Appendix

Abstracts of presentations hold on DeAgamis the 1st International Symposium on Agamid Lizards

Oral Presentations

History of Classifications and Phylogenies

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Darwin in his 1859 "Origin of species ..." eloquently demonstrated that taxonomic classifications could (and should) reflect the past evolutionary history of higher taxa and relationships of the extant species. However the major herpetological works, for example, Boulenger's Catalogue of Lizards, published over the next 100 years did not attempt reconstructions of phylogeny. Indeed Boulenger reversed the earlier named (now recognized again) genera and higher taxa proposed especially by W. Peters and L. Fitzinger. Although, Camp (Classification of Lizards, 1923) and Hennig (Revision of *Draco*, 1936) published pioneering works (they were decades ahead of others) the taxonomic herpetologists ignored them until the "rebirth" of phylogenetic systematics in the 1960's and 1970's. Moody (1980) published a phylogenetic analysis based on 122 morphological characters and reviewed the historical biogeography of the agamid genera and proposed several subfamilies. Within the past two decades beginning with Joger (1991, a molecular phylogeny of agamid lizards) several workers have employed molecular analyses. The hypothesized molecular phylogenies by Macey, Larson, Ananjeva, Papenfuss, Ota, Honda, Schulte and Melville will be compared with my original and revised morphologically based hypotheses. The controversy over the familial status of the various higher taxa within the "acrodont" section of the suborder Iguania that ensued following Frost & Etheridge (1989) also will be reviewed.

The arid corridor from Middle East to Africa – Insights from the Agamidae

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The similarities between fauna and flora of the arid southwest and northeast corners of Africa have been pointed out by several authors. E.g. Poynton underlined this distribution pattern of an arid corridor with instances from Bufonid amphibians, whereas Wagner found instances among reptiles, especially agamid lizards. These arid areas are still connected by a strip of arid country through Kenya, Tanzania and northeastern Zambia to southern Africa. This arid corridor allowed a faunal and floral exchange during dry phases of the Quaternary and influenced the colonization history of the continent. The relations and differences between Africa and Middle East are analysed using the agamid taxa *Trapelus*, *Pseudotrapelus*, *Acanthocercus*, *Agama*, *Xenagama* and *Uromastyx*.

Taxonomic, morphological and ecological diversity of Asian agamids (Agamidae:Acrodonta: Sauria:Reptilia)

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One of important aspect of integrative study of lizards of Agamidae family is an analysis of morphological diversity within this group of squamates according to recognizing compositional, structural and functional biodiversity (Noss 1990). Agamidae is morphologically and ecologically diverse family belonging to Iguania that is a sister group to all the remaining squamates (Sukhanov 1961; Moody 1980; Estes 1983, 1985). Agamid lizards are characterized by acro-pleurodont dentition, lack of the intravertebral autotomy fracture plan existing in most other lizards and high structural diversity of integumental derivatives: scale sense organs, epidermal holocrine glands (femoral pores, callose scalation), and so on. We analyze the representation of different evolutionary lines of agamid lizards in Palearctic and Oriental Asia, as well as morphological variety of dentition and integumental structures in these lines. The study of structure and development of dentition revealed a special type of anlage of the egg-teeth in Iguania in comparison with another suqamates (Sergeyev 1940; Ananjeva & Orlov 1986). The single egg-teeth anlage is synapomorphy for Iguania whereas the paired tooth germs are shared by Gekkota, Scincomorpha, Anguinomorpha and all Ophidia. The next developmental transformations lead to paired state of egg-teeth in Gekkota including dibamids (Underwood & Lee 2000) and unpaired (as a result of reduction of one of the two egg tooth germs, or as a result of fusion) state of egg-teeth in another squamates (Ananjeva & Orlov 1986).
Attempts to nest integumental derivats into the phylogenetic tree of acrodonta lizards (Macey et al. 2000; Ananjeva 2004) and to consider association of morphological and ecological diversity of Asian agamids are discussed.

Phylogenetic relationships and evolution of the agamid lizard subfamily Draconinae

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The agamid lizard clade (subfamily) Draconinae is widespread throughout the Indian subcontinent, Southeast Asia, Indonesia, the Philippines, and associated islands of the Indian and Pacific Oceans. Phylogenetic analyses are presented for this clade at several hierarchical levels. Nuclear DNA recover very robust support for the agamid clade Agaminae as the sister taxon to draconines. Within Draconines, relationships are investigated using mitochondrial and nuclear DNA. *Mantheyus phuwuanensis* is strongly supported as the sister taxon to all other draconine species with *Ptyctolaemus* and *Draco* forming a clade that is sister to all remaining species. A detailed phylogeny of Calotes based on mtDNA also will be presented. Finally, the diversification rate of draconine agamids will be compared with *Chamaeleons*, *Agaminae*, and *Amphibolurinae* to identify possible evolutionary important differences between these clades.

Status survey of the Indian Spiny-tailed lizard *Uromastyx hardwickii* in the arid regions of Rajasthan, North-Western India

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The Indian Spiny-tailed Lizard *Uromastyx hardwickii* is endemic to the arid region between India and Pakistan. Known as the ‘Sanda’ in India, it is protected by law (Schedule II, Indian Wildlife Protection Act, 1972). Existing informa-

tion on this species is largely anecdotal and so sparse that the most detailed observations are almost a century old – this species inhabits self-excavated burrows and occurs in clusters; it is believed to be threatened by local trade in its meat and oil, and habitat destruction caused by anthropogenic activities. In order to effectively conserve this unique species basic information such as distribution, location of clusters and habitat characteristics is essential. Therefore, the objectives of this ongoing survey are to map the distribution of the Sanda in the arid regions of Rajasthan (north-western India), locate large clusters and identify habitats that can support such clusters. In addition, information on threats to the species including extent of exploitation is also being collected. The survey commenced in March and will continue till September 2007: so far, a combination of vehicular transects as well as interviews with locals has been used to assess presence/absence; abundance and habitat parameters have been measured using belt transects. Further, semi-structured interviews with hunting tribes has provided valuable information on exploitation. The survey will also be followed by a more detailed study on the ecology of this species since it is the only herbivorous lizard in the Indian subcontinent.

The genera *Pseudocalotes* and *Bronchocela* in south East Asia: Taxonomy and distribution

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Uncertainty exists about occurrence and differentiation of the species of the genus *Pseudocalotes* in South-East-Asia. The situation in Vietnam and Laos is problematic due to problems in identification, occurrence of different colour morphs or undescribed species. New voucher specimens of that genus from different localities in Vietnam and Laos were examined and compared with type material. A first record of a female *P. poilani* demonstrate sexual dimorphism and differences between *P. poilani* and *P. floweri*. Both species have a restricted distribution to southern Laos (*poilani*) and to southern Cambodia/ Thailand (*floweri*). In Vietnam *P. microlepis* brevipes are more widespread distributed than known. And a third unknonw species occurs in Kon Tum Province /Vietnam. A new species of *Bronchocela* from Nicobar Islands is presented with its variation and distribution. A distribution map for *Pseucocalotes* and *Bronchocela* is presented.

A preliminary phylogeny of the genus *Acanthosaura* Gray 1931, inferred from mitochondrial and nuclear genes

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An analysis of mitochondrial and nuclear DNA from the Southeast Asian lizard genus *Acanthosaura*, was use to asses the phylogenetic relationships of the group. The specimens examined encompass the entire range of the genus, (Myanmar, Thailand, Cambodia, Laos, China, and Malaysia (including its off shore islands, Pulau Tioman, Pulau Aur, Pulau Perhintian, and Pulau Langkawi)) from all seven recognized species. A phylogenteic analysis using parsimony, likelihood, and bayesian analyses was used to test the hypotheses (1) *Acanthosaura* cf. *crucigera* from the Cardamom Mountains forms a distinct group separate from *Acanthosaura crucigera* from its type locality in Thailand (2) *Acanthosaura* sp. from Pulau Aur forms the sister group to other *A. armata*, (3) to see if the Acanthosaura from Pulau Langkawi is more closely related to the Cambodia's *A.* cf. *crucigera* then from the type locality in Thailand, following other biogeographic patterns. This will be the first time all recognized species will be included in a phylogenic context.

Who's who – The Specific status of *Leiolepis belliana* and *Leiolepis reevesi*

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The taxonomy of the lizard genus *Leiolepis* has long been problematic. Much of this is seeded in the high degree of morphological variation in the two most wide spread species, *Leiolepis belliana* and *L. reevesi.* To date all studies involving these species have use specimens from the distant ends of their distribution adding to the evidence that these species are distinct from one another. Through recent collection efforts at the contact zone of these species in southern Indochina, has produced morphological data suggesting that these two species are conspecfic and morphologically grade into one another. A phylogenetic analysis of mitochondrial and nuclear DNA was preformed to test the hypothesis of these two species representing one species. This would indicate that all other species of *Leiolepis* have arisen from one wide-ranging species.

Australian Agamid Lizards: an overview of species diversity, biogeography and evolutionary relationships

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Approximately 70 species of Agamid lizards are currently recognised in Australia and are known as the sub-family Amphibolurinae, which is genetically distinct from other agamid clades. Over the last decade we have undertaken a revision of the systematics of this subfamily, using molecular and morphological techniques. We have completed DNA sequencing of more than 2000 individuals for mtDNA and the nuclear region RAG1. I will be presenting an overview of these results. We have found that species diversity is underestimated in the current taxonomy, particularly in the genera *Diporiphora* and *Tympanocryptis.* In addition, these two genera show distinct geographic centres of species diversity, with multiple sympatric species – *Diporiphora* in north-western Australia and *Tympanocryptis* in north-eastern South Australia. The genetic structuring across arid and semi-arid Australia is highly complex in the genera *Diporiphora, Tympanocryptis, Amphibolurus* and *Lophognathus*, with greater levels of genetic divergence than expected. Our results will provide important insight into evolutionary patterns, historical biogeography and speciation in arid and semi-arid Australia.

Viviparity in the family Agamidae

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When Moody (1980) reviewed reproductive mode within the family Agamidae only two clades were known to be viviparous. *Cophotis ceylanica* is viviparous although the other two closely-related genera (*Lyriocephalus* and *Ceratophora*) have oviparous species. The genus *Phrynocephalus* has several viviparous species although others are oviparous. Surprisingly none of the desert-adapted amphibolurines of Australia are viviparous. The family Chamaeleontidae has both oviparous and viviparous clades and since this family is arguably embedded cladistically within the family Agamidae *sensu lato*, the paucity of viviparity within the large radiation of agamids (Draconinae Moody) in southeastern Asia is enigmatic. I was pleasantly surprised when Bjorn Lardner recently sent to me photographs of a female agamid with a full-term fetus collected in Borneo. Thus a third case of viviparity has been documented *Hylagama borneensis* Mertens. I will review the evolution of viviparity within the agamids in light of ecological and physiological adaptations and restraints, and speculate as to why viviparity has not evolved more frequently within the Agamidae.

Poster Presentations

On Systematics and phylogeography of sun watcher toad agamas *Phrynocephalus helioscopus* (Pallas, 1771)

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Results of our study on historical background and taxonomic status of two Iranian-Transcaucasian forms – *Phynocephalus persicus* DeFilippi, 1863 and *Phynocephalus helioscopus horváthi* Méhely, 1894 was showed recently (Melnikov et al. 2008). Results of our current study on toad agamas of *helioscopus*-group from whole species range with the same mitochondrial marker (ND2, 700 bp) and its congruence with morphology are presented.Two main lineage – Iranian-Transcaucasian and Turanian – were detected on molecular analysis data. Specimens from southernmost locality Abadeh (Southern Iran, Zagros mountains) occupy basal position in Iranian-Transcaucasian lineage. Apical positions in this lineage have specimens from Saveh (Central Iran, type territory of *Ph. persicus*) and specimens from Aralik (Turkey, type territory of *Ph. h. horváthi*), Armavir (Armenia), Iughli (north-western Iran). These two forms also have good morphological differences in distance between nostrils and L/Lcd ratio (Melnikov et al., 2008). Contrary to our previous opinion about *horváthi* as a form of Turanian lineage, now we have strongly supported data that it belongs to Iranian-Transcaucasian lineage. Basal position of agamas from Charyn and Taskarasu (south-eastern Kazakhstan, left bank of Ili River, near to type territory of *Ph. h. cameranoi* Bedriaga, 1907) is most surprising in Turanian lineage. Other lizards from the south-eastern Kazakhstan (Otar, Burylbaital, Ay, Panfilov) are clustered with agamas from Fuyun (western China, type territory of *Ph. varius* Eichwald, 1831) and occupy apical position in this lineage. Specimens from Baskunchak, Tautobe (south-eastern Russia, Astrakhan region) and Akespe, Kamyshlibash (western Kazakhstan, Aral Sea) have another apical position in this lineage. Type territory of *Ph. helioscopus* (Pallas, 1771) is situated between these two areas. Phylogenetic positions of specimens from Kagan and Tamdy, Eddum (southern Uzbekistan) are not clear because of scanty material. Agamas from supported clades demonstrate some difference in morphology. *Ph. h. helioscopus* specimens have jet-black tip of tail, that easy to distinguish even on old collection material. Coloration of lower surface of tail end in males *Ph. h. helioscopus* is ensanguined, in *Ph. h. varius* is vinous, in animals from Charyn and Taskarasu is orange-red. This red coloration is fast to disappear in collection specimens. Morphological features suitable for identification of collection material are working out.

Distribution patterns of agamids in the North Caspian region

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Five species of agamid lizards (*Trapelus sanguinolentus, Phrynocephalus mystaceus, Phrynocephalus helioscopus, Phrynocephalus guttatus, Phrynocephalus interscapularis*) occur in the North Caspian Region. *Phrynocephalus mystaceus* and *Phrynocephalus guttatus* are psammophilous species and they demonstrate a wide north-caspian distribution in the Caspian Depression reaching the Ergeni Hills in the west and Terek-Kuma Sands in the south. The northernmost agamid species, *Phr. guttatus*, is distributed in the Sarpa Depression in the north. The sclerophillic *Phr. helioscopus* occupies only eastern part of the Caspian Depression from the Western Kazakhstan in the east to the Volga River in the west. In the European part of the range this species is distributed sporadically and very rare. *T. sanguinolentus* demonstrates Caucaso-Middle-Asian range disjunction and inhabits the Terek-Kuma Sands in the west and eastern extremity of the Caspian Depression in the east. *Phr. interscapularis* is represented by an isolated relic population in the Caspian Karakum Desert. Three types of distributional patterns could be distinguished for agamids in this region:

1. continiuous north-caspian distribution (*Phr. mystaceus, Phr. guttatus*),
2. disjunctive north-caspian distribution (*T. sanguinolentus*),
3. relic north-caspian distribution (*Phr. helioscopus, Phr. interscapularis*).

Phr. interscapularis is an endemic species of the Middle Asian and the East Iranian deserts. *T. sanguinolentus, Phr. helioscopus* and *Phr. mystaceus* have Middle-Asian ranges and were described as a subendemic species of the Middle Asia and the Eastern Iran. The wide distributed in the Middle and Central Asia, *Phr. guttatus* has possibly Central-Asian origin. Two species in the North Caspian Region are represented by Turanian subspecies (*Phr. h. helioscopus* and *Phr. i. interscapularis*). A subspecific endemism are known for three species of agamids in the North Caspian Region. *Trapelus sanguinolentus, Phrynocephalus mystaceus* and *Phrynocephalus guttatus* are represented here by endemic subspecies (*T. s. sanguinolentus, Phr. m. mystaceus, Phr. g. kalmykus*). In the territory of the Middle Asia these species are represented by Turanian subspecies (*T. s. aralensis, Phr. m. galli, Phr. g. guttatus*).

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Phylogeography & taxonomy of the Agamid lizards (Sauria: Agamidae) of East Africa: morphological and genetic analysis

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The East African members of the *Agama lionotus* complex are analyzed. The results clearly show differences in morphology and colouration between the *A. lionotus* subspecies. Especially the throat of adult males is a characteristic to determine the different species and subspecies.