Temporal variation in reproductive phenology of *Patella* spp.: past and present

M Vale, P Ribeiro, J Golbold, AI Neto, GM Martins & SJ Hawkins

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T19
T19.O1

THE LAND SNAILS OF PENNSYLVANIA, USA: LIKELY EFFECTS OF GLOBAL WARMING UPON SPECIES' DISTRIBUTIONS

Megan E. Paustian, Timothy A. Pearce

Section of Mollusks, Carnegie Museum of Natural History, 4400 Forbes Ave., Pittsburgh, PA 15213
mpaustia@gmail.com, pearcet@carnegiemnh.org

Land snails are relatively immobile animals whose latitudinal and altitudinal ranges may not readily shift in response to climate change. Even if capable of range shifts, high-altitude endemic snails may have little room in which to expand (in Pennsylvania, elevations 700-978 m represent only 2% of land area). We examined whether some land snail species in Pennsylvania are limited to upper elevations to assess whether climate warming poses a threat to them. We surveyed land snails at 108 sites across twelve regional transects at regular 100 m intervals of elevation from 100 to 900 m, and habitat characters at each site were measured. Nine species occurred primarily at higher elevations and are likely to experience population declines with climate warming. In addition, multivariate analyses of region, elevation, latitude, soil chemistry, and other habitat factors were used to describe habitats currently occupied by land snail species.

T19.O2

IMPACT OF ENVIRONMENTAL VARIABLES ON THE DIVERSITY OF FRESHWATER MOLLUSCS

Zahoor Pir, L.K. Mudgal

Department of Zoology, Mata Jijabai Govt. P. G. Girls college Motitabela Indore MP-452001
zahoor7887@yahoo.com

The Narmada river is one among the important river of India, which is subjected to the pollution day by day, due to various anthropogenic activities. Change in physico-chemical parameters of river due to pollution, imparts negative effect on the diversity of Molluscans. The present study was carried out for the period of 24 months from August 2009 to July 2011 at four selected stations viz S_1, S_2, S_3 and S_4 respectively. During the present study about 17 species of class Gastropoda and 8 species of class Pelecypoda were recorded. The molluscan diversity was maximum in April- May months and minimum in July- August months. The value of Shannon and Weaver Index (H) varied from 2.7 to 3.1, indicating the water quality and diversity of species. Both gastropods and pelecypods showed strong negative correlation with turbidity, nitrate, alkalinity and phosphate at all four stations, while strong positive correlation was observed between molluscan species and pH. Multiple k- dominance plot of all stations facilitated the discrimination of molluscs according to species' relative contribution to standard stock. The results of present study showed that the freshwater biodiversity is altered by the change in the physico-chemical parameters of river. Thus regular monitoring of water parameters is necessary in maintaining the diversity of Molluscs.

T19.O3

EFFECT OF TEMPERATURE ON EMBRYONIC DEVELOPMENT OF THE MARINE GASTROPOD *CHARONIA SEGUENZAE* (ARADAS & BENOIT, 1870)

Chrisa K. Doxa[1,2], Aspasia Sterioti[1,3], Pascal Divanach[1,3], Maroudio Kentouri[2]

[1]*CRETAQUARIUM, Hellenic Centre for Marine Research, P.O.BOX 2214, 71003 Heraklion, Crete*
chrisadoxa@cretaquarium.gr, aspasia@her.hcmr.gr
[2]*Department of Biology, University of Crete* kentouri@biology.uoc.gr
[3]*Inst. of Aquaculture, Hellenic Centre for Marine Research* divanach@her.hcmr.gr

The encapsulated development of the marine gastropod *Charonia seguenzae* (Aradas & Benoit, 1870) was studied under 3 temperatures (17, 20 and 23 °C). One hundred eighty (180) egg capsules that were deposited the same day, by the same individual (23,1 °C) and were at the same developmental stage (1 cell stage) were used. At the stage of blastula (7th Day After Deposition – DAD) they were separated in three groups of 60 capsules. One group remained at 23 °C and the other two were acclimated at 20 and 1 °C. Two randomly sampled capsules were collected from each temperature (every day during the first 5 days, D1-D5, every two days from D7 to D17 and every three days from D20 to eclosion), weighed, opened and the eggs, embryos or larvae were photographed under stereoscope. Stages of development, shape and dimensions were studied and measured on microphotographs. All developmental stages were described in relation to temperature and time. At 23 °C eclosion occurred 49 days after capsule deposition, at a free swimming veliger. Embryonic development at 23 °C was 17 and 24 days faster than 20 °C and 17 °C respectively. Temperature is a factor that affects not only the developmental rate but also the size of the embryos, with lower temperature leading to the eclosion of larger individuals.

T19.O4

TEMPORAL VARIATION IN REPRODUCTIVE PHENOLOGY OF *PATELLA* SPP.: PAST AND PRESENT

Maria Vale[1,2,3], Ana I. Neto[2,3], Gustavo Martins[2,3], Stephen J. Hawkins[1]

[1]*Ocean and Earth Science, National Oceanography Centre Southampton, Waterfront Campus, University of Southampton, European Way, Southampton, SO14 3ZH, UK* Maria.Vale@noc.soton.ac.uk, S.J.Hawkins@soto.ac.uk
[2]*Centro Interdisciplinar de Investigação Marinha e Ambiental (CIIMAR/CIMAR), Rua dos Bragas 289, 4050-123 Porto, Portugal* aneto@uac.pt, gmartins@uac.pt
[3]*CIRN & Grupo de Biologia Marinha, Universidade dos Açores, 9501-801 Ponta Delgada, Açores, Portugal*

Global changes occurring in the biogeochemistry of the oceans may influence the ecology of the biota. There is evidence that species are reacting to changes in climate through variations in the abundance and phenology with many species showing a poleward shift in their distributional range. The rocky intertidal is a relatively simple ecosystem but highly susceptible to anthropogenic activities and is thus an excellent model system for the understanding of the consequences of change in climate. This study presents a preliminary analysis of the changes in gonad phenology of *Patella aspera* over time. *Patella aspera* is being collected in various locations of the São Miguel Island (Azores) and their gonad development assessed visually using a trained observer. These data are then compared to unpublished data on gonad development collected in the period of

1985-1987through a chi-square test of independence.Overall, in contrast to the period of 1985-87, there was a much lower number of individuals reaching maturity (gonad development stages IV and V) in 2012-2013 and there was no clear peak in spawning. In addition, the resting period appears to be starting in June, one month delayed compared to data from 1985-87. These variations are important and may affect the population dynamics of the species.

T19.O5

$\delta^{18}O$ AND $\delta^{13}C$ RECORD OF *VIVIPARUS DILUVIANUS* (KUNTH) SHELLS FROM HOLSTEINIAN DEPOSITS AT ORTEL KRÓLEWSKI AND SZYMANOWO, EASTERN POLAND

Marcin Szymanek

University of Warsaw, Faculty of Geology, ul. Żwirki i Wigury 93, 02-089 Warsaw, Poland
m.szymanek@uw.edu.pl

The research is conducted at 2 sites of lake deposits of the Holsteinian Interglacial (MIS 11) in Eastern Poland – Ortel Królewski and Szymanowo. Stable oxygen and carbon isotope composition of *Viviparus diluvianus* shells is investigated in 13 samples. Samples are arranged according to the shell shape changes, noted in different parts of the interglacial identified by pollen analysis. They are chosen in relation to the mean values of the slimness index, which correspond to the certain parts of the interglacial, characterized by definite climatic conditions. One sample comprises 3-5 complete, mature individuals of similar age (the same number of growth segments) living at different time (various pattern of growth lines).
Values of $\delta^{18}O$ and $\delta^{13}C$ at Ortel Królewski varies from -7.73 to -7.23‰ and from -10.06 to -9‰ respectively. Maximum of $\delta^{18}O$ corresponds with the *Taxus* zone of the Holsteinian and the highest slimness of *V. diluvianus* shells (1.41), whereas similar shells from the climatic optimum has the lowest values of $\delta^{18}O$. This may result from deepening of the lake. Constant rise of $\delta^{13}C$ in the lowermost part of the profile points to amelioration of the climate. Maximum values in the intra-interglacial drying and cooling of the climate may be connected with the lake shallowing. At Szymanowo oxygen and carbon isotope curves represent intervals of -8,61 – -7,77‰ and -9,7 – -8,85‰. Samples are correlated with the final part of the climatic optimum and the post-optimal period. Depletion in $\delta^{18}O$ and $\delta^{13}C$ values confirms deterioration of the climatic conditions. Fluctuations in $\delta^{13}C$ curve towards higher values coincides with the cooling of the climate and periods of drop of the water level, noted in pollen and biometric studies of *V. diluvianus* shells.
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T19.P1

CHARACTERIZING DIVERSIFICATION PATTERNS AND DIET EVOLUTION IN CONE SNAILS

Mark Phuong, Michael Alfaro

Department of Ecology and Evolutionary Biology, University of California, Los Angeles; Hershey Hall, 612 Charles E. Young Drive, East, Los Angeles, CA 90095 markphuong@gmail.com, michaelalfaro@ucla.edu

Why are some clades more diverse than others? Evolvability, or a lineage's intrinsic capacity to adapt and diversify, is thought to account for differences in diversity between clades. One component of evolvability is modularity, or the degree in which characters (e.g., phenotype, genes, developmental networks) are able to evolve independently. Over long evolutionary time-scales, lineages with greater evolvability should (1) exhibit higher levels of diversification rates and species richness and (2) exhibit greater levels of phenotypic variance.
I propose to test these predictions in cone snails. Cone snails within the diverse genus, *Conus* (>500 spp.) are a group of predatory snails that typically feed on worms, molluscs, or fish, and capture their prey using a cocktail of venomous neurotoxins (conotoxins). This group is appropriate for two reasons. First, conotoxin genes are well-studied – gene duplication and strong diversifying selection across conotoxin gene superfamilies is thought to allow this group to specialize and partition resources. Gene duplication can increase evolvability because the copied gene is allowed to evolve independently, potentially facilitating the rise of new phenotypes. This provides a natural way to quantify differences in evolvability between clades. Second, species diversity is not distributed evenly in this group - nearly 70% of cone snails are vermivorous (worm-earing). Thus, *Conus* provides a unique opportunity to test whether evolvability predicts the magnitude and rate of diversification.
To begin this work, I present preliminary results characterizing diet evolution in *Conus*. I generated a fossil-calibrated phylogeny of 222 species using six previously published loci. Then, I used phylogenetic comparative methods to characterize diet evolution and test whether diversification rates depend on diet. Finally, I propose future work to quantify the relationship between evolvability and diversification.

T19.P2

EXPERIMENTAL DROUGHT EFFECTS THE REPRODUCTION OF BROODING CLAUSILIID *A. BIPLICATA* (MONTAGU, 1803)

Anna Sulikowska-Drozd[1], Tomasz K. Maltz[2]

[1]*Department of Invertebrate Zoology and Hydrobiology, University of Lodz, Banacha Str. 12/16, 90-237 Lodz, Poland* sulik@biol.uni.lodz.pl
[2]*Museum of Natural History, Wrocław University, Sienkiewicza 21, 50–335 Wrocław, Poland*
tomaltz@biol.uni.wroc.pl

A. biplicata is a viviparous land snail inhabiting Central Europe. Its distribution to the East seems to be limited by the increasingly continental climate (frosty winters and dry summers). To investigate the effect of drought on reproduction of the species we kept snails in dry boxes without any water supply. Control group of snails were kept under high constant humidity. For the experiment we collected snails in the field during their reproductive period.
The proportion of brooding snails in both groups exceeded 50% at the beginning of experiment. After 2 weeks all individuals were dissected and their reproductive activity was assessed (number of released neonates, intrauterine brood size, stages of embryo development). Embryos brooded in snails kept in dry boxes developed to the most advanced stage (shell with > 2 whorls) but were not released. 66% of snails brooded embryos at the end of experiment; 72% of brooded embryos were fully developed and already hatched in the uterus. New eggs did not appear in the uterus during laboratory treatment (3% of eggs without shelled embryo). Control group of snails kept under high constant humidity released neonates in the first and the second week of the experiment. 31% of these snails reproduced; litter size averaged 7.2 neonates (range 3 –

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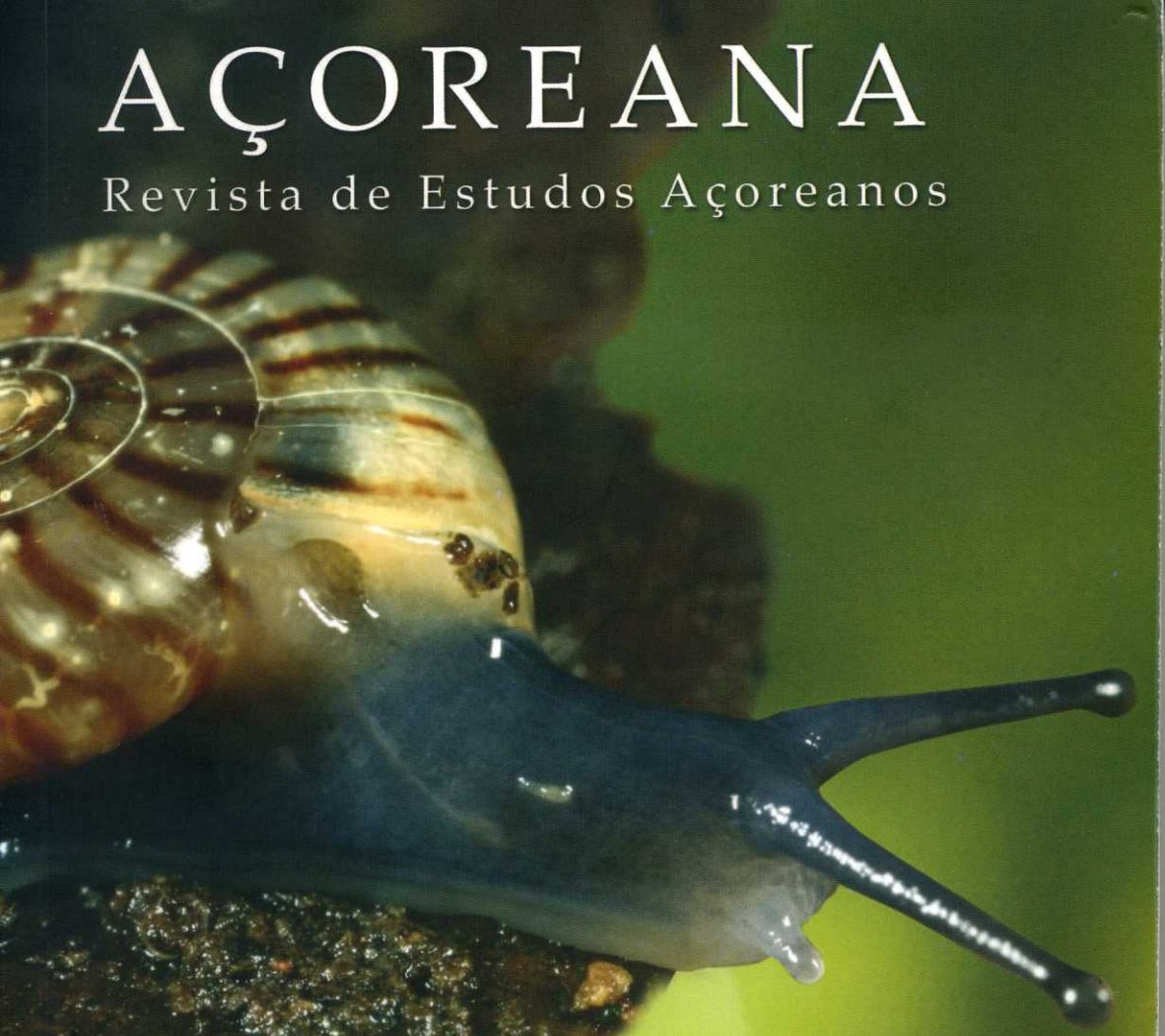

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