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integrative zoologie

DEPARTMENTAL SEMINAR INTEGRATIVE ZOOLOGY Winter Term 2016

Programme and Abstracts

Tuesdays, 10-11:30 hrs
SR 3, UZA1, Althanstraße 14, 1090 Wien

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Programme

New Design, New Signs - Signage about Austrian reptiles, amphibians and mammals in the Blumengärten Hirschstetten

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Zoos are not just sites of recreation and leisure activities. Conservation, research and education are main functions of a scientific managed zoo (van den Brink , 1981). Concerning education in zoos the classic signs are still the cheapest, low-maintenance and in the end the most weatherproof way to impart information. Still there are many disadvantages, which have to be eliminated to create the perfect signage.

The Blumengärten Hirschstetten (Vienna, Donaustadt) give an insight in the diverse world of plants and animals with their various themed gardens, the Zoo Hirschstetten, a historical farm and their palm house. New designed signs with the size of A0 will be established in the Blumengärten concerning Austrian reptiles, amphibians and mammals (European ground squirrel), with them placed at an relevant enclosure/area. The thematic fields on the signs include identification of the species, their habitats and way of living, the endangering of the species and their appearance in Vienna. Concerning the design of the singage, the focus will lie on humorous illustrations, suitable pictures and less words to minimize the disadvantages of classic signage.

Trough an Analysis of the knowledge of visitors, with a questionnaire about the upcoming signpost issues, will be decided which of the issues will be focused on the signage. Questions about all thematic fields for the three taxa and labeling in zoos in general are included.

J. van den Brink (1981): The role of labels in the zoo. Int. Zoo. Yb. 21: 61-63

Kurzeinführung in GIMP

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GIMP 2 Handout

Grundeinstellung:

- Fenster => Einzelfenster-Modus
- Datei => neu=> aus Vorlage wählen.
  Unter „Erweiterte Einstellungen" x/y-Auflösung angeben (=dpi)

Aufbau

- Ebenen-Editor (weiße Blätter übereinandergeschichtet): Für jedes Bild eigene Ebene verwenden. Aufruf über Menü Fenster => Andockbare Dialoge => Ebenen
- Journal (gelber Pfeil): merkt sich alle gesetzten Handlungen (Rückgängig machen): Aufruf über Menü Fenster => Andockbare Dialoge => Journal
- Werkzeugleiste (Symbole)
- Werkzeugeinstellungen (unterhalb der Werkzeugleiste)

Bild einfügen:

- Datei => Öffnen => Bild auswählen => öffnet sich in eigenem Tab.
- Ebene kann in einen anderen Tab gezogen werden (auf Papier legen erscheint dann im Ebenen-Editor)

Bild bearbeiten:

Auswahl für das Zuschneiden wählen:

- Rechteckige, Elliptische und Freie Auswahl (Detailinfos: https://docs.gimp.org/de/gimp-tool-free-select.html): In Werkzeugeinstellungen Modus wählen (ersetzen, hinzufügen, abziehen)
- Zauberstab (wählt angrenzende Pixel, die ähnlich sind, aus) und nach Farbe auswählen (wählt alle Pixel mit gleicher/ähnlicher Farbe im gesamten Bild aus): In Werkzeugeinstellungen Schwellenwert angeben – gibt an, wie nah umgebende Pixelfarben an der gewählten Pixelfarbe liegen dürfen.

- Magnetische Schere: https://docs.gimp.org/de/gimp-tool-iscissors.html

Zuschneiden:

- Wenn Auswahl gesetzt => entfernen drücken (gelöscht wird die Auswahl).
- Soll die Auswahl invertiert werden: Menü Auswahl => invertieren (oder Strg + I)

Unbedingt Auswahl abwählen – sonst kann nicht weitergearbeitet werden:
Umschalt + Strg + a

- Alphakanal hinzufügen: ermöglicht transparenten Hintergrund nach Schneiden; rechtsklick auf Ebene => Alphakanal hinzufügen

Ausbesserungen:

Pinsel, Radiergummi, Sprühpistole, Klonen, Heilen, Weichzeichnen, Verschmieren und Abwedeln funktionieren wie in Photoshop. Einstellungen können in den Werkzeugeinstellungen vorgenommen werden.

Schnelles Zoomen: Strg + Mausrad!

Helligkeit/Kontrast/Farben einstellen

Menü Farben => Helligkeit/Kontrast wählen und Helligkeit bzw. Kontrast anpassen. Auf „Einstellungen als Werte bearbeiten“ und „Einstellungen als Kurven bearbeiten“ ermöglicht dieselbe Einstellung unter Verwendung verschiedener Modi.

Beschriftung:

Beschriftungen können mit dem Text-Werkzeug (großes A) gesetzt werden. Eigene Ebene dazu wird automatisch erzeugt. Einstellungen (Schriftart, -größe, usw.) können in den Werkzeugeinstellungen getätigt werden.

Linien:

- Immer eigene Ebene für Linien erstellen!
- Werkzeug Pfade wählen, Pfad ziehen und in den Werkzeugeinstellungen auf „Pfad nachzeichnen“ klicken => Linienbreite angeben (in px).
- Schwarzer Pfad mit weißem Rand: Farbe Weiß wählen => Pfad zeichnen => Pfad nachziehen => Linienbreite auf 6px setzen => Nachziehen. Farbe auf schwarz stellen => Pfad zeichnen => Linienbreite auf 3 px setzen => Nachziehen

Alternative: Wechsel zu Inkscape!

Hilfslinien:

- Können per Hand gezogen werden: Ins Lineal klicken, gedrückt halten und Hilfslinie ins Bild ziehen
- Können fix angegeben werden: Bild => Hilfslinien => Neue Hilfslinie

Sonstige Befehle

- Stapelverarbeitung: Bearbeitet eine beliebige Zahl an Bildern auf gleiche Weise:
  Ausführliche Anleitung:
  https://www.gimp-werkstatt.de/forum/viewtopic.php?t=424
  Kurzanleitung: Filter => Batch => Batch Prozessor => Add Files => unter den Reitern die jeweilige Option aussuchen (Funktion muss ev. installiert werden)
- Histogramme: Zur Anzeige von statistischer Information zur Verteilung von Farb- und Helligkeitswerten. Aufruf über: Menüleiste Farben => Information => Histogramme
- Alle Ebenen zu einem Bild zusammenfügen: Menüleiste Bild => Bild zusammenfügen

Troubleshooting - „Ich kann nichts mehr machen“:

- Möglicherweise ist eine Auswahl aktiv: Strg + Umschalt + A
- Möglicherweise wurde ein Bereich kopiert und eingefügt => dieser Bereich schwebt im Ebenen-Editor noch frei („Schwebende Auswahl“ erscheint im Ebenen-Editor). Rechtsklick auf diese Ebene => „zur neuen Ebene“.

Birds at the Botanical Garden of the University of Vienna

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The Botanical Garden is located in the 3rd district of Vienna in the highly urbanised centre of the city. This 8 hectare green space is a well structured garden and provides resources for many animal species. The present diploma thesis investigates birds and their habitat use in an urban area. In April and May 2016 a monitoring was performed in the Botanical Garden over 2 periods of 10 days each. Twenty eight bird species were found and their frequency was determined. Sixteen species were found regularly, and two further species seem to be

associated to the Botanical Garden for nutrition reasons. Indications for reproduction were found in 13 species; breeding success could be proven for 9 species. Five to six territories of the Eurasian blackcap (*Sylvia atricapilla*) could be established. It's not surprising that the most abundant breeding species were for example the Great tit (*Parus major*), the Blackbird (*Turdus merula*) and the Carrion crow (*Corvus corone*), which are typical for green spaces in the city of Vienna. The remaining 10 species, which were found in the Botanical Garden only for a few days each, seem to be guests or migratory birds. Common migratory birds were for example the European pied flycatcher (*Ficedula hypoleuca*) or the Ictinerine warbler (*Hippolais icterina*). Additional observations showed that some further species could be found only on single days, indicating the importance of the Botanical Garden as an urban resting place for migratory birds. The comparison to a survey in 2004 by H.W. Krenn shows, that the stock of birds in the Botanical Garden changed during the last 12 years. For example the Syrian woodpecker (*Dendrocopos syriacus*) and the European serin (*Serinus serinus*) were not found anymore, and the Common wood pigeon (*Columba palumbus*), which seemed to be only a guest in 2004 was now breeding successfully.

Functional diversity of the rubber-like protein resilin in arthropod exoskeleton structures

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Resilin is an elastomeric protein typically occurring in exoskeletons of arthropods. It features a unique combination of different outstanding properties. Among those, exceptional rubber-like properties such as a relatively low stiffness, a rather pronounced long-range deformability and a nearly perfect elastic recovery are well known. Within the exoskeleton structures, resilin has various functions including the generation of deformability and flexibility, the storage of elastic energy,

the reduction of fatigue and damage and the sealing of wounds. This presentation will highlight some examples of the research on exoskeleton structures with large proportions of resilin and describe the functional morphologies of the respective structures in detail.

Untangling the molecular phylogeny of tapeworms

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The diversity of tapeworms reaches far beyond of what is typically known about this group from the few representatives of biomedical and veterinary importance (e.g. *Taenia* spp., *Diphyllobothrium* spp.). The large diversity of life cycles (typically involving crustacean intermediate hosts and vertebrate definitive hosts) means they have successfully established themselves throughout aquatic (both marine and freshwater) and terrestrial habitats, where the majority of the ~6000 known species are found parasitizing elasmobranch and tetrapod hosts.
Over the past two decades, molecular data have produced an ever more stable and well-resolved backbone phylogeny, whilst increasing the number of orders from 12 to 19. In this talk, the recent contributions to the construction of the tapeworm backbone phylogeny will be recapped. Additionally, new molecular phylogenetic results will be presented that have been accumulated over the last 5 years from the NSF-funded Planetary Biodiversity Inventory project 'A survey of the tapeworms from vertebrate bowels of the earth'. This international collaborative project targeted previously unexplored hosts and/or geographic regions to increase the sampled diversity of tapeworms. The resultant phylogeny, based on two nuclear (18S and 28S rDNA) and two mitochondrial genes (16S rDNA and cox1), is composed of ~850 taxa, which represents the most significant contribution to tapeworm phylogeny, to date, allowing us to investigate the effects of host-use and phylogeography on the diversification patterns in this group.

Basic research meets agricultural practice: Optimisation of available control measures for wireworms (*Agriotes* spp., Coleoptera: Elateridae) a destructive pest of field crops

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Wireworms, the larvae of click beetles (Coleoptera: Elateridae), are abundant soil-dwelling insects which attack the below-ground parts of a wide range of crops, thereby inflicting severe economic damage. To date, wireworms are considered one of the most difficult pests to control mainly due to a variety of reasons: Depending on soil environmental conditions, wireworms show extensive vertical movements in the soil column, going deeper when conditions are adverse and moving to the upper soil layers for feeding. Predicting these vertical movements and identifying when wireworms actually dwell in upper versus deeper soil layers is crucial for the decision and timing of control measures for these pests. However, there are at least nine pestiferous species of elaterid larvae occurring in European agriculture. Most of these species are indistinguishable for the naked eye and cause similar damage symptoms, but their biology and ecology varies considerably which calls for species-specific control tactics. And, besides the species, also the larval instar needs to be taken into account as the behavior of wireworms can change dramatically according to their developmental stage.

Within two topic-related projects, laboratory experiments will be conducted to reveal how specific parameters affect larval vertical movement behavior of abundant *Agriotes* species. The influence of soil temperature and soil moisture on the behaviour of the main pestiferous species of wireworms will be examined. The two investigated soil types

will represent typical soils in Austrian potato and maize production areas. Further objectives are to find out wether the presence of entomopathogenic fungi affects the vertical migration behaviour of wireworms and if the type of soil influences the virulence of these fungi against *Agriotes* larvae under defined and constant laboratory conditions.

Dynamics of sexual reproduction and embryonic incubation in marine bryozoans

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Our research will focus on the dynamics of sexual reproduction and embryonic incubation in marine bryozoans. The central group will be cyclostome bryozoans, one of the most ancient bryozoan taxa, that is still diverse and abundant in modern seas. We intend to study their: oogenesis, intracoelomic incubation of embryos (viviparity), matrotrophic nourishment of progeny (in a form of placentation) and polyembryony (multiple clonal development of embryos from a single fertilized egg). This exceptionally rare combination of reproductivel characters could have played a key role in their past explosive radiations and current success in marine ecosystems, thus making this group a unique model system for studying role of reproductive mode in evolutionary success. Detailed study, besides describing of processes involved in reproduction of Cyclostomata, aims to answer the following questions: What was the ancestral reproductive mode for Cyclostomata?

How did such complex reproductive mode evolve? What is the source and how does function so-called “nutritive tissue”? What is a major factor controlling the polyembryony in Cyclostomata? Whether embryonic multiplication can be secondarily lost?

Vertical zonation of trochid gastropods in the Northern Adriatic Sea

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The genera *Gibbula*, *Phorcus* and *Steromphala* represent a clade of marine gastropods of the family Trochidae (Vetigastropoda). The species of these genera live along rocky coasts of the Mediterranean Sea and the Atlantic Ocean feeding on biofilms on rocks and seagrass leaves. Although some of these closely related species occur in sympatry, little is known about their ecological niche differentiation. Abiotic parameters such as exposure to wave action, air and temperature, as well as biotic factors like predation and different reproductive strategies are potential key factors for this and may result in different vertical distribution patterns of these snails in the intertidal and shallow sublittoral zones. Reports on vertical zonation of gastropods from British and Italian rocky shores are based on other species or lack the spatial resolution required for detecting species-specific preferences of trochid snails. Preliminary observations indicate different depth preferences when two or more species of these genera co-occur. To quantify this observation, snails were collected at several sites along transects perpendicular to the water line in Rovinj and on Brijuni Islands, Croatia. Specimens were identified by their shell, with additional DNA-barcoding to aid identification of juvenile specimens. During data collection ten different species were found in the study area, although only the seven most abundant species were included in this study. First results match with previous observations and showed that the structure of the assemblages differed among depths with a gradient of distribution from shallow to deep habitats.

Crocodylus moreletii in captivity; a study in cooperation with the Tiergarten Schönbrunn in Vienna

Examining breeding, bioacoustics, behaviour, enrichment & bloodline research

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Crocodylus moreletii was discovered in 1850 by Pierre Marie Morelet. With an average size of about 3m it is the smallest of the four currently recognized species of New World Crocodylus. The distribution of this species is along the Gulf of Mexico and trends to the east coast of Mexico, the peninsula Yucatan to Belize and Guatemala. Even though the Morelet crocodiles suffered from huge population declines in the mid-20th century due to exploitation of it's high quality hide, the species recovered thanks to the excellent conservation work of zoos, farms, and the cessation of hide hunting.

In zoos crocodiles are often very underrated animals; they are both fascinating and frightening to visitors. Because many doubt the intelligence of these animals, let alone believe that they are capable of learning commands and training, crocodiles have unfortunately acquired a very poor reputation.

This thesis is primarily concerned with the three individuals of *Crocodylus moreletii* at the Tiergarten Schönbrunn. While the male hatched in the Zoo of Atlanta in 1985, the much younger females hatched in the Madras Crocodile Bank in 2008.

Breeding problems which occurred during the incubation of the female's first clutch will be examined, and bioacoustic signals of

freshly hatched captive crocodiles with hatchlings of wild individuals will be compared and analyzed.

Included in one of the four chapters in this study will be research into the bloodline of Morelet Crocodiles in European zoos.

Another important part will be a behaviour evaluation of the individuals at the Tiergarten Schönbrunn and a look into how the life of the crocodiles can be enriched in the zoo. Therefore, a concept for efficient training which benefits both the life of the animals and the work routine of the zookeepers will be outlined and tested.

Phänologie der Tagfalter entlang eines Höhen-gradienten in den Zillertaler Alpen

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MSc Thesis
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Es gibt nur wenige Studien über räumlichen Verschiebungen in der Phänologie der Tagfalter, die im alpinen Raum durchgeführt wurden. Die Höhenlage in den Bergen beeinflusst das Auftreten und die Verbreitung verschiedener Arten entscheidend. Die Verkürzung der Vegetationszeit in zunehmender Höhe ist vermutlich ein entscheidender Faktor, um die phänologischen Veränderung zu erklären und das Potenzial einzelner Tagfalter-Arten für das Überleben in verschiedenen Höhen zu verstehen.

Im Rahmen dieser Masterarbeit wurde eine detaillierte Untersuchung zur Phänologie der Tagfalter innerhalb einer Vegetationsperiode in hochalpinen Lebensräumen durchgeführt. Dabei wurden definierte Transekte im Zeitraum von 26.06.2016 – 15.08.2016 (unterbrochen durch mehrere Schlechtwetterperioden) in den Zillertaler Alpen zwischen 1900 m und 2600 m begangen und das Auftreten der Tagfalter-Arten an 23 geeigneten Tagen kartiert.

Dabei konnten bei 1362 Sichtungen insgesamt 40 Arten gezählt werden. In dieser Zeitperiode war der am häufigsten vorkommende Falter *Coenonympha gardetta* (Alpenwiesenvögelchen). Wie erwartet nahm die Anzahl der Arten und der Sichtungen mit der Höhe ab. Allerdings konnte auf 2600 m immernoch fünf Arten registriert werden. Besonders hervorzugeben ist der Fund von *Callophrys rubi* (Grüne-Zipfelfalter) auf fast 2400 m Seehöhe.

Es konnte die Verbreitung von sieben Erebien-Arten über verschiedene Höhenstufen im Laufe der Untersuchung dargestellt und die Ablösung bzw. Überlappung der einzelnen Arten gezeigt werden. Neben der Abfolge des Auftretens bestimmter Tagfalter in verschiedenen Höhenlagen, konnten Falter gefunden werden, die beispielsweise gleichzeitig in allen Höhenlagen vorkommen (*Aglais urticae*, *Vanessa atalanta*) oder deren Erscheinen im Laufe des Sommers mit der Höhe zunimmt (*Erebia pandrose*) oder abnimmt (*Polyommatus semiargus*)

Diese phänologischen Daten stellen eine Basis für zukünftige langjährige Untersuchungen alpinen Schmetterlingen dar, die in einer on-line Datenbank www.tagfalter-db.tk abrufbar sein werden und zukünftig auch Schlussfolgerungen über Veränderungen im Rahmen des Klimawandels ermöglichen könnten.

Flower-visiting, long-proboscid flies and megadiverse monkey beetles: current research in South Africa

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The Capensis is one of the world hotspots of plant diversity that is also inhabited by numerous and uncommon taxa of flower-visiting insects, like long-proboscid flies and the mega-divers group of monkey beetles.

The long-proboscid fly pollination system in South Africa is regarded to be a model system to study the concept of mosaic coevolution.

Pollinator proboscis length and host plant flower spur length coevolved in geographically separated populations. However, it is unknown whether local adaptation may co-vary between years. Our long term study investigates the relationship between body size and proboscis length of the nemestrid fly *Prosoeca* sp. in relation to nectar spur lengths over several years at the same study sites. The results suggest that pollinator body size may be a crucial predictor of the proboscis length. These results oppose the model of reciprocal adaptation in long-proboscid flies and flowers; and cast a new light on the concept of mosaic coevolution. Our results suggest that a temporal pattern of fly size mask the geographic mosaic that has been shown in previous studies.

Monkey beetles (Hopliini) visit flowers to feed on nectar, pollen, and/or floral tissue. Several species use specific flowers as aggregation places where males fight for females and are destructive to flowers by feeding on floral tissue. The first topic to be addressed in our project will be a comparative morphological study of mouthparts and alimentary tracts in flower visiting beetles belonging to different feeding guilds using microCT. The second part of the study will examine the male hind leg morphology of several hopliine species. It aims to evaluate their role in male-male competition for flowers as mating and feeding sites.

Structure and Evolution of the nervous system in Annelida

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Members of the taxon Annelida, the segmented worms, can be found in all marine, limnetic, and terrestrial habitats and as a consequence Annelida constitutes a group of extraordinarily high diversity, among the invertebrates, only comparable to molluscs or arthropods. Recent phylogenomic studies provide a new picture of annelid phylogeny:

besides a basal grade comprising taxa such as Chaetopteridae, Oweniidae, and Magelonidae, the vast majority form a clade Pleistoannelida with Errantia and Sedentaria as the highest ranked sister groups; Clitellata is an in-group within Sedentaria and taxa formerly regarded as separate phyla are in-groups as well: Sipuncula, Myzostoma, Echiura and Pogonophora. Among annelids the polychaetes display by far the greatest structural variation and degree of complexity which includes the nervous and sensory system. Especially the errant forms possess rather advanced nervous and sensory systems. This complexity is correlated to their highly developed sensory structures, including isolated or clustered sensory cells, up to various complex sensory organs. The annelid nervous system is usually described as rope-ladder-like ventral nervous system connected to the dorsal brain via double connectives. The ventral cord is generally seen as a chain of paired segmental ganglia connected by commissures and connectives but does such a structure really exist in nature and how did the brain and the nervous system in the last common ancestor look like? A lot of new information has been gathered which will be reviewed in the present contribution focusing on structure and evolution of the brain and the ventral nerve cord in polychaetes.

Cooperative behavior of captive primates

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This diploma thesis looks at potential cooperative behavior in three captive primate species, namely *Cebus apella*, *Saimiri boliviensis* and *Lemur catta*. Current scientific data from previous studies about the cooperative behavior of *Cebus apella* have ambiguous results, whereas data about cooperative behavior of *Saimiri boliviensis* and *Lemur catta* appears to be omniscient. In order to fill this gap of knowledge, an experiment in which the primates had to act cooperatively to solve a task

was conducted with all three species in the "Tiergarten Wels". During the experiment, the monkeys were presented with an experimental apparatus that had two handles that needed to be pulled simultaneously for solving the task. The handles were attached to a paddle where a reward and weights were located, with the weights having the function that one individual could not pull the reward closer on its own, but needed a partner. There were two main research questions, namely whether the monkeys could solve the task by cooperating and if not by cooperation, which other attempts for solving the task are there. While all three species failed to understand the cooperative task, numerous different alternative solutions, which provide insight into the cognitive abilities of the monkeys, could be observed. The information gained from this experiment can help provide captive primates of the respective species with appropriate enrichment and adds to the current body of knowledge.

Key words
Cebus apella, *Saimiri boliviensis*, *Lemur catta*, cooperation, pulling task, tool use

Testing gene flow between the subspecies of *Trochulus oreinos* in their supposed contact zone

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Trochulus oreinos is an endemic land snail species occurring in the Northeastern Austrian Alps at elevations above tree line. Two morphological highly similar subspecies (*T. o. scheerpeltzi*, *T. o. oreinos*) have been distinguished. Genetic analyses of the nuclear marker sequence ITS2 (internal transcribed spacer 2) as well as mitochondrial marker sequences (cytochrome c oxidase subunit 1 (CO), 16S rRNA gene, 12S rRNA gene) indicated a high genetic divergence between the two taxa. Analysing a large

sample in the potential contact zone at Haller Mauern, a clear phylogeographic break was found: All western samples were part of the clade representing *T. o. scheerpeltzi*, while all eastern samples clustered with *T. o. oreinos*. However, within the sampling sites of the eastern Haller Mauern, a few individuals possessed a COI sequence matching the *T. o. oreinos* clade, while at the ITS2 locus they were heterozygous possessing the alleles of both taxa. Based on these results that suggest historical and/or ongoing hybridization, no decision could be made on whether to consider the two taxa as separate species. Therefore, in a next step, the amount of gene flow between the two subspecies of *T. oreinos* within the Haller Mauern contact zone was investigated using Amplified Fragment Length Polymorphisms (AFLPs), a DNA fingerprinting technique. 200 individuals including samples from the whole distribution range were investigated. The AFLP results verified a clear geographical separation of the two taxa, congruent with the mitochondrial data. Although they occur on the same mountain range without a physical barrier and only about 7.000 m apart from each other no indication of ongoing gene flow between the two taxa was found. The results of the AFLP analysis will also bring further insights into the glacial refugia of the two subspecies.

Feeding preferences of four closely related *Hylaeus*-species (Dentigera) on an abandoned train station in Vienna

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Hylaeus (mask bees) is a genus of solitary bees, consisting of 47 species in Central Europe. Four morphologically similar species of the subgenus *Dentigera*, *H. brevicornis*, *H. gredleri*, *H. imparilis* and *H. intermedius*, are still challenging to distinguish and a critical review including DNA analysis will be necessary for a clear definition. In contrast to other non-parasitic solitary bees, females of *Hylaeus* have no exterior scopa for collecting pollen, but the pollen is swallowed and transported in the crop. Whereas most Central European *Hylaeus* species are deemed to be polylectic (collecting pollen from two or more plant families), three of them are known to be oligolectic (collecting pollen from one single plant family or genus). However, there is still uncertainty about the pollen preferences of mask bees because the bees also visit flowers to drink nectar and the analysis of the crop content requires time-consuming dissections.

The presented master thesis is designed to fill this gap. By analyzing the pollen it aims to investigate whether the four *Dentigera* species are oligolectic or polylectic, whether they differ in their feeding preference in a certain study area, and whether the composition of collected pollen changes spatially and temporally. Furthermore, DNA barcodes and possibly a morphometric analysis of head structures will enable a more reliable identification.

Field work is carried out on the premises of the former Northern train station in Vienna. The collected specimens are dissected by cutting off the abdomen. The pollen is removed from the crop to be analyzed under a light microscope. Of each individual one leg is cut off, stored in 96%

ethanol, and sent to a laboratory for genetic analysis. The data from DNA and pollen analysis might be complemented by morphometry, for which an adequate methodical approach has yet to be developed.

A final synthesis of the results shall clarify ecological, genetic and morphological differences between the four investigated *Dentigera* species.

The power of attraction: Effects of artificial lighting on nocturnal Lepidoptera

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The term „light pollution“ describes the excessive or misdirected use of artificial light (usually outdoors). It can have serious environmental consequences for wildlife and humans. Over the last decades, light pollution has increased as a consequence of urbanization. Previous studies support the negative impact of artificial lighting on nocturnal insects. Once attracted to the light, insects become easy prey or get burned while flighing against the lamp.

During a period of three weeks, five different types of modern commercial street lights where tested in relation to insect attraction. Therefore the lamps where incorporated in special light traps and placed along a street in a mountain region in Vorarlberg, Austria. While all insects where counted and categorized in different orders, special emphasis was placed on the nocturnal Lepidoptera. With an estimated number of 20000 insects from 13 different orders, the study showed high differences between LED and gas discharge lamps. The metal halide lamp had the highest insect attraction with a total number of 6278 individuals, while a LED lamp gave an output of only 230 insects in 9 days. These results showed the enormous impact of streetlights on

insect activity, which is one proposed reason driving insect declines. It also shows that depending on the lamp type, artificial light can have a very high attraction on insects and can be minimized by using the appropriate lamp.

One for all: Mating compatibility among various populations of Olive fruit fly (Diptera: Tephritidae) and with a hybrid strain for sterile insect technique application

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Olive fly is the single key insect pest for olive cultivation, and attempts to eradicate or suppress its populations with the use of the sterile insect technique have been made for the last decades. One of the major obstacles encountered was the inferior quality of the mass reared strains, expressed among others in differential time of mating, and lower mating percentages in comparison with wild counterparts. In this study we examined the mating behaviour of olive flies originating from four countries located in the North Mediterranean (Croatia, Italy, France, Spain), by means of field cage compatibility experiments. Post mating studies measuring the egg hatch from different insect combinations complemented the experiments. Furthermore, we tested the hypothesis that a hybrid strain adopted in laboratory rearing conditions can compete successfully with all the four wild populations. Finally, we examined the effect of colonisation upon the mating compatibility of four newly established populations over 3 consecutive generations.

Our results showed absolute mating compatibility among olive flies from all the Mediterranean regions tested, and effective sperm transfer and egg hatching was observed in all cases. Finally, wild strains undergoing colonization showed almost a stable mating propensity e.g. no assortative mating, over a period of 3 generations. Those findings are discussed under the scope of their potential use for sterile mass releases within an AW-IPM framework.

Annual Lab Safety Instruction

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Documents of the lab safety instructions:
https://zoology.univie.ac.at/fileadmin/user_upload/abt_morphology/Department_Seminar/Unterweisung_Department_englisch_2017_reduziert.pdf

Berthold Hatschek

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Berthold Hatschek, who studied at the University of Vienna (1872-1875), became Head of the Second Zoological Institute at the University of Vienna in 1896. His famous *Trochophora Theory* and his studies on amphioxus‘ development are still highly relevant in modern zoological society, especially in the field of comparative invertebrate morphology. However, hardly anyone is familiar with

Berthold Hatschek's studies on comparative vertebrate morphology. By accident, several photographic plates documenting parts of Hatschek's work on comparative anatomy of acipenser skulls and various handwritings were found among the scientific heritage of his student and later Head of the Department of Morphology, Wilhelm Marinelli.

In the course of our research in cooperation with the Zoological Collection of the University of Vienna (ZCUV) we found out that the figures of Hatschek's studies on Comparative Osteology on Vertebrates have never been published, because he destroyed the completed manuscript entitled "Vergleichende Osteologie der Wirbeltiere" in a moment of doubt and depression. Yet, the figures of the destroyed work have been conserved on photographic plates of which we found 28 references in the index card system of the ZCUV and 13 respective photographic plates in the ZCUV. Nevertheless, comparing handwritten texts found in Marinelli's heritage and documents written by Hatschek himself could not provide any evidence of having ever been part of the destroyed manuscript. In a further step we are planning to search the ZUV for preserved specimen, which could have potentially been models of the found figures in Hatschek's manuscript. Furthermore, the ZCUV wants to create an online platform allowing to publish the identified figures found, the references of the index card system and further information on Berthold Hatschek's work.

Feeding mechanism of *Calyptocephalella gayi*

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The helmeted water toad *Calyptocephalella gayi* is currently classified as endangered. It is a highly aquatic species, which occurs in lakes, rivers and ponds in Chile. It is assumed that *C. gayi* is adapted to the food intake under water, like many other aquatic vertebrates.

There are many publications about terrestrial food intake mechanisms in frogs, which distinguish the three different tongue mechanisms: "Mechanical Pulling", "Inertial Elongation" and "Hydrostatic Elongation". However, there is little knowledge about aquatic food intake mechanisms in frogs. They use forearm scooping, ram feeding, jaw prehension, a combination thereof or suction feeding.

A major goal of this diploma thesis is to compare the aquatic and terrestrial feeding mechanisms of *C. gayi*. To which degree the adaptation to the medium water has evolved and which terrestrial feeding mechanism this frog uses, when feeding on land, are part of the investigation.

Therefore, the food intake-mechanisms are investigated via high-speed filming. The films are analysed by using a MatLab-based tracking software. Variables like motion, duration and velocity of the kinematic profil will be analysed and compared to related frogs.

Preliminary results show that during aquatic feeding, they usually use both hands and the accuracy is much higher than in terrestrial feeding. Interestingly, the tongue seems not to be the main organ

for food uptake on land, just larger prey is caught by mechanical pulling of the tongue.

The animals are temporarily provided from Zoo Schönbrunn's conservation breeding program.

Flat-bellied ground spiders in an alpine glacier foreland

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This study analyses the microhabitat of nocturnal flat-bellied ground spiders (Gnaphosidae) in an alpine glacier retreat zone at about 2000 m above sea level. Based on previously work in the Hornkees glacier forelande (Zillertaler Alpen), the hypothesis is proposed that flat stones which form a shallow space beneath are important habitat structures to rest during the day and to build cocoons for reproduction. The sampling design included comparative sampling in 4 areas where Gnaphosidea were collected and the vegetation, gravel and stone-cover was categorized according to dimensions and ground embedment. Stone and air temperature was measured in all 4 areas at least once unsing the sampling design. During three sampling days 64 individuals of Gnaphodes (*Gnaphosa badia* and *Drassodes lapidosus*) could be found. It could be shown that the preferred stones are medium sized and flat, they are embedded about 0-1.5 cm in the ground and form a space under the stones where the spiders built they webs and/or cocoons. Stone temperature was not related to the occurrence of spiders under the stones.

Functional morphology of the proboscis of fruit-feeding tropical butterflies

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Charaxinae are the only butterflies that perform fruit-piercing behavior among fruit-feeding Nymphalidae. Aim of this study is the first description of this behavior and analysis of the functional morphology of their proboscis.

The behavior was analysed with videos that were made in the glasshouse, and the morphology of the proboscis is presently studied using various techniques of micromorphology.

The individuals of *Consul fabius* mainly performed two techniques of fruit juice feeding:
(1) The proboscis perfomed dabbing movements on the fruit surface. The slits of the dorsal side in the proboscis tip region/drinking region enable the uptake of fruit juice/liquid food.
(2) *Consul fabius* showed piercing behavior of the fruit. This behavior was described for the first time in detail in butterflies. In some cases, the proboscis was stung more than 10 mm into the fruit with anti-parallel movements of the two galeae. These movements opened up the food canal at the apex of the proboscis enabling uptake of the sap.

Results from Confocal Laser Scanning Microscopy indicated a changing composition of the cuticle from proximal to the tip of the proboscis. The sensory equipment and the anatomy of the proboscis will be analysed and compared with other fruit feeding butterflies and moths.

Radula morphology of trochid gastropods and its systematic value

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The genus *Gibbula* has long been a matter of discussion. The current situation is that there are only a few species staying in *Gibbula* and the remaining species are separated into *Steromphala* and *Phorcus*. There are around 20 species in the mediterranean sea. They live on rocky shores and graze of biofilm. There is a high variability within the species themselves. There are only vague original descriptions, which led to a varying identification literature. Therefore the snails are often difficult to categorise by their shell morphology and because of that DNA barcording is necessary.

The main goal of this diploma thesis is to examine, if there are differences in the radula morphology between the genera *Steromphala* and *Phorcus*.

The radula has been frequently investigated because of its importance as a tool in systematics to diagnose the species. It has also been recognized as an important morphological criterion for the taxonomic allocation of species. It shows general similarities at family and generic levels with consistent differences at the species level. The *Gibbula* species have a rhipidoglossan radula type. Each row consists of a large central tooth and, on each side, five laterals and a fan of many slender marginals.

The snails were collected in Croatia on a few sites around Rovinj. Pictures of the radula are taken with the scanning electron microscope and the lightmicrosope.

The Morphology of the feeding apparatus in *Aphanius*

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Aphanius is a genus of pupfishes belonging to the family Cyprinodontidae of ray-finned fish. Unlike other members of this family, which are from America, *Aphanius* species are native to northern Africa, southwestern Asia (as far east as India) and southern Europe. They are present from the Mediterranean coasts of the Iberian Peninsula to the Red Sea and the Persian Gulf basins. They primary occur in freshwater habitats or coastal marine environments, characterized by warm water and mesosaline to hypersaline conditions.
Most *Aphanius* species are threatened because of drought, habitat degradation and loss, as well as water pollution, and the introduction of invasive species, like *Gambusia*.
Aphanius feeds on insect larvae, crustaceans and algae. Therefor they use suction feeding as a mechanism of prey capture. This led to some adaptations like a special mechanism of jaw protrusion.
The objective of this theses is to reconstruct the morphology of the feeding apparatus in *Aphanius mento* and *Aphanius fasciatus* (provided by the Vienna zoo), for comparison with related groups, as well as to prepare a foundation for further kinematic studies.
To investigate the skeletal elements (skull, jaw elements, hyoid apparatus) as well as the appertaining musculature I use micro-computed tomography scans in combination with the software Amira. Furthermore, the specimens' skeletons will get prepared via clearing and staining, a process that renders the flesh invisible, the bone red, and the cartilage blue. Histological sections will be done eventually, if there are any open questions concerning the anatomy.

Neighbour or stranger? Testing the 'dear enemy effect' in the dart-poison frog *Allobates femoralis*

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Many territorial species respond less aggressively to familiar neighbours than to unfamiliar floating strangers based on individual differences in signals. This form of social recognition, termed neighbour-stranger discrimination (NSD) or dear enemy effect has been reported so far from four anuran species.

At the beginning of the rainy season, males of the Pan-Amazonian dart-poison frog *Allobates femoralis* establish multi-purpose territories on the forest floor for up to 3 month, which they advertise by calling from slightly elevated perches. The stable territorial system and the highly vocal male-male communication system make the species a valuable candidate for acoustically-mediated NSD.

A total of 44 playback experiments were performed with 22 territorial males at the study site Treviso (Pará, Brazil) from 23 February to 6 March 2008. We broadcasted the signals [= natural advertisement calls from adjacent neighbours (N) or from strangers (S)] to the focal male from two directions. We randomly attributed to each male the order from where the first experimental trial was performed (neighbour (N) or opposite (O) direction; signal position effect) as well as the signal order (N- or S-signal; signal type effect). During the 5 periods of an experimental trial we documented the following behavioural parameters of the focal male: the number of calls, the number of body orientations, the

number of jumps and the approached distance toward the loudspeaker.

The analyses of 29 valid (= phonotactic approach displayed) experiments with 19 males showed no difference in the behavioural response of territorial males to the advertisement calls of neighbours and strangers, as well as in their response to the position where playback signals were broadcasted.

The results of the study will be discussed with regard to possible methodological short-comings, as well as considering proximate and ultimate level hypotheses for why males of *A. femoralis* do not discriminate behaviourally between neighbours and strangers.

Pieris rapae – a nectar feeding butterfly: Composition of the cuticle of the proboscis

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Pieris rapae is one of the most common nectar-feeding butterflies in Austria and, in the last century, has spread throughout most parts of the world. Although it was the object of numerous studies, yet little is known about its cuticular structure. The rubberlike protein resilin is considered responsible for enabling the coiling of the proboscis. On the one hand, its structure allows itself to double its length by extension without losing its shape. It can withstand millions of such extension cycles. On the other hand, a high level of energy can be stored in these structures. In the last decades the microscopic methods and resolutions have improved greatly so that

it has become possible to make images that allow the detection of resilin.

The aim of this diploma thesis is to describe the composition of the cuticle of the proboscis. Therefore, images were made using Confocal Laser Scanning Microscopy (CLSM), Scanning Electron Microscopy (SEM) and Light Microscopy (LM).

For the cuticle of the food canal the results of SEM showed a regular lamella-like structure from the proximal to the distal end. However, the CLSM indicated a variation in the composition. With SEM the outer cuticle shows a periodic structure in the bend that changes dramatically in the tip. Such a dramatic change cannot be found with CLSM. These results and the morphology of the sensory equipment will be compared with those of different flower visiting butterflies and butterflies with other feeding techniques.

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