis could be distinguished from one another on the basis of the relative speeds with which their radulae and their cartilages moved while feeding on artificially-prepared substrate (fat-coated glass plates). The relative rates of radula and of cartilage motion ($V_r:V_c$) correlated with the standing crop of Aufwuchs available at each site. Snails from sites with low Aufwuchs biomass had low ribbon velocities ($V_r:V_c \approx 1:1.5$) while snails from sites with high Aufwuchs standing crop biomass had high ribbon velocities ($V_r:V_c \approx 1:1$).

INTRINSIC BIOMETRY IN THE RADULA OF HELISOMA TRIVOLVIS (SAY).

SMITH, David A., Department of Biology, Wabash College, Crawfordsville IN 47933.

Infraspecific variation in radula-tooth biometry was quantified for radulae of Helisoma trivolvis (Say) taken from 21 sites in New York State. Both intrinsic (genetically programmed) and extrinsic (environmentally induced) factors influenced radula architecture and lateral-tooth shape in this species. With environmental factors (influencing architecture) eliminated, variation in radula-tooth biometry remained highly significant. Radula-tooth shapes showed no clinal distribution. Although study sites differed in food quality and in several measures of trophic condition there were no obvious correlations between habitat characteristics and either radula-tooth shape or radula-ribbon architecture. Snails showed no feeding selectivity among diatoms.

Evidence from this study indicated that radula-tooth shapes in Helisoma trivolvis are probably nonadaptive at the population level. It is unlikely however that tooth shapes are selectively neutral. Because of the transient nature of freshwater environments it is unlikely that any populations of freshwater molluscs can achieve adaptive optimality. Rather than being optimal, radular form in freshwater molluscs may reflect historical modifications of an otherwise basic pattern of radular secretion, which itself remains under rigid genetic control.

Wednesday Afternoon, July 22

CONTRIBUTED PAPERS: MARINE MOLLUSKS. Presiding: Janice VOLTZOW, Dept. of Biology, University of Puerto Rico, Rio Piedras, Puerto Rico.

*2:20 **ECOLOGY OF TURRITELLINE GASTROPODS: PALEONTOLOGICAL IMPLICATIONS.** Warren D. ALLMON, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

2:40 **POPULATION DISTRIBUTION OF HARD CLAMS, MERCENARIA SPP., IN THE INDIAN RIVER LAGOON, FLORIDA.** William S. ARNOLD, Dan C. MARELLI, and Paige A. GILL, Florida Dept. of Natural Resources, Bureau of Marine Research, St. Petersburg, Florida.

3:00 **NOTES ON THE ECOLOGY OF THE BIVALVES RANGIA CUNEATA (MACTRIDAE) AND POLYMESODA CAROLINIANA (CORBICULIDAE), WITH EMPHASIS ON FACTORS CONTROLLING TIDAL ZONATION.** Dan C. MARELLI, Florida Dept. of Natural Resources, Bureau of Marine Research, St. Petersburg, Florida.

3:20 **BREAK**

*3:40 **CONTRIBUTIONS TO THE BIOLOGY OF BOONEA IMPRESSA (SAY)(GASTROPODA: PYRAMIDELLIDAE).** John B. WISE, Grice Marine Biological Laboratory, Charleston, South Carolina.

4:00 **THE TIMING OF TORSION: A NEW TWIST.** Janice VOLTZOW, Dept. of Biology, University of Puerto Rico, Rio Piedras, Puerto Rico.

4:20 **LEPTONACEAN BIVALVES ASSOCIATED WITH BURROWS OF LYSIOSQUILLA SCABRICAUDA.** Paula M. MIKKELSEN, Harbor Branch Oceanographic Institute, Ft. Pierce, Florida.

4:40 **CONCH: AN INTERACTIVE COMPUTER PROGRAM FOR THE ANALYSIS OF SHELL COILING PARAMETERS.** Ralph E. CHAPMAN, M.G. HARASEWYCH, and Robert HERSHLER, National Museum of Natural History, Washington, D.C.

*In competition for best student paper.

ECOLOGY OF TURRITELLINE GASTROPODS: PALEONTOLOGICAL IMPLICATIONS.

ALLMON, Warren D., Museum of Comparative Zoology Harvard University, Cambridge, MA 02138

Although they are among the most abundant, diverse, and biostratigraphically important fossil mollusks, turritelline gastropods have been neglected by most neontologists, and most aspects of their biology and ecology are unknown. What is known from very few living species may have been unjustifiably extended to all species, fossil and living. This situation has hindered the use of turritellines in evolutionary and paleoecological studies, where they promise to yield interesting results.

Living turritelline species occur from about 60°N to 45°S, most at depths of 0-100m, but some as deep as 300m, with records as deep as 1400m. The group has traditionally been considered characteristic of warm waters, but many living species occur in cooler waters. Occurrence of at least some species may be seasonal, and some correlation may exist with upwelling of cooler, nutrient-rich waters. Most species investigated are ciliary filter feeders at least part of the time; some may also be deposit feeders. They inhabit a variety of substrates, from rocky tide pools to mud. The gregarious habit of turritellines familiar to paleontologists may not be characteristic of all species, and of some only at certain times. Developmental mode is variable within the group, ranging from release of crawling juveniles from egg capsules to long-term brooding to short-term planktotrophy.

NOTES ON THE ECOLOGY OF THE BIVALVES RANGIA CUNEATA (MACTRIDAE) AND POLYMESODA CAROLINIANA (CORBICULIDAE), WITH EMPHASIS ON FACTORS CONTROLLING TIDAL ZONATION.

MARELLI, Dan C., Fla. Dept. Natural Resources, 100 Eighth Avenue S.E., St. Petersburg, FL 33701-5095.

Rangia cuneata and Polymesoda caroliniana occur sympatrically in brackish water areas of many southeastern United States estuaries. Both of these bivalves are large (20-70 mm adult shell length), infaunal, and sedentary. Both are also dioecious broadcast spawners and suspension feeders. These species are segregated by tidal height, R. cuneata being a subtidal inhabitant and P. caroliniana occurring intertidally. Rangia cuneata is unable to colonize the intertidal because it cannot survive the high temperatures and long exposure times that occur there. Polymesoda caroliniana is well adapted to and abundant in the intertidal environment but is rare subtidally; its lower bound may be determined by predation and disturbance. Populations of R. cuneata and P. caroliniana are dominated by large individuals, indicating poor recruitment or survival of juvenile stages and relatively long life.

POPULATION DISTRIBUTION OF HARD CLAMS, MERCENARIA SPP., IN THE INDIAN RIVER LAGOON, FLORIDA.

ARNOLD, William S., Dan C. MARELLI, and Paige A. GILL, Fla. Dept. Natural Resources, 100 Eighth Avenue S.E., St. Petersburg, FL 33701-5095.

Hard clams were sampled at 525 stations in the Indian River Lagoon, Florida, during summer 1986. Clams were abundant throughout the central region of the sampling area but scarce at both the northern and southern extremes. Patterns of environmental variability are invoked to explain the macrodistribution of the animal in the lagoon, whereas water depth and sediment composition influence small-scale distribution patterns. A study of internal growth lines is utilized to explain the recent history of hard clams in the lagoon. Information on age distribution of the population elucidates the pattern of annual recruitment, which is related to macro-scale physical disturbances that impact on the lagoon.

CONTRIBUTIONS TO THE BIOLOGY OF BOONEA IMPRESSA (SAY) (GASTROPODA:PYRAMIDELLIDAE).

WISE, John B., Grice Marine Biological Laboratory, 205 Fort Johnson, Charleston, SC 29412

The prosobranch gastropod Boonea impressa (Say) is an ectoparasite which feeds on a variety of invertebrates, although it is most commonly found on the bivalve Crassostrea virginica. The host-parasite interaction between B. impressa and C. virginica (feeding behavior) is examined. Boonea impressa possesses specialized alimentary structures which are well suited to its methods of nutritional acquisition, these include: 1) an invaginated proboscis, 2) a buccal sac containing the mouth and a tapered stylet, 3) an elongated esophagus, 4) a pair of buccal glands, and 5) a muscular buccal pump. This assemblage of structures, in a coordinated effort, enable the extended proboscis to locate the host's soft tissue, which is then penetrated by the stylet. Subsequently, the muscular action of the buccal pump removes host hemolymph and perhaps some tissue debris. The morphology of these structures are examined utilizing light microscopy, scanning electron microscopy, and transmitting electron microscopy. Boonea impressa was tested for the hydrolytic enzymes alpha-amylase, trypsin, the trypsin-like serine proteinases. Immunocytochemistry proved to be inconclusive; however, substrate enzymology confirmed the presence of alpha-amylase not only in the buccal glands but also in the digestive tissue. The presence of alpha-amylase is not unexpected since there are large aggregates of glycogen in the granulocytes of oyster blood. The absence of trypsin-like enzymes indicates that other proteinases must be produced by B. impressa to facilitate the breakdown of proteins into amino acids it can metabolize.

THE TIMING OF TORSION: A NEW TWIST.
VOLTZOW, Janice, Department of Biology, University of Puerto Rico, Rio Piedras, PR 00931

Earlier descriptions of torsion in Haliotis and other archeogastropods by Crofts (1937, 1945) indicate that there are two distinct phases to torsion. The first 90° occurs fairly rapidly, within a few minutes to hours, but the second requires up to several days to complete. This data has led to many discussions regarding the costs and benefits of torsion to a larva. A half-torted larva that cannot retract into its shell appears mal-adapted; no modern gastropod species only undergoes the first half of the process.

Preliminary results from videotapes of veligers of the abalone Haliotis kamtschatkana indicate that the timing of the second phase of torsion is much more rapid than previously described. Cultures of H. kamtschatkana reared at 12°C took only 18 hours to complete the second half of the 180° rotation of the velum-foot with respect to the shell. In light of this new information, Crofts' work and the significance of torsion to the evolution of the Gastropods is re-evaluated.

CONCH: AN INTERACTIVE COMPUTER PROGRAM FOR THE ANALYSIS OF SHELL COILING PARAMETERS.
CHAPMAN, R.E., HARASEWYCH, M.G., and HERSHLER, R., The National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.

An interactive computer program, CONCH, has been developed to allow researchers to input or digitize points on photographs or drawings of gastropods and calculate Raupian shell coiling parameters as well as linear or angle measurements. Available output includes ASCII files for use with statistical or phylogenetic packages as well as graphical reconstructions on a monitor or plotter. A major option allows input and retrieval of data for analysis of ontogenetic trends. The program is written for DOS microcomputers and is available free from the authors. Sample output is shown illustrating the various options. Future releases will allow the analysis of bivalves and brachiopods.

The history, usefulness, variation, calculation and application of Raupian shell-coiling parameters as well as ontogenetic, allometric and phylogenetic trends are discussed. The calculation of Raupian parameters is very sensitive to measurement or digitizing error but useful results can be obtained given careful point selection and repeated analyses.

LEPTONACEAN BIVALVES ASSOCIATED WITH BURROWS OF LYSIOSQUILLA SCABRICAUDA.
MIKKELSEN, Paula M., Harbor Branch Oceanogr. Inst., Ft. Pierce, FL 33450

The stomatopod Lysiosquilla scabricauda (Lamarck) constructs large, distinctive burrows in shallow-water sand in the Indian River Lagoon, eastern Florida. These burrows were qualitatively sampled using a "yabby pump," an Australian-made suction device sold commercially for the collection of "yabbies" (callianassid shrimp) for use as fish bait. A unique molluscan fauna was discovered, differing dramatically from the typical infauna of unburrowed sand and from that associated with tubes of other local sand burrowers (e.g., callianassids, various worms). The largest and most interesting component of this community includes 4 species of leptonacean bivalves (2 Bornia-like species and 2 galeommatids) capable of active crawling in snail-like fashion, as well as attachment via strong byssal threads. All are presumed to be living attached to the mucus-reinforced walls of the tube, and not directly on the crustacean "host." The morphology and behavior of these bivalves, including shell morphology, mantle elaboration, byssus secretion, and the "yo-yo response," are presented via SEM, still photographs and video footage of the living animals.

Thursday Morning, July 23

CONTRIBUTED PAPERS: MARINE MOLLUSKS. Presiding: James F. QUINN, Jr., Florida Dept. of Natural Resources, Bureau of Marine Research, St. Petersburg, Florida.

*8:20 **A COST-BENEFIT ANALYSIS OF MEMBERSHIP IN PLACIDA DENDRITICA (MOLLUSCA: GASTROPODA: OPISTHOBRANCHIA: ASCOGLOSSA) AGGREGATIONS.** Cynthia D. TROWBRIDGE, Hatfield Marine Science Center, Oregon State University, Newport, Oregon.

8:40 **ASCOGLOSSAN ATTACK IS MEDIATED BY CONDITION OF THE ALGAE: PRELIMINARY RESEARCH.** Cynthia D. TROWBRIDGE, Hatfield Marine Science Center, Oregon State University, Newport, Oregon.

9:00 **INDO-PACIFIC PHILINACEAN OPISTHOBRANCHS.** Terrence M. GOSLINER, Dept. of Invertebrate Zoology and Geology, California Academy of Sciences, San Francisco, California.

9:20 **MOLLUSKS FROM THE CONTINENTAL SLOPE OF RIO GRANDE DO SUL, BRAZIL.** Eliezer de C. RIOS, I.S. CALVO, and L.J. BARCELLOS, Museu Oceanografico da Fundacao Universidade do Rio Grande, Rio Grande do Sul, Brazil.

9:40 **THE CAECIDAE OF BERMUDA.** Donald R. MOORE, Div. of Marine Geology and Geophysics, RSMAS, University of Miami, Miami, Florida.

9:50 **BREAK**

10:10 **BAHAMIAN WENTLETRAPS (EPITONIIDAE).** Robert ROBERTSON, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, PA.

10:30 **LIVING MARINE MOLLUSKS FROM THE TEXAS INNER SHELF.** Thomas R. CALNAN, Bureau of Economic Geology, University of Texas, Austin, Texas; and Thomas G. LITTLETON, College Station, Texas.

10:50 **GASTROPOD FAUNA OF A SUBTIDAL OYSTER REEF IN THE JAMES RIVER, VIRGINIA.** Carrollyn COX and Kevin J. McCARTHY, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, Virginia.

*11:05 **DIVERSITY, DISTRIBUTION, ECOLOGY AND MORPHOLOGY OF SALT-MARSH HYDRODIOID SNAILS OF THE DELMARVA PENINSULA (GASTROPODA: PROSOBRANCHIA).** Mary L. McKEE, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, Pennsylvania.

11:25 **MORPHOLOGY, ECOLOGY AND MOLECULAR GENETICS OF NORTHEASTERN U.S. HYDROBIA (GASTROPODA: PROSOBRANCHIA).** George M. DAVIS, Dept. of Malacology, Academy of Natural Sciences, Philadelphia, Pennsylvania.

*In competition for best student paper.

A COST-BENEFIT ANALYSIS OF MEMBERSHIP IN PLACIDA DENDRITICA (MOLLUSCA: GASTROPODA: OPISTHOBRANCHIA: ASCOGLOSSA) AGGREGATIONS.

TROWBRIDGE, Cynthia D., Department of Zoology, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365.

The ascoglossan Placida dendritica forms feeding aggregations on the green alga Codium. The size-frequency distribution of Placida aggregations was temporally and spatially constant from April to August 1986 in Oregon. The trophic implications of aggregation were examined in a series of laboratory experiments. The effect of group membership on Placida growth depends on the group size and composition (similar vs. dissimilar-sized animals). Members of Placida aggregations composed of similar-sized individuals grow faster than single animals. However, in mixed-sized aggregations, trophic benefits are not shared equally among all members. Small Placida may or may not benefit, depending on the size of conspecifics and the species of Codium consumed.

ASCOGLOSSAN ATTACK IS MEDIATED BY CONDITION OF THE ALGAE: PRELIMINARY RESEARCH.

TROWBRIDGE, Cynthia D., Department of Zoology, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365.

Aggregations of the ascoglossan herbivore Placida dendritica (Mollusca: Gastropoda: Opisthobranchia: Ascoglossa) are distributed patchily within and between populations of the green alga Codium. Research in progress evaluates whether ascoglossan patchiness could be due to differential algal condition. During 1986 ascoglossan attack in the field was concentrated on Codium thalli on the sunny, east and south-facing substrata relative to those on shady, west and north-facing surfaces. In laboratory experiments, Placida exhibits differential attraction to and avoidance of Codium tissue subjected to different levels of three types of stress (desiccation, herbivore attack, sand burial). A minimum threshhold of stress is required to alter algal susceptibility to Placida. Low to moderate stress increases algal attractiveness to Placida, whereas, high stress decreases it relative to unstressed, control thalli.

INDO-PACIFIC PHILINACEAN OPISTHOBRANCHS.

GOSLINER, Terrence M., Department of Invertebrate Zoology and Geology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118

Recent field expeditions to Aldabra Atoll, Papua New Guinea and the Hawaiian Islands have yielded specimens of approximately 30 species of Philinidae, Aglajidae and Gastropteridae. Aspects of the systematics and biology of these taxa are discussed. Included in these are 13 undescribed species and one new genus. The variability exhibited by these species in the morphology of the shell, radula, central nervous system and reproductive system exceeds that known previously for philinaceans. The phylogenetic implications of this variation are discussed. Many of these taxa are widely distributed in the Indo-Pacific. Additional records collected in this study significantly extend the ranges of several taxa.

MOLLUSKS FROM THE CONTINENTAL SLOPE OF RIO GRANDE DO SUL, BRAZIL.

RIOS, E. C., CALVO, I. S. & BARCELLOS, L. J., Museu Oceanografico da FURG , RS, Brazil.

The "Fundação Universidade do Rio Grande," (FURG) is conducting a research project to study the fauna inhabiting the deep waters (100 to 500 m) and bottoms of the continental slope. A series of dredgings were made with the oceanographic vessel "Atlantico Sul" covering an area located between 28º and 32º L.S. This paper presents a preliminary account of the main mollusks sampled during that project. The genus Miomelon is recorded for the first time in Brazil, being possibly represented by a new species to science . Further rare or interesting species are Conus mazei, Bursa benvegnuae, Metula anfractura, Odontocymbiola corderoi, Mitra larranagai, Latiaxis dalli , Fulgurofusus coronatus , Dentalium meridionale, Calliostoma rosewateri and others. It appears that the area is not very rich since the amount of living specimens represented just a small percentage of the samples.

THE CAECIDAE OF BERMUDA.

MOORE, Donald R., Division of Marine Geology and Geophysics, RSMAS, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149

The Caecidae of Bermuda are derived from the West Indian region. At least two species are endemic and appear to be offshoots of species still found in the West Indies and at Bermuda. Since many tropical Atlantic caecids do not live in Bermuda, the open stretch of sea (about 700 nautical miles) between the Bahamas and Bermuda must act as a filter to keep out species with short lived planktonic larvae.

BAHAMIAN WENTLETRAPS (EPITONIIDAE).

ROBERTSON, Robert, Department of Malacology, Academy of Natural Sciences of Philadelphia, PA 19103.

This is a progress report on the book "Marine Mollusks of the Bahama Islands: Identification, Systematics, Zoogeography, and Natural History" by R.R., Jack N. Worsfold & Colin Redfern.

Particular attention is given the Epitoniidae, including their conchology, and life histories. Reference is made to the early works of Mörch, and more recently of Clench & Turner. Future sources of probably useful taxonomic characters include most importantly anatomy and biochemical systematics. Also potentially useful are spermatozeugmata, egg capsules, and egg and first whorl sizes. Little is yet known about larval ecolgy, and the feeding associations with coelenterates. The latter is probably a familial character.

LIVING MARINE MOLLUSKS FROM THE TEXAS INNER SHELF.

CALNAN, Thomas R., Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas 78713; LITTLETON, Thomas G., 411 Harvey Rd., No. 256, College Station, Texas 77840

An extensive survey of the macroinvertebrate populations on the inner shelf of the Texas coast was initiated in 1976. The focus of this inventory was (1) identification and enumeration of the macrofauna; (2) description of faunal communities; and (3) correlation of distribution and abundances, including sediment and faunal relationships. This report summarizes the molluscan data from that survey. Although other inventories of mollusks on the inner shelf have been undertaken, this is the most extensive regional survey ever conducted on the Texas Gulf Coast.

One hundred thirty-seven species of mollusks (76 gastropods, 58 bivalves, and 3 scaphopods) were found in 554 benthic samples from stations located 1.6 to 17.6 km offshore from Brownsville to Sabine Pass, Texas. Both species and individuals of gastropods, bivalves, and scaphopods are more numerous on the South Texas inner shelf.

Cluster analysis separated the fauna into nearshore, transitional, and outer assemblages. Faunal-sediment associations indicate that more molluscan species occur in sands than in muds and that the most abundant species occur where sand content is high (80 to 100 percent). Analysis of the bathymetric distribution of mollusks shows that the average number of species is highest in a depth range of 5.5 to 18.3 m.

Abstracts

GASTROPOD FAUNA OF A SUBTIDAL OYSTER REEF IN THE JAMES RIVER, VIRGINIA.

COX, Carrollyn and MCCARTHY, Kevin J.
Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, Virginia, 23062

Benthic samples were collected from August, 1984 through August, 1985 on Wreck Shoal, James River to enumerate potential oyster predators. Five quantitative samples of 0.0126 m^2 were taken each month using a suction sampler (Larsen, 1974). The unexpectedly large number of gastropod species discovered prompted identification and enumeration of all gastropods collected. Eleven species of gastropods were identified: Boonea (=Odostomia) impressa (Say, 1822); Fargoa bartschi (=Q. dealbata) (Winkley, 1909); Fargoa bushiana (=Q. dux) Bartsch, 1909; Odostomia virginica Henderson and Bartsch, 1914; Epitonium rupicola (Kurtz, 1860); Triphora nigrocincta (C. B. Adams, 1839); Cochliolepis parasitica Stimpson, 1858 (a northern range extension); Acteocina cannaliculata (Say, 1822); Eupleura caudata (Say, 1822); Mitrella lunata (Say, 1862) and Doridella obscura Verrill, 1870. B. impressa, F. bartschi, O. virginica, and D. obscura were found throughout the year with densities in any one replicate sample ranging from 2 to 231, 0 to 24, 0 to 95, and 0 to 62 animals/sample area, respectively. The occurrence and density of remaining species were variable throughout the study. The maximum number of species collected in a single sample was ten; the minimum was two.

MORPHOLOGY, ECOLOGY AND MOLECULAR GENETICS OF NORTHEASTERN U.S. HYDROBIA (GASTROPODA: PROSOBRANCHIA).

DAVIS, George M.,Department of Malacology, Academy of Natural Sciences, Phila., Pa. 19103

Three ecologically distinct populations of Hydrobia from Long Island had different shell phenotypes, the same qualitative internal anatomy, and did not differ significantly genetically. They were compared with populations from Cape Cod. On the basis of results, all are assigned to Hydrobia totteni. A locality was selected to represent the type locality of Hydrobia totteni. The problem involving Hydrobia truncata from the Delmarva Peninsula is discussed.

DIVERSITY, DISTRIBUTION, ECOLOGY AND MORPHOLOGY OF SALT-MARSH HYDROBIOID SNAILS OF THE DELMARVA PENINSULA (GASTROPODA: PROSOBRANCHIA).

MCKEE, Mary L., Department of Malacology, Academy of Natural Sciences, Phila., Pa. 19103

Salt-marsh hydrobioid snail populations are being evaluated to determine the species diversity, distribution, ecological parameters and intra- and interspecific differences in radular morphology and in head-foot structures using SEM. One object is to determine if morphological differences associate with ecological parameters or with clades.

Snails are collected once a month from 12 sites located between 38° 50' and 37° 54' N latitude. Four species belonging to 4 different genera have been found: Spurwinkia salsa, Heleobops sp., Littoridinops monroensis and Onobops jacksoni. Only Spurwinkia and Littoridinops have been found on the east side of the peninsula; all 4 species have been found on the west side. There is sympatry at 58% of the sites; however, no sympatry has been observed on the east side.

Snails are found in crater-like depressions in the low marsh in the upper 1-2 cm of silt-mud substrate. Radulae for all 4 species are similar. All 4 species exhibit a marked difference in the ciliary patterns of the left and right tentacles. However, there are pronounced interspecific differences in ciliary patterns on the left tentacle. Penial morphology also exhibits distinct interspecific differences. Preliminary SEM results are presented.

Thursday Afternoon, July 23

CONTRIBUTED PAPERS: MARINE MOLLUSKS. Presiding: Silvard P. KOOL, National Museum of Natural History, Smithsonian Institution, Washington, D.C.

1:20 **WHAT IS A FASTIGIELLA?** Richard S. HOUBRICK, Dept. of Invertebrate Zoology, National Museum of Natural History, Washington, D.C.

1:40 **PHYLOGENY OF SUPRASPECIFIC GROUPS WITHIN MURICACEA (NEOGASTROPODA).** Silvard P. KOOL and M.G. HARASEWYCH, Dept. of Invertebrate Zoology, National Museum of Natural History, Washington, D.C.

2:00 **SPECIES PAIRS IN THE TEREDINIDAE.** Ruth D. TURNER and C.B. CALLOWAY, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

2:20 **BREAK**

*2:40 **SYSTEMATICS AND EVOLUTION OF THE TRUNCATELLIDAE IN THE WESTERN ATLANTIC.** Gary ROSENBERG, Mollusk Department, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

3:00 **A REVIEW OF POECILOGONY IN MOLLUSKS.** K. Elaine HOAGLAND, Association of Systematics Collections, Washington, D.C.

3:20 **CURRENT RESEARCH ON QUEEN CONCH, STROMBUS GIGAS, IN FLORIDA WATERS.** Carl J. BERG, Florida Dept. of Natural Resources, Bureau of Marine Research, Marathon, Florida.

4:00 **BUSINESS MEETING**

7:30 **SOCIAL HOUR AND BANQUET**

*In competition for best student paper.

Abstracts

WHAT IS FASTIGIELLA?

HOUBRICK, RICHARD S., Department of Zoology, National Museum of Natural History, Smithsonian Intitution, Washington, D.C. 20560

Fastigiella carinata Reeve, 1848, a monotypic taxon known only from its shell has been a puzzle among rare, western Atlantic prosobranchs. Recently, this species was live-collectd in the Bahamas. The shell is sculptured with 3 strong spiral cords, an aperture with a distinct anterior canal, a pseudumbilicus, and a siphonal fasciole. The ovate corneous operculum is paucispiral with an eccentric nucleus and the radula is taenioglossate. Anatomical features are an unusual hypobranchial gland of many transverse leaflets, a ridge dividing the anterior oviducal groove, and an open pallial oviduct with the seminal receptacle in the medial posterior lamina. On the basis of conchological, radular and anatomical characters, Fastigiella is assigned to the Cerithiidae, close to the genus Pseudobertagus Vignal.

PHYLOGENY OF SUPRASPECIFIC GROUPS WITHIN MURICACEA (NEOGASTROPODA).

KOOL, Silvard P. and HARASEWYCH, M.G., Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560

The main features of the reproductive and alimentary systems, the pallial complex, and the shell of the following taxa, which serve as representatives of the generally recognized muricacean families, are described: Rapanidae, Rapana rapiformis, Forreria belcheri; Coralliophilidae, Coralliophila violacea; Thaididae, Thais nodosa, Nucella lapillus; Muricidae, Muricanthus fulvescens, Hexaplex cichoreus. A phylogenetic tree of these taxa is presented, based on cladistic analyses of the data.

SPECIES PAIRS IN THE TEREDINIDAE.

TURNER, R. D., and CALLOWAY, C. B., MCZ, Harvard University, Cambridge, MA 02138.

Classification and identification in the Teredinidae is based on the anatomy of major organ systems, the shells, and particularly the pallets. Variations in the reproductive system and/or reproductive behavior are common in teredinids and life history studies have shown that in at least four cases named forms which had been considered synonymous are separate species. Most teredinids are oviparous but Lyrodus and Teredo are larviparous, retaining larvae in the gills to the straight-hinge or pediveliger stage, a condition not easily distinguished except in adults with larvae in the gills. The problem of species with similar pallets but different life history patterns, noted by Turner and Johnson (1971), was documented by Calloway and Turner (1984) for Lyrodus pedicellatus, a long-term, sequential brooder and L. floridanus, a short-term brooder. All short-term brooders are synchronous but long-term brooders may have a single brood, and release larvae synchronously, or a series of broods in different stages of development releasing them sequentially. By rearing larvae in the laboratory, examining living adults carrying larvae, and by histological studies we have documented three additional species paris. Each has a long-term synchronous or sequential member and a short-term member. These results emphasize the fact that pallets can no longer be used as the sole means of identification of teredinids, particularly Lyrodus and Teredo.

SYSTEMATICS AND EVOLUTION OF THE TRUNCATELLIDAE IN THE WESTERN ATLANTIC.

ROSENBERG, Gary. Mollusk Department, Museum of Comparative Zoology, Cambridge, MA 02138

Electrophoretic and anatomical studies of Western Atlantic truncatellids provide clear-cut differentiation of species, supporting groupings based on shell morphology. Truncatella pulchella, T. caribaeensis, and T. scalaris live sympatrically in the Florida Keys; they occupy distinct but overlapping microhabitats. T. pulchella populations are extremely monomorphic: only 3 of 38 enzymatic loci show any polymorphism. This monomorphism cannot easily be explained by a bottle-neck effect. The species may be under intense selection pressure.

Abstracts

A REVIEW OF POECILOGONY IN MOLLUSKS.

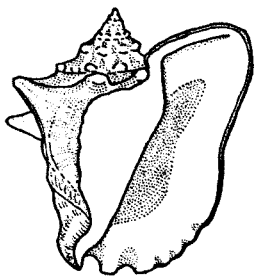
HOAGLAND, K. Elaine, Association of Systematics Collections, 730 11th St., N.W., 3rd Fl., Washington, D.C. 20001

Poecilogony, or two types of larval development in a single species, has been reported for numerous marine mollusks but primarily for opisthobranchs and prosobranchs. The larval types are usually planktotrophic development and lecithotrophic development via nurse eggs, yolky brooded eggs, or yolky demersal eggs. Geographic and seasonal poecilogony are most frequently-claimed, but sympatric, contemporaneous poecilogony has also been reported. All reported cases are reviewed. Some authors suggest that nutritional levels can determine egg size and type of development, but no proof has been offered. Nearly all cases of poecilogony are attributed to mistakes in taxonomy, in which separate species differing in morphology as well as reproduction were not recognized. The few remaining possible cases of poecilogony are given, and the evolutionary implication of the rarity of poecilogony is discussed.

CURRENT RESEARCH ON QUEEN CONCH, STROMBUS GIGAS, IN FLORIDA WATERS.

BERG, Carl J., Florida Dept. of Natural Resources, Bureau of Marine Research, 11400 Overseas Highway, Marathon, FL 33050

Stocks of queen conch in Florida waters have declined markedly in the past decade and a moratorium on all collecting has been in effect for two years. The State of Florida's Bureau of Marine Research has initiated a major research effort to measure stock size, population dynamics, and reproductive activity of near-shore populations. Stock rehabilitation will be attempted through hatchery rearing and tagged-release of juvenile conch. The biochemical-genetics of Florida populations will be compared with other conch populations throughout the Caribbean to estimate the amount of gene flow that occurs among island populations. The up-to-date progress of all these programs will be discussed.



POSTERS, July 20-23

POSTER SESSION. Seabreeze Room. Posters will be set up by noon of Monday, July 20. Presenters of posters will be on hand to discuss their work and answer questions between 2:30 and 5:00 p.m. Wednesday, July 22, and sporadically at other times during the meeting.

THE USE OF DESCRIPTIVE MATRICES FOR MOLLUSCAN TAXONOMIC STUDIES. David HARGREAVE, Western Michigan University, Kalamazoo, Michigan.

COMPARATIVE STUDY OF THE EPITHELIUM OF NUDIBRANCH GILLS (GASTROPODA, OPISTHOBRANCHIA). Mechthild JONAS, Friday Harbor Laboratories, Friday Harbor, Washington.

A LIFE CYCLE OF CORBICULA FLUMINEA FROM THE WILLAMETTE RIVER, OREGON. Christine A. MILLER-WAY and Carl M. WAY, USAE Waterways Experiment Station, Vicksburg, Mississippi.

A CUSTOM SOFTWARE APPLICATION FOR THE AUTOMATED COLLECTION, STORAGE, AND STATISTICAL MANIPULATION OF LARGE, MULTIPLE DATA SETS. Carl M. WAY, Dept. of Ecology and Evolutionary Biology, Northwestern University, Evanston, Illinois, and USAE Waterways Experiment Station, Vicksburg, Mississippi.

THE USE OF DESCRIPTIVE MATRICES FOR MOLLUSCAN TAXONOMIC STUDIES.

HARGREAVE, David, General Studies, Western Michigan University, Kalamazoo, MI 49007

Given adequate sample sizes, normal statistical techniques provide one with the ability to differentiate intraspecific variation from significant morphologic variation over time for those elements of shell morphology that are described in terms of linear or angular measures, ratios of such measures or counts. However, descriptions of species have often relied heavily on qualitative and subjective assessments of shape and surface sculpture that would seem to defy statistical analysis. Descriptive matrices represent a method whereby that subjectivity can be reduced and at least limited statistical inferences can be drawn for many descriptive features of shell morphology.

In general, two-dimensional matrix arrays consist of a number of uniquely labeled columns and rows which intersect forming cells. The critical factor in establishing useful descriptive matrices is the requirement that each column and row be defined in terms of a precise geometric relationship, with adjacent rows or columns reflecting geometrically understandable changes in shell morphology. Once such a matrix has been developed individual specimens can be compared with it and assigned the value of the cell most closely approximating the specimen. Eventually the percentage of the total sample assigned to each cell can be displayed using the same matrix format with empty cells.

An analysis of lip shape and spiral sculpture among members of the subgenus Tricornis (Gastropoda: Strombidae) in the Florida tertiary is presented to exemplify the technique.

A LIFE CYCLE OF CORBICULA FLUMINEA FROM THE WILLAMETTE RIVER, OREGON.

MILLER-WAY, C.A. and C.M. Way, USAE Waterways Experiment Station, Vicksburg, MS.

The life cycle of Corbicula fluminea from the Willamette River, Oregon, was studied. Samples were collected monthly from a well-sorted gravel-sand substrate during 1983 except during periods of reproduction when sampling was conducted biweekly and during periods of high water when the study site was inaccessible. This Corbicula population was iteroparous. The spring and fall generations had longevities of approximately 12-14 months. Corbicula exhibited very rapid growth rates (0.25 - 0.30 mm/day) during the spring and fall months. Pediveligers were released during May-June and August-September. The spring and fall release of pediveligers corresponded to a water temperature of 14° ± 1° C. This is well below the temperatures reported in the literature for triggering reproduction. However, the majority of studies concerning the life cycle of Corbicula fluminea have been on populations in the southeastern and southwestern United States.

COMPARATIVE STUDY OF THE EPITHELIUM OF NUDIBRANCH GILLS (GASTROPODA, OPISTHOBRANCHIA).

JONAS, Mechthild, Friday Harbor Laboratories, Friday Harbor, WA 98250.

A light microscopic, TEM and SEM study of the epithelium of the pinnate gills of dorid and dendronotid nudibranchs reveals differences in epithelial cell types, that may have evolutionary significance.

In dorids the epithelium of the anal gills consists of respiratory and glandular cells that form a single layer separated from the hemolymph in the gill vessels by a basal lamina and only a thin layer of connective tissue. On the gill pinnules the respiratory cell is the most prominent cell type in the epithelium. It is characterized by a large nucleus, an elaborate basal labyrinth, a brush border of dense microvilli, and often additional cilia. Even though the dorid gills are located on the dorsum, their epithelium shows no similarities in histology and fine structure to the dorsal epithelium.

The dendronotid gills are arranged in a longitudinal series dorsolaterally on the dorsum edges. In the gills of Tritonia diomedea, glandular and ellipsoid-vacuolate cells form a single layered "vacuolated epidermis" which is also found on the dorsum and the rhinophores. The epithelium of these gills thus resembles the dorsal epithelium in histology and fine structure.

These differences in dorid and dendronotid histology might result from the putatively different origins of the gills, from primary gills (ctenidia) in dorids vs secondary (adaptive) gills in dendronotids. The anal gills of dorid nudibranchs, or more likely the epithelium that forms these gills, may, therefore, be derived from the anterior right side of the animal beneath the mantle rim rather than from the dorsum. In contrast, the gills of dendronotids are derived directly from the dorsum, formed by the dorsal epithelium.

A CUSTOM SOFTWARE APPLICATION FOR THE AUTOMATED COLLECTION, STORAGE, AND STATISTICAL MANIPULATION OF LARGE, MULTIPLE DATA SETS.

WAY, Carl M., Dept. Ecology and Evolutionary Biol., Northwestern University, Evanston, IL, 60201 and USAE Waterways Experiment Station, Vicksburg, MS, 39180

A custom software application for the IBM-PC and compatibles was developed using the relational database manager Paradox. The application is capable of combining information contained in three large independent data sets for calculating simple statistics, generating customized reports, and exporting data to either another PC program (Lotus 1-2-3, PC-SAS) or a mainframe computer. This application was specifically designed for direct field entry of data into laptop microcomputers. The application has several distinct advantages: 1) field researchers have instant access to summary information permitting immediate necessary modifications to project design; 2) operation requires no computer knowledge as the application is entirely menu driven with detailed help screens; 3) the system can be altered at any time to reflect changes in project needs; and 4) output type (data entry screens, statistical tests, report types) generated by the program can be designed to meet the exact specifications of the user. This type of custom software can be designed for most types of research projects in which multiple databases must be maintained and manipulated.

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