

CISNEROS-HEREDIA, DIEGO F.

Laboratory of Amphibians & Reptiles FHGO-USFQ, Life Sciences College, Universidad San Francisco de Quito, Ave. Interoceanica, Campus Cumbaya, Edif. Maxwell, PO Box 17-12-841 Quito, Ecuador

Herpetofauna of the Rio Guajalito Protection Forest, northwestern Ecuador: biodiversity, community changes, and conservation issues

The herpetofauna of the Rio Guajalito Protection Forest, northwestern Ecuador, was studied over a period of four-years. The species richness and relative abundance of the amphibians and reptiles was determined through the application of 'inventory multiple methods' (visual encounter survey transects, leaf litter plots, larval survey, and random sampling points). A new species of frog of the genus *Phyllonastes* endemic to the area, several restricted-range species of the genus *Eleutherodactylus* (Amphibia), *Dipsas* and *Atractus* (Reptilia) are present at the forest. Using data obtained since the late 70's, several changes in the composition and relative abundance of species have been observed. At least three taxa of amphibians are extirpated or extinct and some local declines have been detected on anurans and lizards. The extinctions and declines at the area could be related to several factors working synergistically: habitat destruction, introduced species, diseases and local climate change. However, the patterns of changes of the community of amphibians and reptiles at the Rio Guajalito Protection Forest are similar to those reported for Monteverde, Costa Rica, not just for the herpetofauna but for birds as well, suggesting a link to recent climate changes. Issues concerning the conservation of the amphibians and reptiles of the region are discussed.

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Laboratory of Amphibians & Reptiles FHGO-USFQ, Life Sciences College, Universidad San Francisco de Quito, Ave. Interoceanica, Campus Cumbaya, Edif. Maxwell, PO Box 17-12-841 Quito, Ecuador

Herpetofauna of the Tiputini Biodiversity Station, Amazonian Ecuador: biodiversity and survey methods in neotropical rainforest

A total of 170 species of amphibians and reptiles were identified over a four-year period at the Tiputini Biodiversity Station (TBS), Ecuadorian Amazonia. TBS protects approximately 650 hectares of primary rainforest. The composition of species was determined through "inventory multiple methods" (visual encounter survey transects, leaf litter plots, pitfall traps, larval survey, and random sampling points). TBS maintains one of the most alpha-diverse community of amphibians (100 species), including two new species of treefrogs of the genus *Hyla*, and two of the genus *Eleutherodactylus*. The application of several survey methods synchronically, here called 'inventory multiple methods', is discussed and suggested as an efficient way to survey communities in neotropical rainforest areas.

*** CISNEROS-HEREDIA, DIEGO F.; MCDIARMID, ROY W.**

(DFCH) Laboratory of Amphibians & Reptiles FHGO-USFQ, Life Sciences College, Universidad San Francisco de Quito, Ave. Interoceanica, Campus Cumbaya, Edif. Maxwell, PO Box 17-12-841 Quito, Ecuador; (RM) USGS Patuxent Wildlife Research Center, Smithsonian Institution, PO Box 37012, National Museum of Natural History, Room 378, MRC 111, Washington, DC 20013-7012, USA

Ecuadorian glass frogs: current state of knowledge, new research trends and conservation

Ecuador has the biggest number of amphibian species per unit of area in the world (427 species in 276,840 km²). Glass frogs (Centrolenidae) with 30 species, constitute 7.06 % of the Ecuadorian anurans. However, the current state of knowledge of this family in Ecuador is still very basic. Several species of glass frogs are currently undescribed, confused with previously described taxa, not yet reported from the country but present in local museum collections, not yet discovered in Ecuador, or even described under two different names. The genus *Hyalinobatrachium* is poorly known in the country (four species), but at least three undescribed taxa are present in the western lowlands of Ecuador. Among the genera *Cochranella* and *Centrolene*, at least 6 new species are known from tropical and subtropical areas in western and eastern slopes of the Ecuadorian Andes. Several characters such as the patterns of skin, eye, peritoneum and pericardium color, the prepollicall spine, the nuptial pad, and the presence of the bulla are discussed, especially around its taxonomic potential. At least one undescribed taxon from western lowlands of Ecuador is critically endangered, if not extinct. In the last decade, conservative estimates indicate that at least 26 species of Ecuadorian amphibians have declined or gone extinct, two of them belong to the family Centrolenidae. The reasons for this crisis are not clear but have been related to habitat destruction, climate change, and fungal disease such as the chytridiomycosis.

*** CLARK, ERIN E.; TUBERVILLE, TRACEY D.; GIBBONS, J. WHITFIELD;
BUHLMANN, KURT A.; WARREN, ROBERT J.; NESTOR, JOHN P.; CLARK, KELLY
A.**

(EEC, TDT, JWG, KAB, JPN) Savannah River Ecology Laboratory, P O Drawer E, Aiken, SC 29802, USA, (RJW) Warnell School of Forest Resources, Athens, GA 30602, USA, (KAC) Coastal Georgia Community College, Biology Department, 3700 Altama Avenue, Brunswick, GA 31520-3644, USA

The effect of penning following relocation on dispersal, movement and density in the gopher tortoise

The gopher tortoise has been the focus of a number of conservation strategies. Of these, relocation has been one of the most controversial. Concerns stem from potential impacts on social structure, genetic mixing and spread of infectious disease. A post-relocation movement study was conducted to better understand tortoise behavior following relocation and to improve relocation success. Adults and juveniles relocated from McIntosh County, Georgia, to Aiken County, South Carolina, were separated into experimental groups then penned for varying lengths of time in 1 ha enclosures. All groups were overwintered between capture and release. Release group 1 was released shortly after emerging in the spring of 2002. Release group 2 was released in July 2002. Release Group 3 was released in September 2002. Movement and diffusion of tortoises were monitored during the first active season. Animals that established a burrow within the compartment and regular home range areas were generally considered successful. Failures characterized by a number of factors including straight-line movement, failure to establish burrows, movement outside dispersal boundaries and repeated dispersal were more common in the first release group. Release group 1 showed the lowest

success rate (30.7%), while release group 3 showed the highest success rate (91.7%). Release group 2 had an intermediate rate of success (61.5%). Long-term penning of multiple tortoises may significantly improve relocation success. Additionally, information is now available on site selection for burrows, density changes from pre-relocation conditions and tortoise interaction following relocation.

*** CLARK, EUGENIE; MOLTZER, MAYA; STOLL, MARY JANE; RUBIN, JUDITH; KOGGE, STEVE**

(EC) Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL, 34236, USA; (MM) 7 Rockwell Crescent, Apt. 1502, Potts Point, NSW 2011, Sydney, Australia; (MJS) 565 Bellevue Avenue, #1702, Oakland, CA, 94610, USA; (JR) 2417 Eastern Canal, Venice, CA, 90291, USA; (SK) 10600 Stoneyhill Court, Silver Spring, MD, 20901, USA

Swarming behavior of juvenile *Pholidichthys leucotaenia* (Pholidichthyidae) off coral reefs and in aquaria

In Papua New Guinea and the Solomon Islands, we have observed site-attached juveniles of *Pholidichthys leucotaenia* leave their burrows at dawn and return at dusk. During the day they feed on plankton as far as 50 m from their home burrows. Swarms from a single burrow vary from 30 to over 10,000 juveniles. Larger swarms form huge balls that "explode" like fireworks, then contract repeatedly. Occasionally, swarms completely leave the reef and stream far out into open water in long snake-like formations. We are raising groups of juveniles that have grown in eight months from 2 to 15 cm TL in two 80-gallon aquaria: (1) the "reef tank" is a "control" with 18 cm-deep coral sand and large coral stone formations; and (2) an experimental aquarium with less than 2 cm sand depth and a fiberglass tunnel, open-sided against the aquarium glass. The juveniles readily go into the artificial tunnel when live food (*Artemia*) is released directly into it. We hope they will breed in the tunnel. Juveniles in aquaria also form loose swarms in their limited space. At night they go into shallow burrows they have made in the sand under rocks in the "reef tank." In the experimental tank, they lie on the bottom at night. Individuals can be told apart by their markings.

CLARK, RULON W.

Cornell University, Department of Neurobiology and Behavior, Ithaca, NY 14853, USA

The effect of feeding experience on ambush site selection in a sit-and-wait predator, *Crotalus horridus*

Many predators capture their prey through ambush. In order to effectively ambush prey, a predator must locate a site wherein profitable prey are likely to return. One means by which predators evaluate potential ambush sites is by recognizing high-use areas through chemical cues deposited by their prey. I examine the selection of ambush sites by timber rattlesnakes exposed to trails made from chemical extracts of the integument of various prey species. I evaluate the role of feeding experience by comparing ambush site selection before and after timber rattlesnakes have experience with prey items. Timber rattlesnakes are more likely to select ambush sites adjacent to chemical trails from prey they have feeding experience with. However, only snakes feeding on relatively large prey showed an increase in responsiveness. Furthermore, increased responsiveness after feeding experience was only exhibited in trials using integumentary extracts of mammals (the natural prey of timber rattlesnakes), and not fish. These findings show that timber rattlesnakes can learn to recognize chemical cues present

on the integument of food items, and use that knowledge to modify their ambush hunting strategies.

CLARK, STEVE; VIOLETTA, GARY; * HENNINGSSEN, ALAN; REISCHUCK, VAL; MOHAN, PETE; KEYON, JOE

(SC) Sea World, Inc., Corporate Zoological Operations, 7007 Sea World Drive, Orlando, FL, 32821, USA; (GV) Sea World Adventure Park Florida, 7007 Sea World Drive, Orlando, FL, 32821, USA; (AH) Biological Programs. National Aquarium in Baltimore, Pier 3,501 E. Pratt Street, Baltimore, MD, 21202, USA; (VR) Six Flags Worlds of Adventure. 1060 North Aurora Road, Aurora, OH, 44202, USA; (PM) 5802 Thorndale Drive, Kent, OH, 44240, USA; (JK) Sea World Adventure Park Texas, 10500 Sea World Drive, San Antonio, TX, 78523, USA

Growth in captive smalltooth sawfish, *Pristis pectinata*

All species of sawfish are listed as endangered to critically endangered on a global basis. The smalltooth sawfish, *Pristis pectinata*, is listed as critically endangered in the western Atlantic, and has been extirpated from much of its former range. Many details on the life history of this species are lacking in the literature. Although limited in scope, information from captive specimens may provide information on growth that is otherwise unavailable. We provide results on growth from nine captive specimens, four males and five females. These results indicate that smalltooth sawfish are indeed slow -growing and long-lived. Because of limitations in sample size and size range included, these results are only preliminary in nature. Missing are the critical upper and lower size ranges for this species. Data were fitted to the von Bertalanffy growth model, resulting in the following parameters: $k = 0.067 \text{ yr}^{-1}$, $t_0 = -2.57 \text{ yrs.}$, $L_{\text{inf}} = 385.4 \text{ cm}$, and $k = 0.034 \text{ yr}^{-1}$, $t_0 = -4.09 \text{ yrs.}$, $L_{\text{inf}} = 469.9 \text{ cm}$, for males and females respectively. Although the parameters predict a realistic size at birth of 60 cm TL, limitations of the dataset lead to an underestimate of L_{inf} , as smalltooth sawfish attain a maximum length of 600cm, and have been reported to reach 760 cm TL. Additional institutional collaboration may add valuable data particularly for the small juveniles. These results provide insight into the shape of the growth curve despite the limitations imposed by captivity, sample size, and size range included. Additional information on morphometrics allowed us to estimate the weight length relation, $W(\text{kg}) = 4.0 \times 10^{-5} \text{ TL}(\text{cm})^{2.565}$, and the TL to FL relationship, $\text{FL} = 0.91 \text{ TL} + 9.62$.

CLARK, TIMOTHY B.

University of Hawaii, Dept. Zoology, 2538 McCarthy Mall, Edmondson 152, Honolulu, HI 96822, USA

Habitat use of the manta ray (*Manta birostris*) in Hawaii

The manta ray (*Manta birostris*) is coming under increasing pressure from fisheries, yet very little is known about their basic ecology. Manta rays were acoustically tracked along the leeward coast of the island of Hawaii to investigate their fine scale habitat use. Results of this on-going study will be discussed, along with possible relationships to the feeding ecology of the manta.

*** CLARKE, SHELLEY; McALLISTER, MURDOCH; MICHIELSENS, CATHERINE; KIRKWOOD, GEOFF**

Renewable Resources Assessment Group, Department of Environmental Science and Technology, Faculty of Life Sciences, Imperial College London, 4/F Royal School of Mines Building, Prince Consort Road, South Kensington Campus, SW7 2AZ London, United Kingdom

Estimates of sharks represented in the global shark fin trade and assessment of sustainability

The burgeoning and largely unregulated trade in shark fins is believed to represent one of the most serious threats to shark populations worldwide. Given the deficiencies in global shark fin production and trade statistics, quantitative studies of the world's major market for fins in Hong Kong were undertaken to better understand the quantity and species composition of sharks represented. Approximately 29% of daily merchant association auction records were obtained for an 18-month period spanning October 1999 to March 2001. Chinese trade names for fins contained on the sheets were mapped to taxonomic nomenclature using molecular genetic techniques. Bayesian statistical modelling and data-filling methods were implemented in WinBUGS to address the missing records and derive estimates of the total traded weight of fins for each shark species. The model was then expanded to convert fin weights into estimates of the number and landed weight of shark species represented by the trade. These estimates for the Hong Kong auctions were then extrapolated to the entire global trade, using figures from national customs databases. Comparison of landed weight estimates from the trade to the total shark capture production reported to the Food and Agriculture Organization (FAO), allows inferences regarding the accuracy of FAO figures and the degree of utilization of captured sharks in the fin trade. A simple evaluation of the sustainability of existing fin trade demands on shark populations will be presented based on a Schaefer model for blue sharks (*Prionace glauca*).

*** CLARO-JR, LUIZ H.; FERREIRA, EFREM J. G.; ZUANON, JANSEN; ARAUJO-LIMA, CARLOS A. R. M.**

Instituto Nacional de Pesquisas da Amazônia-INPA, Manaus, AM, 69011-970, Brazil

Consumption of allochthonous items by fishes in floodplain lakes in Central Amazon, Brazil, and its relationship with the amount of flooded forest

The human exploitation of the Amazonian floodplain has caused major landscape alterations, primarily due to logging, cattle farming, agriculture and commercial fishing. The flooded forest of the white waters rivers are the feeding ground for many organisms, specially fish. The aim of this study was to verify the relationship between the consumption of forest litter (seeds, fruits, leaves and also canopy insects) and the amount of flooded forest in floodplain lakes in Central Amazon, Brazil. Fish were collected in July 2000 in 11 lakes, using a set of 13 gill nets, in a 24 hour period, at each lake. The stomachs were analyzed using occurrence and point methods. The amount of flooded forest was estimated using radar images (SLAR). The abundance, biomass and richness of fish species that fed on allochthonous items were related with the flooded forest, using simple linear regressions. The richness of species that fed on allochthonous items varied between 5 and 19; their abundance range from 9 to 119 individuals and their biomass range from 972 to 24,845 g. The biomass of fish feeding on allochthonous items was positively ($R^2=0.045$; $N=11$; $p=0.04$) related with to amount of flooded forest, which suggests that the conservation of the flooded forest is important for fish production and consequently the Amazon fisheries.

COHEN, DANIEL M.; * NIELSEN, JØRGEN G.

California Academy of Sciences, San Francisco Zoological Museum, University of Copenhagen,
Universitetsparken 15 2100 Copenhagen Ø, Denmark

A new bythitid cavefish from Sulawesi

Some years ago an unknown bythitid fish was photographed in a limestone cave in Tomia, an island off southeastern Sulawesi. Subsequently a ripe male from the same cave was sent to us for study. We identified it as an undescribed species of the bythitine genus *Grammonus*. This is the sixth known species of *Grammonus*, which occurs in the warmer parts of all oceans. The new species differs from the other *Grammonus* species in size of head, numbers of anal fin rays and vertebrae and its unique otolith. A video film (kindly sent to us by the photographer Werner Thiele, Austria) reveals that although the vertical fins appear to be joined, the caudal fin can move independently from the dorsal and anal fins. Presence versus absence of a free caudal fin is the single character that distinguishes the subfamilies Bythitinae and Brosmophycinae from each other. A reassessment of the classification is required.

*** COLE, K.S.; SUNDARESAN, A.; PELLIS, N.; GREEN, S.M.**

(KSC) Department of Biology, University of Louisiana at Lafayette, P.O. Box 42451, Lafayette, LA 70504; (AS) Universities Space Research Association, Division of Space Life Sciences, 3600 Bay Area Blvd., Houston, TX 77058; (NP) Chief, Biological Systems Office, NASA-Johnson Space Center, 2101 Nasa Road 1, Mailcode: SJ, Houston, TX 77058-3696; (SMG) Department of Biology, University of Louisiana at Lafayette, P.O. Box 42451, Lafayette, LA 70504

Developmental abnormalities in brain morphology and skeletal configuration in a simulated altered gravity environment in the cypriniform fish, *Rivulus marmoratus*

Embryos of the cypriniform fish, *Rivulus marmoratus*, were maintained either in a static container or rotating cell culture system (RCCS) to assess the effects of prolonged exposure to RCCS conditions. The RCCS is used to simulate ground-based microgravity conditions analogous to those experienced in space. Experimental embryos were placed in the RCCS shortly after fertilization and maintained until hatching, approximately 21 days later. Survival of viable embryos was 100% in both experimental and control groups. Control post-hatchlings exhibited normal morphology and locomotory movements associated with swimming, as well as successful visual tracking and prey capture of live *Artemia* nauplia. In addition, they were highly responsive to tactile stimuli. In contrast, experimental fish exhibited extensive curvature of the axial skeleton, abnormal elongation of the lower jaw and marked postorbital cranial depression. Experimental fish were also unresponsive to tactile stimuli and failed to visually track or capture live prey. All experimental fish died within 7 days of hatching. A subsequent histological examination of the brains of both experimental and control individuals revealed a conspicuous lack of neural aggregations within the white matter regions of experimental animals, as well as a reduction in ventricle volume. In addition, among experimental fish, retinal layers of the eye were expanded resulting in either the lack of development, or occlusion, of the vitreous humor region, rendering image formation impossible.

COLEMAN, RONALD M.

California State University, Dept. Biological Sciences, Sacramento, CA 95819-6077, USA

Tunnel nesting and nonadhesive eggs in a Central American cichlid, *Hypsophrys nicaraguense*

Hypsophrys nicaraguense, a cichlid native to Costa Rica and Nicaragua, has long been known to be unique among substrate spawning neotropical cichlids because of its nonadhesive eggs (other substrate spawners lay eggs with adhesive threads that attach the egg to a hard substrate). Here I report that the reason for the nonadhesive egg is that *Hypsophrys nicaraguense* constructs horizontal tunnels in the hard clay banks of the fast-flowing rivers where they live in eastern Costa Rica. These tunnels are drilled into the substrate and may range from 20cm to over 60 cm in length. The eggs are laid at the end of the tunnel and do not adhere to the clay. This unusual nesting strategy allows *Hypsophrys nicaraguense* to lay smaller eggs than could normally succeed in the fast-water portions of the river.

*** COLLI, GUARINO R.; COSTA, GABRIEL C.; WIEDERHECKER, HELGA C.; CALDWELL, JANALEE P.; VITT, LAURIE J.**

(GRC, GCC, HCW) Departamento de Zoologia, Universidade de Brasília, 70910-900 Brasília, DF, Brasil; (JPC, LJV) Sam Noble Oklahoma Museum of Natural History, 2401 Chautauqua Avenue, Norman, OK, 73072-7029, USA

The effectiveness of two methods for sampling the herpetofauna of Neotropical rainforests

Due to the high pace of habitat destruction in Neotropical countries, the collection of biodiversity data from poorly sampled areas became a priority. Many sampling methods are currently available to herpetologists, but detailed comparisons of their strengths and weaknesses in neotropical regions are scarce. We compare the effectiveness of haphazard sampling versus a combination of pitfall traps and drift fences in Amazon Rainforest at Guajará-Mirim, Rondônia, Brazil. Haphazard sampling was conducted during 90 days by experienced collectors, whereas 75 sets of pitfall traps were used during 33 days. Each set consisted of 4 plastic buckets arranged as an Y and connected by 5m of plastic fence; sets were placed approximately 10m from each other. We produced species accumulation curves based on 10,000 randomizations (with replacement) using the software EstimateS. We used non-linear regression analyses to find the best fit of the data among the Clench, Linear, and Exponential models. The Clench model provided the best fit for both anurans and lizard accumulation curves. For lizards, models indicate that richness estimates are the same using either sampling method, but the rate of species accumulation is higher with pitfall traps. In general, Gymnophthalmids were collected more effectively with pitfall traps, whereas Polychrotids and Tropicidurids, with haphazard sampling. For anurans, richness estimates using haphazard sampling were approximately twice those from pitfall traps. This resulted especially from the poor performance of pitfall traps in sampling hylids coupled with the high diversity of this group in the region. The inflexion point of all curves is reached only after approximately 30 days of collecting. Our results indicate that short-term herpetofaunal inventories in the Amazon may grossly underestimate richness and that a combination of different sampling techniques is the best strategy to obtain reliable estimates.

COLLINS, JAMES P.

Arizona State University, Dept. Biology, Tempe, AZ, 85287-1501, USA

From metamorphosis to eco-devo

Early studies of amphibian metamorphosis focused mainly on understanding the physiological mechanisms that controlled transformation from an aquatic larva to a terrestrial form. Studies of how the environment might influence the process were generally limited to abiotic factors like temperature or concentrations of elements like oxygen or iodine. The latter, for example, was suggested as a possible explanation for the delay or absence of metamorphosis under some circumstances. Experiments were usually done in the laboratory and were designed to uncover the proximate causes of metamorphosis. Models of population dynamics prior to the 1970s generally assumed that all individuals in a population were alike. Natural historians knew that the assumption was wrong, but it was needed to simplify the mathematical models. Individual variation is no longer dismissed as easily since there is now sufficient evidence suggesting that intraspecific specialization has important consequences for population dynamics. In the mid-1970s an interest in testing how individual variation affected population dynamics and some 50 years of research into the causes of amphibian metamorphosis intersected. Ecologists began analyzing amphibian metamorphosis as a context-dependent process; transformation was envisioned as a function of an individual's performance within a group of congeners, and by extension, other species. Investigators combined models with laboratory and field experiments to elucidate the proximate and ultimate causes of metamorphosis. Research over the last 30 years has demonstrated how growth, morphology, larval performance, and trophic level are functions of population and community dynamics. We still, however, have not adequately connected population dynamics and physiological mechanisms. I will review how a range of studies that integrate phenotypic plasticity, size-structured populations, and amphibian metamorphosis exemplify what some are calling eco-devo, or ecology and development.

*** COLLINS, JAMES P.; BRUNNER, JESSE L.; JANCOVICH, JAMES; SCHOCK, DANNA M.**

(JPC, JLB, DMS) Arizona State University, Dept. Biology, Tempe, AZ, 85287, USA; (JJ) Arizona State University, Dept. Microbiology, Tempe, AZ, 85287, USA

Evolutionary ecology of a model salamander-virus system

Pathogens are among the suspected causes of declining amphibian populations, but studying pathogens in small, threatened populations is ethically and experimentally problematic. We need model host-pathogen systems in which sample sizes are large enough for good designs, but the pathogen does not threaten the host with extinction. We report on viral geographic variation, persistence, and differences in host susceptibility of a model salamander-virus system. Insights from this system are helping us understand the ecological and evolutionary interactions that may threaten amphibian populations. Our model pathogen is *Ambystoma tigrinum* virus (ATV), which causes recurrent epidemics in tiger salamander populations in western North America from southern Canada to southern Arizona. ATV is a large cytoplasmic dsDNA virus that causes systemic infections. The genome of ATV is sequenced, and an analysis of structural and functional genes reveals geographical relationships among viral isolates from Canada to Arizona. We studied ATV persistence in tiger salamanders (*Ambystoma tigrinum*). The virus is transmitted via direct contact, feeding on infected tissues, and in water with high viral titers. ATV degrades quickly in pond water and dry mud, precluding long-term persistence in the environment; alternate syntopic hosts are unknown. ATV is usually lethal within 2-3 weeks, although some salamanders lose overt symptoms of infection and survive

indefinitely. In one experiment ATV was re-isolated from 40% of these survivors, and transmission to uninfected salamanders occurred. Sublethal infections also occur in natural populations and appear to be the means by which ATV persists between epidemics. Lastly, a cross-infection, laboratory study of two Canadian population clusters separated by 800 km revealed significant differences in susceptibility to viral isolates. The causes of the differences are unknown, but several hypotheses are being tested.

COLONELLO, JORGE H.; * LUCIFORA, LUIS O.

Instituto Nacional de Investigación y Desarrollo Pesquero, Casilla de Correo 82, Correo Central, Mar del Plata 7600, Argentina

Ontogenetic dietary shift in the Rio skate, *Rioraja agassizi*

The Rio skate is an endemic species from the Southwest Atlantic. It is abundant off Argentina and Uruguay, which may make it an important benthic predator. However, the feeding habits of *Rioraja agassizi* are unknown in the region. We analyzed the feeding habits of the Rio skate from two areas: the La Plata River estuary (LP, 34-37° S) and off Blanca Bay (BB, 39-41° S). We examined 140 specimens, of which 114 had prey into the stomach. The specimens were sorted into four groups: juveniles from LP (15), juveniles from BB (42), adults from LP (18), and adults from BB (39). Cumulative prey curves as a function of sample size were constructed in order to estimate the minimum sample size for describing accurately the diet of each group. All curves showed that the sample size was large enough as to describe the diet of each group. Prey importance was quantified through the percent index of relative importance (IRI). Also, the prey-specific importance index (Pi) was calculated. The IRI gives information about the population feeding habits, while Pi brings individual-based information on foraging strategy. In general, decapod crustaceans were the most common prey (IRI = 55.5%). The diet of juveniles from both areas was composed mainly of amphipods (IRILP = 65.1%, IRIBB = 42.5%). Adults of both areas were mostly specialized in the consumption of decapod crustaceans (IRILP = 88.6%, IRIBB = 64.8%). Polychaetes and cephalochordates were consumed more often in BB than in LP. Pi showed that most juvenile individuals (43.1%) were specialized in the consumption of amphipods (Pi = 66.5). In contrast most adults (58.9%) consumed mainly decapod crustaceans (Pi = 76.3). This ontogenetic shift in diet could be due to several causes such as changes in mouth structure and dentition, changes in energetic requirements and/or prey availability.

COMMENS, AMY M.; * WARREN, MELVIN L., Jr.; HAAG, WENDELL R.

USDA Forest Service, Center for Bottomland Hardwoods Research, 1000 Front St., Oxford, MS 38655, USA

Annual patterns of length-frequency distributions of the Yazoo shiner *Notropis rafinesquei* in three streams in northern Mississippi

We studied demographics of the Yazoo shiner *Notropis rafinesquei*, a species endemic to the upper Yazoo River system, in three northern Mississippi streams. We sampled each population approximately monthly from March 1993 to October 1994. Preliminary analysis of length-frequency distributions suggests several life history features. Spawning, as evidenced by appearance of young-of-year in samples, occurred twice each year (late spring-summer and fall) in all streams. Recruits from spring spawning reached 10-20 mm standard length by July-August, and by October are large enough to potentially participate in fall spawning. Length-frequency distributions were similar at all sites in both years. However, animals appeared to live 2-3 years in Buckhorn and Cypress creeks, but only 1.5-2 years in Hotopha Creek.

Maximum adult size was lower in Hotopha Creek. Our results show that the Yazoo shiner shares life history traits with related species, particularly the orangefin shiner *Notropis ammophilus*. Further analysis of life history strategies of the Yazoo shiner and comparisons among close relatives will allow discriminations of ancestral characteristics from species-specific adaptations.

*** CONTRERAS-BALDERAS, SALVADOR; ARTURO CONTRERAS-ARQUIETA**

(SCB) Bioconservacion, A.C., Apdo. 504, San Nicolas, N.L., Mex. 66450; (ACA) Area Protegida de Flora y Fauna, Domicilio Conocido, Cuatro Ciénegas, Coahuila, Mexico

Exotics/endemics: relations in fishes, amphibians and reptiles in Mexico

Exotic invasive species established may become pests, outcompeting or eliminating local species, especially endemics, when developing highly similar niches. Competition levels have been reported in many places worldwide, either for food, breeding places, or shelter, and comes usually from predation, interbreeding, or parasitizing. Mexican nation-wide reports are known only in freshwater fishes, and show an increase from 54 in 1984 to 100 in 2002. Several localities with long recorded history of collections disclose reductions of 15 to 100% of native species, as compared to invasives. International programs by USF&W and FAO are also responsible for most introductions or training, combining with national programs to produce food for people, usually disregarding native species. Exotic amphibians and reptiles in Mexico are poorly recorded, only 16 are reported herein. Fishes have shown indications of replacement, competition, or hybridization with native species in Mexico, whereas amphibians and reptiles show no similar evidence. Differences between responses in ichthyological and herpetological groups may be due to their biological properties, collecting methods and deficiencies or lack of interest of specialists. Research in their presence, distribution and impacts is needed on the relationships between invasive and native species, to develop strategies for protecting Mexican biodiversity.

CONTRERAS-MACBEATH, TOPILTZIN

Centro de Investigaciones Biologicas, Universidad Autonoma de Morelos, Cuernavaca, Morelos 62210, Mexico

Towards the sustainable management of Mesoamerican fresh water fishes

The Mesoamerican region contains a large diversity of fresh water environments. Their understanding is urgent due to the apparent deterioration. Their utilization as sources of water and dumping sites for domestic, farm and industrial refuse represents the main anthropogenic threat to their physical and biotic integrity. However, it is also evident how little attention they have received from planning processes and environmental legislation to support their protection and conservation. In this contrasting context, between the imperative need for resource conservation and management toward the future, through the Mesoamerican Biotic Resources Network we have integrated a task force to initiate a discussion among Mexico and the Central American countries to point out and systematize the knowledge of fresh-water ecosystems that has been accumulated in the region and the perspectives that multiple use, planning and legislation permit for its adequate use, and to establish a starting point toward integrated discussion of the strategies that allow conservation and sustainable management in these ecosystems based not only on its large biodiversity, but also on the quality and quantity of environmental services furnished to the Mesoamerican inhabitants. We have defined fresh water fishes as our indicator species in terms of (1) the vast knowledge we have on them with

respect to other aquatic organisms, and (2) they are easy to collect and identify. As an outcome of a workshop held on July of 2002 at the Universidad Autonoma de Queretaro, Mexico, an ample number of ideas, proposals and recommendations regarding research needs, public policies, conservation and management strategies were gathered. As well as an evaluation of the current status was also obtained, where the impact of exotics, habitat loss and environmental degradation in general, has led to the extinction of numerous species, a situation that is most severe in Mexico where 19 fresh water fish species have been lost.

*** COOPER, W. JAMES; MARK W. WESTNEAT**

(WJC, MWW) University of Chicago, Dept. of Organismal Biology and Anatomy, Chicago, IL, 60537; Field Museum of Natural History, Fish Division, Dept. of Zoology, Chicago, IL, 60605

Damsel fish jaws: comparative and functional morphometrics in labroid fishes

Damsel fishes (Labroidae, Pomacentridae) constitute a diverse group (>340 sp.) of marine fishes that have been thought to exhibit little trophic diversity. Despite widespread interest in labroid feeding, the morphological and functional variation of pomacentrid jaws has not been quantified. We combined morphometric analyses of the oral jaws of damselfishes with biomechanical models of jaw function in order to measure the functional diversity of pomacentrid jaws. Biomechanical modeling generated estimates of jaw functional parameters that are strongly associated with trophic habitats. Results show that accounting for muscle morphology and physiology yield different estimates of jaw mechanics than bone lever ratios alone. We compared the functional diversity of damselfish oral jaws to those wrasses (Labridae), another species rich lineage of marine fishes. Results show that the morphological and functional diversity of damselfish oral jaws was greater than expected. The hypervolume of shape space occupied by damselfishes is similar to that occupied by wrasses although the two groups have different functional specializations. The lower jaw lever of many pomacentrids confers a high mechanical advantage (0.15-0.70) and is extreme in the coral eating species *Cheiloprion labiatus*. Surprisingly, the bite of *C. labiatus* is estimated to have a mechanical advantage (0.70) greater than those predicted for parrotfishes (0.50). A significant finding of the study was that the hypervolumes of shape space occupied by wrasses and damselfishes are completely independent. We reject the hypotheses that the low degree of trophic diversity reported for damselfishes is associated with low functional and morphological diversity of their oral jaws relative to other fish clades.

*** CORBINO, JEFFREY M.; CASHNER, ROBERT C.**

University of New Orleans, Dept. of Biological Sciences, 2000 Lakeshore Dr., New Orleans, LA, 70148, USA

Habitat dependent ontogeny of *Brevoortia patronus* in an oligohaline estuary

Developmental rates of young of the year fish may be influenced by temporal and spatial variability of physicochemical factors within a nursery area. To elucidate the relationship between developmental state and environmental variation, we collected larval and juvenile *Brevoortia patronus* from unique habitats within an oligohaline estuary. Over 22,000 *B. patronus* (19-88 mm TL) were collected by beach seining from five stations in the Lake Pontchartrain estuary, Louisiana from February to June of 2001 and 2002. The majority of the specimens were collected from the lower estuary near freshwater tributaries or in low salinity and turbid waters. Relative to total length, specimens directly associated with the tributaries had higher weights, a deeper keel, and a more sophisticated gut. Specimens collected outside of the tributaries

immediate influence were more likely to retain a shallow keel and a simpler gut over a wide range of total length. Habitat dependent variation in morphological development may convey a survival advantage to young of the year *B. patronus* associated with Lake Pontchartrain's tributaries.

* **CORDEIRO, ANA C.; SANAIOTTI, TÂNIA, M.**

Instituto Nacional de Pesquisas da Amazônia, Coordenação de Pesquisas em Ecologia, Caixa Postal 478, 69.011-970, Manaus, AM, Brasil

Composition of amphibian fauna in the Conservation Area (APA) Urubuí, Presidente Figueiredo, AM

Amphibian surveys in pristine forest were conducted in a conservation area (APA) Urubuí, located North of Manaus in BR-174, Km 107, Presidente Figueiredo, AM. The area covered by the APA includes a dozen small waterfalls, and access to the area is by trails which cross several types of forest [dense forest, heath forest (Campinarana) and alluvial forest]. Surveys included calling and visual records. The night surveys were done mostly during the rainy season, between April and July 2001 and in February 2002. Trails were walked slowly searching for amphibians on the forest litter, trunks and branches, mainly around water bodies (streams and pools). Twenty five species of amphibians anurans from 6 families (Hylidae 9; Leptodactylidae 6; Bufonidae 3; Microhylidae 3; Dendrobatidae 2 e Centrolenidae 2). A new record for Brazil was the centrolenid, *Hyalinobatrachium nouraguensis*, which was found only near waterfall.

* **CORREIA, J. P.; SILVA, I. M.**

Oceanário de Lisboa, Doca dos Olivais, 1990-005 Lisboa, Portugal

Case studies of elasmobranch husbandry at Oceanário de Lisboa II

During 2002 Oceanário de Lisboa introduced two large *Mobula mobular*, one large *Manta birostris* and two small *Prionace glauca* in its Opean Ocean 5.000 m³ exhibit. Notes on the husbandry challenges created by the introduction of such unusual species are given, with regards to feeding and general behavior.

CORTES, ENRIC

NOOA/NMFS, Southeast Fisheries Science Center, Panama City Laboratory, 3500 Delwood Beach Road, Panama City, FL, 32408, USA

Investigating the population dynamics of elasmobranchs: past, present, and future

Population dynamics attempt to describe changes in the cohort-specific abundance of a population in space and time as a result of ecological and genetic processes. Three basic vital rates (birth, growth, and death) and the demographic processes of emigration and immigration, under the effect of various sources of stochasticity, ultimately determine population abundance and fate. Thus, an ideal population dynamics model should capture the interaction of vital rates and demographic processes with all sources of variability. However, the reality for elasmobranch population modeling is quite different. Our knowledge of basic vital rates and demographic processes is still fragmentary for most species, let alone our grasp on the spatial distribution of populations, stock-recruitment dynamics and the effect of most sources of

stochasticity on elasmobranch populations. However, considerable progress has been made in the last decade alone. The population modeling approaches applied to elasmobranchs are reviewed and models classified according to their structure (biomass or cohort based), type, cohort type considered, and treatment of time and uncertainty. One main conclusion that emerges is that there may be greater predictive return from investing in increased data collection and quality rather than model sophistication.

*** COSTA, GABRIEL C.; VIEIRA, GUSTAVO H. C.; TEIXEIRA, RUSCAIA D.; GARDA, ADRIAN A.; COLLI, GUARINO R.; BÃO, SÔNIA N.**

(GCC) Departamento de Ecologia, Universidade de Brasília, 70919-970, Brasília, DF, Brasil; (GHCV) Pós Graduação em Biologia Animal, Universidade de Brasília, 70919-970, Brasília, DF, Brasil. E-mail: ghcv@unb.br; (RDT) Departamento de Biologia Celular, Universidade Estadual de Campinas, 13083-970, Campinas, SP, Brasil. E-mail: ruscaia@hotmail.com.; (AAG) Sam Noble Oklahoma Museum of Natural History, 2401 Chautauqua, 73072-7029, Norman, OK, USA. E-mail: garda@ou.edu; (GRC) Departamento de Zoologia, Universidade de Brasília, 70919-970, Brasília, DF, Brasil. E-mail: grcolli@unb.br; (SNB) Departamento de Biologia Celular, Universidade de Brasília, 70919-970, Brasília, DF, Brasil. E-mail: snbao@unb.br

An ultrastructural comparative study of the sperm of *Hyla* and *Scinax* (Amphibia: Anura; Hylidae)

Based on sperm morphology, species of the *Hyla rubra* group were placed in a new genus, *Scinax*. The spermatozoa of species in this group showed two tail filaments, whereas other species of *Hyla* showed one filament. Additional work describing the sperm ultrastructure of *Hyla* and *Scinax* can provide characters for comparisons among other genera. We realized descriptions of sperm ultrastructure of *H. pseudopseudis*, *S. squalirostris*, and *S. rostratus* and discuss the variation of these characters within hylid genera. Acrosome complex consists of the acrosome vesicle and subacrosomal cone. In *H. pseudopseudis*, mitochondria are separated from the tail forming a mitochondrial collar around the anterior portion of the flagellum. In *S. rostrata* and *S. squalirostris*, however, the mitochondrial collar is formed only at the posterior portion of the midpiece. *Scinax* shows a juxta axonemal fiber, an undulating membrane, and an axial fiber. The justaxonemal fiber originates the undulating membrane and the axial fiber. In *H. pseudopseudis*, the tail of spermatozoon is formed by the axoneme and the juxta axonemal fiber. No undulating membrane or an axial fiber is seen. In the *S. rostrata* and *S. squalirostris*, the flagellum is formed by the axoneme and the paraxonemal rod at the most anterior portion. The major difference between the two genera consists of the caudal elements present in *Scinax* and absent in *Hyla*. All species on *Hyla* that have been investigated lack the undulating membrane and the axial fiber, whereas *Scinax*, *Pachymedusa*, *Litoria*, and *Cyclorana* have this trait. The morphology of amphibian sperm can be a source of characters for phylogenetic studies. Studies of sperm ultrastructure are needed especially on families and genera never investigated. The sperm ultrastructure can also provide useful information on the reproductive biology of anurans, but this can only be investigated with well-resolved phylogenies.

COSTA, MARCIO C.; SOUZA, CLAUDIANO A.; SILVA Jr. NELSON J.; * O'REILLY, JAMES C.

(MCC) *Naturae - Projetos e Consultoria Ambiental Ltda, Rua 34, no 137, Jardim Goias, CEP74805-370, Goiânia, GO, Brasil;* (CAS, NJS) *Departamento de Biologia, Universidade Católica de Goiás, Setor Universitário, CEP74605, Goiânia, GO, Brasil;* (JCO) *Department of Biology, University of Miami, Coral Gables, FL, 33124, USA*

A comparison of maximum pushing performance in three sympatric amphisbaenians from central Brazil

Limbless squamates burrow by compacting soil with their heads, the work required to build a tunnel of a given length increasing as a function of body cross-sectional area (CSA). The maximum relative strength of an animal will determine the threshold of soil compaction where burrowing is no longer possible. An evolutionary increase in maximum strength per body CSA will permit a given lineage to burrow in a wider variety of soils and presumably allow access to new microhabitats. Therefore, differences in pushing strength will likely influence the distribution of burrowing squamates on both a local and landscape scale. *Amphisbaena alba*, *Amphisbaena vermicularis* and *Leposternon infraorbitale* are three species of sympatric amphisbaenians from central Brazil that differ in maximum body size, head shape, burrowing mechanics and body proportions. The goal of this study was to determine if the morphological and biomechanical variation among these species translated into differences in pushing strength. Specimens were collected at the Cana Brava hydroelectric dam on the Rio Tocantins in northern Goiás, Brazil. Individuals were induced to push into small vials of substrate attached to a force plate from a series of artificial tunnels. *A. vermicularis* produced approximately twice as much forward force per body cross-sectional area than either *L. infraorbitale* or *A. alba*. However, *L. infraorbitale* or *A. alba* grow much larger and produce much larger absolute forces than *A. vermicularis*. The total force produced (both directly anterior and perpendicular vectors) was similar in *L. infraorbitale* and *A. vermicularis* which were both about twice as strong as *A. alba*. These data suggest that *A. vermicularis* and *L. infraorbitale* can probably burrow in more compact soils than *A. alba*. These differences in performance are likely to be associated with variation in microhabitat use in these species.

COSTA, OSCAR T. F.; * ARAÚJO, MARIA L. G.; DUNCAN, WALLICE L. P.; FERNANDES, MARISA N.

(OTFC, MLGA, WLPG) *Federal University of Amazonas State, Dept. Morphology, Cytology Lab, 3000 Rodrigo O. J. Ramos Road, Manaus, AM, 69700-000, Brazil;* (MNF) *Federal University of São Carlos, Dept. Physiological Sciences, São Carlos, SP, 13565-905, Brazil*

Stereological analysis on the gills of freshwater stingray *Potamotrygon motoro*

The stingray *Potamotrygon motoro* (Chondrichthyies, Potamotrygonidae) occurs in the Amazon and Plata Basin. Although this species is intensively exported as ornamental fish, no information exists about the morphometry of the respiratory system, which can be used as base for future programs of specie conservation or comparative studies of gas exchanges systems in lower vertebrates. The stereological morphometry of vertical sections profiles in fish gill enables the functional capacity for O₂ transport to be established. Following this method, the harmonic mean thickness (*ht*) of the lamellar diffusion barrier and the total lamellar surface area at gills are related to produce the morphometric diffusing capacity of O₂ and CO₂ and the anatomical diffusing factor. To avoid technical artifacts, the fish gills were fixed *in situ* in flowing 2.5% glutaraldehyde in 0.1M phosphate buffer followed by immersion in the same fixative. Trimmed arches were orientated for embedding in glycol methacrylate, exhaustively sectioned and

analyzed in a light microscope coupled with a drawing tube. The gills of *P. motoro* are composed of five arches, the first of which bears only a hemibranch. The gases must pass through two epithelial cells, the basement membrane, and the flange of the pillar cell, as they move between the blood and the water at lamella. The height of the lamellar barrier was estimated in $4.75 \mu\text{m}$ ($2/3 \text{ ht} = 3.17 \mu\text{m}$). This value (reflecting the efficacy of gaseous exchange) is comparable with that of trout but exceeds three times that of tuna, remaining within the range waiting for water-breathing fish. Ours results indicate a good agreement between smallest diffusion distance and most active fish, particularly in view of the fact that *P. motoro* is one of the more active freshwater stingrays. This study discusses the implications of the gill morphometry for gas-exchange function in Amazonian elasmobranchs fish.

*** COWAN, JAMES H., JR; STRELCHECK, ANDY J.; SHAH, ARVIND**

(JHC), Coastal Fisheries Institute, Louisiana State University, Baton Rouge, LA, 70803-7503; (AJS), Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries, 620 South Meridian Street, Mailbox MF, Tallahassee, FL 32399-1600; (AS), Department of Mathematics and Statistics, University of South Alabama, Mobile, AL 36688

Artificial reefs in the northern Gulf of Mexico: their role in a dynamic coastal geography

The red snapper *Lutjanus campechanus* is a highly exploited reef fish in the northern Gulf of Mexico that has been commercially important since the late 1800s; stocks declined rapidly throughout the Gulf until the early 1990s. In recent years, the stock has begun to recover as a result of management actions; many have attributed this recovery in part to an increase in habitat in the form of artificial reefs. This is especially true off coastal Alabama where more than 20,000 reefs have been constructed since the 1950s, within 3,100 km² of permitted artificial reef zones, even though there still is considerable scientific debate about the effectiveness of artificial reefs as management tools. To determine the effects of reef fish population dynamics attributable to the Alabama artificial reef program, we placed experimental reefs in a sampling grid south of Dauphin Island aimed at addressing this debate. We sampled reef fish abundance, size structure, species diversity, and turnover rate on 14 reefs using multiple fishery sampling techniques, including diver surveys. Estimates of reef fish demographics were then related to nearest-neighbor variables based upon detailed side-scan sonar mapping. Nearest-neighbor variables include the abundance, proximity, and total bottom area of natural and artificial habitats within 1.0 km² of each experimental reef, and have been quantified using GIS database applications. Sampling year 1999-2002 estimates of CPUE, biomass, species diversity, site fidelity, and red snapper size varied by season, reef design, and sampling method. Importantly, distance to natural reef, distance to artificial reefs, artificial reef abundance, total bottom area of artificial reefs, substrate, and total bottom area of natural reefs explained a significant fraction (> 50%) of the observed variability in reef fish demographics, suggesting that the ability of artificial reefs to attract or produce fish may be dependent on a dynamic coastal geography.

*** COWMAN, DEBORAH F.; SPARLING, DONALD W.; FELLERS, GARY M.; BICKHAM, JOHN W.; LACHER, THOMAS E.**

(DFC, DWS) USGS/BRD Patuxent Wildlife Research Center, 11510 American Holly Drive, Laurel MD, 20708, USA; (DFC, JWB, TEL) Texas A&M University, 2258 TAMU, College Station, TX, 77843, USA; (GMF) USGS/BRD Western Ecological Research Center, 1 Bear Valley Road, Pt. Reyes Station, CA, 94956, USA

Frogs and pesticides in the Sierra Nevada Mountains, CA

Previous studies have shown that organophosphorous pesticides from the Central Valley of CA enter the Sierra Nevada ecosystem through aerial deposition in snow and rain, and that surface concentrations of certain pesticides are within an order of magnitude of the 96hr LC50 of amphibians. Sparling et al. (2001) found significant levels of pesticides (chlorpyrifos, diazinon, and endosulfan) in tissues of adult Pacific chorus frogs (*Hyla regilla*) collected in the Sierras. This study tests the null hypothesis that pesticides are not having adverse effects on Pacific chorus frog tadpoles. Tadpoles were translocated (with controls in each park) and placed in cages among sites located in Lassen, Yosemite, and Sequoia National Parks. Tadpoles were sampled at 28 days and upon metamorphosis. Preliminary results show 1) a significant difference ($p = 0.04$) in DNA damage in metamorphs between Lassen (reference site) and the other two parks; 2) greater survivorship to metamorphosis at Lassen; and 3) hindlimb deformities (brachymelia) in 25% of animals sampled at Yosemite and 5% at the other two parks. Discovery of detrimental effects in Pacific chorus frog larvae and metamorphs may help in the evaluation of amphibian declines in the Sierra Nevadas.

*** COX FERNANDES, CRISTINA; LUNDBERG, J. G.**

(CCF) Department of Biology, Morrill Science Center, 611 North Pleasant Street, University of Massachusetts, Amherst, MA 01003-9297, USA and Instituto Nacional de Pesquisas da Amazonia (INPA); (JGL) Department of Ichthyology, The Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103, USA

On the sex life of *Oedemognathus exodon* (Gymnotiformes: Apterontidae)

In 1936 George Myers described *Oedemognathus exodon* based on a singleton from Iquitos. This nominal species is notable for its bizarre snout covered with enlarged external teeth. While investigating the sexual characteristics of apteronotid electric fishes, we had the opportunity to examine older museum specimens of the rare *O. exodon*. All five individuals available at the time are mature males. Subsequent field work yielded more than 100 mature *Oedemognathus* often associated with other electric fishes in breeding condition. Still, all known *Oedemognathus* are males. Comparison of these to other apteronotids leads us to suspect that *Oedemognathus* are the mature and reproductively active males of *Sternarchogiton nattereri* (Steindachner, 1868), a species based on specimens from the rio Negro. As visualized in cleared and stained and x-rayed individuals, and several measurements, the morphology and development of characters grades across the large specimen series of *Oedemognathus* and *S. nattereri*. "*Oedemognathus*" males with teeth exhibit larger gonads than the ones with no teeth and several have scars and scratches on their napes. Mature females tend to be smaller than males.

CRAIG, MATTHEW T.

Scripps Institution of Oceanography, Marine Biology Research Division, 9500 Gilman Dr., Mail Code 0208, La Jolla, CA, 92093, USA

Phylogeny and biogeography of the serranid fish genus *Epinephelus*

The genus *Epinephelus* is comprised of 99 species of perciform fishes commonly known as groupers. This large and diverse group of fishes is distributed in tropical and sub-tropical waters worldwide. Although being recognized in the taxonomic literature for more than 200 years, recent molecular evidence suggests that this genus is polyphyletic and in need of revision (Craig, et al. 2001). Mitochondrial DNA sequences for 83 species of epinepheline serranids, including over 40 within *Epinephelus* alone, were gathered to 1. Expand upon the phylogenetic hypothesis of Craig, et al. (2001), 2. Determine biogeographic structure within this diverse group of shore fishes, and 3. Evaluate rates of evolution across the Panamanian isthmus. Mitochondrial DNA sequences confirm that *Epinephelus* is indeed a polyphyletic genus with at least three independently evolving lineages. Biogeographic interpretations of these data suggest that the new world may be the location of origination of many tip clades within this diverse group, and that the main radiation of many grouper lineages may have taken place during the Miocene. Examination of geminate species pairs separated by the Isthmus of Panama suggest that rates of mitochondrial DNA and morphological evolution are not equal even within closely related species groups. Additionally, this data cautions against assuming that morphologically similar species separated by the Panamanian Isthmus are sister taxa.

*** CRAIG, MATTHEW T.; HASTINGS, PHILIP A.; PONDELLA, DANIEL J., II.**

(MTC, PAH) Scripps Institution of Oceanography, Marine Biology Research Division, 9500 Gilman Dr., Mail Code 0208, La Jolla, CA, 92093, USA; (DJP) Vantuna Research Group, Occidental College, 1600 Campus Rd., Los Angeles, CA, 90041, USA

Notes on the systematics of the crestfish genus *Lophotus* (Lampridiformes: Lophotidae), with a new record from California

On 17 November 1995, a specimen of crestfish, genus *Lophotus*, was collected from northern California. Investigation into recent California records of crestfishes indicated that several anecdotal accounts were reported north of Pt. Conception during the 1990s. Uncertainty regarding the taxonomy of the genus prompted a review of its systematics as well as a genetic analysis of the specimen. 16S and 12S rDNA sequences were obtained and data were compared with that of published sequence data for a second specimen collected in the Tasman Sea to determine the affinities and/or existence of multiple species within this genus. A moderate degree of genetic differentiation was found between the two individuals that was congruent with meristic differences in number of dorsal-fin rays and total vertebrae suggesting the presence of two species in the Pacific basin. While we are unable to resolve the taxonomy of *Lophotus* on a worldwide basis, our study indicates that the eastern and western north Pacific forms are conspecific and distinct from south Pacific *Lophotus*. The oldest available name for a north Pacific crestfish is *Lophotus capellei* Temminck and Schlegel, 1845 (type locality seas of Japan), thus we consider this to be the valid name for this species.

* **CRAMPTON, WILLIAM G.R.; LOVEJOY, NATHAN; ALBERT, JAMES S.**

(WGRC, JSA) Florida Museum of Natural History, University of Florida, Gainesville, FL, 32611-7800, USA; (NL) Department of Zoology, University of Manitoba, Winnipeg, MB, R3T 2N2

Species and electric signal evolution in a species-rich sympatric assemblage of *Gymnotus* (Gymnotidae: Teleostei) from the Upper Amazon

An eight-year intensive survey of the area within a 50 km radius of Tefé, Brazil, near the confluence of the Japurá and Amazon Rivers, revealed an assemblage of ten species of *Gymnotus*, eight of which are new to science. Six occur only in high conductivity whitewater floodplains (várzea). Two occur only in low conductivity blackwater terra firme systems. Two species are cosmopolitan. An extensive library of electric organ discharge (EOD) recordings was compiled and waveform parameters analyzed using a computer program designed by the senior author. This program recognizes homologous landmarks of EOD waveforms, measures the duration, voltage and area of sections between landmarks to characterize waveform shape, and conducts Fourier Analysis. Data are adjusted to compensate for temperature variations during recording and are tabulated for intra and inter-species comparisons using multivariate statistical analysis. Pairs of species in the Tefé region with a syntopic distribution exhibit non-overlapping frequency and or temporal parameters of the EOD waveform allowing, in principle, unambiguous recognition. The absence of hybrid phenotypes and preliminary behavioral experiments leads us to presume that this divergence of signal parameters facilitates (and may have evolved) to allow mate choice and prevent hybridization in a diverse community of congeners. Species with allotopic distributions are free from selective forces for signal divergence and, as expected, often exhibit overlapping waveform parameters. Phylogenetic analysis of all 32 known *Gymnotus* species shows that the Tefé assemblage is not monophyletic. Rather these species are members of at least four distinct clades, each with sister taxa in other parts of South America. The Tefé assemblage is inferred to have been assembled incrementally from species that originated either in situ or elsewhere. Aspects of waveform (and possibly ecological) partitioning in this assemblage may therefore result, at least in part, from processes operating in the past, or in communities external to the Tefé region. Nonetheless, the partitioning of signals in syntopic species is surprisingly tidy. For a more complete picture, future work will include analysis of electric signals from a wider range of taxa sampled from the entire range of the genus.

* **CRESPI, ERICA J.; DENVER, ROBERT J.**

University of Michigan, Dept. Molecular, Cellular, and Developmental Biology, Ann Arbor, MI, 48109, USA

Physiological mechanisms underlying plasticity in metamorphic timing in amphibians

Wilbur & Collins (1973) presented a synthetic ecological model that proposed growth rate and body size are the main factors determining timing of metamorphosis. This model inspired several studies aimed at understanding the physiological mechanisms mediating plasticity in metamorphic timing in response to a changing environment. Work from our lab and others has shown that the neuroendocrine stress axis, specifically corticotropin-releasing hormone (CRH), plays a central role in linking sensory information about the external environment with changes in development and growth rate. In tadpoles CRH activates both the interrenal (corticosterone) and thyroid axes which work in concert to promote metamorphosis. Hypothalamic content of CRH increases in response to environmental stress, such as pond drying, and CRH injections accelerate metamorphosis in many amphibian species. Recent studies suggest that CRH produced in peripheral tissues also plays a role in the regulation of morphological changes

associated with metamorphosis. Interestingly, environmental stressors such as food restriction, high population density, and reduction in water volume accelerate development during the prometamorphic phase (stages after hindlimb growth), but they retard development and growth rates during the premetamorphic phase. Even 30 years after Wilbur & Collins, little is known about the endocrine controls of growth rate and their impact on the thyroid axis in either pre- or prometamorphic phases, and less is known about how growth factors change in response to environmental conditions. Studies investigating the neuroendocrine controls of growth and energy balance, such as insulin-like peptides, melanocortins, CRH and neuropeptide Y, in different environmental conditions and developmental stages are needed. Ultimately, we need to know how growth factors, energy balance indicators, developmental hormones, and stress hormones interact to develop a comprehensive understanding of metamorphic timing. This work demonstrates the importance of the integrated neuroendocrine stress response in metamorphic timing in amphibians, and serves as a valuable model for studying the roles of stress hormones in timing critical life history transitions in other vertebrates. (Supported by NSF grant IBN9974672 to RJD).

CREWE, TARA L.

University of Guelph, Dept. Zoology, Guelph, Ontario, N1H 2W1, Canada

Does forest harvesting affect the distribution of amphibians?

Forest harvesting is thought to be one cause of amphibian population declines because of an associated decline in resources such as moisture and canopy cover. Ideal Free Distribution theory assumes that individuals should distribute themselves in relation to habitat quality such that fitness is maximized. Accordingly, if forest harvesting decreases the quality of habitat, abundance of amphibians should also decrease relative to habitats of higher quality. However, abundance may not be a good indicator of habitat quality for amphibians because, not only can pond breeding amphibian populations fluctuate widely between years, but high abundance does not necessarily represent high quality habitat. Rather, it may represent a sink habitat in which the population would not remain viable without input from a source population. To explore these issues in the boreal forests of Northwestern Ontario, 72 pitfall arrays (3 arrays/stand) were established in 12 forest stands in each of two landscapes (harvested vs. nonharvested). In total, 246 American toads (*Bufo americanus*), 83 wood frogs (*Rana sylvatica*) and 33 blue-spotted salamanders (*Ambystoma laterale*) were caught over 4892 trap nights. Individual mass and length were used as an index of relative fitness, and moisture, canopy cover and leaf litter were used as an index of habitat quality. Because of the predicted association between fitness and habitat quality, if amphibian abundance and fitness are positively associated with habitat quality, or fitness remains constant regardless of habitat, management policies aimed at conserving amphibian populations would be justified in conserving areas of high amphibian abundance. However, if fitness decreases with increased abundance, managers should be cautious in choosing areas to conserve.

CRNKOVIC, AMANDA C.

Museum of Life Sciences, Louisiana State University in Shreveport, One University Place, Shreveport, LA, 71115-2399, USA

A systematic study of the species of *Pyxicephalus* (Anura: Ranidae) occurring in southern Africa

The frog genus *Pyxicephalus* is comprised of three species that are distributed throughout sub-Saharan Africa. This genus has been in taxonomic confusion throughout its entire distribution but continues to be a problem in southern Africa, where both *P. adspersus* and *P. edulis* occur and where their distributions and diagnostic field characters remain unclear. To investigate the geographic distributions and the systematic relationships of these two species I examined more than 280 museum specimens of *Pyxicephalus* from throughout southern Africa. An analysis of more than 130 morphological characters, including many characters not previously examined, was used to clarify the geographic distributions and systematic relationships between the two species. Statistical analyses (multivariate analysis and PAUP) were used to compare morphological characters between the species, and to establish phylogenetic trees that best explain the evolutionary history of this genus based on morphological data.

CROW, KAREN D.

University of California - Santa Cruz, Department of Ecology and Evolutionary Biology, Santa Cruz, CA 96064, USA

Hybridization, reproductive isolation, and speciation in three *Hexagrammos* fishes

Reproductive isolation is the defining point in the process of speciation, but in the absence of strict allopatry divergence must occur with some gene flow. Gene flow is antagonistic to the process of speciation, yet incipient species often hybridize. Hybridization results in (1) complete introgression leading to collapse of species boundaries and loss of biodiversity, (2) reinforcement of species boundaries, or (3) formation of entirely new "hybrid" taxa leading to increased biodiversity. The eventual outcome depends on the relative fitness of hybrid progeny compared to parental species. The fishes of the genus *Hexagrammos* exhibit several interesting reproductive life history traits including high dispersal potential, parental care, sexual selection and hybridization. The southern sympatric species *H. otakii* (*Hot*) and *H. agrammus* (*Hag*) hybridize with the northern allopatric species *H. octogrammus* (*Hoc*). Results from a molecular phylogeny of the genus *Hexagrammos*, based on 1992 bp from 5 loci: CaM, S7RP, Ldh (nuclear), 16S, and Cyt b (mtDNA) genes, indicated that *Hoc*, *Hag* and *Hot* are indeed distinct species, yet reproductive isolation appears to be incomplete. Of 226 random samples from Japan, 21.3% were F-1 hybrids resulting in two emergent patterns: all hybrids were female and *H. octogrammus* was their maternal ancestor. Overall, 4% were hybrid-backcrossed individuals indicating gene flow does occur between species. Fitness costs associated with hybridization were assessed to determine how they relate to processes of speciation within this genus. Hybrid larvae were significantly more likely to exhibit reduced fitness, measured as survivorship and growth, than larvae produced in specific crosses. Furthermore, hybrid larvae were significantly more likely to exhibit developmental abnormalities indicating reduced fitness of hybrids compared to parental species. This pattern is consistent with tension zones and the reinforcement model of speciation.

*** CUMMER, MICHELLE R.; PAINTER, CHARLES W.**

(MRC) Utah State University, Department of Biology, 5305 Old Main Hill, Logan, UT, 84322, USA;
(MRC) Los Alamos National Laboratory, RRES-Ecology Group, MailStop M887, Los Alamos, NM,
87545, USA; (CWP) New Mexico Department of Game and Fish, P.O. Box 25112, Santa Fe, NM,
87507, USA

The effect of wildfire on the state threatened Jemez Mountains salamander (*Plethodon neomexicanus*) in New Mexico

Fire regimes in North America, including the American Southwest, have undergone relatively dramatic shifts in the last century. The Jemez Mountains of northern New Mexico have undergone rapid shifts in fire regimes over the past century. A trend of large-acreage, high-intensity, stand-replacing fires have supplanted historically low-intensity, high-frequency fires. The Jemez Mountains are inhabited by the state threatened, endemic Jemez Mountains salamander (*Plethodon neomexicanus*), which could be impacted by the sudden and severe surface habitat alterations resulting from the shifts in the historic fire regimes. We investigated the immediate effects of the Cerro Grande Fire of 2000 on historic populations, and the effects of the Dome Fire of 1996 on a single, well studied population. No differences in numbers of salamanders were detected between high burn severity sites and non-burned sites in 2000 or 2001 following the Cerro Grande Fire. Preliminary analysis of the single population examined after the 1996 Dome Fire suggests no increasing or decreasing trend in the numbers or body condition of salamanders.

*** CUNNINGHAM, PATRICIA T.M.; MATTOX, GEORGE M.T.; GONDOLO, GUILHERME F.**

Instituto Oceanográfico (Lab. ECOPEX) - USP/SP - Praça do Oceanográfico, 191 - Cidade
Universitária/Butantã, São Paulo SP Brasil 05508-900

Biodiversity and marine fish community alterations of a coastal region in southeastern Brazil

The Flamengo Cove, Ubatuba/SP, located at the northern shore of São Paulo State, Brazil, has been under anthropic pressure due to the growing human occupation, mainly in the last three decades. This study aimed to evaluate the biodiversity and some of the fish community descriptors regarding composition, structure and temporal dynamic aspects, relating them to environmental stresses. Data from trawl fishing were used, from Falls in the years 1979, 1990, 1991, 2000, 2001 and 2002. The trawls were 10 minutes long, at 2,5 knots, and the cod-end seine was 25 mm. The evaluations were made considering all the 54 bottom-dwelling species. The calculus of the Relative Importance Index showed that three species of the Sciaenidae, *Paralonchurus brasiliensis*, *Ctenosciaena gracilicirrhus* and *Menticirrhus americanus* were the most important ones. The number of individuals almost doubled in the 23-year period and the total weight average decreased to less than 50% of its initial value during the whole period. The average number of species also decreased with time. The calculus of the Jaccard Similarity Index showed that the species composition changed almost 50% from the first period to the second (1979-1992), and changed another 50% from the second period to the third and last one (1990-2002). These alterations may reflect the major anthropic stresses happening in the Flamengo Cove, i.e. the construction of marinas, submarine sewage emissary, population increase as well as fishing activities.

*** CURCIO, FELIPE F.; ZAHER, HUSSAM**

Museu de Zoologia, Universidade de São Paulo, Av. Nazaré 481, São Paulo, SP, 04263-000, Brasil

Comparative cranial osteology of the blind-snakes of the family Anomalepididae Taylor, 1939 (Serpentes; Scolecophidia)

Scolecophidians (blind-snakes) represent a poorly known group of strictly fossorial snakes. Three families of this group of snakes are presently recognized: Anomalepididae, Leptotyphlopidae and Typhlopidae. Mostly because of their secretive nature, blind-snakes are rare in herpetological collections. Among scolecophidians, members of the Anomalepididae are by far the least known in terms of morphology and Biology. The present study furnishes a comparative analysis of the skull of the 4 known genera of anomalepidid snakes (*Anomalepis*, *Helminthophis*, *Typhlophis* and *Liotyphlops*), comparing them with representatives of the 2 remaining families of Scolecophidia. All specimens used in the analysis were cleared and stained. Some bony elements were prepared on stubs and photographed under a Scanning Electronic Microscope (SEM). We first present a concise description of the skull morphology the Anomalepididae based on a sample including *Anomalepis mexicanus*, *Helminthophis flavoterminalis*, *H. praeocularis*, *Liotyphlops albirostris*, *L. beui*, *L. ternetzi*, *L. schubarti* and *Typhlophis squamosus*. One of the species, *Liotyphlops beui*, is represented by a large series of specimens that ranges from young individuals to adult ones. Such large series allowed us to report on late developmental aspects of cartilage elements (particularly the trabeculae crani) and intraspecific variation of some characteristics related to growth. A detailed description for the genera *Helminthophis* and *Typhlophis* is made available for the first time. Our observations provide evidence supporting the monophyly of the Anomalepididae, a taxon that appears to represent the sister group of the Typhlopidae. Results from a preliminary phylogenetic analysis suggest the following affinities between the 4 anomalepidid genera: (*Anomalepis* (*Typhlophis* (*Helminthophis*, *Liotyphlops*))).

*** DA COSTA, FRANCIMARA S.; OLIVEIRA, PAULO H.G.; ANDRADE, PAULO C.M.**

UFAM / IBAMA - Dep. Ciências Biológicas, Laboratório de Animais Silvetres, Av. Gal Rodrigo Otávio Jordão Ramos, 3000, 67000-000 Manaus, AM, Brazil

Protein levels in rations of chelonians (*Podocnemis expansa*, *P. unifilis* and *P. sextuberculata*) in captivity

The Amazonian chelonians are an important protein source, mainly for population of the hinterland of the Amazonia. The demand for specific knowledge for commercial production, is growing significantly, and has increased the number of legalized nursery for animals. In this study we evaluated the effect of 3 crude protein levels (20, 30 and 40 % of CP) and 2 levels of gross energy (3,500 and 4,500 kcal de GE/kg) in rations, for hatchlings of *Podocnemis expansa*, *Podocnemis unifilis*, and *Podocnemis sextuberculata* in captivity. The performance of raising hatchlings from different natural populations was also evaluated (Biological Reserve Abufari-AM and Rio Branco-Roraima). The experiments were undertaken in two distinct places: the experimental Farm of University of Amazon, being the 360 hatchlings of *P. expansa*, 90 of *P. unifilis*, and 90 of *Podocnemis sextuberculata*, lodged in floating river cages of 0.8 m³ and at Iranduba-AM, where the animals were reared in tanks of 48.8 m². The turtles were maintained at a density of 12.5 individuals/m². Measurements were taken bimonthly. *Podocnemis expansa* gained weight the fastest (1.51 ± 0.34 g/day) in relation to *P. unifilis* (1.19 ± 0.73 g/day) and *P. sextuberculata* (0.59 ± 0.28 g/day) to 2 years of age. Animals fed with 20% of CP grew faster (0.523 ± 1.08 g/day), in relation to those that had been fed with 30% of CP (0.489 ± 0.89 g/day)

and 40% of CP (0.492 ± 1.13 g/day) and animals fed with 3,500 Kcal de GE/kg (0.536 ± 1.16 g/day) surpass the animals fed with 4,500 Kcal de GE/kg (0.466 ± 1.93 g/day). In regards to the origin, turtles proceeding from the REBIO Abufari - AM, grew faster (1.51 ± 0.37 g/day) than those turtles proceeding from the Rio Branco - RR (0.92 ± 0.51 g/day).

*** DA COSTA, PEDRO M.; ANDRADE, PAULO C.M.; DUARTE, JOAO A. M.; DA COSTA, FRANCIMARA S.; OLIVEIRA, PAULO H.G.; CANTO, SONIA L.O.; MONJELÓ, LUIS A**

UFAM / IBAMA – Departamento de Ciências Biológicas e Ciências Agrárias, Universidade Federal do Amazonas, Laboratório de Animais Silvestres, Av. Gal. Rodrigo Otavio Jordao Ramos, 3000-Aleixo, CEP 67000-000, Manaus, Amazonas, Brazil

Growth of different species and populations of chelonians in captivity in Amazonas, Brazil

This study compared the performance of the three species of chelonians more consumed in Amazon (turtle, *Podocnemis expansa*; tracaja, *P. unifilis*; and iaca, *P. sextuberculata*) and of the different populations of *P. expansa* (Purus river/Abufari, Branco river and Uatuma river) in captivity and the sexes. They had been analyzed, bimonthly (1997-1999), animals of 0 to 14 months of registered nurseries and carried through experiment with 350 fingerlings of *P. expansa* lodged in circular nursery of 16 m². In captivity was verified that, in 1° year, tracaja presents greater weight gain (2.9 % of BW; 0.59 g/day) than turtle (0.42 % of BW; 0.24 the 0.87 g/day) and that iaca, (0.25 % of the PV; 0.04 g/day) and that animals fed with animal protein they had presented consumption to the 2-12 months of, respectively, 3.6 and 15 g/day, while that the fed ones with vegetal protein had presented consumption of 1.7 and 4.7 g/day. Turtles of Abufari had presented trend to a bigger weight and minor weight gain (WG) than of Branco (141.63 ± 53.39 g and 0.48 g/day versus 108.36 ± 24.9 and 0.53 g/day, respectively). In the experiment it was observed that the turtle posses greater WG (0.698 ± 0.37 g/day; 0.237 ± 0.32 % of BW) that tracaja (0.326 ± 0.18 g/day; 0.199 ± 0.34 % of BW) and iaca (0.164 ± 0.12 g/day; 0.239 ± 0.33 % of BW), being the WG in percentage of BW changeable with the age between the species. Animals of the Uatuma had presented greater WG (2.39 ± 1.46 g/day) in relation to the ones of Abufari (2.23 ± 1.2 g/day) and Branco (2.07 ± 1.27 g/day). How much to the sex difference was not found significant ($T < 0.431$) enters the WG of males (0.94 ± 0.82 g/day) and females (0.89 ± 0.77 g/day) in the first year of captivity. Females grow more when fed with ration of 30-42 % CP (0.99 g/day versus 0.88 g/day) and males grow more when fed with bovine gut (1.28 g/day versus 1.13 g/day).

DA SILVEIRA, RONIS

Universidade Federal do Pará, Centro de Ciências Biológicas, Departamento de Biologia, Campus Universitário do Guamá, R. Augusto Corrêa Num.1, Belém/PA, CEP 66075-110, Brazil

A history of crocodilian hunting in Brazilian Amazonia

Four species of crocodilians belonging to the family Alligatoridae occur in Amazonia. From the pre-colombian period until now, the amazon people and crocodilians have had negative interactions and the use of crocodilian products has been intense. Accidents with crocodilians are relatively common in some areas of Amazonia and often result in death or human mutilation. In the XVIII century, the skins were used as war shields by indigenous people, and now their teeth are common in the local handicraft. At the beginning of the XIX century, oil from crocodilian fat was used as fuel for electric generators. Between 1950 and 1970, tens of

millions of skins were exported from Brazilian Amazonia. At the end of 1970s the market of skins was banned and it was substituted immediately by a meat trade, which is now the most widespread illegal fauna market in Brazilian Amazonia. At the beginning of the XXI century, crocodilian meat became used on a wide scale as bait for fish. Until the first decades of the XX century the only available information on crocodilians in Brazilian Amazonia was limited to anecdotal descriptions by European naturalists during the previous centuries. Throughout the last decades, the scientific knowledge on the Amazonian crocodilians has increased greatly, principally due to researches developed in the Mamirauá Reserve and the Anavilhanas Archipelago in the State of Amazonas, and in the Uaçá Indigenous land, in the State of Amapá. However, that scientific progress has not been taken in consideration by the official Brazilian environmental agencies, and the management proposals elaborated by scientists have not been implanted due to restrictions of a Federal Law decreed by the military government more than 30 years ago, when the Amazonian reality was very different from the current situation. New politics of sustainable use must be created to achieve conservation, management and monitoring of the largest and most abundant predators of the Amazonian basin.

*** D'AGOSTINI, FERNANDA M.; RIBEIRO, SÍRIA L.; LEMA, THALES DE; MELCHORS, J.**

(FMD, SLR, TDL, JM) Pontificia Universidade Católica do Rio Grande do Sul, Museu de Ciências e Tecnologia & Instituto de Biociências, Av. Ipiranga 6681, Cx. postal 1429, CEP 90619-900, Porto Alegre, Rio Grande do Sul, Brasil

Dorsal scale microdermatoglyphy of eight snake genera of tribe Colubrini

The dorsal snake scale microdermatoglyphy has been included in the systematic and phylogeny of several species. The tribe Colubrini has 37 genera and is distributed in Holartic and Neotropical regions, with some representatives in Eastern and African regions. The scales of eight Neotropical genera of this tribe were analyzed, totaling 92 specimens: *Drymobius*: *D. margaritiferus*, *D. melanotropis*, *D. rhombifer*, *D. chloroticus*; *Drymoluber dichrous*; *Drymarchon corais*; *Chironius*: *C. bicarinatus*, *C. flavolineatus*, *C. fuscus*, *C. exoletus*, *C. quadricarinatus*; *Spilotes pullatus*; *Dendrophidion dendrophis*; *Mastigodryas*: *M. bodaerti*, *M. bruesi*, *M. bifossatus*; *Pseustes*: *P. sulphureus*, *P. argus*, *P. sexcarinatus*, *P. poecilonotus* preserved in the following institutions: ANSP, CAS, CM, IB, KU, LACM, LSUMZ, MCP, MCZ, MNHN, MPEG, MPM, TCWC, UCM, UIMNH, UMMZ, UNAM, UTACV, ZMH. The objective was to observe, describe and compare the scale microdermatoglyphy patterns of this tribe, testing the validity of this character. The methodology and identification followed PRICE (1982) with modifications. The observations were done from the antero-longitudinal position in five points: anterior, posterior and middle portions, kill and pits, under 400X, 4000X, 8000x and 18000X magnification. All genera, except *Dendrophidion dendrophis*, presented on middle region longitudinal ridges forming parallel lines composed by sharp spine-like projections that differed from each other on size, form and arrangement. *D. dendrophis* presented papillate pattern. The kill presented a set of the ornamentation observed on middle region. The anterior portion presented the same pattern as the middle, with differences concerning arrangement and form. The posterior portion presented strioreticulate pattern with longitudinal lines formed by small spines anastomosed into a network, varying in form, size and morphology of spines and arrangement of lines. The pits have foveoreticulate form with pits and walls anastomosing into a network and differing regarding the ornamentation of these networks, with or without sharp projections that may be symmetric or not.

*** DAMASCENO, ROBERTA P.; DA ROCHA, PEDRO LUÍS B.**

(RPD) Universidade de São Paulo, Instituto de Biociências, Departamento de Zoologia, Cidade Universitária, Rua do Matão, Travessa 14, no 321 CEP: 05508-900, São Paulo, SP, Brasil; (PLBR) Universidade Federal da Bahia, Instituto de Biologia, Departamento de Zoologia, Campus Universitário de Ondina, CEP. 40.170-000, Salvador, BA, Brasil

Assessment of adaptation in resource use: study with vicariant fossorial Squamata communities

Two very important factors that lead to the establishment of community organization are historical processes concerning taxa and environment involved, and ecological processes, namely the contemporary interactions between populations. This paper tests if ecological processes have selected apomorphies (selected apomorphies= adaptations) in the pattern of resource use by the species of fossorial Squamata of two vicariant communities in the quaternary sand dunes of middle São Francisco River, Bahia. Diet and time of activity of thirteen species of fossorial Squamata were analyzed and compared with that of sympatric species and phylogenetically proximate taxa and with environment's resource availability. In order to group species with similar diets, a cluster analysis was performed. The proportional utilization of food categories by each species was statistically different from environmental availability. The diets of sympatric species were distinct. However, the comparison between communities (allopatric species) showed that diet and time activity of congeneric species were quite similar. Comparisons of our results and data available for phylogenetically related species indicated that: the clade *Calyptommatus*+*Nothobachia* presents divergent diet from that of other *Gymnophthalmidae*, *Calyptommatus* is unique in being nocturnal, and all other Squamata analyzed have kept the plesiomorphic pattern of diet and activity time. Cluster analysis grouped phylogenetically related taxa more closely than sympatric species. The trophic webs of the two subtterranean communities have at least three trophic levels and the two upper levels are occupied by congeneric species that assume equivalent trophic roles. Differences in community composition and food availability were not able to select changes in the pattern of resource use (food and time) for any of the analyzed species. We suggest that morphological or behavioral specializations to fossorial habit could limit adaptation to the pattern of resource use. The deep trophic interdependence among endemic fossorial species from the dunes brings special concerns about their conservation.

*** DARDIS, GABRIELA Z. P.; CASTRO, RICARDO M.C.; MANFRIN, MAURA H.**

(GZPD, RMCC) Universidade de São Paulo, FFCLRP, Dept. Biologia, Laboratório de Ictiologia, Av. Bandeirantes 3900, Ribeirão Preto, SP, 14040-901, Brasil; (MHM) Universidade de São Paulo, FFCLRP, Dept. Biologia, Laboratório de Genética Evolutiva, Av. Bandeirantes 3900, Ribeirão Preto, SP, 14040 901, Brasil

Phylogeography of *Astyanax altiparanae* from the upper Parana River Basin in São Paulo State, Brazil

We are doing a phylogeography analysis of *Astyanax altiparanae* Garutti & Britski, 2000 (Characiformes, Characidae) populations coming from streams and headwaters areas of 11 sub-basins of the upper Parana River Basin in São Paulo state, Brazil. Our goals are to establish not only the current phylogenetics patterns, but also the evolutionary processes that caused them, testing Castro (1999) hypothesis, which relates low displacement capacities with the occurrence of vicariants events, speciation and aloptry of stream species characterized by the restricted geographical distribution. Thus, it is being used as a molecular marker the cytochrome B mitochondrial gene, that in agreement with the literature, has information for intraespecific

analysis. The obtained sequences are read through the program Chromas v. 1.55 and aligned with the aid of the programs Mega v. 2.1 and Se-Al v.2.0. The gene network and the test of the relationship between the haplotypic variation and the geographical distribution are made with the aid of the programs TCS v. 2.1 and Geodis v. 2.0. Until this moment, our results show no geographical structuring among the sampled populations, which can be explained by the following factors: those populations are isolated for a short time or those populations are not isolated. This study is of significant importance to understand the evolutionary process that shaped the biogeography pattern in the streams and headwaters of the upper Parana River Basin.

DE BRITO-GITIRANA, L.; * AZEVEDO, R.A.

Laboratory of Animal and Comparative Histology, Department of Histology and Embryology, Federal University of Rio de Janeiro, RJ, Brazil, Av. Trompowsky s/no, Ilha do Fundão, Cidade Universitária, CCS, Rio de Janeiro, Brasil, CEP: 21044-970

Morphological study of the integument of *Bufo ictericus* (Amphibia, Bufonidae) through stereoscopic, low-vacuum scanning electron and light microscopy

Bufo ictericus integument was investigated by stereoscopic, low-vacuum scanning electron and light microscopy. The studies revealed that dorsal skin surface is rougher than ventral surface. Three types of projections are visualized: larger rounded or ovaled verrucae, smaller conical cornified tubercles, and conical thorn-like projections. Prominent verrucae are observed on the dorsal surface that on the ventral surface they are flatter. The tubercles are visualized only on the ventral surface and correspond to an increase of the cellular volume of the spinous layer accompanied with an augmentation of keratin of the horny layer. The conical thorns are visualized on both surfaces, and correspond to an augment of the cellular volume of the second to last layer with keratin accumulating in these cells. In both surfaces, there is a deep anastomosed network of grooves that run between the verrucae. Considering the groove's profundity, they are classified in primary, secondary and third grooves. The grooves are important, because they promote the water transport from ventral to dorsal surface, maintaining the skin humid and protecting the animal against desiccation. This work demonstrates that the dorsal and ventral surfaces of *Bufo ictericus* are morphologically distinct. The structure is related to the integument physiology of each surface and represents an adaptation to habitat, reflecting a life style of the animal.

DE BRITO-GITIRANA, L.; CARVALHO-E-SILVA, S.P.; * FARIAS, C.F.

Laboratory of Animal and Comparative Histology, ICB - UFRJ, Brazil, Laboratory of Amphibians and Reptiles - IB - UFRJ, Brazil, Av. Trompowsky s/no, Ilha do Fundão, Cidade Universitária, CCS, Rio de Janeiro, Brasil, CEP: 21044-970

The occurrence of typical Bidder's organ in female of *Bufo ictericus*

Although the Bidder's organ has been related since last century, the available information about the morphology of Bidder's organ is very scarce (Farias et al. Micron, 2002). The literatures relate that the Bidder's organ is present only in male of Bufonidae Family and it has been used as a systematic characteristic. In this study, we used females of *Bufo ictericus* in order to verify if this structure is also present in female of Bufonidae. Macroscopical observations and standard technique for light microscopy was used in order to verify the presence of the Bidder's organ in female of *Bufo ictericus*. This study reveals that the female of *Bufo ictericus* shows a typical

Bidder's organ in close spatial relationship to ovary. These data suggest that it is not an exclusive structure for the male Bufonidae, but it may also present in active females.

*** DE CARVALHO, MARCELO R.; GRANDE, LANCE; MAISEY, JOHN G.**

(MRC) Departamento de Biologia, Universidade de São Paulo, Av. dos Bandeirantes, 3900, Ribeirão Preto, SP 14040-901, Brazil; (LG) Department of Geology, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL, 60605-2496, USA; (JGM) Division of Paleontology, American Museum of Natural History, Central Park West at 79th St., New York, NY, 10024-5192, USA

Phylogenetic relationships of stingrays: insights from the Eocene Green River genera

The results of a phylogenetic analysis of stingray genera, based on morphological characters, will be presented. The analyses were undertaken as part of a larger study describing a new fossil freshwater stingray genus from the Green River Formation of Wyoming (Early Eocene). The impact of the new taxon (and that of *Heliobatis*, the other stingray genus from Green River) on the phylogenetic relationships of Recent stingrays will be discussed. The results of our phylogenetic study of stingrays, the most comprehensive to date based on morphological characters, contradicts those of previous authors in relation to various components. Biogeographic implications concerning the evolution of the Neotropical freshwater stingrays (Potamotrygonidae) will be advanced, suggesting that potamotrygonids are considerably older than previous (Late Miocene) estimates.

*** DE LA RIVA, IGNACIO J.; PADIAL, JOSE M.**

(IJDLR) Museo Nacional de Ciencias Naturales, CSIC, C/ José Gutiérrez Abascal 2, 28006 Madrid, Spain; (JMP) Museo de Historia Natural Noel Kempff Mercado, Area de Zoología, Sección Herpetología, PO Box 2489, Santa Cruz de la Sierra, Bolivia

Amphibians of Madidi National Park, Bolivian Amazon: a preliminary survey

The Madidi National Park and the surrounding "Area Natural de Manejo Integrado" (Natural Area of Integrated Management) occupies an extension of 18.957 square km in the Amazonian part of the Departamento La Paz, Bolivia. The park includes lowland rainforests, dry forests, savannas, cloud forests, paramo, and puna, with an altitudinal gradient from 200 m in the lowlands to 6000 m in the Andean highlands. The area is contiguous to some other Peruvian and Bolivian protected zones, altogether encompassing an extension of almost 60.000 square km. A great portion of the park is hardly accessible and few expeditions aimed to survey amphibians and reptiles have been completed. Thus, the herpetofauna of Madidi is still poorly known. A project funded by the Spanish Ministry of Foreign Affairs is making possible the inventory of the amphibians and reptiles in collaboration with the Colección Boliviana de Fauna (La Paz). The exceptional dry conditions during the rainy season of 2002-2003 made field work mostly unsuccessful for the inventory of amphibians. However, under such unfavorable conditions, 40 species of frogs were found in 12 days at a single locality (Chalalan). The combined information obtained from previous field work, literature, and collection examination indicate that at least 67 species of amphibians are present in Madidi. This is a highly underestimated figure that will be rapidly increased as new surveys are completed under better conditions. Based on the known occurrence and distribution patterns of the frog fauna in the SW Amazon and the Andean region of SE Peru, as many as 60 additional species are expected to occur in Madidi. If the figure of 127 amphibian species in Madidi proved to be true, around 50% of the amphibian diversity of the country would occur in an area representing less than 2% of Bolivian territory.

*** DE PINNA, MARIO; GRANDE, TERRY**

(MDP) Museu de Zoologia da Universidade de Sao Paulo, Caixa Postal 42594, Sao Paulo-SP 04299-970, Brazil; (TG) Department of Biology, Loyola University, Chicago, 6525 North Sheridan Road, Chicago, IL 60626, USA

Morphological homologies among otophysans, clupeomorphs and other lower teleosts

The recently proposed sister-group relationship among clupeomorphs and ostariophysans has stimulated a search for putative synapomorphies between the two groups. In this paper, we expand on our previous observations, and propose various special similarities in the structure and development of the anterior vertebrae and caudal fin of clupeomorphs and ostariophysans. Of particular interest is a comparison among the elements of the Weberian apparatus. The development of Weberian ossicles entails modifications which are seen, in various degrees, in homologous vertebrae of at least basal clupeiforms. Especially (but not exclusively) in pristigasteroids, vertebral modifications in part homologous to the Weberian apparatus are almost certainly involved in some sort of otophysic connection subsidiary to the swimbladder diverticula. We also explore the poorly-known fine structure of vertebral and some of the caudal-skeleton elements based on SEM observations. This technique reveals a surprising amount of unreported variation in the details of vertebral structures, second ural centrum, pleurostyle and urostyle. The information gathered is also relevant for understanding homologies among otocephalans and other lower teleosts. Some characters indicate that esocoids may be the closest relatives of otocephalans.

*** DE SÁ, RAFAEL O.; HEYER, W. RONALD**

(RDS) Department of Biology, University of Richmond, Richmond, Virginia, 23173, USA; (WRH) Amphibians and Reptiles, MRC 162, PO Box 37012, Smithsonian Institution, Washington, DC 20013-7012, USA

Amazonian *Leptodactylus*: diversity beyond morphology?

Frogs of the genus *Leptodactylus* are a common, often dominant, and important component of the lowland biota of the Neotropics. *Leptodactylus* is distributed from southern Texas throughout lowland (< 1800 m) Mexico, Central America, portions of the Greater and Lesser Antilles, and in South America on both sides of the Andes to Peru on the west and Argentina on the east. Currently, there are about 60 recognized species, about 2/5 of them inhabiting, at least partially, the Amazon Basin. Resolution of how many species are in the genus is the focus of continuing research; particularly since advertisement calls and sequence data suggest that there is considerable differentiation among and within the taxa recognized as distinct species on the basis of morphology. Herein we present three case examples of *Leptodactylus* to illustrate the diversity of Amazonian frogs beyond their morphological diversity. In the first example, we re-examine the purported sister taxa relationship between *Leptodactylus mystaceus* and *Leptodactylus didymus*. These two taxa are morphologically indistinguishable; however, they are recognized as separate taxa based on advertisement calls. The other examples will focus on the analysis of the genetic diversity of *Leptodactylus ocellatus*, *Leptodactylus pentadactylus*, and *Leptodactylus fuscus*. These three taxa previously were considered as single species, however we are now re-evaluating the species limits and consider each of them to represent a species complex. Sampling problems (i.e., lack of representative populations or overlapping areas) hinders resolution in species with widespread distributions. The examples from *Leptodactylus* show that the correlation between genetic and morphological diversity at the species level in Amazonian frogs is not predictive. Furthermore, given the current loss of species and habitats, these examples indicate that in order to understand the diversity of Amazonian frogs, estimates of

genetic diversity will have to be undertaken in a comprehensive fashion immediately, while forest frogs are still available for sampling throughout the Amazon Basin. These comprehensive analyses will be more successfully accomplished through international cooperation and collaboration.

*** DE SANTANA, CARLOS D.; STEWART, DONALD J.**

(CDS) Instituto Nacional de Pesquisas da Amazônia, Laboratório de Biologia Evolutiva de Peixes Eletrosensitivos, Aleixo, Manaus, 69083-000, Brasil; (DJS) State University of New York, College of Environmental Science and Forestry, 1 Forestry Drive, Syracuse, NY, 13210, USA

A new genus and species of sternopygid knifefish from Guyana (Otophysi, Gymnotiformes) and its phylogenetic relationships

We describe a new genus and species of sternopygid knifefish from Guyana and analyze its phylogenetic relationships. The new species is distinguished by low number of anal fin rays (141-170 vs. over 175 in all known sternopygids) and color pattern with transverse band or saddle mark across the back at mid-body. Several osteological characters place this taxon within subfamily Eigenmanninae (e.g., scapula with scapular foramen included, posttemporal and supracleithrum fused, reduced number of precaudal vertebrae, etc.). The new genus can be diagnosed by having parapophysis of 2nd vertebrae curved ventrally, pointed and clearly separated from rib of 4th vertebrae; a distinct row of small teeth on base of upper oral valve; and forms for the coronomeckelian, coracoid and cleithrum. Among eigenmannines, *Archolaemus* has been recognized as sister-taxon to a clade including *Eigenmannia*, *Distocyclus* and *Rhabdolichops*. Form of the Weberian complex and pectoral girdle suggest the new genus may be sister-taxon to all four of those genera; but a free orbital rim and form of lateral ethmoid suggest *Archolaemus* could be sister-taxon to the other four genera. We are studying additional characters in an effort to better resolve relationships. Another undescribed species from Rio Sao Francisco, Brazil, may be closely related to the new genus. This study indicates that Sternopygidae may be more diverse and complex than previously supposed.

DEAN, MASON N.; * NANCE, HOLLY A.; HUBER, DAN R.

(MND, DRH) University of South Florida, 4202 East Fowler Ave., SCA 110, Tampa, FL, 33620, USA; (HAN) The University of Texas at Austin, Jackson School of Geosciences, Mail Code C1140, Austin, TX, 78712, USA

Functional morphology of jaw trabeculation in *Narcine brasiliensis*: an application of high-resolution X-ray computed tomography

The design of efficient, yet durable structures that retain their integrity under dynamic loading regimes has long challenged engineers and functional morphologists alike. The trade-off between weight and strength can be optimized by hollowing a structure and replacing its inner core with support struts. In animals, this design is observed in sea urchin test, avian beak and wing bone, and the cancellous bone of tetrapod limbs. Additionally, within the elasmobranch fishes, mineralized trabeculae have been reported singularly in durophagous myliobatid stingrays (Elasmobranchii: Batoidea), and are believed to be absent in basal members of the batoid clade. However, this study presents a secondary case of batoid trabeculation in the lesser electric ray, *Narcine brasiliensis*, a small, benthic member of the electrogenic Torpediniformes. While orientation of myliobatid trabeculae is perpendicular to the crushing plane of the jaws, high-resolution X-ray images reveal that the trabeculae of *N. brasiliensis* are arranged in the frontal plane, normal to the long-axis of the jaws. This morphological difference might be

explained functionally. Stingrays use their reinforced jaws to crush bivalves, yet *N. brasiliensis* feeds by ballistically protruding its jaws into the sediment to retrieve polychaete prey. At peak protrusion, the jaw arch is medially compressed such that the trabeculae are positioned to resist the forces resulting from this excavation mechanism. These struts are localized to specific areas most likely to experience the highest load: the medial quadratomandibular jaw joint and the thinnest section of the jaw immediately caudal to the tooth plates. In this way, these supports are positioned to resist both compression at the jaw joint, and local buckling of the jaws as they contact the sediment. Thus, trabeculation in batoids appears to perform strikingly different ecological functions, and was either independently derived in two taxa or was secondarily lost by intermediate members of this clade.

*** DEGROSS, DOUGLAS J.; MEAD, LOUISE S.; ARNOLD, STEVAN J.**

Oregon State University, Department of Zoology, Corvallis, OR, 97331, USA

Assessing gene flow across contact zones between *Plethodon elongatus* and *Plethodon stormi* using microsatellite markers

Many species of plethodontid salamanders exist as complexes with varying degrees of gene flow across regions of contact. Western members of this family are known to exhibit complex patterns of gene flow at these boundaries. *Plethodon elongatus* and *P. stormi* are parapatrically distributed sister taxa with clinal variation reported for some morphological characters. Initial analyses of mitochondrial DNA do not indicate hybridization between *P. elongatus* and *P. stormi*. For this study we designed microsatellite markers to further describe the genetic structure of these species. Comparisons of genetic structure and intergradation using morphological traits and mitochondrial and nuclear (microsatellite) markers will be presented.

DELGADO, MANUEL; SUÁREZ, MELVIN; CARDONA VERÓNICA; * PUENTE-ROLÓN, ALBERTO R.

Universidad Interamericana de Puerto Rico, Recinto de Arecibo, PO Box 4050, Arecibo PR, 00614-4050, USA

Comparison of external bacterial flora between newborns and adults of the Puerto Rican boa (*Epicrates inornatus*)

The Puerto Rican boa (*Epicrates inornatus*) is the largest native species of snake in the Island. This species was included in the Federal List of Endangered Species in October 13, 1970. Sterile swabs and phosphate buffered saline (PBS) were used to take samples from the ventral, cloacae, oral (in adults) and dorsal area. The bacteria identification process was throughout biochemical tests. A total of twenty different bacteria genus were found at this moment in adults of the Puerto Rican Boa and nine different bacteria genus in newborns. The most common genus found in both snakes was *Staphylococcus*. However, the second most frequent genus in adults was *Proteus*. In the other hand, *Enterococcus* was the second genus to be found in newborns. At this moment adults present the larger diversity were found on the dorsal area. Meanwhile, in newborns the ventral area had the larger diversity.

*** DELGADO-ACEVEDO, JOHANNA; RESTREPO, CARLA**

University of Puerto Rico, Dept. of Biology, PO Box 23360, San Juan, Puerto Rico 00931, USA

Museum collections as a useful resource for assessing patterns of diversity: amphibians and the threatened karstic region of Puerto Rico

Amphibians comprise an important component of the vertebrate fauna in the Caribbean region: they are very diverse and abundant and levels of endemism are high. At the island level, however, patterns in the distribution and diversity of Amphibians remain obscure hindering efforts to establish conservation strategies. Here we make use of preserved specimens found in numerous collections over the world to establish patterns in the distribution and diversity of Amphibians in the little known and threatened northern karstic region of Puerto Rico. To accomplish this goal we created a database using the information recorded for a total of 467 preserved specimens (six museum collections) that were collected between 1930-2002. This database was used with Geographic Information System (GIS) to retrieve geographic coordinates that were used to (1) to generate distribution maps for each species and (2) a map on patterns of Amphibian diversity. This will help us to establish a base data to understand the diversity patterns and the distribution of Amphibians of Puerto Rico that may be used for further investigations to establish conservation strategies.

DELIS, PABLO R.

Shippensburg University, Dept. Biology, Shippensburg, PA 17257, USA

Fossorial preferences of three West Central Florida treefrogs: implications for conservation

Species in the family Hylidae (Amphibia: Anura) are generally known as treefrogs because of their ability to climb and use branches to perch and move about. This behavior clearly contrasts with that of burrowing frogs such as the Pelobatids (spadefoot toads). The fossorial habits of treefrogs are not well known but anecdotal accounts have reported burrowing in many Hylid taxa including the barking treefrog (*Hyla gratiosa*). *Hyla gratiosa* has been the focus of considerable concern because it is rare in comparison to other treefrogs. The purpose of this study was to assess the potential fossorial behavior of three *Hyla* species known from west central Florida: *H. gratiosa*, *H. cinerea* (green treefrog), and *H. femoralis* (pinewoods treefrog). In laboratory conditions, individuals of the three species were placed in terraria containing leafy tree branches from natural vegetation on a sandy substrate. *Hyla gratiosa* spent nearly 14 % of the time perched on branches and was the only species that burrowed significantly (43.0 % the time). *Hyla femoralis* rarely burrowed or spent time directly on top of the soil (5.3 % of the time). *Hyla cinerea* was never found burrowed in, or directly on top of, the soil. The fossorial behavior of the barking treefrog has implications for the protection of appropriate habitats for this species, as the burrowing behavior of *H. gratiosa* in the laboratory may reflect an ecological requirement in its natural environment. Given that substrate type influences the biomechanics of burrowing in other frogs, and that natural substrates are often altered by human disturbance, the preservation of suitable substrates should be an additional consideration when establishing natural preserves for populations of the barking treefrog.

DENOEL, MATHIEU

Chargé de Recherches FNRS, University of Liège, Department of Life Sciences, Laboratory of Fish and Amphibian Ethology, 4020 Liège, Belgium

Evolutionary ecology of paedomorphosis in the Alpine newt *Triturus alpestris*

Paedomorphosis, in which individuals retain ancestral characteristics in the adult stage, is widespread in newts and salamanders and is suspected to play an important role in evolution. In some species, paedomorphosis is facultative with some individuals skipping the metamorphic stage. Dimorphic populations of the Alpine newt inhabit a large variety of aquatic habitats such as permanent lakes and temporary ponds. The aim of this study was to determine the benefits of the alternatives in these different habitats. To this end, I focused on resource partitioning, energy intake, body condition and age structures in different populations composed of the two morphs. In deep lakes, there was a substantial trophic differentiation between morphs. Paedomorphs primarily preyed on plankton whereas metamorphs foraged on terrestrial invertebrates that fell to the water surface. By reducing competition, resource partitioning may contribute to the coexistence of the alternative morphs in heterogeneous habitats. On the contrary, in a small pond, resource use was similar in the two morphs. Maturity is reached earlier in the paedomorphs from this small pond than in metamorphs (progenetic process), favoring then a rapid turn-over of the population, while similar gonadal development was observed in one of the deep lake (neotenic process). Body condition was generally higher in paedomorphs than in metamorphs in each studied population. These results show that facultative paedomorphosis is adaptive in varied habitats, but that different factors may favor it depending of the characteristics of the environment. Paedomorphic phenotypes can thus be selected in low altitude productive ponds and high altitude oligotrophic lakes.

* **DENOEL, MATHIEU; DUGUET, R.; DZUKIC, G.; KALEZIC, M.; MAZZOTTI, S.**

(MDN) Chargé de recherches FNRS, University of Liège, Dept. Life Sciences, Laboratory of Fish and Amphibian Ethology, 4020 Liège, Belgium; (RD) Biotope, 75980 Paris Cedex 20, France; (GD) Institute for Biological Research 'Sinisa Stankovic', 11000 Beograd, Yugoslavia; (MK) Institute of Zoology, Faculty of Biology, 11000 Beograd, Yugoslavia; (SM) Museo Civico di Storia Naturale, 44100 Ferrara, Italy

Biogeography and ecology of a dimorphic trait in *Triturus alpestris* (Amphibia, Caudata)

Paedomorphosis is an evolutionary process in which larval structures are retained in adult animals. In newts and salamanders, this heterochronic process is widely represented and concerns the retention of gill slits. Our aim was to find out whether habitat and geographical determinants may be associated with paedomorphosis in a European species of newt. To this end, we determined the main characteristics of the aquatic sites containing paedomorphic Alpine newts that have been described in the literature or discovered by one of us. Although metamorphs are widely distributed in Europe, paedomorphs were only found at the southern margin of the geographic range of the species: mainly in the Italian and Balkan peninsulas. They were recorded in 87 aquatic sites. No single trend was outlined for the analyzed ecological parameters of the aquatic and surrounding terrestrial habitats (e.g. altitude, maximum water depth, drying and presence of forest). These results show that paedomorphs can be found in favorable aquatic habitats surrounded by hostile terrestrial landscapes, but also in temporary waters located in proximity to appropriate terrestrial environments. Models predicting paedomorphosis in varied environments are thus supported, but require complementary investigations on the costs and benefits of each alternative ontogenetic pathway. On the other hand, the southern limitation of the heterochronic phenomenon and the existence of favorable

sites in northern and eastern Europe suggest a genetic basis for paedomorphosis in the studied species.

*** DEUS, CLÁUDIA P.; FARIAS, IZENI P.; HRBEK, TOMAS**

(CPD) Instituto Nacional de Pesquisas da Amazônia (INPA), CPBA, CP 478, Manaus, Amazonas, Brazil; (IPF) Universidade do Amazonas, ICB, Manaus, Amazonas, Brazil; (TH) Department of Anatomy and Neurobiology, Washington University School of Medicine, Campus Box 8108, St. Louis, MO 63110, USA

A new species of killifish of the genus *Rivulus* (Cyprinodontiformes) from northeast of Manaus, Brazil

Recent collections of cyprinodontiform fishes in Reserva Ducke and in forested areas northeast of Manaus resulted in the discovery of a new species of *Rivulus*. In the Manaus area three *Rivulus* species occur: *R. obscurus*, *R. cf. micropus* and the new species provisionally identified as *R. sp. Ducke*. Molecular phylogenetic analysis indicates that the new species is member of a clade of small *Rivulus* species from the Guyana Shield. Its sister taxon is a clade consisting of *Rivulus retrocaudatus* from Quisto Cocha area of Peru, and *Rivulus tecminae* and *R. sp. Tobogan de la Selva* from upper Orinoco River tributaries of the Amazonas state, Venezuela. The new species occurs sympatrically with *R. cf. Micropus*; however, they are not syntopic. *R. cf. micropus* occurs in flooded leaf litter or remnant pools of larger creeks, while *R. sp. Ducke* occurs in the main-stream of fast-flowing small rivulets hiding under rocks and vegetation. The new species is found in low densities, and as single individuals. Aquarium observations support the hypothesis that the new species is highly territorial and aggressive towards conspecifics. Males and females of the new species show little sexual dimorphism, and females lack the *Rivulus*-spot; this characteristic is common of all members of small *Rivulus* species clade from the Guyana Shield.

DEYNAT, PASCAL P.

Muséum national d'Histoire Naturelle, Département Milieux et peuplements aquatiques, USM 0403 "Biodiversité et Dynamique des Communautés aquatiques", 43 rue Cuvier, 75231 Paris cedex 05, France

The Odontobase project: first results

The Odontobase project has been created two years ago to permit an identification of chondrichthyan fishes by the mean of their isolated dermo-epidermic structures (dermal denticles, thorns, tubercles, bucklers). This identification is based on the study of all species of sharks, skates and chimaeras at different stages of growth and is focused on the morphology of the basal plate, peduncle, crown, on the relations between peduncle and crown and on the presence of superficial relief. Twenty morphological characters have been identified and used in a first attempt in European species. The first results indicate that the characteristics of the isolated dermal structures can be used sometimes to the specific level in some genera (*Somniosus*, *Alopias*) and only at the generic level for other ones (*Scyliorhinus*, *Rajidae*). These first observations confirm that some genetically and ecologically closely related groups share the same type of dermal covering and permit to question on the validity of some species.

* **D'HEURSEL, ANNE; HADDAD, CÉLIO F. B.**

Departamento de Zoologia, Universidade Estadual Paulista, Caixa Postal 199, 13506-900 Rio Claro, São Paulo, Brasil

Anatomy of the buccal cavity of hyloid larvae from the *Hyla albomarginata* group and *Aplastodiscus perviridis*

The relationship between several species of the *Hyla albomarginata* group and the species *Aplastodiscus perviridis* A. Lutz (in B. Lutz, 1950) remains controversial. A few studies show that *A. perviridis* has several characteristics that are similar to species of the genus *Hyla*. This investigation aimed to verify if similarities exist between the internal buccal anatomy of larvae of *A. perviridis* and larvae of species from the *H. albomarginata* group. The internal buccal anatomy of tadpoles of *H. albomarginata*, *H. albofrenata*, *A. perviridis*, *H. callipygia*, *H. leucopygia* and *Hyla* sp. (aff. *ehrharti*), was analyzed under stereomicroscope and scanning electron microscope. Many common characteristics were found between the species, including vacuities in the anterior region of the nares. All species also have a major pair of infralabial papillae, which is smaller in *H. albomarginata*, compared to the other species. The number and shape of the minor infralabial papillae also differs amongst the species. The median ridge is a triangular structure in all species except in *H. albomarginata* and *H. leucopygia* where it is semi-circular. All the species, with the exception of *H. albomarginata*, possess many papillae in the lateral and sometimes posterior part of the buccal floor arena, as well as lateral ridge papillae in the buccal roof. Considering the data obtained in the analysis of the internal buccal anatomy, the tadpole of *A. perviridis* does not possess any characteristic that distinguishes it from the larvae of the species of *Hyla* studied. The fact that all the species analyzed here possess vacuities anterior to the nares suggests that they all belong to the same species group of *Hyla*, since other species of this genus do not possess this characteristic. Moreover, the species of the *H. albofrenata* and *H. albosignata* complexes have more characteristics in common with *A. perviridis*, than with *H. albomarginata*.

DI DARIO, F.

Seção de Peixes, Museu de Zoologia-USP, Caixa Postal 42594, CEP 04299-970, São Paulo, SP, Brasil

Homology between the *recessus lateralis* and cephalic sensory canals, with the proposition of additional synapomorphies for the Clupeiformes and the Clupeoidei

The *recessus lateralis*, a complex structure in the otic region of the skull that is probably associated with detection and analysis of small vibrational pressures and displacements, is a synapomorphy of the Clupeiformes. The Clupeiformes includes the Denticipitoidei, with one single living species, *Denticiceps clupeoides*, and the Clupeoidei, with about 360 species commonly known as herrings and anchovies. Although shared by the two groups, the *recessus lateralis* of the Denticipitoidei is less developed and specialized than that of the Clupeoidei. Comparisons between the *recessus lateralis* of the Clupeoidei and Denticipitoidei and the sensory cephalic canals of teleosts lead to hypotheses of a series of transformations of the cephalic sensory canals. As a consequence, the *recessus lateralis* is not treated as a single binary "presence versus absence" character as was the traditional practice, and more precise synapomorphies in that system are proposed for the Clupeiformes and the Clupeoidei. Hypothesized synapomorphies for the Clupeiformes are the presence of a dilated and internal temporal sensory canal in the pterotic, a postorbital branch of the supraorbital sensory canal located in a bony groove in the lateral wing of the frontal, and a proximity of the terminal portions of preopercular and infraorbital sensory canals. Hypothesized synapomorphies for the Clupeoidei are the presence of a postorbital branch of the supraorbital sensory canal located deep within the body of the lateral wing of the

frontal, with the distal portion of that branch totally internal on the cranium, and an expanded diameter of the distal portion of the postorbital branch of the supraorbital sensory canal. The homology of the *sinus temporalis* of the Clupeoidei and the homology of the dermosphenotic of *Denticeps* and the Clupeoidei with that of other teleosts are also discussed.

* **DIAZ DE ASTARLOA, JUAN M.; MABRAGAÑA, E.**

(JMDA) Departamento de Ciencias Marinas, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Funes 3350, B7602AYL, Mar del Plata, Argentina. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET); (EM) Museo del Mar, Mar del Plata, Argentina

Bathyraja cousseau sp.n., a new softnose skate from the southwestern Atlantic
(Rajiformes, Rajidae)

A new species of the rajid genus *Bathyraja* Ishiyama is described from the southwestern Atlantic. The description was based on 20 specimens collected from off northern Patagonia and southern Malvinas Islands. Methods for making measurements and counts followed standard procedures. One mature male and one mature female were dissected in order to examine the skeletal structures (neurocranium, scapulocoracoids and claspers). The specimens exhibit a rhomboid-shaped disc, its length 0.5 times in total length. Preorbital length 2.41 - 2.93 times interorbital distance. A large and more distinct round pale area ocellus-like, margined with dark brown on posterior part of each pectoral base of the upper side of disc. Lower surface of the disc largely creamy- white, with posterior margins of pectoral fins, and edges of posterior lobes of pelvic fins narrowly edged dusky brown. Underside of tail almost entirely dark-brown. Upper surface of disc completely covered with numerous small spinules, also placed on interorbital area, tail, dorsal fins and posterior pelvic lobes. No ocular thorns. A row of 7 to 9 strong thorns in a median dorsal line (two of them set on the nuchal and 1 to 2 thorns on the suprascapular regions). No gap between nuchal-suprascapular and the anterior median thorns. Tail with 16 to 18 strong midrow thorns extending from axil of pelvic fins to the first dorsal fin. Males with elongated, slender rod-shaped claspers. Dorsal fins densely spinulose, close to the end of tail and with no space between them. Ventral surface of disc, pelvics, claspers and tail without of dermal denticles. Besides the external morphological features, skeletal characteristics are also analysed, and are compared with those of other congeneric species. *Bathyraja cousseau* n. sp. was named in honor of Prof. Dr. María Berta Cousseau who has been contributing greatly to the marine fishes of Argentina.

* **DI-BERNARDO, MARCOS; MASCHIO, GLEOMAR F.; PONTES, GLAUCIA M. F.**

Pontifícia Universidade Católica do Rio Grande do Sul, Museu de Ciências e Tecnologia & Faculdade de Biociências, Av. Ipiranga 6681, CEP 90619-900, Porto Alegre, RS, Brazil

Sexual maturity, reproductive cycle, and fecundity of the false coral snake, *Oxyrhopus rhombifer rhombifer* (Serpentes, Colubridae), in southern Brazil

Popularly known as Falsa-coral, *O. r. rhombifer* is an opisthoglyph, medium-sized colubrid snake of the tribe Pseudoboini that occurs in southeastern and southern Brazil, northeastern Argentina, and Uruguay. Its reproductive biology is known only by opportunistic observations of mating, clutches, and hatchlings. The data presented here come from the analyses of 164 specimens preserved in scientific collections, and observations on gravid females kept in captivity. All specimens are from Rio Grande do Sul State, southern Brazil. Mature females are larger than mature males (t test, $P < 0.001$; $n = 95$), despite the absence of sexual dimorphism in snout-vent length (SVL) of immature specimens. Females attain the sexual maturity with

approximately 496 mm SVL and 24 months of age, and males with 325 mm and 12 months. Reproduction is seasonal. Mating (n = 2) was observed in August and November. Vitellogenesis (n = 40) and oviposition (n = 15) occurred from September to February, and December to January, respectively. Under captive conditions, two females produced more than one clutch within the same reproductive season, which leads to the supposition that multiple clutches may also occur in the nature. The clutch size ranged from 1 to 21 eggs (mean = 9.48; n = 58), and it is significantly correlated with female SVL (Pearson linear correlation, $t = 7.319$, $r = 0.733$; $P < 0.001$; n = 48). Recruitment (n = 8) was recorded from February to April.

*** DICKEN, MATT L.; SMALE, MALCOLM J; BOOTH, TONY**

(MLD, MJS) Port Elizabeth Museum, PO Box 13147, Humewood, Port Elizabeth 6013, South Africa; (TB) Rhodes University, Department of Ichthyology and Fisheries Science, Grahamstown, 6410, South Africa

An initial estimate of the population size of the juvenile Spotted ragged tooth shark (*Carcharias taurus*) in Eastern Cape nursery areas off South Africa

A maximum likelihood model is developed using mark-recapture data to estimate the population size of immature, juvenile Spotted ragged tooth sharks in the Eastern Cape of South Africa. The model is composed of 4 major components: (1) A population dynamics model, which describes the number of tagged animals surviving to the next time interval. (2) An Observation model, which describes how the tags are recovered and reported. (3) A likelihood function that specifies the likelihood of observing a specific number of recoveries as a function of the number expected according to a specific set of parameters of the population dynamics and observation models. (4) A bootstrapping program to estimate variances for the parameters F (Fishing mortality), Z (Total mortality) and N (Population size). There was insufficient contrast in the data to estimate all model parameters consequently an instantaneous tag shedding rate, non-reporting rate and M (natural mortality) had to be fixed while allowing free estimation of F (Fishing mortality), Z (Total mortality) and N (population size). In this study fishing mortality was estimated to be 0.127 year^{-1} , with a 95% confidence level ranging from 0.089 and 0.158. Total mortality Z was estimated to be 0.327 year^{-1} , with a 95% confidence level ranging from 0.289 and 0.358. The mean annual population estimate for juveniles from 1994/95 to 2001/2 was 5540 with a 95% confidence level ranging from 4583 and 6306.

DICKSON, KATHRYN; * PORCU, CHRISTINA M.

California State University, Fullerton, Department of Biological Science, 800 North State College Blvd., Fullerton, CA 92831, USA

Mitochondrial densities in the locomotor muscle of ectothermic and endothermic scombrid fishes

Tunas are unique among scombrid fishes because they can conserve metabolic heat to maintain the temperature of the slow, oxidative myotomal muscle (red muscle) elevated above water temperature (i.e., they are regional endotherms). Other scombrid fishes, including mackerels and bonitos, are ectothermic species. Red muscle, a major source of heat used for endothermy, is a highly vascularized, aerobic tissue with a high density of mitochondria to support aerobic muscle contraction. Recent studies have shown that tunas have a higher standard metabolic rate (SMR) than mackerel and bonito do. This study tests the hypothesis that tunas also have a greater muscle mitochondrial density than is found in mackerel and bonito. Chub mackerel (*Scomber japonicus*), eastern Pacific bonito (*Sarda chiliensis*), and albacore tuna (*Thunnus alalunga*)

were obtained off the coast of southern California. Samples of slow, oxidative and fast, glycolytic myotomal muscle fibers were prepared via standard procedures for analysis with a transmission electron microscope (TEM). Individual whole muscle fiber cross-sections were photographed at low magnification (1,000-2,000 x) on the TEM and the negatives were scanned into a computer and overlaid with a grid. Using the Scion Image program, the muscle fiber area composed of mitochondria was calculated for each fiber via the point-contact method. Preliminary results indicate that red muscle fiber mitochondrial densities of the chub mackerel are greater than those of tuna. [Supported by NIH grant # R25GM56820]

*** DIOGO, RUI; PARMENTIER, ERIC; CHARDON, MICHEL; VANDEWALLE, PIERRE**

Lab. Functional and Evolutionary Morphology, Bat. B6, Université de Liège, B-4000 Liège, Belgium

Catfish phylogeny: a general cladistic analysis based on morphological data

The Siluriformes, or catfishes, with 35 families and more than 420 genera and 2500 species, represent about 33% of all freshwater fishes, and their presence in the African continent is particularly important. The relationships among catfishes have since long been the subject of several studies and discussions. However, most of these studies concern pre-cladistic analyses and/or cladistic analyses of some specific groups within the order, with only two of studies, namely those of Mo (1991) and de Pinna (1998), presenting explicit cladistic phylogenetic hypothesis on the higher-level phylogeny of the whole order. And, despite both these studies, and particularly that of de Pinna, which described and analysed a considerable amount of morphological data within an also considerable number of terminal taxa, the higher-level phylogeny of catfishes continues to be mainly a subject of discussions and contradictions, with most of the researchers considering it as largely unresolved. Therefore, the members of our laboratory, a laboratory with strong and long traditions on the functional morphology and evolutionary relationships of teleosts in general and of ostaryophysans in particular, decided to focus on this interesting and puzzling topic. In order to do so, we have studied, for the last 6 years, more than 450 morphological characters concerning the bones, muscles, ligaments and cartilages of both the cephalic region and the pectoral girdle of about 90 terminal taxa representing all the extant catfish families. In this presentation we describe and discuss main results of our research.

*** DIXO, MARIANNA; MARTINS, MARCIO**

Universidade de São Paulo, Instituto de Biociências, Dpto. Ecologia, Rua do Matão, travessa 14, N. 321, CEP 05508-900, São Paulo, SP, Brasil

Effects of forest fragmentation on the diversity of lizards and frogs in the Atlantic forest

The effect of forest fragmentation on neotropical vertebrate fauna is still poorly understood and most information available come from Central America and the Amazon. The Atlantic forests of eastern Brazil were severely fragmented in the last decades and the effects of this fragmentation on vertebrate assemblages has never been addressed. Here we describe how the diversity of leaf litter lizards and frogs is affected by forest fragmentation at the southern portion of the State of Bahia, eastern Brazil. The abundance, richness, diversity, dominance, and evenness of leaf litter lizards and frogs were compared among six different habitats: interior of continuous forest; edge of continuous forest; interior of forest fragments; edge of forest fragments; secondary growth forest; and 'cabruças' (shaded cocoa plantation). Lizards and frogs were sampled with pitfall traps with drift fences, from October 1999 to February 2000. The diversity, dominance,

abundance, and evenness of lizards were significantly different among habitats. Diversity was greater in edges of fragments than in cabruças; in cabruças, lizards were more abundant and their abundances were less even than in the other habitats. Lizard dominance was also significantly different among habitats, being higher in cabruças than in other habitats (with the exception of interior of continuous forests). Lizard abundance was not different between continuous forests and fragments, indicating that species in this assemblage is not significantly affected by forest fragmentation. Furthermore, the assemblage of leaf litter lizards of the Una region seems not to be affected by edge effects. Cabruças and secondary forests at the Una region landscape may function as forest extensions, although apparently more selective to some species of lizards. None of the frog diversity measures considered varied significantly. Only one species, *Chiamocleis* sp. 2, was significantly more abundant in secondary forests than in cabruças. The presence of leaf litter alone and the maintenance of a forested habitat at the cabruças and secondary forests, as well as the high humidity throughout the year in the region, may be sufficient to support the diversity of this guild of frogs even in the disturbed areas studied.

*** DIXO, MARIANNA; PERUZIN, MARIA CRISTINA J.; MORGANTE, JOÃO S.; METZGER, JEAN PAUL W.**

Universidade de São Paulo, Instituto de Biociências, Dpto. de Ecologia (MD, JPWM) e Dpto. de Biologia (MCJP, JSM), Rua do Matão, travessa 14, N. 321. CEP 05508-900, São Paulo, SP, Brasil

Diversity of frogs and lizards in fragmented landscapes at the Atlantic Plateau of São Paulo

The effects of forest fragmentation on the structure of leaf litter frogs and lizards community and on the genetic structure of some target species were studied in forest fragments of the Atlantic Rain Forest. The study area comprised the Morro Grande Forest Reserve, considered as the control (non-fragmented) area, and an adjacent fragmented landscape. The composition and diversity of the herpetofauna were sampled with pitfall traps in six areas inside the Reserve and in 20 fragments with different sizes and degree of connectivity. Partial sequences of mitochondrial control region were used to investigate the genetic population structure of the common frog *Bufo* cf. *crucifer*. Fifty two individuals from seven small fragments (< 6 ha) were sequenced. Genetic analyses were done using the program Arlequin version 2.0. Results showed that the frog community was more diversified in the control area than in the fragments. No difference of richness, diversity and abundance were found between connected and non-connected fragments. Three species seemed to be sensitive to fragments size. *Proceratophrys boiei* and *Physalaemus cuvieri* were more abundant in the fragments, contrary to *Cycloramphus* sp. that was more abundant in the Reserve. Lizards richness and abundance were higher in the Reserve than in the fragments. There was no difference of lizards richness and abundance between connected and non-connected fragments. *Eubleopis gaudichaudii* and *Enyalius perditus*, were affected by forest fragmentation, being present at a higher number in the larger fragments. We sequenced 591 base pairs and 20 haplotypes were found. Significant values of F_{st} were obtained in four pair wise comparisons that included, as expected, 3 fragments 3 km distant from each other. Nevertheless, one of the comparisons showed an unexpected significant F_{st} despite the low distance between the fragments (< 1 km). Distance between fragments may be important, but other characteristics of the landscapes and the history of fragmentation may have an important influence on the genetic structure of this common species of frog.

*** DO VALE, JULIO D.; SANTOS, GERALDO M.; ZUANON, JANSEN; FERREIRA, EFREM J.G.; AMADIO, SIDINÉIA A.**

Instituto Nacional de Pesquisas da Amazônia, CPBA, Manaus, AM, 69011-970, Brazil

Fish diversity in a floodplain system at the confluence of Solimões and Negro Rivers, central Amazon, Brazil

This study deals with the composition and diversity of the fish fauna of Catalão, a floodplain system at the confluence of Solimões and Negro Rivers. Collecting was done monthly from September 1999 to February 2001 at two sites, utilizing a set of gill-nets (mesh sizes 30 to 120 mm) both during day and night. A total of 19,211 specimens were captured, belonging to 180 species (eight orders, 30 families). Nearly 60% of the fish were Ostariophysi (Characiformes, Siluriformes and Gymnotiformes) and 6.7% Perciformes. *Tripottheus albus* and *Hemiodus* sp. were the most abundant and frequent species, while *Acestrorhynchus falcirostris* had the highest biomass. Catches were higher at low water, yielding 46% of the total specimens. The mean species diversity (Shannon's H) by monthly catch was 4.59, and 5.44 overall for the system. Species dominance (Simpson's D) averaged 0.08. Diversity and dominance values did not change significantly among hydrologic periods; only equitability values were significantly lower during dry season ($E = 0.73$) and averaged 0.79. High diversity and species richness are common characteristics of Amazonian aquatic systems; however, despite the intense and historical fisheries developed in the area, the results obtained in the Catalão are higher than reported from other fish community studies in Amazon floodplain lakes. The geographic position of the Catalão at the confluence of two huge and very different aquatic systems (Solimões and Negro Rivers) probably explains the high fish species richness and diversity found.

*** DOAK, NAOMI; HERO, JEAN-MARC**

(ND, J-MH) Griffith University, School of Environmental and Applied Sciences, PO Box 50, GC Mail Centre, Bundall, QLD. Australia 9726

Movement and activity in Fleays' Barred Frog, South East Queensland, Australia

When attempting to investigate and determine the movements of amphibians there are few methods currently available that compare with the advantages of radio telemetry and cotton thread spooling. Combined, these methods allow detailed investigation of the movement patterns and potential dispersal ability of individuals. Like many of Australia's threatened frogs there is little quantitative information available on non-breeding habitat requirements of *Mixophyes fleayi*. Radio-tracking and cotton thread spooling methods were used to assess movement patterns and microhabitat preferences of *M. fleayi* at Cainbale Creek in Lamington National Park, southeast Queensland. Eight males and 17 females were radio-tracked during two consecutive summer breeding periods, while 25 males and 8 females were spooled with cotton thread. The activity of both sexes is characterised by intervals of small, localised movements. In females however, this behaviour is punctuated by large movements which generally displace individuals away from breeding habitat. Females tended to leave the breeding habitat after relatively short amounts of time, while males remained within the breeding area, rarely moving away from the stream. This complements observations of many females, but no adult males, found on walking tracks and roads, hundreds of metres from streams. This project is part of a larger study investigating the population dynamics of *Mixophyes fleayi* and provides valuable insights into movement and habitat use by this species.

* **DOHM, MICHAEL R.; MAUTZ, WILLIAM J.; SALAS, LONEY J.**

Department of Biology, University of Hawaii at Hilo, 200 W. Kawili St., Hilo, HI 96720, USA

Effects of ozone on marine toad bronchopulmonary macrophages: implications for amphibian declines?

Disease and pathogen outbreaks have been implicated in many amphibian population declines, but anthropogenic changes to the environment are suspected as a contributing factor. We are investigating the effects of ozone exposure on the behavior, immune function, and physiology of amphibians. Ozone is a common urban air pollutant, and in wildlife habitats adjacent to urban sources, ozone levels often exceed the U.S. federal and World Health Organization standards. Ozone has long been recognized as a major health risk in humans and it is known to cause metabolic, immunological, and respiratory tract inflammatory responses in mammals. Amphibians may be particularly sensitive to ozone exposure because a significant portion of the respiratory exchange surface (skin) of amphibians may receive direct exposure to airborne pollutants. In the toad, *Bufo marinus*, we found that innate immune function is altered following exposure to ozone under laboratory conditions. Techniques were developed to extract viable macrophages from the lungs of adult toads. Yields of macrophages ranged from 50-200,000 cells per milliliter. Average viability from Trypan blue tests were 80%. One and 24 h following exposure, fewer viable macrophages were extracted from ozone-exposed toads. By 48 h, no differences in macrophage viability were found. In a phagocytosis assay, pulmonary macrophages from ozone-exposed toads consumed fewer microsphere test particles, suggesting depressed ability to phagocytize pathogens. Phagocytic capacity is only one of many immune functions of macrophages. Macrophages also secrete powerful oxidant radicals (reactive oxygen species, ROS) that can kill invading pathogens. We are currently testing for in vitro ROS generation by the toad bronchopulmonary macrophages with chemiluminescent detection of luminol.

DOLMAN, GAYNOR

The University of Queensland, Dept. Zoology and Entomology, Queensland, 4072, Australia

Speciation processes in *Carlia* skinks from the Australian Wet Tropics rainforest: inference from multiple loci

The rainforests of northeastern Australia are among the most biodiverse areas on the continent and have a known history of contraction and expansion from discrete refugia, providing a good natural system for exploring the interaction of allopatric and other evolutionary forces on diversification. This project investigates these processes in two endemic species of the ecologically and morphologically diverse Australo-Papuan radiation of the rainbow skink genus *Carlia*. The red-throated rainbow skink (*Carlia rubrigularis*) inhabits Wet Tropics rainforest in north eastern Australia, while the blue-throated rainbow skink (*Carlia rhomboidalis*) is distributed further south in the Wet Tropics and in rainforest patches in Mid-eastern Queensland. Extensive mitochondrial DNA studies show *C. rubrigularis* is split into two deeply divergent (~ 20% ND4) but morphologically indistinguishable phylogeographic lineages, structured across a well characterized biogeographical barrier, the Black Mountain Corridor. A mtDNA phylogeny of the genus indicated that *C. rubrigularis* is paraphyletic, with *C. rhomboidalis* more closely related to the southern of the two phylogeographic lineages. These observations suggest contrasting histories of divergence, vicariance and drift between northern and southern lineages of *C. rubrigularis* and sexual or natural selection forces, associated with throat colour, between *C. rubrigularis* and *C. rhomboidalis*. Detailed molecular genetic analyses, combined with morphological and mate choice analysis and bioclimatic modelling are in

progress to further understand the relationship between genetic, morphological and reproductive divergence and speciation within these two (or three) species. Here I will present data from 7 nuclear loci (introns and anonymous DNA segments), which have been used to estimate important population genetic parameters associated with lineage divergence, such as population size, gene flow and divergence times, using a coalescent approach.

DOMEIER, MICHAEL L.

Pfleger Institute of Environmental Research, 901-B Pier View Way, Oceanside, CA 92054, USA

Behavioral patterns and space requirements for adult goliath grouper (*Epinephelus itajara*)

In the late spring of 2000, acoustic tags were placed on two goliath grouper at an offshore wreck in the Gulf of Mexico. The tags transmitted the presence of the individual fish, as well as swimming depth, to a data logging hydrophone moored above the site. Each fish remained at the wreck nearly continuously for the duration the tag remained on each fish (36 and 73 days), indicating very small space requirements for this species. Interesting patterns of repeated shallow water forays, occurring at sunrise during the full moon period of July, may be an indication of reproductive activity.

DOMEIER, MICHAEL L; * NASBY-LUCAS, NICOLE

Pfleger Institute of Environmental Research, 901 Pier View Way, Oceanside, CA 92054, USA

An acoustic tracking study of giant sea bass (*Stereolepis gigas*)

A large continuous hydrophone array has been deployed around Anacapa Island, one of California's Channel Islands. This array is currently tracking several species of fishes, one of them being the protected giant sea bass (*Stereolepis gigas*). This array has continuously monitored over 15 individual giant sea bass; some for over 3 years. We have amassed enormous datasets for each fish, giving us location, time/date and swimming depth for the duration of the experiment. These data have revealed habitat preferences, movement patterns and space requirements. We have documented inter-island movement of some individuals that is linked to the formation of a spawning aggregation at Anacapa Island. Resident individuals have large home ranges that encompass the entire island. A clear pattern of relatively deep habitat usage during winter months and shallow habitat usage during summer months has emerged.

*** DOMINGUEZ DOMINGUEZ, OMAR; DOADRIO VILLAREJO, IGNACIO**

(ODD) Posgrado en Ciencias del Mar y Limnología, Instituto de Ciencias del Mar y Limnología, UNAM, Mexico, D.F. and Universidad Michoacana de San Nicolas de Hidalgo, Facultad de Biología, Edificio "R" plata baja, Ciudad Universitaria, C.P. 58000, Morelia, Michoacan, Mexico; (IDV) Museo Nacional de Ciencias Naturales, Jose Gutierrez Abascal 2. 28006, Madrid, España

Taxonomic implication of the Goodeidae based on a molecular phylogenetic hypothesis (cytochrome b)

A phylogeny among the species of the Goodeidae was constructed based on the complete mitochondrial cytochrome b gene (1140 pb). Molecular phylogeny was used to revise current classification of the group, and to characterize the evolution of some reproductive characters.

We confirmed the monophyly of the two subfamilies, Empetrichthyinae and Goodeinae, and defined five different lineages within of Goodeinae: Chapalichthyini, Girardinichthyini, Goodiini, Ilyodontini and Characodontini. The morphology of the trophotaenia (widely used to infer phylogenetic relationship within goodeids) appears to be homoplasious. In a primitive condition, the trophotaenia seem to be a very simple structure as occurs in the Characodontini lineage and is it considered an evolutionary trend to increase trophotaenia surface. Goodeidae originated in the middle Miocene and it was in the Pliocene when they presented their highest radiation in the Mesa Central of Mexico.

*** DOMINGUEZ DOMINGUEZ, OMAR; DOADRIO VILLAREJO, IGNACIO; PEREZ PONCE DE LEON, GERARDO**

(DDO) Posgrado en Ciencias del Mar y Limnología, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Mexico, D.F. and Laboratorio de Biología Acuática, Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, Edificio "R" planta Baja, Ciudad Universitaria, Morelia, México; (DVI) Museo Nacional de Ciencias Naturales, Jose Gutierrez Abascal 2. 28006, Madrid, España; (PPG) Instituto de Biología, Universidad Nacional Autónoma de México, Ciudad Universitaria, Mexico, D.F.

Historical biogeography of the Goodeidae (Osteichthyes: Cyprinodontiformes) in the Mesa Central of Mexico

The Goodeidae is a family of cyprinodontiforms that includes 20 genera and about 42 species distributed from the South-Western USA, to the Mexican highlands, reaching the Balsas and Panuco river basins in the Pacific and Atlantic slopes in Mexico. The Mesa Central of Mexico has the highest number of goodeid species. This region is characterized by an extensive volcanic and tectonic activity starting since the early Miocene, resulting in a complex surface configuration. Goodeids are particularly useful for testing paleohydrological and biogeographically hypothesis regarding the Mexican Plateau because: 1) limited dispersal capabilities, 2) Miocene origin 3) wide distribution range across the Mexican Plateau, and 4) high diversity. Using a molecular phylogenetic analysis (with cytochrome b genes) of the goodeidae as a framework, here we present patterns of historical biography incorporating information from the geological and hydrological history, as well as the dates when those events occurred. In addition, an analysis of endemism is presented using Parsimony Analysis of Endemism (PAE). Ancestors of the Goodeidae might have been originated in the middle Miocene and it was in the Pliocene when they presented their highest diversification during a dry period which caused basin splitting in the Mesa Central of Mexico. There is a close association among the tectonic and volcanic events in this region of the country and the history of diversification of this group of fishes, resulting in high levels of endemism.

*** DOMINGUEZ DOMINGUEZ, OMAR; ESCALERA VAZQUEZ, LUIS HUMBERTO**

(DDO) Posgrado en Ciencias del Mar y Limnología, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D.F. and Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, Edificio R planta Baja, Ciudad Universitaria, Morelia, Michoacán, México; (EVLH) Facultad de Biología, Universidad Michoacana de San Nicolás de Hidalgo, Edificio R planta Baja, Ciudad Universitaria, Morelia, Michoacán, México

Biology and conservation of Mexican Goodeids

Mexico has a wide variety of freshwater ecosystems. Combination of complex geological and zoogeographic histories and the diversity of freshwater ecosystems have resulted in high

aquatic species richness and endemism. Unfortunately, aquatic ecosystems are heavily impacted systems in the country. Water pollution, reductions in groundwater, basin deforestation and exotic species introduction, are some causes that degraded aquatic ecosystems. Conservation and restoration of these systems and the organisms that inhabit them are urgent. Improvements must be made in the decision-making process related to social-ecological systems, so that accelerated degradation processes can be stopped. Among the endemic fishes of Mexico, members of the subfamily Goodeinae (Goodeidae) are of particular importance. Include 19 genera and about 40 species of fishes, distributed throughout the Mexican highlands. They have a high biological and ecological value, but they have a low economic importance. Consequently, the group has been largely ignored in conservation efforts, and some species have been driven to extinction. In contrast to this, goodeids have for years been chosen by national and international researchers as particularly suitable models to test palaeohydrological hypothesis regarding the Mexican Plateau. To investigate topics in evolutionary biology such as the evolution of viviparity and the utility of characters associated to reproduction. Two different life histories are present in Goodeidae. Goodeinae species (endemics from the Mesa Central of Mexico) present internal fertilization, viviparity and matrotrophy, whereas those of the Empetrichthyinae are characterised by external fertilization, oviparity and lecithotrophy. In addition, international aquarists have given these species enormous attention and have been breeding these species for decades. Species such as *Skiffia francesae* and *Zoogoneticus tequila*, now extinct in nature, have been maintained ex-situ for over 20 years and have now been returned to Mexico in large part thanks to the aquarists efforts.

*** DONASCIMIENTO, CARLOS; PROVENZANO, FRANCISCO**

(CD) Museo de Historia Natural La Salle, Fundación La Salle de Ciencias Naturales, Av. Boyacá con Maripérez, Apdo. 1930, Caracas 1010-A, Venezuela; (FP) Instituto de Zoología Tropical, Facultad de Ciencias, Universidad Central de Venezuela, Av. Los Ilustres, Los Chaguaramos, Apdo. 47058, Caracas 1041-A, Venezuela

New trichomycterid catfishes (Otophysi, Siluriformes) from the Venezuelan Guyana Shield

As part of a survey on the diversity of the Family Trichomycteridae in Venezuela, several specimens collected in two different tributaries of the Caroní River, Venezuelan Guyana Shield, previously identified as *Trichomycterus* sp. were analyzed. The results show that specimens fit into two different species, one for each tributary, and they do not match with any of the described species of the genus *Trichomycterus*. Additionally some characters of the external morphology do not support the generic allocation. Specimens resemble superficially species of *Trichomycterus*, but two characters are unique for the two new species: a pair of small fleshy outgrowths on the base of the rictal barbel and a labial fold in the upper lip, anterior to a naked area forming a band, preceding the premaxillary patch of teeth. A set of putative plesiomorphic traits that in combination are unique into trichomycterids are also distinctive for this genus: an anteriorly elongated expansion of the interopercular patch of odontodes, more than nine rays in the pectoral fin, a relative anterior position of the dorsal fin (55-63% SL) and caudal fin bilobed. The two new species are very different from one another, differing in the presence or absence of opercular odontodes as well as coloration patterns.

*** DOODY, J. SEAN; STEER, DAVID W.**

Applied Ecology Research Group, University of Canberra, ACT 2601, Australia

Can daily timing of nesting in turtles be explained by daily activity patterns?

Daily timing of nesting in turtles (e.g., diurnal vs. nocturnal vs. crepuscular) is highly variable among and within families. Can we explain this variation? A parsimonious but yet-untested hypothesis is that daily activity patterns explain daily timing of nesting. We tested this hypothesis by examining published nesting and activity data for a large number of the world's turtle species. We also searched for patterns underpinning this relationship, such as biases due to phylogeny, nesting habitat, and nest predation. We offer alternative hypotheses for the evolution of daily timing of nesting in turtles.

DOOLEY, JAMES K.

Adelphi University, Dept. Biology, South Avenue, Garden City, New York 11530, USA

Status of the western South Atlantic tilefish "Batata" (*Lopholatilus villarii*, Miranda-Ribeiro, 1915) compared to the "Great Northern tilefish" (*L. chamaeleonticeps*, 1879) of the western North Atlantic

Little is known of the life history and population dynamics of the "Batata" tilefish of Brazil although more than 1,000 metric tons (mt) are landed per year. The fish is also exported to cities as far away as New York, NY, USA. Catches according to FAO statistics have exhibited a 10-year cycle similar to *L. chamaeleonticeps* of the western North Atlantic. Landings for *L. villarii* have ranged from 30 to 1,500 mt/yr since 1950, while *L. chamaeleonticeps* have fluctuated from 30 to nearly 4,000mt/yr over the same period. These cycles indicate a limited population vulnerable to natural and fishing mortalities. The specific habitat requirements (150-400m depths; mud-clay bottom for cave construction) and complex life history known for *L. chamaeleonticeps* are also probably similarly limiting for stocks of *L. villarii*. Fishery conservation measures have been recently instituted (2001) for *L. chamaeleonticeps*, and should be considered for stocks of *L. villarii*. First, fishery and life history studies need to be undertaken in order to eventually manage this valuable Brazilian marine resource.

*** DORCAS, MICHAEL E.; TUBERVILLE, TRACEY D.; WILLSON, JOHN D.; GIBBONS, J. WHITFIELD**

(MED) Davidson College, Department of Biology, Davidson, NC 28035-7118, USA; (TDT, JDW, JWG) Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, USA

Evaluating amphibian and reptile diversity: herpetological inventories of the Southeast Coastal Network National Parks

The Southeast is the stronghold of amphibians and reptiles in North America. Of the more than 450 species of reptiles and amphibians native to the United States, approximately half occur in the Southeast and about 20% are endemic. However, few areas have been inventoried, thus hampering efforts to monitor and protect populations. Additionally, determining when an inventory is complete is difficult due to the clandestine nature of most amphibians and reptiles and the skill and techniques used by investigators. We conducted 2-year herpetological inventories of 16 parks within the National Park Service Southeast Coastal Network. We developed lists of expected amphibian and reptile species based on published range maps. We

then predicted numbers of those species occurring in the parks based on park size, habitat diversity, and degree of isolation. To document species occurrences, we used historical data from museums and other reliable sources and then sampled amphibians and reptiles using a wide variety of sampling techniques. Thus far, we have documented 1800 records comprising 98 species from the 16 parks. We use data from other protected areas with relatively complete herpetological inventories to develop and test our predictive model. Our approach provides a possible method of estimating and then documenting the diversities of amphibians and reptiles occurring in national parks and other protected areas.

*** DOUGLAS, MARLIS R.; DOUGLAS, MICHAEL E.; SCHUETT, GORDON W.**
(MRD, MED) Dept. Fishery and Wildlife Biology, Colorado State University, Ft. Collins, 80523-11474, USA; (GWS) Curator of Herpetology, Dept. Herpetology, Zoo Atlanta, 800 Cherokee Av. SE., Atlanta, GA 30315-1440, USA, and Dept. Biology, Georgia State University, Atlanta

Phylogeography of the Arizona Black Rattlesnake, *Crotalus cerberus*

The Arizona Black Rattlesnake (*Crotalus viridis cerberus*) was originally described as a variant of *Caudisoma lucifer* by Coues in 1875. In 1949, Klauber subsumed it as a subspecies of the *Crotalus viridis* complex, where it remained taxonomically stable for 53 years. In 2002, Douglas et al. elevated *C. viridis cerberus* to specific status, based upon an extensive molecular phylogeny of the entire *C. viridis* complex. *Crotalus cerberus* ranges from chaparral (circa 1000 meters asl) to pine forest (circa 3000 meters asl), and is frequently found on isolated mountains (i.e., sky islands) in southern and eastern Arizona. It is the only species of rattlesnake endemic to Arizona (its range extends slightly into extreme western New Mexico), and it could justifiably be considered the state rattlesnake of Arizona. Given the variety of habitats occupied by this species, and its potential for isolation, an evaluation of its molecular biodiversity is warranted. This was accomplished by sequencing 840 base pairs of the mtDNA ATPase 8 and 6 genes sampled from 60 specimens collected range-wide. The tree was rooted with *Agkistrodon* and subsequently explored using Bayesian analysis. *Crotalus cerberus* is divided into four clades: a western/ north-central Arizona clade encompasses the southern aspect of the Colorado Plateau. A central Arizona clade is localized in along the breakdown of the Mogollon Rim (i.e., the old Plateau margin). A third clade extends southward into the southern sky islands. A fourth clade, basal to these, includes only individuals from western New Mexico. This suggests that evolution of *C. cerberus*, and thus the entire *C. viridis* complex, was clearly along a southern trajectory from east-to-west, with the Gila River drainage serving as the probable westward conduit.

*** DOUGLAS, MICHAEL E.; DOUGLAS, MARLIS R.; SCHUETT, GORDON W.; BECK, DANIEL D.; SULLIVAN, BRIAN K.**
(MED, MRD) Department of Fishery and Wildlife Biology, Colorado State University, Ft. Collins, CO 80523-1474 USA; (GWS) Dept. Herpetology, Zoo Atlanta, 800 Cherokee Av. SE. Atlanta, GA 30315-1440, USA, and Dept. Biology, Georgia State University, Atlanta; (DDB) Department of Biological Sciences, Central Washington University, Ellensburg, WA 98926, USA; (BKS) Department of Life Sciences, Arizona State University West, 4701 W. Thunderbird Road, P.O. Box 37100, Phoenix, Arizona 85069-7100, USA

Molecular biodiversity of Helodermatidae (Reptilia, Squamata)

The Helodermatidae, a broad-ranging, monophyletic and venomous clade of lizards, consists of a single genus (*Heloderma*) diagnosed by the presence of bead-like osteoderms on the dorsal

surfaces of head, limbs, body and tail. The genus is comprised of two species. *Heloderma suspectum* (Gila Monster) ranges from the Mojave Desert of extreme southern NV, southwestern UT, southeastern CA and northwestern AZ, throughout the Sonoran Desert region of Arizona and Sonora, México (exclusive of Baja California), and into the Chihuahuan Desert of southeastern AZ/ southwestern NM. Two subspecies are recognized: *H. s. suspectum* (Reticulate Gila Monster, in the southern part of the range) and *H. s. cinctum* (Banded Gila Monster, northern part of the range). *Heloderma horridum* (Méxican Beaded Lizard) is distributed from sea level to 1600 m along the Pacific foothills from southern Sonora to Chiapas, along Pacific drainages in southern Guatemala, and in two Atlantic drainages of Chiapas and eastern Guatemala. Four subspecies are recognized: *H. h. alvarezii* (central Chiapas, México to extreme western Guatemala), *H. h. charlesbogerti* (eastern Guatemala), *H. h. exasperatum* (southern Sonora, northern Sinaloa), and *H. h. horridum* (western México). We examined the molecular diversity within the Helodermatidae by sequencing 840 bp of two mtDNA genes (ATP 8 and 6), from 50 *H. horridum* and 87 *H. suspectum* sampled across their respective ranges. The tree was rooted with *Elgaria* (Anguidae) and explored using Bayesian analysis. Both species are monophyletic and clearly diagnosable, but genetic diversity within *H. suspectum* is significantly reduced when compared to that found in *H. horridum*. Furthermore, our morphological, biogeographical, and mtDNA analyses provide no basis for recognizing either of the two *H. suspectum* subspecies. However, the observed mtDNA variation in *H. horridum*, while congruent with current taxonomy, questions whether these clades should instead be recognized at the specific level.

*** DOWNES, SHARON J.; BAUWENS, DIRK**

(SJD) School of Botany and Zoology, Australian National University, Canberra, ACT, 0200, Australia;
(DB) Institute of Nature Conservation, Kliniekstraat 25, B-1070 Brussel, Belgium

How do first encounters between dyads affect the formation of social relations in lacertid lizards?

We used an experimental approach on pairs of conspecific newborn lacertid lizards (*Podarcis sicula* and *P. melisellensis*) to examine the association between the outcome of first social encounters and the formation of social relations during the ensuing several weeks. Differential expression of behaviour between paired lizards was examined by calculating the difference between the individual values for the two lizards in a pair. During brief first encounters both the direction and magnitude of contrasts in basking time paralleled that of the contrasts in aggression score, which strongly suggests that access to a localized basking site was determined by agonistic interactions between lizards. Cohabitation of two lizards during prolonged encounters resulted in an increased divergence of their growth rates; this variation was not a continuation of divergences that existed when they were housed alone. Furthermore, differences in growth rate between paired individuals mirrored differences in thermal habitat usage when they cohabited during the prolonged encounters, but not when they were housed alone. The direction and magnitude of the interactions exhibited during the first social encounter between two lizards affected differences in thermal habitat use and divergence in growth rates during prolonged encounters. Moreover, during prolonged encounters differences between two cohabiting lizards in social interactions, thermal habitat use and growth rate parallel differences exhibited when lizards were housed alone. These results demonstrate that the formation of social relations between pairs of lizards may be largely influenced by the outcome of first social encounters. They further suggest that it may be possible to predict the behaviour of pairs of lizards during prolonged encounters based on variation in the differential expression of traits between two lizards housed in isolation.

DRYMON, J. MARCUS

College of Charleston, Grice Marine Laboratory, Charleston, SC, 29412, USA

Age, growth and maturation of the finetooth shark, *Carcharhinus isodon*, in southeastern U.S. waters: a preliminary report

The life history of finetooth sharks, *Carcharhinus isodon*, in the coastal waters off South Carolina was studied by determining age, growth and size at maturity. Finetooth sharks were collected from the near shore and estuarine waters of South Carolina from April 2002 through April 2003. Cervical vertebrae were extracted from 111 finetooth sharks (49 males and 62 females), ranging in size from 380 to 1262mm FL, and were prepared for age analysis using standard techniques. The annual periodicity of growth band formation was partially verified using marginal increment analysis. Sex specific von Bertalanffy growth models were generated using observed and back calculated data. To determine size and age at which 50% of the population is mature a logistic model was fitted to binomial maturity data using least squares non-linear regression. Females were considered mature if gravid or contained eggs larger than 26 mm in diameter, or when the oviducal gland was 20 mm or greater. Calcification of claspers, ability of claspers to rotate anteriorly, ability of siphon sac to inflate, and the ability of rhipidion to open freely were noted to assess maturity in males. There is a growing body of evidence which indicates that regional differences in important life history characteristics exist within shark species. As a result, the future direction of this study is to compare the life histories of finetooth sharks in the western North Atlantic and the Gulf of Mexico.

*** DUARTE, JOAO A.M.; ANDRADE, PAULO C.M.; DA COSTA, FRANCIMARA S.; OLIVEIRA, PAULO H.G.; DA COSTA, PEDRO M.; CANTO, SONIA L.O.; MONJELÓ, LUIS A.**

UFAM – Departamento de Ciências Biológicas e Ciências Agrárias, Universidade Federal do Amazonas, Laboratório de Animais Silvestres, Av. Gal. Rodrigo Otavio Jordao Ramos, 3000-Aleixo, CEP 67000-000, Manaus, Amazonas, Brazil

Effects of dietary levels of energy, installations and density in amazon chelonians freshwater (*Podocnemis* sp.) in captivity

Amazonas possesses the biggest number of turtle farms in Brazil. It was objectified to evaluate the effect of levels of gross energy (3500, 4000 and 4500 kcal of EB/kg) in rations, types of installations (wooden circular nursery with earthen floor, tank-net without and with plastic covering) and captivity density (12, 25 and 37 animal/m²) in the development of fingerlings of *Podocnemis expansa*. During 422 days, 360 fingerlings of 3 months of age with 45.66 ± 3.63 g had been used in nursery type tank-net, divided in 18 pen of 1m³, 50% covers with screens and 50% with plastic type greenhouse. Others 350 fingerlings had been lodged in wooden circular nursery (16 m²) in excavated tank. The treatments had been distributed in randomized complete design, factorial arrangements 3X2X3 (3 levels of GE, 2 installations with and without greenhouse, 3 densities). It did not have differences of the temperature of the water between pen without and with greenhouse ($31.05 \pm 0.81^\circ\text{C}$ versus $30.52 \pm 0.90^\circ\text{C}$), however, pen with greenhouse possess, respectively, more constant temperatures and bigger humidity (76.25%). Of the analyzed variables, length, width and height of carapace and final weight had not had significant differences between the treatments. Animals created in tank-net with greenhouse have a trend to represent greater weight gain (1.25 ± 0.47 g/day versus 1.18 ± 0.29 g/day). Chelonians lodged in tank-net (weight = 810.87 ± 141.80 g and WG = 1.22 ± 0.65) had presented similar performance to the servant in circular nursery of earthen floor (weight = 754.71 ± 202.38 g and WG = 1.2 ± 0.87 g/day). Significant difference of WG between the different densities does

not exist ($D_{12} = 1.20 \pm 0.39$ g/day versus $D_{25} = 1.22 \pm 0.10$ g/day versus $D_{37} = 1.21 \pm 0.11$ g/day). Turtles that had received a ration with 4500 kcal from GE/kg had had a trend to represent greater WG (1.33 ± 0.33 g/day) of that the ones that they had received 3500 and 4000 kcal, respectively (1.22 ± 0.44 and 1.10 ± 0.42 g/day).

DUELLMAN, WILLIAM E.

Natural History Museum, University of Kansas, Lawrence, Kansas, 66045, USA

Resource utilization by an anuran community in Amazonian Peru

Cusco Amazonico, a site in lowland rainforest in the Departamento de Madre de Dios in southeastern Peru has a known anuran fauna of 67 species represented by 8086 records. Resource utilization was determined from data on diel activity, habitat, microhabitat, foraging more, prey, and mass. Cluster analysis revealed 11 guilds, ranging from diurnal, terrestrial anurans (5 species) and nocturnal, terrestrial anurans feeding on vertebrates (1 species) to nocturnal, terrestrial anurans feeding primarily on ants (6 species) to nocturnal, arboreal anurans feeding primarily on orthopterans (23 species). The greatest percentage of individuals is in the two nocturnal, arboreal guilds, whereas the greatest percentage of mass is in the terrestrial, nocturnal and arboreal nocturnal guild feeding primarily on orthopterans. Of the 62 nocturnal anurans, two are aquatic, 18 are terrestrial, and 42 are arboreal. Most species are sit-and-wait feeding strategists, but three diurnal, terrestrial dendrobatids are active foragers. A significant correlation exists between anuran gape and prey size, but many large anurans feed on small, as well as, large prey. Ants occur in the diets of 50 species, and several species are ant specialists; these include one bufonid, one hylid, and four microhylids. Two species are termite specialists, and one feeds primarily on moths. Comparison of diurnal, terrestrial anurans and lizards shows that of anurans and lizards having the same gapes, lizards tend to eat larger prey; also, these anurans feed primarily on ants, which constitute a small part of the diets of the lizards.

DUGO, MARK A.

University of Southern Mississippi, Department of Biological Sciences, Hattiesburg, MS, 39406-5018, USA

Fine-scale population structure of Gulf sturgeon, *Acipenser oxyrinchus desotoi*, in the Pascagoula River drainage, Mississippi

Previous range-wide genetic surveys of the imperiled Gulf sturgeon, *Acipenser oxyrinchus desotoi*, have reported population structure across their range along the north-central coast of the Gulf of Mexico. Radio-telemetry and capture-recapture data within the Pascagoula River drainage, Mississippi, U.S.A, highlight features of Gulf sturgeon movement with potential implications for genetic structure in this anadromous species. Noteworthy observations include: 1) philopatry to a verified spawning site in the Bouie River, 250 river km upstream from the mouth of the Pascagoula River drainage, 2) springtime movement into the upper Chickasawhay River, (338-370 rkm from the Bouie River), and 3) the utilization of the Pascagoula River summer holding area, 40-60.5 rkm above the mouth of the drainage. To address questions of fine-scale population structure within the Pascagoula drainage, sturgeon from the Bouie River spawning site, the Pascagoula holding area, and individuals captured in summer holding areas of adjacent drainages (Pearl, Escambia, Yellow, Choctawhatchee, and Apalachicola) were genotyped using eight microsatellite loci. These data corroborate reports of moderate to strong levels of interdrainage structuring with significant F_{st} estimates for all drainage level

comparisons. Furthermore, assignment and self-classification tests indicate that the Pascagoula holding area is an admixture of sturgeon genetically assigned to the Bouie River spawning site, the Pearl River, and several Florida drainages. Interestingly, assignment scores of some individuals in the Pascagoula holding area suggest the presence of a spawning population within the drainage that is genetically distinct from the Bouie River population. Field observations lead to the hypothesis of a Chickasawhay River source population, although there is a lack of sufficient material to test this hypothesis directly. Conservation implications are two-fold. These genetic data support another spawning population in the Pascagoula drainage, and the Pascagoula River holding area is important for more than just fish natal to the Pascagoula River drainage.

DUNCAN, WALLICE P.; COSTA, OSCAR T. F.; * MARCON, JAYDIONE L.

(WPD) University of Norte, Av. Joaquim Nabuco 1232, Centro, Manaus, Amazonas Brazil; (OTFC, JLM) Federal University of Amazonas, Av. Gal. Rodrigo Octavio Jordao Ramos, 3000, Japiim, CEP 69077-000, Manaus, Amazonas, Brazil

Enzymes of energy metabolism in hatchlings of amazonian freshwater turtles

The energy metabolic profile in selected tissues was analyzed in hatchlings of the amazonian freshwater turtles: *Podocnemis expansa*, *P. unifilis* and *P. sextuberculata*. Metabolic design in these species was judged based on the key enzymes of energy metabolism, with special emphasis on carbohydrate, lipids, amino acids and ketone bodies metabolism. All species show a high glycolytic potential in all sampled tissues. As judged based on low levels of hexokinase, glycogen may be an important fuel for these species. The high lactate dehydrogenase activity in the liver may play a significant metabolic role on carbohydrate catabolism, possibly during diving. Oxidative metabolism in *P. sextuberculata* appears to be designed for the use of lipids, amino acids and ketone bodies. The maximal activities of 3-hydroxyacyl-CoA dehydrogenase, malate dehydrogenase, glutamine dehydrogenase, alanine aminotransferase and succinyl-CoA keto transferase display high aerobic potential, especially in muscle and liver tissue. Animal protein is an important content of diet in wild *P. sextuberculata*. Therefore, amino acids and ketone bodies may be critical for the oxidative metabolism. On the other hand, *P. expansa* and *P. unifilis* show minor dependence for amino acid and ketone bodies, indicating that carbohydrate and lipid are the major fuels for these species. Our results are consistent with food habits and life-style of amazonian freshwater turtles. The metabolic design, based on enzyme activities, suggests that *P. unifilis* and *P. expansa* are predominately herbivorous, while *P. sextuberculata* rely on dietary protein animal or a mixed diet of animal matter and vegetation.

*** DUONG, CINDY A.; POWERS, AMANDA; DICKSON, KATHRYN A.**

California State University, Fullerton, Department of Biological Science, 800 N. State College, Fullerton, CA 92834, USA

The contribution of mitochondrial proton leak to heat production in lamnid sharks

Endothermic fishes can elevate the temperature of certain tissues above water temperature through adaptations in the circulatory system (counter-current heat exchangers) that conserve metabolically generated heat. Although adaptations for heat retention in endothermic fishes have been well studied, sources of heat production in endothermic tissues are not well understood. Proton leak is an intrinsic, non-enzymatic property of the inner mitochondrial membrane that may serve as a heat source in endothermic fishes. This study involves comparing mitochondrial proton leak rates of two endothermic tissues in the short-fin mako

shark (*Isurus oxyrinchus*): red muscle and liver. The rate of proton leak across the mitochondrial membrane is a non-linear function of membrane potential and is measured by titration of respiration rate with inhibitors of the electron transport chain. The respiration rate and membrane potential in isolated mitochondria was measured simultaneously using a Clark-type polarographic oxygen electrode and a lipophilic probe (TPMP+), respectively. Based on preliminary measurements, mitochondrial proton leak rates are similar in the red muscle and liver of the mako shark. Ongoing experiments include measuring mitochondrial proton leak rates of red muscle and liver in ectothermic sharks for a comparative study, as well as determining mitochondrial densities of these endothermic tissues.

*** DURTSCHKE, RICHARD D.; ROBERTSON, MARY; BENDELE, KATHARINE A.**
Northern Kentucky University, Dept. Biological Sciences, Highland Heights, KY, 41099, USA

Effects of gut nematodes on the digestive efficiency of the omnivorous teiid lizard, *Cnemidophorus murinus*

The consumption of plant material is rare among lizards with only 3% or about 90 species that use plants in their diets. The completely herbivorous lizards (i.e., Iguaninae) acquire energetics through hindgut fermentation with an enlarged partitioned colon for cellulose breakdown. These colons are often packed with nematode worms that have been suggested to play some role in the breakdown of plant tissue. Omnivorous lizards may use plants as a supplemental food source if prey are not abundant, or may consume plants as a staple part of the diet if under nutritional constraints. Some of these omnivorous species also possess enlarged colons (though not partitioned), and many are found with large quantities of gut nematodes. The role of gut nematodes has been speculated, but no tests have been made on their role in plant fiber digestion or their effect on assimilation efficiencies in lizards. We conducted feeding experiments with the omnivorous teiid lizard *Cnemidophorus murinus* after we had dewormed half of the study group with Fenbendazole (an anthelmintic drug targeting nematodes). We feed both wormed and dewormed lizards a high fiber (25.9%) guinea pig chow food for 3 weeks and collected their fecal material. Initiation and conclusion of the experiment was marked with food containing fluorescent polyacrylic bead powder. Oven dried food and fecal samples were then analyzed for assimilation efficiencies. Tests were made for Neutral Detergent Fiber (NDF), calorimetric values, Kjeldahl protein content, and a variety of macromineral components. Deworming the lizards did not have a significant effect on their ability to digest plant fiber, with lizards assimilating close to 50% of the fiber in each test group. Similar nonsignificance was seen in energetic assimilation with both groups assimilating approximately 80% of the caloric content.

EBERT, DAVID A.

Pacific Shark Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Rd., Moss Landing, CA, 95039, USA

Reproductive biology and habitat utilization of skates along the eastern Bering Sea continental slope

The reproductive biology and habitat utilization of skates collected along the eastern Bering Sea continental slope was studied (EBSCS). Data were collected during a National Marine Fisheries Service (NMFS) exploratory research cruise along the EBSCS during June-July 2002. A total of 1,330 specimens comprised of nine species were examined for reproductive information. The survey area extended the length of the EBSCS from northwest of Unalaska Island (55° 95'N, 168°

92°W) to the southern Navrin Canyon (60° 16'N, 179° 68'W) in waters ranging from 209 to 1,556 m deep. The survey area was divided into two strata types, one by area and another by depth. The EBSCS can be characterized by three distinct habitats; a broad, gentle, sloping area referred to as shelf habitat, areas bisected by submarine canyons referred to as canyon habitat, and areas of steep profile referred to as slope habitat. Skates are an important component of the demersal fish community along the EBSCS and are commonly caught in groundfish fisheries. Despite the abundance and diversity of skates in this region very little is known about their basic life history and ecology. The results presented are part of an ongoing, broad-based, study of the demersal chondrichthyan fauna in the eastern North Pacific and Bering Sea.

EDEN, CHRISTOPHER J.; DUOBINIS-GRAY, LEON; * WHITEMAN, HOWARD H.
(CJE, LD, HHW) Department of Biological Sciences, Murray State University, Murray, KY 42071 USA; (CJE, HHW) Rocky Mountain Biological Laboratory, P.O. Box 519, Crested Butte, CO 81224, USA

A skeletochronological assessment of alternative life histories in tiger salamanders, *Ambystoma tigrinum nebulosum*

Facultative paedomorphosis in salamanders is a complex phenomenon resulting in two distinct morphs. Environmental conditions affect the growth of salamander larvae, resulting in either terrestrial, metamorphic adults or aquatic, paedomorphic adults. Although the occurrence of this salamander dimorphism has been well documented, the mechanisms that maintain coexistence of the two morphs are not well understood. The focus of this study was to test three hypotheses for the maintenance of facultative paedomorphosis in the tiger salamander, *Ambystoma tigrinum nebulosum*. These ecological hypotheses predict the effects of dimorphism on various fitness components, such as body size, survivorship, age at maturity, and longevity. Skeletochronology was used to assess the age of 270 individuals that were initially sampled during 1990-1991. Age was determined by counting the number of lines of arrested growth (LAG) in cross-sections taken from phalanges. By combining age with previously collected data such as morph, snout-vent length (SVL), and mass, the fitness of each morph was assessed. The implications of these results in regard to the hypotheses will be discussed.

*** EDWARDS, TAYLOR; SCHWALBE, CECIL R.; SWANN, DON E.; GOLDBERG, CAREN S.**

(TE, CRS, CG) School of Renewable Natural Resources, University of Arizona, 125 Biological Sciences East, Tucson, AZ 85721 (CRS) U.S. Geological Survey, Western Ecological Research Center, University of Arizona, Tucson, AZ 85721 (DES) Saguaro National Park, 3693 S. Old Spanish Trail, Tucson, AZ 85730

Conservation genetics of the Sonoran desert tortoise, *Gopherus agassizii*

The desert tortoise, *Gopherus agassizii*, inhabits the Mojave and Sonoran Deserts of North America. Desert tortoises face many threats to their continued survival, including habitat loss and fragmentation. In the Sonoran Desert, tortoises are found in rocky foothills surrounded by low desert valleys. Concern has arisen that habitat fragmentation due to anthropogenic landscape changes may hinder the ability of tortoises to make cross-valley movements. We collected samples from 170 individuals in 9 populations in southern Arizona. To assess historic rates of gene flow, we determined the amount of genetic variability within and among tortoise populations. We analyzed mitochondrial DNA sequences and developed 6 novel microsatellite markers. Our estimates show little genetic differentiation among populations, indicating that

gene flow occurred historically among Sonoran Desert populations. In addition, we used radiotelemetry to document an inter-population movement made by a desert tortoise and conclude that the urban topography of the modern landscape makes such emigration events virtually impossible. Data indicate that Sonoran desert tortoise effective population sizes are small and that dispersal events probably play an important role in the long-term maintenance of populations. Life history traits of the desert tortoise, a long-lived species with delayed sexual maturity, suggest that there are severe constraints on the ability of small populations to respond to chronic disturbances. The high level of gene flow we detected among populations suggests that if a population were to experience a catastrophic decline, its recovery may rely heavily on the immigration of new individuals from adjacent mountain ranges to repopulate it. This has broad implications for the long-term survival of this species.

*** EISEMBERG, CARLA C.; BERTOLUCI, JAIME**

Laboratório de Herpetologia, Departamento de Zoologia, Universidade Federal de Minas Gerais, Caixa Postal 486, CEP 31.270-901, Belo Horizonte, MG, Brazil

Differences in fluctuating asymmetry in stressed and nonstressed *Physalaemus cuvieri* (Leptodactylidae) from Southeastern Brazil

To assess the impact of environmental stress on amphibian populations we examine fluctuating asymmetry (FA) in the leptodactylid frog *Physalaemus cuvieri*. Selected morphological characteristics (radio-ulna, femur, tibio-fibula, and foot length) of a stressed rainforest population were compared with those of two nonstressed (cerrado and riparian forest) populations in Southeastern Brazil. An analysis of these characters revealed a highly significant increase in asymmetry of foot length in the degraded area but no differences in the preserved areas. There was no significant difference among the three areas for FA in the other characters. These results confirm that FA measures can provide a sensitive system for monitoring stress effects in threatened ecosystems. The absence of significant FA in radio-ulna, femur, and tibio-fibula suggests that the bilateral symmetry in these structures is more important than in foot length for the survivorship of these animals.

ELIZALDE-HERNANDEZ, JOSE A.; * VILLAVICENCIO-GARAYZAR, CARLOS J.; SANDOVAL-CASTILLO, JONATHAN

UABCS, Lab. de Elasmobranchios, Carretera al sur km 5.5, La Paz, Baja California Sur, Mexico, 23000 A.P: 19B

Collapse of shark fishery in the Gulf of California, Mexico

During 1995 to 2002 we visited two fishing camps in the Gulf of California, Mexico: San Francisquito and El Barril, B.C., there, elasmobranch fishery is artisanal; fishermen use 22ft vessels, drift-gillnets (10-12in sms) for big sharks, and bottom-gillnets (6in sms) for small sharks, skates and rays. We observed elasmobranch catch composition. Shark's CPUE was calculated based on landing registries of June and July 1991, 1994 and 2002. We also did a census in a carcasses' waste ground to compare with catch composition. Main organisms caught with drift-gillnets were individuals of families: Charcharhinidae, Sphyrnidae and Alopiidae. *Rhinobatos productus* and *Mustelus californicus* were the main species caught with bottom-gillnets. Although the Gulf of California is an important shark congregation area to mate and as nursery, due to overfishing, results show a decreasing tendency of CPUE, reaching a collapse in July 2002, when companies had to stop fishing in the middle of the season.

*** ELLIS, JULIA K.; MUSICK, JOHN A.**

Department of Fisheries Science, Virginia Institute of Marine Science, College of William and Mary,
Gloucester Point, VA 23062, USA

The diet of the sandbar shark, *Carcharhinus plumbeus*, in Chesapeake Bay and adjacent waters

Chesapeake Bay, USA and the barrier islands of Virginia's Eastern Shore are important nursery grounds for the northwest Atlantic population of the sandbar shark *Carcharhinus plumbeus* (Carcharhinidae). The abundance of species in the Bay during the summer months (May through October) provides a diversity of prey items for both neonates and returning juveniles. The sandbar shark's role as a predator in the summer food web of Virginia coastal waters indirectly affects commercially important species, and monitoring its diet is an important component of ecosystem-based management. Previous studies of sandbar shark diet have encompassed very small study areas (Chincoteague Bay, VA, USA) and very large areas (from Georges Bank to Cape Hatteras). This study has characterized the diet of *C. plumbeus* in the Chesapeake Bay, Virginia, as well as the adjacent waters Virginia's Eastern Shore, highlighting differences in diet within various portions of the nursery area, as well as ontogenetic changes in diet. Stomach samples were obtained in 2001 and 2002 from 234 sharks caught in gillnets or by longline gear. These data were analyzed using standard diet indices of frequency of occurrence, number, and weight for each prey type. Historical data from the Virginia Institute of Marine Science (VIMS) Shark Ecology program were also analyzed. Ontogenetic changes in diet were evident, with crustacean prey decreasing in importance and frequency with increasing shark size, and elasmobranch prey importance and frequency increasing with increasing shark size. While previous research in Chincoteague Bay, VA showed the blue crab, *Callinectes sapidus*, as the dominant crustacean in sandbar shark diet, the mantis shrimp, *Squilla empusa*, dominated the crustacean portion of the diet in this study.

EMBERT, DIRK

Zoologisches Forschungsinstitut und Museum Alexander Koenig, Sektion Herpetologie, Adenauerallee
160 53113 Bonn Germany

Distribution and conservation status of the genus *Chironius* in Bolivia

The genus *Chironius* is one of the most species rich snake genus in Bolivia. Until now eight species have been reported for the country. A taxonomic revision for all taxa occurring in Bolivia is presented. This formed the basis to receive the necessary information about distribution and diversity pattern which are part of a new methodology to determine the conservation status of each species. Here first results of this revision of the genus *Chironius* are shown, including first results about their conservation status with a short explanation of the methodology. Extrapolated distribution maps for Bolivia, based on collections and climatic data, as well as vegetation types and altitudes, are shown for most of the species of the genus.

*** ENDRISS, DEBORA A.; MCNULTY HAULTON, STACY**

(DAE) State University of New York, College of Environmental Science and Forestry, Dept. Environmental and Forest Biology, Syracuse, NY, 13210, USA; (SMH) State University of New York, College of Environmental Science and Forestry, Adirondack Ecological Center, Newcomb, NY, 12852, USA

Terrestrial salamander abundance and relationship to habitat type and environmental variables in the central Adirondack Mountains

Terrestrial salamanders are sensitive to disturbances and therefore are good indicators of ecosystem health and biodiversity, but differences in environmental variables such as temperature and soil moisture may affect salamander abundance at the soil surface. We monitored terrestrial salamanders at Huntington Wildlife Forest in the central Adirondack Mountains of New York. We checked 32 sets of artificial cover objects (ACOs) in 5 habitat types, 5-7 times per year, from May to October 1998 to 2001. Total daily precipitation and minimum and maximum daily temperature were recorded. We investigated the relationship between habitat type, climatic variables, and salamander abundance. Mean abundance (\pm SD) per ACO over all years and habitat types was 0.95 ± 1.15 for redback salamanders (*Plethodon cinereus*), 0.57 ± 1.08 for dusky salamanders (*Desmognathus fuscus* and *D. ochrophaeus*), 0.12 ± 0.42 for two-lined salamanders (*Eurycea bislineata*), and 0.10 ± 0.41 for red-spotted newts (*Notophthalmus viridescens*) (eft stage). There was no trend in abundance for any species over the four-year period. Redback abundance on HWF was higher in mixed hardwood/conifer wet sites, while deciduous wet sites had higher dusky abundance. Neither two-lined nor dusky salamanders were found in coniferous sites. Redbacks were less abundant as both maximum and minimum daily temperatures increased, whereas dusky salamanders were more abundant. Abundance of redbacks generally decreased from May- October, whereas duskys were most abundant during mid-summer. This may reflect selection of wetter microhabitats by duskys. Salamander abundance was also negatively related to precipitation on the day of sampling. Redback abundance under ACOs declined as precipitation increased during or in the days prior to sampling. When soil moisture increases after a rain event, terrestrial salamanders are likely to be foraging in the leaf litter and not under ACOs. Environmental variables and habitat type are important to terrestrial salamander distribution and abundance under artificial cover objects. Researchers should include the effects of these factors into interpretations of salamander abundance estimates.

ENGSTROM, TAG N.

Section of Evolution and Ecology, University of California, Davis, CA 95616, USA; (Present address) Dept Ecology and Evolution SUNY Stony Brook, Stony Brook NY, 11794, USA

Genetic estimates of migration among *Podocnemis unifilis* populations, in the Reserva Nacional Pacaya Samiria, Peru

The aquatic chelonian conservation project in the Reserva Nacional Pacaya Samiria (RNPS) has been very successful but operates in the absence of fundamental information on demographic and genetic interchange among protected populations. The use of traditional mark and recapture methods to gather direct estimates of these parameters would require decades of intense field studies. As a compliment to field studies, population genetics can provide powerful tools for understanding ecology of difficult to study animals. In this study I reconstruct patterns of migration among protected populations of *Podocnemis unifilis* in the three main river drainages of the RNPS using mitochondrial DNA sequence data from a total of total 468 turtles (22-50 individuals per population from ten populations). The level of genetic

diversity in the RNPS is very low with little geographic structure. Coalescence based estimates of migration among populations revealed a complicated pattern in which migration among most populations was extensive and migration between populations in different river systems was often higher than migration between populations within a river drainage. These results contrast with previous studies of *P. unifilis*, which have found extensive differentiation among local populations, and caution against using results from one area to plan conservation programs in another.

ENSUNCHO-MORALES, J.E.; UBARNES-CORONADO, G.M.; and * OLAYA-NIETO, C.W.

Universidad de Córdoba, Departamento de Acuicultura, Laboratorio de Investigación Biológico Pesquera (LIBP), AA 895, Montería, Colombia

Growth and mortality of the yellow mojarra *Caquetaia kraussii* in the Sinu river basin, Colombia

Growth and mortality parameters of the yellow mojarra *Caquetaia kraussii* were estimated based on length frequency data (ELEFAN) from January to December 2000. Total length (TL) in centimeter was measured. The class interval was of 0.5 cm. The estimated values for asymptotic length (L_{inf}), growth coefficient (K) and age at zero length (t_0) were 29.7 (± 0.13) cm TL, 0.26 (± 0.01) year⁻¹ and -0.65 years, respectively, with average environmental temperature taken as 28 °C and 95% confidence intervals. Average performance growth index (ϕ prime) was 2.36. Total mortality (Z) estimated was 1.09 (± 0.13) year⁻¹ with 95% of confidence intervals, natural mortality (M) 0.74 year⁻¹ and mortality by fishing (F) 0.35 year⁻¹ and the Exploitation rate ($E = F/Z$) 0.32. The mean length at first capture (L_c) was 1.9 cm TL, and the mean length in the catch 19.0 cm TL. In this work, 41.4% and 20.9% of the individuals were captured under the mean length at maturity estimated by the INPA. This species so has not been affected, as the reofilic fishes, by the introduced changes in the dynamics of the Sinú river because the construction and starting of the Urrá hydroelectric, reason by which its capture is stable, and his fishery is not as critical as of the reofilic fishes, then yellow mojarra is becoming replacement species for them. Nevertheless his fishery must be regulated in the medium term, considering that the yellow mojarra is the fifth species in commercial importance in the Sinú river basin.

ERISMAN, BRAD E.

Nearshore Marine Fish Research Program, Department of Biology, California State University, Northridge, CA 91330-8303, USA

Spawning behavior of the kelp bass, *Paralabrax clathratus*, from Santa Catalina Island, California, USA

The spawning behavior of the kelp bass, *Paralabrax clathratus*, was studied on Santa Catalina Island, California from 2000 to 2002. Behavioral observations were conducted at several sites near the marine reserve adjacent to the USC Wrigley Marine Science Center. In addition, an aggregation of 108 individuals was observed in a 700m³ outdoor, floating net-pen for more detailed descriptions of spawning behavior. Approximately 250 spawning events were observed over the entire study period. Adults formed aggregations that ranged in size from 30 to 200+ individuals. However, spawning occurred within smaller subgroups of 3 to 20+ individuals. Spawning groups consisted of a single, gravid female and several males. Adults were sexually dichromatic during the spawning season, with ripe males adopting bright orange snouts. Males and females also exhibited ephemeral color changes during courtship and

spawning periods. Spawning occurred between 1900-2130 hours and the onset was highly correlated with sunset. Both males and females were capable of spawning multiple times during a single evening. Spawning occurred on a daily basis from June through August 2002 and showed no significant relationship with the lunar cycle. The behavior patterns observed in the field were virtually identical to those observed in the captivity study. In general, the spawning behavior of kelp bass was consistent with other gonochoric, group-spawning serranids.

*** ESCOBAR-SÁNCHEZ, OFELIA; ABITIA-CÁRDENAS, L. ANDRÉS; GALVÁN-MAGAÑA, FELIPE**

Centro Interdisciplinario de Ciencias Marinas, Dept. Pesquerías y Biología Marina, Av. Instituto Politécnico Nacional s/n. Col. Playa de Santa Rita, La Paz, Baja California Sur, México

Trophic spectrum of Pacific angel shark *Squatina californica* in the southern Gulf of California, Mexico

During September 2000 to May 2002, shark stomach contents were sampled monthly in the southern Gulf of California, Mexico. The objective to our study is to know the spectrum trophic of Pacific angel shark, *Squatina californica*, and their variations by lengths and sex. We apply the Index of Relative Importance as a measure of trophic preferences. A total of 376 stomachs were examined, which 163 (43%) contained food and 213 (57%) were empty. The spectrum trophic was of 22 prey species, 14 fishes, 2 cephalopods and 5 crustaceans, corresponding to 12 family, 11 genus, and 14 species. According to the Index of Relative Importance, the most importance prey were the fishes (67%) and unidentified organic matter (11%), followed by benthic fishes, mainly Daisy Midshipman *Porichthys margaritatus* (6.2%), *Diplectrum* spp (4.1%) and the inotted lizardfishes *Synodus evermanni* (3.6%). The analysis of importance of each sex, indicated that females feed more on fishes and unidentified organic matter, representing 62.4% and 10.5% respectively. The fish *P. margaritatus* (10.9%), *Diplectrum* spp (6.8%), *S. evermanni* (1.8%) and rainbow cusk eel *Ophidion iris* (1.6%); while males, the rest of fishes contributed 71.4% of the food supply, the unidentified organic matter represented 88.3%, the peanut rock shrimp *Sicyonia penicillata* (8.5%), *Diplectrum* spp (5%) and lizardfish *S. evermanni* (3.3%). No significant differences were found in the gravimetric composition of prey species between sexes ($P > 0.05$).

*** ESPINOZA, ROBERT E.; DEAN-BRADLEY, K.; TRACY, C. RICHARD**

(REE) Department of Biology, California State University, Northridge, CA 91330-8303, USA; (KD-B) U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Building C, Fort Collins, CO 80526-8118, USA; (CRT) Biological Resources Research Center, University of Nevada, Reno, Reno, NV 89557, USA

Herbivory imposes constraints on the life-history strategies of reptiles

Extracting energy from plants is thought to be most challenging for small herbivores, especially neonates, because of their high energy needs and small guts. Herbivores could provide a digestive advantage to their offspring if they produced small clutches of large eggs. We tested this prediction for turtles (151 species) and lizards (176 species). Conventional analyses indicate that both herbivorous turtles and herbivorous lizards produce smaller clutches of larger eggs relative to nonherbivores. Clutch mass is not different among trophic groups of turtles, but is larger in herbivorous lizards. Nonherbivorous turtles produce larger clutches of smaller eggs with increasing latitude, but no such relationship exists for herbivorous turtles or for any trophic group of lizards. Phylogenetic analyses support the relationships between diet and

reproductive traits for lizards, but not for turtles. This disparity is attributed to the larger eggs and smaller clutches produced by omnivorous turtles. Hence, producing small clutches of large eggs may evolve prior to strict herbivory in turtles. Herbivory has evolved infrequently in reptiles, consequently, phylogenetic analyses are less likely to provide statistical support for trends observed in conventional analyses. Moreover, these life-history traits appear to be correlated with both phylogeny and diet, so phylogenetic analyses may conceal ecological trends. When considered concurrently, the relationships among these reproductive traits and herbivory from these two disparately related lineages of reptiles provide compelling evidence that herbivory affects the evolution of life-history traits. We hypothesize that herbivorous reptiles invest more in individual offspring (vs. offspring number) to provide their neonates with two advantages conferred by large body size: (1) lower mass-specific energy needs and (2) larger gut size.

ETEROVICK, PAULA C.

Pontifícia Universidade Católica de Minas Gerais, Programa de Pós-Graduação em Zoologia de Vertebrados, Av. Dom José Gaspar, 500, Prédio 41, Belo Horizonte, MG, 30535-610, Brasil

Distribution of anuran species among montane streams in southeastern Brazil

The composition of anuran assemblages was studied in 16 streams at the Serra do Cipó, southeastern Brazil, in which 26 anuran species were found. Volume and isolation level of stream sections of 150 m were estimated; tadpoles, adult anurans, and potential tadpole predators were searched for during 16 consecutive months. Stream size, isolation, richness and diversity of tadpole predators, and some additional physical and biotic variables were measured and related to anuran species richness. Smaller streams tended to shelter more anuran species than larger ones. Neither stream size nor stream isolation explained variations in anuran species richness. Anuran species richness tended to increase with tadpole predator diversity. Tadpole species richness was influenced by predator species richness, and was highest when there were seven types of tadpole predators present. The distribution of few anuran species could be clearly related to some physical and biotic variables. The behavioural flexibility of anurans and the similarity among streams may have contributed to this pattern.

*** ETEROVICK, PAULA C.; KALAPOTHAKIS, EVANGUEDES**

(PCE) Pontifícia Universidade Católica de Minas Gerais, Programa de Pós-Graduação em Zoologia de Vertebrados, Av. Dom José Gaspar, 500, Prédio 41, Belo Horizonte, MG, 30535-610, Brasil; (EK) Universidade Federal de Minas Gerais, ICB, Departamento de Farmacologia, Belo Horizonte, MG, 30161-970, Brasil

Isolation and characterization of microsatellite markers in populations of the frog *Hyla saxicola*

Hyla saxicola, a frog species endemic from the Espinhaço mountain chain and broadly distributed at the montane meadows of the Serra do Cipó (southeastern Brazil), was chosen as a model to start studying genetic variability in anuran populations from Brazilian montane meadows. A genomic library was constructed using DNA extracted from tadpoles. Four microsatellite regions were located through library screening using radiolabelled fish microsatellites. Two of these regions have been characterized and showed great variability (30 and 33 alleles, respectively, were found in 77 tadpoles from seven different streams), indicating that these loci are suitable for studies on population subdivision. Genetic similarity among

populations from different streams was not correlated to geographic distance at the spatial scale considered. It may be due to high migration levels or a small sample size.

FACHIN-TERAN, AUGUSTO

Universidade do Estado do Amazona, Escola Normal Superior, Avenida Darcy Vargas S/N. Bairro Chapada, CEP: 69050-020, Manaus, Amazonas, Brasil

Conserving turtles with native riverine community participation

Freshwater turtles of the genus *Podocnemis* have received special attention by the governing agencies of many countries during the last few decades, due to the reports of population declines and over exploitation throughout their distribution. This resource has been continually used by Amazonian communities for food, without their participation in plans for preserving the species; this is one of the principal problems for the recuperation of the populations of these turtles. The question is how to involve the participation of the consumers in the preservation of this resource. The Institute for the Sustainable Use of Mamiraua was founded in 1996, presenting an ideal format to test this type of activities, since in this reserve the people were not removed and they persist as consumers of the natural resources. In this reserve we have been monitoring the effects of protecting nesting beaches since 1996. Three beaches are protected in the Solimoes River, one in the Aranapu tributary, and another in the Japura River. *Podocnemis sextuberculata*, *P. unifilis* and *P. expansa* nest on these beaches. The greatest change in the number of nests of *P. sextuberculata* occurred at Horizonte beach on the Solimoes River. In 1998, we found 261 nests, in 1999 641, and in 2000 1008 nests. With the participation of the local communities we received the necessary political clout to facilitate our research and monitoring programs that promote the recuperation of populations of threatened species. But the activation of these programs is dependent on the approval and initiative of the community leaders. In conclusion it is possible to preserve turtles with the participation of the people who prey on them in the local communities.

*** FALLAHPOUR, KAMELIA; ESPINOZA, ROBERT E.**

California State University, Northridge, Department of Biology, Northridge, CA, 91330, USA

Frigid females frustrate flirtatious males: the role of breeding coloration in leopard lizards, *Gambelia wislizenii*

Female breeding coloration, although uncommon, is phylogenetically widespread in iguanian lizards and influences mate choice in both sexes. This coloration is exhibited during the breeding season, with mature females developing vibrant coloration (e.g., red or orange) over parts of their bodies. Here we report the first of a three-part study to determine the relationship between female breeding coloration and associated reproductive behaviors in long-nosed leopard lizards, *Gambelia wislizenii* (Iguania: Crotaphytidae). We tested three adaptive hypotheses for the role of bright-female coloration (1) sex recognition: breeding coloration is a signal to males to recognize females during the mating system; (2) aggressive avoidance: breeding coloration allows males to recognize gravid females; or (3) courtship rejection: females exhibiting breeding coloration advertise their receptiveness for fertilization. We observed courtship behaviors exhibited by leopard lizards when females lacked or possessed breeding coloration. Time-release hormones were implanted in lizards in January 2003. Male and female pairs were introduced into an arena and their behaviors were recorded. Males attempted to copulate with females regardless of female coloration and male behavior did not differ before and after the development of female breeding coloration. Females rejected copulation

regardless of their coloration. Our results suggest that (1) female coloration does not signal sex recognition, because males recognized females exhibiting or lacking the coloration; (2) the coloration may not be a signal of courtship rejection because females rejected male advances regardless of female coloration; and (3) the coloration may not signal courtship stimulation because males attempted to copulate with females regardless of female coloration. However, these results may not typify lizards that develop breeding coloration (and respond to it) naturally during the usual breeding season (early summer). Subsequent studies will examine the timing of female receptiveness and associated male responses as a function of breeding coloration.

*** FANGUE, NANN A.; RUMMER, JODIE L.; BENNETT, WAYNE A.**

(NAF) University of British Columbia, Dept. Zoology, Vancouver, BC, V6T 1Z4, Canada; (JLR, WAB) University of West Florida, Dept. Biology, Pensacola, FL, 32514, USA

Comparative batoid thermal tolerance

Most of what is known about temperature's effects on distribution and activity of elasmobranchs comes from anecdotal field descriptions. The purpose of our study was to empirically model the relationship of acclimation temperature on upper and lower thermal tolerance of three batoid species from different thermal habitats and use these data to construct ecological thermal tolerance polygons defining each species' thermal niche as an aerial measure ($^{\circ}\text{C}^2$). The Atlantic stingray, *Dasyatis sabina*, was the most eurythermic species with a polygon area of 978°C^2 . Conversely, the blue spotted ribbontail stingray, *Taeniura lymma*, and big skate, *Raja binoculata*, from equatorial Indonesia, and the cold California coast, respectively, were stenothermic species with polygon areas of 350 and 216°C^2 . The Atlantic stingray encounters a wide range of seasonal temperatures from nearly freezing to over 35°C , and demonstrated marked gains in cold or heat tolerance as acclimation temperatures change. Conversely, the big skate, limited to deep, cold, stable waters off the Pacific west coast, exhibited almost no change in thermal tolerance as acclimation temperatures changed. Stenothermic blue spotted ribbontail stingrays showed a hyperthermal polygon pattern with moderate changes in polygon area relative to changing environmental temperature. The three species tested in our experiments clearly demonstrate that elasmobranchs have evolved sophisticated thermal strategies to exploit a wide range of thermal habitats.

*** FARIA, VICENTE V.; RYBURN, JULIE A.; LEANDRO, LUIS F.; NAYLOR, GAVIN J.**

Iowa State University, Dept. Zoology and Genetics, Ames, IA, 50011, USA

Pristiform molecular phylogeny

The sawfishes, family Pristidae, is comprised of seven species: *Anoxypristis cuspidata*, *Pristis clavata*, *P. pectinata*, *P. perotteti*, *P. pristis*, *P. microdon* and *P. zijsron*. Uncertainty remains about systematic relationships for several of these species (e.g., the *P. perotteti/microdon/pristis* complex). In an effort to elucidate the evolutionary pattern of inter-relatedness for the sawfish group, we sequenced three mitochondrial genes (NADH-2, NADH-4, and Cytochrome B), and one nuclear gene, *rag1* for representatives of six sawfish species. A hypothesis of pristiform evolution is discussed in the context of molecular inference, morphology-based hypotheses, and geographical distribution of the group.

*** FARIA, VICENTE V.; RYBURN, JULIE A.; LEANDRO, LUIS F.; WILEY, TONYA; SIMPFENDORFER, COLIN; NAYLOR, GAVIN J.**

(VVF, JAR, LFL, GJN) Iowa State University, Dept. of Zoology and Genetics, Ames, IA, 50011, USA;
(TW, CS) Center for Shark Research, Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL, 34236, USA

Florida sawfish (*Pristis pectinata*) genetic variability: preliminary analyses

Sawfish abundance has been dramatically reduced throughout the past century by fishing and habitat degradation. This lower abundance may reduce the genetic variability of these populations, compromising their capacity to respond to changing selection pressures and thereby increasing their vulnerability to extinction. In the present study we assess the genetic diversity of *P. pectinata* by sequencing the mitochondrial NADH-2 and D-loop regions from individuals sampled at four locations on the Florida coastline. Genetic variability inferences based on our results are discussed in the context of sawfish conservation.

FARIAS, C.F.; CARVALHO-E-SILVA, S.P.; * DE BRITO-GITIRANA, L.

Laboratório de Histologia Animal e Comparada, ICB, Universidade do Brasil – UFRJ, Laboratory of Amphibians and Reptiles, IB, Universidade do Brasil – UFRJ, Av. Trompowsky s/no, Ilha do Fundão, Cidade Universitária, CCS Rio de Janeiro, Brazil CEP: 21044-970

Bidder's organ of *Bufo ictericus*: a light and electron microscopy analysis

Male toads of the Bufonidae Family have rudimentary ovaries designated Bidder's organs, and if the testes are removed this organ develops into a functional ovary, representing a morphological strategy for the reproduction of the species. The Bidder's organ of *Bufo ictericus* was examined using routine and histochemical techniques by light microscopy and transmission electron microscopy. Each Bidder's organ presented a typical ovarian morphology, being composed of a cortex and a medulla. Bidderian follicles in different stages of development were visualized in the cortex, where they are better developed. The germ cells exhibit a large oocyte with a round-shaped nucleus. The Bidderian follicles are supported by a loose net of reticular fibers. In the medullar region, collagen fibers were immersed in the matrix rich in blood vessels that also contained a small quantity of neutral glycoproteins rich in hexose and/or sialic acid and carboxylated polymers with a characteristic distribution of glycosaminoglycans. The oocyte and the follicular cells were separated by a narrow space containing microvilli. The oocyte exhibit a well developed smooth endoplasmic reticulum, a poorly developed Golgi apparatus, and occasional lysosomes. Concentric cisternal complexes (CCC) are often visualized; however, their morphological significance remains unclear. The peroxisomes display a fine granular matrix without a crystalline core, with a weak DAB-reaction. Intimate association between peroxisomes, peroxisomes and lipid inclusions was observed in the oocyte, suggesting its participation in yolk metabolism.

*** FARIAS, I. P.; HRBEK T; CROSSA M.; SAMPAIO I.; MEYER A.**

(IPF) Universidade do Amazonas, Departamento de Biologia, ICB, Manaus, Amazonas, Brazil; (TH) Washington University School of Medicine, Department of Anatomy and Neurobiology, St. Louis, MO, USA; (MC) IPAM, Santarém, Pará, Brasil; (IS) Universidade Federal do Pará, Campus de Bragança, Pará, Brazil; (AM) University of Konstanz, Faculty of Biology, Konstanz, Germany

Characterization of DNA microsatellite loci and their utility for the study of population genetics of *Arapaima gigas*, a severely over-exploited fish species of the Amazon basin

Arapaima gigas is a CITES II listed species, but also one of the most important food fishes of the Amazon basin with a historically very large commercial and subsistence fishery. By the 1980s it became commercially extinct in many areas, and in early 2001 the Brazilian government banned all fishing, however, this has not prevented illegal fishing. Therefore we have developed 14 variable microsatellite markers for *A. gigas* to assess the level of genetic variability in *Arapaima*, and to determine whether any significant population structuring could be detected in this economically important fish from the Amazon. Our results suggest that *Arapaima* is genetically depauperated. *Arapaima* shows significant deficit of heterozygosity, significant deviation from Hardy-Weinberg equilibrium, linkage disequilibrium among microsatellite loci, and *Arapaima* appears to have undergone a recent genetic bottleneck. These results suggest strongly a recent decrease in population size across its demographic range, with the possible exception of few localities. *Arapaima* natural populations need to be kept at a size sufficient to retain genetic diversity and minimize their risk of extinction. Our results strengthen concerns over over-exploitation and the loss of genetic diversity in *Arapaima*, as well as contributing to the urgent need to draft a species conservation plan.

*** FAUNCE, CRAIG H.; SNEDAKER, SAMUEL C.; SERAFY, JOSEPH E.**

(CHF, SCS) Division of Marine Biology and Fisheries, University of Miami, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Cswy. Miami FL, 33149, USA; (JES) National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149, USA

Mangrove fish-assemblages: a review of published studies

Mangroves are found inhabiting the coastal shorelines of tropical and sub-tropical latitudes worldwide. Because they are positioned at the land-sea interface, mangroves occur in tumultuous environments resulting from natural and anthropogenic factors. Compared to adjacent seagrass and reef habitats, the study of mangrove-fishes is still in its infancy, and whether mangroves act as an 'essential fish habitat' is of debate. To assess the current status of knowledge of mangrove-associated fishes worldwide (i.e., type of data collected, frequency and location of collections, gear type, species assemblages, statistical manipulations, and interpretations), 55 published articles were reviewed. Most studies (91%) were undertaken to characterize the species utilizing these habitats, and 'fishery value' in these studies was inferred from the presence/absence of exploited taxa. Different sampling methodologies are favored in the Americas versus other portions of the world, and bias inherent in these methods may have confounded interpretation of data among studies. In addition, the type and number of environmental/habitat measurements made in conjunction with fish collections differ widely among studies. These differences obscure our ability to identify important environmental variables associated with greater fish abundance and/or diversity. In many tropical countries where mangroves occur, sampling is often conducted according to logistical and economical constraints, and may not incorporate designs or sample sizes needed to meet the assumptions of conventional statistical methods. In fact, statistical tests were lacking in 71% of the seasonal and

45% of geographical comparisons reviewed. Despite these problems, mangrove fish assemblages worldwide generally contain two groups: 1) a numerically dominant resident group adapted to harsh conditions, and 2) a biomass dominant seasonal group containing some, usually juvenile phase, exploited taxa. The role of mangrove habitat in the early-life history of these exploited taxa, and their linkages with adjacent habitats are reviewed.

*** FELDBERG, ELIANA; PORTO, JORGE I. R.; SANTOS, ALDALÉIA C.; BENZAQUEM, DENISE C.; SILVA, ADAILTON M.; MESQUITA, DÉBORA R.; ALECRIM, BRENO J. C.; NAKAYAMA, CELESTE M.**

Instituto Nacional de Pesquisas da Amazônia, Coordenação de Pesquisas em Biologia Aquática, Manaus, AM, 69083, Brasil

Chromosomal evolution of cichlids with a description of 15 karyotypes of Amazonian cichlids

The astounding number of cichlid hobbyists increases everyday mainly because cichlids are so distinctive in appearance and behaviour. This ornamental fish group represents 1.6% of total exported from Amazon also plays a very important role in fisheries either as a food source for the human population or as a recreation/commercially important activity for eco-tourists named "catch and release fishing". We present an overview of the cytogenetic studies on cichlids showing that 135 species of cichlids have their karyotype analyzed, 106 from the New World (33 genera) and 29 from the Old World (11 genera). The main chromosomal rearrangements and pathways that probably have occurred in their evolutionary process are described. In addition, we present karyotypic data for the 15 species of cichlids where cytogenetic analysis revealed that *Hypselecara coryphaenoides* had $2n = 42$; *Chaetobranchopsis orbicularis*, *Cichlasoma amazonarum*, *Crenicichla cincta*, *Crenicichla inpa*, *Crenicichla cf. johanna*, *Crenicichla lugubris*, *Crenicichla reticulata*, *Hypselecara temporalis*, *Mesonauta festivus*, *Mesonauta insignis*, *Pterophyllum scalare* and *Satanoperca jurupari* had $2n = 48$ chromosomes; *Symphysodon aequifasciatus* and *Symphysodon discus* had $2n = 60$. From a cytogenetic viewpoint, cichlids have been considered a conservative group because of the standard macrokaryotype since this is still verified by the trend in maintaining the diploid number of $2n = 48$ chromosomes, mainly acrocentric ones in 60% of the cichlids. Nevertheless, we believe that the term "conservative chromosomal evolution" is not very appropriate to describe the real condition of this fish group. Indeed, despite the predominance of $2n = 48$ and acrocentric chromosomes, the occurrence of several chromosomal rearrangements is very clear, as can be seen through recent data.

FELDHEIM, KEVIN A.; * GRUBER, SAMUEL H.; ASHLEY, MARY V.

(KAF) Pritzker Laboratory for Molecular Evolution and Systematics, Field Museum, 1400 South Lake Shore Dr., Chicago, IL, 60605, USA; (SHG) Division of Marine Biology and Fisheries, Rosenstiel School of Marine and Atmospheric Sciences, 4600 Rickenbacker Causeway, Miami, FL, 33149, USA; (MVA) Dept. of Biological Sciences, University of Illinois at Chicago, 845 West Taylor St., Chicago, IL, 60607, USA

Breeding biology of the lemon shark, *Negaprion brevirostris*: inference through genotypic reconstruction of unsampled adults

We present a new technique involving computer-assisted, manual genotypic reconstruction of unsampled individuals to infer parentage and patterns of breeding in the lemon shark, *Negaprion brevirostris*. By employing nine highly variable microsatellite loci, we used genetic tags of unsampled parents to demonstrate that lemon shark mating is polyandrous, iteroparous

and that the same females return biennially to a particular nursery to produce litters of 8 to 18 half-siblings. In contrast, males rarely if ever return to the same nursery. Between 1995 and 2000 we sampled 910 lemon sharks. We determined year-of-birth for 735 young sharks and assigned these young to sibling groups using the program Kinship. We then used the sibling groups to reconstruct genotypes for their unknown parents. We were thus able to assign 710 juvenile sharks to one of 45 female genotypes (96.3%) while 485 (66.0%) were assigned to one of 84 male genotypes. Results demonstrated that adult females reliably and accurately returned to Bimini, Bahamas on a biennial cycle for parturition, and the majority of litters were the result of polyandry (multiple mating with two or more males) by females. However, adult males rarely sired more than one litter at Bimini. Thus, males almost certainly mate over a broader range than females and our finding of low genetic diversity throughout the western Atlantic is likely explained by male-mediated gene flow. Genetic tagging of unsampled adults, based on multi-locus genotypes of newborn sharks, proved to be an effective method of unraveling details of the breeding biology of this protected large, coastal, species.

*** FERMON, YVES D.M.; BUSSON, FRÉDÉRIC; COMMERGNAT, RICHARD; KSAS, RÉMI; JEGU, MICHEL; MEUNIER, FRANÇOIS J.M.**

(YDMF, FB, RC, RK, FJMM) USM 403 " Biodiversité et Dynamique des Communautés Aquatiques ", Département des Milieux et Peuplements Aquatiques, Muséum national d'Histoire naturelle. 43, rue Cuvier, 75231 Paris Cedex 05, France; (MJ) Antenne IRD, UR 131, " Biodiversité et Dynamique des Communautés Aquatiques ", Département des Milieux et Peuplements Aquatiques, Muséum national d'Histoire naturelle. 43, rue Cuvier, 75231 Paris Cedex 05, France

Preliminary investigations of the fish communities of rapids in the upper Maroni (French Guiana)

The ichthyofauna of rapids of High Maroni Basin have been following up along several months during dry and rainy seasons. Samples have been made by standardized set of gillnets regularly put down on the different biotopes of the rapids in a night-day approach. Sixty-eight species have been recorded belonging from 19 families. Main species were from Characidae (22 species, 9 of which Serrasalminae) and Locariidae (7 species). There is night-day differences in catch composition: 13 species were only caught during the night, mainly catfishes as *Doras cf. micropoeus*, *Ageneiosus brevifilis*, *Hemisorubim platyrhynchosor*, *Hemiodopsis huraulti*, and 7 species were caught only during day time as *Brycon pesu* and *Cichla ocellaris*. Captures of *Platydoras costatus* and *Acnodon oligacanthus* vary with moon period. Finally the catch per effort unit and the composition of captures vary according to hydrological cycle. Gymnotiforms were mainly caught during the low water period, a period where Loricariidae were more abundant than other groups. Then, we investigated the communities according the different kind of biotopes. If some species have been found quite everywhere, some have been found only in specific habitats. Three major habitats may be defined: (i) under forest areas with soft substrate and vegetation pieces where *Electrophorus electricus*, *Leporinus friderici*, *L. fasciatus*, *Myloplus rubripinnis* and *M. ternetzi* have been found; (ii) gravel bottom where cichlids, *Geophagus harreri*, *G. surinamensis* and the piranha *Pristobrycon striolatus*, have been caught; (iii) Podostemaceae grassland, rocks and sand where piranhas *Serrasalmus rhombeus* and *Pristobrycon eigenmanni* and *Prosomyleus rhomboidalis* have been only recorded. Comparing areas nearby amerindian village and areas so far to be considered without influences of human pressure, abundance of fish and size of specimen caught, and number of species captured are smaller around the village. The results show that the fishing pressure nearby village can be very huge. However, the rapids are very sensitive areas which may be damaged by human pressure.

*** FERMON, YVES D.M.; JEGU, MICHEL; SERBIELLE, CÉLINE; LOPEZ, M.; FOSSATI, ODILE; KEITH, PHILIPPE; MERIGOUX, SYLVIE; MEUNIER, FRANÇOIS J.M.**

(YF, FJMM, PK) USM 403 “ Biodiversité et Dynamique des Communautés Aquatiques ”, Département des Milieux et Peuplements Aquatiques, Muséum national d'Histoire naturelle. 43, rue Cuvier, 75231 Paris Cedex 05, France; (MJ, SC) Antenne IRD, UR 131 “ Biodiversité et Dynamique des Communautés Aquatiques ”, Département des Milieux et Peuplements Aquatiques, Muséum national d'Histoire naturelle. 43, rue Cuvier, 75231 Paris Cedex 05, France; (OF) Antenne IRD, UR 131, Université Lyon 1, Ecologie des hydrosystèmes fluviaux, 43 bd du 11 novembre 1918, 69622 Villeurbanne-Cedex, France; (ML, SM) SM Université Lyon 1, Ecologie des hydrosystèmes fluviaux, 43 bd du 11 novembre 1918, 69622 Villeurbanne-Cedex, France

Feeding habits and characteristics of two large phytophagous Serrasalminae (Characiformes, Characidae) in the upper Maroni (French Guiana)

The Serrasalminae subfamily is mainly known by the carnivorous piranhas but several phytophagous and fruit eaters species are also well known because of their importance in fisheries. The feeding habits of two new species *Tometes lebaili* and *Myloplus planquettei* have been studied in the High Maroni Basin, French Guiana. These two species are mainly recorded nearby the plain of Podostemaceae plants in the rapids. Juveniles of *T. lebaili* (size under 40 mm SL) mainly feed on insects. The stomachs of fish longer than 60 mm contain mainly Podostemaceae pieces (more than 90% of the stomachal volume), other aquatic plants, leaves of the riverine vegetation, seeds and very few invertebrates. The fish of this species shift from an invertebrate diet to a strictly Podostemaceae diet, which reveals the its strict of *T. lebaili* to the Podostemaceae. We found mainly fruits and seeds of the riverine vegetation in the the stomach of large specimens of *M. planquettei*. The diet of this species covers a wide variety of plants, which may indicate that *M. planquettei* is less dependant of the Podostemaceae grassland. In front of the degradation of the Podostemaceae grasslands by the rejection of sediments from mining activity or the modification of flow by hydroelectric dam, the conservation of *M. planquettei* is less critical than that of *T. lebaili*. In the case of *T. lebaili*, Podostemaceae grasslands do not have only a food paper for the adults but they have also a role of nursery for the young specimens who find refuge there and feed from invertebrates. *T. lebaili* and *M. planquettei* belong to the 12 larger fish species of High Maroni basin, 9 of them are carnivorous species strongly contaminated by the methyl mercury. As species with the highest social, hedonic and economic value among the Amerindians people and as phytophagous species unharmed of methyl mercury contamination, *T. lebaili* and *M. planquettei* conservation require however a detailed attention.

*** FERNANDES, F. M. C.; ALMEIDA-TOLEDO, L. F.**

Universidade de São Paulo, Dept. Biologia, Lab. Ictiogenética, São Paulo, SP, Brasil

Tetranucleotide microsatellites genome distribution in *Gymnotus* species: evidences of evolutionary processes in Gymnotidae nuclear genome

Patterns of amplified DNA fragments flanked by tetranucleotide microsatellites, obtained by single primer amplification reaction (SPAR) from *Gymnotus* species reflected the distribution of simple sequences repeats in their nuclear genome. The technique employed is based on polymerase chain reaction (PCR) amplification of DNA markers, using single primers of simple sequences repeats (SSR) or microsatellites. Species-specific amplification patterns were observed for all species analyzed, presenting a relatively small number of bands as following: *G. carapo* (2 bands), *G. pantherinus* (3), *G. sylvius* (1), *G. inaequilabiatus* (4) and a new species of *Gymnotus* (2).

These species-specific patterns were observed for all the primers tested. According to previous phylogenetic analyses based on mitochondrial genes sequences using the maximum likelihood approach, *G. pantherinus* lineage represents the oldest one, and could be considered as the sister group of the other species. *G. carapo* and *G. sylvius* seem to be a clade formed by the most recent divergence. Since the SPAR marker indirectly reflects the microsatellites distribution in the genome, it appears that microsatellites loci are more plentiful in the basal lineages of Gymnotidae. If so, we can speculate that in the evolutionary Gymnotidae history, a loss of single repeated sequences loci had occurred. This variation might be generated by inverted sequence blocks or might reside within some larger repeat structure, such as satellite sequences or ribosomal internal transcriber spacer regions. Alternatively, this variation might be associated with some kind of dispersed repeats, such as short interspersed repeated sequences (SINES). FAPESP, CNPq

*** FERREIRA, EFREM J.G.; ZUANON, JANSEN A.S.; SANTOS, GERALDO M.; AMADIO, SIDINEIA A.**

Coordenação de Pesquisas em Biologia Aquática (CPBA)/Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araujo, 2936, C.P. 478, Manaus, Amazonas, 69083-000, Brazil

Fishfauna of the Cantão State Park, Araguaia River, State of Tocantins, Brazil

In a research carried out in the Cantão State Park (88,928 ha), in the Araguaia River, State of Tocantins, Brazil, in a period of one year, with sampling in four different hydrological periods (high, lowing, low and rising water) using gillnets and seine, 233 species of fish were captured, belonging to 162 genera, 42 families and 12 orders. Characiformes was the group with the greatest number of species (110) representing 47%, followed by Siluriformes with 70 (30%), Perciformes with 23 (10%) and Gymnotiformes with 12 (5%) of the total species. The other eight orders composed about 8%. The proportions among the orders are a little different from the composition estimated for Amazonia, specially Siluriformes which was supposed to have 39% of the species. The family with the highest diversity was Characidae with 44 species (18.9% of the total), followed by Loricariidae with 23 (9.9%), Cichlidae with 20 (8.6%) and Serrasalminae with 16 (6.9%). This fauna is a mix of species from different regions, the Tocantins River, the Guiana and Brazilian Shield, the Central Amazon, and the low Amazon River. The number of species captured, so far, in this small area is comparable to those of Europe (192), Mississippi River (250), or Brazilian Pantanal (263). This number of fish species makes this Park one of those with the highest diversity in Amazonia.

*** FERRY-GRAHAM, LARA A.; WAINWRIGHT, PETER C.; NEAR, THOMAS J.**

(LFG) Moss Landing Marine Labs, 8272 Moss Landing Rd., Moss Landing, CA 95039, USA; (LFG, PCW, TJN) Center for Population Biology, Section of Evolution and Ecology, University of California Davis, Davis, CA 95616, USA

Phylogenies and functional morphology: an investigation of the pharyngeal jaw key innovation in labroid fishes

The teleost clade Labroidei (labrids, cichlids, pomacentrids and embiotocids) is characterized as having functional and morphological novelties associated with the pharyngeal jaw apparatus (PJA); most notably extension and fusion of muscles to form a sling that supports the fused 5th ceratobranchial, or lower pharyngeal jaw (LPJ). A suite of PJA characters was used to unite the fishes into a monophyletic group. However, recent molecular studies have not supported monophyly of the Labroidei. Thus, PJA modifications may be convergent, or perhaps are not as

similar as we once thought. Given that much of the success and diversity of the labroid fishes is attributed to the novel PJA, we sought to 1) understand more fully labroid relationships within the teleosts, and to 2) re-examine the anatomy and function of the PJA specifically in labrids and cichlids. Our generation of phylogenetic hypotheses from mitochondrial and nuclear-encoded gene DNA sequences using maximum parsimony and maximum likelihood optimality criteria also did not suggest labroid monophyly. Our examination of PJA anatomy in five distantly-related cichlid species and four similarly diverse labrid species revealed that there are differences in which PJA muscles are hypertrophied; the external levator (LE3/4) in cichlids and the posterior levator (LP) in labrids. Further, examination of the juvenile labrids *Semicossyphus pulcher* and *Bodianus* ssp. suggested that in some labrids, like cichlids, there may be a single sling supporting the LPJ. But, this sling is formed by different muscles in the two groups; again, the LE3/4 in cichlids and the LP in labrids. Our electromyographic investigation of PJA function in *S. pulcher* and the basal cichlid *Paretroplus menarambo* indicated that no muscle activity patterns exhibited by either species could be identified as novel. Our comparisons suggest that the generally conserved perciform activity patterns work even in the highly morphologically modified cichlids and wrasses. The two types of morphological modification suggest functional convergence between the groups.

FIALHO, AFONSO P.

Universidade Católica de Goiás, Centro de Biologia Aquática, Av. Bela Vista Campus II - UCG, Goiânia, GO, 74605-010, Brazil

Spatial and temporal variability of fish community in the Meia Ponte River basin, Goiás, Brazil

The present study was carried out in the Meia Ponte River basin, Goiás, Brazil (16°16'38" and 18°32'53" South and 48°46'38" and 49°44'51" West), which drains 35 cities of the State of Goiás. The basin has an area of 12350Km² and 480km of main channel length. 32 stations were sampled corresponding to 31 tributaries and one station in the main channel upstream region of the Meia Ponte River. Fish community and environmental variables related to substrate and physico-chemical water characteristics were sampled throughout a stretch of 100m during the period of high waters (March/2001) and low waters (August/2001). 3520 specimens distributed in 31 species, 10 families and 5 orders had been collected using bolters of 30mm of mesh size. A multivariate analysis (Co-Inertia Analysis) of the software ADE-4 was used to determine the relation between the habitat and the fish communities. The results demonstrated that among the 24 environmental variables considered (physico-chemical and type of substrate) the conductivity, DQO, water hardness, phosphate, pH, turbidity, temperature and the types of substrate mud, organic matter, sand and gravel influence on the structure of the fish community. However, the influence of these variables is linked to the environmental modifications due to the regional seasonal changes.

FIALHO, AFONSO P.; * CECILIO, ROSELY V.; TEJERINA GARRO, FRANCISCO L.

(AFP, RVC, FLTG) Universidade Católica de Goiás/Centro de Biologia Aquática, Campus II - UCG, Av. Bela Vista, J. Olímpico, Goiânia, GO, Brazil, CEP 74506-010

Ecological study of the fish community in the Mambaí preservation unity - IBAMA, Tocantins basin, Goiás, Brazil

The Mambaí preservation unity has an area of 118400 ha and is located in the Mambaí county (14°32'16" S and 45°59'51" W). The watercourses sampled are small (creek), where the riparian

vegetation is interrupted in some cases by deforestation. 14 creeks were sampled during low (September/2002) and high waters (December/2002). In each creek was delimited a 100m stretch, where fish and environmental parameters were sampled. Fish were collected using sieves (mesh size 30mm) and minnow traps. Physico-chemical (depth, Secchi transparency, water temperature, conductivity, dissolved oxygen) and qualitative data (shading of riparian vegetation, substrate composition, riverside type) were also collected. All specimens sampled were conserved in formaldehyde 10%. Afterward, in the laboratory fish were identified, measured and weighted. 5220 specimens were collected distributed in 16 species, 7 families and 3 orders with a predominance of Characiformes. A partial result suggests that water transparency and channel length differentiate the creeks sampled and influences on fish community structure.

FIDELIS, U.; * MELLO E SOUZA, PABLO F.; LAZZAROTTO, HENRIQUE

(UF) Lab. de Ecologia de Peixes, Dpto. de Ecologia, UFRJ., Av. Pau-Brasil, 221 – Prédio do CCS – Bloco A. – Sala A0-010. Ilha do Fundão – Cidade Universitária – Rio de Janeiro, RJ, Brasil, Cep 21941-590. photograma@yahoo.com.br; (PFMS) LAPSA, IOC-FIOCRUZ. pablof@rio.com.br; (HL) LBRP / UFRJ. kiko_almeida@hotmail.com

Relationship between fish assemblage and habitat structure along a longitudinal gradient in a southeastern Brazilian coastal stream

The aim of this study is to describe the fish assemblage longitudinal distribution relating to habitat description in a tropical coastal stream. Data were obtained from eight locations of Pereque-Acu basin (Paraty, RJ, southeastern Brazil), two localities in each reach: headwater, upper, medium and lower reaches. Habitat description was based on six environmental parameters (current, substrate, vegetation, shadow, width and depth) measured in 120 points, in each locality. Fish data was obtained using kicking-nets, sieves and underwater observations. A total of 23 species was registered. A process of species addition and substitution was observed along the river's course. Headwater localities presented the lowest richness (3 and 5 species), with a distinct ichthyofauna dominated by *Loricariidae* species (*Loricariidae* sp.5, *Pareiorhina rudolphi*) rarely found in other reaches. Richness peak occurred on a medium reach locality, presenting 14 species: *Awaous tajasica*, *Brycomamericus microcephalus*, *Eleotris pisonis*, *Geophagus brasiliensis*, *Gobionellus shufeldti*, *Hisonotus notatus*, *Kronichthys heylandi*, *Deuterodon* sp., *Phalloceros caudimaculatus*, *Pimelodella laeteristriga*, *Rhamdia quelen*, *Rhamdioglanis frenatus*, *Schizolecis guntheri*, *Symbranchus mamoratus*. To relate habitat and fish assemblage, three cluster analyses (Wards method/ euclidean distance) were done, two using biological data (presence/absence and relative abundance) and one with the environmental data. Headwater localities presented a high similarity, being grouped together in both environmental and presence/absence analysis. In the same analysis, the lowest location was also separated from the other localities, being grouped with all other but the headwaters locations. When the species presence/absence was analyzed, the ichthyofauna found on both upper reach localities was more similar among each other and then between the headwaters than to the lower and middle reaches. The cluster obtained with the species relative abundance did not form the same groups. Other factors not described in the present study, such as physical barriers, species capturability and resources availability may have affected the analysis.

*** FIGUEROA, DANIEL ENRIQUE; MACCHI, GUSTAVO**

Laboratorio de Ictiología, Depto. Cs. Mar, FCEyN, Universidad Nacional de Mar del Plata, Funes 3350, Mar del Plata (7600), Argentina; Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), CC175, Mar del Plata (7600), Argentina

The Western South Atlantic congrid eel *Bassanago albescens* (Barnard, 1923)

The species of the genus *Bassanago* are deep water congrid eels found in the Southern Hemisphere. They inhabit temperate and cold waters from Australia, New Zealand, Chile, Argentina, South Africa and insular regions. In the outer Argentinian shelf and slope. The species *Bassanago albescens* is captured with the important commercial common hake *Merluccius hubbsi*. Data of *Bassanago albescens* in the literature are very scarce. Study material: 50 specimens caught for RV Dr. Eduardo E. Holmberg. External and internal morphologies were studied. Counts and measurements following Smith (1989). For histological observations, samples of the ovaries were prepared. Leptocephalus was determined. The adults have body robust, vent placed well before mid-length; snout rather swollen, projecting noticeably in front of lower jaw when mouth is closed; mouth subterminal, extending to below middle of the eye. Teeth cardiforms in jaws. Anterior nostril is a simple tube almost on tip of the snout, posterior nostril is a wide, oval aperture just in front of the moderate large eyes; dorsal origin further forwards the middle of pectoral; body surface covered with minute epidermal papillae which are scattered and difficult to locate in small specimens. They are predators, feeding on ophiurods, crustaceans, polychaete worms and small fishes. The oocyte composition revealed iteroparous reproduction. The gas bladder is free of vertebrae with a large pneumatic duct. Larval description is not according to leptocephali of the Subfamily Congrinae, they are large in size (characteristic not seen in all members of the Subfamily Congrinae), about 20 cm in TL, without pigment except the crescentic patch below eye; they inhabit subantarctic waters. The caudal skeleton is composed for 2 elements, this character was useful in linking larvae with adults.

*** FILIZOLA, BRUNO C.; SILVA, HÉLIO R.**

Universidade Federal Rural do Rio de Janeiro, Instituto de Biologia, Depto. de Biologia Animal, 23890-000, Seropédica, RJ, Brasil

The inquiline's associations between mites and ostracods with two bromeliad treefrogs from Serra dos Órgãos National Park, Teresópolis, RJ, Brasil (Amphibia: Anura: Hylidae)

Mites and ostracods are often cited as inquilines commonly associated with vertebrates, using them as hosts for transport or as food. Parasitism may cause injure to the hosts and decrease their fitness. Phoretic associations are non harmful to the host. Bromeliad frogs may be found carrying ostracods and/or mites, but little is know about the biology of these relationships. In order to understand more about the association between frogs and these arthropods, we conducted a survey of bromeliad frogs from the Atlantic forest of southern Brazil, between September and December of 2002. Whenever either mites or ostracods were found on frogs, we would register the presence, density and localization in a specific body area. We studied the association for two bromeligenous hylids: *Scinax v-signatus* (Hylinae) and *Flectonotus goeldii* (Hemiphractinae). The hylina species found was not host to any arthropod (n = 32). The 29 hemiphractine sampled presented trombiculids (Acari) as exoparasites (n = 25) and limnocytherids (Ostracoda) as phoretic inquilines (n = 9). The mites presented average density of 21 (1-135) individuals by frog, distributed preferentially by the side of the frog trunk. The evolutionary significance of the associations of the ostracods, and principally of the mites with

F. goeldii is unknown, so is the massive occurrence only at this specie. It is possible that *S. v-signatus* presents some sort of skin toxin that repels both the mites and the ostracods.

* **FILIZOLA, BRUNO C.; SILVA, HÉLIO R.; ARAÚJO, ALEXANDRE, F. B.**

Universidade Federal Rural do Rio de Janeiro, Instituto de Biologia, Depto. de Biologia Animal, 23890-000, Seropédica, RJ, Brasil

Habitat use by *Flectonotus goeldii* Boulenger, a bromeligenous treefrog, endemic to the Atlantic Rain Forest (Anura, Hylidae, Hemiphractinae)

Females of the marsupial treefrog *Flectonotus goeldii* carry fertilized eggs exposed in their backs until non-feeding tadpoles hatch and are released in bromeliads to complete development. Due to this behavior, the differential use of bromeliads, with some degree of choice, may occur among these frogs, so as to maximize tadpole survival. In order to investigate this hypothesis of habitat and microhabitat selection by *F. goeldii*, we conducted field studies in a bromeliad assemblage at anthropogenic sites in the Serra dos Órgãos National Park, Teresópolis, RJ, Brazil from February 2002 to February 2003. We registered 157 larvae and 198 adults. Tadpoles were collected only from the central tank of two of the 13 bromeliad species considered (n = 149): *Aechmea nudicaulis* (62 %) and *Neoregelia concentrica* (38 %). Adults were registered in six bromeliads, principally *A. nudicaulis* (40 %) and *Alcantarea geniculata* (n = 22 %). Pregnant females (n = 18), presenting 16-28 eggs were found in four species, principally *A. nudicaulis* (73 %). Males were found calling preferentially at the lateral leaves (72 %) and gravid females inside the central tank (85 %) of the plants. Tadpoles, calling males and pregnant females were more frequent in the most tubular bromeliad in the area. These data clearly indicate choice of bromeliad species by *F. goeldii*.

FISHER, HEIDI S.

Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA, 02543, USA

Discordant clines in neutral and sexually-selected traits across a swordtail hybrid zone

A recently discovered natural hybrid zone between two swordtail species with divergent sexual phenotypes, *Xiphophorus malinche* and *X. birchmanni*, is characterized by numerous recombinants for male sexually-dimorphic traits. Previous work has shown an upstream-to-downstream clinal shift from *X. malinche*- to *X. birchmanni*-type traits based on allozyme and morphological variation among hybrid populations. This pattern is consistent with the highland distribution of allopatric *X. malinche* populations, compared with the lowland distribution of *X. birchmanni*. Recent results using mtDNA markers, however, show a dramatically different pattern, with *X. birchmanni* markers predominating upstream and marker genotypes of both species found downstream. The discordance between the mtDNA and male phenotypic clines suggests that natural and sexual selection are acting very differently across the hybrid zone. Behavioral experiments evaluating female mate preferences for species-typical male traits are discussed.

*** FISHER, ROBERT N.; HATHAWAY, STACIE A.; CASE, TED J.; ROCHESTER, CARLTON J.; BACKLIN, ADAM R.; BROWN, CHRIS W.**

(RNF, SAH, CJR, ARB, CWB) US Geological Survey, Western Ecological Research Center, 5745 Kearny Villa Rd., Suite M, San Diego, CA 92123, USA; (TJC) University of California, San Diego, Division of Biological Sciences, 9500 Gilman Drive, La Jolla, CA 92093, USA

Development of inventory and monitoring tools for herpetofauna in diverse landscapes in southern California

Rapid declines in multiple species including reptiles and amphibians have resulted in regional conservation planning and a need for accurate information to assist making costly reserve-design decisions. Decisions sometimes are made with data that are incomplete, out-of-date or of poor quality. Three steps to filling the information gaps identified by managers include: identifying geographic and historic data gaps, systematic data collection protocols, and integrated data management. The U. S. Geological Survey has been implementing a variety of inventory and monitoring tools in southern California to determine their effectiveness for detecting diversity and for their value in tracking long-term trends in populations of at-risk species of reptiles and amphibians. Since 1995, we have used pit-fall traps throughout southern California at over 55 sites with over 750 trap arrays to capture terrestrial reptiles and amphibians. We have recorded in excess of 50,000 captures resulting in the detection of more than 60 herpetofauna species. The study sites have been developed under a variety of environmental conditions, an elevational range of -69 m to 2288 m, and across multiple habitat types along a 470 km transect in southern California. Sampling has taken place across seasons and years to understand spatial and temporal patterns in these species. Additional techniques have been used for aquatic systems, including plastic artificial coversites at springs, turtle traps, minnow traps, and a variety of diurnal and nocturnal habitat surveys for wetlands. Data has been compared where possible with historical data and is being stored in a pilot multi-taxa regional monitoring database created by USGS with collaboration from local and state partners. Our goal has been the development of systematic protocols and decision-making tools that can be implemented across species and landscapes to determine trends for reptiles and amphibians to fill these data gaps and assist decision-making.

*** FITZPATRICK, BENJAMIN M.; SHAFFER, H. BRADLEY**

Center for Population Biology and Section of Evolution & Ecology, University of California, Davis, CA 95616, USA

Environment-dependent and locus-dependent constraints on gene exchange in a tiger salamander hybrid zone

After an estimated 5my of independent evolution, the barred tiger salamander (*Ambystoma tigrinum mavortium*) was introduced by bait dealers into the native range of the California tiger salamander (*A. californiense*). Hybridization and backcrossing have been occurring in central California for 50-60 years. We studied genetic and ecological factors influencing admixture of these two divergent gene pools by analyzing frequencies of various hybrid genotypes in 3 kinds of breeding habitats: natural vernal pools, ephemeral man-made cattle ponds, and perennial man-made ponds. Perennial ponds tended to have higher frequencies of nonnative alleles than either type of seasonal pond. Certain nonnative traits such as facultative paedomorphosis and flexible breeding phenology could be advantageous in perennial ponds. Natural selection on these traits could create a hitchhiking effect, increasing the frequency of nonnative genetic markers in perennial ponds. Asymmetrical linkage disequilibria suggest that nonnative alleles are more likely to invade native genetic backgrounds. One marker showed a consistent deficit

of heterozygotes across pond types. Another showed heterozygote deficits only in vernal pools. A third was more likely to have heterozygote excess in ephemeral cattle ponds. These patterns indicate that admixture is influenced by complex genotype-by-environment interactions

*** FITZSIMMONS, NANCY N.; BUCHAN, JASON; REED, MARK A.; MILLER, JEFF D.; KAY, WINSTON; MORITZ, CRAIG; LIMPUS, COL J.; GRIGG, GORDON G.**

(NF, JB, WK, CM, GG) Department of Zoology and Entomology, University of Queensland, Brisbane, Qld 4072, Australia; (NF) present address: Applied Ecology Research Group, University of Canberra, ACT, 2601, Australia; (JB) present address: Biological Sciences, Duke University, Durham NC, 27708, USA; (CM) present address: University of California, Berkeley, Museum of Vertebrate Zoology, 3101 Valley Life Sciences Bldg, Berkeley, CA, 94720-3160, USA; (MR) Queensland Environmental Protection Agency, Queensland Parks and Wildlife Service, Northern Region, PO Box 5391, Townsville, Qld, 4810, Australia; (JM) Queensland Environmental Protection Agency, Queensland Parks and Wildlife Service, Far Northern Region, PO Box 2066, Cairns, Qld, 4870, Australia; (CL) Queensland Environmental Protection Agency, Queensland Parks and Wildlife Service, PO Box 155, Brisbane, Qld, 4002, Australia

Genetic insights into Australia's crocodile populations; a comparison between freshwater and estuarine species

Australia has two very different species of crocodile, one a freshwater species, *Crocodylus johnstoni*, and the other a large, primarily estuarine species, *C. porosus*, which also extend its range into freshwater. Both species occur in rivers that run into the sea and there is an extensive overlap in the river systems they each occupy. Although crocodiles are able to travel hundreds of kilometres to neighbouring rivers, little is known whether these migratory events result in gene flow among populations. To investigate the extent of gene flow among populations we have sampled both species throughout their range in Australia and used microsatellite loci to determine the genetic structure among populations. This effort has included 470 freshwater crocodile samples and 580 estuarine crocodile samples, each analysed at ten loci. Our results indicate significant genetic heterogeneity among river systems in both species and that gene flow is more limited among populations of the freshwater species relative to the estuarine crocodile. There is a significant isolation by distance effect observed for both species and this accounts for about 30% of the observed genetic structure among populations. These results will be discussed in relation to crocodile biology and management issues.

*** FLAMMANG, BROOKE E.; EBERT, DAVID A.; CAILLIET, GREGOR M.**

Pacific Shark Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Rd, Moss Landing, CA, 95039-9647, USA

Preliminary findings on the distribution, abundance, and reproductive biology of deep-sea scyliorhinids off central California

These findings are part of a broad-based ecological investigation into the life history of three deep-sea catsharks (Scyliorhinidae), *Apristurus brunneus*, *A. kampae* and *Parmaturus xaniurus*, in the eastern North Pacific. Preliminary results on the distribution, abundance, and reproductive biology of these species off central California will be presented. Specimens were collected from trawl and longline survey cruises by the National Marine Fisheries Service (NMFS) from June 2002 through May 2003 from Año Nuevo to Point Sur, California. Distribution, occurrence, and abundance of specimens were analyzed to identify trends associated with season, depth, maturity, sex, and species. On average, longline hauls were mainly comprised of *P. xaniurus*, with an occasional catch of gravid female *A. brunneus*. *Parmaturus xaniurus* were usually found

less than 485 m deep. Conversely, trawl cruises were primarily comprised of *Apristurus* spp. *Apristurus brunneus* were typically found between 300-942 m, while *A. kampae* occurred deeper than 1,005 m. The total lengths at first reproductive maturity were determined for all species using nidamental gland width, egg diameter, and outer clasper length measurements, as well as gonadosomatic indices (GSI) for males and females. Size at first reproductive maturity as determined by GSI is being compared to the maturation of other sexual organs to determine if development is synchronous. Initial analyses are attempting to determine if reproductive seasonality is evident by associated changes in the GSI and hepatosomatic index (HSI).

*** FLECKER, ALEXANDER S.; TAYLOR, BRAD W.; HALL, ROBERT O.; ANDERSON, JILL T.**

(ASF, JTA) Cornell University, Dept. of Ecology & Evolutionary Biology, Ithaca, NY, 14853, USA;
(BWT, ROH) University of Wyoming, Dept. of Zoology & Physiology, Laramie, WY, 82071, USA

Migratory fishes as functional subsidies in Neotropical riverine ecosystems

Migratory fishes are major components of Neotropical river systems and often constitute the mainstay of freshwater fisheries. Migratory fishes can act as important subsidies from the dual perspectives of representing significant material inputs as well as important functional linkages across landscapes. Here we present research conducted in Andean piedmont streams that show that some migratory fishes can play unique functional roles in Neotropical riverine ecosystems. We focus on our work with the flannelmouth characin, *Prochilodus mariae*, a migratory detritivore that is often seasonally abundant in Andean piedmont streams. Observational and experimental studies reveal that this species strongly modulates ecosystem structure and function. Selective exclusion of *Prochilodus* at different spatial scales dramatically alters the composition of biotic assemblages, as well as particulate carbon and nutrient dynamics. In addition, Neotropical rivers contain frugivorous fishes that potentially play unique functional roles as fruit dispersal agents for a variety of tree species found in seasonally flooded forests. We conclude that consideration of the functional roles of migratory fishes is critical for understanding the ecology and conservation management of Neotropical river systems.

FLÓREZ ALVAREZ, O; SOLANO PEÑA, D.; * OLAYA-NIETO, C.W.

Universidad de Córdoba, Departamento de Acuicultura, Laboratorio de Investigación Biológica Pesquera (LIBP) AA 895, Montería, Colombia

Growth and mortality of blanquillo *Sorubim cuspicaudus* in the Sinu river, Colombia

Growth and mortality parameters of blanquillo *Sorubim cuspicaudus* was estimated by using length frequency analysis (ELEFAN) to the information collected between March/1998 - February/2000 (1 and 2 samples). Standard length (SL) in centimeter and total weight (TW) in gram was measured. The class interval was of 2 cm. The values for asymptotic length (L_{inf}), growth coefficient (K) and age at zero length (t_0) were 85.8 (\pm 7.3) cm SL, 0.28 (\pm 0.01) year⁻¹ and 0.45 years and 78.4 (\pm 7.3) cm SL, 0.29 (\pm 0.01) year⁻¹ and -0.44 years, respectively, with mean environmental temperature taken as 27 °C and 95% confidence limits for each sample. The performance growth index (prime phi) were 3.31 and 3.25 for samples 1 and 2, within the rank reported for the Pimelodidae family. The total mortality (Z) was 0.98 (\pm 0.8) and 1.77 (\pm 0.8) year⁻¹ with 95% confidence intervals, natural mortality (M) 0.57 and 0.65 year⁻¹, mortality by fishing (F) 0.41 and 1.12 year⁻¹, respectively. The exploitation rate ($E = F/Z$) were 0.42 and 0.63, and the mean length at first capture (L_c) were 24.7 and 34.6 cm SL for samples 1 and 2. The estimations of growth coefficient, age at zero length, and condition factor are similar while asymptotic

length decrease from one year to another. The mean length in the catch is smallest than recommended value by INPA, and over fishing in sample 2 is observed. With constant fishing effort, the catch of blanquillo decreasing, the reproductive performance and the recruitment oscillating, the possible diminution of flood plains productivity because to the control of inundations, they affects the fishery of Blanquillo in Sinu river. Therefore, the competent agency will have to arrange actions than lead to the regulation and sustainability of the fishery and resource.

*** FOGARTY, JARROD H.; JONES, JEANNE C.**

(JHF, JCJ) Mississippi State University, Dept. Wildlife and Fisheries, Mississippi State, MS, 39762

Efficacy of pitfall trap versus area searches for herpetofaunal research

Area searches and pitfall trap methods are used to assess the diversity of reptile and amphibian species. In most studies, one method is implemented. We used both methods and compared their efficacy in detecting abundance and species richness of herpetofauna. Our study was conducted on public lands, Tombigbee National Forest and Noxubee National Wildlife Refuge, in east central Mississippi. Area searches consisted of belt transects measuring 300 X 6 meters. Transects were marked at 0, 25, 50, 75, and 100 meters from selected first and second order streams in parallel manner. Pitfall traps were placed along transects at 0, 50, and 100 meters from streams. Transects were checked at least three times/year from April 2000 - October 2002. Pitfall traps were installed in March 2001 and checked three times/year. Transect data encompasses 111 surveys over 21 study sites. Twenty-five reptile species (1,162 individuals) and 17 amphibian species (757 individuals) were recorded during transect surveys. Nine reptile species (135 individuals) and 11 amphibian species (315 individuals) were captured using pitfall traps. Each method detected several species the other did not detect. Conclusions drawn from either method alone would differ significantly due to detection biases, but both methods together gave a more complete picture of the herpetofauna community. One possible source of bias is depredation of captured animals in buckets by raccoons (*Procyon lotor*). Infrared cameras were set near randomly chosen sets of pitfall traps to monitor predator activity around buckets. Pictures revealed high levels of raccoon activity around pitfall traps. Therefore, we theorize that depredation of animals trapped in unprotected buckets could be a major form of bias in assessing herpetofauna diversity with the use of pitfall traps alone. This depredation could have significant consequences for sensitive herpetofauna populations if threatened or endangered species are captured in buckets.

*** FOGARTY, JARROD H.; VILELLA FRANCISCO J.**

(JHF) Department of Wildlife and Fisheries, Mail Stop 9690, Mississippi State University, Mississippi State, MS, 39762, USA; (FJV) U.S. Geological Survey, Biological Resources Division, Cooperative Fish and Wildlife Research Unit, Mail Stop 9691, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, MS, 39762, USA

Short-term effects of Hurricane Georges on frog populations of the Cordillera Central, Puerto Rico

Caribbean hurricanes can impact terrestrial vertebrate communities in forested environments. These impacts can be more pronounced at higher elevations compared to coastal areas. On 21 September 1998, Hurricane Georges passed over the island of Puerto Rico with sustained winds in excess of 240 Km/hr. Damage to the montane forests of the Cordillera Central, the island's largest mountain chain, was extensive. We estimated frog populations in two forests reserves of

the Cordillera Central in 1998 and 1999, before and after the passage of Hurricane Georges. Hurricane impacts were extensive on both the Guilarte and Maricao Forest Reserves, with areas of near total defoliation and a high percentage of trees (>50%) suffering major breakage and uprooting. We monitored frog populations at Maricao and Guilarte using call counts conducted during April and May of 1998 and 1999, along marked transects distributed throughout both forest reserves. We used distance sampling to generate empirical population models for all species detected. The most common frog species in both reserves, *Eleutherodactylus coqui*, significantly increased in abundance by 33% after the hurricane. Five other relatively abundant species decreased after the hurricane, however, not all decreases were statistically significant. Post-hurricane population decreases by species included, *E. antillensis* (80%), *E. brittoni* (59%), *E. richmondi* (83%), *E. wightmanae* (8%), and *Leptodactylus albilabris* (17%). Our results were similar to frog population responses reported in the Luquillo Experimental Forest, a montane rainforest reserve located in eastern Puerto Rico, after extensive damage following passage of Hurricane Hugo in September 1989. Long-term frog population responses may be closely related to post-hurricane forest successional changes in forest reserves of the Cordillera Central.

*** FONTENOT, BRIAN E.; GUTBERLET, RONALD L., JR.**

University of Texas at Tyler, Dept. of Biology, Tyler, TX, 75799, USA

Molecular and morphological analysis of the taxonomic status of the East Texas toad, *Bufo velatus*

Considerable ambiguity persists concerning species limits and interspecific relationships within the *Bufo americanus* group, a widespread complex of North American toads. In particular, the status of *B. velatus* is unresolved: various authors recognize the East Texas Toad as a distinct species, a subspecies of *B. woodhousii*, or a hybrid form. The goal of this study was to evaluate variation within the *B. americanus* group in order to better understand the evolutionary history of toads that have been referred to *B. velatus*. Fifteen body measurements from representative members of the *B. americanus* group, including a large sample from throughout the putative range of *B. velatus*, were analyzed using discriminant function and principal components analysis. Mitochondrial DNA sequences from the cytochrome *b* gene were obtained from 50 individuals sampled from across the geographic range of each species. Sequences were analyzed using maximum parsimony and Bayesian analysis. The morphometric analyses suggest that *B. velatus* is morphologically distinct from *B. woodhousii* and indistinguishable from *B. fowleri*, *B. houstonensis*, and *B. americanus charlesmithi*. Preliminary mtDNA analyses do not reveal strong geographic structure, and superficial phenotypic differences do not appear to be particularly useful for predicting haplotype lineages. These results illustrate the need for further study of the evolutionary history of toads from Eastern and Central North America and support the findings of recent authors who have called for taxonomic revision of the *B. americanus* group.

FONTENOT, CLIFFORD

Southeastern Louisiana University, Department of Biological Sciences, Hammond, LA 70402, USA

Behavioral ecology and resource partitioning in the garter snakes *Thamnophis atratus*, *T. hammondi*, *T. sirtalis*

The garter snakes *Thamnophis atratus* and *T. hammondi* are presently in secondary contact, at the terminal ends of the *T. couchii*-complex ring distribution around the Central Valley of California. Although anecdotal observations (and genetic similarity as sister taxa) suggest a

very high degree of ecological overlap, this is in conflict with limiting similarity theory. A well-corroborated phylogeny has been proposed for these taxa, but how they have responded ecologically to one another in sympatry has not been investigated. To address this issue, a field study was conducted in central (coastal) California to determine the respective ecologies of *T. atratus* and *T. hammondi*, although *T. sirtalis* was also included for a more complete analysis of the system. Field data indicate partitioning on all resource axes (temporal, spatial, and diet), and seasonal snake activity times are correlated with the seasonal activity times of their prey. In addition, each snake species employs a distinctly different suite of foraging behaviors in the presence of the same prey base, providing a sound basis for ecological classification in itself. *Thamnophis hammondi* is an aquatic specialist that uses specialized behaviors (e.g., bottom crawling) to catch fish early in the season (March), and then switches to generalized behaviors (e.g., open-mouth sweeping) to take advantage of superabundant anuran larvae May-June. It persists in the drying creek by switching back to fish (in isolated pools) for the rest for the season (into September). *Thamnophis atratus* instead timed its activities in the creek to coincide exclusively with peak numbers of anuran larvae May-June, and used primarily generalist behaviors to catch them. *Thamnophis sirtalis* seasonal activity was similar to that of *T. atratus*, and employed only generalist behaviors, some of which were inappropriate for the given foraging context.

*** FONTES, CRISTIANO; WARD, CHELSEA; MENDONCA, MARY**

Auburn University, Dept. Biological Sciences, Auburn, Al, 36849, USA

Characteristics of toad (*Bufo terrestris*) corticosteroid binding globulin (CBG)

The southern toad, *Bufo terrestris*, can be found throughout southeastern U.S.. Some populations live within ash basins near coal powered electrical facilities in Aiken, South Carolina. The ash basins create a habitat greatly polluted with heavy metals, which in most species, leads to elevated corticosterone levels and a decrease in reproductive activity. This raises the question of how these toads deal with this stressful environment and still manage to thrive. One hypothesis suggests that corticosteroid binding globulins (CBG) may play a role in the heavy metal stress response of the toad. CBGs are thought to be responsible for binding corticosterone, thus limiting its availability, and transporting it to target cells and membranes. To test this hypothesis, the toad CBG must first be characterized. Using a radioimmunoassay, we have examined the binding specificity of CBG for several hormones, including testosterone (T), estrogen (E), progesterone (P), and corticosterone (B). Our data indicates that toad CBG has the greatest binding affinity for B, binding at a concentration of 10^{-7} M, and a moderate affinity for P and T, both binding at approximately 10^{-6} M. The toad CBG demonstrated low affinity for E, with virtually no binding observed. A corticosterone saturation curve for CBG indicates that the equilibrium constant, K_d , is 11 nM.

*** FORD, DAWN K.; ROOSENBURG, WILLEM M.**

Ohio University, Dept. Biological Sciences, Athens, OH, 45701, USA

Sublethal physiological effects of PCB 126 on the energy allocation patterns of *Malaclemys terrapin*

Stress is an environmental condition or external constraint that restricts the rate of resource acquisition and energy allocation that may ultimately reduce survivorship or fecundity. An organism incurs an energetic cost, such as an increase in metabolic rate, when exposed to an environmental stressor. This increase in metabolic rate commonly causes a decrease in growth

or reallocation of energy from storage or reproduction. Due to its estuarine natural history, diamondback terrapins are exposed to a wide range of salinities and multiple chemical stressors. I conducted a study to determine the effects of an anthropogenic environmental contaminant (PCB 126) delivered via intraperitoneal injection on resource allocation. Animals that were contaminated showed a higher incidence of shell rot, increased mortality and significantly reduced growth. Interestingly, significant effects of the PCB were not manifested until five months after exposure, suggesting that extended studies are necessary to properly document sublethal effects of contaminants in turtles and perhaps other long-lived species. Based on these findings, a larger study has begun to assess physiological stress by measuring differences in energy allocation among unstressed and stressed groups. The two stressors used in this experiment are PCB 126 and a natural stressor, salinity. Due to its estuarine natural history, diamondback terrapins are exposed to a wide range of salinities and multiple chemical stressors. Data collection from this experiment is ongoing and results will be discussed.

FORDHAM, SONJA V.

The Ocean Conservancy 1725 DeSales Street, NW Washington, DC 20036, USA

Conservation of smalltooth sawfish (*Pristis pectinata*) in U.S. waters

Sawfish are among the most endangered fish in the world and yet even the most developed countries have failed to make sawfish conservation a priority. As with other elasmobranchs, the low reproductive potential of sawfish leaves them exceptionally vulnerable to overexploitation and slow to recover from depletion. Scientists with keen awareness of these characteristics stand to influence and improve management of this and other elasmobranch species, yet this potential remains largely untapped. The United States has a stated commitment to precautionary shark management and has led international elasmobranch conservation efforts, including a 1997 proposal to restrict international trade in all sawfish species under the Convention on International Trade in Endangered Species (CITES). Domestic sawfish recovery, however, has not been a U.S. priority due in large part to lack of active, public pressure. The U.S. population of smalltooth sawfish (*Pristis pectinata*) is estimated to have declined by more than 95% and to require more than a century to rebuild. There are no federal sawfish regulations; existing Atlantic and Gulf state measures are inadequate to protect the population. The National Marine Fisheries Service (NMFS) has yet to take final action on a 1999 petition from The Ocean Conservancy to list smalltooth sawfish as Endangered under the U.S. Endangered Species Act, although the final decision is expected soon. This process involved a comprehensive scientific status review for the species and a resulting NMFS proposal for ESA listing that, if finalized, would prompt a recovery plan and may result in designation of sawfish critical habitat and protection of look alike species (*Pristis perotteti*). The history, latest developments and next steps related to U.S. sawfish recovery efforts will be reviewed with a view toward encouraging increased participation from scientists in the management process for this and other imperiled elasmobranch species.

*** FORERO, GERMAN; CASTAÑO, OLGA V.; MONTENEGRO, OLGA**

(GF) Universidad Nacional de Colombia, Departamento de Biología, Ciudad universitaria, Bogotá, Colombia; (OVC, OM) Universidad Nacional de Colombia, Instituto de Ciencias Naturales, Ciudad Universitaria, Bogotá, Colombia

Abundance, population structure and conservation of *Kinosternon scorpioides albogulare* in San Andrés Island (Colombia)

Information on population size and density, as well as population structure is often needed in order to know the status of a population, and to start long term monitoring, specially for endangered species. In this study, we estimated population sizes, densities, structure and sex ratio of an endangered species of mud turtle, *Kinosternon scorpioides albogulare* in a Caribbean island in Colombia. We also gathered information on importance and use of the species by the islanders as well as possible threats. Fieldwork was conducted from March to July - 2002 at San Andrés Island, Colombia. After identifying the different populations living at the island, we used the mark-recapture model in order to estimate their population size and density. Turtles were captured by hand and marked by scale notching. We estimated population size using Petersen model for closed populations. We found that 4343 (3569-5800 approximated 95% confidence interval) turtles inhabited the island during the study period in fresh water ponds and mangroves. Densities for the main populations varied from 77 to 254 turtles/ha. Population structure showed that most of the individuals belong to intermediate size classes (110-140 mm carapace length CL) and few belong to the smaller or bigger size classes (<110 or >140 mm CL). The sex ratio was significantly different from 1:1 ($\chi^2 = 120.18$, $p < 0.05$) and was skewed toward females, one male per 1.97 females. No common use was found for the species among native islanders although people from the continent living in the island use it for diverse purposes. Some threats were identified such as mangrove fragmentation and the presence of the introduced species *Tupinambis teguixin*. Population size and density are discussed taking into account populations of other species of the genus *Kinosternon* and other studies in islands. The possible causes and significance of the skewed sex ratios are also discussed.

*** FORESTI, FAUSTO; SATO, LUCIANA R.; OLIVEIRA, CLAUDIO**

Departamento de Morfologia, Instituto de Biociências, UNESP, Botucatu, SP, 18618-000, Brazil

Karyotype description of nine species of *Trichomycterus* (Teleostei, Siluriformes, Trichomycteridae)

The family *Trichomycteridae*, which comprises about 200 species, is a family of small-sized catfishes widely distributed throughout South America and Southern Central America. In spite of its large number of species and wide distribution, only a few cytogenetic studies have been conducted in the group. In the present study the karyotypes of nine species of *Trichomycterus* were analyzed. The present study showed that in the species *T. florensis*, *T. reinhardti*, *T. davisi*, *T. auroguttatus*, *T. sp. aff. T. itatiayae*, *T. sp. 1* and *T. sp. 2* from Fernandes stream, *T. sp. 3* from Piranga river and *T. sp. 4* from Alambari river have $2n=54$ chromosomes, 42 being metacentric, 10 submetacentric and 2 subtelocentric. *T. reinhardti*, *T. auroguttatus*, *T. sp. aff. T. itatiayae* and *T. sp. 4* from Alambari river exhibit only one chromosome pair with nucleolus organizer regions. The available cytogenetic data suggest the existence of at least two species groups in the genus *Trichomycterus*, a cis-Andean group in which all the species have $2n=54$ chromosomes and a trans-Andean group in which the species have diploid numbers different from $2n=54$. The relative conservativeness of the karyotype of the cis-Andean species of *Trichomycterus* contrasts with the wide diversification observed in the trans-Andean species, reinforcing the hypothesis concerning the polyphyletic characteristic of the genus.

*** FORNI, JESICA B.; KAJIURA, STEPHEN M.; SUMMERS, ADAM P.**

Ecology & Evolutionary Biology, University of California, Irvine, CA 92697, USA

Stereo olfaction in hammerhead sharks – smells like a red herring

The evolution of the hammerhead shark cephalofoil has been the subject of much speculation. The 'enhanced olfaction' hypothesis persists as one of the most popular explanations for the evolution of this peculiar structure despite the lack of empirical evidence. It has been suggested that the widely separated nares provide sphyrnid sharks with better directional localization of odors and that the accompanying lateral expansion of the nasal capsules provides them with a larger volume in which to accommodate a larger nasal organ. We tested these hypotheses by comparing the morphology of the peripheral olfactory system for representatives of all eight sphyrnid shark species and two closely related carcharhinids. Although the maximum narial separation distance is greater for sphyrnids than carcharhinids, a pre-narial groove along the anterior edge of the cephalofoil of most sphyrnid species channels water into the nares, effectively reducing the separation distance. Therefore, whereas sphyrnids sample a greater volume of water, they are not able to resolve odor direction any better than carcharhinids. To address the question of olfactory acuity, the surface area of the individual lamellae, which comprise the olfactory rosette, was compared among species. Although sphyrnids possess a significantly greater number of lamellae than carcharhinids, the total lamellar surface area did not differ among the species. Therefore, the inability of the sphyrnids to spatially resolve odors any better than the carcharhinids, coupled with the similar lamellar area among the species, combine to suggest that the 'enhanced olfaction' hypothesis is not strongly supported as a mechanism for the evolution of the hammerhead shark cephalofoil.

*** FORSBERG, BRUCE R.; MELACK, J.M.; SIPPLE, SUZANNE J.; HAMILTON, STEPHEN K.; NOVO, EVELYN M.M.**

(BRF) Instituto Nacional de Pesquisas da Amazonia, INPA-CPEC, C.P. 478, Manaus, AM, CEP 69011-970, Brazil; (JMM) Bren School of Environmental Science and Management, University of California, Santa Barbara, CA, 93106, USA; (SKH, SJS) Kellogg Biological Station and Department of Zoology, Michigan State University, 3700 E. Gull Lake Dr., Hickory Corners, MI, 49060, USA; (EMMN) Divisao de Sensoriamento Remoto, Instituto Nacional de Pesquisas Espaciais, C.P. 515, Sao Jose dos Campos, SP, CEP 12201, Brazil

The use of passive microwave derived inundation area to predict fish yield in the Amazon

Effective management of commercial fish populations in the Amazon will require an understanding of the natural factors controlling fish yields. Strong relationships have been found between the maximum annual extent of flooding and annual fish yield in several other tropical river systems. Here we use estimates of regional flooding, derived from analyses of passive microwave imagery, and historical time series of fish yield to investigate the influence of inter-annual variations in inundation area on fish yield in the Brazilian Amazon. Annual fish yields for the periods 1980 -1990 and 1993-1998 were obtained from the Instituto Brasileiro de Geografia e Estatística (IBGE) and the Instituto Brasileiro do Meio Ambiente dos Recursos Naturais Renováveis (IBAMA), respectively. Total regional fish yield was obtained by aggregating data for the states of Amazonas, Para, Rondonia, Acre, Amapa and Roraima. Flooded areas along white water river floodplains (varzea) were estimated using passive microwave images from the Nimbus-7 satellites. Monthly flooded areas were determined for 12 reaches along the central Amazon floodplain between 70 and 52,5° W longitude and for the floodplains of the Madeira, Jurua e Purus rivers for the period of 1978-1987. Total regional

maximum and minimum annual flooded areas were obtained by aggregating maximum and minimum flooded areas from all reaches and tributaries. No significant relationship was found between total fish yield and flooding using several different time lags. However when different sized classes and trophic levels of fish were analyzed separately, several significant regression relationships were found. Improved fisheries statistics and longer time series of passive microwave derived inundation could greatly improve the predictive power of these relationships and their value for regional fisheries management.

* **FOX, ALICIA M.; ARCHIE, JAMES W.**

California State University, Long Beach, Dept. Biological Sciences, Long Beach, CA, 90840, USA

Genetic structure and home range overlap in the granite spiny lizard, *Sceloporus orcutti* (Phrynosomatidae)

Male mating success in vertebrates is directly dependent on both female mate choice and male-male interactions. In many species of phrynosomatid lizards, males are territorial and territory size determines the number of females that a male will have access to for mating. *Sceloporus orcutti* is a sexually-dimorphic, diurnal, and conspicuous phrynosomatid that occupies distinct home ranges, but in which territorial interactions between males have not been observed. In such a species it is unclear what mating system should exist or what factors determine male mating success. To investigate the mating system, patterns of reproductive success, and juvenile dispersal in *S. orcutti*, I estimated home ranges during the breeding season from April-June 2002 for eleven adult *S. orcutti* (n = 4 females = $79.5 \pm 60.3\text{m}^2$; n = 7 males = $331.6 \pm 334.9\text{m}^2$). Home ranges of males varied in percent overlap (0-66.2%) with adjacent male home ranges while females exhibited no overlap with other females. I obtained DNA samples (n=46) from toe clippings for adult, immature, and juvenile lizards for parentage analysis using microsatellite loci. One gravid female was captured during the breeding season. However, no hatchlings were found on the study site and surrounding areas from late summer to late fall 2002, indicating the absence of a breeding pulse for the year. This was presumably due to the dry conditions during the study period (less than 1/3 of the normal rainfall occurred). DNA analysis was used to assign parentage to immature lizards to characterize dispersal and population structure.

* **FOX, STANLEY; YOSHIOKA, JOY; CUELLO, MARIA ELENA; UBEDA, CARMEN**

(SF, JY) Oklahoma State University, Dept. Zoology, Stillwater, OK 74078, USA; (MEC, CU) Universidad Nacional del Comahue, Centro Regional Universitario Bariloche, 8400, San Carlos de Bariloche, Argentina

The status and distribution of an endangered frog in Argentinean Patagonia, *Atelognathus patagonicus*

Atelognathus is a small, leptodactylid genus confined to Patagonia. One species, *A. patagonicus*, is restricted to a small area of northern Patagonia in the province of Neuquén, Argentina. Although extremely abundant when first collected in 1948 and in subsequent years, it declined sharply in the mid-1980's. It previously inhabited the principal lake (Laguna Blanca: 39 °S, 70 °W; 1,276 m elevation) of Laguna Blanca National Park, and was the most abundant amphibian of the lake up to the late 1970's. The species is now extinct in Laguna Blanca, presently found only in nearby small lakes and ponds. It is under consideration for listing as in danger of extinction by Dirección Nacional de Fauna y Flora Silvestres of Argentina, listed as a special value species by Administración de Parques Nacionales, and as in danger of extinction by the Argentine Herpetological Association. The disappearance of *A. patagonicus* from Laguna Blanca

appears to be related to the introduction of an exotic perch (*Percichthys colhuapiensis*), which occurred without authorization in 1965. However, the fish and frog coexisted at high densities for 18 years until the frog was exterminated in 1985-1986. During 2001-02, we conducted quantitative surveys of Laguna Blanca and neighboring lakes to assess the status and distribution of *A. patagonicus*. We confirmed the absence of the frog in Laguna Blanca, but found populations in 14 other localities, 9 of which are new ones for this species. Ten populations are wholly or partially inside the national park. Densities of the frog were high in many populations, up to 1.15 individuals/m² in one sample. In both years we observed high rates of infection of an unknown pathogen and significant die-offs, especially of tadpoles and young metamorphs, but populations recovered toward the end of the summer. We are currently attempting to identify the pathogen.

*** FRANCO, FRANCISCO L.; FERREIRA, TALITA G.**

Instituto Butantan, Lab. Herpetologia, São Paulo, SP, 05503-900, Brazil

Taxonomic status of Colubridae snakes genus *Thamnodynastes* Wagler, 1830

The genus *Thamnodynastes* is currently composed by 12 species. They are viviparous and opisthognath snakes, that occupy an ample variety of habitats and environments. It is distributed for great part of the South America, from, approximately, 10 °N in Colombia until to 37 °S in Argentina. The taxonomic literature of about this genus is chaotic, even after recent contributions, where some authors had proposed new taxonomic arrangements and description. Six species are recognized in the Brazilian territory: *Thamnodynastes pallidus*, *T. rutilus*, *T. strigatus*, *T. hypoconia*, *T. chaquensis* and, the recently described *T. almae*. There are more two new species to be published and, more two under preparation. *T. almae* occur in domains of the Caatinga Forest, represented only for three specimens from the area of the Usina Hidroelétrica Luiz Gonzaga, city of Rodelas, state of the Bahia. This is a robust species, with possessing a very pale coloration and keeled dorsal scales arranged in 19 rows at midbody reducing to 15 posteriorly. There are more two unnamed species from Caatingas, one from southeastern Atlantic Forest and other specie from a single locality in an Amazonian basin and other locality from Paraguay basin.

*** FREEMAN, BARBIE; OSENTOSKI, MATTHEW F.; NICO, LEO G.; JELKS, HOWARD; COLLINS, TIMOTHY**

(BLF, MFO, TC) Department of Biological Sciences, Florida International University, Miami, FL 33199, USA; (LGN, HJ) U.S. Geological Survey, FISC - Center for Aquatic Resources Studies, Gainesville, FL 32652, USA

Species identification and systematics of *Serrasalmus manueli* and *Serrasalmus gouldingi* (Characidae: Serrasalminae)

Currently, relationships within the subfamily Serrasalminae (piranhas and their relatives) are uncertain. Some of the uncertainty stems from the difficulties surrounding species-level identification. Ontogenetic changes further complicate our understanding of the link between juvenile and adult morphology within serrasalmine species. We collected mitochondrial DNA sequences from juveniles and adults of two similar species, *Serrasalmus gouldingi* and *Serrasalmus manueli*, from sites in the Orinoco and Negro River basins. The goal was to test the monophyly of each species and to link juvenile and adult stages. We sampled additional species within *Serrasalmus*, as well as species in the genera *Pygocentrus*, *Pristobrycon*, and *Piaractus*. Superficially, juvenile *S. gouldingi* are similar in appearance to and easily confused with juvenile

Pristobrycon. Preliminary results suggest that *S. gouldingi* forms a paraphyletic assemblage with *Serrasalmus manuei*. This result suggests either that either *S. gouldingi* is not a valid species, that specimens in our study are misidentified, that these two species have differentiated recently and have not achieved reciprocal monophyly, or that hybridization has occurred between these species. The genus *Serrasalmus* is polyphyletic in our analysis, consistent with the results of Ortí, Porto and Sivasundar (2000).

*** FREIRE, KÁTIA DE M.F.; PAULY, DANIEL**

University of British Columbia, Fisheries Centre, 2204 Main Mall, Vancouver, British Columbia, V6T 1Z4, Canada

Standardization of common names of Brazilian marine fishes

Dealing with statistics related to recreational and commercial Brazilian fisheries is a hard task when one tries to relate the reported common name to the scientific name of each species. This was the reason that triggered this work that compiles 3,950 common names of 619 species of marine and estuarine fishes. These names are based on 30 sources from 1962 to 2000, which are linked to different Brazilian coastal states, from Pará to Rio Grande do Sul. Firstly, we assessed the general diversity of names: 23% of the species present only one common name and 50% of them have between 4 and 37 common names (the latter refers to *Macrodon ancylodon*); on the other hand, although 74% of the common names were related to only one species, there are cases where more than 20 species have the same common name ('linguado' and 'manjuba'). Secondly, we analyzed the naming process in general. Most of the names are derived from Latin and Ameridian languages, and they are either related to the fish morphology or color pattern, or make use of non-fish animals. These names also reveal the importance of commercial use and easy accessibility in the process of naming fishes, earlier noticed for Philippine fishes. Finally, we suggest an initial list of unique common names for each species based on criteria previously used for North American fishes, but modified to the Brazilian context. Thus, we give preference to names that allow for consistency among states and authors, linguistic diversity, tradition, simplicity, use of structural and ecological attributes and of geographic distribution, but we avoid keeping names that honor people, using the word 'common', capitalized letters, and hyphens. We would like to take this opportunity to invite contributions from other researchers into this study to allow for a more comprehensive process of standardization.

FROESCHKE, JOHN T.

California State University, Northridge, Department of Biology, 18111 Nordhoff St., Northridge CA, 91330, USA

A comparison of reef fish assemblages between Santa Catalina Island and the Los Angeles breakwall

The fish assemblage of the rocky reef kelp forest habitat of Santa Catalina Island, California was compared to the outside of Los Angeles Federal breakwater, a mature artificial reef. Two sites along the breakwall as well as four sites at Catalina (two inside and two outside of a marine reserve) were sampled approximately bimonthly using visual census on SCUBA at depths of six and 12 meters. Cryptic fishes were sampled at the breakwall and at Catalina outside the reserve using mesh bags and anesthetic in one meter square collections at each site. Preliminary data suggests significant differences in both density and species composition of fishes between the mainland and island sites. Densities of recreationally important species, *Paralabrax clathratus* and *Semicossyphus pulcher* were significantly higher at Catalina within the marine reserve.

Densities of cold water fishes including scorpaeniformes and embiotocids were significantly higher at mainland sites. Clustering analysis by species and sites resulted in primarily mainland and island groups. Inclusion of cryptic fishes significantly increased both densities and species richness at both island and mainland locations. Preliminary results of this study suggest that there are more significant differences between the island and mainland reef fish assemblages than would be predicted with only 40 kilometers separating the two locations.

FRUTCHEY, KAREN P.

University of Central Florida, Dept. of Biology, Orlando, FL 32816, USA

Plasma levels of vitamins, (retinol and α -tocopherol), necessary for reproduction in nesting marine turtles from the Archie Carr NWR

Although marine turtles are relatively well-studied endangered and threatened species, critical discontinuities exist in the literature regarding numerous significant blood values, especially those of free-ranging populations. Gaining a better understanding of marine turtle ecological physiology is an urgent priority, considering the impact such information could have on conservation management plans and population health assessments. Vitamins A (retinol) and E (α -tocopherol) are fat-soluble organic compounds required for the survival of all higher animals. Turtles must obtain both of these nutrients through dietary intake, either directly from animal-based foods or through conversion of dietary carotenoids. Growth, differentiation and integrity of epithelial tissue, bone remodeling, reproduction and vision are all reliant on a supply of vitamin A. Vitamin E has been found to be essential for reproduction and is an integral constituent of cell membranes where it acts as an antioxidant and free radical scavenger. The purpose of this study is to establish baseline blood values for vitamin A and vitamin E in marine turtles nesting in the Archie Carr National Wildlife Refuge (Melbourne Beach, FL) and to determine if the stress of the nesting season can be related to a decline in these values as the season progresses. This research is also an attempt to provide a nutritional explanation for the 2 to 3 year interval between reproductive migrations. Blood from green turtles (*Chelonia mydas*) and Loggerheads (*Caretta caretta*) was sampled via the bilaterally located cervical sinus, using a 20 gauge, 1 1/2 inch needle and a vacutainer containing lithium heparin. Vitamin analysis was conducted using high performance liquid chromatography and standardized methodologies. Mean plasma concentrations of retinol and α -tocopherol were found to be in the range of values previously reported for other chelonians.

*** FUIMAN, LEE A.; MC CARTHY, IAN D.; ALVAREZ, MARIA C.**

University of Texas at Austin, Marine Science Institute, 750 Channel View Drive, Port Aransas, TX 78373, USA

Low levels of contaminants impair survival skills of Atlantic croaker (*Micropogonias undulatus*) larvae

We evaluated the effects of environmentally realistic levels of a PCB (Aroclor 1254) and methyl mercury on the growth and survival skills of Atlantic croaker larvae (*Micropogonias undulatus*). Adult fish were given a dietary administration of the contaminant and induced to spawn by hormone injection. Larvae were reared and three behavioral assays were conducted to evaluate the larvae for growth rate, foraging potential, and predator evasion skills at different stages of development (during yolk absorption, during oil absorption, and during exogenous feeding). Maternal transfer of the PCB resulted in reduced growth of larvae between 2 and 13 days posthatching, with dosed larvae showing a 4-day delay in attaining the same size as control

larvae. Routine swimming speed and activity were similar for control and dosed larvae. There was a significant dose x age interaction in the responses of the control and dosed larvae to a vibratory stimulus. The percentage of control larvae responding to the stimulus, and their average and maximum burst speeds increased with age. No such age-related response was found in the dosed larvae. Results for methyl mercury contamination will also be presented. Results suggest that environmentally realistic body burdens of some contaminants can transfer to the eggs and larvae, reducing their growth rates and impairing their startle responses, possibly making the larvae more susceptible to predation.

*** FURTADO-NETO, MANUEL A.; CARR, STEVE**

(MFN) Universidade Federal do Ceara, Departamento de Engenharia de Pesca, Rua Joao Cordeiro 638, Fortaleza, CE, 60110-300, Brazil; (SC) Department of Biology, Memorial University of Newfoundland, NF, A1B3X9, Canada

Molecular phylogeny of angel sharks (Squatinae, Elasmobranchii) from Brazil

Angel sharks (Squatinae; Elasmobranchii) comprise a single genus that includes fifteen extant species. Three species of the genus *Squatina* are endemic to the continental shelf of southeastern South America, between latitudes 24°S and 42°S: *Squatina argentina*, *S. guggenheim*, *S. occulta*. In 1991, *Squatina occulta* was described and *S. guggenheim* was redescribed. Before that, only one species was thought to occur in the southern coast of South America whereas *S. occulta* and *S. guggenheim* were misidentified as *S. argentina* in some studies. PCR (polymerase chain reaction) was used to amplify 401-base pair sequences of the mitochondrial DNA cytochrome b gene from each species. Sequences of this gene from the three species of *Squatina* were obtained. Phylogenetic analyses were performed with the PAUP computer program of Swofford. Maximum parsimony tree was obtained with the heuristic search algorithm. The phylogenetic analyses indicate that the three species from southern Brazil constitute a monophyletic group, with the newly described species *S. occulta* more closely related to *S. guggenheim* than to *S. argentina*. This result suggests that evolution of the genus *Squatina* in southeastern South America waters occurred from deeper to shallower waters. Probably, *S. argentina* was the first species to occupy the continental shelf in depths of 200m or more. Fossil records suggest that this genus has existed since the Upper Jurassic. *S. occulta* and *S. guggenheim* may have evolved more recently and speciation probably occurred as an adaptation to life in shallower waters on different types of sea bottom. If this suggestion is true, *S. guggenheim* that lives from 0 to 80m, is the most recent species among the three *Squatina* from southern Brazil.

GAINSBURY, ALISON M.; WIEDERHECKER, HELGA C.; * COLLI, GUARINO R.

Departamento de Zoologia, Universidade de Brasília, Brasília, DF 70.910-900, Brasil

Morphological variation of *Ameiva ameiva* populations from natural open vegetation enclaves in Amazonia

Patterns of morphological variation depend on dataset and species considered, and may be a response to similar ecological conditions or a consequence of phylogenetic inertia. Thus, clarifying the role of these processes on specific datasets is one of the most intriguing questions in biology. We present data on *Ameiva ameiva* populations from natural open vegetation enclaves of Amazonia, from three different substrates; latosoil, rock, and sand. Geographic distance was used as a measure of connectedness and substrate as a measure of ecological conditions. If morphological variation is due to ecological convergence, populations from the same habitat will be more similar. Otherwise, if degree of connectedness is predominant,

geographically closer populations will be similar. Eight morphometric and eight meristic variables were recorded from reproductive males (SVL>80mm). The effect of body size was removed from the log 10 transformed morphometric variables by Burnaby's method. A Mantel Z test revealed that neither morphometric (Mantel t-test = 0.75, $r = 0.20$, $p = 0.77$) nor meristic variation (Mantel t-test = 0.07, $r = 0.02$, $p = 0.53$) were associated with geographic distance. UPGMA clustering of meristic data showed no clustering for locality or substrate. Morphometric data demonstrated clustering by locality. A backward discriminant analysis revealed a significant difference in morphometry among substrates (Wilk's lambda = 0.6746, $df = 8, 164$, $p = 0.0001$). The results highlight two important aspects. First, isolation by distance cannot fully explain the observed pattern, thus interpopulation variability is not a direct consequence of random variation of characters caused by genetic drift after isolation. Second, meristic and morphometric characters have distinct microevolutionary behaviors. The discordance with both geographic distance and ecological hypothesis, and the restricted value ranges of meristic variables suggest that characters originally had little variability in the species, thus fragmentation has not influenced its distribution among populations. Finally, populations living in the same substrate showed strong convergence in morphometric characters, indicating ecomorphological patterns likely produced by natural selection or by molding phenotypic plasticity.

GALATTI, U.

Coordenação de Zoologia, Museu Paraense Emílio Goeldi, C.P.399. 66040-170 Belém, Pará, Brasil

Collection data for amphibian fauna in the Belem area, Brazil

A comparison between amphibian species deposited at the Museu Goeldi collection and those recorded in the Belem area, according to published studies, shows that the collection contains species which do not appear in publications. Most of those species were collected in areas or habitats not covered by published studies. These *new records* can be used to assess distributional data in the region, and to evaluate the relationship between species richness and size of the area sampled. However, most interesting is the examination of historical records in the collection, from the beginning of the twenty century until the last years. These historical records pertain to species not even collected in the recent decades, just simultaneously with habitat loss in the region. Although there was no attempt to standardise collection or sampling effort for a more detailed analysis, we conclude that collections such as that at the Museu Goeldi can offer relevant data on the still little known conservation status of the Amazonian amphibian fauna.

*** GALOIS, PATRICK; OUELLET, MARTIN**

Canadian Amphibian and Reptile Conservation Network, 4252 rue Garnier, Montréal, Québec H2J 3R5, Canada

Amphibian declines and conservation challenges in the Monteregian Hills of Québec, Canada

The 10 Monteregian Hills are ancient intrusive formations now rising up to 550 m above the St. Lawrence River Lowlands of Québec. This region is potentially home to 33 (89%) of the 37 amphibian and reptile species occurring in the Province. The accessibility of these forested Hills, their diversity in terms of size and habitat, past and present alterations of the landscape along with the availability of some historical data, make them good candidates to study the effect of isolation on species richness. First initiated in 1997, an intensive herpetological survey of the Mont Saint-Hilaire Biosphere Reserve showed that 4 amphibian species (*Desmognathus fuscus*,

Eurycea bislineata, *Pseudacris triseriata*, *Rana septentrionalis*) have disappeared since the 1960s and the status of two other species (*Hemidactylium scutatum*, *Rana pipiens*) is rather precarious. In 2002, the survey was expanded to other nearby Hills. These Hills still present a rich herpetofauna and serve as 'green refuges' for rare species. However, our results suggest that intensive industrial agriculture and rapid urban development have increased the insularity of these remnant natural areas, transforming them into 'green prisons'. Furthermore, the progressive shrinking of their buffer zones and the rapid deterioration of the Monteregian Lowlands prevent any future colonization or genetic exchange. *Pseudacris triseriata*, a vulnerable species in southern Québec, is now absent from these sites and is in serious decline in the surrounding plain. With continuing habitat loss and fragmentation, the future of the remnant amphibian and reptile populations on some of these isolated Monteregian Hills is severely compromised. Since most are private properties, these mountains do not benefit from any particular protection from development. Stewardship agreements and promotion of conservation corridors among landowners are some of the actions currently implemented in collaboration with local conservation organizations.

*** GALVAN-MAGAÑA, FELIPE; OLSON, ROBERT J.**

(GMF) Centro Interdisciplinario de Ciencias Marinas, Apartado Postal 592, La Paz, Baja California Sur, Mexico; (RJO) Inter-American Tropical Tuna Commission, 8604 La Jolla Shores Drive, La Jolla, California 92037-1508

Stomach contents of pelagic sharks in the Eastern Pacific Ocean

The bycatch of large predators, including sharks is common in the tuna purse-seiner fishing in the Eastern Pacific Ocean. We analyze 508 stomach contents from 6 shark species and three shark groups, which were sampled at sea by observers of the Inter-American Tropical Tuna Commission (IATTC) aboard of vessels from Colombia, Mexico, Panama, and Venezuela. The purse-seine sets yielding the samples were distributed across the geographical range of the EPO tuna fishery during December 1992 through September 1994. Our results including that Blue shark (*Prionace glauca*) predate mainly on cephalopods (decapods), *Argonauta* spp. and *Onychoteuthis banksii*. The Bull shark (*Carcharhinus leucas*) feed on *Auxis* spp. and cephalopods. Silky shark (*C. falciformis*) predate on *Engraulis mordax*, *Cubiceps pauciradiatus* and *Decapterus* spp. The mako shark (*Isurus oxyrinchus*) consumes *Abraliopsis* spp., *Acanthocybium solandrii*, *Auxis* spp. and *Euthynnus lineatus*. The white nose (*Nasolamia velox*) feed on *Katsuwonus pelamis* and *Thunnus albacares*; whereas the oceanic white tip (*C. longimanus*) predate on *C. pauciradiatus* and *Stenoteuthis oualaniensis*. The group of hammerhead sharks feed on cephalopods (*S. oualaniensis*, *Dosidicus gigas*, and *Abraliopsis falco*). The group of thresher sharks consumes on epipelagic fishes as *E. mordax*, *C. pauciradiatus* and mesopelagic fishes as *Benthoosema panamense*. The carcharhinid group feed mainly on *E. mordax*. Discussion on width breadth and overlapping between shark species will be shown.

*** GALVIS, GERMAN; JIMENEZ, LUZ F.**

(GG) Division of fishes, Institute of Natural Sciences, National University of Colombia, Bogotá, Colombia; (LFJ) Laboratory of Ichthyology, Institute of Biology, University of Antioquia, Calle 67 No 53-108, Medellín, Colombia

Floating meadows belt as a mean of dispersal for forest stream fishes

Most catches of ornamental fishes around Leticia, a colombian town bordering the Amazonas river, are done in lowering water period by pulling out with seines patches of the floating

meadows growing in the border of the river. The tangle of roots serve as a shelter and feeding ground to many smaller species of fishes and as well to fry of bigger ones living in the river or on it is adjacent lakes and streams. Many of this smaller species are found also in the forest streams but not in the open areas of river channel, a barrier for their dispersal to another streams and lakes. Species composition of catches made on floating meadows systems were compared with fishes species present in little streams and floodplain lakes. We found important similarity values on fish species composition so we assume that the continuous belt of floating grasses along the border of the main rivers acts as a bridge habitat for dispersal of little fish species upstream or downstream river. It has been proposed formerly by Fittkau that patches of floating meadows ripped of by the stream act as rafts for long distance dispersal downstream. As commented by Gery (1979) forest stream fish faunas share many species in the upper Amazon basin, since those brooks are well isolated from each other, one would expect a high degree of endemic species, which it is not the case. There are only two possible explanations: stream captures rather common in fast up rising mountain chains but not in such slow flowing brooks of the Amazonian lowlands, or the use of the belt for floating grasses bordering the rivers, as proposed by Fittkau for downstream dispersal and in both directions, as we propose. The first may happen sporadically, the second, every year in high waters.

*** GALVIS, GERMAN; MOJICA, JOSE I.; LOBON-CERVIA, JAVIER; GRANADO, CARLOS; DUQUE, SANTIAGO**

Universidad Nacional de Colombia - (GG) Departamento de Biología; (MJI) Instituto de Ciencias Naturales; (DS) Instituto IMANI. Ciudad Universitaria, Bogotá, Colombia; (L-CJ) Museo Nacional de Ciencias Naturales - CSIC. C/. Jose Gutierrez Abascal, 2. 28006 Madrid- España; (GC) Universidad de Sevilla, Departamento de Ecología, Sevilla, España

Book: Fishes of the Leticia Region, Colombian Amazonia

This book is the result of a project: Fishes of the Leticia Region, comprising the Amazon river, its old channels locally called lakes and one forest stream. Those different biotopes have been sampled repeatedly during one year through the different climatic periods and sporadically for more than four years. 360 fish species have been identified of which 183 were captured in the forest stream 133 in the lakes and 109 in the river itself. Most surprising has been the high diversity found in the black water forest stream, a kind of biotope formerly described as extremely poor in nutrients, with low pH and rather simple fish community. Moreover, we discuss the faunistic relations existing between those 3 biotopes (river, channels and forest stream), their changes through the hydrological cycles and trophic and reproductive aspects of some of more important species. All species included are illustrated with pictures and drawings of key details for their fast identification and relevant ecological information. This project has been sponsored by CYTED of Spain, Universidad Nacional de Colombia and Fundacion Tropenbos Colombia.

GAMBLE, TONY

University of Minnesota, Conservation Biology Graduate Program, 100 Ecology, 1987 Upper Buford Circle, St. Paul, MN, 55108, USA

The impact of commercial harvest on painted turtles (*Chrysemys picta*)

Tens of thousands of painted turtles (*Chrysemys picta*) are commercially harvested in Minnesota each year for sale to biological supply companies and the pet trade. To date, little is known about the impact of this harvest on painted turtle populations. I sampled twelve harvested and

ten non-harvested lakes in Central Minnesota in 2001 and 2002 and used a multiple regression model to compare the relative abundance of painted turtles, measured as catch per unit effort, between lakes of different harvest status. I also looked at whether painted turtle populations subject to harvest exhibit differences in adult body size or sex ratio. The results of these analyses indicate that harvested lakes have a lower relative abundance of turtles than non-harvested lakes. There are also significant differences in the size but not sex ratios of painted turtles in harvested lakes compared to non-harvested lakes. I will discuss how these results are influenced both by painted turtle life history and turtle harvester behavior.

* **GARCEZ, RIVIANE; FERNANDES, FLORA M. C.; ALMEIDA-TOLEDO, LURDES F.**

Laboratório de Ictiogenética, Departamento de Biologia, Instituto de Biociências, Universidade de São Paulo, Rua do Matão 277, sala 237, São Paulo, SP, 05508-900, Brazil

Genetic variability of wild and farmed populations of *Prochilodus lineatus* (Characiformes: Prochilodontidae)

Prochilodus lineatus is a freshwater fish, of great economic importance in Brazil, and has been used in restocking programs of reservoirs and in fish farming. In order to analyze the impact that this farmed populations may cause in natural populations of *P. lineatus*, we carried out a study involving the restriction fragment length polymorphism of the displacement loop region of mtDNA, amplified by polymerase chain reaction, with five restriction enzymes (*Bam*HI, *Dde*I, *Dra*I, *Hinf*I and *Msp*I). A total of 101 specimens from five samples was analyzed: three were collected from wild populations [Mogi-Guaçu river, SP/BRA (n = 21), Paraguai river, PAR (n = 9) and Aquidauana river, MS/BRA (n = 8)], and two were collected from the fish farms of IBAMA-Chapécó, SC/BRA (n = 25) and CESP-Cachoeirinha, SP/BRA (n = 38). The results showed no variability in the IBAMA sample. In the CESP sample, the values of haplotype (h) and nucleotide diversity (π) ($h = 0.672$ and $\pi = 4.17\%$) showed a loss of variability when compared with wild populations ($h = 0.778$ and $\pi = 2.00\%$, for Mogi-Guaçu, $h = 0.861$ and $\pi = 3.39\%$, for Paraguai, $h = 0.857$ and $\pi = 3.50\%$, for Aquidauana). The results showed that, in the neighbor-joining tree, the related haplotypes has no relationship with the geographic distribution of populations. This indicates that *P. lineatus* populations may form a unique panmitic unit, and, if so, the introduction of farmed samples in the Paraná-Paraguai basin may, possibly, affect this unit. Our results involving farmed samples showed two different situations: the founder stock of the IBAMA sample is, probably, composed of individuals of the same F1 generation, or it may have been formed by a small number of specimens. In the CESP sample, on the other hand, part of the variability found in the wild populations was observed. Studies like this show the importance of molecular markers applied to fish farm, with the goal of conservation genetics of natural populations.

*** GARCIA, ALEXANDRE M.; RASEIRA, MARCELO B.; VIEIRA, JOÃO P.; WINEMILLER, KIRK O.; GRIMM, ALICE**

(AMG, JPV, MBR) Federal University of Rio Grande, Department of Oceanography, Rio Grande, RS, Brazil; (KOW) Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258, USA; (AG) Department of Physics, Federal University of Paraná, PR, Brazil

Inter-annual and spatial trends of shallow-water freshwater fishes in a large coastal lagoon in Brazil

Patos Lagoon is one of the largest coastal lagoons in the world covering an area of 10,360 km² (250 km long and 60 km wide). It has an estuarine zone restricted to the southern portion of the lagoon (ca. 10 % of total area), which is connected to the ocean via a single and narrow channel (4-km long and 740 m wide). Based on a standardized sampling protocol, we collected the shallow-water freshwater fishes focusing both the spatial and temporal scales. During 1-yr (2000-2001) we conducted 5 beach seine hauls in 11 beach stations along the longitudinal axis of the lagoon. Also, during a 5-yr period (1996-2001) we conducted 5 beach seine hauls in 4 beach stations located at the estuarine zone. Our goal was to estimate hydrological and physicochemical conditions associated with spatiotemporal variation in the abundance and diversity of freshwater fishes, and temporal dynamics of abundances of dominant fish orders. During our study, the region experienced two periods of average rainfall and two periods with above-average rainfall. The characids *Astyanax eigenmaniorum* and *Oligosarcus jenynsii* and the siluriform *Parapimelodus nigribarbis* were the most abundant freshwater fishes in the estuarine area during wet periods when water levels were higher and salinity was lower. Increases in the abundance of these species, all of which correspond to primary-division freshwater families, apparently were associated with transport from freshwater habitats and pulses of reproduction. Abundance of secondary freshwater families, such as poecillids and cichlids, were less correlated with hydrological conditions, and their patterns of occurrence indicated migration into the estuary from middle and upper reaches of the lagoon. Our findings indicate that freshwater discharge in the basin and expansion/retraction of freshwaters in the upper-middle lagoon determined patterns of freshwater fish abundance and diversity in the estuarine zone of the lower lagoon.

*** GARCIA, ALEXANDRE M.; VIEIRA, JOÃO P.; WINEMILLER, KIRK O.; GRIMM, ALICE; TEIXEIRA E SILVA, LILIANE**

(AMG, JPV, LTS) Department of Oceanography, Federal University of Rio Grande, RS, Brasil; (KOW) Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258, U.S.A.; (AG) Department of Physics, Federal University of Paraná, PR, Brazil

Strong El Niño events affect the fish assemblage and mullet fishery in a Brazilian estuary

The El Niño phenomenon refers to a warming of the tropical Pacific basin that occurs at intervals of 3-7 years. The 1982-83 and 1997-98 El Niño episodes represented the strongest warming observed since 1950. Meteorological impacts of these El Niño events were observed in locations throughout the world. In southern Brazil, El Niño events are associated with increased rainfall and higher freshwater discharge into Patos Lagoon, a large coastal lagoon that empties into the Atlantic Ocean. The estuarine zone of Patos Lagoon provides a nursery ground for coastal fishes including several species that support important artisanal fisheries. Our study analyzed shallow-water fish assemblage structure and dynamics in this estuary during the very strong El Niño of 1982-83 and 1997-98, and recruitment variability and artisanal landings of mullet *Mugil platanus* in the region. Most response variables showed greater differences

between El Niño and non-El Niño conditions during the 1997-98 event. Elevated rainfall and freshwater outflow during both El Niño episodes resulted in extremely low salinity in the estuary, which in turn was associated with lower abundance of juvenile fishes. In contrast, freshwater vagrant fishes expanded their ranges into the estuarine zone during both El Niño events. Both El Niño events seemed to negatively influence recruitment and the artisanal fishery of mullets. We hypothesize that a) high freshwater outflow during very strong El Niño events inhibits passive immigration of mullet recruits into the estuary, and/or b) strong El Niño episodes result in prolonged periods of near-zero salinity conditions in the estuary that negatively affect the aggregation of pre-spawning mullets and capture efficiency of artisanal fishers. Thus, predictive models of juvenile recruitment and management of the mullet stock in this region should include indicators of the onset of El Niño conditions in the Pacific Ocean, and its meteorological effects in southern Brazil.

*** GARCÍA, MIRTA; JAUREGUIZAR, ANDRÉS; PROTOGINO, LUCILA C.**

(MLG, LCP) Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET; División Zoología Vertebrados, Facultad de Ciencias Naturales y Museo, UNLP, Paseo del Bosque s/n, 1900 La Plata, Argentina; (AJ) Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET, Instituto Nacional de Investigación y Desarrollo Pesquero, INIDEP, Casilla de Correo 175, 7600 Mar del Plata, Argentina

Fish assemblages along a riverine-marine environment gradient

The Rio de la Plata estuary, located at 36 S on the Atlantic coast, drains the second largest basin in South America. While physicochemical and biotic gradients are known to occur along the gradient environment from the fresh and shallow water to marine and deeper water on the continental slope across the Rio de la Plata estuary, no studies to date have investigated how fish assemblages vary along the riverine - marine gradient. Cluster analysis and non-metric multidimensional scaling [MDS] were used to define spatial distribution of fish assemblages based on fish composition (presence-absence, abundance and biomass) and BIO-ENV process was used to estimate their association with depth, temperature and salinity of surface and bottom waters. The results of these analyses showed that fish community along the riverine-marine gradient was structured in four assemblages: Riverine, Estuarine, Shelf and Slope. These assemblages differed significantly in their species composition (ANOSIM), their fish composition was characterized by several common and discriminator species (SIMPER) and they were characterized by differing environmental conditions. Surface temperature and salinity were the environmental variables most strongly associated with the differences in assemblage structure among areas. The changes in assemblage structure between areas are gradual, with no sharp boundaries.

GARCÍA, VERÓNICA B.; * LUCIFORA, LUIS O.

(VBG) Universidad Nacional de Mar del Plata, Casilla de Correo 82, Correo Central, Mar del Plata 7600, Argentina; (LOL) Instituto Nacional de Investigación y Desarrollo Pesquero, Casilla de Correo 82, Correo Central, Mar del Plata 7600, Argentina

Predation on eggcases of skates (Rajidae) in the Southwestern Atlantic: quantification and life history implications

Mean predation rates (\pm SD) on eggcases of four skate species, *Bathyraja macloviana*, *B. albomaculata*, *Amblyraja doellojuradoi*, and *Psammobatis* spp., from the Southwestern Atlantic were estimated to be 0.151 (\pm 0.230), 0.423 (\pm 0.344), 0.254 (\pm 0.390), 0.150 (\pm 0.288), respectively. These

estimates are within the ranges reported elsewhere (14-40%). Eggcases of *B. albomaculata* were preyed on in higher proportion than expected from their abundance, and suffer a heavier predation rate where the snail *Trophon acanthodes* was present. Predation rates were not correlated with the thickness of the eggcase wall, which indicates that other factors (ecological or chemical) could explain this pattern. Five types of boreholes were found in the eggcases, one was attributable to muricid gastropods, one to naticid gastropods, a third type to an unknown gastropod (probably *Fusitriton magellanicus*), and the remaining were of unknown origin. Published cladistic analyses showed that skates are secondarily oviparous and maximized adaptations for a living in deep water. We suggest that oviparity in skates appeared as an adaptation to maximize fecundity (45-150 eggs per year, as compared to 2-18 pups annually or biannually in viviparous guitarfishes, the plesiomorphic sister clade of skates). If a predation rate of 24% (the mean of predation rate of all skate species studied to date) is applied to the range of fecundities reported for skates, the result is that 18-114 viable pups are produced annually per female skate. Even with a high mortality rate of 64% (the only direct estimate of natural mortality for any elasmobranch), each female skate produces 17-54 eggs annually. These values are higher than most elasmobranch fecundities. This maximization of fecundity is possible mainly because the fecundity of oviparous species is not limited by body size, as in viviparity. The protracted egg-laying season (4-12 months) of most skates (like in many other deep-sea fishes) maximizes the number of eggs laid.

* **GARDA, ADRIAN A.; COSTA, GABRIEL C.; COLLI, GUARINO R.; BÁO, SÔNIA N.**

(AAG) Department of Zoology, The University of Oklahoma, Norman, Oklahoma, 73072, USA; (GCC, GRC) Departamento de Zoologia, Universidade de Brasília, 70919-970, Brasília, DF, Brasil; (SNB) Departamento de Biologia Celular, Universidade de Brasília, 70919-970, Brasília, DF, Brasil

The spermatozoa of Pseudidae (Anura) and the correlation between anuran sperm ultrastructure and reproductive modes

We describe, for the first time, the sperm ultrastructure of the two genera of Pseudidae. According to sperm ultrastructure, the five species herein described can be separated in three groups: one containing *Pseudis paradoxa*, *P. bolbodactyla*, and *P. tocantins*, the second containing *P. minuta*, and the third containing *Lysapsus laevis*. The intermediate piece is similar in all species and auxiliary fibers and the undulating membrane are absent. In *Pseudis* a subacrosomal cone and a multilaminar structure (*P. minuta*) or a granular material (*P. paradoxa* group) is seen above the nucleus. *Lysapsus laevis* has only remnants of the subacrosomal cone. All species have peripheral fibers in the axoneme. Our results suggest that Pseudidae may be more related to Leptodactylidae than Hylidae, by virtue of shared characters with some Telmatobiinae. We tested the hypothesis of correlation between presence of undulating membrane and fertilization environments in anurans, using a Concentrated Changes Test (CCT) based upon Hay et al (1995) hypothesis of phylogenetic relationships among anuran families. Only a subset of the resolved topologies derived from Hay et al (1995) cladogram, where Ranoidea is the sister-group of Sooglossidae, produced significant probabilities of the CCT. Therefore, support for the correlation between sperm ultrastructure and fertilization environments in anurans is, at best, equivocal.

* **GAWLICKA, ANNA; HORN, MICHAEL H.**

Department of Biological Science, California State University Fullerton, 800 N. State College Blvd., Fullerton, CA, 92834-6850, USA

Glycogen storage and lipase activity in liver of carnivorous and herbivorous prickleback fishes (Stichaeidae): ontogenetic, dietary, and phylogenetic effects

We investigated possible diet-related specializations of the digestive system in four closely related carnivorous and herbivorous stichaeid fishes to determine whether these species are genetically predisposed to digest specific diets or whether they exhibit phenotypic plasticity of gut structure and function. Two of the four species, *Cebidichthys violaceus* and *Xiphister mucosus*, shift from carnivory to herbivory at a small size (45 mm SL), whereas the other two species, *X. mucosus* and *Anoplarchus purpureus*, remain carnivorous throughout life. We assessed liver structure and function using quantitative histochemistry (for glycogen storage) and quantitative enzyme histochemistry (nonspecific lipase activity) by comparing (one-way ANOVA, $n=3-5$) these capabilities in three feeding categories of the four target species: (1) small wild-caught juveniles representing the carnivorous condition before two of the species shift to herbivory; (2) large wild-caught juveniles representing the natural diet condition of the two carnivorous species and the two that have shifted to herbivory; and (3) large lab-fed juveniles produced by feeding a high-protein animal diet to small juveniles until they reached the size of the large wild-caught juveniles. Comparisons of glycogen storage and lipase activity in categories (1) vs. (2) allowed us to test for an ontogenetic effect, in (2) vs. (3) for a dietary effect, and within categories (1) and (2) for a phylogenetic effect. Our analysis to date shows some ontogenetic and dietary effects in both glycogen storage and lipase activity and indications of differences in the two clades represented by the four species based on our working phylogenetic hypothesis.

* **GEERINCKX, TOM; ADRIAENS, DOMINIQUE; TEUGELS, GUY G.; VERRAES, WALTER**

(TG, DA, WV) Ghent University, Vertebrate Morphology, K.L. Ledeganckstraat 35, 9000 Ghent, Belgium; (GGT) Africa Museum, Ichthyology Department, 3080 Tervuren, Belgium and KULeuven, Laboratory of Comparative Anatomy and Biodiversity, Leuvensesteenweg 13, 3000 Leuven, Belgium

New insights on the systematic status of two African catfish genera *Parauchenoglanis* and *Anaspidoglanis* (Siluriformes: Claroteidae)

In the past the catfish genus *Parauchenoglanis* was a good example of how taxonomical fallacies can tangle up systematics at the species and genus level. The erroneous description of a species, the description of the genus *Parauchenoglanis* based on this species, and the subsequent designation of this species as the type species caused a long-lasting misconception. Obscure species descriptions, juvenile and badly preserved type specimens, and poor communication between scientists added to the confusion. Therefore an in-depth systematic study has been carried out to renew the genus definition, and to determine which species are valid, and which have to be placed in synonymy. 294 specimens, including all type specimens, were examined on 67 metric, meristic and qualitative features. The metric data were statistically processed by means of principal components analysis (PCA). Only ten out of nineteen species are found to be valid. Some features that are important to recognize species in *Parauchenoglanis*, are the serration of the anterior edge of the pectoral spine, the shape of the caudal peduncle, the length of the barbels, the size of the adipose fin, the shape of the humeral process and the color pattern on the body. One species, *P. akiri*, appeared to differ substantially from all other species in the genus. Biometric as well as osteologic evidence reveals that this species should belong to the closely related genus *Anaspidoglanis*. As a consequence, both genera receive a slightly altered

diagnosis. For each valid species a correct description is given, and the area of distribution is determined.

*** GELSLEICHTER, JIM; SZABO, NANCY J.; MANIRE, C.A.; MORRIS, J.**

(JG, CAM, JM) *Elasmobranch Physiology and Environmental Biology Program, Center for Shark Research, Mote Marine Laboratory, Sarasota, FL 34236, USA; (NJS) Analytical Toxicology Core Laboratory, University of Florida, Gainesville, FL 32611, USA*

Organochlorine contaminants in sharks of the U.S. east coast

Even at sub-lethal concentrations of exposure, organochlorine contaminants such as pesticides and industrial chemicals pose significant health hazards to marine organisms. These compounds have been associated with a variety of health disorders in several taxa, especially those inhabiting increasingly degraded nearshore and estuarine habitats. Due to use of such regions as pupping and/or nursery grounds, certain shark species are often exposed to organochlorine contaminants at concentrations that may have detrimental effects on embryonic development, maturation, growth, and/or reproductive activity. However, despite the risks that such effects pose to these fishes, few studies have investigated the levels of these compounds in elasmobranch populations. To address such concerns, the present study describes organochlorine levels in three shark species (the bonnethead shark *Sphyrna tiburo*, blacktip shark *Carcharhinus limbatus*, and the sandbar shark *Carcharhinus plumbeus*) inhabiting estuaries and nearshore regions of the east coast of the United States. Topics including routes of exposure and potential effects of contaminant accumulation are discussed.

GERLANC, NICOLE M.

Kansas State University, Division of Biology, Manhattan, KS, 66506, USA

Bison wallows, chance, and frogs: does breeding habitat affect population dynamics in a prairie amphibian?

Western chorus frogs, *Pseudacris triseriata*, in a native tallgrass prairie ecosystem, breed primarily in bison wallows, which fill for a few days to a few weeks and in intermittent streams, which flow for 3-10 months a year. Thus, this species is ideal to use as a model to study the effects of breeding habitat choice on population dynamics and gene flow. Choice of breeding habitat could affect the population in two ways. First, habitat directly influences growth and development of tadpoles, determining the relative contribution of individuals from each habitat type to the next generation. Second, choice of breeding habitat over time may lead to formation of genetically distinct subpopulations because of differences in selection pressure on tadpoles developing in each type of habitat type and possible fidelity of breeding frogs to natal sites. I previously demonstrated that natal habitat differentially influenced life history responses of *P. triseriata* tadpoles to abiotic factors that vary between wallows and streams. Those results led me to conduct a mark-recapture study of population dynamics and an analysis of gene flow using microsatellites to test for possible barriers to gene flow within the tallgrass prairie population. Barriers to gene flow could result in local adaptation by western chorus frogs to each of the breeding habitats. Analysis of differentiation between the sample population of wallow breeding frogs and the sample population of stream breeding frogs indicated that these populations are not genetically distinct and that migration plays a crucial role in counteracting the potential for local adaptation in this system. Further, phenotypic plasticity, not genetic differences, is likely responsible for the differential responses of *P. triseriata* to their natal breeding habitat. This plasticity allows frogs to reproduce in both wallows and intermittent

streams, which is advantageous as climatic variation dictates which habitat is optimal in any specific year.

*** GERMANO, DAVID J.; BURY, R. BRUCE**

(DJG) Department of Biology, California State University, Bakersfield, Bakersfield, CA, 93311, USA;
(RBB) U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR, 97331, USA

Where have all the little turtles gone . . . long time passing?

Surveys for turtles generally yield few small-sized individuals, especially in comparison to larger sizes (subadult to adult). This often is interpreted as a lack of recruitment of juvenile in populations and that such turtle populations may be declining. Conservation concerns clearly may be justified in some cases, especially where all size classes are reduced in numbers. However, young turtles may exist in many populations and simply not be found in proportion to their numbers. We present data for *Clemmys marmorata* from northern California and for *Terrapene ornata luteola* from New Mexico that show that the apparent lack of young turtles did not result in significant decreases in numbers of turtles 25 and 10 years later, respectively. There were very few hatchling to 2 yr age classes in *C. marmorata*, but fair numbers at age 3 onward (when turtles are larger size). In New Mexico, few *T. o. luteola* were found until turtles were close to adult size (and were > 9 yrs old). Further, growth data for *C. marmorata* from the Central Valley and coastal California show that turtles grow extremely rapidly in these areas and that adult-sized turtles could be as young as 3 or 4 years old. These data indicate to us that in some cases young, small-sized turtles may be extremely hard to detect in natural habitat. If so, and if only size categories are used as an indication of age, then we might grossly misinterpret the demography and population trends. It may be prudent to model populations starting with older age groups for which we are reasonable sure we have censused accurately. For example, this may be age 3 and older in northern California *C. marmorata*. Further, time needs to be taken to estimate ages accurately using scute ring data and to validate aging for the population (usually through mark/recapture methods).

*** GEURGAS, SILVIA R.; RODRIGUES, MIGUEL T.; MORGANTE, JOÃO S.**

(SRG, JSM) Universidade de São Paulo, Depto de Biologia, Laboratório de Biologia Evolutiva e Conservação de Vertebrados (LABEC), São Paulo, SP, 05508-900, Brasil; (MTR) Universidade de São Paulo, Depto de Zoologia, São Paulo, SP, 05508-900, Brasil

Intraspecific analysis and phylogeny of *Coleodactylus* (Sphaerodactylinae, Gekkonidae)

The genus *Coleodactylus* belongs to the subfamily Sphaerodactylinae (Gekkonidae) and comprises 5 species that occur in the northern South American continent. The great relevance of *Coleodactylus* to the South American biogeography lies on its distribution. While the other Sphaerodactylinae genera range from northwest South America to Central America, *Coleodactylus* is the only one that occurs in the east of the continent, inhabiting both the Amazon and Atlantic forests, and open areas of Cerrado. Two taxa that are considered closely related species exhibit wide geographical discontinuity: *C. meridionalis* is found in the Atlantic forest in the northeastern Brazil, while *C. septentrionalis* occurs in the northwestern Amazon forest. The region between the range of these two species, the amazonic hylaea, is occupied by *C. amazonicus* which is possibly simpatric with *C. meridionalis* and *C. septentrionalis*. This work intends to access the intraspecific genetic variability, and understand the phylogenetic relationships within the genus. The first 408 base pairs from the mitochondrial gene cytochrome

b, representing 136 amino acids, were amplified and sequenced. From all species analyzed, *C. meridionalis* showed the lowest values of haplotype divergence (0.2 to 1.0%), followed by *C. amazonicus* (0.2 to 2.6%) and *C. brachystoma* (1.3 to 64.6%). The highest levels of sequence divergence ranged from 16.4 in *C. amazonicus* to 64.6% in *C. brachystoma*. Only two individuals from the same population were analyzed for *C. septentrionalis*. The phylogenetic relationships found in the present study are in disagreement with the current hypothesis suggested for this group. *C. meridionalis* is recovered as the sister taxa of *C. brachystoma*, and *C. septentrionalis* as the sister group of these two species. Besides, the hypothesis that *C. amazonicus* is derived from *C. meridionalis* is not confirmed. Financial support: FAPESP

GHAZZI, MIRIAM S.

Museu de Zoologia Universidade de São Paulo, Av. Nazare, 481, Sao Paulo, 04263-000, SP, Brazil

Systematics of the genus *Sturisoma* Swainson (Siluriformes, Loricariidae)

The species of *Sturisoma* Swainson are widely distributed in the major South American drainages. The species composition of the genus has been controversial and the interrelationships among the nominal species are not known. This is the first attempt to review the taxonomic status of the species and to propose a phylogenetic hypothesis of their relationships. Specimens of several drainages were examined and meristic and morphometric data as well as comparative skeletal data were used to characterize the species morphologically. The results obtained show that *Sturisoma* is a paraphyletic genus, composed of two clades. (1) Cis-Andean species group and (2) Trans-Andean species group characterized by synapomorphies of the branchial arches, Suspensorium, Weberian Apparatus and color pattern. The taxonomic revision revealed the presence of new species in Trans-Andean and Cis-Andean rivers.

*** GIBRAN, FERNANDO Z.; CASTRO, RICARDO M. C.**

(FZG, RMCC) Laboratório de Ictiologia de Ribeirão Preto (LIRP), Departamento de Biologia, FFCLRP-Universidade de São Paulo, Av. Bandeirantes 3900, Ribeirão Preto, SP, 14040-901, Brazil

Biology and ecomorphology of a coastal marine fish community in southeastern Brazil

In present study 67 coastal marine fish species from an approximately 25 km long stretch of the continental margin of the São Sebastião Channel, State of São Paulo, southeastern Brazil (approximately 23°49'44" S 45°25'24" W) were studied employing an ecomorphological and naturalistic approach. The fish species were chosen to represent the general fish morphology variance found in the community, and ecological data were obtained combining underwater and tide pool observations with data from the scientific literature. Nine one to two weeks long trimonthly field trips were made, resulting in a total of 140 hours of direct observations, including diurnal, nocturnal and crepuscular periods. *Ad libitum* and focal animal observations were performed in all types of principal habitats present at the study site (muddy and sandy beaches; rocky shores and reefs; surface, middle and bottom sections of the water column). Underwater observations were performed in depths up to 20 m and were documented with the help of underwater photography and video. For the ecomorphological analysis, measurements of 25 morphological features on 10 preserved individuals samples of each species (of the same sex and roughly the same size) were taken in the laboratory. With those measurements 19 ecomorphological attributes were calculated. The measured morphological features were selected based on inferred ecological significance. Principal component analysis and cluster analysis (multivariate statistics) are being employed to analyze the morphological similarity

among species, and these results, together with the ecological data being gathered from direct observations and the scientific literature, are being analyzed in the light of available hypothesis on the studied taxa evolutionary relationships (phylogenetic) to try to detect evolutionary divergence and convergence among them. Financial support: FAPESP (grant No. 00/06722-8 to FZG); CNPq (grant No. 301309/91-4 to RMCC) and PRONEX/FINEP/CNPq (grant No. 661058/1997-2). Logistical support: CEBIMar and FFCLRP-USP.

GIMENES, MICHELE F.; LOPES, CÉLIA A.; * BENEDITO-CECILIO, EVANILDE; MARTINELLI, L. A.

(MFG, CAL, EBC) Nupelia, University of Maringá, Avenue Colombo, 5790, 87020-900, Maringá, Paraná, Brasil; (LAM) CENA, University of São Paulo, Piracicaba, SP, Brasil

The sources of energy for benthic fishes in the Paraná river floodplain

The sediment is an important deposit of resources for the trophic chain, and one of the main ways flow of energy and nutrients for flooded areas. In this sense, the present work investigated the composition of the detritus using stable isotope of carbon and nitrogen to compare its with the exploiting benthic fishes from floodplain of Paraná river. It was collected samples of the sediment, primary producers (C_3 and C_4 macrophytes, periphyton, phytoplankton and riparian vegetation) and muscles of benthic fishes (*Prochilodus lineatus*, *Loricariichthys platymetopon* and *Liposarcus anisitsi*) in the sites of the Paraná, Baía and Ivinheima river between February/99 to March/03. The samples were prepared and sent to CENA/USP (SP), for identification of the proportions of the isotope ones. The organic matter of the sediment had larger contribution of the periphyton, followed by C_3 macrophytes and POC (Carbon Organic Particulate). Significant spatial differences were verified in the sediment (ANOVA: GL = 5; F = 7,8501; $p < 0.05$). In the Canal Baía was smallest medium values of ^{13}C was registered (-27.5 ± 0.6 ‰), while the largest happened in the Paraná river (-24.3 ± 1.2 ‰). In this last station the medium value of ^{15}N was the more negative (-14.4 ‰). The same tendency was observed for ^{13}C of fish (*P. lineatus*: Paraná = -24.7 ± 4.5 ‰ and Bay = -31.5 ± 2.6 ; *L. anisitsi*: river Paraná = -26.5 ‰ and Baía = -29.4 ± 1.8 ‰; and *L. platymetopon*: Paraná = -22.1 ± 3.6 ‰ and Baía = -26.6 ± 1.3 ‰). The largest values of the ^{15}N were verified in the Paraná river. These results suggest that the exploiting benthic species, be looking for in its sediment autothrophic resources, however the low value of ^{15}N of the sediment can be related with the fixation of nitrogen for the primary producers not being reflected by the fish.

*** GIORA, JÚLIA; FIALHO, CLARICE B.**

Universidade Federal do Rio Grande do Sul, Depto. Zoologia, Programa de Pós-Graduação em Biologia Animal, Av. Bento Gonçalves, 9500, bloco IV, Prédio 43435, Porto Alegre, RS, 91501-970, Brasil

Reproductive biology of *Eigenmannia virescens* (Valenciennes, 1842) (Teleostei, Sternopygidae) from Parque Estadual de Itapuã, RS, Brazil

Eigenmannia virescens is a gymnotiform fish that has been assigned as distributed in several rivers and ponds in South America. This paper analyses the reproductive biology of a population from the lagoa Negra, located in the Parque Estadual de Itapuã, a state conservation area in Rio Grande do Sul, Brazil. It is analyzed and described the reproductive period, spawning and fecundity. Samples were taken June 2002 to May 2003, with dip net. The reproductive period was estimated through the analysis of the monthly variation of the mean of the Gonadosomatic Index. Fecundity was estimated counting vitelogenic oocytes of mature females. Spawning was determined through the analysis of the largest diameter of the oocytes

in different stages of gonadal maturation. *Eigenmannia virescens* presents a short reproductive period, extending from October to December 2002, a relative fecundity of 0,27 oocytes per mg of body weight and parceled spawn. The sex ratio was 1:1 along the sampled months; it was detected a sexual dimorphism related to body length, with males larger than females.

GIVEN, MAC F.

Neumann College, Biology Program, Aston, PA, 19014-1298, USA

Why do pickerel frogs call underwater?

My purpose was to identify circumstances that would cause male pickerel frogs (*Rana palustris*) to call underwater. An informal survey of Pennsylvania ponds (USA) demonstrated that although males usually vocalize into the air from stationary calling sites, calling can occur exclusively underwater in some populations. Males have a complex vocal repertoire consisting of an advertisement call and two additional calls (snicker and growl) that are emitted during aggressive interactions. All call types are emitted into the air or underwater. I conducted several experimental manipulations with resident males that, initially, were calling above water. Three of these involved playbacks in which I presented males with either one conspecific advertisement call, or two minutes of continuous advertisement calling from *Pseudacris crucifer* or *Bufo americanus*. When I broadcast a conspecific advertisement call, eight of 14 males emitted underwater some combination of the three call types before calling above water again. In contrast, males did not call underwater in response to *P. crucifer* (N=5) or *B. americanus* (N=8) calls, although they often emitted snickers and growls in response to the toad stimuli. In a final experiment, I poked 11 males in the rear with either a pencil or the tip of a fishing rod. All but one male predictably moved underwater in response to the disturbance. Eight of these did not stop vocalizing and called underwater for up to four minutes before calling above water again. These data demonstrate that pickerel frogs can potentially communicate through both air and water, and that when threatened, it may be better to call underwater than to not call at all.

GLOR, RICHARD E.

Washington University, Department of Biology, Saint Louis, MO, 63130, USA

Testing factors that underlie geographic variation in dewlap color and pattern in *Anolis cristatellus*

The Puerto Rican crested anole (*Anolis cristatellus*) is a geographically variable species that occurs across the island of Puerto Rico. The dewlap of this species, which plays an important role in mate recognition and territorial defense, is particularly variable. Northern populations have a two-tone dewlap with an orange/red margin and greenish base, while populations from the south coast have a monotone yellow/orange dewlap. Recent studies suggest that such differences may have evolved to provide the signal that is best suited to the local light environment. In the present study, I use mtDNA sequence data and polymorphic microsatellite loci to test processes that have contributed to the evolution and maintenance of geographic variation in dewlap color and pattern. In particular, I test whether historical isolation of these populations has contributed to their differentiation and whether the observed variation is being maintained despite ongoing gene flow between the northern and southern populations.

*** GOMEZ-MESTRE, IVAN; WARKENTIN, KAREN M.**

Boston University, Department of Biology, 5 Cummington St., Boston, MA, 02215, USA

Embryo response to risk varies among species of leaf-breeding treefrogs, genus *Agalychnis*

Arboreal embryos of red-eyed treefrogs, *Agalychnis callidryas*, hatch prematurely in response to various egg-stage risks, including attack by egg-eating snakes and wasps, infection by pathogenic fungus, and submergence underwater (risk of drowning). Early hatching is an effective defense against egg-stage risks (ca. 80% escape from snakes and wasps), but early-hatched tadpoles are more vulnerable to aquatic predators. Similar risk-cued hatching plasticity occurs in several other anuran species, as well as in salamanders, fishes, and spiders. To understand its evolution, we need comparative studies including species that are unresponsive to risk, as well as risk-sensitive species. We examined embryo responses to risk in other species of *Agalychnis* to assess how variable they are across the genus, as a first step toward a phylogenetic analysis of the evolution of hatching plasticity. Like *A. callidryas*, both *A. spurrelli* and *A. annae* showed extended hatching periods (4-6 and 5-8 d after oviposition, respectively). *A. spurrelli* co-occurs with *A. callidryas* at breeding sites, and is also preyed upon by egg-eating snakes. However, when exposed to snake attack within the hatching period, the escape rate of *A. spurrelli* embryos was substantially less than that of *A. callidryas* eggs, averaging only 15%. Most embryos that were consumed showed no attempt at escape, remaining passive during the physical disturbance of their clutch. In contrast, *A. annae* clutches exposed to artificial mechanical disturbance (simulated predation), or to submergence underwater, hatched rapidly as much as 30% before the undisturbed hatching stage, much like *A. callidryas*. Also like *A. callidryas*, the survival of early-hatched *A. annae* with fish was less than that of later-hatched tadpoles, demonstrating a trade-off between egg- and larval-stage risks. Planned work will examine hatching responses to standardized risk treatments in other *Agalychnis* species and frame the results in a phylogenetic context.

GONZALEZ, DAVID B.

Brigham Young University, Dept. Int. Bio, Provo, UT, 84602, USA

Nested clade analysis of phylogenetic data in the Order *Salmoniformes*

We describe associations in the Order *Salmoniformes* using nested clade analysis as well as standard phylogenetic methods.

*** GONZALEZ, DAVID B.; BELK, MARK**

(DBG, MB) Brigham Young University, Dept. Int. Bio, Provo, UT, 84602, USA

Life-history constraints and behavioral compensation in *Gambusia affinis*

Life-history constraints in reptiles and birds have shown evidence of physical constraints on life-history events. This study examines volumetric body constraints with respect to performance intervals and related behavioral compensation in mosquitofish.

* **GONZALEZ, SHANNON M.; MUSHINSKY, HENRY R.; MCCOY, EARL D.**
University of South Florida, Department of Biology, Tampa, FL, 33620-5150, USA

Using anurans to measure wetland health on a central Florida, USA wellfield

Worldwide, biologists have documented a disappearance and/or decline of amphibian populations, species or groups of species. While much attention has been aimed at identifying large scale, or even global threats to anurans, evidence exists that local populations are in decline because of changes in their habitats. Many habitat alterations, deemed detrimental to anurans, are associated with increased human disturbance and urbanization. In Florida, such alterations are manifest in conversion of upland habitats to agriculture and development and more subtle alterations to aquatic habitats caused by groundwater pumping. The regional water supply authority estimates that approximately 502 million gallons of water was used per day in 2000 for public use in west-central Florida. Much of the public supply is groundwater pumped from large regional wellfields resulting in a lowering of the water table, and desiccation of wetland habitats. The effects of wellfield pumping have been assessed by periodic sampling of the vegetation and monitoring water levels. Our study assessed the relative health of anuran populations in selected cypress domes at a wellfield in central Florida to determine if current assessments based on vegetative measurements are mirrored by the health of anuran populations. Specifically, we used the number of calling males of each species and counts of anuran larvae to measure breeding activity and success in wetlands that exhibit different levels of degradation. Our assessments are based on twelve surveys for calling males and about 4,000 tadpoles representing 13 species over two years. Results indicated that anuran reproductive success could not be predicted accurately using vegetative factors alone. Reproductive success of anuran populations, however, could be predicted using a combination of vegetative data, presence of fish, and level and phenology of inundation in the wetland.

GONZÁLEZ-ACOSTA, ADRIÁN F.; DE LA CRUZ-AGÜERO, JOSÉ; * ORTIZ-GALINDO, JOSÉ LUIS; CASTRO-AGUIRRE, JOSÉ LUIS

Colección Ictiológica, Centro Interdisciplinario de Ciencias Marinas IPN, Apartado Postal 592, La Paz, Baja California Sur, México, C.P. 23096

Taxonomic revision of *Eugerres* spp., (Teleostei: Gerreidae), from the Eastern Tropical Pacific

A taxonomic and morphosystematic study was carried out on the fish species of the genus *Eugerres* from the Eastern Tropical Pacific. On the basis of the analysis of type specimens as well as other material from its range of distribution, and their respective diagnoses, a confusion was discovered in the ichthyological literature. This situation was originated by the wrong gill rakers numbers assigned to *E. axillaris* (Günther, 1864) and *E. lineatus* (Humboldt & Valenciennes, 1821) by Meek & Hildebrand (1925). On the basis of meristic analysis of specimens from several fish collections (BMNH, CAS, CICIMAR, ENCB, IBUNAM, SIO, UABC and UCR), was observed the presence of more than 15 (mode 17) gill rakers on the lower limb of the first branchial arch for *E. lineatus* [EL], which differs from the 11-14 (mode 13) gill rakers in *E. axillaris* [EA] and 12-13 (mode 13) in *E. brevimanus* (Günther 1864) [EB]. Morphometric analysis based on the traditional measurements of Hubbs & Lagler and box truss of Strauss & Bookstein were made, previous data transformation and excluding the standard length. An analysis of comparison by groups was applied for variables derived from both methods, showing differences in almost cases, except for the length of the pelvic fin between EL and EB ($p > 0.0659$). As well as differences in the distance among the second dorsal and anal spines ($p > 0.3548$), length of the third anal spine ($p > 0.1726$), and the distance isthmus-snout ($p > 0.1189$)

was observed between EA and EB. A discriminant analysis was applied for the separation in the multivariate space of the groups herein studied. Mahalanobis's distances between the groups using the traditional method were: EA-EL (24.3), EA-EB (68.33) and EL-EB (102.46). Whereas, using the box truss the distances were: EA-EL (18.58), EA-EB (24.17) and EL-EB (51.59). Both methods showed a great morphometric similarity between *E. axillaris* and *E. lineatus*, however they differ on the gill raker number. *E. brevimanus* is separated by possessing more pored scales on lateral line, besides shorter pectoral fins, and thicker lips. Finally, the nomenclatorial confusion between the complex EL-EA is clarified, therefore *E. lineatus* has more than 15 gill rakers (not 11) and *E. axillaris* has 12 or 13 gill rakers (not 15).

*** GONZALEZ-BACA, CRISTOPHER; CUARON, ALFREDO D.**

Departamento de Ecología de los Recursos Naturales, Instituto de Ecología, Universidad Nacional Autónoma de México, Apartado postal 27-3 (Xangari), Morelia, Michoacán, 58089, México

Foraging ecology of *Boa constrictor*, an introduced predator to a Caribbean island

Predation is one of the key processes in any natural system. Understanding of predation processes is particularly important in the case of introduced species in vulnerable ecosystems, such as the Caribbean islands. *Boa constrictor* was introduced onto Cozumel Island, Mexico, in the early 1970's. We describe boa diet patterns in Cozumel, considering prey abundance and habitat availability. From August 2001 to February 2003 we used nocturnal road transects by car around the island, and occasional encounters, to capture boas. We analyzed digestive tracts contents to estimate boa diet preferences. To estimate prey availability we used diurnal line transect sampling, intensive search plots, and Sherman and Havahart trap lines. Independent replicates were made on each vegetation type (subdeciduous tropical forest, deciduous low tropical forest and mangroves). Boas were generalist. The most common prey found in boas digestive tract were rodents and domestic chicken. Prey abundance varied among vegetation types. Our data indicate the species that are being affected by the introduction of the boa onto Cozumel, and their grim conservation status. Many of these species are endemic to the island. This information will assist management decisions in order to promote the conservation of the native biota of Cozumel.

GONZALEZ-CABELLO, A.

(AG) Centro de Investigaciones Biológicas del Noroeste, S.C. Mar Bermejo No. 195, Col. Playa Palo de Santa Rita, Apdo. Postal 128, La Paz, BCS, 23090, México

Spatial and temporal variability of cryptic reef fish assemblages on coral heads and rocky walls

Cryptic reef fishes have been subestimated in most of the community ecological studies. To understand assemblage dynamics and formulate hypotheses about the mechanisms that regulate diversity and species distribution, differences and similarities in assemblage patterns of two complex habitats (coral and rocky reefs) were compared. Bimonthly samples using quinaldine anesthetic were taken on isolated coral heads and rocky walls in 12 different sites of Bahia de La Paz, Gulf of California, Mexico. One hundred and ten species represented by 30 families were recorded. Gobiidae and Labrisomidae incorporate the greatest number of species. Dominant species on isolated coral heads were *Cirrhitichthys oxycephalus*, *Scorpaenodes xyris* and *Stegastes rectifraenum*, and on rocky walls were *Lythrypnus dalli*, *Scorpaenodes xyris* and *Apogon retrosella*. Differences in species richness, density and biomass between habitats were determined. Spatial variability in composition and abundance were detected on rocky walls, but

not on isolated coral heads. Coralline spatial uniformity may be related to the scarce availability of coralline areas in the Gulf of California. Temporal analysis showed no clear relationship between densities and temporal descriptors. A comparison between visual census and quinaldine methods revealed apparent differences in both species composition (visual census omitted up to 35% of the total species number) and dominance.

* **GONZALEZ-PORTER, GRACIA; RICHARD, VOGT**

Instituto de Biología, UNAM, Ciudad Universitaria, Mexico D.F.; Instituto Nacional de Pesquisas da Amazonia, Caixa Postal 478, Manaus, Amazonas, Brasil 69011-970

Captive and husbandry of *Abronia graminea* (Squamata: Anguidae): setting basis for a conservation program

Some conservation strategies were proposed involving the design of a captive management program for this population. I designed an environmental education program for this species and its habitat. I also proposed a design of facilities for captive breeding and research areas for the green alligator lizard *Abronia graminea*. I also developed an environmental education program for this species and its habitat, designed at local and general levels. This program will be applied informally through education by talks, workshops, creating audiovisual and multimedia material, and through the exhibition of the animals in naturalistic conditions. I studied the basic behavior and reproduction of *Abronia* in captivity. In the behavior study, 15 basic displays were categorized, and divided into postures, activities and interactions. Within the reproductive studies, sexual dimorphism, including sexual dichromatic forms presented in adults and juveniles, and significant differences within head length and width and tail base width, were described. In addition to sexual dimorphism, the study described the animal annual cycle. Copulation activities were observed during October and births between March and May. This coincides with a fall ovulation cycle with winter gestation. Newborns were monitored during their first year of life.

GOODSELL, T.L.

Applied Ecology Research Group, University of Canberra, A.C.T., 2601, Australia

Gene flow in highly variable environments: investigating the population structure of an Australian freshwater turtle

Flow in Australia's dryland rivers is dependant on variable rainfall patterns that result in episodic flooding events. The low topographic relief that is typical of arid Australia produces a complex river character that usually exists as isolated waterholes, although at times can extend into vast floodplains covering up to 100,000km². Connectivity of the aquatic populations that are resident in this river habitat range from being highly connected by floodplain, to being reduced in isolated waterholes. The freshwater turtle, *Emydura macquarii*, inhabits the waterholes of two dryland rivers in southwest Queensland. Waterholes in this environment vary in permanency and as this turtle is unable to travel far overland, populations inhabiting ephemeral waterholes are decimated periodically. Permanent waterholes form refugia; areas that enable organisms to persist during adverse conditions. This study investigated the genetic divergence and gene flow between populations of freshwater turtles in the Cooper Creek and Warrego River. Analysis of highly variable microsatellite loci were used to detect the population structure of *E. macquarii*. The genetic divergence, calculated with F_{ST} and R_{ST} estimates, of populations within and between the two dryland rivers were found to be among the highest reported for any freshwater turtle in the world. Migration was further investigated

by assigning individuals to populations using their multilocus genotypes. Gene flow was not present between the two river catchments, although a pattern of migration was revealed between populations within each separate catchment. Australia's unique dryland rivers, characterized by variation of flow and ranging in aquatic connectivity, have resulted in the development of highly structured turtle populations contained within a network of waterholes. Understanding these processes will guide future management plans toward a better conservation of dryland rivers and of the populations of freshwater turtles they sustain.

*** GORDON, NOAH M.; COSTANZO, JON P.; LEE, RICHARD E.**

Department of Zoology, Miami University, Oxford, OH, 45056, USA

Frozen or supercooled: determining overwintering strategies of hatchling turtles in the field, a novel method

Tolerance of temperatures below the equilibrium freezing point of tissue has been reported for several vertebrates. While it is well documented that some species of hatchling turtles can use either supercooling or freeze tolerance as a strategy to survive temperatures below the freezing point of tissues, the strategy that is actually employed by these turtles in the field remains a subject of some debate. Some laboratories (Packard *et al.*, 1997) have suggested that hatchling turtles use only supercooling as their survival mechanism, while others (Costanzo *et al.*, 1995) suggest the use of a mixed strategy – tolerance of freezing under some conditions and supercooling under others. Environmental factors such as ice nucleating agents, soil type, soil moisture content and seasonal variation in cryoprotective responses have complicated this issue and made it more difficult to determine the state of turtles based on laboratory experiments alone. We have devised an easily portable calorimetry system that permits discrimination between frozen or supercooled turtles in the field. Preliminary lab experiments indicate that this chamber can detect endotherms of thawing turtles (a signature of a frozen animal) within the biologically relevant range of -1.5 to -5.0 °C.

GRANT, JACQUALINE B.

Cornell University, Dept. Neurobiology and Behavior, Ithaca, NY, 14853, USA

Chemical underpinnings of an induced defense in gray treefrogs (*Hyla versicolor*)

Chemical alarm cues from tadpoles of gray treefrogs (*Hyla versicolor*) elicit distinct morphological changes, commonly called inducible defenses because they are only expressed when the threat of predation is imminent. The occurrence of this type of phenotypic plasticity in numerous taxa has recently generated several theoretical models explaining its evolution. These models predict that plasticity will evolve under the following circumstances: 1) the environment varies unpredictably; 2) no single phenotype is superior in all environments; 3) costs of plasticity are low; and 4) reliable cues about the state of the environment exist. Tadpole alarm cues are thought to be reliable indicators of predation levels because they are released only after other tadpoles have been attacked. However, since the exact structure of this cue is unknown, the dose-response relationship, variability among populations, and persistence of the cue, three important measures of reliability, are difficult to quantify. Primary predators of gray treefrog and other tadpoles are aquatic dragonfly nymphs: insatiable marauders of the pond community. Tadpoles exposed to low levels of predator activity have small, shallow tailfins with little pigmentation, while those exposed to high levels possess large, deep tailfins mottled with red and black. The red and black coloration is hypothesized to deflect attack toward the dispensable tailfin margins and away from the more vulnerable body and tail musculature. This

quantifiable morphological response makes the gray treefrog tadpole alarm cue an ideal candidate for chemical characterization. I present here initial findings concerning the chemistry of this defense.

GRAYSON, KRISTINE L.

Davidson College, Dept. Biology, Davidson, NC, 28035-7118, USA

Seasonal body temperature variation in the eastern painted turtle (*Chrysemys picta*)

For ectotherms, body temperature plays an important role in many aspects of their ecology including their activity, metabolism, and growth. Unfortunately, little is known about the temperature variation of most ectotherms, especially in free-ranging animals. To measure body temperature variation, we attached newly developed micro-dataloggers (iButton Thermochrons, Dallas Semiconductor) to the carapaces of free-ranging painted turtles (*Chrysemys picta*) in a farm pond located in Davidson, NC. Environmental temperatures were simultaneously monitored using Onset dataloggers. We successfully recorded body temperature variation in 18 turtles from September 2001 to April 2002 and 14 turtles from April 2002 to October 2002. Periods of basking were most frequent in the spring and fall months. Significantly more basking events took place during the spring. Body temperatures steadily decreased through the fall and basking events continued throughout the middle of December. Minimum yearly temperatures (1-3° C) occurred on the same day (January 3, 2002) for all turtles. Body temperatures then steadily rose until basking resumed in February. During the summer, turtles were able to achieve body temperatures similar to those achieved via basking during cooler months, apparently without leaving the water. The average minimum weekly temperatures were significantly higher in females while the average maximum weekly temperatures were significantly higher in males. We suspect this difference is influenced by the significantly larger body sizes of female turtles. This research demonstrates the effectiveness of iButton Thermochrons for measuring body temperature in small reptiles and provides the first critical step in developing a more complete understanding of painted turtle thermal biology. This research was funded by grants to KG from Sigma Xi and the North Carolina Academy of Science.

*** GRAZZIOTIN, FELIPE G.; MONZEL, MARKUS; LEMA, THALES; ECHEVERRIGARAY, SERGIO; WÜSTER, WOLFGANG; BONATTO, SANDRO**

(FGG, TL) Pontifícia Universidade Católica do Rio Grande do Sul, Museu de Ciências e Tecnologia, Laboratório de Herpetologia, Av. Ipiranga 6691, CEP 90619900, Porto Alegre, RS, BR; (MM) Universität Trier, Biogeographie Universitätsring 15 D - 54286, Trier, DE; (SE) Universidade de Caxias do Sul, Instituto de Biotecnologia, Laboratório de Biotecnologia Vegetal, Rua Francisco Getulio Vargas, 1130, CEP: 95070560, Caxias do Sul, RS, BR; (WW) University of Wales, School of Biological Sciences, Bangor LL57 2UW, UK; (SLB) Pontifícia Universidade Católica do Rio Grande do Sul, Faculdade de Biociências, Centro de Biologia Genômica e Molecular, Av. Ipiranga, 6691, CEP 90619900, Porto Alegre, RS, BR

Study of the mitochondrial diversity in *Bothrops jararaca*

Bothrops jararaca is a serpent distributed in the most populated areas of Brazil, in the region that would represent the original area of Atlantic Forest, mainly in the states of both south and SE of Brazil. Its morphological variation is very great, mainly in the background coloration and in the drawing patterns. However, nothing is known about the genetic variability of the populations and their evolutive history. The aim of our project is to evaluate the variability of mitochondrial

regions (cytochrome b, control region and NAD4) along the distribution of *B. jararaca*, and thus to estimate both the genetic diversity and genetic flow, to infer on the demographic processes, to assess the geographic structure of the variability and to interpret the evolutive process. We got 237 samples of 114 localities from seven Brazilian states. We used skin, blood and liver for DNA extraction, through four distinct methods, depending on the type of material used and its way of storage. The regions of the mitochondrial DNA have been amplified by PCR and the sequencing have been carried out using MegaBACE 1000 and ABI 377. The diversity analyses have been performed with MEGA using Kimura-2 parameter. We point out the use of formalized materials for the DNA extraction, from which we got a 30% average of success in the amplification of small fragments (<600pb) and in some samples it was possible to amplify fragments of 1,8 Kbp with a good quality. Comparing *B. jararaca* with other species, we found a difference of 300pb in the amplified region of 2,8Kbp (tRNA-Glu at the beginning of the 12S rRNA) in relation to both *B. atrox* and *Crotalus durissus* and of 100 bp in relation to *B. insularis*. The preliminary results about the phylogeography show two phylogroups: one conformed by Sao Paulo and northward and the other by Parana and southward. They have a similar within group diversity (0,024 and 0,031), and the between groups diversity is of 0,030. The topology of the NJ tree (using *B. erythromelas* as an outgroup) shows the monophyly of the two groups of *B. jararaca*, while *B. insularis* is included in the northern group of *B. jararaca*.

GREBEL, JOANNA M.

Moss Landing Marine Laboratories, 8272 Moss Landing Rd, Moss Landing, CA 95039, USA

Age, growth, and maturity of cabezon, *Scorpaenichthys marmoratus*, in California

The cabezon, *Scorpaenichthys marmoratus*, is a major component of the live fish fishery along the western United States with landings averaging 240,000 lb since 1995. Though size and catch regulations for both commercial and recreational fishing exist, they are based on limited scientific information and important life history information is missing in this species. This research provides comprehensive age estimates and maturity analysis of cabezon in California using four ageing structures. Ages were first estimated from sectioned otoliths producing von Bertalanffy growth parameters indicating that females grow slower and reach a larger size ($L_{inf}=6968.05$, $k=0.13$, $t_0=-2.81$ ($n=181$)) than males ($L_{inf}=466.23$, $k=0.42$, $t_0=-1.28$ ($n=161$)). Both sexes reached a maximum age of 14 years in this study. Sectioned dorsal spines, dorsal fin rays, and vertebrae were examined for potential use as alternative ageing structures. Multiple structural comparisons of the first three methods revealed that dorsal fin ray counts were similar to those of otoliths, while dorsal spine counts were less reliable. Males reach sexual maturity at a smaller size (10%=160 mm, 50%=271 mm, 90%=355 mm) than females (10%=175 mm, 50%=301 mm, 90%=400mm). Efforts are underway to examine vertebrae as an ageing structure and to attempt validation of otolith ages by edge analysis.

*** GREGORY, PATRICK T.; ISAAC, LEIGH ANNE; GRIFFITHS, RICHARD A.**

(PTG, LAI) Department of Biology, University of Victoria, PO Box 3020, Victoria, BC, Canada V8W 3N5; (RAG) The Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent CT2 7NS, UK

Playing dead: responses of grass snakes (*Natrix natrix*) to capture by human predators

Snakes exhibit a wide diversity of apparent defensive behaviours. One of the most peculiar of these is death-feigning, which may have links with tonic immobility, a common response of animals to predators. In snakes, death-feigning has been reported in three families, wherein it is

likely convergent, but it is perhaps best known and most frequently seen in the North American hognose snakes (*Heterodon*) and the grass snake (*Natrix natrix*). During a study of the ecology of grass snakes near Canterbury, UK, we recorded incidence of death-feigning and potential correlates of this behaviour. A majority of snakes feigned death, but there was wide variation in the extent of display and the timing of its onset during handling. There was no difference in occurrence of death-feigning between the sexes, nor could we detect effects of feeding status, time of season, or most other factors. Data on consistency of behaviours within individuals were equivocal, largely because of low recapture rate. However, hatchlings showed no sign of death-feigning behaviour and there was a strongly significant increase in occurrence of death-feigning with increasing body size. Further, at a given body size, snakes with stumped tails were less likely to feign death than were those with intact tails. Interpretation of these results is hampered by lack of observations of encounters between snakes and their natural prey in the field.

*** GRIFFITHS, RICHARD A.; GRAUE WIECHERS, VIRGINIA; BRIDE, IAN G.**

(RAG, IGB) *The Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent CT2 7NS, UK;* (VGW) *Centro de Investigaciones Biológicas y Acuícolas de Cuernavaca (CIBAC), Universidad Autónoma Metropolitana, Unidad Xochimilco, Calzada del Heuso No. 1100, Col. Villa Quietad, Deleg. Coyoacán, México 04960, Mexico*

A recovery programme for the axolotl at Lake Xochimilco, Mexico

The Mexican axolotl (*Ambystoma mexicanum*) is a conservation paradox. Endemic to the remnant canals of Lake Xochimilco on the edge of Mexico City, the species is facing extensive habitat loss, pollution, introduced predators and collection for human consumption. It is therefore one of the most threatened amphibians in Latin America. On the other hand, the species is widespread throughout the world in laboratories and aquaria, where its reproductive biology has been extensively studied. A recovery programme for the axolotl has been formulated based around a partnership of Mexican, North American and British institutions and with funding from the British government's Darwin Initiative programme. The programme is focusing on promoting the axolotl as a flagship species at Xochimilco through ecotourism and conservation education initiatives. These initiatives aim to capitalize upon Lake Xochimilco's importance as a recreation area for local and international visitors by building capacity among local stakeholders. Parallel work is being conducted on censusing the wild population and mitigating the human threats. The recovery programme is therefore embracing the socio-economic - as well as the biological - issues that the axolotl is faced with. Such a multidisciplinary approach is essential in conservation programmes that impinge upon the livelihoods and interests of local people.

*** GRIFFITHS, RICHARD A.; KRAAIJEVELD-SMIT, F.; MOORE, ROBIN D.; BEEBEE, TREVOR J. C.**

(RAG, FK-S, RDM) *The Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent CT2 7NS, UK;* (FK-S, TJCB) *School of Biological Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QG, UK*

Does captive breeding result in maladapted stock for reintroduction? A test using an endangered amphibian

The conservation programme for the Mallorcan midwife toad (*Alytes muletensis*) represents one of the most successful captive breeding and reintroduction projects of any endangered amphibian. A small number of toads was collected from one population in the mid 1980's to

found a captive colony, and reintroductions of animals produced from this stock have been carried out since 1989. These have resulted in the establishment of several new populations on the island of Mallorca. However, it is important to determine whether such reintroduced populations have suffered any maladaptations as a result of the small number of founders used to start the captive colony. Particularly important for *A. muletensis* is its ability to respond appropriately to natural and introduced predators on the island. We compared the antipredator responses of naive tadpoles from a reintroduced (i.e. potentially bottlenecked) population with those from a natural population. Tadpoles from the reintroduced population showed no reduction in antipredator responses to the snake *Natrix maura*, the principle predator of the toad. Tadpoles from both populations reduced activity and had deeper tail-muscles relative to controls when exposed to chemical cues from snakes. Both natural and reintroduced populations have therefore retained the ability to respond to predators, which is an important component of fitness. Heterozygosity levels at 10 microsatellite loci were positively related to tail muscle depth. We also investigated genetic diversity in five natural populations and one reintroduced population. Populations were genetically highly differentiated but varied in their genetic variability. It is reassuring that reintroduced *Alytes muletensis* appear to have retained antipredator responses and a relatively high degree of genetic variability despite multiple generations of captive breeding.

*** GUARINO, FIORENZO; GEORGES, ARTHUR; WEBSTER, IAN; THOMS, MARTIN; DOODY, J. SEAN**

(FG, AG, MT, JSD) Applied Ecology Research Group and CRC Freshwater Ecology, University of Canberra, ACT, 2601, Australia; (IW) CSIRO Division of Land and Water, Canberra, ACT, 2602, Australia

Modelling the impact of water extraction on a flag-ship species, the pig-nosed turtle (*Carettochelys insculpta*)

Alteration of the hydrological regime is arguably the most serious and continuing threat to the sustainability of river ecosystems. Flow regimes and ecological water requirements of rivers must be understood before setting appropriate environmental flows for large-scale agricultural developments. We modelled the impact of potential flow reduction on dry-season river connectivity and water temperatures in the Daly River, Australia (a catchment targeted for extensive agricultural development) and explored the impact this would have on the life history and viability of a flagship species, the pig-nosed turtle (*Carettochelys insculpta*). Surprisingly, the issue of fixed flow allocation in our study emerged as not one of what reduction leads to an unsatisfactory outcome in a given year, but rather what reduction leads to an unacceptable increase in the frequency of unsatisfactory years. For example, high-flow years, important for sustaining turtle populations, reduce in frequency from 1 in every 5 years to 1 in 10 years. The major conclusion to come from this analysis is that the maintenance of natural patterns of river connectivity is essential to the viability of pig-nosed turtles and possibly those fish and other aquatic species with concordant requirements. Adverse impact on these species would be regarded as major degradation of the riverine environment.

*** GUERRA-FUENTES, RICARDO A.; ZAHER, HUSSAM**

(RAGF) (HZ) Museu de Zoologia-USP, Av. Nazare # 481, CEP 04263-000, Sao Paulo/SP, Brasil

Description of the development of the skull in *Polychrus acutirostris* (Squamata: Polychrotidae)

The present work represents the first description of the ontogenetic development of the skull of an "iguanid" lizard, *Polychrus acutirostris* (Squamata: Polychrotidae). Clearing and staining procedure and histological sections were used to study an ontogenetic series of 29 embryos. This series consist of individuals from 10 to 241 days of age. The development of chondrocranium and dermatocranium are described. Data obtained are compared to chondrocranial embryonic developmental patterns described for the non-"iguanid" lizards. Synapomorphies regarded in morphological analyses as supporting the clades Iguania and Chamaleontidae are also re-described and discussed under an ontogenetic viewpoint. The chondrocranial developmental pattern of *Polychrus acutirostris* is typical of lizards in general, showing a cartilaginous tissue reduction of the orbito-temporal region and a single origin of the basal plate. On the other hand, several aspects are peculiar of the species. As an example, the *crista sellaris* in *Polychrus acutirostris* forms by the development of the anterior corners of the basal plate, fusing together in the medial region. This represents a deviation of the common pattern described for the non-"iguanid" lizards. Concerning the dermatocranium, the lacrimal and posfrontal are absent in the adult of *Polychrus acutirostris*. During the ontogeny of the cranium the corresponding ossifying centers of these bones fail to develop which explains their absences in adult specimens.

*** GUIMARÃES, LORENA D.; PINTO, RICARDO M.**

Universidade Estadual de Goiás, Unidade Universitária de Morrinhos, Rua 14, n°625, Jardim América, Morrinhos, Goiás, 75650-000, Brasil

Herpetofaunal community of Morrinhos, south of the State of Goiás, Brasil

This work was made in the city of Morrinhos, south of the State of Goiás, during the months of October 2002 to April 2003, a rainy period on the area. The objective was to do a rise of the communities of the amphibians of the area, comparing the diversity and abundance between four types of atmospheres (altered swamp, swamp associated to the forest and associated swamp the savannah sensu strictu and ciliary forest), and to describe the ranches used for vocalization. An effort of two hours sample was accomplished to each area. Were found representative animals of the families: Bufonidae (two species), Hylidae (ten species), Leptodactylidae (ten species) and Microhylidae (one species). After the rise, it noticed that the species *Hyla* gr. *rubicundula* presented bigger abundance compared to other species. The species *Barycholos savagei* the one with smaller abundance being found only one sample of that species. Compared to the ranches occupied for vocalization; 36.3% of the species were found on the ground, 31.8% on bushes and 31.8% on puddles. For the four atmospheres showed, 37.4% were founded on altered swamp, 5.3% on swamp associated to the forest and on ciliary forest and the area with bigger abundance was the associated swamp the savannah sensu strictu with 57.1% of the found species.

GUTIERREZ-C, PAUL DA.; * PAEZ, VIVIAN P.; BOCK, BRIAN C.

(PDAGC y VPP) Instituto de Biología, Universidad de Antioquia, Medellín, Colombia; (BCB) Departamento de Ciencias Forestales, Universidad Nacional de Colombia, sede Medellín, Medellín, Colombia

Biogeographic analysis of amphibian diversity in Antioquia Department, Colombia

Antioquia is the most diverse department in Colombia in terms of its amphibian fauna, containing 219 (30%) of the 724 known Colombian species. Altitudinally, the premontane forest life zone is the most diverse, followed by lowland forests. In these two forest types, species of the genus *Eleutherodactylus* predominate (44% of the total fauna). Biogeographically, the Andean region contains 82% of the amphibian fauna of Antioquia, while the Pacific zone contains 31%. Lynch recognized 10 ecogeographic regions in Colombia, of which four occur in Antioquia (Choco, Caribbean and Interandean valleys, Western Cordillera, and Central Cordillera). Within this classification, the two cordilleras are the most diverse, sharing 89 species, with *Eleutherodactylus* species comprising 38%. The Caribbean and Interandean valley ecogeographic region is dominated by hylids and is second in terms of amphibian diversity, followed by the Choco. Thus, in Antioquia as in Colombia as a whole, the greatest amphibian diversity occurs in the mountainous habitats, especially between 800 and 1700 m elevation. This is precisely the prime coffee growing region of Colombia, where economic incentives for alteration of natural habitats is high, increasing the risk of losing a significant portion of this highly diverse amphibian fauna.

HAAG, WENDELL R.

USDA Forest Service, Center for Bottomland Hardwoods Research, 1000 Front Street, Oxford, MS, 38655, USA

Strong evolutionary linkages between fish and freshwater mussels in the eastern United States

The diverse freshwater fish and mussel faunas of the eastern United States are intimately linked through a host-parasite relationship in which mussel larvae are obligate parasites on fishes. Because many mussel species have a high degree of host specificity, attributes of fish communities are important in influencing the species composition and abundance of mussel communities. I examined patterns of host-fish use and host infection strategies in mussel communities in the eastern United States. Overall, communities of host-specialist mussels parasitized an average of 44% of available fish species. Although host-fish use differs widely among many mussel species, mean niche overlap in host use in these communities was no different, or greater, than predicted by null models of host use. However, variances of average overlap values were significantly greater than predicted by null models. These results suggest that mussel communities are organized into host-use guilds that have low overlap in host use among guilds, but high overlap within guilds. Mussel species within a guild share similar, elaborate host infection strategies that increase the likelihood of successful transmission of their larvae to host-fishes. Infection strategies differ among guilds and reduce the likelihood of infection of unsuitable host-fishes by targeting specific feeding guilds and exploiting predator-prey relationships of fishes. These close fish-mussel relationships illustrate the high degree to which adaptive radiation of the North American freshwater mussel fauna has occurred in concert with the radiation of their host-fishes.

*** HABIT, EVELYN; VICTORIANO, PEDRO; RODRIGUEZ-RUIZ, AMADORA**

Universidad del Bío-Bío, Departamento de Química, Facultad de Ciencias y Centro de Ciencias Ambientales, EULA-Chile, Concepción, Chile; Universidad de Concepción, Departamento de Zoología, Facultad de Ciencias Naturales y Oceanográficas, Concepción, Chile; Universidad de Sevilla, Departamento de Biología Vegetal y Ecología, Facultad de Ciencias, Sevilla, España

Spatial and temporal variations of the fish assemblage of a low order fluvial system (Chile)

The Nonguen stream (order 3) is a lower zone tributary of the Andalien river coastal mountain basin (Biobio Region, Chile) which displays a marked difference between its rithral sector (well-conserved and with a secondary *Nothofagus* forest) and its potamal area (urbanly-used and organically polluted waters). This contrast could imply an alteration in the normal pattern of Chilean ichthyofauna, as described for a variety of fluvial systems in the country: a downstream increase in numbers of species, individuals, and diversity downstream, as well as increased corporal sizes of individuals in the lower zones of the river. Species composition of fishes of the Nonguen stream and their community patterns along the fluvial system within an annual cycle have been studied. The results show a high number of species in the lower parts, i.e. four species in the rithron and ten in the river mouth. The diversity, abundance and distribution of the fishes varied according to the season of the year, reflecting displacements associated with the fauna's ontogeny, reproduction and feeding. The sampling stations of the middle and lower zones of the river presented an assemblage with smaller individuals than those found at the head of the river, with the consistent dominance of larger salmonidae in the upper zone. Accordingly, it is suggested that: (i) the alteration of the potamal area does not significantly modify the characteristic patterns of ichthyofauna in fluvial systems, and (ii) the Nonguen stream is a reproduction and growth system for juveniles of both native and introduced species which make up permanent associations in the fluvial system.

*** HADDAD, CÉLIO F. B.; FAIVOVICH, JULIAN; GARCIA, PAULO C. A.**

(CFBH, PCAG) Departamento de Zoologia, Universidade Estadual Paulista, Cx. Postal 199, 13506-900 Rio Claro, São Paulo, Brasil; (JF) Herpetology, Division of Vertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, New York, NY, USA; and Division Herpetologia, Museo Argentino de Ciencias Naturales, Angel Gallardo 470, 1405 Buenos Aires, Argentina

Systematic implication of the specialized reproductive mode of the treefrog *Aplastodiscus perviridis* (Anura: Hylidae)

Males of the South American treefrog *Aplastodiscus perviridis* construct concealed subterranean nests near ponds or streams. Using a complex courtship behavior, that involves touches and vocalizations, males guide the females to the subterranean nests where eggs are laid. Embryos and facultatively oophagous tadpoles (at least in stage 25) stay in subterranean nests until flooding transports them to ponds or streams. This is a rare reproductive mode previously known for few species. *Aplastodiscus perviridis*, *Hyla cavicola*, and *H. leucopygia*, and perhaps *H. albosignata* and *H. callipygia*, are the only hylids known to have this distinctive reproductive mode. All the species referred above are included in the *Hyla albosignata* complex, except *A. perviridis*. Based on the lack of clear synapomorphies, some authors have used the combination *Hyla perviridis*, considering *Aplastodiscus* to be a synonym of *Hyla*. Considering the reproductive mode, the species in the genus *Aplastodiscus* and in the *H. albosignata* complex may have had a monophyletic origin. If true all the involved species should belong to the same genus.

*** HALLER, ÉRICA CRISTINA P.; RODRIGUES, MIGUEL T.**

Departament of Zoology, Institute of Biosciences, University of São Paulo, São Paulo, São Paulo, 05508-090, Brazil

Reproductive biology of *Podocnemis sextuberculata* Cornalia, 1849, in Biological Reserve of Rio Trombetas, Para, Brazil

Conservation of Amazonian turtles is important to preserve the biological diversity and the high economic and social value they have to development of this area. The reproductive biology of *Podocnemis sextuberculata* was investigated along two consecutive years (2000 and 2001) at Reserva Biologica do Rio Trombetas, state of Para, Brazil. The nesting behavior of females presents the following phases: the females walk on the beach, with occasional pauses, looking for a proper place to the nest; once the place is selected they start digging with the hind limbs, the egg are laying and, they fill in the nest with sand using the hind limbs alternately; finally they stamp and sweep the sand on the nest and return to river. Egg laying was observed during night from 20:30h to 04:30h. Carapace length is positively correlated to carapace width, skull height, length and width of plastron, head width, tail length, weight, and minimum and maximum width of foot-print. Female carapace length is positively correlated to number of eggs, average weight, and average volume of eggs. Our data suggests that larger females produce more, larger, and heavier eggs. In both years, the reproductive activity started by middle September and the egg laying extended until middle October. Clutch size varied from 8 to 24 eggs (mean = 15) in both years. Incubation period varied from 48 to 64 days (mean = 57). In these two years of study, the eclosion finished about one month before the beginning of the rainy season. Manipulated eggs undergone larger periods of incubation and lower hatching success than non manipulated eggs. Eggs of selected clutches were measured regularly (each 10 days or each 20 days) until eclosion. The egg development of both *Podocnemis sextuberculata* and *P. unifilis* suggests that eggs increase in volume and weight from the laying until the 40th day of incubation. Although the study area is protected by law, the females, nests and neonates are still highly predated, since they are used as food resource.

*** HALSTEAD, BRIAN J.; MUSHINSKY, HENRY R.; DELIS, PABLO; MCCOY, EARL D.**

(BJH, HRM, EDM) University of South Florida, Department of Biology, 4202 E. Fowler Ave., SCA 110, Tampa, FL, 33620, USA; (PD) Shippensburg University, Biology Department, 1871 Old Main Drive, FSC 335, Shippensburg, PA, 17257, USA

Spatial and temporal mechanisms affecting anuran population fluctuations in Florida sandhill habitat

A global decline in amphibian populations has been noted by the scientific community for the past 15 years. Few long-term studies exist that demonstrate that population fluctuations are, in fact, long-term declines. We examined the abundance and diversity of amphibian populations on 12 study plots in xeric upland sandhill habitat surrounded by a riverine swamp in Hillsborough County, Florida. The study plots varied in prescribed burn regimen and distance from wetlands. Study plots were examined for up to seven years (1982-1988). We captured 2,396 individuals from 13 species; the four most abundant species accounted for over 90% of the individuals captured. These four species' annual abundances varied considerably and asynchronously during the course of the study. Ordination methods were used to examine the relationships between spatial (burn regimen, distance from wetland) and temporal (weather data, time since last burn) variables and abundance patterns of each species. Results reinforce the difficulty in describing long-term population trends in amphibian abundance and provide

hypotheses regarding the interaction of spatial and temporal mechanisms resulting in population fluctuations. Understanding the role of natural fluctuations in amphibian population biology is essential for addressing potential global amphibian declines.

* **HALSTEAD, NEAL T.; MUSHINSKY, HENRY R.; MCCOY, EARL D.**

University of South Florida, Department of Biology, 4202 E. Fowler Ave. SCA 110, Tampa, FL, 33620, USA

Temporal and spatial effects of prescribed fire on reptile abundance and diversity

Historically fire has been an important factor in the maintenance of sandhill habitat in south-central Florida. Frequency of prescribed burning in fire-suppressed areas has been shown to have differential effects on demography of reptiles. Data on long-term effects of prescribed burn regimes on reptile abundance and diversity are critical for making wise management decisions. Prescribed burning of an area of sandhill habitat in west-central Florida began in the late 1960s. Twelve plots in this area have been burned on 1, 2, 5 and 7-year intervals since the early 1980s. Reference plots have not been burned since the 1960s. Data collected on reptile species using pitfall trap arrays from 1985-7 indicated that *Cnemidophorus sexlineatus*, *Eumeces inexpectatus* and *Tantilla relicta* were the three most abundant species. Research initiated in 2003 will assess the long-term effects of controlled burns on those and other reptile species. Abundance and diversity of reptile species will be analyzed and effects within and between sampling events determined.

HAMPTON, PAUL M.

University of Texas at Tyler, Dept. of Biology, Tyler, TX 75799, USA

Habitat use by herpetofauna in a disturbed floodplain in East Texas

Bottomland forests are among the most important ecosystems in North America. Several species of amphibians and reptiles are dependent upon the ephemeral pools, and high primary production found in bottomland forests. Due to logging and human activities, the area of this valuable habitat has been greatly reduced. Herpetofauna abundance and diversity were measured around ephemeral pools in three habitats (food plots, near oil pumps, and forest) at the Old Sabine Wildlife Management Area, Smith County, in northeastern Texas. Cover items, dipnetting and minnow traps were used to capture individuals. Morphometrics of individuals at each site were compared to determine population health. Habitat measurements and water quality were collected to compare each site. Various trends were observed among species. For example, Ambystomids were more abundant in the forest plots, while Ranids utilized the food plot pools for reproduction. Reptiles were found to be more abundant in the open canopy of the food plots and oil pumps.
