V Jornada Científica

20 anys de l'ICBiBE: la cruïlla entre diversitat i evolució

Institut Cavanilles de Biodiversitat i Biologia Evolutiva (ICBiBE)

26.10.2018

Jardí Botànic de la Universitat de València

Organitza

VNIVERSITAT DE VALÈNCIA ICBiBE Institut Universitari Cavanilles de Biodiversitat i Biologia Evolutiva

Col·laboren

VNIVERSITAT DE VALÈNCIA

UNITAT D'IGUALTAT
VNIVERSITAT DE VALÈNCIA

Pausa germinal, Monjalés, 1960

VNIVERSITAT DE VALÈNCIA

ICBiBE
Institut Universitari Cavanilles
de Biodiversitat i Biologia Evolutiva

Comissió organitzadora de la Jornada

María José Carmona (coordinadora)

Pau Carazo

Eduardo García

Carlos Martínez

Tonyi Rodrigo

Col·laboradors

Roberto García-Roa

Jose Luis Herraiz

Ivana Jezkova

Daniel Morant

Eric Puche

Eva Tarazona

Zahida Sultanova

Victor Villén

Composició de la portada i cartell commemoratiu de la jornada elaborats a partir d'una fotografia de l'obra Pausa Germinal *(Monjalés, 1960) cedida per l'autor, a qui volem expressar el nostre agraïment.*

PROGRAMA / PROGRAM

DIVENDRES 26 D'OCTUBRE 2018

VIERNES 26 DE OCTUBRE / FRIDAY 26th OCTOBER

9:00-9:30 Lliurament de documentació
Entrega de documentación / Reception

9:30-10:00 Apertura de la jornada
Apertura de la jornada / Symposium opening

10:00-11:00 Conferència plenària
Conferencia plenaria / Plenary talk

The tension between generality and diversity: what makes biology so cool
Hanna Kokko (University of Zurich)

SESSIÓ DE MATÍ

Sesión matinal / Morning session

11:00-11:20 **Temperature, sexual conflict and population viability in *D. melanogaster***
Roberto García-Roa (e3 - Etologia)

11:20-11:40 **Environmental uncertainty and the reinforcement hypothesis in rotifers**
Raquel Ortells (e3 - Ecologia Evolutiva)

Moderador / Chair: *Pau Carazo*

11:40-12:10 PAUSA (CAFÉ I COCA)
CAFÉ / COFFEE

12:10-12:30 **Charophyte diversity and aquatic community performance affected by global change**
Tonyi Rodrigo (e3 - Ecologia Integrativa)

12:30-12:50 **Random tanglegram partitions (Random TaPas): An Alexandrian approach to the cophylogenetic Gordian knot**
Juan Antonio Balbuena (Ecologia i Evolució de Simbionts)

12:50-13:10 **Lichens as microecosystems: symbiotic microalgal diversity/coexistence and Chlorophyta phylogenomics**
Patricia Moya (Biodiversitat Vegetal i Ecofisiologia)

13:10-13:30 **Photoferrotrophy: Vestiges of a Precambrian microbial metabolisms in modern environments, or how photosynthesis evolved in the primigenious times** Antonio Camacho (Limnologia)

13:30-13:50 **Exploring the morphological diversity and hydrodynamic performance of extinct jawless vertebrates**
Carlos Martínez-Pérez (Paleobiologia)

***Moderador / Chair**: Eduardo García*

13:50-15:00 DINAR (a l'Umbracle)
COMIDA / LUNCH

SESSIÓ DE VESPRADA
Sesión vespertina / Afternoon session

15:00-15:20 **Changing modularity by bone detachment: the case of the mammalian middle ear evolution**
Aitor Navarro-Díaz (Biologia Teòrica)

15:20-15:40 **Sensitivity of *Margaritifera auricularia* (Spengler, 1793) to heavy metals and ammonium: first approximation**
Keiko Nakamura (Ecologia i Biogeografia de Sistemes Aquàtics)

15:40-16:00 **Elucidating the ecological diversity of thelodonts (Agnatha, Vertebrata) from the study of their squamations**
Héctor Botella (Paleobiologia)

16:00-16:20 **New park policies, new House Sparrow problems**
Edgar Bernat-Ponce (Ecologia de Vertebrats Terrestres)

***Moderadora / Chair:** Tonyi Rodrigo*

16:20-17:00 PAUSA (CAFÉ I COCA)
CAFÉ / COFFEE

17:00-17:20 Symbiotic associations between *Balaenophilus* spp. (Copepoda: Harpacticoida) and marine vertebrates: a striking evolutionary and ecological tale
Francesc Domènech (Zoologia Marina)

17:20-17:40 Biodiversidad de parásitos aporocotílidos en peces de interés comercial
José F. Palacios Abella (Zoologia Marina)

17:40-18:00 Secondary contact of hegdehogs in central Europe
Ignasi Lucas Lledó (e3 - Genètica de Poblacions)

18:00-18:20 Holidays? Not for all. Eagles have larger home ranges on holidays as a consequence of human disturbance
Arturo M. Perona (Ecologia de Vertebrats Terrestres)

18:20-18:40 Intensity of male-male competition predicts morph diversity in a color polymorphic lizard
Guillem Pérez i de Lanuza (e3 - Etologia)

Moderador / Chair: *Carlos Martínez*

18:40-21:00 SESSIÓ DE PÒSTERS, PISCOLABIS i MÚSICA (a l'Umbracle)
SESIÓN DE POSTERS, PISCOLABIS & MÚSICA / POSTERS, FOOD & MUSIC

CONFERÈNCIA PLENÀRIA / PLENARY TALK

The tension between generality and diversity: what makes biology so cool

Hanna Kokko

Kokkonuts. Department of Evolutionary Biology and Environmental Studies, University of Zurich

All questions in biology in some sense take the same form: "why is life the way it is?" This question is multifaceted for the simple reason that there's very many species (and also variation within a species, either in discrete categories — e.g. male, female; polymorphisms). The temptation to come up with idiosyncratic explanations has to be balanced against the temptation to study what is most convenient (hence the focus on model organisms) and/or what appears most appealing to us because it is more familiar to us (taxonomic biases). I will reflect on these issues, also presenting some current work on the evolution of sex, where it is good to be reminded that not all sexual reproduction follows rules most familiar to us.

Keywords: biodiversity, evolution of sex

Hanna Kokko is a Professor of Evolutionary Ecology at the University of Zurich. Her research covers a huge variety of topics usually applying mathematical theoretical models to an extraordinary range of real world biological systems and questions. Amongst others, she has worked on evolutionary ecology of sexual and asexual reproduction, analysis and management of animal populations, evolution of reproductive and social strategies and sustainability science. She has been a Fellow of the Australian Academy of Science, and has been distinguished with the Per Brinck Oikos Award and the Founder's Prize of the British Ecological Society.

ORAL PRESENTATIONS

Temperature, sexual conflict and population viability in *Drosophila melanogaster*

Roberto García-Roa, Valeria Chirino-Borges & Pau Carazo

e3 - Etologia/e3 - Ethology

Sexual conflict is a fundamental driver of male/female adaptations, an engine of biodiversity, and a crucial determinant of population viability. For example, sexual conflict frequently leads to behavioural adaptations that allow males to displace their rivals, but in doing so harm those same females they are competing to access. Sexual conflict via female harm hence not only deviates females from their fitness optimum, but can decrease population viability and facilitate extinction. Despite this prominent role, we are far from understanding what factors modulate the intensity of sexual conflict, and particularly the role of ecology in mediating underlying behavioural adaptations. We show that, in *Drosophila melanogaster*, variations in environmental temperature of ±4ºC (within the normal range experienced by natural populations) decrease female harm (i.e. reduction of female fitness due to harmful male adaptations) by between 45-73%. Rate-sensitive fitness estimates indicate that such modulation results in an average rescue of population productivity of 7% at colder temperatures and 23% at hotter temperatures. Our results: a) show that the thermal ecology of social interactions can drastically modulate sexual conflict via behaviourally plasticity, b) identify a potentially crucial ecological factor to understand how sexual conflict operates in nature, and c) suggest that behavioural plasticity can lessen the negative effect of sexual conflict on population viability precisely when it is most necessary: in the face of rapid environmental temperature changes (e.g. global warming).

Keywords: behaviour, behavioural plasticity, sexual conflict, ecology, temperature, population viability

Environmental uncertainty and the reinforcement hypothesis in rotifers

Raquel Ortells, Eva Tarazona, Ivana Jezkova, Lluís Franch-Gras, María José Carmona, Eduardo García-Roger & Manuel Serra

e3 - Ecologia Evolutiva/e3 - Evolutionary Ecology

A couple of challenging evolutionary questions potentially related are how species cope with environmental uncertainty and how their populations diverge to get adapted to local conditions. Rotifers are good models in evolutionary ecology because their short generation times and large population sizes allow for a rapid adaptive response with ecological consequences at a short-time scale, with an impact on population differentiation, species persistence, speciation and hence on biodiversity. Cyclical parthenogenetic rotifers include a sexual phase in their life cycle that involves the formation of diapausing eggs, so that their life cycle is considered to be an adaptation to cope with temporary habitats. We used natural and experimental rotifer populations to test the theoretical hypothesis that bet-hedging strategies evolve as a response to environmental uncertainty. We found that both the correlation of diapause-related traits with the uncertainty in the natural habitats and the evolution of these traits in the laboratory agree with the theoretical predictions. Our results revealed that rotifers populations are able to adaptively diverge in diapause-related traits in response to local conditions. Within this context, we also aimed to test the reinforcement hypothesis, which predicts that divergent populations select for prezygotic isolation, so that gametes are not invested in low fitness matings and local adaptive characteristics are preserved. We found preliminary evidence that partial mating isolation exists between populations of the same species that have diverged in the adaptation to the environmental uncertainty.

Keywords: cyclical parthenogenesis, diapause related traits, environmental uncertainty, prezygotic isolation, bet-hedging, temporary habitats

Charophyte diversity and aquatic community performance affected by global change

Maria A. Rodrigo, Sara Calero, Eric Puche, Mati Segura & Carmen Rojo
e3 - Ecologia Integrativa/e3 - Integrative Ecology

Currently, there is plenty of evidence that global change is affecting natural systems. Some of the effects of this change (warming, increases in nitrogen loading, variations in radiation quality, etc.) alter vulnerable Mediterranean waterbodies, and charophytes, one of the most affected groups, play a key role in ecosystem processes. Their affection by global change factors on their physiology, phenology, distribution, *in situ* adaptation, etc., will be transmitted along the interaction webs, which include trophic and non-trophic relationships. We subjected charophyte populations of the same species from distinct locations (different altitudes, degree of pollution, water depths, etc.) to common garden experiments to unravel if the different populations have enough phenotypic plasticity to acclimatize and survive under rapid factors' variations and, if all the studied populations respond in a different way under the same factor change. We also addressed the possible interaction between global change factors on the response of several charophyte populations. Some results suggest, for example, that lower-altitude populations have a greater tolerance to temperature increase, and they would be favored by climate change. These different intraspecific responses to warming will impact the ecotype distribution and diversity. We demonstrate how charophyte response to the factors' interaction is species-specific and population-specific, and different under isolated stressors. Our studies highlight how simultaneous drivers of global change might affect the composition of charophyte meadows in Mediterranean shallow wetlands. These differential responses to the factors will modify charophytes' community diversity, which might be reflected in ecosystem performance, a matter of concern in such habitats.

Keywords: climate change, macrophytes, local adaptation, phenotypic plasticity, interactive stressors, interaction webs

Random tanglegram partitions (Random TaPas): An Alexandrian approach to the cophylogenetic Gordian knot

Juan Antonio Balbuena, Óscar Pérez-Escobar, Cristina Llopis-Belenguer & Isabel Blasco-Costa

Ecologia i Evolució de Simbionts/Symbiont Ecology and Evolution

The staggering complexity of biological systems makes estimation of their evolutionary history a challenging task. Cophylogeny attempts inference of the past relationships among ecologically linked groups of organisms, such as hosts and parasites, based on comparison of their phylogenetic relationships. A central assumption is that congruence between the phylogenies of the associated groups indicates a shared evolutionary history. However, perfect phylogenetic congruence is rarely, if ever, observed in nature, because several biological phenomena promoting incongruence can act concurrently. This often leads to situations that can be described as coevolutionary Gordian knots. While several current approaches (i.e., event-based methods) focus on disentangling the knots, we propose here an Alexandrian solution. Random Tanglegram Partitions. Given a tanglegram, consisting of two phylogenies, representing each the relationships among the associated taxa, and the information of associations between matching taxa across both phylogenies, Random TaPas resorts to recursive random partitions to (1) quantify cophylogenetic signal in the system, (2) determine whether this signal is evenly distributed or more concentrated in specific regions of the tanglegram. We analysed the performance of Random TaPas with simulated coevolutionary histories built using a varying number of common coevolutionary events (cospeciation, lineage duplication, failure-to-diverge, loss, spreading and host switching) and demonstrate its applicability with a real dataset. In addition to cophylogenetic settings, Random TaPas is also amenable to exploring, among other questions, the concordance between gene trees, the geographic variation of ecological traits, and the parallel evolution of genes and culture.

Keywords: cophylogeny, coevolution, cospeciation, symbiosis

Lichens as microecosystems: symbiotic microalgal diversity/coexistence and Chlorophyta phylogenomics

Patricia Moya, Arantzazu Molins, Lucia Muggia & Eva Barreno

Biodiversitat Vegetal i Ecofisiologia/Plant Biodiversity and Ecophysiology

Lichens provide interesting and poorly known habitats (microecosystems) for many other organisms besides the traditionally considered as unique lichen symbionts: a mycobiont and one photobiont. The current literature reveals that the coexistence of multiple microalgal taxa in lichens is more common than previously lichens-inhabiting fungi (micobiome), bacteria (microbiota) and basidiomycete yeasts support thought, and additional complexity. *Ramalina farinacea* (L.) Ach. has proven to be suitable model to study this multiplicity due to the constant coexistence of at least two microalgae species (*Trebouxia* sp. TR9 and *T. jamesii*) in long-distance populations. In 2017, we analyzed the microalgal diversity and its community structure in the lichen *R. farinacea* applying a 454 pyrosequencing approach. In addition to corroborating the coexistence of *Trebouxia* sp. TR9 and *T. jamesii* taxa in the same thallus, this study showed a much higher microalgal diversity associated with this lichen. Along the thallus branches, we also detected variations in phycobiont distribution that might correlate with bottlenecks and founder effects. These results were the background to perform an Illumina pair-end assay to go into detail about the microalgal diversity, here we show interesting preliminary results. Likewise, different NGS techniques were applied to sequence the nuclear and organelle genomes of *Trebouxia* sp. TR9. Recently, we published the complete mitochondrial genome, the first available for a lichen-symbiont microalga. A comparative study of the mitochondrial genome of *Trebouxia* sp. TR9 with other chlorophytes showed important changes in their organization including variations in genome size, gene repertories and intron content even between closely related taxa. (PROMETEOIII//2017/039/GVA; MINECO, CGL2016-79158-P y FEDER).

Keywords: Chlorophyta, microalga, mitochondria, next generation sequencing, *Ramalina farinacea*, *Trebouxia*

Photoferrotrophy: Vestiges of a Precambrian microbial metabolisms in modern environments or, how photosynthesis evolved in the primigenius times.

Limnologia/Limnology

Photoferrotrophy is a microbial metabolism involving the light-dependent fixation of inorganic carbon into microbial biomass using reduced iron Fe(II) as electron donor. This ability shown by quite a few microorganisms has been proposed as an early Earth primary production mechanism, which putatively was extensively used in the photic zone of the Archean ocean before the evolution and proliferation of sulfidic or oxygenic photosynthesis. Modern photoferrotrophs remain then as a vestige of a formerly most relevant microbial guild on the biogeochemical cycle of carbon. Nowadays, they are restricted to aquatic environments somewhat mimicking the redox conditions of ancient oceans. The meromictic Lake La Cruz (Spain), which has a sulfide-poor, Fe(II)-rich, illuminated chemocline, is likely suitable to sustain this metabolism. Photoferrotrophs in Lake La Cruz represented only a minor fraction of the whole anoxygenic phototrophic community, however, our studies demonstrated in-situ photoferrotrophic activity through stimulation of phototrophic carbon uptake in the presence of Fe(II). This shows the direct relationship between anoxygenic photoferrotrophy and the anoxic precipitation of Fe(III)-oxides in a ferruginous water column. Furthermore, this provides a plausible mechanism for the bacterial origin of the Precambrian Banded iron-formations (Precambrian BIFs), a chemical deposition observed in the geologic record conventionally attributed to abiotic reactions. Here, we contextualized these findings within the current knowledge on iron-driven photosynthesis in other analogous lakes to La Cruz (i.e., lakes Matano, Pavin, and Kivu), as remains of an ancient biogeochemistry before the advent of free oxygen in the Earth.

Keywords: photoferrotrophy, Archean ocean, Lake La Cruz, anoxygenic photosynthesis, ferruginous water column, carbon fixation

Exploring the morphological diversity and hydrodynamic performance of extinct jawless vertebrates

Carlos Martinez-Pérez, Humberto G. Ferrón, Imran Rahman, Victor Selles de Lucas, Philip C.J. Donoghue & Héctor Botella

Paleobiologia/Palaeobiology

Most extinct jawless vertebrates are characterised by the presence of a heavy cephalic shield, which has traditionally been related with poor swimming capabilities and a bottom-dwelling lifestyle. However, the huge morphological diversity of the cephalic shields suggests that these groups could be more ecologically diverse than previously thought. Interestingly, galeaspids and osteostracans show a similar range of forms, which were acquired independently in each lineage in different geographical regions. Thus, the study of such taxa provides a great opportunity to analyse whether the morphological simliarites was the result of a convergent evolution to similar aquatic environments. With this aim, we have created a morphospace for 70 species of galeaspids and osteostracans using geometric morphometrics and tested the hydrodynamic performance of the most extreme forms using computational fluid dynamics. Our results show that both groups occupy broadly the same areas of morphospace. In addition, comparison of their hydrodynamic performance (i.e. drag and lift forces and their coefficients) allowed us to better understand variations in morphology in terms of swimming strategies and modes of life. This opens up a new opportunity to investigate the ecology of these groups of early vertebrates.

Keywords: early vertebrates, Agnathans, hydrodynamic performance, computed fluid dynamics, palaeoecology

Changing modularity by bone detachment: the case of the mammalian middle ear evolution

Aitor Navarro-Díaz, Borja Esteve-Altava & Diego Rasskin-Gutman
Biologia Teorica/Theoretical Biology

The mammalian middle ear evolution from the craniomandibular articulation of their synapsid ancestors is a very well-known evolutionary event. The richness of the fossil record and the multitude of phylogenetic and ontogenetic studies have allowed a very good stepwise reconstruction of this evolutionary pattern, evidencing the homology between the articular-prearticular, quadrate, and angular bones of early synapsids with the malleus, incus, and ectotympanic bones of derived mammals, respectively. Many authors have suggested several evolutionary causes as responsible for this functional exaptation, such as an increase of the masticatory musculature, the cranial disconnection of the quadrate bone, and the detachment of the mandibular bones from the dentary. Our results of Anatomical Network Analysis (AnNA) show that the latter was the key step in the mammalian middle ear evolution, causing a change in the morphological modularity of the skull following by the acquisition of new functions for these bones. Furthermore, our analysis highlights that an ontogenetic event was key to provoke this modularity change: the ossification and posterior degradation of Meckel's cartilage in primitive mammals.

Keywords: AnNA, mammalian middle ear evolution, Meckel's cartilage, modularity, Synapsida

Sensitivity of *Margaritifera auricularia* (Spengler, 1793) to heavy metals and ammonium: first approximation

Keiko Nakamura, Jésica Cañete, Diego Vijuesca, Víctor Sorribas, Natalia Guillén, Cecilia Sosa, Xavier Armengol, Ester Ginés, Ronaldo Sousa, Francesc Mesquita-Joanes

e3 - Ecologia i Biogeografia de Sistemes Acuàtics/e3 - Ecology and Biogeography of Aquatic Systems

Margaritifera auricularia is one of the 200 species of unionids assessed in the IUCN Red List, being listed as critically endangered. The population of the Ebro basin (Spain) has suffered a strong reduction in recent years, registering very high mortalities of adult specimens, especially those found in the Canal Imperial de Aragón. Different hypotheses have been considered to explain these declines and may include contamination by heavy metals, pesticides, fungicides or other contaminants. Between 2014 and 2017, water and sediment samples plus soft tissues of dead individuals of *M. auricularia* and live individuals of the non-native species *Corbicula fluminea* were collected and analysed for heavy metal characterization. Heavy metals such as lead, cadmium, zinc or copper in variable concentrations were detected in the water, sediment and in both species. Given this situation, in 2017 and 2018 acute toxicological tests (96h) were carried out following the ASTM International standard guide for conducting laboratory toxicity tests with freshwater mussels. We used new-born *M. auricularia* juveniles (age <24h) that came from a captive breeding program carried out annually by the Aragón government. For the first time, the LC_{50} of each contaminant tested were estimated in *M. auricularia* juveniles: cadmium (CdCl2) = 38.85 µg/L, copper (CuSO4) = 58.64 µg/L, nickel (NiCl2) = 124.6 µg/L, zinc (ZnCl2) = 267.4 µg/L, chromium (CrCl3 • 6H2O) >1000 µg/L, lead (PbCl2) >2000 µg/L and ammonium (NH4Cl) = 11.8 mg/L. Compared with other unionids, the sensitivity of *M. auricularia* juveniles seems to be higher for cadmium and zinc, and instead it is more resistant to copper and ammonium. Overall, these results can be used as an important management tool in the study area regarding the conservation of *M. auricularia* because it may help to identify the heavy metal (and ammonium) tolerance thresholds of this critically endangered species.

Keywords: acute toxicological tests, endangered species, freshwater mussel conservation, heavy metals, Margaritiferidae

Elucidating the ecological diversity of thelodonts (Agnatha, Vertebrata) from the study of their squamations

Héctor Botella, Carlos Martínez-Pérez, Esther Manzanares, Jose Luis Herraiz, María Victoria Paredes-Aliaga & Humberto G. Ferrón

Paleobiologia/Palaeobiology

Thelodonts are an enigmatic group of Paleozoic jawless vertebrates that have been well studied from taxonomical, biostratigraphic and paleogeographic points of view, although our knowledge of their ecology and mode of life is still scant. Their bodies were covered by micrometric scales whose morphology, histology and the developmental process are extremely similar to those of extant sharks. Based on these similarities and on the well-recognized relationship between squamation and lifestyle in sharks, we use classic morphometrics and discriminant analysis to characterize the squamation patterns of a significant number of extant shark species whose ecology is well known, thus establishing a comparative framework for inferring lifestyles in thelodonts. The study of the squamation of the currently described 147 species of thelodonts suggests a remarkable ecological diversity. A large number of thelodonts were demersal species inhabiting hard substrates, within caves and crevices in rocky environments or reefs, taking advantage of the flexibility provided by their micromeric squamations. Contrary to classical interpretations, only few thelodonts were demersal species inhabiting sandy and muddy substrates. Schooling species with defensive scales against ectoparasites could be also abundant suggesting that social interactions and pressure of ectoparasites were present in vertebrates as early the Silurian. The presence of species showing scales suggestive of low to moderate swimming and lifestyles related to open water environments indicates adaptation of thelodonts to deep water habitats. Scale morphology suggests that some other thelodonts were strong-swimming pelagic species, most of them radiating during the Early Devonian in association with the Nekton Revolution.

Keywords: Thelodonti, sharks, squamation pattern, ecology, classic morphometrics, discriminant analysis

New park policies, new House Sparrow problems

Edgar Bernat-Ponce, José Antonio Gil-Delgado & Germán López-Iborra
Ecologia de Vertebrats Terrestres/Ecology of Terrestrial Vertebrates

The House Sparrow (*Passer domesticus*) is experiencing sharp declines in urban areas of Europe. The species follows the same negative trend in Spain. Several hypotheses have been proposed to explain this situation but its generalized decline seems to be linked to numerous factors. However, one of the most accepted hypotheses is related to changes in urban planning, which is affecting parks and green areas, their main feeding areas in the cities. In some towns and cities of the Valencian Community (Spain), parks are suffering modifications, such as paving and replacement of natural lawn by plastic grass. Our aim was to detect if House Sparrow populations of parks with changes decline at higher rates than those of parks without alterations. The abundance of sparrows in 32 parks of 4 locations in south-eastern Spain (north of Alicante and south of Valencia) was recorded by point counts in 4 summer seasons (2015-2018). Ten parks suffered changes during the study. Growth rates between seasons in both kinds of parks and their means before and after changes were analysed. Our results show that, even though growth rates in both kinds of parks were negative, House Sparrow populations decrease at higher rates in modified parks. Changes in these key habitats seem to be very harmful to the populations of urban sparrows. Green urban planning is needed in our cities to support House Sparrow populations. Political measures should take into account the conservation of urban biodiversity as an important problem and not as a minor issue.

Keywords: urban planning, park modification, plastic grass, paving, negative trend, political measures

Symbiotic associations between *Balaenophilus* spp. (Copepoda: Harpacticoida) and marine vertebrates: a striking evolutionary and ecological tale

Francesc Domènech, Jesús Tomás, Juan Antonio Raga & Francisco Javier Aznar
Zoologia Marina/Marine Zoology

The genus *Balaenophilus* includes two species, *B. unisetus* and *B. manatorum*, which dwell on the baleen plates of whales, and the skin of marine turtles and manatees, respectively. The exceptional association between these harpacticoids and vertebrates has been the focus of our research during the last decade. We found that, regardless of developmental stage, *B. unisetus* feed on baleen plates and likely is a commensal, whereas *B. manatorum* consumes skin and behaves as an ectoparasite, sometimes provoking the death of turtles in captivity. We hypothesized that this striking evolutionary history, full of host-switching events, was due to an exceptional resource-tracking of α-keratin-rich microhabitats at sea. However, preliminary stable isotope analysis does not support the hypothesis that *Balaenophilus* spp. derives energy from their hosts. Another key issue is how host-to-host transmission occurs. Our analysis of morphology and swimming ability reveals that only late copepodites and adults are able to swim. However, fecundity is very low and subject to a clear number/size trade-off, meaning that *Balaenophilus* spp. does not have long-dispersal stages but must rely on bodily contacts for transmission. Such contacts are arguably frequent in whales and manatees, but what about marine turtles? In the western Mediterranean, over 80% of juveniles of loggerhead sea turtle harbours *B. manatorum*, yet conventional wisdom states that contacts of marine turtles at early and late juvenile stages are exceptional. In summary, there are still big puzzles awaiting answers, but these tiny crustaceans certainly stimulate our curiosity and sense of wonder when looking at their symbiosis.

Keywords: *Balaenophilus,* cetacean, manatee, marine turtle, resource-tracking, host-switching, transmission, α-keratin

Biodiversidad de parásitos aporocotílidos en peces de interés comercial

José F. Palacios Abella
Zoología Marina/Marine Zoology

España es uno de los principales productores de acuicultura marina en el Mediterráneo, principalmente centrado en la dorada *Sparus aurata* L. y la lubina *Dicentrarchus labrax* (L.). Otra especie recientemente cultivada en el Mediterráneo es el atún rojo del Atlántico *Thunnus thynnus* L., el pez más valioso del mundo. El desarrollo de cultivos requiere la adquisición del conocimiento para las tecnologías de producción y mantenimiento, incluido el control de enfermedades. En el desarrollo de este trabajo trabajamos con peces de la familia Sparidae donde i) se describió una nueva especie de parasito aporocotílido (Trematoda: Digenea) en el corazón, el riñón cefálico y los vasos sanguíneos branquiales de la breca, *Pagellus erythrinus* (L.); ii) se describió un nuevo aporocotílido en el cerebro del besugo *Pagellus bogaraveo* (Brünnich), estudiando los efectos patológicos de esta familia de parásitos en su hospedador, y iii) se describe la presencia de aporocotílidos en la dorada, *S. aurata* (L.) tanto de cultivo como de medio salvaje. Por otra parte se trabajó con *T.thynnus* donde iv) se estudió la biodiversidad de aporocotílidos en este pez de gran valor en diferentes áreas de Mediterráneo y v) se desarrolló un técnica para optimizar el diagnostico de estos parásitos en peces de gran tamaño como el atún.

Keywords: *Skoulekia*, *Cardicola*, espáridos, atún rojo, diagnostico

Secondary contact of hegdehogs in central Europe

Kristýna Eliášová, J. Ignacio Lucas Lledó, Pavel Hulva, Barbora Černá Bolfíková
e3 - Genómica de Poblaciones/e3 - Population Genomics

Secondary contact of previously diverged lineages gives a chance for ad-mixture, with different potential evolutionary outcomes. European hedgehogs (*Erinaceus europaeus*) and Northern white-breasted hedgehogs (*E. roumanicus*) are a classical example of postglacial recolonization with an extensive contact zone in central Europe. In this study we use genome-wide markers (SNPs via RADseq) and a pan-European sampling design to examine the detailed population structure of these species. We reveal a deeper genetic structure in *E. europaeus*, related to historical isolation in different refugia. We confirm a low rate of hybridization between the two species, and we are able to compare the signal of historical introgression with the actual genomic blocks of introgression in one hybrid individual. Our detailed analysis help explain the evolutionary forces that shape the population structure and the interactions between European and Northern white-breasted hedgehogs.

Keywords: *Erinaceus europaeus, Erinaceus roumanicus, Erinaceus concolor*, contact zone, hybridization, introgression, genetic structure, RADseq, SNPs, postglacial recolonization

Holidays? Not for all. Eagles have larger home ranges on holidays as a consequence of human disturbance

Arturo M. Perona & Pascual López-López

Ecologia de Vertebrats Terrestres/Ecology of Terrestrial Vertebrates

Human-wildlife conflicts are object of raising concern in conservation biology. People living in urban areas are rapidly increasing worldwide and thus the temporal pattern of occupation of natural areas for recreation, resulting in an ever-increasing concentration of people during weekends and holydays. This is particularly evident in First World societies, where more recreationists visit natural areas on holidays and weekends, causing disturbance to wildlife in the so-called "weekend effect". Here, we tested the response to disturbance of 30 Bonelli's eagles tracked by high-frequency GPS/GSM telemetry. We analyzed daily home-range size, a measure of changing behavior that integrates their vital requirements, throughout the annual cycle considering three different levels (95%, 75% and 50% kernel density estimators). Our results showed that eagles made a higher ranging effort on weekends and holidays all over the annual cycle. This was particularly evident during the non-breeding period, when larger home-ranges were observed. Higher ranging effort can lead to conservation problems such as extra energy expenditure, hunting interference, and eventually nest and/or territory abandonment, decreasing eagles' fitness. Measures aimed at reducing human-wildlife conflicts including spatio-temporal limitation of leisure activities particularly during the most critical periods (i.e., incubation, chick rearing) are urgently needed. Finally, where possible, high quality information of animal movement should be incorporated into conservation plans in order to delineate efficient spatially-explicit management measures.

Keywords: GPS human disturbance outdoor activities, raptors recreational activities telemetry

Intensity of male-male competition predicts morph diversity in a color polymorphic lizard

Guillem Pérez i de Lanuza, Miguel A. Carretero & Enrique Font
e3 - Etologia/e3 - Ethology

Sexual selection is one of the main processes involved in the emergence and maintenance of heritable color polymorphisms in a variety of taxa. Here, we test whether the intensity of sexual selection, estimated from population sex ratio, predicts morph diversity in *Podarcis muralis*, a color polymorphic lizard with discrete white, yellow, orange, white-orange, and yellow-orange male and female phenotypes (i.e., morphs). In a sample of 116 Pyrenean populations and 5421 lizards, sex ratios (m/f) vary from 0.29 to 2.5, with the number of morphs for each sex ranging from 2 to 5. Male-biased sex ratios are associated with increased morph diversity as measured with Shannon's diversity index. The main factor accounting for this relationship is male morph richness (i.e., the number of morphs). In contrast, female morph diversity is not related to sex ratio. These results suggest a relationship between the intensity of male intrasexual competition and male morph diversity. While other selective forces may interact with sexual selection in maintaining the color polymorphisms in *P. muralis*, this evidence suggests a complex evolutionary scenario possibly involving frequency-dependent selection of alternative reproductive tactics and/or complex balancing selection.

Keywords: behaviour, alternative strategies, color polymorphism, sexual selection

POSTERS

Metacommunities and biodiversity patterns in Mediterranean versus Tropical temporary ponds

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e3 - Ecologia i Biogeografia de Sistemes Aquàtics/e3 - Ecology and Biogeography of Aquatic Ecosystems

The recent establishment of alternative conceptual models of metacommunity theory and the development of numerical techniques accounting for environmental and spatial constraints on species distributions have motivated a burst of empirical tests over the past decade. Some patterns have arisen, such as the predominance of environmental over spatial effects, or the reduction of spatial effects in taxa with higher dispersal abilities and smaller body size. Still, large geographic gaps exist, as most studies have been carried out in temperate climates. In addition, there is evidence for an influence of the spatial extent of the study, and the results from surveys that consider temporal effects suggest that the response of metacommunity organization to niche and neutral processes strongly differ between time periods. Through the METACOMM project we aim to disentangle the role of space, environment and time in structuring metacommunities of a variety of aquatic organisms (prokaryotes, algae, macrophytes, invertebrates and vertebrates), explored using standardized methods at the same spatial extent, by comparing a set of temporary ponds in a -tropical climate (Guanacaste, Costa Rica) with another set in a Mediterranean landscape (Valencia, Spain). Among other hypotheses, we expect a stronger impact of environment and space on community assembly in the temperate area, as compared to tropical zones which experience higher precipitation rates and reduced temperature variations. Strong rains in seasonal tropical areas may counteract spatial filters by increasing connectivity. Furthermore, environmental constraints may be reduced in the tropics with more constant and constant temperature. At this first stage of the project we will provide some preliminar data on biodiversity of different aquatic taxa in a selected set of ponds.

Keywords: metacommunities, Tropical seasonal. Mediterranean, ponds, biodiversity, space, environment time

The life cycle of a parthenogenetic population of *Chara canescens* in an interdunal pond in the Mediterranean coast

Sara Calero & Maria A. Rodrigo

e3 - Ecologia Integrativa/e3 - Integrative Ecology

Chara canescens lives in shallow brackish waters along the northern hemisphere. It is an annual and dioecious species that usually reproduces by parthenogenesis, being the only one species of *Chara* able to do so. During an annual cycle, we monitored a *C. canescens* parthenogenetic population growing in an inter-dunal shallow within *Albufera de València* Natural Park. Thirty specimens were collected every 15-30 days to detect oogonia and oospores formation. Largest polar axis (LPA) and largest equatorial diameter (LED) for 521 oogonia and 201 oospores were measured. The isopolarity index (ISI=LPA/LED×100) and other relations between size variables were explored. Only a few small and fragmented *C. canescens* individuals overwintered around the emergent vegetation shoots. From March, new shoots appeared from germinating oospores; they grew fast and colonized more open waters. First oogonia showed up in April, enlarging and ripening along the first 5 whorls of the shoots. Unripe and ripe oogonia were distinguished due to their different size relation (swollen process). Oospores were produced in less than 15 days from the first oogonium emergence, mostly present between the 4th and the 9th whorls. Ripe oospores were small (average size=392x219 µm; ISI=181). Parthenogenetic reproduction lasted 5 months, without any new fructification after September. This population had a short life cycle, according to the species annual character and the temporality of its habitat. The oospores' size was out of the ranges described in the literature for the species. However, they were clearly viable and enabled the persistence of the population after the winter.

Keywords: Characeae, life cycles; reproductive phenology, sexual *vs* parthenogenetic populations, oospores

Myrmecia israeliensis as the primary symbiotic microalga in terricolous squamulose lichens across Europe and Canary Islands

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Biodiversitat vegetal i ecofisiologia/Plant Biodiversity and Ecophysiology

Myrmecia israeliensis (S.Chantanachat & H.Bold) T. Friedl has been traditionally considered as a green coccoid free-living microalga. This microalga was suggested as the primary phycobiont in two related lichen genera *Placidium* and *Heteroplacidium*, and recently in *Psora decipiens*. However, due to the absence of nrITS DNA sequences (barcode information) these previous studies could not confirm this microalga as living in symbiotic state. The aim of this study was to settle the presence of *M. israeliensis* as the primary microalga in different terricolous squamulose lichen species (*Psora* spp., *Placidium* spp. and *Clavascidium* spp.) by using both molecular and ultrastructural techniques, along to 31 localities from European and Canarian ecosystems. The lichen forming-fungi were identified using ITS rADN as barcode. Phycobiont phylogenetic analyses were made using both chloroplast (LSU rDNA) and nuclear (nrDNA ITS) molecular markers. In addition, fluorescence microscopy, transmission electron microscopy and scanning electron techniques were used to characterize *M. israeliensis*. The mycobiont analyses for *P. decipiens* showed a surprisingly variability in this lichen species. Our results proved *M. israeliensis* to be the primary symbiotic microalga in all the lichens analyzed, which its nrITS DNA barcode information was obtained for the first time by our team. Finally, the presence of this microalga was verified using different microscopic observations. Combination of different techniques both molecular and microscopic allowed to the accurate identification of this symbiotic microalga, beforehand only known as free living. (PROMETEOIII//2017/039/GVA; MINECO, CGL2016-79158-P y FEDER)

***Keywords**: Clavascidium* spp., ITS rDNA (barcoding), *Myrmecia israeliensis*; *Placidium* spp., *Psora* spp., ultrastructure

Comparative anatomy in the light of network thinking

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Biologia Teorica/Theoretical Biology

From genetics to ecology, network thinking has changed the way we look at biological systems; specifically, how their structure determines their overall behavior. Ever since the fundamental principles of comparative anatomy were laid down in the 19th century, connections among anatomical elements have been essential for the recognition of evolutionary relations among body parts (homology). Yet, comparative anatomy has seldom participated of the widely application of network thinking in biology. Anatomical systems are readily modeled as networks. Even a delimited anatomical structure, such as a limb or the head, is made of many parts that we can model as nodes—bones, muscles, nerves, vessels—interacting together to perform various functions, while growing and evolving together. In recent years, networks have begun to be used to unveil evolutionary patterns, developmental constraints, and neuro muscular interactions. Network thinking brings a fresh look at old problems in comparative anatomy, such as homology, developmental constraints on evolution, morphological variation, and functional adaptations. In turn, anatomy offers network scientists new problems to solve, such as assessing the likelihood of reconstructions of extinct animals from fossils, characterizing topological constraints on congenital malformations, or identifying morpho-functional modules in evolution and development. The study of anatomy using network science opens new lines of research that can shed some light on a wide variety of problems.

Keywords: comparative anatomy, anatomical network analysis (AnNA), anatomical models, homology, morpho-functional modules, evo-devo

Patterns of ecological diversification in early vertebrates: Thelodonti (Agnatha, Vertebrata) as a case study

Humberto G. Ferrón, Susan Turner, Carlos Martínez-Pérez, Esther Manzanares, Jose Luis Herraiz, María Victoria Paredes-Aliaga & Héctor Botella

Paleobiologia/Palaeobiology

Ecological diversification is the core mechanism that underlies adaptive radiations and is a major player in shaping morphological, molecular and behavioural traits. Here we explore the spatial, temporal and phylogenetic patterns of ecological diversification for the entire clade of thelodonts, one of the earliest groups of vertebrates, shedding light onto the ecological evolutionary history of one of the first representatives of our own clade. Parsimony and maximum-likelihood methods are used to reconstruct ancestral states of their geographical distributions, habitats and lifestyles. Our results support the concept that thelodonts originated during the Middle?–Late Ordovician probably in marine open waters of Laurasia, with a demersal lifestyle on hard substrates being the ancestral condition for the whole clade. Later, thelodonts underwent a complex ecological diversification and palaeobiogeographical history, comparable in many aspects to those of some major groups of living fishes. Different modes of life evolved repeatedly and a wide range of habitats were colonized by distinct groups, including deep waters and brackish marine and/or freshwater environments. Diadromous strategies presumably appeared on nine different occasions. The palaeobiogeographical history of thelodonts reveals significant differences in the dispersal potential of some major groups. Dispersal of thelodontiforms entailed displacements over long distances and the crossing of deep-water biogeographical barriers, whereas those of furcacaudiforms were always limited to areas interconnected by shallow platforms. We propose that the evolution of pelagic larval stages in thelodontiforms might explain this biogeographical pattern and could satisfactorily account for the greater evolutionary success of this group.

Keywords: Thelodonti, early vertebrates, ecological diversification, lifestyles, habitats, dispersal events

ICBIBE-PASLAB. Apoyo a tareas de investigación. ¿En qué podemos ayudarte?

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PASLAB-Institut Cavanilles de Biodiversitat i Biologia Evolutiva

Se presenta un esquema de las actividades de apoyo a la investigación que el ICBiBE gestiona a través de su equipo de personal auxiliar PAS. Procesos administrativos y contables, tareas de asistencia a laboratorio y mantenimiento de equipamientos comunes, son actividades consideradas como Servicios Comunes a disposición de los grupos de investigación. Los servicios de soporte a la investigación experimental son mantenidos por la plantilla de PAS de laboratorio (PASLAB) y se concretan en dos grupos principales de actividades: asistencia personalizada a los diferentes grupos de investigación y gestión de servicios comunes. Entre estos últimos se incluye: servicio de autoclavado, mantenimiento de infraestructuras y equipos científicos, soporte integral de adquisición de material científico, gestión de residuos peligrosos. Adicionalmente el equipo colabora en actividades de formación tanto de personal interno como tutorizando prácticas externas de estudiante de FP. Las actividades ligadas a la Prevención de Riesgos Laborales son también coordinadas desde PASLAB. Destacar que la plantilla PASLAB destinada a estas actividades de soporte a la investigación es de 3 técnicos, contando en la actualidad con el apoyo extra de un técnico PTA en su último año de contrato. Por tanto, la actual proporción técnico/PDI en la sede central de 4 técnicos vs 31 PDIs (0.129) pasará a 3 vs 31 (0.097). Sin duda escasa, pero contamos con que el compromiso del nuevo equipo rectoral de atender las evidentes necesidades de personal técnico en los Institutos Universitarios de Paterna, permita ver recuperada y potenciada la capacidad del equipo PASLAB y que podamos seguir mejorando nuestro nivel de servicio.

Palabras clave: apoyo a la investigación

Análisis preliminar del dominio vital del erizo moruno *Atelerix algirus* y del erizo europeo *Erinaceus europaeus* en un área periurbana del este de la península Ibérica

Héctor Gago, Robby Drechler y Juan S. Monrós

Ecologia de Vertebrats Terrestres/Ecology of Terrestrial Vertebrates

El erizo común (E*rinaceus europaeus*) se distribuye por la totalidad de la península Ibérica, mientras que el erizo moruno (*Atelerix algirus*) presenta una distribución restringida a la franja mediterránea. En la Comunidad Valenciana se encuentran en simpatría, y las posibles relaciones que pueden darse entre ellos no han sido hasta el día de hoy estudiadas. Con el fin de determinar las áreas de campeo de estas dos especies en un área simpátrica, se capturaron mediante la técnica de trampeo en vivo y transectos nocturnos, 10 machos (6 de erizo moruno y 4 de erizo común) y se les colocaron emisores VHF para poder radioseguirlos durante un mes en la primavera-verano de 2017. Los erizos monitoreados presentaron áreas de campeo y distancias recorridas variables. El máximo polígono convexo (MCP) varió entre un mínimo de 0,45 ha, y un máximo de 24,9 ha para el erizo europeo con una media de 8,79 ha. Para el erizo moruno osciló entre un mínimo de 3,8 ha y un máximo de 30,3 ha (Media = 11,34 ha). No se han encontrado diferencias significativas en los dominios vitales calculados a través de los estimadores kernel (90 % y 50%) y máximo polígono convexo (100% y 95%). Por otro lado, tampoco se han encontrado diferencias significativas en las distancias recorridas entre localizaciones entre ambas especies. En cambio, considerando el movimiento de ambas especies en conjunto, se movieron significativamente más en primavera que en verano. Durante la monitorización se observaron a estas dos especies compartiendo zonas de descanso y alimentación solapándose de esta manera sus dominios vitales.

Palabras clave: *Atelerix algirus,* dominio Vital, *Erinaceus europaeus,* erizo europeo, erizo moruno, radio seguimiento

On the use of quantitative versus qualitative methods to study zooplankton in tropical ponds

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e3 - Ecologia i Biogeografia de Sistemes Aquàtics/e3 - Ecology and Biogeography of Aquatic Ecosystems

In the study of zooplankton from lakes and ponds, quantitative and qualitative, or semi-quantitative, methods are commonly used. Quantitative ones are mostly used to estimate zooplankton densities more accurately. They usually include water samples of small volumes but precisely measured, such as hydrographic bottles, plankton traps or metered jars, although these methods frequently underestimate bigger and scarcer organisms as large crustaceans. Qualitative or semi-quantitative methods, as plankton nets, usually acquire higher volumes of water but less accurately measured, so they are considered better to estimate species richness but worst to calculate densities. In order to compare both methodologies we surveyed several temporary ponds in Costa Rica using 1) a plankton net (20 cm diameter and 63 microns porous size) which filtered a volume between 50 and 500 liters and 2) a sample of 5 to 15 liters, took with a metered plastic jar, and filtered through 30 microns. Samples were taken in June (few weeks after ponds flooding) and in September (at the maximum flooding season) in 2017, and they were taken from the different microhabitats of the ponds. We have identified zooplankton (rotifers, copepods and cladocerans) to species when possible and counted them, estimating densities for the different species, and richness for the different groups. Results show great differences in the estimate of density. Plankton net densities were significantly lower than quantitative ones. The species richness and order 1 alpha diversity were higher in the net samples during the second season, although no significant differences between both methods were found in order 2 alpha diversity. Thus, different methods should be carried out in order to estimate plankton density or species richness, depending on the season of the year.

Keywords: density, graduated jar, plankton net, species richness, tropical temporary ponds, zooplankton

Ageing via perception costs of reproduction magnifies sexual selection

Roberto García-Roa, Manuel Serra & Pau Carazo
e3 - Etologia/e3 - Ethology

Sexual selection is one of the main engines of biodiversity so that understanding what factors modulate it is thus crucial to a wide variety of evolutionary processes. Recent studies show that perception of sex pheromones can severely impact male mortality when it is not followed by mating (perception costs of reproduction). Here, we examine the idea that this may magnify sexual selection by further decreasing the fitness of males with inherently low mating success, hence increasing the opportunity for sexual selection. We use mathematical modelling to show that even modest mortality perception costs can significantly increase variability in male reproductive success under a wide range of demographic conditions. We then conduct a series of assays to show that in *D. melanogaster* failure to reproduce early in life will, via perception costs of reproduction, significantly reduce the subsequent fitness of males (ca. 25%), due mostly to increased reproductive ageing. Altogether, our results strongly suggest that perception costs of reproduction can indeed magnify sexual selection in a biologically significant way. Finally, we estimate that around 29% of available studies quantify sexual selection based on short-term fitness estimates that may fail to capture these effects (if they were present in their subject species), and suggest addressing the existence and impact of perception costs of reproduction across taxa should thus be a priority.

Keywords: ageing, sexual selection, perception, costs

Abscisic acid and saline stress responses in symbiotic green alga *Trebouxia* sp. TR9 isolated from the lichen *Ramalina farinácea*

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Biodiversitat Vegetal i Ecofisiologia/Plant Biodiversity and Ecophysiology

Although tolerance to saline conditions has been thoroughly studied in plants and, to an extent, free-living microalgae, scientific data regarding salt stress on symbiotic lichen microalgae is scarce to non-existent. Since lichen phycobionts are capable of enduring harsh, restrictive and rapidly changing environments, it is interesting to study the metabolic machinery operating under these extreme conditions. We aim to determine the effects of prolonged exposure to high salt concentrations on the symbiotic phycobiont *Trebouxia* sp. TR9, isolated from the lichen *Ramalina farinacea.* Our results suggest that, when this alga is confronted with extreme saline conditions, the cellular structures are affected to an extent, with limited chlorophyll content loss and photosynthetic activity remaining after 72 h of exposure to 5 M NaCl. Furthermore, this organism displays a rather different molecular response compared to land plants and free-living halophile microalgae, with no noticeable increase in ABA levels and ABA-related gene expression until the external NaCl concentration is raised to 3 M NaCl. Despite this, the ABA transduction pathway seems functional, since the ABA-related genes tested are responsive to exogenous ABA. These observations could suggest that this symbiotic green alga may have developed alternative molecular pathways to cope with highly saline environments. Despite this, the ABA transduction pathway seems functional, since the ABA-related genes tested are responsive to exogenous ABA. These observations could suggest that this symbiotic green alga may have developed alternative molecular pathways to cope with highly saline environments. (PROMETEOIII//2017/039/GVA; MINECO, CGL2016-79158-P y FEDER).

Keywords: ABA, lichen, *Ramalina,* saline stress, terrestrial, microalgae, Trebouxiophyceae

Reproductive isolation and differentiation in rotifer populations

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Ecologia Evolutiva/Evolutionary Ecology

Population differentiation arises as a result of restricted gene flow in a spatially heterogeneous landscape. The spatial structuring of populations may be the result of genetic drift and/or local adaptation, and eventually leads to speciation. This process may imply a degree of reproductive isolation, which can be reinforced by mating preferences when selection acts against less efficient offspring from mixed populations. Brachionus plicatilis populations in Eastern Spain show strong population differentiation arising from historical effects and local adaptation to unpredictability in their localities. In this research, we aim to quantify premating and total reproductive isolation as a function of phylogenetic distance and local adaptation to unpredictability. To this purpose, test on mating behaviour with selected populations will be performed, and signatures of total isolation will be searched from diapausing eggs of mixed populations. After these results, divergence in the MMR region (coding the mate recognition protein responsible for male-female recognition) will be investigated. We expect higher reproductive isolation with increasing phylogenetic distance and with increasing divergence in MMR between populations. We also expect higher differences between ponds at the extremes of the unpredictability gradient. Here we present this background, the design of the experiments and our first results.

***Keywords**: environmental predictability, isolation reinforcement, local adaptation, phylogeographic structure*

A functional trait framework to study diversity of helminth parasites

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Ecologia i Evolució de Simbionts/Symbiont Ecology and Evolution

Traditionally, Taxonomic Diversity (TD) is used to measure diversity, mainly as richness or abundance of species. The main limitation of TD metrics is that they consider species as equivalent entities, with no consideration of their phylogenetic relationships and functional role in the community. To tackle this issue, one needs to incorporate phylogenetic and functional distances between species when measuring diversity. Thus, Functional Diversity (FD) estimates diversity in a community based on distances between functional traits of species (i.e. phenotypic traits that impact fitness of individuals via their effects on growth, reproduction and survival). Studies of FD can unveil the processes that determine species composition in ecosystems and the responses of organisms to different factors. However, despite the ubiquity of parasites in ecosystems, few FD studies have targeted parasite communities. We propose here a framework of functional traits of aquatic helminth parasites ready for application in FD studies and demonstrate its application to the helminth parasite fauna of the flathead grey mullet (*Mugil cephalus*) in three habitats: one marine and two brackish. For TD and FD analyses, we measured diversity at alpha (individual host) and beta (locality) levels of organisation using the Rao quadratic entropy index. Moreover, we define the heterogeneity of the community composition in terms of both parasite species and functional traits. We expect that our framework of functional traits would inspire future FD analyses of parasite communities.

Keywords: functional diversity, community ecology, helminths, grey mullets

Analysis by next generation sequencing (NGS) of bacterial communities inhabiting sediments of Spanish wetlands showing marked trophic, hydrological and salinity gradients

Javier Miralles-Lorenzo, Antonio Picazo, Carlos Rochera, Anna C. Santamans, Maria Belenguer, Daniel Morant & Antonio Camacho

Limnologia/Limnology

The use of next generation sequencing (NGS) techniques has been a great innovation in the studies of microbial diversity of natural environments as it offers high level of detail. However, studies addressing prokaryotic diversity of sediments from wetlands of Spain that use this approach are still scarce. This work explores the bacterial diversity of sediments from 17 lagoons, most of them saline, located in the UNESCO Biosphere Reserve of La Mancha Humeda (Central Spain) and 2 coastal marshes from Valencian Community (East of Spain). The former waterbodies showed a marked gradient of salinity, as well as, contrasting hydrological periods and trophic status. On the other hand, coastal marshes presented a less variable hydrological regime, although they showed also different degrees of anthropogenic alteration. For the determination of the bacterial diversity in sediments, sequencing by NGS with MySeq (Illumina) was carried out based on specific libraries of the 16S rRNA. The structure of bacterial communities contrasted markedly among lakes and was related with limnological characteristics and environmental variables of the sites. On this sense, our findings proved that exists a close relationship between the typology and/or anthropic alterations of the sites and the microbial community structure at lower phylogenetic levels. Interestingly, the later allows establishing more suitably relationships between structural and functional aspects of these divergent microbial communities.

Keywords: next generation sequencing, bacteria, saline lakes, microbial diversity, marshes, Biosphere Reserve of La Mancha Humeda

Use of substrates and enzymatic activities by the aquatic microbial assemblages of endorheic lakes along a salinity gradient

Javier Miralles-Lorenzo, Anna C. Santamans, Antonio Picazo, Carlos Rochera and Antonio Camacho
Limnologia/Limnology

Salinity is a main environmental variable shaping the structure and phenotypic characteristics of microbial communities inhabiting aquatic environments. In this work, we aim to assess the community-level physiological profile (CLPP) and enzymatic activities of the aquatic microbial community of 17 endorheic lakes located in La Mancha Húmeda Biosphere Reserve (Central Spain). These lakes varied in salinity and trophic status. The phenotypic assay was performed using the Biolog EcoPlate system, which is particularly designed to assess the potential aptitude of microbiota for consume different sources of organic carbon. Additionally, we measured phosphatase and celobiase enzymatic activities in the same samples. As a general pattern, lakes with a higher salinity showed bacterial communities with a lower capability to use different sources of organic carbon, however, consumption rates over few substrates were quantitatively higher compared to other sites. This pattern was even more pronounced during warmer periods. By contrast, bacterial communities in less saline sites were able to use a wider range of substrates but, in general, at lower rates. These findings shed light on how microbial functions related with carbon cycle may vary along to main environmental gradients.

Keywords: community-level physiological profile, Biolog EcoPlate, saline lakes, phosphatase activity celobiase activity, Biosphere Reserve of La Mancha Humeda

Presence of microplastics in the digestive tracts of stranded loggerhead turtles (*Caretta caretta*) in the Valencian Community coasts

Olga Novillo, Juan Antonio Raga & Jesús Tomás

Zoologia Marina/Marine Zoology

Plastic input to the sea has increased steadily over the past three decades; likewise the interaction between marine turtles and plastic. Among these turtles, loggerhead turtles (*Caretta caretta*) are especially prone to ingest plastics due to their opportunistic and generalist diet, as well as due to their migratory nature. In the present study we analyse *de visu* in the western Mediterranean the abundance of microplastics in the digestive tracts of stranded or by-caught dead loggerhead turtles along the Valencian Community coast (East Spain). We also analyze the relationship between the amount of microplastics and macroplastics found in the digestive contents. We analysed microplastics in 12 turtles dead in 2017 and 2018. In total, 9 loggerheads had microplastics in their digestive tracts, 8 of which presented macroplastics as well. Concerning microplastics' characteristics, 44.4% of them were fibres and 55.5 % were irregular fragments. Most of the fibres were black (59%), followed by degraded colours (36.4%), translucent and red (2.3% each). By the contrary, most of the fragments found were blue (30.9%), followed by white (27.7%), translucent (20%), degraded colours (16.4%) and green (3.6%). Microplastic size varied in between 0.5 and 5 mm. Concerning these results, presence of microplastics in loggerhead turtles' from the western Mediterranean seems to be frequent. Therefore, these species look a good candidate to be bioindicator for monitoring microplastics' presence at marine ecosystems. It is necessary to continue with these analyses, with a greater temporal and spatial scale in order to detect trends in the amount of plastic in our seas and their impact on marine fauna.

Keywords: loggerhead, caretta, microplastics, strandings, western Mediterranean

New insights in supplementary feeding by means of high-resolution telemetry. Eagles diminish their ranging effort with extra food

Arturo M. Perona & Pascual López-López

Ecologia de Vertebrats Terrestres/Ecology of Terrestrial Vertebrates

Food availability is one of the most important factors limiting bird populations, being especially important in the pre-breeding and the breeding season, influencing hatching synchrony, age at first brood and growth rate of the nestlings. Human pressure is increasing in natural landscapes, which can considerably reduce the amount of resources available. This is of major concern in territorial raptors which depend on the resources of a unique and stable territory. A low food availability can lead individuals to waste more amount of energy in feeding tasks, which reduce body condition affecting fitness and breeding success, with important conservation consequences. Supplementary feeding has been used as a tool by conservationists for many decades, being associated with increased breeding success, nestlings` survival and better growth rates besides a reduction of sibling aggression and starvation. We fed, experimentally, 6 territories occupied by Bonelli's eagles from February to June twice a week. Taking advantage of high-resolution GPS/GSM telemetry, we analyzed daily home ranges and revisitation frequency in days with and without supplementary feeding as a measure of changing behavior. In days with supplementary feeding, eagles did a minor ranging effort. Supplementary feeding also resulted in high breeding performance. Higher ranging effort can lead to conservation problems such as extra energy expenditure, hunting interference, and eventually nest and/or territory abandonment, decreasing eagles' fitness. Supplementary feeding is been proved as a useful management tool to deal with short-term threats on endangered species.

Keywords: *Bonelli's Eagle, conservation, food availability, GPS/GSM telemetry, raptors*

Bathycotyle sp.: a fish trematode living outside

Aigües Repullés-Albelda, M. Víllora-Montero, Francisco E. Montero, S. Mele & Jose Antonio Raga.
Zoologia Marina/Marine Zoology

As a result of a fishing competition we could perform parasitological analyses on 30 specimens of *Coryphaena hippurus*. The gills of these fish were not only infected by traditional ectoparasites but also by some trematodes, usually considered endoparasites. Samples were collected from Atlantic Spanish waters during two years (2015 and 2016). Gills were examined for parasites and trematode specimens were isolated. Morphological analyses were conducted using specimens fixed in ethanol 70 and stained with ferric acetocarmine while, for molecular studies, specimens were fixed in absolute ethanol. Histology was performed with formalin fixed specimens decalcified in 8% formic acid and embedded in paraffin. Sections of 5 µm were stained with hematoxylin-eosin and analyzed using a light microscope (40x–1000X). Total infection prevalence (P) was 23.3%, with P: 33.3%, mean abundance (MA): 0.86±1.59 and mean intensity (MI): 2.6±1.8 for 2015 and P: 13%, MA: 0.13±0.35 and MI: 1±0 for 2016. Specimens 15.8±2.8 long and 2.2±0.3 wide, were mostly found free in the gill rinse although two of them were directly attached to the tip of the gill filaments with their ventral sucker. Based on morphological traits, specimens were identified as adult specimens of *Bathycotyle* sp.. Molecular results did not reveal significant coincidences with any sequence available in GenBank. The attachment of these trematodes modifies the gill filaments which have a bended tip and become club-shaped. This slight and local host reaction is in contrast with that caused by *Accacoelium contortum* in *Mola mola*, another trematode infecting gill.

Keywords: common dolphinfish, trematode, molecular taxonomy, habitat selection, attachment

Charophyte hosts drive the metacommunity of periphyton assemblages

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From the viewpoint of aquatic community organization, we must answer whether charophytes affect periphyton composition, but also evaluate the importance of this source of periphyton to seston. Our first hypothesis is that periphytic assemblages are charophyte species-specific and hence their metacommunity structure also corresponds to niche-based paradigms. Analysing the importance of dispersal to periphytic populations allows us to discriminate between the two niche-based paradigms. From this perspective, our second hypothesis is that the periphytic assemblages distribution is also dependent on waterbody morphometry and meadow location. To test these hypotheses, we analysed periphyton assemblages growing on *Chara hispida, Chara vulgaris, Chara aspera and Nitella hyalina* meadows in an interdunal Mediterranean warm pond and a deep cold lake in Central Spain. We compared these assemblages with microalgae-cyanobacteria in the seston around each meadow. The effective number (diversity) of periphyton species on hosts from shallower meadows was 12±2 and 17±5 in their corresponding seston, a variation not significantly different. However, in deeper meadows, the diversity on hosts was 16±6, a value significantly higher than 5±2 for seston. In the ponds, three groups emerged based on the hosts and their location in the ponds. The clustering in the lake segregated free-water assemblages from those of the periphyton; this highlights the more homogeneous compositions of free-water periphyton. Charophytes exert an influence on periphyton composition and diversity, and while shallower sites shared more periphytic and planktonic species (mass-effect and patch dispersion processes) the most isolated meadows shared few periphyton species with water column assemblages (species-sorting paradigm).

Keywords: Charophytes, community organization, niche-based paradigms, species sorting or mass-effect views

Comparación entre *Ceratium furcoides* (Levander) Langhans en embalses de la cuenca del Ebro (España) y embalses del estado de Sao Paulo (Brasil)

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Limnologia/Limnology

Se compara las características morfológicas del dinoflagelado *Ceratium furcoides* procedente de varios embalses de la cuenca del Ebro y embalses del estado de Sao Paulo, relacionando si las características fisicoquímicas y biológicas de dichos embalses favorecen o determinan dichas tipologías del alga. Mientras *Ceratium hirundinella* es una especie común en la comunidad fitoplanctónica de algunos embalses de la cuenca del Ebro, *Ceratium furcoides* tan sólo aparece en unos determinados embalses junto con *Ceratium hirundinella*. Es de notar que *Ceratium furcoides* es el único representante del género *Ceratium* solamente en uno de los casos estudiados, el embalse de El Val en 2017, siendo el responsable de prácticamente el total de la biomasa algal en dicha ocasión. Sin embargo, consideradas ambas especies invasoras en América del Sur, *Ceratium furcoides* ha desplazado a *Ceratium hirundinella* en los embalses brasileños estudiados, alcanzando grandes densidades y llegando también a formar, en algunos casos, blooms uniespecíficos. El análisis morfométrico pone de manifiesto diferencias significativas referidas tanto a la longitud total de la célula como a la longitud de sus cuernos y la presencia o no de un cuarto cuerno. De ese modo, se observan desde las células de menor tamaño con tres o cuatro cuernos hasta embalses con las células de mayor tamaño y cuernos muy bien desarrollados. El presente estudio morfológico utilizando la microscopía óptica (NIC) y electrónica (SEM) aporta información sobre las preferencias ecológicas de los distintos morfotipos, pero un análisis de genética molecular de las poblaciones de *C. furcoides* sería un complemento interesante.

Palabras Clave: *Ceratium*, embalses, cuenca Ebro, estado trófico, morfotipo

Estima del CDOM como aproximación a la concentración de DOC en embalses y variables que influyen

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El carbono orgánico disuelto (DOC) constituye la mayor reserva de carbono orgánico de los ecosistemas acuáticos y juega un papel importante en el ciclo biogeoquímico del carbono, clave en modelos climáticos globales, para los que es necesaria una alta resolución espacial y temporal de los datos de concentración de DOC. Actualmente, diversos trabajos de investigación muestran la aplicación de la fluorescencia in situ como un método de detección de la concentración del DOC a través de su componente ópticamente activo, la materia orgánica disuelta cromofórica (CDOM). No obstante, la relación está influenciada por factores como la superficie de cuenca drenada, el tiempo de residencia hidráulica (TRH), la concentración de sólidos en suspensión y clorofila a [Chl-a]. El objetivo de este estudio es buscar una relación entre el DOC y el CDOM en los embalses de la Cuenca del Ebro para el período estival y definir las condiciones en las que la relación entre el CDOM y el DOC sea más significativa. Entre 2011 y 2013 se muestrearon un total de 83 embalses. El análisis del CDOM se obtenía en un perfil vertical mediante un sensor fluorométrico conducido conectado a una sonda mutiparamétrica. La medida de DOC se obtenía en un analizador de carbono a partir de una muestra integrada de agua de la zona fótica. Los únicos factores que establecían grupos estadísticamente diferentes fueron el TRH cuando era inferior a tres meses, que estableció una buena relación DOC-CDOM y la [Chl-a] cuando su valor era inferior a 4 µg L-1.

Palabras clave: CDOM, DOC, embalses fluorimetría, tiempo de residencia hidráulica

Environmental unpredictability shapes the adaptive responses of rotifers

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Rotifers are adapted to environmental fluctuations, which have a variable unpredictable component. Theory predicts that bet hedging is adaptive for unpredictability. Here we combine previous results on *Brachionus plicatilis* populations and their habitats in Eastern Spain in order to offer a unified analysis relating unpredictability, diapausing-related life-history traits (propensity to sex and diapausing egg hatching ratio) and genomic data. Our first, methodological aim is to assess the potential and difficulties of research programs relating (1) habitat features, which can be elusive to define (e.g., unpredictability) and needed of long-term monitoring (e.g., satellite remote sensing) to be estimated, (2) phenotypic (e.g., life-history) traits as observed in both natural and experimentally evolving populations, and (3) detecting and annotating genetic variation (e.g., SNPs and associated genes). Our second aim is to assess the evidence for the hypothesis of bet-hedging strategies in rotifers. By combining results from different studies, we conclude that populations, despite having close genetic and geographic relationships, can locally diverge accordingly to the unpredictability of their environments. We suggest that this adaptation is possible because, as observed experimentally, rotifers evolve quickly in response to unpredictability. We hypothesize why differences do exist between experimental and natural populations in their relationships with unpredictability

Keywords: environmental fluctuation, bet hedging, diapause, propensity for sex, genomic analysis, local adaptation