ARIANTA 5

REPORT ON THE WORKSHOP ALPINE LAND SNAILS 2016

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ALPINE LAND SNAILS

Impressum:

Arianta 5

Editors: Elisabeth Haring, Oliver Macek & Helmut Sattmann

© 2016 Naturhistorisches Museum Wien - ISBN 978-3-903096-09-7

The "Workshop Alpine Land Snails" took place in Johnsbach, Steiermark, Austria from August 1st – 5th 2016

Publisher:

Verlag des Naturhistorischen Museums Wien, Burgring 7, 1010 Vienna, Austria

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Für den Inhalt der Beiträge sind die Autoren verantwortlich.

Erscheinungsdatum: September 2016

Layout: Oliver Macek

Front coverphoto: *Arianta arbustorum* copula; © K. Jaksch

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"Land snails extended" - Wissenschaft im Wirtshaus

Dauernd werden neue Schlagwörter kreiert und oft kümmert mehr der Klang als der Inhalt. Wir sind sicher, dass das bei unserem heurigen "Workshop Alpine Landschnecken" nicht der Fall war, dass nicht alles bloß Schall und Rauch war. Nun schon zum neunzehnten Mal trafen "SchneckenforscherInnen" in zunehmend internationaler Zusammensetzung einander beim "Workshop *Alpine Land Snails*".

Beim diesjährigen Workshop wollten wir unser internes, sehr spezielles Programm durch eine öffentliche Komponente erweitern und aufwerten und damit dem immer sichtbarer werdenden Trend einer Öffnung der Wissenschaft für die interessierte Öffentlichkeit Rechnung tragen. Auch hier gibt es immer wieder neue Schlagwörter wie *Citizen Scientists*, *Open Innovation*, *Crowd Science*, *Open Data*, die alle dem Gedanken der angestrebten gegenseitigen Durchdringung von Gesellschaft und Wissenschaft Rechnung tragen. In diesem Sinne wollten wir an zwei Abenden einem interessierten Publikum wissenschaftliche Themen verständlich näher bringen. Allen Vorträgen war das Thema Biodiversität gemein, deren Wert, deren Status, deren Erhebung. Biodiversität ist auch wieder so ein Schlagwort, das jeder kennt, aber kaum jemand hat einen genauen Begriff von dessen Inhalt und Bedeutung. Es beschreibt die Vielfalt von Lebensräumen, von Tier- und Pflanzenarten sowie die genetische Vielfalt innerhalb der Arten. In unseren Beiträgen wollten wir nachvollziehbar einen Eindruck von der Erforschung dieser Vielfalt und von ihrem Wandel im Laufe der Jahrmillionen vermitteln, aber ebenso von deren Bedeutung für Umwelt und Menschen. Die Themen waren breit gestreut von Fossilien bis zu heute lebenden Tieren und Pflanzen, darunter vielerlei Arten, die wir aus dem alpinen Raum kennen, von Steinadlern und Fischen, von Wölfen und Schnecken. In einem der Vorträge wurde beispielhaft ein Projekt beschrieben, in dem Schüler wissenschaftliche Daten zur Biologie, Evolution und Vielfalt von Schnecken erheben: Citizen Science.

Oft ist heute die Rede von gesellschaftspolitischer Bedeutung: auch bei der Erhaltung der biologischen Vielfalt (für jetzige und künftige Generationen) und ebenso bei der Einbeziehung der Bürger in die Wissenschaft und Forschung (für jetzige und künftige Generationen). Unser Vermittlungsformat „Wissenschaft im Wirtshaus“ halten wir für besonders gesellschaftsrelevant, vor allem, wenn der Kölblwirt im Bergsteigerdorf Johnsbach der Gastgeber ist. Wir wissen, dass der *spiritus loci* hier besonders gut passt. Schließlich haben wir die Mehrzahl unserer Workshops bisher beim Kölblwirt, einer absolut wissenschaftsaffinen „Location“, abgehalten und sind den Einheimischen ja schon seit Jahren als „die Schnecken sind wieder da“ bekannt. Auch viele Touristen haben unser Tun als exotische Bereicherung ihres Urlaubs empfunden, denn es war immer die Tür für alle Interessierte offen. Die Themen waren natürlich sehr speziell und die Vorträge meist in Englisch. Doch beim letzten Workshop, im August 2014, wagten wir bereits einen wirklichen „öffentlichen“ Versuch, mit zwei deutschsprachigen Vorträgen über unsere Forschungsprojekte, in deren Zentrum alpine Landschnecken stehen, und – als Beitrag für alle Altersstufen – der Aufführung eines Schneckentheaters.

Dieses Jahr entschlossen wir uns, den Workshop noch breiter – über die Schneckenperspektive hinaus - anzulegen und haben engagierte und didaktisch begabte Kollegen eingeladen, die ersten beiden Abende mit zu gestalten. Sehr entgegen kam uns dabei, dass uns der Nationalpark Gesäuse unterstützend zur Seite stand und natürlich das Naturhistorische Museum Wien, beides Institutionen, die einen gesetzlich definierten Bildungsauftrag haben. Das Wirtshaus im Allgemeinen und dieses Gasthaus im Speziellen sind

eine exzellente Plattform für das gemütliche Gespräch der BürgerInnen mit den WissenschaftlerInnen. Schließlich arbeiten letztere nicht zum Selbstzweck, sondern für die Allgemeinheit und werden von den Steuergeldern ersterer finanziert.

Der speziellere Teil des Workshops an den beiden darauffolgenden Abenden war den Schnecken gewidmet. Phylogenetische und evolutionsbiologische Themen standen im Vordergrund, vor allem mit geografischen Bezügen zu den Alpen und zu Süd- und Osteuropa. Die Präsentationen beschrieben Fragestellungen und Ergebnisse aktueller Schneckenforschungsprojekte, "*Land snails condensed*" sozusagen. Aber auch sie fanden nicht unter Ausschluss der Öffentlichkeit statt. Alle Interessenten waren eingeladen zuzuhören, mitzudiskutieren oder *after work* mit den ForscherInnenn gemütlich zu plaudern. Wobei nicht nur diese vieles von jenen lernen konnten, sondern auch umgekehrt. Eben Wissenschaft im Wirtshaus und "*Land snails extended*"!

Für die Unterstützung unserer Forschung danken wir den Fördergebern, für die Programmgestaltung danken wir allen Mitwirkenden, für die freundliche Aufnahme seit vielen Jahren und für die aktive Förderung und Ermöglichung dieses „Formats“ danken wir ganz besonders den Kölbl-Wirtsleuten.

Die Herausgeber
Wien, August 2016

Abbildung 1. „Wissenschaft im Wirtshaus“ 2016; © B. Däubl

Workshop schedule

Monday, 1st August

Arrival and get together at Kölblwirt

Guided tour to the Natural History Museum at Admont Monastery by Karl-Heinz Krisch

Wissenschaft im Wirtshaus – Biodiversität vom Gesäuse bis ins Klassenzimmer

Tuesday, 2nd August

Guided tour to fossil sites at Gams by Heinz Kollmann

Excursion: Johnsbach Valley and to Kölblalm)

Wissenschaft im Wirtshaus – Biodiversität vom Erdmittelalter bis heute

Wednesday, 3rd August

Excursion to Bosruck

Evening lectures

Thursday, 4th August

Excursions to Scheiblingstein and Großes Maiereck

Evening lectures

Friday, 5th August

Excursion to Dachstein-Krippenstein

Overnight stay Gajdalm

Saturday, 6th August

Excursion at Dachstein-Krippenstein

Afternoon: Farewell

Abbildung 2. Sammeln fossiler Schnecken am GeoPfad Gams; © M. Sonnleitner

Vorträge / Lectures

I. Wissenschaft im Wirtshaus: Biodiversität - Vielfalt auf allen Ebenen

Monday, 1st August 18:30 -20:00 **- Biodiversität vom Gesäuse bis ins Klassenzimmer**

Alexander Maringer
Park der Vielfalt: Biodiversitätsforschung im Nationalpark Gesäuse

Frank E. Zachos
Von Wölfen und Wanderern – Sinn und Nutzen von Biodiversität

Stephan Koblmüller
Smaragdgressling und mehr: Neues über die Fische der Steiermark

Katharina Jaksch & Gabriele Baumgartner
Schneckensex im Klassenzimmer: SchülerInnen erforschen die Biologie einer Schnecke

Tuesday, 2nd August 18:30 -20:00 **- Biodiversität vom Erdmittelalter bis heute**

Thomas Neubauer
Skilift am Tropenstrand – 250 Millionen Jahre Kalkalpen

Carina Nebel
Gute Zeiten – schlechte Zeiten: Die genetische Vielfalt der Steinadler

Elisabeth Haring
Durch Sonne und Eis: Die Vielfalt der ostalpinen Schnecken

Michaela Sonnleitner
ABOL – die Biodiversitätsinitiative des 21. Jahrhunderts

II. Project reports: Alpine and other land snails

Wednesday, 3rd August 18:30 -20:00

Olga Bondareva
Genetic variability and invasion routes of *Arianta arbustorum* L. in St. Petersburg and Leningrad area

Zoltan Feher
What do nuclear markers tell about *Montenegrina* phylogeny?

Willy de Mattia
Taxonomical evaluation of anatomical features in *Montenegrina* (Clausiliidae)

Anatoly Schileyko
Adaptations of pulmonate molluscs to terrestrial live

Poster session

Thursday, 4th August 18:30 -20:00

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

Luise Kruckenhauser
The case of *Cylindrus obtusus*: indication for selfing in geographically separated populations and evidence for Pleistocene survival within the Alps

Michael Duda
The efficiency of landscape management on selected thermophilous land snails – a small-scale case report from the vineyard area in northern Vienna

Luise Kruckenhauser
ABOL Mollusca – status report

Abstracts
Wissenschaft im Wirtshaus:
Biodiversität - Vielfalt auf allen Ebenen

Arranged in chronological order of the program

Park der Vielfalt: Biodiversitätsforschung im Nationalpark Gesäuse

Alexander Maringer
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Das Gesäuse ist ein Durchbruchstal des Flusses Enns im nordöstlichsten Teil der Ennstaler Alpen im Bundesland Steiermark. Der Nationalpark Gesäuse wurde 2002 gegründet und als internationales Schutzgebiet der IUCN Kategorie II anerkannt. Der 113 km² große Nationalpark erstreckt sich über eine vertikale Ausdehnung von 490 m üNN (Enns bei Hieflau) bis 2369 m üNN (Hochtor). Eine hohe Reliefenergie prägt die Hauptlebensräume Fels, alpine Rasen, Wald und Gewässer. Die relativ rasche Verwitterung der Kalkgesteine führt zu ausgedehnten Schuttrinnen und begünstigt dynamische Naturprozesse. Am Rande des alpinen Gletscherschildes der letzten Eiszeit gelegen, hat sich im Gesäuse eine besonders hohe Zahl (73) von endemischen Arten erhalten. Neben historisch herausragenden Persönlichkeiten haben sich bis heute mehr als 400 ForscherInnen den Nationalpark Gesäuse als Forschungsraum erschlossen und umfangreiche Erkenntnisse über das Gebiet publiziert. Ein Wissensschatz, der beständig erweitert wird und heute wichtige Grundlagen für das Management des jungen Schutzgebietes bereithält.

Abbildung 3. Blick von der Enns auf die Hochtorgruppe im Nationalpark Gesäuse (links); © A. Hollinger; Außergewöhnliche Naturerlebnisse in Österreichs jüngstem Nationalpark (rechts); © H. Hudelist

Biodiversity and Research in the Gesäuse National Park

The Gesäuse is a water gap of the river Enns in the northeastern part of the Ennstal Alps in the Austrian federal province of Styria. Gesäuse National Park (NP) was founded in 2002 and shortly after accepted as an IUCN Cat. II protected area. The NP covers 113 km² and reaches from 490 m (Enns at Hieflau) up to an altitude of 2369 m (Hochtor). High relief energy characterizes the main habitats of rock, alpine meadows, forest and aquatic areas. The comparatively fast weathering of the dolomites creates extensive debris chutes and deep slopes enhancing dynamic natural processes. Situated on the edge of the Alpine glacial shield during the last ice age, the Gesäuse has retained a particularly high number of 73 endemic species. Renowned historical personalities and over 400 present-day scientists did research in the NP and published intimate knowledge of its nature. Today this provides a firm basis for nature conservation and management by the NP authorities.

Von Wölfen und Wanderern – Sinn und Nutzen von Biodiversität

Frank E. Zachos
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Die „biologische Vielfalt“ ist in aller Munde, die Vereinten Nationen haben sogar das Jahrzehnt der Biodiversität (2011-2020) ausgerufen. Doch was verbirgt sich eigentlich hinter diesem Begriff, und warum ist Biodiversität wichtig? Die Frage, warum eine zunehmend in Städten konzentrierte Weltbevölkerung Rücksicht auf weit entfernt lebende Orchideen im Regenwald und auf Korallenriffe nehmen soll(te), ist nicht bloßer Zynismus, sondern offenbart, dass der Wert von Biodiversität nicht unmittelbar für jeden einsichtig ist – zumal, wenn das für den Naturschutz benötigte Geld auch für andere sinnvolle Projekte gebraucht wird. Der Vortrag wird diese Frage aufgreifen und neben unserer Verantwortung für die „Schöpfung“ auch ganz handfeste Vorteile einer diversen Natur anführen – Vorteile, die gleichwohl nicht umsonst zu haben sind.

Of wolves and tourists – do we really need biodiversity, and if so – what for?

Biodiversity has become a real buzzword, and the United Nations have declared the years 2011-2020 the Decade on Biodiversity. But what does biodiversity really refer to, and why is it relevant? The question why an increasingly urbanized human population ought to care about coral reefs and orchids in rain forests is not cynical but rather reveals that the value of biodiversity is not immediately obvious to everyone – even more so, since the money necessary for conservation could just as well be spent in other important and underfinanced areas. The short talk will address this question and deal with our responsibility for “Creation” as well as with very practical services that biodiversity has in store for us – services that, however, come at a price.

Abbildung 4. Biodiversität – unsere Verantwortung; ©India Business and Biodiversity Initiative

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Smaragdgressling und mehr: Neues über die Fische der Steiermark

Stephan Koblmüller
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Wer kennt nicht Forelle, Hecht oder Karpfen? Auch der seltene und gefährdete Huchen ist in aller Munde. Die heimische Fischfauna ist aber noch viel diverser und es gibt immer noch Neues zu entdecken. Dies gilt besonders für die Gründlinge (Gattungen *Gobio* und *Romanogobio*), kleine und unscheinbare Karpfenartige, die auch in den Fließgewässern der Steiermark weit verbreitet sind. So stellt der neu entdeckte, vermutlich nur in der oberen Mur vorkommende Smaragdgressling eine Reliktart dar, deren nächste Verwandte am südlichen Balkan zu finden sind. Auch war bisher nicht klar, wie viele Gründlingsarten der Gattung *Gobio* eigentlich in Österreich bzw. der Steiermark vorkommen. Der Vortrag stellt die heimischen Gründlinge dar und berichtet über erstaunliche neue Erkenntnisse zu ihrer Diversität.

Emerald gudgeon and more: new findings on Styrian fishes

Trout, pike and carp are well known even among lay people, as is the rare and endangered Danube salmon. But, the Styrian fish fauna is much more diverse and exciting new discoveries are still being made. This is particularly true for the gudgeons of the genera *Gobio* and *Romanogobio*, small and inconspicuous cyprinids that are widely distributed in Styrian rivers. Thus, the emerald gudgeon, a relic species likely endemic to the upper Mur River, was discovered only recently. Also, it is still unclear how many species of gudgeons of the genus *Gobio* actually do occur in Austria or Styria. The talk introduces the Styrian gudgeons and highlights some interesting new findings regarding their diversity and phylogenetic relationships.

Abbildung 5. Smaragdgressling (1), Steingressling (2) & Huchen (3); © W. Gessl, pisces.at

This project is funded by the Federal Ministry of Science Research and Economy.

Schneckensex im Klassenzimmer: SchülerInnen erforschen die Biologie einer Schnecke

Katharina Jaksch[1], Gabriele Baumgartner[2]
[1]*Museum of Natural History Vienna, 1010 Vienna, Burgring 7; katharina.jaksch@nhm-wien.ac.at*
[2]*GRg 13, 1130 Vienna, Wenzgasse; gabriele.b@aon.at*

Warum halten rund 100 ambitionierte SchülerInnen eines Wiener Gymnasiums seit zwei Jahren über 200 Schließmundschnecken in Mini-Terrarien im Klassenzimmer? Weil sie in einem umfassendes Zuchtprojekt die Tiere beobachten, pflegen und dabei wichtige biologische Daten im Rahmen eines Citizen Science-Projekts erheben. Bisher waren die jungen SchneckenforscherInnen sehr erfolgreich und haben rund 300 Jungtiere herangezogen. Anhand dieser Jungtiere sollen Veränderungen verschiedener Schalenmerkmale der Tiere untersucht werden. Die einheimische Gitterstreifige Schließmundschnecke (*Clausilia dubia*) ist in ihrem Aussehen nämlich sehr variabel und es existieren viele verschiedene morphologische Formen. Diese unterscheiden sich hauptsächlich anhand von Merkmalen der Schale, wie zum Beispiel Höhe, Breite, Farbe oder der Rippung. Um dem Ursprung dieser Vielfalt auf die Spur zu kommen, beobachten die JungforscherInnen, ob diese Merkmale der Schale genetisch bedingt sind oder von der Umwelt beeinflusst werden. Wäre letzteres der Fall, würde man eine Veränderung der Merkmale unter veränderten Haltungsbedingungen erwarten. Neben ersten Ergebnissen über abweichende Schalenmerkmale wurden vor allem wichtige Daten zur Biologie dieser Schneckenart erhoben, die bisher unbekannt waren.

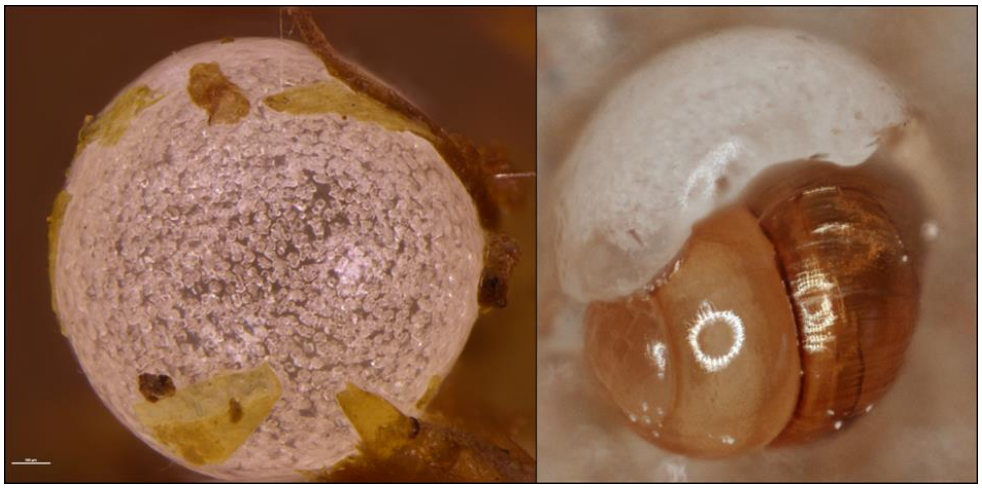

Abbildung 6. *Clausilia dubia*: Ei (links); O. Macek CC BY SA; schlüpfende Schnecke (rechts); © K. Jaksch

Snail sex in the classroom: pupils study the biology of snails

Why are more than 200 snails kept by 100 ambitious pupils of a Viennese second grade school in their class room? They conduct a huge breeding experiment in which they observe and rear them and gain important data on the animals' life biology in the frame of a Citizen Science project. So far the young snail scientists were very successful and reared about 300 young snails from eggs to adult. On the offspring changes in several shell characters are investigated, as the native Craven Door Snail (*Clausilia dubia*) is known for its very variable appearance and many different morphotypes. These types are mainly distinguished by certain shell traits like height, width, colour or the shell ribbing. To study the causes of this diversity the young researchers try to observe if the shell characters are determined by the genes or by the environmental conditions. Would the latter be true, variation of shell characters were expected in changed environmental conditions. Beside first results about the variation of shell characters, very important and so far unknown, insights on the biological life cycle of this snail species were gained.

Skilift am Tropenstrand – 250 Millionen Jahre Kalkalpen

Thomas Neubauer, Mathias Harzhauser
Museum of Natural History Vienna, 1010 Vienna, Burgring 7; thomas.neubauer@nhm-wien.ac.at

Die Kalkalpen sind mehr als Naturschutzgebiet und Erholungsraum für Wanderer und Skitouristen. Vielmehr sind sie Zeugnis einer bewegten Erdgeschichte, in der die heutigen Berge noch Schlamm am Kontinentalschelf des tropischen Tethys-Ozeans waren. Ebenso lassen sie sich als „Unfallprotokoll" einer gewaltigen Kollision zwischen Afrika und Europa lesen. Die Klimageschichte der Region reicht vom Wüstenklima des ausgehenden Erdaltertums über Monsunsysteme der Trias mit ausgedehnten Sumpfwäldern bis zu den Gletschern der Eiszeiten. Ebenso vielfältig sind die Fossilvergesellschaftungen, die die Lebensbedingungen der einzelnen Zeitabschnitte reflektieren. Auf sonnendurchflutete Korallenriffe folgten lebensfeindliche Bedingungen eines „gekippten" Ozeans. Selbst die Spuren des katastrophalen Asteroideneinschlags, der vor 66 Millionen Jahren die Herrschaft der Dinosaurier beendete, lässt sich in den Kalkalpen als wenige Zentimeter dicke Schicht des „Fallouts" nachweisen. Millionen Jahre später bildete ehemaliger Meeresboden wiederum die Küsten eines viel jüngeren Meeres und Bohrmuscheln und Brandung nagten an den bereits fossilen Korallenriffen.

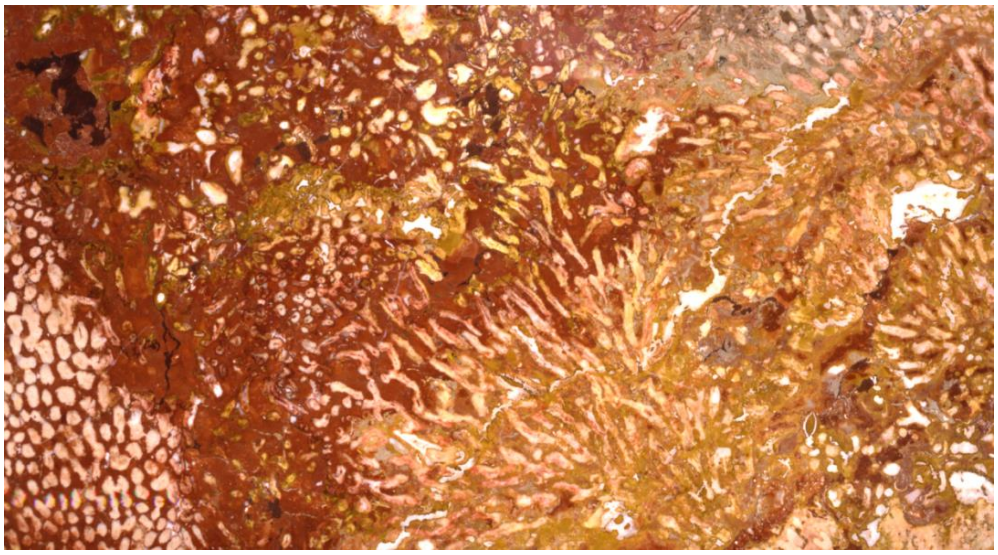

Abbildung 7. Polierte Platte mit Korallenstöcken eines Trias-Riffes. Adnet, Salzburg, 205 Millionen Jahre alt; © M. Harzhauser

Ski-lift at the beach – 250 million years Calcareous Alps

The Calcareous Alps are much more than just a nature reserve and recreation area for hikers and ski tourers. They are evidence of an eventful Earth's history, when today's mountains were just mud on the continental shelf of the tropical Tethys Ocean. Likewise, they can be read as "accident report" of a giant collision between Africa and Europe. The climate history of the region encompasses desert-climate of the late Palaeozoic, Triassic monsoon-systems with vast swamp-forests and glaciers of the ice-ages. The fossil-assemblages are like-wise manifold, reflecting the changing environmental conditions through time. Sunlit coral reefs were followed by hostile conditions of a collapsed Ocean. Even traces of the catastrophic asteroid impact, which terminated the era of the dinosaurs 66 million years ago, can be found as a thin fallout-layer in the Calcareous Alps. Million years later, the former sea-bottom formed the coasts of a much younger sea and piddocks and breakers eroded the fossil coral-reefs.

Gute Zeiten – Schlechte Zeiten: Die genetische Vielfalt der Steinadler

Carina Nebel

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Der Steinadler, der „König der Lüfte“, ist eines der bekanntesten Tiere der Alpen. In Mitteleuropa wird er heutzutage vor allem mit dem Hochgebirge assoziiert, doch er zählt zu den am weitesten verbreiteten Greifvögeln: in Nordeuropa, Nordafrika, Asien und Nordamerika kommt er auch in tiefen Lagen vor. Die Eiszeit hatte einen massiven Einfluss auf alle Tier- und Pflanzenarten, die heute in den gemäßigten Zonen der Nordhalbkugel verbreitet sind. Doch wo überdauerten Steinadler diese für sie klimatisch ungünstige Zeit? Die Genetik kann hier helfen, einen Einblick zu erlangen und tief in die Vergangenheit dieser charaktervollen Tierart zu blicken. Basierend auf knapp 300 Feder- und Gewebeproben wurde der Steinadler über sein gesamtes Verbreitungsgebiet genetisch untersucht. Die Ergebnisse zeigen ein deutliches Bild; während der letzten Eiszeit überdauerten Steinadler die klimatisch ungünstige Zeit in mindestens zwei Regionen: Im Mediterranen sowie im Asiatischen Raum. Während der Kaltzeit konnten sich in diesen isolierten Populationen genetische Unterschiede verstärken. Aus diesen eiszeitlichen Rückzugsgebieten erfolgte, als sich das Klima wieder erwärmte, die Wiederbesiedelung wieder zugänglicher

Lebensräume. Aus den genetische Unterschieden und deren geographischen Mustern lassen sich die Ausbreitungsrouten ableiten. Ein weiteres Ergebnis der Untersuchung: Trotz hohen Verfolgungsdrucks im 18. und 19. Jahrhundert ist die genetische Diversität des Steinadler im Alpenraum überraschend hoch.

Good times – bad times: the genetic diversity of Golden eagles

The Golden eagle, the „King of the skies“, is one of the best-known species of the Alps. In Central Europe, this eagle is nowadays associated with high mountains, although it is among the most widespread birds of prey. In Northern Europe, North Africa, Asia and North America it occurs in low-land areas as well. The ice age had a significant impact on all animal and plant species that are nowadays found in the temperate zones. Where did the Golden eagle survive these climatically unfavourable times? Genetics can help to answer this question and offers a unique look into the distant past of this iconic species. Based on almost 300 feather and tissue samples we investigated the Golden eagle over its distribution range. We unveil that during the last glaciation period Golden eagles survived in at least two refuge areas that were still climatically beneficial for the animals: in the Mediterranean and in Asia. These populations were isolated from each other during these cold times and accumulated genetic differences. When the climate got warmer after the Last Glacial Maximum the species repopulated newly accessible habitats. Genetic patterns we observe today reflect these ancient routes the animals took during recolonization. An additional surprising result of the study: Although the Golden eagle was heavily persecuted during the 18th and 19th century in the Alps, we still observe high genetic diversity there.

Abbildung 8. Steinadler (*Aquila chrysaetos*); R. Bartz CC BY SA 2.5

This project is funded by the Deutsche Falkenorden and the Dr.-Elmar-Schlögl-Stiftung.

Durch Sonne und Eis: Die Vielfalt der ostalpinen Schnecken

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Unscheinbar und meist unbemerkt und unbekannt sind die Landschnecken der Ostalpen. Besonders artenreich sind sie in den östlichen Ausläufern der Alpen, wo sie von Tallagen bis in Gipfelregionen vorkommen. Die Evolutionsgeschichte der mannigfaltigen ostalpinen Landschnecken hängt eng mit der vielgestaltigen Landschaft zusammen: Durch tiefe Täler isolierte Gebirgsstöcke, durch Wälder, Wiesen und Schneefelder getrennte Felswände. Die strukturierten Lebensräume brachten eine Fülle von Arten und Unterarten hervor. Aber auch der Wechsel von Kalt- und Warmzeiten der letzten 2 Millionen Jahre hat die alpine Schneckenfauna geprägt. Große Teile der Alpen waren während der Kaltzeiten vergletschert und wurden in darauf folgenden Warmzeiten, ausgehend von Populationen, die am Rande der vereisten Regionen überdauerten, wieder neu besiedelt. Wohl im Schneckentempo, denn die meisten Schnecken haben kleine Aktionsradien und geringes Ausbreitungspotenzial. Vor allem für felsenbewohnende Schnecken, die an alpine Umweltbedingungen angepasst sind und in wärmeren Tallagen nicht leben können, stellen Gebirgsstöcke daher oft Inseln dar, auf denen sie sich isoliert von anderen Populationen entwickeln. So können neue Arten entstehen. Mit genetischen Analysen sowie Untersuchungen der Schalen und der komplizierten Anatomie lassen sich Stammbäume und Geschichte verschiedener alpiner Schneckenarten rekonstruieren. Manche kann man sogar als alpine Ureinwohner bezeichnen. Auch wenn Sonne oder Eis periodisch ungünstige Lebensbedingungen boten, haben viele Schneckenarten als alpine Überlebenskünstler die Zeiten überdauert.

Abbildung 9. *Cylindrus obtusus* (links) & *Trochulus hispidus* (rechts)*;* © WG Alpine Land Snails

In sun and ice: diversity of eastern Alpine snails

Unimposing, mostly unnoticed and unknown are the land snails of the Eastern Alps. They are especially species-rich in the easternmost foothills of the Alps, occurring from lowlands to high elevations. The evolutionary history of the highly diverse eastern Alpine land snails is connected with the variously shaped landscape: mountain ridges disconnected by deep valleys, rock faces isolated by forests, alpine meadows and snowfields. The highly structured habitats gave rise to a manifold of species. Furthermore, the oscillations of cold and warm periods during the last 2 million years shaped the alpine land snails fauna. Major parts of the Alps were glaciated during cold periods of the Pleistocene and were repopulated from populations that survived at the border of the glaciated regions. Probably quite slowly as many snails have small activity radius and a low expansion capacity. Especially for rock-dwelling snails, which are adapted to alpine habitats and cannot survive in lowland areas, mountains can be considered as islands where populations evolve independently. This may lead to new species. With molecular genetic methods and investigations of shell morphology and genital anatomy the phylogenetic history of several Alpine land snails was reconstructed. Some of them are like indigenous Alpine inhabitants. Even if sun and ice periodically offered unfavorable conditions, many snails have managed to survive up to the present.

ABOL – die Biodiversitätsinitiative des 21. Jahrhunderts

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Die letzten Jahre sind gekennzeichnet durch eine zunehmende Wahrnehmung und Wertschätzung biologischer Vielfalt seitens der Bevölkerung. Nichtsdestotrotz ist die Biodiversität durch die Aktivität des Menschen in vielerlei Hinsicht gefährdet. Das Projekt ABOL hat sich als überinstitutionelle und nationale Initiative zur Aufgabe gemacht, alle 70.000 in Österreich vorkommenden Arten von Tieren, Pilzen und Pflanzen genetisch zu erfassen. Damit wird eine vielseitig anwendbare Datengrundlage geschaffen, die u.a. für Naturschutz, Land- und Forstwirtschaft, Lebensmittelsicherheit, Forensik und Forschung genutzt werden kann. Die Barcoding-Methode verwendet einen bestimmten Teil der Erbsubstanz (den DNA Barcode), um Arten eindeutig zu identifizieren. Als Basis dafür dienen von Spezialisten sicher bestimmte Individuen, deren genetische „Barcodes“ als Referenz in einer frei zugänglichen Datenbank abgelegt werden. Die beprobten Individuen werden als Belegexemplare in wissenschaftlichen Sammlungen aufbewahrt. Diese Datengrundlage ermöglicht eine rasche und eindeutige Bestimmung von Organismen, auch wenn nur Gewebeteile oder Larvenstadien vorhanden sind, welche in dieser Form auch von Spezialisten oftmals nicht bestimmt werden können. Auch Boden- oder Wasserproben können so effizient auf ihre biologische Diversität untersucht werden. ABOL befindet sich derzeit in einer dreijährigen Anstoßphase, in der Pilotprojekte die Methodik etablieren und erste Ergebnisse generieren. Weiters erfolgt die Planung des auf 10 Jahre ausgelegten Gesamtprojektes, das 2017 anlaufen soll.

Abbildung 10. ABOL als Schnittstelle zwischen Biodiversität und Molekulargenetik; © ABOL

ABOL – a biodiversity initiative for the 21st century

The past decades are characterized by an increase in awareness and appreciation for biological diversity. Nonetheless, biodiversity is threatened by the impact of various human activities. The project ABOL as multi-institutional initiative aims at recording all 70.000 Austrian species of animals, fungi and plants. The resulting data sets may serve as reference for manifold applications, e.g., for nature conservation, agriculture, forestry, food safety, forensics and research. The DNA barcoding method utilizes a certain part of the genetic substance to unambiguously identify species. The genetic barcode of individuals, reliably identified by specialists, will be stored in an open accessible database. The sampled individuals will be deposited as voucher specimens in scientific collections. These data subsequently allow fast and precise identification of organisms on the species level even if only parts or larval stages are available, thus hardly can be identified even by specialists. ABOL is currently in a three year pilot-phase which aims at planning the ABOL overall project. Four pilot projects establish the methods and already generate first data sets. The overall project is scheduled for 10 years and should start in 2017.

This project is funded by the Federal Ministry of Science Research and Economy.

Abstracts: Project reports: Alpine and other Land Snails

arranged in chronological order of the program

Genetic variability and invasion routes of *Arianta arbustorum* in St. Petersburg and Leningrad area

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Biological invasions may be considered as ‘‘natural experiments’’, offering unique insights into ecological and evolutionary processes occurring in real-time (Lee, 2002; Sax *et al.,* 2007). The terrestrial snail *Arianta arbustorum* L., 1758 demonstrates a case of extremely successful invasion of regions in north-western Russia during a short period. According to the literature and personal observations snail numbers dramatically increased in the last 20 years and the species very rapidly extended its distribution in eastern and northeastern direction. The aim of our study was to find the source of this invasion using a section (284 bp) of the mitochondrial *cytochrome oxidase subunit 1* gene *CO1* as molecular marker. We tried to test several hypotheses of invasion modes: (1) independent multiple introductions of the species from its native range resulting in a genetically diverse invasive population, (2) a “step and stone” scenario with declining genetic diversity along the colonization route, (3) a ‘‘bridgehead effect’’, which means that a particularly successful invasive population with small genetic diversity is the source for extensive secondary invasions in other regions.

In a first step we studied variation within and between populations of Leningrad region and compared the results with variation in snail populations at other territories. Specimens of *A. arbustorum* were collected at seven sites located on opposite shores of the Gulf of Finland with maximum distance of 100 km between collection sites. Among 47 sequences from snails gathered at this territory, we discovered only 4 haplotypes with 6 variable sites. All discovered haplotypes were unique as compared to Western Europe. Then we enlarged the study area and included snails collected in Denmark, Sweden, Finland, Baltic countries and in Pskov region of Russia.

The final alignment of sequences of 385 specimens contained 138 haplotypes, with 118 variable and 95 informative sites. At the territory surrounding the Baltic countries, Scandinavia and the north-west of Russia only 9 haplotypes were detected among 75 sequences. These haplotypes had only 3 informative and 19 variable sites. Thus, mollusks from this vast territory demonstrate extremely low genetic diversity as compared for instance with Austria, where 119 haplotypes were detected at the territory of 5 km^2 (Haase, Misof, 2009). The haplotype network shows very close connections of haplotypes from Russia, Baltic countries and Scandinavia in contrast to haplotypes of mollusks from Western Europe that scattered all over the network. Some haplotypes from Austria and The Netherlands cluster with the Russian samples, but differ by 7 and 10 nucleotide substitutions, respectively. All haplotypes from West European countries differ from the Russian ones by more than 15 substitutions. Despite small nucleotide and haplotype diversity within the Baltic countries, Scandinavia and the north-west of Russia, it is noteworthy that all discovered haplotypes are unique as compared to Western Europe. The data obtained suggest the 'bridgehead' model of the land snail invasion in the region, as all haplotypes recovered in the studied area were unique, differing from the closest haplotype from Denmark by several mutations. This fact together with extremely low haplotype and nucleotide diversity implies that snails accumulated mutations at a small

newly populated territory during a rather long period. Neutrality tests are in accordance with balancing selection.

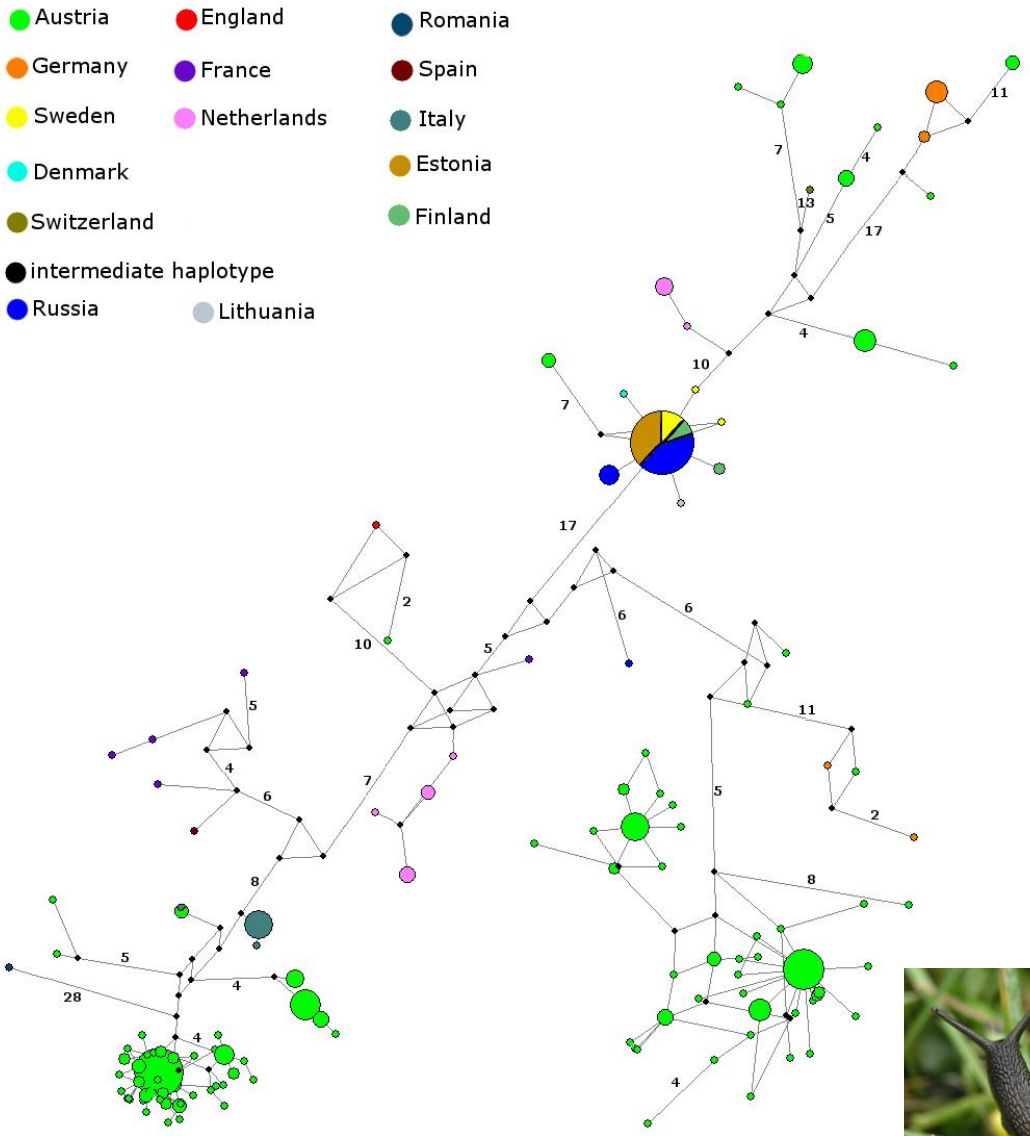

Figure 11. Genetic Network of Arianta arbustorum from St. Petersburg and Leningrad area; Arianta arbustorum; H. Svensson CC BY SA 3.0

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This project is funded by grants from RFBR NN 15-29-02526, 16-34-00958, TOPCONS ENPI CBC grant contract 2011-022 SE511.

What do nuclear markers tell about *Montenegrina* phylogeny?

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Montenegrina is among the most taxon-rich obligate rock-dwelling gastropod taxa. In the door-snail family (Clausiliidae) it is the second most speciose genus after *Albinaria*. The geographic range of *Montenegrina* extends to ca. 400–450 km in NW–SE direction and includes the coastal regions of Montenegro south of the Bay of Kotor, Albania, western Macedonia, and northwestern Greece. Within this relatively narrow range, there are almost 400 known populations that are classified in 29 species (including subspecies 106 taxa altogether) according to the current morphology-based system (Fehér and Szekeres 2016). The range size and the number of populations can be deemed large enough, but still accessible to almost comprehensive sampling, rendering this hyperdiverse genus an attractive system to study and to better understand the general mechanisms of speciation and spatial distribution of rock-dwelling gastropods.

To obtain an overall phylogenetic framework we conducted a phylogenetic analysis based on the mitochondrial genes for *cytochrome c oxidase subunit 1*, *16S rRNA*, and *12S rRNA* (*COI*, *16S, 12S*). The reconstructed DNA-based tree confirmed by and large the traditional classification of the genus, but there were some discordant or at least noteworthy points.

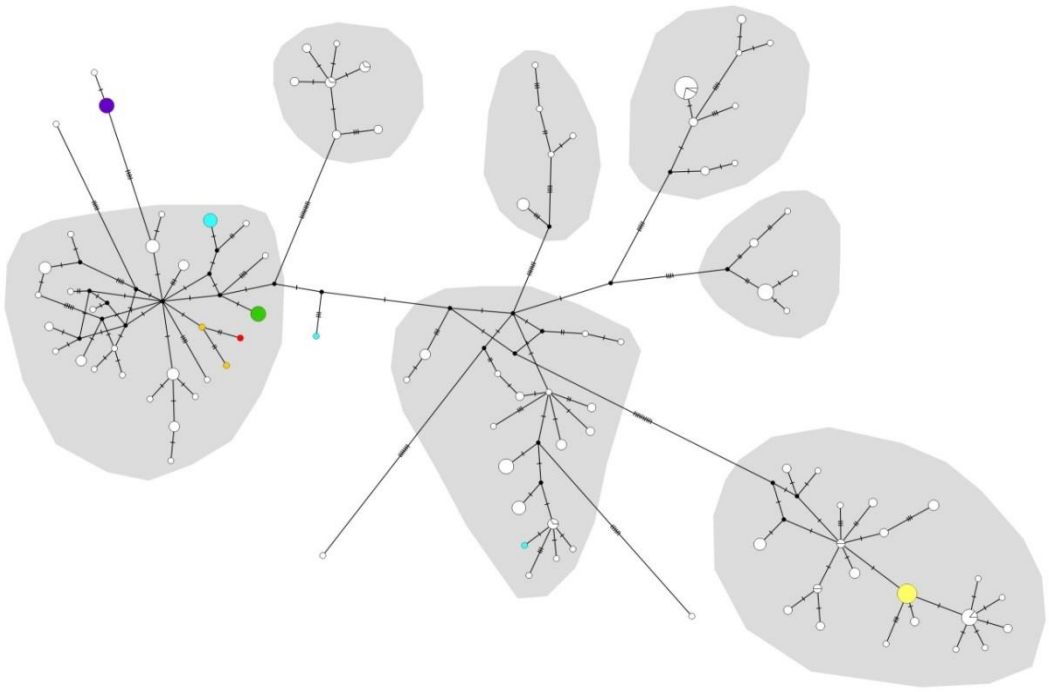

Figure 12. Statistical parsimony network, based on the spacer region between *histone H3* and *H4* genes of *Montenegrina*. Sequences / taxa mentioned in the text are highlighted: *M. dofleini kastoriae* and *M. hiltrudae robusta* – green; *M. fuschi fuchsi* – red; *M. rugilabris golikutensis* – orange; *M. stankovici* and *M. dofleini pinteri* – navy blue; *M. perstriata drimica* specimens belonging to different mitochondrial haplogroups – yellow; three different sequences from the same *M. hiltrudae desaretica* specimen – cyan

Some morphologically different but geographically nearby located taxon pairs like *M. dofleini kastoriae* and *M. hiltrudae robusta*, *M. fuchsi fuchsi* and *M. rugilabris golikutensis* or *M. stankovici* and *M. dofleini*

pinteri are closely positioned in the mitochondrial tree. At the same time, we have found two highly different mitochondrial haplogroups in *M. perstriata drimica* populations. Although these populations along the Drin River Valley are somewhat heterogeneous, no distinct morphotypes could be delimited and therefore, *M. perstriata drimica* was up to now considered one polymorphic taxon. Divergent mitochondrial genes might indicate the presence of a cryptic species, but introgression is also a plausible explanation for this phenomenon.

In order to resolve the above contradictions, we analysed two nuclear DNA markers, the *histone H3* and *H4* genes. Apart from the specific interest in the cases mentioned above, we also hoped to see how concordant the trees based on mitochondrial and nuclear genes are. As we have amplified a section of the histone cluster that involves the *H3* and *H4* genes and a spacer region in between (*H3–H4)* (see also Harl *et al*. 2014 a,b), our second objective was to test how suitable this spacer region is in the phylogenetic reconstruction of *Montenegrina*. We obtained 211 *histone H3–H4* sequences from 199 specimens. In several cases it was necessary to clone the amplified DNA fragments due to double peaks in the electropherograms. In those cases 3 clones were sequenced per specimen, resulting in two or sometimes three different sequences.

Unsurprisingly, as *histone* genes are under strong purifying selection (Nei and Rooney 2005), there was little variation in the coding regions, while the spacer section revealed considerable variation: 98 different haplotypes were found with at most 53 pairwise differences between aligned sequences (if gaps are excluded). To some extent, the *histone* tree reflects the mitochondrial one, but in some cases the spacer sequences of the same species, subspecies, population, or even the same specimen are positioned strikingly far from each other in the reconstructed tree or network. This possibly indicates hybridization events. Due to this phenomenon, this marker can only be used for phylogenetic inference in *Montenegrina* with some restrictions and care.

Nevertheless, the *H3–H4* sequence served as a useful supplementary tool in the above mentioned cases of incongruent mitochondrial phylogeny and morphology. In the cases of *M. dofleini kastoriae* / *M. hiltrudae robusta*, *M. fuschi fuchsi* / *M. rugilabris golikutensis* as well as *M. stankovici* / *M. dofleini pinteri* identical or very similar spacer sequences indicate close relationship (conspecificity or sister taxon status)

Figure 13. Cliffs along the shore of Lake Ohrid, north of Trpejca, Macedonia. This is one of the known sites where two different *Montenegrina* species can be found at the same locality. *M. stankovici* (on the right) prefers the lowest regions directly above the water surface, while *M. dofleini pinteri* inhabits higher parts of the same cliff; © Z. Feher

and confirm the 'rapid morphological alteration' scenario against the 'mitochondrial introgression'. In contrast, the spacer sequence similarity of *M. perstriata drimica* specimens that belong to different mitochondrial haplogroups renders the 'introgression' scenario more likely for this taxon than that of 'cryptic species'.

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This project is funded by the Austrian Science Fund (P 26581-B25) and "Freunde des Naturhistorischen Museums Wien".

Subgeneric Taxonomy of the limestone rock-dwelling Clausiliidae: has the genital anatomy been neglected until now? A preliminary overview about *Montenegrina*, *Siciliaria, Charpentieria* and *Medora* (Pulmonata: Clausiliidae)

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The systematics of Clausiliidae at generic level is mainly based upon shell features even if differences in the genital apparatus are known to partially define each genus-group. The whole picture is still far from clear, and what is currently known is almost entirely due to the work of H. Nordsieck (*Zur Anatomie and Systematick der Clausilien* series).

Nonetheless, in his series and related papers, Nordsieck gave large relevance priority to a systematics based upon "shell-taxonomy", considering the morphology of genitalia of substantial importance only at generic level.

Genital morphology features are, on the other hand, considered of great importance at species-level in most of the Pulmonata families (e.g.: Zonitidae, Hygromiidae, Limacidae, Milacidae etc.) and in many Architaenioglossa (i.e. Hydrobiidae, Cochostomatidae etc).

The remarkable lack in literature of genital data at specific level in Clausiliidae does not necessarily mean that comparative genital morphology could not play an important role as a complementary tool, as well as together with molecular genetic analysis, in the complicated taxonomy and systematics of this family. It is worth stressing that the "shell-taxonomy" alone already proved to have clear limits in many groups (i.e. Zonitidae and Cochlostomatidae).

The genital anatomy of the genus *Montenegrina* is currently being investigated, having processed approximately 20 species until now. Not only the outer features of genitalia (mainly shape and proportions)

have been investigated but also the inner ornamentation of the main sections that already revealed to be of fundamental importance in other groups: atrium, penial complex, penial papilla, epiphallus, vagina, free oviduct and complex of bursa copulatrix. Except for the penial papilla, most of the above-mentioned features have been never or only seldom considered, and never in an overall comparative frame.

As for many hygromiid and zonitid groups, specific and stable differences have been found among *Montenegrina* species and also in what is currently regarded as conspecific subspecies.

These differences sometimes follow and confirm the current systematic position of the species. For instance, as in *Montenegrina subcristata* and its subspecies where a general common arrangement can be detected, or as other cases, like *Montenegrina laxa*, where remarkable differences are observed in taxa currently considered as subspecies (*M. laxa laxa* and *M. laxa iba*).

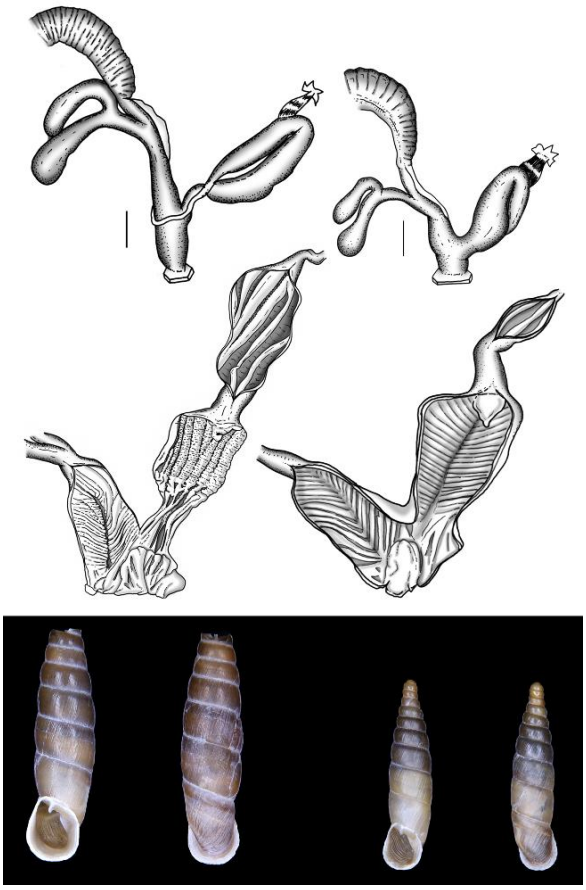

Figure 14. Comparison of genital structures and shells of *Montenegrina laxa laxa* (left) & *Montenegrina laxa iba* (right); © W. de Mattia

In the wake of this new taxonomical approach to the Clausiliidae, other genera with a similar distributional pattern with isolated (or alleged so) populations, restricted along limestone-island, were investigated to test if this new model could be extended and validated.

Siciliaria, *Charpentieria* and *Medora* have been evaluated, providing results commensurate with those of *Montenegrina*, revealing specific and stable differences among the species so far investigated. More investigations are required to better evaluate the real taxonomical value of the genital morphology investigations on the systematics of Clausiliidae. Considering the huge extent of this family as regards its diversity and distribution, the possible new taxonomical approach will require a huge amount of work.

In a frame of a global overview of the systematics and taxonomy of the Clausiliidae, only extending the classic shell morphology to a global "holistic" approach that includes both genital morphology and molecular genetic data could be the way for a better comprehension and definition of this family.

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Adaptations of pulmonate Molluscs to life on land

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Representatives of only one class (out of 7) of the phylum Mollusca, namely Gastropoda, were able to come from the sea onto the dry land.

The principal difference between life in water and life on the land is that water represents a much more conservative environment. First, for aquatic animals, the problem of saving of water does not exist while for many land invertebrates this problem is, probably, the most important. Second, changes in water temperature usually are more buffered and do not shift instantaneously, and not so extreme, while animals living on land often have to cope with fast temperature changes.

Although initially terrestrial pulmonates are moisture-loving animals, many of them have mastered almost all types of biotopes including zones with arid climate.

A principal and permanent danger threatening land mollusks living in conditions of moisture deficit is the danger of dehydration. Nevertheless, in arid areas a large number of species live and even prosper well. Accordingly, terrestrial mollusks elaborated a number of peculiarities which minimize this danger (Schmidt-Nielsen et al., 1971; Yom-Tov, 1971). Moreover, a majority of xerophilic snails cannot live in wet conditions.

All the diversity of adaptations may be assigned to four categories:

1. **Morphological** (shell shape and size, coloration, sculpture, apertural barriers); 2. **Biological** (reproduction); 3. **Ethological** (behavioral); 4. **Physiological** (breathing, water balance). As we will see, these categories are somewhat conditional, they often are combined with each other, and sometimes it is difficult to attribute this or that character to a particular category.

1. Morphological adaptations

The aperture is the main channel of communication of a mollusk with the outside world and thus, any elements of the apertural structure are related, directly or indirectly, with the adaptation of the animals to the environment. It is obvious that different teeth in the aperture play a significant role in the regulation of water balance and speed of withdrawal of a snail into the shell.

A more or less swollen last whorl is characteristic for helicoid shells. This whorl is a container for withdrawal of the cephalopodium: the larger relative volume the cephalopodium occupies, the more effectively the animal can burrow into the soil for aestivation or hibernation. At the same time, the presence of a relatively bulky cephalopodium means that the animal is able to store a sufficiently large volume of water in its tissue, which is essential for the snails inhabiting regions with a dry season.

Coloration in some cases may be considered as adaptation to survival during the dry season. Snails living openly often form aggregations (clusters) on grass or bush branches and the shells of such snails often have white color (usually with dark bands or radial stripes). White surface reflects sun rays which reduces evaporation. Besides, such snails usually have a toothless aperture; the absence of teeth promotes faster withdrawal of the snail into the shell.

To reduce evaporation of water through the aperture, terrestrial prosobranchs use an operculum; since pulmonates have no operculum, they have acquired a special structure, the epiphragm, which is formed by dried mucus.

2. Biological adaptations

Various specializations of the life cycle reflect mainly adaptations of animals to life in conditions of seasonal changing. In climates without seasonal changes reproduction of mollusks takes place throughout the year. In areas where the wet season gives way to dry, the snails usually survive the dry season, falling into estivation and closing the aperture by an epiphragm. In the inactive state all life processes, especially loss of fluid, are strongly slowed down. In the state of estivation some obligatory xerophiles (for example, Sphincterochilidae, Fig. 15) can remain viable for several years (Yom-Tov, 1971).

3. Ethological adaptations

To the category of behavioral adaptations one can, with some reservations, attribute the ability of many snails to stick to the substrate by means of mucus. This is an effective way to slow down the evaporation, but it is fraught with a certain danger: the complete sticking around the perimeter of the aperture would mean that the aperture is hermetically sealed which prevents gas exchange. A way out of this situation is possible in two ways. In some snails the aperture edges are bent, hence they do not lie in the same plane. As a result, a full adjoining of the aperture to the substrate cannot occur (some Enidae, many Helicodontidae). Another way to avoid complete sealing are small tubercles formed on the aperture edges, which also prevent a complete adhesion of the aperture to the substrate (some Chondrinidae and Lauriinae). This is a good example of interdependence of morphological and behavioral adaptations.

In many of mesophilous and hygrophilous snails the cephalopodium during mating is out of the shell, which imposes significant limitations on the duration of copulation. At the same time xerophilic snails, due to some anatomic reconstructions, can copulate, almost entirely hiding in shells, thus deminishing evaporation. In this case, there is also a combination of morphological and behavioral adaptations.

At last, xerophilic species with white shell usually have a behavioral adaptation – they often create dense clusters. Temperature within the cluster is lower than the ambient temperature.

4. Physiological adaptations

To this category one can attribute, in particular, the problem of overheating and evaporation. Any structural elements that are found on the cephalopodium surface are connected, directly or indirectly, with the problem of expenditure of water since an animal with soft integuments when it is in an active condition, is in permanent danger of dehydration. If the weather is hot, there is also a risk of overheating, which can be reduced by evaporation from the surface of the foot, but again this is connected with expenditure of water.

In terrestrial pulmonates (especially in slugs) gas exchange occurs not only through the lung, but also through the skin. However, skin respiration demands additional water loss. Thus, one of the most important tasks which a land mollusk must decide is searching for optimal balance between expenditure and economy of water. There are two ways of saving water: either to reduce water consumption, or to re-utilize it. The first method is the most common and is carried out due to: (1) the presence of the shell, (2) the ability to estivation and/or (3) using of various shelters. The second way is observed in some Helicarionoidea and Arionoidea.

As stated above, one of the most important factors of life of land snails is the water regime. The main, and often the constant danger is the risk of dehydration. Water loss performs mainly through the aperture. Obviously, improving mechanisms that slow down evaporation – is, perhaps, the most urgent problem, which strongly depends on habitat conditions.

There are three methods to slow down evaporation rate: 1) the narrowing of the last whorl toward the aperture; 2) the formation of a lip and some teeth; 3) the formation of a protective film (epiphragm). The third method usually supplements the first two.

The snails usually survive dry seasons by one of two ways.

1. Snails bury themselves in the soil or hide deep in the crevices of rocks. These snails lack traits listed above, but in fact they exist under the conditions where the temperature is lower and humidity is always high enough.

2. Snails live openly, glued to stones or other flat surfaces by the mucus. Such species are often characterized by three features: a toothless aperture, white shell color as well as by a behavioral feature – they often form dense aggregations. All three characters can be regarded as adaptations to life under arid conditions: lack of apertural teeth allows fast retraction of the snail into the shell; due to the white shell the risk of overheating is reduced and the temperature within the cluster, as has been said, is lower than the temperature of the ambient air.

Also the problem of water saving during movement of the snails is of importance. Movement itself is associated with a significant expenditure of liquid. When the animal is crawling, from the pedal gland, the orifice of which is located beneath the mouth, the mucus (the base of which is water) becomes excreted, and the snail moves upon this mucuous path by using cilia that cover the sole. Reducing water loss is achieved due to the fact that the sole in many mollusks not all the time adheres to the substrate, but during crawling it undulates wave-like in the vertical plane. Mollusk crawling on a dry surface, often show that the wet trace when moving, is not continuous, but consists of a series of spots, thus achieving water saving.

There is another way to save water when a snail is moving, for example, in many Helicarionidae, Zonitidae, Vitrinidae, etc. The sole in these mollusks is divided by grooves into three longitudinal zones, but the cilia cover only the middle zone. Only this zone contacts with dry surface and just it is responsible for the progressive movement of the snail.

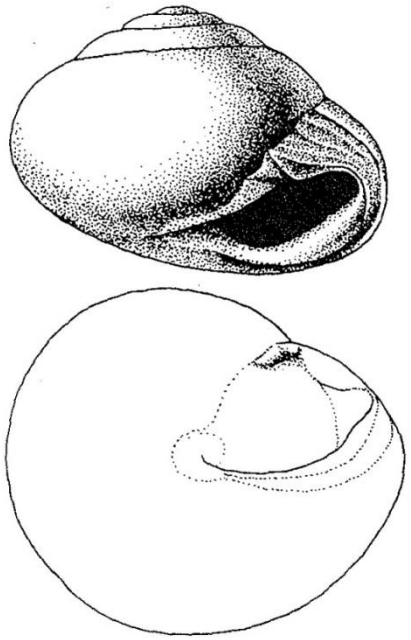

Figure 15. *Sphincterochila boissieri* shell; © A. Schileyko

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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 (1,600 - 2,300 m a. s. l., Klemm 1974). Previous studies found *T. oreinos* to be clearly separated ecologically, morphologically and genetically from the highly polymorphic and widespread *T. hispidus*. Within *T. oreinos*, two morphologically highly similar subspecies have been distinguished. The easterly distributed *T. o. oreinos* features an additional penial fold whereas the westerly distributed *T. o. scheerpeltzi* differs by a groove beneath the shell keel. This morphological trait, however, appears only sometimes and occurs in intermediate forms (Duda et al. 2011, 2014). First genetic analysis of three mitochondrial marker sequences, *cytochrome c oxidase subunit 1 (COI), 16S rRNA gene (16S),* and *12S rRNA gene (12S)* has revealed a high genetical divergence between the two subspecies. In addition, the nuclear marker sequence *ITS2* (*internal transcribed spacer*), albeit not informative to distinguish several other species of the genus *Trochulus*, separated the two taxa clearly (Kruckenhauser et al. 2014). Focussing on the potential contact zone of the two subspecies, an expanded sample set of *COI* sequences (178 individuals) and nuclear *ITS2* sequences (70 individuals) revealed evidence of a deep genetical split between the two lineages. Both taxa occur within the Haller Mauern mountain range, but a clear geographic split was found: all the western samples were part of the clade representing *T. o. scheerpeltzi* while all the eastern samples clustered with *T. o. oreinos*. The only exception were the sampling sites in the eastern Haller Mauern from which a few individuals possessed a *COI* sequence matching the *T. o. oreinos* clade, but the *ITS2* was found either homozygous for a sequence of the *T. o. scheerpeltzi* clade or heterozygous for both taxa. As these results are based on one nuclear marker only, no decision could be made on whether *T. o. oreinos* and *T. o. scheerpeltzi* should be considered as separate species. Therefore, in a next step, potential gene flow between the two subspecies of *T. oreinos* within the contact zone was investigated using Amplified Length Fragment Polymorphisms (AFLPs), a DNA fingerprinting technique. A set of 200 individuals including samples from the whole distributional range was selected. First preliminary results of the nuclear AFLP marker set show a clear (geographic) separation of the two subspecies with no indication of gene flow among them. The results of the AFLP analysis will help to gain further insights into the delimitation of the two taxa and the clarification of the taxonomic status of the two subspecies of *T. oreinos*.

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Figure 16. *Trochulus oreinos* ssp.*;* © K. Jaksch

Figure 17. Natternriegel: sampling site in the eastern Haller Mauern; ©WG Alpine Land Snails

The case of *Cylindrus obtusus*: indication for selfing in geographically separated populations and evidence for Pleistocene survival within the Alps

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Cylindrus obtusus (Helicidae) is a hermaphroditic land snail, endemic in the Austrian Alps, which is restricted to high elevations (1600 to 2500 m asl) and limestone. As a specialist of high alpine rocky habitats, *C. obtusus* has a quite patchy distribution area (Klemm 1974). Previous investigations revealed geographic differences in the genital apparatus: All specimens from the more western populations had one stylophore and two equally developed mucus glands more than twice the length of the stylophore. In contrast, in individuals from the eastern margin of the species distribution one or two mucus glands were found and the size ratio between stylophore and mucus gland(s) was highly variable (Schileyko, 1996; 1997; Zopp et al., in prep). To find out whether these anatomical differences reflect a genetic differentiation, which might be an indication for distinct glacial refugia, we investigated a 650 bp fragment of the mitochondrial *cytochrome oxidase subunit 1* gene (*COI*) (280 individuals) and 9 microsatellite loci (487 individuals from 29 populations) from samples covering the whole distribution range of the species. The *COI* sequences show a geographic differentiation between eastern, central and western populations, indicating at least three refugia during the last ice ages. The most western localities which were covered under the ice sheet are characterized by harbouring only single haplotypes. Overall genetic distances among all individuals are small (max. 1.7 %), which implies that *C. obtusus* has experienced severe bottlenecks in the past. The microsatellite analysis reveals a high differentiation between populations implying restriction of gene flow. The highest genetic variability was found in the central populations. Remarkably, nearly all individuals from the eastern populations (Veitsch to Schneeberg), which are variable in their genital morphology, are homozygous in all microsatellite loci (although different alleles were found within populations). The most plausible explanation for this finding is an altered mode of reproduction. It was shown by Chase and Blanchard (2006) in *Cornu aspersum* that the mucus from the mucus glands, that covers the love dart before injection, is the reason for the increased probability for paternity of the dart shooting partner. This feature would, of course, not be necessary in a selfing organism. Hence the co-occurrence of the deformation of the mucus glands and the high excess of homozygosity point towards a high degree of selfing in the eastern populations. This finding is also supported by the calculated selfing rates between 0.82 and 0.96 in the eastern populations.

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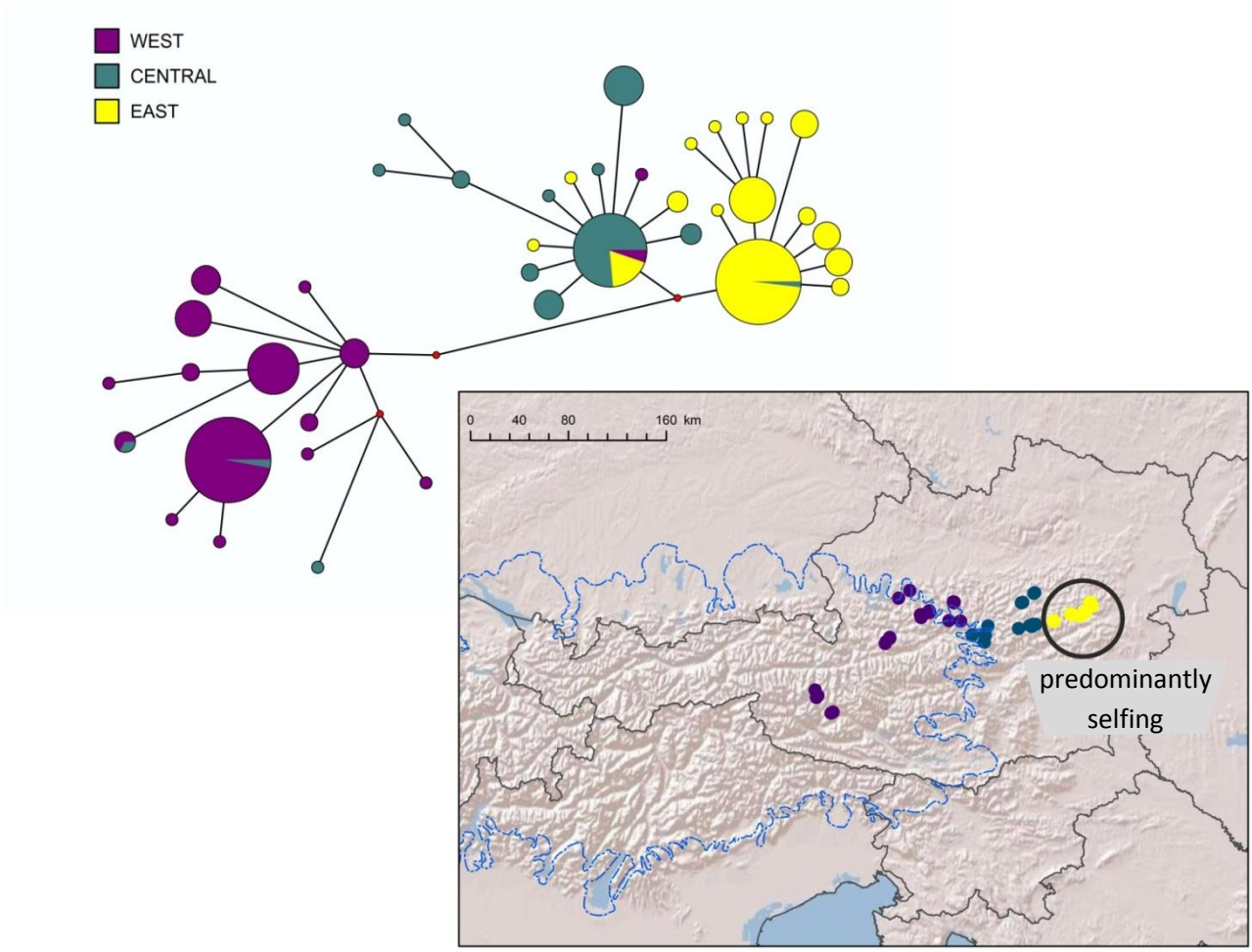

Figure 18. Network showing the three mitochondrial clades of *Cylindrus obtusus* and distribution of haplogroups.

This project is funded by the Austrian Science fund (FWF P 19592-B17) and the "Freunde des Naturhistorischen Museums Wien".

The efficiency of landscape management on selected thermophilous land snails – a small-scale case report from the vineyard area in northern Vienna

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Direct implications of landscape management measures, such as clearing and grubbing, on snails are only sparsely published. In this study, the impact of management on two xerothermophilous terrestrial gastropod species, *Zebrina detrita* and *Caucasotachea vindobonensis*, and on land snails in general, was evaluated in the vineyard area of Northern Vienna. This area belongs to the buffer zone of the UNESCO Wienerwald Biosphere Reserve in Austria.

A total of 18 sites were investigated, including vineyard embankments and dry meadows with different intensity levels of clearing and grubbing in recent years. Occurrence of both target species and their ability to recolonize newly created habitats were assessed. Both target species are only able to colonize new created habitats in numbers above detection level areas in direct vicinity of existing populations, a fact also

described in other studies (Boschi & Baur 2008; Knop et al. 2011). Only annually repeated clearing of meadows and embankments with originally strong shrub coverage resulted in a visible effect. Continuous clearing efforts over 10 years (2002-2013) were associated with a dense population of *Z. detrita* on a formerly unsuited bush-covered meadow. In contrast, vineyard embankments that were cut free just once within two years (2012 and 2013) before the study harboured only a few specimens of *Z. detrita*. A similar effect was found in the composition of ecological groups of land snail species at the different sites. Only on the long-term managed sites the majority of species (>75%) were definitely open-land dwellers, while on the short-term managed vineyard embankments the number of forest dwellers and euryoecious species increased.

In general, landscape management suitable for xerothermophilous snails should be first applied at sites with existing populations of the targeted species and then extended to neighbouring sites. Also the former occurrence of empty shells of grassland species should be taken into consideration when planning landscape management, because they can provide information on the potential success of restoring open grassland. For the long-term success of landscape management, a sustainable maintainability of new created habitats avoiding both too less but also too much management activity (Boschi & Baur 2008) must be guaranteed.

Figure 19. Mukental (Vienna) & *Caucasotachea vindobonensis;* © M. Duda

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The project was funded by the state of Austria, the city of Vienna and the European Union with funds of the European Agricultural Fund for Rural Development (EAFRD).

ABOL Mollusca – status

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Molluscs are in different ways appropriate as pilot group for barcoding the Austrian organisms (ABOL/ Austrian Barcode of Life). There are important indicator species among native snails and mussels, which are suitable for answering conservation-related issues, like the evaluation of habitat quality. Also the number of endemics is quite impressive with 19.3% of all native molluscs (Rabitsch & Essl 2009). Accordingly high is the threat of extinction of many molluscs: about 35% of the snails (especially freshwater species) and 37% of the mussel species are endangered (A. &. P.L. Reischütz 2007). All these facts increase the interest to investigate the approximately 400 different Austrian mollusc species also genetically.

Due to the large number of subspecies – approximately one-third (30%) of all native species is divided into subspecies (Cuttelod, Seddon & Neubert 2011) – and the high genetic diversity in some molluscs, interesting results can be expected.

Genetic investigations in land pulmonates showed extreme high intraspecific diversity (up to 30% p-distance in *COI*). Hence there is no standard value for the genetic distance which marks taxonomic delimitations in molluscs. In many cases no barcoding gap can be found due to the overlap of intra- and interspecific variation (Davison et al. 2009).

Previously collected data and experiences from past and running projects – see homepage of "Alpine land snails" (snails.nhm-wien.ac.at) and "Monitoring in the Biosphere Reserve Wienerwald"(Eschner et al. 2014) – provide good pre-conditions for a successful DNA-barcoding.

Up to now material of approximately 234 Austrian mollusc species are available in the collections of the Natural History Museum Vienna. This includes material from the above mentioned projects which was collected and preserved for DNA analyses, but also older material from the museum collection. DNA that is extracted from such material can be fragmented and of low concentration, therefore we will choose it only, if there is no other material from this species available, which is the case for 26 species. Up to now we established from 105 different species 180 barcodes with all relevant metadata.

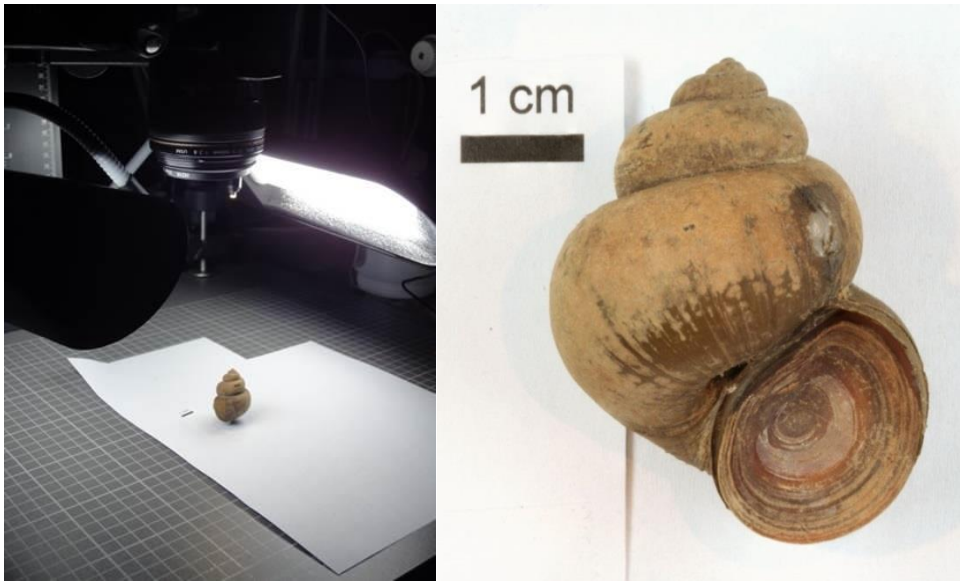

Figure 20. Apparatus for photo documentation (left) and the finalized photo of a *Viviparus acerosus* ABOL-voucher (right); © ABOL

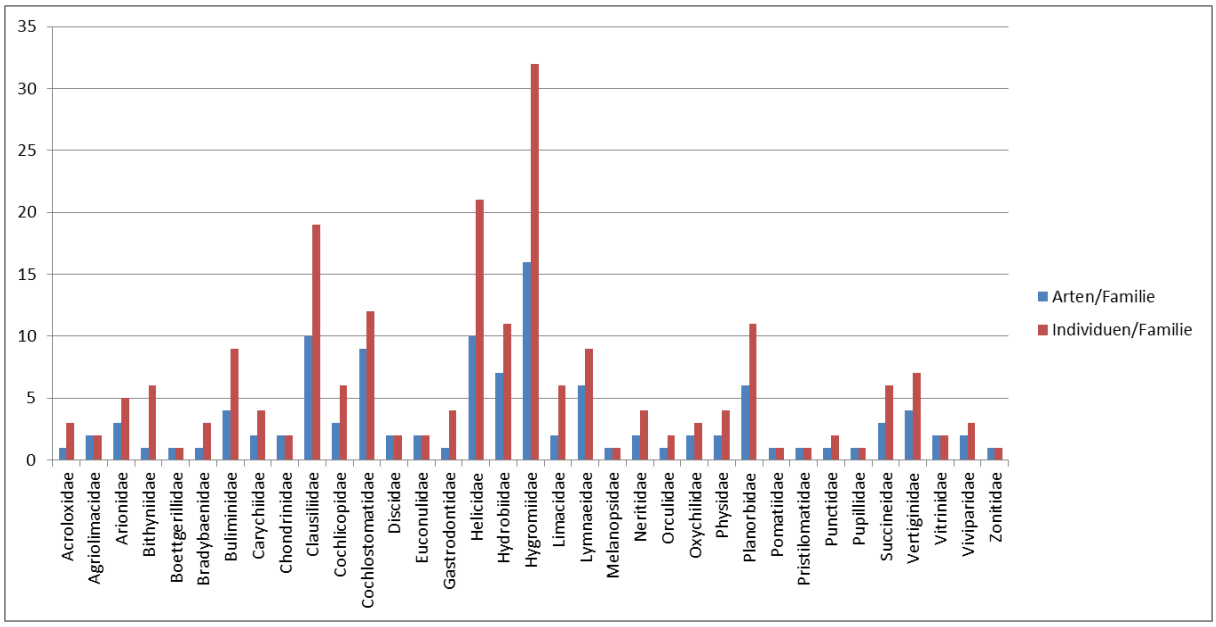

Abbildung 18. Numbers of DNA barcodes obtained from species and individuals per family

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This project is funded by the Austrian Federal Ministry of Science Research and Economy.

Short Communication

On the variability of structures of the genital tract of *Cylindrus obtusus* (Draparnaud, 1805) (Gastropoda, Helicidae)

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In the 1990ties, noticeable variation of length of mucus glands and dart sac of two different populations of *Cylindrus obtusus* were detected (Schileyko 1996; Schileyko et al. 1997). Subsequently, during field trips in 1997/98 individuals of an additional number of populations over the whole distribution area of the species were collected. The aim of this investigation was to learn if there is any geographical pattern in lengths and variation of mucus glands and dart sac. Visual inspections of the sections indicated that there is a clear east-west separation concerning the variability of these traits. Yet, besides drawings resulting from this material, no further investigations, quantifications of the differences and tests of their statistical significance were attempted. Thus, these findings have never been published.

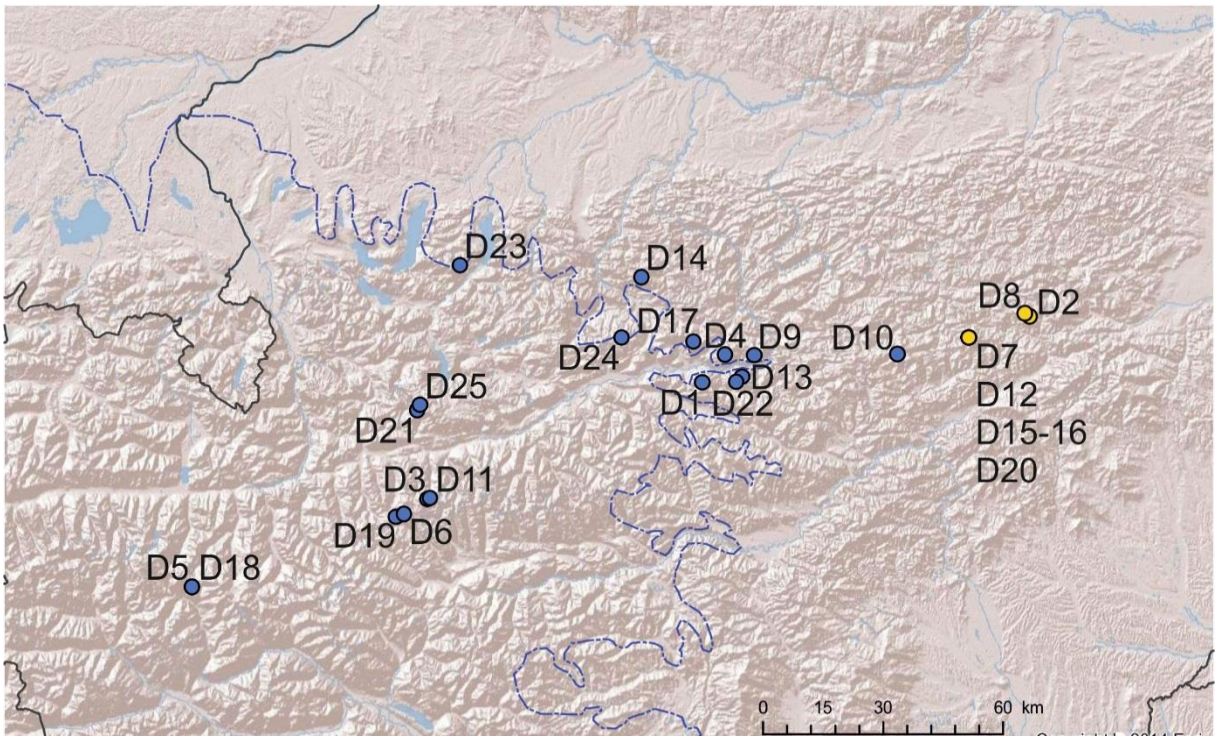

Figure 21. *Cylindrus obtusus* sampling sites.

After extensive collecting of new material of *C. obtusus* starting in 2005, detailed studies on anatomy as well as on molecular phylogeny and population genetics were performed on this comprehensive material. Those analyses revealed a similar geographic separation in *C. obtusus*, confirming previous assumptions. These recent studies will be presented at the "Workshop Alpine Land Snails" 2016 in Johnsbach (Kruckenhauser et al. 2016) and the manuscripts are now ready to be submitted for publication. Therefore, we decided to present the hitherto unpublished initial drawings here, allowing to refer to these important preliminary results.

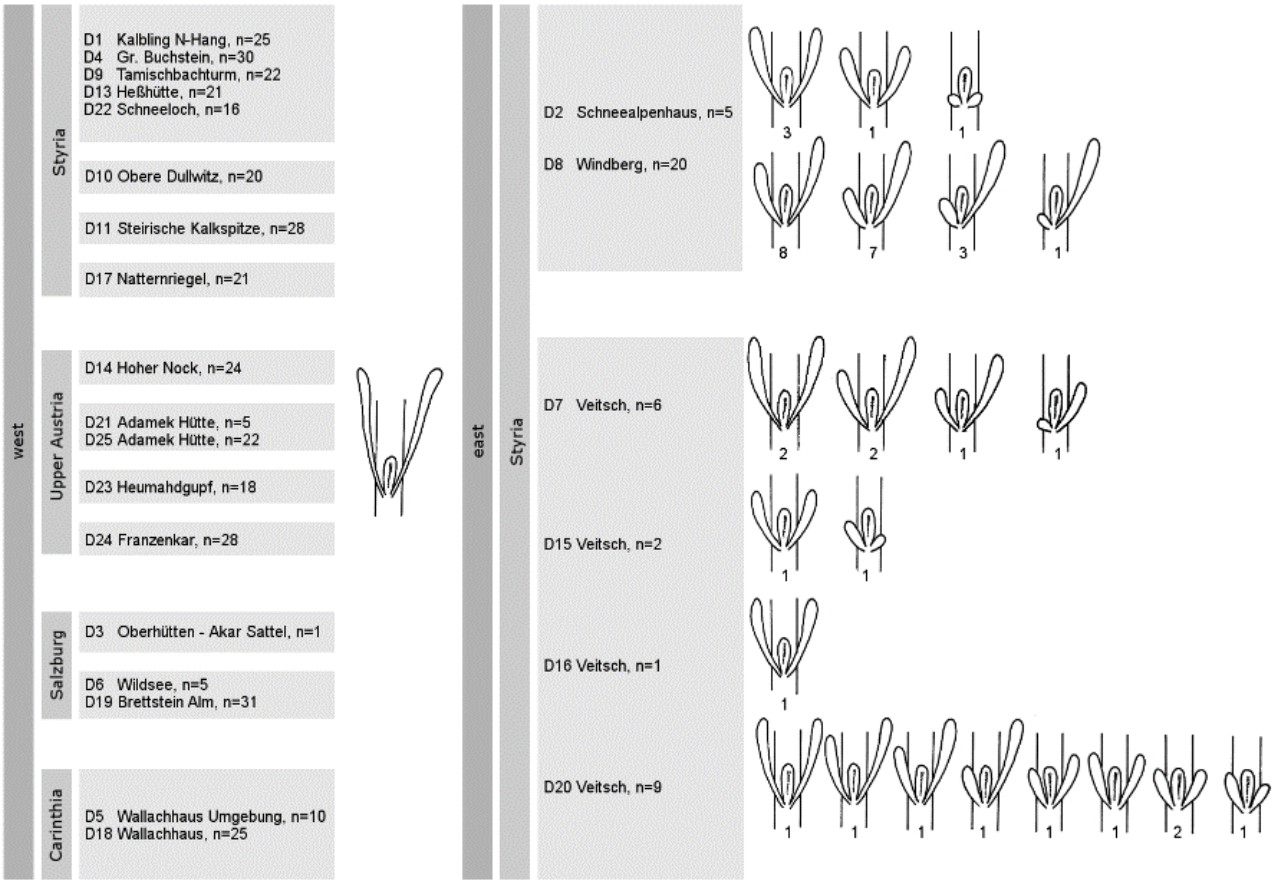

Figure 22. *Cylindrus obtusus* genital anatomy at various sampling sites; © A. Schileyko

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Figure 23. *Cylindrus obtusus* in the Haller Mauern; © M. Sonnleitner

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The "Workshop Alpine Land Snails" 2016 was supported by

- Naturhistorisches Museum Wien
- Freunde des Naturhistorischen Museums Wien
- Nationalpark Gesäuse

Projects presented at the Workshop were supported by

- Austrian Science Fund (FWF)
- Department for Forestry and Urban Agriculture of Vienna (MA 49)
- European Agricultural Fund for Rural Development (EAFRD)
- Federal Ministry of Science, Research and Economy (BMWFW)
- Freunde des Naturhistorischen Museums Wien
- Russian Foundation for Basic Research (RFBR)
- TOPCONS ENPI CBC grant

Great thanks to all participants!


Gasthof
Gösser


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