6th WORLD CONGRESS ON MOUNTAIN UNGULATES AND 5th INTERNATIONAL SYMPOSIUM ON MOUFLON

BOOK OF ABSTRACTS

SECOND EDITION - ebook

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Cleopatra Hotel, Nicosia (Lefkosia) Cyprus,

Male Cyprian mouflon, Pafos Forest. Photo: E. Hadjisterkotis

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FOREWORD

First of all I would like to thank the Minister of the Interior of the Republic of Cyprus Mr. Socrates Hasikos and the Permanent Secretary of the Ministry Mr. Constantinos Nikolaides for providing their full support for the organization of the *6th World Congress on Mountain Ungulates* congresses and the *5th International Symposium on Mouflon*. In addition, I would like to thank the Chairman of the Caprinae Specialist Group of the Species Survival Commission of IUCN Prof. Marco Festa-Bianchet for his support, and Prof. Sandro Lovari former Chairman, but also upcoming Chairman of the Caprinae Specialist Group for their support, as well as all the members of the scientific committee (Fig. 1 and 2), Prof. Marco Festa Bianchet, Prof. Sandro Lovari, Prof. Raul Valdez, Mr. Gerhard R. Damm, Prof. Juan Herrero, Dr. Charudutt Mishra, Dr. Francesco Ferretti, Prof. Igor Domskiy, Dr. Luca Rossi, Prof. Bruno Masala, Prof. Náhlik András, Dr. Walburga Lutz, Prof. Salvatore Naitana, Dr. Paolo Mereu, Dr Jean-Michel Gaillard, Dr. Luca Corlatti, Dr. K.E. Ruckstuhl, and Prof. Steeve D. Côté. Members of the Scientific Committee throughout the congress kept notes and analyzed presentations, participated in discussions and contributed to the writing of the Resolutions of the Congress. The Resolutions were presented and discussed in front of all the participants during the closing ceremony, to come up with the final Resolutions of the Congress, which are presented below. This is the first time in the history of wild sheep taxonomy that scientists from around the world accepted unanimously that:

- That the name *Ovis gmelini* be the designated name of the Asiatic mouflon and *Ovis vignei* for urial; *Ovis orientalis* may enter into homonymy
- To uniformly update the taxonomy of the Cyprus mouflon to *Ovis gmelini ophion* within all the relevant legal and scientific frameworks such as the Cypriot law, EU Habitats Directive, CITES, IUCN Red List of Threatened Species, and the Genetic Database repositories

Fig. 1. Members of the Scientific Committee during the opening ceremony. From left to right: Prof. SANDRO LOVARI, Italy, Prof. SALVATORE NAITANA, Italy, Prof. JUAN HERRERO, Spain, Prof. RAUL VALDEZ, USA, Mr. GERHARD DAMM, South Africa, Dr. ELEFTHERIOS HADJISTERKOTIS (Congress Chairman) Cyprus, Prof. IGOR DOMSKY, Russian Federation, Prof. PAOLO MEREU, Italy, Prof. BRUNO MASALA, Italy, Prof. ANDRÁS NAHLIK, Hungary. (Photo: Ieronymos Hadjisterkotis)

Furthermore, I would like to thank all the participants and co-authors, because with their participation and scientific work contributed to the success of the congress. I am thankful to the personnel of Frederick University (Nature Conservation Unit), Dr. Constantinos Kounnamas, Dr. Marios Andreou and Dr. Nicolas - George Eliades, who gave their full support during the congress, as well as to Ieronymos Hadjisterkotis, Andreani Hadjisterkoti and Elena Yerolemou, who joined the organizing Committee and assisted voluntarily throughout the congress in all aspects of organization.

For the administrative work, and success of the congress, extremely valuable was the help provided by Mr. Andreas Varnava, Administrative Officer, Ministry of the Interior. I would like also to thank our sponsors, Photos Photiades Foundation – Museum of Natural History and Vouni Panayia Winery, as well as those who contributed with their photographs for the photo gallery of this volume.

The Organizing and the Scientific Committee is particularly proud with the large participation of students and young scientists from around the world. Most of them were presenting their scientific work in an international congress for the first time. Their participation gave them the opportunity to gain new experience, friendships and cooperation's, and we are particularly thankful to the Minister Mr. Socrates Hasikos who decided to provide them with free participation fee and to cover the cost of all social events during the congress. Finally, I must note that the abstracts are presented by alphabetic order of the name of the first author.

Dr. Eleftherios Hadjisterkotis,
Congress Chairman, Ministry of the Interior, Nicosia.

Fig. 2. Some of the Members of the Scientific Committee during the opening ceremony. From left to right: Prof. SANDRO LOVARI, Italy, Prof. SALVATORE NAITANA, Italy, Prof. JUAN HERRERO, Spain, Prof. RAUL VALDEZ, USA, Mr. GERHARD DAMM, South Africa, Dr. ELEFTHERIOS HADJISTERKOTIS (Congress Chairman) Cyprus, Prof. PAOLO MEREU, Italy. (Photo: © Ralf Bürglin)

THE WORLD CONGRESSES ON MOUNTAIN UNGULATES AND THE INTERNATIONAL SYMPOSIA ON MEDITERRANEAN MOUFLON

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Back in 1983, one of us (SANDRO LOVARI) organized the *4th International Conference on Chamois and Other Mountain Ungulates* (Pescasseroli AQ, Italy), which was an attempt at making previous national meetings centred on goat-antelopes, wild sheep and goats, international and wider-ranging. That conference was so successful that its proceedings were published as a book (Lovari 1985) and some of its chapters are still being quoted in international publications, after over 30 years since its publication. In the wake of that meeting, others followed at irregular time intervals: the *World Congresses on Mountain Ungulates* were born (*1989*: Camerino MC, Italy; *1997*: St. Vincent, Italy; *2002*: Zaragoza, Spain; *2006*: Munnar, Kerala, India; *2009*: Granada, Andalucia, Spain). Each congress worked as an excellent phorum for biologists involved in Caprinae - and not only Caprinae - research to exchange ideas, discuss and establish collaborations.

Because of a number of reasons all related to the harsh habitat they inhabit, mountain ungulates leave few fossils and are rather difficult to watch as well as to study. For example, only in relatively recent years technology - especially GPS GSM radiotracking - has allowed the collection of sound spatial data on them, not to speak of the contribution provided by genetics to systematics and to aspects of social behaviour. Yet, while by now we know a lot on the ecology and behaviour of mountain ungulates from North America and parts of Europe, there are very wide areas in Asia - the cradle of Caprinae - from which information quality and quantity should be improved: very little is known on secretive, elusive species as the Mainland serow, the goral and the takin, as well as on the Caucasian tur, several argali subspecies and the Arabian tahr, just to name a few. Lack of knowledge opens up to mis-management, which is a quite dangerous issue with species that, conversely, are popular "trophy game" and local source of proteins. Also, the ongoing climatic changes are likely to impact first on species dwelling in extreme climatic conditions which have required the development of special adaptations through millions of years: as certainly it occurred already in the far past, most of them will know how to adapt to habitat changes, but the new factor - partly or totally absent in the past - is the present anthropogenic heavy impact on the environment, which calls for a wise and well informed management. Where else could scientists meet and discuss, if not in a congress? The *World Congresses on Mountain Ungulates* have never been more relevant.

The *1^st International Symposium on Mediterranean Mouflon* was organized by the University of Sassari in Sardinia on May 1994, under the direction of Professor BRUNO MASALA and Professor SALVATORE NAITANA. There were mainly scientists from Sardinia as well as Dr E. HADJISTERKOTIS from the Island of Cyprus and Professor PAUL FRANCESCHI from the Université de Corse. The meeting became the venue for the development of new scientific cooperation, new research and management projects.

The next symposium was held on 17–20 April 1996 in Nicosia, Cyprus, which is the home of the endemic Cyprus mouflon (*Ovis gmelini ophion*). The symposium in Cyprus was sponsored by the Game Fund (Game and Fauna Service) of the Ministry of the Interior. The scientific program was organized by Dr ELEFTHERIOS HADJISTERKOTIS who also edited the proceedings with 26 contributions (Hadjisterkotis 1997). The

symposium was endorsed by the Species Survival Commission (SSC), Caprinae Specialist Group of IUCN, and the Caprini Working Group of CIC. There were 32 participants from eight countries, including Canada and Russia. Another 23 scientists were co-authors in the studies presented.

The *3rd International Mouflon Symposium* was organized by Professor ANDRÁS NAHLIK from the University of Sopron in Hungary on 27-29 October 2000. The symposium was attended by participants from 13 countries, and 29 oral and 9 poster presentations were given. The proceedings of the meeting were edited by Professor ANDRÁS NAHLIK and Mr. WALTER ULOTH, and published by Professor ANDRÁS NAHLIK (Nahlik and Uloth 2001).

The *4th International Symposium on Mouflon* was held in Nuoro, Italy, from 10–12 October 2002. Nuoro is a town in the centre of Sardinia, capital of Gennargentu, where mouflon are still ranging free (Hadjisterkotis 2002). This symposium examined recent developments and research, conservation and management of mouflon worldwide.

Taking the opportunity of the organization of the *6th World Congress on Mountain Ungulates* by the Ministry of Interior of the Republic of Cyprus, with the cooperation of Frederick University and the Caprinae Specialist Group of the I.U.C.N. Species Survival Commission, after the suggestion of the Chairman of the Organizing Committee Dr. E. HADJISTERKOTIS, and the unanimous decision of the organizing and the Scientific Committee, the 5th International Symposium on Mouflon is taking place together with the *6th World Congress on Mountain Ungulates*, hoping to develop new international cooperation and the promotion of scientific research for the benefit of these species.

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ADDRESS BY THE PERMANENT SECRETARY OF THE MINISTRY OF THE INTERIOR MR CONSTANTINOS NIKOLAIDES AT THE OPENING SESSION OF THE 6TH WORLD CONGRESS ON MOUNTAIN UNGULATES AND THE 5TH INTERNATIONAL MOUFLON SYMPOSIUM

It gives me great pleasure to address the 6th World Congress on Mountain Ungulates and the 5th International mouflon Symposium. This is the first time that we host the International Congress on Mountain Ungulates, however, is the second time that the International Mouflon Symposium takes place in our country. I wish to congratulate and thank most warmly the Species Survival Commission, and Caprinae Specialist Group of IUCN, for having chosen Nicosia as the venue of the meeting and to express my appreciation to the Chairman of the Caprinae Specialist Group Prof. Marco Festa-Bianchet from Canada, as well as to the Former Chairman Prof. Sandro Lovari from Italy, for supporting every step during our preparations to have two successful and fruitful congresses. In addition, I wish to thank Frederick University for their cooperation, as well as our sponsors, and all the members of the Scientific and the Organizing Committee for their contribution and volunteering to assist us.

The presence at these Symposiums of so many distinguished scientists from more that 25 countries, is an expression of the keen interest in the subject and the protection and management of the mountain ungulates, from the European Alps, the Himalaya, the Canadian Rocky Mountains, the vast Siberia and up to the Troodos mountains of Cyprus.

No doubt, the exchange, amongst our countries, of ideas and experiences on the topic contributes positively to the formulation of those rational policies which are so much needed for the conservation and management of mountain ungualates, which in many cases are threatened with extinction.

The Ministry of the Interior, recognizing the value of these meetings, in the past undertook the organization of similar international congresses, such as the 25th International Congress of the International Unions of Game Biologists and the 9th International Perdix Symposium in 2001, and the 6th International Symposium on Wild Boar and Sub-Order Suiformes in 2006. The fact that these Congresses are taking place in Cyprus reflects the great care and concern of our government and the Ministry of the Interior in particular about wildlife management and conservation – not only on the cyprian fauna – but for the fauna of the whole planet.

This care and consideration is reflected in our success in the management and conservation of our unique endemic wild sheep, the Cyprian mouflon. This is a species that in the past came close to extinction. In the seventies, it was estimated that there were only about 200 animals. Presently there are several thousands, with an expanding population. For this reason, in our program we included a visit to the natural habitat of the Cyprus mouflon, to see and enjoy this endemic species, which is our national emblem.

I am sure that at the end of the Congress and the Symposium you will reach constructive and informative conclusions, which will contribute to the wildlife conservation not only for my country, but for the ungulates of the world in general.
Concluding, I would like to welcome to Cyprus all the participants and wish them a pleasant and fruitful stay in our island.

I declare this Symposium open and wish you every success in your deliberations.

The Permanent Secretary of the Ministry of the Interior of the Republic of Cyprus Mr. CONSTANTINOS NIKOLAIDES addressing the opening session of the 6th world congress on mountain ungulates and the 5th international mouflon symposium (Photo: V. Korshunov).

Dr ELEFTHERIOS HADJISTERKOTIS, Mr. CONSTANTINOS NIKOLAIDES, Permanent Secretary of the Ministry of the Interior and Mr. MATTHEOS EKONOMIDES, Ministry of Interior, of the Republic of Cyprus.

ΠΡΟΣΦΩΝΗΣΗ ΤΟΥ ΓΕΝΙΚΟΥ ΔΙΕΥΘΥΝΤΗ ΤΟΥ ΥΠΟΥΡΓΕΙΟΥ ΕΣΩΤΕΡΙΚΩΝ ΣΤΗΝ ΕΝΑΡΚΤΗΡΙΑ ΤΕΛΕΤΗ ΤΟΥ 6ΟΥ ΠΑΓΚΟΣΜΙΟΥ ΣΥΝΕΔΡΙΟΥ ΓΙΑ ΤΑ ΟΡΕΣΙΒΙΑ ΟΠΛΗΦΟΡΑ ΘΗΛΑΣΤΙΚΑ ΚΑΙ ΤΟΥ 5ΟΥ ΠΑΓΚΟΣΜΙΟΥ ΣΥΝΕΔΡΙΟΥ ΓΙΑ ΤΑ ΑΓΡΙΝΑ.

Με ιδιαίτερη χαρά και ικανοποίηση σας καλωσορίζω στο 6ο Παγκόσμιο Συνέδριο για τα Ορεσίβια Οπληφόρα θηλαστικά και το 5ο Παγκόσμιο Συμπόσιο για τα Αγρινά. Αυτή είναι η πρώτη φορά που το Υπουργείο Εσωτερικών οργανώνει και φιλοξενεί το Διεθνές Συνέδριο για τα Οπληφόρα Θηλαστικά, ωστόσο, είναι η δεύτερη φορά που οργανώνουμε και φιλοξενούμε στη Λευκωσία το Διεθνές Συμπόσιο για τα αγρινά.

Θα ήθελα να συγχαρώ και να ευχαριστήσω θερμά την Επιτροπή Species Survival Commission, και Caprinae Specialist Group της IUCN, που έχουν επιλέξει τη Λευκωσία ως τον τόπο διεξαγωγής των δύο Συνεδρίων και να εκφράσω την εκτίμησή και τις ευχαριστίες μου προς τον Πρόεδρο της Ομάδας Εμπειρογνωμόνων Caprinae Specialist Group καθηγητή Marco Festa-Bianchet από τον Καναδά, καθώς και τον πρώην Πρόεδρο καθηγητή Sandro Lovari από την Ιταλία, για την υποστήριξη που μας παρείχαν σε κάθε μας βήμα κατά τη διάρκεια των προετοιμασιών μας, για να έχουμε δύο επιτυχή και εποικοδομητικά συνέδρια. Επιπλέον, θα ήθελα να ευχαριστήσω το Πανεπιστήμιο Frederick για τη συνεργασία, καθώς και τους χορηγούς μας και όλα τα μέλη της επιστημονικής και Οργανωτικής Επιτροπής για τη συμβολή τους και την εθελοντική τους συνδρομή.

Η παρουσία στα εν λόγω συνέδρια, τόσων διακεκριμένων επιστημόνων από πάνω από 25 χώρες από σχεδόν όλες τις ηπείρους του πλανήτη, υποδεικνύει το έντονο ενδιαφέρον που υπάρχει για την προστασία και διαχείριση των ορεσίβιων οπληφόρων θηλαστικών, από τις Ευρωπαϊκές Άλπεις, τα Ιμαλάια Όρη, τα Rocky Mountains του Καναδά, την αχανή Σιβηρία, αλλά και μέχρι τα βουνά του Τροόδους στην μικρή μας Κύπρο.

Χωρίς αμφιβολία, η ανταλλαγή γνώσεων, ιδεών και εμπειριών μεταξύ των χωρών μας, θα συμβάλει θετικά στη διαμόρφωση των αναγκαίων ορθολογικών πολιτικών που απαιτούνται για τη διαμόρφωση και λήψη σωστών διαχειριστικών μέτρων για την προστασία και την ανάπτυξη των Ορεσίβιων Οπληφόρων Θηλαστικών, που σε πολλές περιπτώσεις κινδυνεύουν με εξαφάνιση.

Το Υπουργείο Εσωτερικών, αναγνωρίζοντας την αξία αυτών των συναντήσεων, στο παρελθόν ανέλαβε την διοργάνωση παρόμοιων διεθνών συνεδρίων, όπως το 25ο Διεθνές Συνέδριο της Παγκόσμιας Οργάνωσης Βιοθηραματολόγων και το 9ο Διεθνές Συμπόσιο Perdix που έγιναν το 2001 και το 6ο Διεθνές Συμπόσιο για τα Αγριογούρουνα το 2006. Το γεγονός ότι το Υπουργείο Εσωτερικών της Κυπριακής Δημοκρατίας αναλαμβάνει και στηρίζει την διοργάνωση αυτών των παγκόσμιων συνεδρίων στην Κύπρο, αντικατοπτρίζει το μεγάλο ενδιαφέρον και ανησυχία της κυβέρνησής μας - και ιδιαίτερα του Υπουργείου Εσωτερικών - για τη διαχείριση και διατήρηση - όχι μόνο της κυπριακής πανίδας - αλλά της πανίδας ολόκληρου του πλανήτη.

Το ενδιαφέρον και η φροντίδα του Υπουργείου Εσωτερικών αντικατοπτρίζεται και μέσα από την επιτυχία μας για τη διαχείριση και διατήρηση του κυπριακού αγρινού, ενός μοναδικού ενδημικού αγριοπρόβατου. Το είδος αυτό στο παρελθόν ήρθε κοντά στην εξαφάνιση. Στη δεκαετία του εβδομήντα, εκτιμάται ότι υπήρχαν μόνο περίπου 200 ζώα. Επί του παρόντος υπάρχουν μερικές χιλιάδες, με ένα διευρυνόμενο πληθυσμό. Για το λόγο αυτό, στο πρόγραμμα μας έχουμε συμπεριλάβει μια επίσκεψη στο φυσικό βιότοπο του κυπριακού αγρινού, για να δείτε και να απολαύσετε από κοντά αυτό το ενδημικό είδος, το οποίο είναι και το εθνικό μας έμβλημα.

Είμαι βέβαιος ότι στο τέλος του Συνεδρίου και του Συμποσίου θα καταλήξετε σε εποικοδομητικά και κατατοπιστικά συμπεράσματα, τα οποία θα συμβάλουν στη διατήρηση και συντήρηση της άγριας ζωής, όχι μόνο για τη χώρα μου, αλλά του κόσμου γενικότερα.

Κλείνοντας, θα ήθελα να καλωσορίσω στην Κύπρο όλους τους συμμετέχοντες και να σας ευχηθώ ευχάριστη και γόνιμη παραμονή στο νησί μας. Κηρύσσω την έναρξη των εργασιών του συνεδρίου, και εύχομαι κάθε επιτυχία στις εργασίες σας.

Participants of the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon. First row: Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy, Dr. LUCA CORLATTI, Italy, Dr. FRANCESCO FERRETTI, Italy, Ms LYNE MCFARLANE, New Zealand, Ms MICHELLE GROSS, Germany, Ms. ANTONELLA COTZA, Italy. Second row: Mr. PANIKOS PANAYIDES, Cyprus, Prof. FILIPPO BARBANERA, Italy, Dr. MONICA GUERRINI, Italy (Photo: E. Hadjisterkois)

The following article was submitted and accepted for publication in the Caprinae News, official publication of the Caprinae Specialist Group of the IUCN Species Survival Commission:

RESULTS AND RESOLUTIONS OF THE 6th WORLD CONGRESS ON MOUNTAIN UNGULATES and 5th INTERNATIONAL SYMPOSIUM ON MOUFLON

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The Ministry of Interior of the Republic of Cyprus, with the cooperation of Frederick University (Nature Conservation Unit) and the Caprinae Specialist Group of the Species Survival Commission of IUCN, has organized the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon. The meeting took place at Cleopatra Hotel in Nicosia, from the 29th of August 2016 to the 1st of September 2016. The congresses were under the auspices of the Minister of Interior of the Republic of Cyprus, Mr. Socrates Hasikos.

During the four day meeting, 67 scientific papers were presented, 43 oral presentations 24 posters from about 100 participants. There were participants from Armenia, Australia, Austria, Canada, Croatia, Cyprus, France, Georgia, Germany, Greece, Hungary, India, Iran, Italy, Mongolia, New Zealand, Norway, Portugal, Pakistan, Russian Federation, Slovenia, South Africa, Spain, United Arab Emirates, United States and United Kingdom. The participants were mainly university professors, researchers, graduate students, wildlife managers, biologists, veterinarians, foresters, park managers, etc. The presentations were selected and accepted by the scientific committee, which consisted of leading scientists in the field of mountain ungulates and mouflons, such as Prof. Marco Festa Bianchet, Département de biologie – Université de Sherbrooke, Canada, Chairman of the IUCN Caprinae Specialists Group, Dr. Walburga Lutz, Institute of Wildlife Research, Bonn, Germany; Special Advisor to the Chief Editor, European Journal of Wildlife Research, Dr. Francesco Ferretti and Prof. Sandro Lovari from the University of Siena, Prof. Raul Valdez of the Department of fisheries and Wildlife Sciences, New Mexico State University, USA, Prof. Juan Herrero of the University of Zaragoza, Spain, Dr Luca Corlatti of the University of Natural Resources and Life Sciences of Vienna, Dr. Charudutt Mishra, Director of the Nature Conservation Foundation of India, Dr Luca Rossi, of the Department of veterinary services of the University of Torino (Italy), Prof. Igor Domsky, Manager at the All-Russian Institute of Management Game and Fur Farming in Kirov, Russia, Prof. Bruno Masala, Prof. Paolo Mereu and Prof. Salvatore Naitana from University of Sassari, Italy, Prof. András Náhlik from the University of western Hungary, Mr. Gerhard Damm, President, Applied Science Division, International Council for Game and Wildlife Conservation CIC, South Africa and Hungary, Dr. Eleftherios Hadjisterkotis (Congress Chairman) from the Ministry of Interior of the Republic of Cyprus, and others.

The presentations were supported with photographic documentation of ungulates from Mountainous regions from all over the world, such as the Himalayas, Rocky Mountains, Alps, Siberia, and Mediterranean islands, such as Sardinia, Crete and Cyprus. The participants had the opportunity to visit Pafos Forest, the natural habitat of

the endemic Cyprus mouflon *Ovis gmelini ophion*. This included a visit to the famous cedar valley, a Natura 2000 site, which is considered as a biodiversity "hotspot", and a center of endemism of birds, plants and mammals, but mainly known for the endemic and majestic cedar of Cyprus. At Stavros tis Psokas Forest Station the participants had the opportunity to see the Cyprian mouflon.

At the end of the Congresses, the Scientific Committee, after taking into consideration all the presentations and the discussions after each presentation, issued resolutions which were adopted unanimously by all participants. These resolutions define policies and clarify scientific issues on mountain ungulates. For a number of these issues until now there was strong disagreement among scientists, and sometimes even confusion. As it was noted during the congress, the classification of Mediterranean and Asiatic mouflons, urials and their hybrids was under constant debate, taxonomic confusion and spelling inconsistencies. For these ungulates, several scientific names prevailed, but for decades there was disagreement whether they belonged to the genus *gmelini* or *orientalis*. For example, for the Cyprus mouflon, which belong to the subspecies *ophion*, intermittently was named as *Ovis gmelini ophion* or as *Ovis orientalis ophion*, although the name *Ovis orientalis* Gmelin 1774, was placed on the Official List of Specific Names in Zoology by ICZN, Opinion 2027 (2003). Things became more confused by the decision of the International Committee on Zoological Nomenclature (ICZN) in 2003, which considered the Cyprus Mouflon as a feral domesticate, and therefore should be included in the same species as domestic sheep, *Ovis aries* (Gentry *et al*. 1996).

The gathering of experts on wild sheep from all over the world, provided the opportunity, in the light of new scientific studies and new molecular evidence, to discuss and to come into unanimous conclusions on the taxonomy of the above taxa. First, the name *O. orientalis* (Gmelin 1774) was discussed extensively. The participants concluded that *Ovis orientalis* seems to refer to the hybrid Alborz red sheep, a reason for which the name is unusable and may enter into homonymy (Groves and Grubb 2011).

Based on recent complete sequence of Cyprian mouflon mtDNA and phylogenetic analyses using a large dataset of whole *Ovis* mitogenomes, as well as D-loop analysis comprising samples from the main Mediterranean islands (Sanna *et al*. 2015), as well as other phenotypic and Forensic studies, the participants agreed that the Cyprus mouflon must be included with *Ovis gmelini*, i.e. *O. g. ophion*.

Cyprian mouflon (Photo: E. Hadjisterkotis)

Thanks are due to all those onsite for helping to make the 6th World Congress on Mountain Ungulates and the 5th International Symposium on Mouflon a fruitful and sustainable event. Presented below are the resolutions and decisions taken at these congresses:

Resolutions

6th World Conference on Mountain Ungulates and 5th International Symposium on Mouflon

The participants in the 6th World Conference on Mountain Ungulates and the 5th International Symposium on Mouflon recommend:

Taxonomy & Genetics

- To combine molecular and ecological methodologies
- That the name *Ovis gmelini* be the designated name of the Asiatic mouflon and *Ovis vignei* for urial; *Ovis orientalis* may enter into homonymy
- To uniformly update the taxonomy of the Cyprus mouflon to *Ovis gmelini ophion* within all the relevant legal and scientific frameworks such as the Cypriot law, EU Habitats Directive, CITES, IUCN Red List of Threatened Species, and the Genetic Database repositories

Monitoring & Biometrics

- Long-term basic monitoring be established to gather reliable data on population abundance, trend and distribution (e.g. to assess the effects of global changes)
- Long-term collection of biometric measurements (e.g. age, body mass, horn size and increments) be initiated to investigate the effects of hunting and of density-dependent changes
- To establish collaboration among different interest groups (researchers, rangers, hunters and conservationists)

Behaviour & Ecology

- Behavioural and ecological studies be undertaken at individual and population levels to predict responses to global changes and to plan comprehensive conservation measures
- Sound research be promoted on coexistence between species (ungulates-carnivores-humans), as well as interactions with livestock
- Appropriate science-based measures be used to manage livestock grazing in wild ungulate habitats
- Prioritisation and research on basic ecology of relatively less studied mountain ungulates in remote areas of the world, e.g. central-south-eastern Asia

Conservation & Sustainable Hunting

- Sound and effective management plans should be a priority in wildlife conservation
- Hunting be considered as one tool to promote the conservation of hunted populations, although it tends not to follow Darwinian selection
- Hunting as a tool to promote recovery, mitigate conflicts with human activities, generate benefits for local communities and private landowners

- To avoid translocations of non-native taxa for hunting and recreational purposes

Health

- The creation of a specialist website on infectious and parasitic driven diseases and good health management
- To coordinate these efforts internationally

Finally, the participants express their gratitude and appreciation to the Minister of the interior of the Republic of Cyprus for hosting these congresses, and for the great hospitality and support.

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Some of the members of the Scientific Committee preparing the resolutions of the the 6th World Congress on Mountain Ungulates congresses and the 5th International Symposium on Mouflon. From left to right: Prof. ANDRÁS NAHLIK, Hungary. Dr. CHARUDUTT MISHRA**,** India, Prof. GIOVANNI G. LEONI, Italy, Prof. RAUL VALDEZ, USA, Prof. PAOLO MEREU, Italy, Dr. ELEFTHERIOS HADJISTERKOTIS (Congress Chairman) Cyprus, Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy, Dr. LUCA CORLATTI, Italy, SALVATORE NAITANA, Italy, and Dr. F. FERETTI (Photo: Ieronymos Hadjisterkotis)

ORAL PRESENTATIONS

MARKHOR IN JAMMU AND KASHMIR; THREATS TO ITS SURVIVAL AND CONSERVATION

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Markhor is a restricted range species, with its distribution mostly along the volatile region from northwestern India through Pakistan and Afganistan to Tajkistan and Turkemanistan. In India markhor is confined to the State of Jammu and Kashmir (J&K), where we did range-wide studies on its major threats and explored conservation solutions. For this, we conducted 54 semi-structured interviews including poachers, local people and herders and also did direct field surveys in Pir Panjal (Poonch and Hirpura) and Kazinag distribution ranges of markhor. We found that livestock grazing, especially by migratory herders, habitat fragmentation through linear intrusions, poaching, and lack of awareness are the main threats to markhor. The issue is aggravated due to lack of sufficient official jurisdiction of the State's wildlife department over many markhor areas, their meager manpower and poor infrastructure. Since 2001, there has been three-folds increase in livestock numbers in Hirpura and Kazinag, the last two viable markhor populations of Jammu and Kashmir (Fig. 1). This is primarily due to changes in customary herding practices of the migratory herders. The unstable political conditions in J&K had resulted in fencing all along the Line of Control (LoC) with Pakistan that includes prime markhor habitat of the Kajinag National Park and adjacent areas, thus fragmenting it. Farther from the border, the Mughal Road has fragmented the Hirpura Wildlife Sanctuary. Our observations suggest that in the past decade more proposals for linear intrusions such as transmission lines, communication cable and roads through potential markhor areas are being put forward. Rampant poaching of markhor in areas such as Poonch, Shamshabari is happening mainly due to lack of control over these areas by the Wildlife Department. We found that the awareness among students about markhor in areas around Kazing and Hirpura is very low (below 2%), thus a concern for long term conservation of markhor. Markhor status in J&K, and possibly elsewhere in its range, is affected by these common issues of unprecedented political unrest, livestock grazing, poaching, fragmentation, etc and a more serious effort to understand its status needs to be made. We feel that any downgrading of the species' IUCN status should be baked with more information and caution of the immediate future. Wildlife Trust of India in collaboration with Wildlife Department of Jammu and Kashmir have proposed actions and initiatives to address the major threats through intergrated management plans. The proposed initatives include involvement of local community and migratory herders to protect critical markhor habitats, phasing out non-traditional herders and non-traditional ways of grazing, and spreading awareness among major stakeholders and policy makers.

Fig. 1. Two magnificent mature Kashmir markhor males in Chitral, Pakistan. Photo Credit: © Imran Shah www.flickr.com/photos/imranthetrekker/ from CIC Caprinae Atlas of the World, Damm & Franco, 2014

DO MARCO POLO SHEEP (*OVIS AMMON POLII*) PERSIST IN PAKISTAN?

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The distribution range of the endangered Marco Polo sheep (*Ovis ammon polii*) is restricted to the Pamir Mountain range (Fig. 1) encompassing Afghanistan, Tajikistan, China, and Pakistan. Until the early 1970s, Marco Polo sheep used to be abundant in Pakistan's northern areas, particularly in the Khunjerab and Misgar valleys around the Pamir Knot bordering China, Afghanistan, and Tajikistan. Today, the species is confined in Pakistan to one small watershed in Khunjerab National Park (KNP) bordering China, where they make sporadic visits during the summers. Our GIS-based questionnaire surveys, the double observer method and camera traps revealed that the Kilik and Mintika (Pamir Knot) populations have vanished due to increasing anthropogenic factors like poaching, competition with livestock, habitat disturbance, and the construction of fences on the Chinese side of the border. We observed a herd of 19 Marco Polo sheep in Karachanai Nallah of KNP in 2012, whose survival may have been facilitated by improved surveillance systems and the absence of livestock from lambing areas. The Kilik and Mintika populations may have a chance to visit, and possibly expand their range into Pakistan if anthropogenic pressure in Pakistan is controlled by limiting livestock grazing and by convincing Chinese authorities to not fence the Kilik-Mintika border as these are necessary conditions for maintaining transboundary migration of Marco Polo sheep and ultimately the species' persistence in Pakistan.

Fig. 1. Group of Pamir Argali Rams in Tajikistan Photo Credit: © Brian Martin, Asian Mountain Outfitters from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

ECOLOGY OF NILGAI AND THEIR INTERACTION WITH HUMANS IN ABOHAR WILDLIFE SANCTUARY, INDIA

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Asia's largest open privately owned sanctuary, Abohar wildlife sanctuary spreads over an area of 186.5 km^2, covering 13 bishnoi villages that have shown concern and taken up the responsibility to protect the sole extant member of genus Antelope, *Antilope cervicapra* (black buck) and largest Asian antelope, *Boselaphus tragocamelus* (nilgai). The area under agriculture in the sanctuary has expanded over more than 80 percent. Gradually**,** the natural habitat of the nilgai has whittled down, forcing them to survive near agricultural fields. The raiding herds of nilgai frequently invade agricultural fields and feed off crops. The herd tramples whatever comes in its course, causing irreparable damage to farmers. However, some village residents have now started barricading their fields with mud walls, barbed and cobra wires to protect their crops which restricted the movement of animals. This has resulted in 200 deaths of nilgai because of road mishaps, barbed fence, mud walls, wells and canals in the last 4 years. A recent survey has revealed that on an average one animal dies every fourth day in the sanctuary while one animal receives serious injuries on an alternate day. This can be attributed to the skewing habitat as a result of which, nilgai and other animals are unable to find sufficient open space to run and get entangled in the barbed fence or fail to scale the mud wall while being chased by feral dogs. Being open, various incidents of poaching at night have been reported in the sanctuary over the past years. Moreover, the sanctuary has a state highway and various connecting roads running through it, which are the major cause of the deadly road mishaps between the commuters and animals.

Analyzing the exigency of the issue, maiden research study on wildlife ecology in Abohar wildlife sanctuary has been designed with the following objectives:

1) To estimate the current population status, density and distribution of nilgai
2) To study social organization: group size and structure of nilgai
3) To study the habitat use and food habits of nilgai
4) To investigate diurnal activity and ranging pattern of the species
5) To study the agricultural crop depredation by nilgai: qualitative and quantitative crop damage assessment.
6) To suggest mitigation strategies for control of crop damage and conservation of species

Methods

The aforesaid objectives shall be performed executed by various methods including a questionnaire in all the 13 villages, vehicle transects, line drive count, king's method, fourier series estimator, age and sex classification, estimating fecundity and mortality, habitat use pattern, dietary pattern, activity pattern and movement pattern (by focal sampling for 12 hours a day or scan sampling if the former one is not feasible), crop damage assessment by protected plots ('n' may vary from 3 to 5) and transects ('n' may vary from 20 to 200, depending upon the feeding area).

GENOMIC SIGNATURES OF ADAPTIVE INTROGRESSION BETWEEN EUROPEAN MOUFLON AND DOMESTIC SHEEP

Mario Barbato[1,2], Frank Hailer[1], Pablo Orozco-terWengel[1], James Kijas[3], Paolo Mereu[4], Pierangela Cabras[5], Raffaele Mazza[6], Monica Pirastru[4] and Michael W. Bruford[1]
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Mouflon (*Ovis aries musimon*) (Fig. 1) became extinct from mainland Europe after the Neolithic, but remnant populations persisted on the Mediterranean islands of Corsica and Sardinia and have been used for reintroductions across continental Europe since the 19th-century. Documented mouflon *x* sheep hybrids are larger-bodied than mouflon, potentially showing increased male reproductive success, but little is known about genomic levels of admixture, or about the adaptive significance of introgression between resident mouflon and local sheep breeds. Here we analysed Ovine medium-density SNP array genotypes of 92 mouflon from six geographic regions, along with data from 330 individuals of 16 domestic sheep breeds. We found lower levels of genetic diversity in mouflon populations than in domestic sheep, consistent with past bottlenecks in mouflon and with unusually high variability in sheep compared to other domesticates. Most mouflon populations appeared largely unaffected by admixture, although mouflon enclosures in Italy harboured admixed individuals, highlighting the need for careful genetic monitoring of these populations. Conversely, we found clear signals of mouflon introgression into domestic sheep, affecting most breeds. Using a novel approach to identify consistent signals of introgression, we infer (a) that domestic sheep show significant introgression from mouflon, and (b) that introgressed genomic regions are enriched for functions of triggering Neutrophil Extracellular Traps (NETs), an innate immunity mechanism. Further, we infer that Soay and Sarda sheep, two breeds with broad dietary preferences, carry introgressed mouflon genomic regions involved in bitter taste perception and/or innate immunity. Our results provide evidence of adaptive introgression from mouflon in domestic sheep, and our analytical framework can be applied to any low- to mid-density SNP array data.

Fig. 1. European mouflon ram (Slovakia). Photo Credit: © Patrik Michál from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

SPECIES DISTRIBUTION MODELLING FOR MOUNTAIN UNGULATES IN KHANGCHENDZONGA BIOSPHERE RESERVE: COMPARISON OF THREE DIFFERENT APPROACHES

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We prepared species distribution models for the ungulate species of Khangchendzonga Biosphere Reserve (BR). The modelling approach was applied for blue sheep (*Pseudois nayaur*), musk deer (*Moschus* spp.), serow (*Capricornis thar*) (Fig. 1), goral (*Nemorhaedus goral*), barking deer (*Muntiacus vaginlis*) and wild pig (*Sus scrofa*). The entire modelling process was carried out on three stepwise schemes-1) Rule based models provided a platform to identify the possible area where the species are expected to be found based on the existing knowledge of their habitat use pattern. 2) Logistic regression modelling enabled to create a surface map of probability of occurrence using the potential covariates that were recognized to be influencing the distribution of the ungulates 3) Ecological Niche Factor Analysis (ENFA) enabled to mitigate the problem of false absence and spatial autocorrelation as only the information of species presence was used. Discriminant function analysis of ENFA enabled to understand the niche separation and characteristic of each ungulate species in the entire Khangchendzonga BR. Spatial distribution of each species in the light of these three different approaches and the potential of these models for the contribution of proper conservation and management of these ungulates in Khangchendzonga BR landscape have been delineated. As the methodological approach of ENFA was more sophisticated and quantitative than rule based model and the basic requirement of 'true absence' recognition for logistic regression was not always possible for all the study species due to terrain and logistic constraints, the results of ENFA were regarded as the best potential prediction for ungulate distribution in Khangchendzonga BR.

Fig. 1. Himalayan Serow, India Photo Credit: © Layan Singh Sajwan from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

INTERFERENCE BETWEN EUROPEAN MOUFLON AND AXIS DEER IN MEDITERRANEAN HABITAT USING CAMERA TRAPS

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Using camera-traps we investigated the activity pattern of a European mouflon and Axis deer (Fig. 1) to see how overlapping patterns may relate to interference among species. Study was conducted during a 12-month period between April 2015 and March 2016 in area of total 800 ha. Study area was located in the western part of the Adriatic Island of Rab which belongs in eu-mediterranean vegetation zone. The major islands forest ecosystems are holm oak forests with black ash and artificially established stands of Aleppo pine, Maritime pine, and Turkish pine. The average annual air temperature is 15.3 °C, and the amount of rainfall is 1,100 mm. Results of daily activity of two ungulate species can be described as a bimodal which is typical pattern described in most other ungulates species. European mouflon are mostly active during dawn and dusk, while Axis deer are mostly active during the evening, throughout the night until early morning. The obtained coefficient of overlapping for two species was 0.8 and indicate almost identical activity patterns. Interspecific competition between species were observed, Axis deer were more aggressive and dominant versus European mouflon. Further studies are needed to clarify whether this activity pattern is typical or it reflects a temporal niche shift, because impact such as temperature and/or tourism may also effect on animal activity.

Fig. 1. Activity pattern of European mouflon and Axis deer using camera-traps.

MALE REPRODUCTIVE TACTICS IN CHAMOIS: STATUS-DEPENDENT SELECTION, TRADE-OFFS AND ENVIRONMENTAL STOCHASTICITY

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The increase in opportunity for sexual selection typically promotes the development of traits that improve the ability of individuals to achieve reproductive success. This selective pressure often results in the development of mixed strategies of allocation between different fitness components, i.e. alternative reproductive tactics (ARTs). Two major processes may concur to maintain ARTs within animal populations: *(i)* frequency-dependent selection, when fitness depends on the relative frequency of ARTs in the population, *(ii)* condition-dependent selection, when the fitness of ARTs depends on variations in internal variables such as age, body mass or hormonal status (status-dependent selection) or in exogenous factors such as weather conditions, predation or population density (environment-dependent selection). In male ungulates frequency-dependent selection – which often associates with genetic polymorphism – has found little support and ARTs appear to be under strong status-dependent selection (e.g. age and body mass in bighorn rams and Alpine ibex), while little is known about the role of environmental conditions in the evolution of different reproductive behaviours. Although the intensity of sexual selection in male chamois *Rupicapra* spp. (Fig. 1) may be lower than in highly dimorphic mountain-dwelling ungulates such as ibex or bighorn rams, recent studies revealed the occurrence of tactic-dependent variation in male reproductive success. As territorial and non-territorial male chamois do not show major differences in age, body mass or weaponry size, status-dependent selection on ARTs may primarily operate through variations in skills such as agility or strength. Male types also differ in their health status during the rut, owing to different levels of immunosuppression caused by tactic-dependent variations in hormonal concentrations, which may possibly lead to different trade-offs between mating effort and survival. In addition to that, earlier studies suggested that stochastic variations in snow cover may favour environment-dependent selection on ARTs by altering the spatial distribution of females and, in turn, male reproductive success. Large snowfalls may favour the territorial tactic, as females would be forced to move to lower elevations, while non-territorial males may be advantaged in years with little snow cover, as females would prefer staying at higher elevations. To test this hypothesis, we investigated the spatial behaviour of GPS-collared females, territorial males and non-territorial males over 3 consecutive rutting seasons (2010-12) in the Gran Paradiso National Park, western Italian Alps. We considered elevation overlap between males and females a suitable proxy for mating opportunities, as previous studies showed that the number of females in the proximity of males positively correlated with mating and reproductive success. As expected, female (Fig. 2) altitudinal movements negatively correlated with snow depth; non-territorial males largely followed female movements, while territorial males showed much less altitudinal variation. In years of normal or deep snow depth, females overlap much more with territorial males than with non-territorial males until late in the rut, when territorial males release their investment. In contrast, in years of low snow depth, females remain higher up in the mountains and their elevation overlaps much more with non-territorials', hence increasing mating opportunities for subordinate

males. In turn, this suggests that stochastic variations in snowy precipitations may promote different mating opportunities to ARTs over the years. Our results provide insights into the exogenous mechanisms that may favour the long-term maintenance of ARTs in Alpine chamois populations.

Fig. 1. A male Apennine chamois in winter pelage (November) Photo Credit: © Bruno d'Amicis from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

Fig. 2. Female Apennine chamois with kid (Photo Credit: © F. Ferretti).

THE CAPRINAE HUNTER AS CITIZEN SCIENTIST

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Citizen Science refers to a project or program of scientific work, embedded in a structure designed and overseen by scientists, in which a network of volunteers, who may have no specific scientific training, perform or manage tasks such as recording observations or measurement. Such programs can yield a wealth of information that would not be possible otherwise, given the limitations of research funding and personnel. The value of citizen science is particularly obvious, and indeed essential, for the conservation and sustainable use of Caprinae throughout the northern hemisphere (Fig. 1).

The CIC Caprinae Phenotype System supports the collection of data by hunters acting as citizen scientists. Hunter-collected data based on standardized procedures can generate a broad database of morphometric measurements and physical descriptions; assist in refining distribution range maps, contribute towards resolving taxonomic questions and describe local rural development aspirations and their conservation implications.

With modern optics and range finders, accurate satellite and topographical maps, on-line mapping systems, GPS devices, tablet computers, small digital cameras and other mobile gadgets, as well as safe and user-friendly methods of collecting, transporting and storing DNA material, modern hunters venturing into the remote haunts of Caprinae have extraordinary tools to collect, store and distribute information at almost no cost and with acceptable additional effort.

The CIC Applied Science Division wants to cooperate with Caprinae scientists and field workers to develop a **CIC Caprinae Conservation Hunting Report** as basis for a **Global Caprinae Management Data Bank** and a **Caprinae Identification System**. This process can ultimately lead to transparent principles, criteria and indicators for sustainable Caprinae hunting and a cost-effective sustainability certification of Caprinae hunting.

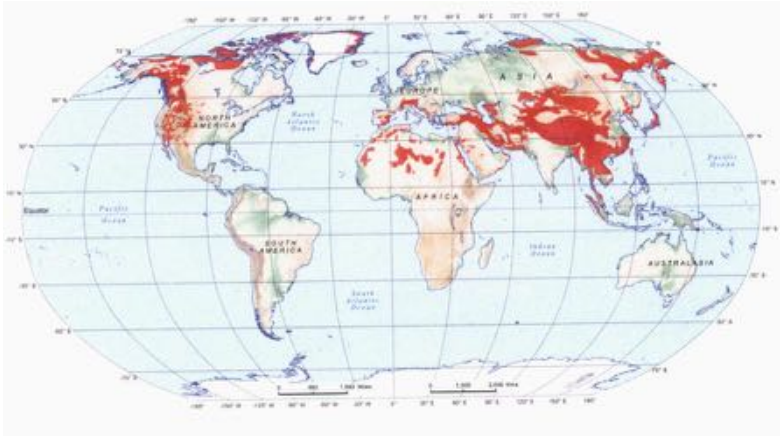
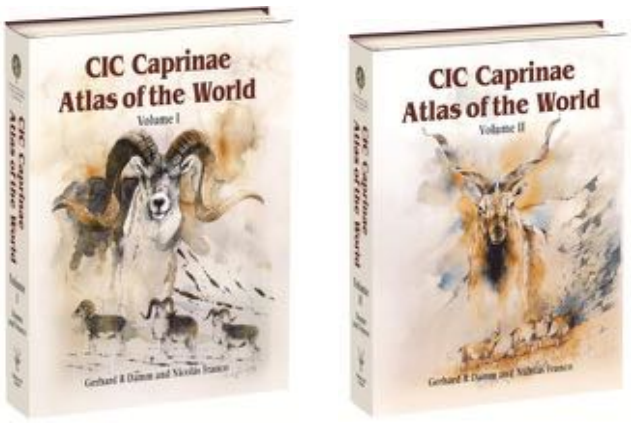


Fig. 1. World Distribution Map of Caprinae (excluding introduced or exotic populations) from CIC Caprinae Atlas of the World, Damm & Franco, 2014

CIC CAPRINAE ATLAS OF THE WORLD Vol. I & II
Gerhard R Damm & Nicolás Franco
Атлас Caprinae Мира CIC Том I & II
Герхард Р. Дамм и Николас Франко



The two-volume Caprinae Atlas presents a comprehensive overview of the distribution ranges of the wild Caprinae, their physical appearance, life history, conservation status and sustainable use. It aims to stimulate involvement of policy makers who create the administrative and legislative frameworks for Caprinae conservation; researchers and taxonomists who are at work to fill knowledge gaps; public, communal and private landowners on whose lands wild Caprinae dwell; management authorities who need to find workable conservation solutions; hunters who are getting intense awards from pursuing wild Caprinae; and last not least the women and men who follow the tracks of wild sheep and goats to admire and photograph them.

Caprinae conservation must connect traditional field work and innovative laboratory biology with the complexity of ecologic systems, and the associated human dimensions, in a multifaceted system of economics, traditional values and socio-cultural aspects. The CIC Phenotype System introduced in this atlas is intended as an element to assist field workers, researchers and management authorities in focusing research efforts, developing sound management plans and regulating sustainable use for discrete Caprinae populations. The CIC phenotypes will help identifying the conservation needs of local, regionally restricted populations and provide solutions to reconcile Caprinae conservation with the development aspirations of rural communities.

Painstaking research went into the creation of 130 color distribution maps for the 96 described Caprinae phenotypes. The chapters also present more than one thousand field photos as well as skull and horn photos from specimens in museum collections.

Marco Festa-Bianchet said of the CIC Caprinae Atlas of the World "*[It] marks a milestone in the scientific and conservation activities of the CIC. While sport hunters are the primary intended readership, this very ambitious book will also interest researchers and wildlife managers. It presents a massive amount of information on mountain ungulates, including a detailed description of known and perceived taxonomic varieties ... This monumental work took an enormous effort on the part of some very able and determined people ...*"

The Russian Edition of the Atlas has been expertly translated by Dr. Andrey Lissovsky of the Zoological Museum (Moscow State University), funded by the Mountain Hunters' Club and Eduard Benderskiy.

The two volumes of the English and Russian editions (hardcover, linen with gold foiling and dust jackets, 520 and 584 pages, 210 X 275mm) can be purchased by participants of the 6th World Congress on Mountain Ungulates at a special price including postage of Euro 145.00 (normal price Euro 250 plus postage).

GENETIC CHARACTERISTIC OF SNOW SHEEP (*O. NIVICOLA LYDEKKERI*) OF THE VERKHOYANSK MOUNTAIN CHAIN USING MICROSATELLITE MARKERS

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The Verkhoyansk mountain chain is the most significant habitat of Yakut snow sheep (*Ovis nivicola lydekkeri*), the only mountain ungulate of the region. We evaluated genetic diversity and relationships of fifty-nine snow sheep representing the Verkhoyansk Rang along the entire length including Kharualakh ridge - Tiksi (TIK, n=11) and Orulgan ridge (ORU, n=17) on the North (71°N and 67°N, respectively), Verkhoyansk ridge (VER, n=21) at the Central part (64°N) and Suntar-Khayata ridge (SKH, n=10) on the South (62-63°N). We used seventeen microsatellite loci of domestic sheep in *O. nivicola lydekkeri*. Fragment analysis was carried out in ABI 3131xl genetic analyzer. Calculations were performed in GenAIEx software 6.5.1. All studied loci were 100 % polymorphic in *O. nivicola lydekkeri*. The highest number of average and effective alleles per locus was detected in VER (8.53±0.88 and 4.38±0.61, respectively), whereas the lowest values were found in TIK (5.53±0.51 and 3.32±0.33). Number of informative alleles (with frequency ≥5%) varied from 6.12±0.71 in SKH to 3.65±0.34 in TIK. The ORU population showed the greater level of genetic diversity (Ho=0.565; He=0.700) whereas the lowest was found in TIK (Ho=0.366; He=0.641). Significant heterozygote deficiency was detected in all investigated populations of snow sheep and ranged from 13.5% in ORU (F_{IS}=0.18) to 27.5% in TIK (F_{IS}=0.44). Estimated pairwise F_{ST} values were the lowest between neighboring ORU and VER (F_{IS}=0.025), SKH and VER (F_{ST}=0.028) and the greatest between distant TIK and SKH (F_{ST}=0.093) and TIK and VER (Fst =0.083). To evaluate genetic differentiation of four *O. nivicola lydekkeri* populations we constructed phylogenetic tree, based on Nei's unbiased genetic distances, using PAST software v. 1.81. The phylogenetic tree structure was in agreement with the geographical location of the ridges inhabiting by the studied snow sheep groups in direction from north to south within the Verkhoyansk mountain chain. Group TIK was found to be more distant from the other populations.

CONTRIBUTION OF DIFFERENT POPULATIONS OF YAKUT SNOW SHEEP *(OVIS NIVICOLA LYDEKKERI)* TO THE SUBSPECIES GENE POOL

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Snow sheep or Siberian bighorn *(Ovis nivicola)* along with its closely related thinhorn sheep *(Ovis dalli)* in North America inhabit the most northern territories among all ovine species. Yakut snow sheep *(O. nivicola lydekkeri)* (Fig. 1) is the most numerous subspecies of snow sheep inhabiting mountainous regions of Russian region Sakha (Yakutia). The recent study has shown that this subspecies is genetically structured with low gene flow across the area of its habitat. Our research was aimed at evaluating the contribution of different populations to the gene pool of the subspecies of Yakut snow sheep.

A total of 76 individuals of Yakut snow sheep from various sampling sites were genotyped on the Illumina OvineSNP50K BeadChip to obtain the subset of polymorphic markers suitable for examination of this "non-model" species. The markers were selected only if they were genotyped in 90% of the samples with GenCall Score > 0.5, had minor allele frequency (MAF) > 1% and were in Hardy-Weinberg equilibrium ($p<1e-6$). Individuals were included into one group if the sites of their sampling were within a 120 km distance from each other. Groups with at least 10 individuals were taken for the analysis. All the individuals that had not been included into any of the groups were only used to obtain the subset of polymorphic markers. Quality control was performed using PLINK 1.07 software, allelic richness was calculated in HP-Rare 1.1 program.

After quality control 1,102 SNP distributed on all the ovine chromosomes were selected for the subset of markers. The four groups representing Kharaulakh Range (Tiksi Bay) - (TIK), Orulgan Ridge (ORU), Central part of Verkhoyansk Range (VER) and Suntar-Khayata Range (SKH) consisted of 12, 20, 16 and 10 individuals, respectively and covered the distance of more than 1,000 km from north (71º lat.) to south (62º lat.). The overall number of polymorphic alleles in TIK was 668, in ORU – 865, in VER – 876 and 853 in SKH. 520 alleles were common in all the populations and the numbers of alleles unique for each population were 9, 32, 43 and 65 for TIK, ORU, VER and SKH, respectively. The numbers of alleles specific for two populations were higher for pairs VER-SKH – 76 and VER-ORU – 52 SNPs, while only 3 SNPs were common for both TIK-SKH and TIK-VER pairs. The highest number of SNPs that occurred in three populations were in ORU-VER-SKH – 113, and the lowest - 17 in TIK-VER-SKH triplet.

The highest rarified allelic richness was observed in SKH – 1.77, and the lowest in TIK – 1.59. The numbers for ORU and VER were 1.72 and 1.74, respectively.

The mean numbers of polymorphic loci per individual were 219.5±5.70 (19.9%) for TIK, 250.7±3.17 (22.8%) for ORU, 266.9±4.99 (24.2%) for VER and 278.8±3.28 (25.3%) for SKH and were similar to their respective medians: 218, 252, 268.5 and 278.

Our results have shown that the number of alleles as well as average individual heterozygosity were significantly smaller ($p\leq0.01$) for a northern population in comparison with a southern population. It could be explained by the fact that the most

northern population – TIK inhabits the edge of Yakut snow sheep areal, while the southern population SKH inhabits the region where gene flow between two major mountain ranges in Sakha (Yakutia) is mostly possible. It could also be explained by the fact that these populations inhabit different climate zones.

The research was conducted under financial support of the Russian Scientific Foundation (project № 14-36-00039).

Fig. 1. Magnificent male Okhotsk snow sheep (*O. n. lydekkeri, syn. alleni*) in summer. Koni Peninusula, Olskiy cluster, Magadanskiy National Nature Reserve, Magadan Oblast, Russia. Photo Credit: © Alexander Andreev, Institute of Biological Problems of the North from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

HABITAT AND FOOD PREFERENCE OF MOUFLON AND COMPETITION FOR FOOD RESOURCES WITH RED DEER

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The habitat use and diet composition of mouflon (Fig. 1) and the competition for food between mouflon and red deer was investigated in the North Hungarian Mountains. Habitat use was determined by pellet group counts. The estimation of diet composition was performed by examining the rumen content of mouflons and through faecal analysis of both species using macroscopic and microhistological methods. In the course of estimating habitat and food preference we used the Ivlev-index and tested for significance with the Bonferroni Z-test. The dietary niche width of the mouflon and red deer was calculated with the Levins' formula, while the niche overlap was determined with the Renkonen index.

Our results show that mouflon preferred open grass areas, old growth turkey oak / sessile oak forests and young reforestations; all of these habitat types have dense ground cover vegetation. Mouflon shunned dense thickets and medium-age stands. Mouflon and red deer adapt their feeding habits according to the season, to changes in their habitat (e.g. snow cover), and their dietary overlap. In the case of mouflon, grasses make up 56% of food intake. The consumption of grasses decreased only during snowy winters when the overwhelming majority of its diet was beech twigs (84%). Due to the scarce food supply of the shrub cover that is characteristic to mountainous habitats, red deer became predominantly grass and roughage eaters; more than 50% of its diet was grass. Consequently, there is significant competition for food between red deer and mouflon. The niche overlap between the two species measured with the Renkonen index was the highest in winter (58.17 %). This decreased in spring (54.52%) and summer (52.12%) and was the lowest in autumn (40.78%).

Fig. 1. European mouflon (Photo: © Prof. S. Naitana)

IMPROVING UNGULATE POPULATION MONITORING USING GROUP COMPOSITIONAL DATA

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Knowledge about population trend is critical for species conservation. Central Asia harbors a diverse array of ungulates threatened by overharvest, burgeoning livestock populations, and habitat loss. Exacerbating these threats is an absence of tenable methods to reliably monitor ungulate populations, undermining managers' ability to identify at-risk populations or evaluate conservation interventions. Here, we present an effective low-cost tool to monitor mountain ungulates, female: young age ratios, which can accurately estimate population growth when adult survival is known. Existing methods typically estimate population size – such as double observer counts, distance sampling, and mark-resight – but yield little information on population growth. Monitoring population trend with age ratios can either be done as a stand-alone method or can occur in tandem with data collection from other survey methods. Age ratios are amenable to participatory monitoring by local communities because data can be collected on diverse terrain with little training, minimal equipment, and without the need for time-intensive systematic surveys; age ratio data are also relatively robust to differences in group-specific detection probabilities across both landscapes and observers. These factors represent marked improvements over methods to estimate population size, while providing much more information than simple presence/absence data. We highlight key points for properly designing age ratio surveys. Next we expand on current knowledge by demonstrating how to broadly infer population growth from age ratios when information on adult survival is incomplete, using a 12-year case study of argali (*Ovis ammon*). As a practicality, age ratios can immediately improve monitoring for six ungulate species native to Central Asia for which survival estimates have been published. Telemetry is the best method for estimating ungulate survival, and telemetry data are available from another nine species in the region – eight of which are threatened with extinction. Calculating survival for these species would unlock new avenues for meaningfully engaging local communities, improve monitoring, and enable researchers and associated governments to quantitatively evaluate population trends.

EFFECTS OF WEATHER VARIATIONS AND INTERSPECIFIC COMPETITION ON THE FORAGING BEHAVIOUR OF THE APENNINE CHAMOIS

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Climate change has significant impacts on interspecific interactions, e.g. mutualistic relationships, parasite-host dynamics and trophic interactions. Effects on competition between animal species have been relatively under-studied. Both climate and competition can influence the availability of high-quality food for herbivores during nursing/weaning, which is a critical period in the life cycle of these animals. In this work, we have analysed the effects of weather conditions (temperature, rainfall) and competition with red deer *Cervus elaphus* on the foraging behaviour of adult female Apennine chamois *Rupicapra pyrenaica ornata* in summer (Fig. 1), as well as on winter survival of chamois kids. We evaluated the effects of rainfall and temperature on feeding intensity of female chamois (indexed by bite rate) to predict relevant effects of climatic changes, as well as whether they were greater under interspecific competition with red deer. We observed negative effects of high temperature and low rainfall on feeding intensity. Effects of weather were greater in forb-dominated patches, which included cold-adapted, nutritious plants of key importance to chamois, than in graminoid-dominated ones. Feeding intensity was lower where grasslands were also grazed by red deer, but there was no interaction between climate and competition. Survival and demographic models supported a negative effect of competition on survivorship of chamois kids. Most likely, harsh weather conditions and competition with deer had additive, negative effects on foraging behaviour and survival of chamois. Our results suggest that climate change and interspecific competition could reduce pasture quality and ungulate viability through independent processes. Climate is expected to influence dispersion, growth and/or nutritional quality of plants, whereas competition decreases food availability through depletion of scarce resources. Both factors appear to limit food/energy intake rates during summer, in turn reducing the survival of the youngest cohorts in winter.

We suggest that interspecific competition can be an important additive factor to the effects of climate changes on population viability of mountain ungulates.

Fig. 1. Two prime aged male Apennine Chamois in action during November rut. Photo Credit: © Bruno d'Amicis from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

SPACE USE AND ACTIVITY PATTERNS OF INTRODUCED BARBARY SHEEP (*AMMOTRAGUS LERVIA*) IN SOUTHERN DINARIDES, CROATIA

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The Barbary sheep (*Ammotragus lervia*) is a species of caprid (goat-antelope) native to the mountain chains across the Sahara belt in Northern Africa. During 2002 five Barbary sheep (three females and two males) of unknown origin have been illegally released in the southern Dinaric region (Mosor Mountain; 1.339 m a.s.l.) of Croatia. The current population size is estimated at around 210 animals. The study area is also home to grey wolves, which regularly predate the Barbary sheep. Wild boars are occasionally recorded at the periphery; no other large mammals occur in the area, except for domestic sheep and goat. Illegal introduction of Barbary sheep has caused much controversy between hunters and environmental community since first animals were released. Hunters perceive the introduced animals as attractive game species and potential source of income, while environmentalists emphasize possible negative effects of introduced alien species on native flora and fauna and call for application of existing laws that prescribes complete removal of the introduced animals.

In order to study ecology, activity patterns, habitat selection, potential for further spatial expansion of the Barbary sheep and their interactions with wolves, we captured and tracked six animals (two females and four males aged 2-4 years) with the use of GPS-GSM collars (Vectronic Aerospace GmbH). GPS collars were set to record a position every hour, 24-hours per day over one year and then automatically drop-off.

One 4-year old female was killed by wolves 11 days after capture (predation event occurred at night at 23:45), and one of the collars failed immediately after tagging. Other four animals cumulatively moved 1.63 km per day and their circadian activity has two pronounced peaks at morning and evening. Peak activity changed in accordance to seasonal dynamics of the photoperiod. Generally, the tracked animals moved mainly along the mountain ridges of Mt. Mosor and several times moved along entire range (approx. 25 km) in relatively short time (2-4 days). On the other hand, movements perpendicular to the main mountain range were short and usually stopped at the mountain foothills with higher vegetation cover and less extreme terrain. Monthly home-range size ranged from 0.6 to 17.0 km^2 (mean: 5.9 km^2). For one animal we were also able to estimate annual home-range size: 26.0 km^2.

Current data suggest that Barbary sheep in the study area are restricted to the Mosor Mountain range and are unlikely to expand their range. This could be associated with the characteristics of the surrounding habitat, which makes them vulnerable to wolf predation, as well as with illegal hunting in the surrounding hunting grounds.

A REVIEW OF THE CONSERVATION VALUE OF ISLET AGRIMI *CAPRA AEGAGRUS CRETICA* POPULATIONS – RECOMMENDATIONS FOR MANAGEMENT

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The vulnerable Cretan Wild Goat or Agrimi *Capra aegagrus cretica* is the only ungulate taxon living in a free-ranging state on the island of Crete where it serves as an 'umbrella species'. According to survey-based estimates, its numbers have increased there over the last 50 years. Nevertheless, it is still being threatened with extinction due, mainly, to poaching and hybridization with domestic goats *Capra hircus*.

Agrimi is safer on the islets where it has been introduced for conservation purposes. Yet, body size comparisons between Cretan (Lefka Ori), islet Game Reserve (GR) and islet Controlled Hunting Zone (CHZ) populations, reveal differences in nutritional histories within sites, and in habitat quality between sites. The phenotype is subject to a range of selection pressures created, partly, by the availability of feeding sites and population density. Food quantity and quality affect horn size which is linked to male reproductive fitness and, perhaps, is significant in the inter-specific competition with feral and hybrid goats. They also determine body weight which appears associated with recorded islet population fluctuations. Given that the combined gene pool on the islets is just a fragment of the original one, potential stochastic events could have unfavorable consequences on agrimi's adaptability as a result of, the expected, high homozygosity levels (founder effect).

In view of these findings, it is suggested that agrimi would benefit from a revised action plan encompassing and coordinating all GR and CHZ islet populations, to support *in situ* conservation efforts on Crete. A captive-breeding programme involving new individuals from Lefka Ori would contribute significantly in safeguarding more of agrimi's genetic polymorphism. Site-specific measures are recommended to control population size in the islets, reduce poaching pressure and to raise public awareness.

DECLINE IN UNGULATE POPULATIONS OF IRAN'S OLDEST NATIONAL PARK CALLS FOR URGENT ACTIONS AGAINST POACHING

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Poaching for wild meat threatens the population of many ungulate species in different parts of the world. Despite steady declines in population of exploited species, often no information on this trend exists. Due to challenges of monitoring in rugged landscapes, such information is even harder to obtain for mountain ungulates. However, to advice for appropriate conservation measures, knowledge on population trends and poaching incentives is necessary. We estimated the abundance of four ungulate species, in Golestan National Park, Iran, where poaching is widespread despite four decades of law enforcement efforts. We used line transect sampling (186 km), camera trapping (2777 camera-nights), point counts (64 scans) and dung counts (38 km), and compared them with those from earlier records. We also analysed incentives of local poachers using a semi-structured and qualitative interview surveys. Population estimates from 2011-2014 indicated a 66-89% decline in bezoar goat (*Capra aegagrus*), maral red deer (*Cervus elaphus maral*) and urial (*Ovis vignei*) compared to 1970-1978. Only wild boar (*Sus scrofa*) showed a population increase by 58% during the same period, possibly due to religious restrictions regarding the consumption of pork meat. Local poachers' incentives were categorized (in a non-ordinal manner) as subsistence, pleasure, tradition, trade of wild meat, and conflict with conservation regulations and bodies. The alarming declines in ungulates of Iran's oldest national park call for urgent conservation actions in the study area and also other reserves of the country. The country requires adoption of participatory conservation strategies, improvement of law enforcement practices and cooperation of international expertise in resolving its poaching problem. Taking into account poachers' incentives, a combination of economic and non-economic strategies should be considered.

POPULATION GENETICS AND FORENSIC DNA FOR CONSERVATION MANAGEMENT OF THE CYPRIOT MOUFLON (*OVIS ORIENTALIS OPHION*)

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The mouflon (*Ovis orientalis ophion*) is the largest wild terrestrial mammal of Cyprus. Considered as the flagship species of the island, its population (*c*. 3000 head) has a distribution range limited to the mountainous Paphos Forest and adjacent areas including parts of Troodos National Forest (> 700 Km^2). The species is protected by a rigorous national legislation supported since 1996 by management plans carried out by the Game and Fauna Service, and, together with its habitat, by the National Law 152 (I)/2003 for the Protection & Management of Wild Birds and Game Species. The species is listed in the Annexes II and IV of 92/43 Habitats Directive, in the Appendix I of CITES, and classified as "vulnerable" by the IUCN. Poaching, habitat loss, road network building and livestock intrusion (i.e., increased risk of pathogen infection) represent the main threatening factors. We aimed at elucidating the systematic placement of the Cypriot mouflon to enforce its protection within an adaptive conservation framework. Therefore, we attempted to determine its genetic structure and relationships with either historically preserved (Corsica, Sardinia) or recently introduced (central Italy) populations including also GenBank entries from the historical range of the species (Near East). The Game and Fauna Service in collaboration with the Cyprus Veterinary Service collected 63 blood samples: 53 were from mouflons captured in the Paphos forest, eight from captive individuals and two of unknown origin. We also sampled 20 mouflons in Sardinia either in the wild (16) or in captivity (4), and collected scats of both Corsican (19) and central Italy (23: Tuscan Archipelago National Park, 13; Tuscan-Emilian Apennines National Park, 6; Apuan Alps Regional Park, 4) mouflon populations in order to increase geographical scope. We genotyped each sample at the entire mitochondrial DNA Cytochrome-*b* codifying gene (Cyt-*b*, 1140 bp) and up to 12 microsatellite DNA markers (Short Tandem Repeats, STR) isolated from goat, sheep and cattle genomes. We found that the Cypriot mouflon strongly diverged from western Mediterranean conspecifics, while North West Iran appeared as the most credited geographic region as the source for its ancient introduction to Cyprus. Although we disclosed much lower mitochondrial and nuclear DNA diversity in the Cypriot than in other island populations, neither evidence of genetic bottleneck nor significant low level of both average pairwise relatedness and inbreeding coefficient was detected. Overall, present mitochondrial and STR dataset worked reliably as crime-fighting tool to tackle illegal mouflon killing in Cyprus. Between 2008 and 2013, the Police and the Game and Fauna Service, in collaboration with the Cyprus Veterinary Services, confiscated 29 samples (meat, hairs, bloodstains) dealing with nine episodes of supposed poaching against the Cypriot mouflon. In all cases, we identified the species in point by sequencing the mtDNA Cyt-*b* gene. In one case, we were specifically requested to establish if there was a link between three dead mouflons recovered at a roadside and 12

bloodstains collected in the car of suspected poachers at the crime scene. With reference to this case, we were able to match nine bloodstains to two out of the three carcasses (seven with very strong support: Likelihood Ratio >3000 and Random Match Probability $<10^{-3}$), overall assigning 22 out of 29 samples to the Cypriot mouflon and the remaining ones to wild boar, cow, domestic goat, horse and hare. These results included the first genetic reference for the Cypriot mouflon and the first published material of forensic wildlife investigations in Cyprus.

Cyprian mouflon male and female during the breeding season. (Photo: ©E. Hadjisterkotis)

POPULATION CENSUS AND DISTRIBUTION OF MOUNTAIN UNGULATES IN GEORGIA

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Four species of mountain ungulates are found in Georgia: *Capra cylindricornis*, *Capra caucasica*, *Capra aegagrus* and *Rupicapra rupicapra*. All of these species are native to the Great Caucasus Mountains, but Rupicapra rupicapra inhabits in the Lesser Caucasus Mountains as well. Capra aegagrus used to inhabit in the Lesser Caucasus Mountains in the past, now it is extinct. The census of mountain ungulates of all four species in Georgia was done from 2012 to 2014.

The East Caucasian Tur (*Capra cylindricornis*)

The East Caucasian Tur can be found in the Great Caucasus of Georgia east of the mount Shkhara, on the territory of the West Georgia in Svaneti. The area might be inhabited by West Caucasian Tur, although this one is rarely found. The East Caucasian Tur is found non systematically in Racha region that means that the existance of a stable population here is doubtful. The same situation is in Svaneti east to Shkhara. There are 3 populations of Capra cylindricornis in the East Georgia.

- ✓ The natural area of Capra cylindricornis in Tusheti is 99 642 ha, the total number is 1400 individuals in 2012, 3600 in 2013, 2100 in 2014;
- ✓ The natural area of Capra cylindricornis population in Kazbegi and Khevsureti is 90000 ha, the total number is about 1400 individuals in 2012, 1150- in 2013, 900 in 2014;
- ✓ The natural area of Capra cylindricornis population in Lagodekhi is 7358 ha, the total number is about 220 mature individuals in 2012, 490 -in 2013, 300 - in 2014.

The West Caucasian Tur (*Capra caucasica*)

The results of summer (during the overland calculation 2 female goats and one he-goat were found) and autumn data (during the air calculation one female and one he-goat) are so poor that the statistical analysis is impossible. Taking into account the periodical movements (from spring to the first half of autumn) of individuals to the other habitat areas (e.g. Racha), according to the experts the number of The West Caucasian Tur does not increase 100-150 animals, the results were made in 2013-2014.

Bezoar Goat (*Capra aegagrus*)

The Bezoar Goat is found only in Tusheti and Pirikita Khevsureti (the nothern slope of the Great Caucasus) (in small numbers) in Georgia. 200 individuals were registered in 2012, 310- in 2013, 350 - in 2014.

Chamois (Rupicapra rupicapra)

The Chamois is native to the main ridge of the Great Caucasus mountains and on Lesser Caucasus. The population number of the Great Caucasus mountains: 2781 individuals in 2012, 3300 in 2013, 1000 in 2014 only in eastern part of great Caucasus;

- ✓ The population number of the Lesser Caucasus mountains: 770 individuals in 2012, the census was not done in 2013 and 2014.

POPULATION, ECOLOGY AND FOOD HABITS OF THE CYPRUS MOUFLON

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The Cyprus mouflon is an endangered species of wild sheep found in the Pafos Forest of Cyprus. Population, reproductive and feeding ecology of mouflon was studied in two main habitats: the central Pafos Forest and at the forest-agriculture interface. In addition a seasonal chemical analysis of the major mouflon forage species from Pafos Forest was conducted. The contents of 32 rumens were examined. Stomachs were collected from all seasons. Data on feeding habits were also collected by watching feeding sheep with 20X60 binoculars. The main item in the diet consisted of forbs and grasses with a greater variety of woody browse and fruit in the diet of the Forest dwelling animals than in the diet of the forest edge mouflon. Eighty-five forage species were collected and analyzed for nutrient content, based on plants which occurred in the rumen and on visual observations of mouflon while feeding in the wild. The data were analyzed for macromineral or micromineral deficiencies or harmful levels in the samples analyzed. Usually by June all grasses are dry, and forage is reduced in quantity and quality. As pasture forage matures, the protein content declines, fibre increases, and both forage intake and digestibility decline. The sseasonal chemical analysis of the major mouflon forage species from Pafos Forest indicated that during late Summer and early Fall, grass, which is the main item in the diet of mouflon, was below the minimum requirements for maintenance required by sheep, which is 7%. The animals are further stressed at the end of October with the beginning of the rutting season. Males lose body weight, because the time that would be spent grazing is replaced with reproductive activities such courting estrous females and fighting rival males. Therefore, the highest mortality for Cyprus mouflon is during the rut, and for one or two months immediately following the rut. Depending on the rains, fresh grass might not appear, particularly inside the forest until one, and sometimes two months after the rut. Due to the stress of the rutting season, poor nutrition in late summer and autumn, old age, diseases, and cold weather, many rams do not recover from nutritional deficiencies and die. Shortly after the rains the vegetation begins to grow, providing young, digestible forage rich in protein and nutrients, especially forbs and grasses, which enable the surviving animals to recover. The population at the edge of the forest supplemented their diet with agricultural plants, and foraged in open fields adjacent to the forest, rich in grass. This population had a longer lambing season; the onset of their reproductive cycle occurs approximately two weeks earlier than the animals in the forest; the lambing period was longer; ewes produced more lambs; lambs suckled for longer period; and fewer female were barren. The shortage in protein and nutrients in the forest is probably the cause of the observed reduced pregnancy rate, the lower number of twins produced, and the lower lamb per ewe ratio. Mouflon had a wide range of diseases and bone lesions affecting domestic animals. The most important defect, which affects mainly older males, is spondylosis.

A REVIEW OF THE NOMENCLATURAL SPELLING VARIATION OF THE ARMENIAN MOUFLON (*OVIS GMELINI GMELINII*) AND THE CYPRIAN MOUFLON (*O. G. OPHION*)

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Ovis gmelini gmelinii

The classification of Mediterranean and Asiatic mouflons, urials and their hybrids are under constant debate, taxonomic confusion and spelling inconsistencies. Based on morphological criteria, karyological and biochemical evidence and geographic distribution, several classifications and revisions of the above species have been proposed during the last two centuries. More recently, the name *Ovis orientalis* Gmelin 1774, was placed on the Official List of Specific Names in Zoology by ICZN, Opinion 2027 (2003), but it probably refers to refer to a hybrid (Fig. 1) (Valdez, 1982), however, the name is nonetheless unusable (Art. 17.2) (Groves and Grubb 2011) and may enter into homonymy (Art. 23.8). Besides these taxonomic inconsistencies, there is also a nomenclatural spelling variation which appears in publications using the name *Ovis gmelini* or *O. gmelinii*. Since the name *gmelini* was first published by Blyth 175 years ago (YA) as *gmelinii,* there are spelling variation sometimes appearing as *gmelini* and sometimes as *gmelinii*. This confusion is particularly prominent with the Armenian mouflon, where the name *gmelini* appears in three different combinations, i.e. *O. gmelini gmelini*, or *O. gmelini gmelinii* or *O. gmelinii gmelinii*. The inconsistency even exists with the species name *gmelini* of several other mouflon subspecies, such as the Konya or Anatolian mouflon *O. gmelinii anatolica*/*O. gmelini anatolica*. Even in the cases where the species name for *O. gmelini* was replaced by *O. orientalis* or *O. ammon*, and the name *gmelini* was applied to a subspecies, the subspecies name terminates with *–i* and sometimes with *–ii*.

To examine this inconsistency, we examined the rules and guidelines of Transliteration and Latinzation of personal names. Based on these rules, in forming a species-group, not Latinized, nor of Greek origin, the genitive singular case-ending *–i*, in preference to the termination *-ii,* should be added to the entire name, e.g., sm*ithi* rather than *smithii*, (from Smith"), *Krupai* (from Krupa), *bonarellii* (from Bonarelli).

(a) Such a name may also be formed by adding the adjectival ending *–ianus*, **-***iana*, **-***ianum* to the entire name, but it is better to use the genitive singular.

(b) Latinization by the addition of –ius to a proper name, which would produce the genitive *–ii*, is not recommended.

Therefore, based on the above article, in forming the species-group for mouflon, since the name Gmelin is not Latinized, nor of Greek origin, the correct ending is the genitive singular case-ending *gmelini*, in preference to the termination *gmelinii*.

However, in forming the ending of the subspecies name: *Ovis gmelini gmelini*/*gmelinii*, based on art. 17(a), "If the name is based on a Latin or Latinized name of a modern man, the nominative singular ending *–us* should be replaced by the genitive singular ending *–i*, e.g., *fabricii, aurivillii, sartorii*.

(c) If the name is Greek, the Latinized genitive should be used; if the correct Latinized genitive cannot be found in either Greek or Latin lexicons, the genitive ending *–i* should be added to the entire name."

In our opinion, since the subspecies name *gmelini*/*gmelinii,* is based on the Latinized name *gmelini*, this indicates that the subspecies name *gmelini* should be terminating with *–ii,* i.e. *gmelinii*. Therefore, our recommendation is that the correct combination of this species should be *Ovis gmelini gmelinii* Blyth 1841.

Ovis gmelini ophion

The ICZN (2003) ratified the published 1996 Bulletin of Zoological Nomenclature opinion that the Asian mouflon shall be called *O. orientalis* and the European/Mediterranean mouflons were relegated with the domestic sheep, *O. aries*. According to Jiang et al. (2015) the Sardinian (European) mouflon posses the same β globin gene cluster arrangement (haplotype A) found in goats, whereas that of Cypriot mouflon, appears to be of the haplotype B as it is for most, allele frequency being 71% of sheep. This is an indication that the Cyprus mouflon has a separate evolutionary history from the European mouflon, which is actually related to domestic sheep of haplotype A. Sanna et al. (2015) recently reported the first complete sequence of a Cypriot mouflon mtDNA and performed phylogenetic analyses using a large dataset of whole *Ovis* mitogenomes, as well as D-loop analysis comprising samples from the main Mediterranean islands. Based on the work of Sanna et al. (2015), since the Cyprian mouflon mitogenome sequence was not included within anyone of the domestic sheep haplogroup (HPG) cluster discrebed so far, we can argue that the *O. g. ophion*:

- is not a feral form of the domestic sheep but rather a real wild sheep, related but different from *O. aries*;
- it should be considered as one of the most probable ancestors of the domestic sheep species belonging to HPGs C and E.

In addition, the Cyprian mouflons were found closely related to the Anatolian individuals (Fig. 2) carrying the haplotype X (Demirci et al. 2013) at the D-loop region, something which confirms Hadjisterkotis (1993, 1996) and Hoefs and Hadjisterkotis (1998) observations, based on the phenotype of the Cyprus mouflon and the Armenian mouflon, that the Cyprian wild sheep is a subspecies of *Ovis gmelini*. The mouflon of Cyprus are characterized by perverted supracervical horn growth (Fig. 3) (Hoefs and Hadjisterkotis, 1998). Such types of horns are rare in wild sheep, being diagnostic only for two subspecies of mouflon (Cyprian and Armenian), with occasional specimens also reported for the European mouflon and the "Red sheep" of the Elbrus Mountains of northern Iran. These "Red sheep" are assumed to be hybrids between the Armenian mouflon and the Transcaspian urials (*Ovis orientalis arkal*). Therefore, we concluded that the Cyprus mouflon, should not be included with *O. aries*, but should be kept as a separate and distinct genetic conservation unit *O. gmelini ophion*.

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Fig. 1. Approximate Distribution and Interaction of *Ovis gmelini* (red) *O*. *vignei* (green) and Hybrids (blue) in Iran, based on a map by R. Valdez (from CIC Caprinae Atlas of the World, Damm & Franco, 2014)

Fig. 2. Konya Mouflon *O*. *gmelini anatolica* during the rut - flehming ram. Photo Credit: © DKMP Turkey, Akyut Ince from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

Fig. 3. Cyprian mouflon with the characteristic perverted supracervical horn growth. Photo Credit: ©E. Hadjisterkotis

IBERIAN WILD GOAT EXPANSION IN A SEMIARID ENVIRONMENT

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Iberian wild goat (Fig. 1) has experienced an important distribution increase throughout its entire range, mainly due to natural expansion. Between 2006 and 2015 we monitored this process in one of the largest populations of the species, the Iberian System and its neighbouring areas (Saragossa and Huesca provinces, Spain). Starting with a questionnaire and a pilot sample to rangers (2006) we determined the existence of a population in the area since the end of the eighties of last century. Four (2007-2011) and 3 annual (2013-2015) samplings were undertaken in the study area using itineraries (~24) by car or walking, using binoculars and spotting scopes The species occupies today 17 different areas and it is still expanding in a favourable habitat. In 2015 the minimum population size was 874 goats, with a normal population structure and parameters, and an annual rate of increase of 16.6% (2007-2015). Relief generated by river erosion produced non-continuous cliffs that act as stepping stones which represent natural migratory roots. Goats have crossed one important river in at least two points establishing new subpopulations. Agricultural damages are scarce but determine population control since 2008. Hunting started in 2010 in subpopulations over 40 individuals, with hunting quotas below 10%. Poaching is present and not quantifiable. Necropsies (12) indicate trauma as the main reason of death in a habitat with a high road network.

Fig. 1. Iberian wild goats *Capra pyrenaica* Photo Credit: Alberto Portero.

CURRENT STATUS, POPULATION DYNAMICS AND CAUSES OF MORTALITY IN CYPRUS MOUFLON

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The mouflon of Cyprus *Ovis orientalis ophion* or Agrino, is an endemic subspecies of wild sheep restricted to the island, with a strict protection status given through its inclusion in the European Union Habitats Directive 92/43/EEC (Annexes II and IV) but also through the national legislation. An updated Species Management Plan has been in place since 2011, as a part of an integrated Management Plan for the Pafos Forest.
Mouflon has expanded their range from their Pafos forest stronghold eastwards to areas of Troodos National Forest during the last decade. Also small groups are found in areas not controlled by the Cyprus Government. Its current geographical coverage of the island exceeds 700 km^2. Herd social structure is similar to other wild sheep species where same-gender groups are separated all year except from the rut.
Mouflon exhibit smaller group size (mean group size = 2.9 individuals) compared to other species inhabiting more open habitats.
Fall counts are carried out each fall since 1997 to have an estimate of mouflon numbers and distribution. Latest surveys indicate a relatively stable mouflon population of 2574 $\pm$ 599 individuals based on analysis by program DISTANCE.
Lambing surveys are conducted each spring to estimate lamb: 100 ewe ratios. The ratio of rams: ewes: yearling: lamb for fall counts was 96:100:35:13 for 2014 and 90:100:52:29 for 2015.
Mortality causes for the years 2011-2015 (99 total specimens) from animals found and taken to the Veterinary Services for autopsy, indicated disease-related mortality of 30%, predation by feral dogs and foxes 25%, poaching accounted for 16% of total mortality, collisions with vehicles 13%, with the rest being accidents, snake-bites and unknown. Mortality causes from 31 mouflon radio-tagged in years 2002-2007, indicated relatively higher levels of predation-related mortality (32%) and poaching-related (19%).
The increase of livestock both in numbers and in areas, foraging within mouflon range along with the increased presence of feral dogs, poaching, as well as habitat degradation due to incompatible development projects in mouflon's prime range are the biggest threats the species is facing.

DISTRIBUTION AND POPULATION OF ASIATIC IBEX IN AN AREA OF THE CENTRAL KARAKORAN NATIONAL PARK, PAKISTAN

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Studies of Asiatic ibex *Capra ibex sibirica* were conducted in Hushey valley (*ca*. 832 km^2), the south-eastern part of CKNP, Pakistan during spring and winter of 2011-2013. Ibex were observed at elevations of 3342-4973 m, and their average density was 1.2 animals km^{-2} and biomass 84 kg km^{-2}. Minimum count, based on winter observations, was 368 animals (±146) of which 29% were adult males, 28% adult females, 15% yearlings, 23% kids while 5% could not be aged or sexed. In spring (pre-parturition) male to female sex ratio was 1:1.14 with 31 yearlings and 46 kids to per 100 females while in winter it was 1:0.9 with 54 yearlings and 80 kids per 100 females. Adult sex ratio in the population was almost at unity. Groups (typical size=18, mean size=13, range 1-40 in winter and 1-49 in spring) were mostly comprised of mixed herds (90%) while female-young, female and male groups were rarely encountered. The mean group size and group type did not vary significantly across different seasons and habitat types. Large males were relatively more frequent in snow-covered areas, while kids and female-young groups in grassland. Despite a decade-long community-based conservation programme and having a good reproductive potential, the limited growth of Asiatic ibex population may be due to various factors such as severe winters, predation pressure and dietary competition with domestic stock, which need to be explored and dealt with appropriate conservation measures.

POPULATION STRUCTURE OF BLUE SHEEP (*PSEUDOIS NAYAUR*) IN SHIMSHAL VALLEY, GILGIT-BALTISTAN PAKISTAN

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Blue sheep *Pseudois nayaur* (Fig. 1) is found on the Tibetan Plateau and on the bordering massifs throughout Central Asia. In Pakistan it is endangered and its distribution range is restricted to higher altitude areas of Gilgit-Baltistan including Khunjerab and Shimshal. Blue sheep is an important trophy animal in Gilgit Baltistan, and in order to maintain its trophy hunting program a harvestable population size needs to be estimated using a reliable method.

Little is known about the current distribution range and population status of blue sheep in Pakistan. The present study was conducted from the 25th of September 2014 to the 23rd of October 2014, to estimate the population size of blue sheep in Shimshal and Socterabad Community Controlled Hunting Areas. The independent double observer method based on capture-mark-recapture techniques (CMR) was tested for the first time in Pakistan to estimate the population of blue sheep. A population size of 834 ±356 individuals was estimated in Shimshal and Socterabad CCHAs, with an estimated density of 0.6 sheep/km^2. The highest density of blue sheep was recorded in Shimshal (1.06 sheep/km^2) followed by Socterabad (0.2 sheep/km^2). A total of 17 herds with mean size of 44.5 animals/herd (SE ±10.8) were sighted. The largest herd, consisting of 150 individuals, was recorded from Maidoor in Shimshal CCHA. The present study showed a female-biased sex ratio. The sex ratio was 80 male/100 females, while the weaning success was 50 young/ 100 females suggest satisfactory number of males and recruitment of young's.

The trophy hunting is based on the possibility to maintain sustainable use of the resource, and it may generate substantial economic revenues for poor mountain communities; limited harvesting allows the conservation of the entire population of trophy animals and of the associated ecosystem. The present study successfully tested CMR method, and produced reliable and accurate estimate of the population, which could help in determining sustainable trophy quota.

Fig. 1. Blue sheep (*Pseudois nayaur*) in Shimshal valley, Gilgit-Baltistan Pakistan.

ARABIAN TAHR (*ARABITRAGUS JAYAKARI,* THOMAS, 1894) DIET IN NATURAL HABITAT

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Distribution of Arabian tahr in the territory of Arabian Peninsula is restricted by the Hajar Mountains in Oman and the UAE. Presently, tahrs inhabit Jebel Hafeet mountains and possibly live in the territory of Wadi Wurrayah NP in the UAE. To determine feeding habit preferences of tahr in native habitat, field studies were executed. The research was performed within the period of 5 years from spring 2007 until spring 2012 in the Jebel Hafeet massif. Only plants, near which we could detect fresh evidences of Arabian tahr presence were taken into account – tracks, pellets (pellet groups), digs, and urinary points. In the majority of cases direct observations of grazing animals were performed and consumed plants were registered visually. All plants consumed were photographed for identification by botanists. For the same purpose, samples of some cnsumed plants were collected for identification in the laboratory. More than 200 species of plants grow within the limits of Jebel Hafeet. We found that tahr feeds on about 54 plant species from 25 families. The plants were divided in 4 groups: trees and bushes, low shrubs, herbs, ephemers. The diet of tahr consists of low shrubs (45.3%), trees and bushes (20.8%), herbs (20.8%) amd ephemerous plants (13.1%). Such overbalance in nutrition in favor of low shrubs can be explained by their rich species composition, wide distribution and big quantity, as well as by their availability throughout the year. Ephemerous plants appear only during the spring period and after heavy rainfalls, which occurs not every year, which explains their small percentage. The tahr prefers trees and bushes such as *Acacia tortilis, Acacia ehrenbergiana, Ziziphus spina-cristi, Lycium shawii, Periploca aphylla*. In addition, it feeds on low shrubs such as *Aerva javanica, Convolvulus sp., Fagonia sp., Helianthemum kahiricum, Pulicaria edmonsonii*. The most preferred herbs are: *Pennisetumdivisum, Sporobusspicatus, Cenchrusciliaris, Panicumantidotale, Stipagrostisplumosa*. We didn't detect strict seasonality in nutrition. However, during the summer months, which can be characterized by deficit of moisture, the tahr consumes lush leaves of trees, buds fruit of *Capparis cartilaginea* as well as *Cymbopogon commutatus*. This herb contains a large amount of ethereal oils in its fresh form, and it is inedible. The tahr eats dry small shrubs of this herb, which are not vegetans, early in the morning, when the moisture from air is soaked by this plant like by sponge. Tahrs prefergrazing in the morning and evening hours, when the air is cool and not so dry. The tahr can be seen grazing during twilight more often, especially within hot months.

Our research was taken as the basis for revision of the mode and quantity of Arabian tahr nutrition when it is kept in simulated conditions. Branches of trees were introduced into the fodder of these animals. A special nursery garden was created, where we planted trees and bushes, followed by planting them in the confined areas where these animals were kept. It brought artificial feeding nearer to the natural needs of tahrs, and increased selectivity of feeding. Such measures improved physical fitness of these animals and decreased mortality.

On the basis of these researches, a nursery garden is being built at the present moment in the Wadi Wurrayah national park.

REPRODUCTIVE STRATEGY OF ARABIAN TAHR

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Arabian tahr (*Arabitragus jayakari*) is an endemic mountain ungulate in Oman and the UAE. The main objective of our research was to study separate elements of its reproductive strategy, which have an adaptive character, and to find out possibilities for the preservation and reintroduction of the Arabian tahr. The data were colelcted between 2005 and 2012 in the mountainous terrain and in the special nurseries in the UAE and partially in Oman.

As a rule, Arabian tahrs never form family groups, which are typical for the majority of hoofed mountain mammals. The major part of a year, Arabian tahrs are active during the early morning and late afternoon hours, because of the high day-time temperatures, which force these animals to hide in the caves, niches and cliffs. Extreme poverty of pastures and mosaic structure of vegetation cover impact to a large extend on distribution of tahrs in the territory. This primarily affects tahr reproduction strategyies. The biggest and the most aggressive males occupy the most productive areas, mark them and guard them actively from the end of August to the beginning of September. Females are dispersed throughout the territory and only individually visit the marked plot of male for coupling. The active phase of the main rut lasts from the middle of September and till the end of November. Afterwards, the males become leave the rut territories and start searching and pursuing females who did not participate in the rut, including females which were born in the current year. According to our data, full formation of the tahr body finishes at the age of 3 years old, and females became reproductive at the age of 1.5 years. The permanently high hormone level of males promotes their readiness for coupling all-yearround. The majority of females (74.8%) are ready for coupling during the main period of the rut, however, as demonstrated in practice, birth of youngsters is possible any time of the year. Pregnancy of Arabian tahr females lasts from 157 to 180 days (on an average – 168 days) There are two peaks birthing periods – spring (March – May) and autumn-winter (October – December), adapted to seasons with the most favorable habitat conditions .

The sex-age structure of the tahr group in the territory of Jebel Hafeet consists of males – 41% (74 observations) females – 35% (63) and youngsters – 24% (42) with a gender ratio of 1:0.85, i.e. ♂ - 54%, ♀ - 46%. Female have 0.67 kid, demonstrating a high survival ability of youngsters and a correspondingly high breeding potential.

On the basis of data analysis about birth of 281 Arabian tahrs in the Jebel Hafeet nursery between 2003 and 2012, the relation of new born males 151 (53.7%) to females 130 (46.3%) amounted to 1:0.87. The biggest probability of female birth for parents of both sexes is observed in the following ages – before taking up the hierarchical status fights and from confirmation of their specific hierarchical status until the end of life. In the age interval between 2-3 and 5-6 years (females), as well as between 3-5 years old for males, the biggest probability of male birth is observed. The sex of future kid is basically affected by the hormonal background and genetically conditioned disposition of its parents.

So, the reproductive strategy of the Arabian tahr, fully developed during development, provides survival of this species in the extreme climatic conditions, due to high capacity for survival of youngsters, the possibilities to adjust birth periods of youngsters for favorable conditions of habitat and preservation of genes of the most adjusted animal units in the populations.

GENETIC DIVERSITY OF TIBETAN ARGALI (*OVIS AMON HODGSONI*) POPULATION OF LADAKH, INDIA AND ITS RELATIONSHIP BETWEEN OTHER POPULATIONS AND CONSERVATION IMPLICATIONS

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The argali or the mountain sheep (*Ovis ammon*) is a wild sheep that roams the highlands of Central Asia (Himalaya, Tibet, Altay).This is the largest species of wild sheep around the world. Studies so far undertaken have reported presence of nine subspecies *viz.* Altai argali (*O. a. ammo)*, Karaganda argali (*O. a. collium)*, Gobi argali (*O. a. Darwini)*, Tibetan argali (*O. a. hodgsonii),* North China argali (*O. a. jubata),* Tian Shan argali (*O. a. karelini),* Kara Tau argali (*O. a. nigrimontana)*, Marco Polo argali (*O. a. poli),* and Severtzov argali (*O. a. severtzovi).* In India, the Tibetan argali (*O. a. hodgsoni*) is a threaten subspecies of Argali. India does not have large resident of, however small herds are reported to migrate to Ladakh in the summer and back to the high plains of Tibetan Autonomous Region (TAR) in winter. The habitat of the Tibetan argali in India is the north-eastern part of Ladakh (n=300–360 individuals) and North Sikkim (n=127 Individuals), at altitudes between 3700 and 5500 m above sea level. Over the years, the population of the Tibetan argali has declined alarmingly, primarily due to overhunting and poaching, competition from introduction of domestic sheep and Habitat loss, and Disease transmission from domestic sheep. So far no genetic data on this subspecies have been reported, although there are a few studies on the Chinese and Mongolian residence population. We describe for the first time the genetic variation in the Indian population of the Tibetan argali. We selected the hypervariable 450 bp control region and 400 bp cytocrome b mitochondrial genes, amplified in 25 Tibetan argali samples that were collected from in eastern Ladakh, India. We also retrieved control region sequences of other Argali subspecies (n=35) available in the public domain from NCBI. In 25 sequences, we found 5 haplotypes within Indian argali populations, the nucleotide (π) and haplotype diversity (h) were 0.012 and 0.067, respectively. The present study revealed the presence of sub-clade of the Indian population along with the haplotypes reported other population. Observed presence of low nucleotide and haplotype diversity in eastern Ladakh population, we therefore, suggest that genetic monitoring of the Argali population should be initiated covering the entire distribution range to ensure the long term survival of Tibetan argali in India.

A MOUNTAIN LIVES IN MORTAL FEAR OF ITS DEER (AND SO DO CHAMOIS!)

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In ungulates, access to high-quality food resources on the warm months, i.e. during nursing/weaning, is crucial for growth and winter survival of offspring. Pasture depletion can be expected to affect the foraging behaviour of females. In turn, cascading negative effects would affect suckling behaviour, social behaviour, offspring survival and, ultimately, population dynamics. The combination of environmental changes and interspecific competition is a determinant of pasture depletion, but information on effects on the ecology of mountain ungulates is scarce.

In an area of the Central Apennines (Abruzzo, Lazio and Molise National Park; 2010-2015), we evaluated (*a*) the potential for competition between Apennine chamois *Rupicapra pyrenaica ornata* ("vulnerable", *sensu* IUCN) and reintroduced red deer *Cervus elaphus*, and (*b*) the effects of pasture depletion on key-aspects of foraging, maternal and social behaviour of adult female chamois, and on winter survival of chamois kids. We compared aspects of foraging, social behaviour, suckling and kid survival across three sites (two of them with a "*poor*" pasture, i.e. with a reduced availability of nutritious forage and high deer density; one with a "*rich*" pasture, ungrazed by deer), through micro-histological analyses of faecal samples, vegetation/pellet group count surveys and behavioural observations. We found out that (1) there was a great space (> 75%) and diet (> 90%) overlap between deer and chamois; (2) there was a significant increase of unpalatable plant species and a decreasing trend of the nutritious, most grazed species by chamois, in respect to when deer were absent; (3) irrespective from vegetation type, there was a significantly reduced feeding intensity (*bite rate*) of adult female chamois in areas used also by deer, compared with the area without deer; (4) the size of bare soil patches, because of grazing/trampling, was positively associated with deer density and, in areas with deer, it increased throughout July–October; (5) the volume of nutritious plants (*i.e*. legumes) in the diet of female chamois was lower and decreased faster between summer and autumn, in areas with deer than in that without deer; (6) there was a lower success, frequency and duration of suckling bouts of chamois kids in areas with deer; (7) there was a greater frequency of aggression between female chamois in areas with deer; (8) there was a greater frequency and duration of vigilance behaviour, in areas with deer; (9) chamois kids showed a significantly greater winter mortality, with a lower proportion of younger individuals, in areas with deer than in that without deer.

Most likely, in the last 2-3 decades, climatic variations in combination with environmental changes in secondary meadows have triggered the spread of unpalatable plant species and the decrease of nutritious, cold-adapted, vegetation patches for chamois, in sites at a comparatively lower altitude. The effects of these changes have been accelerated and emphasised because of resource exploitation by red deer. Our results suggest that interspecific competition can amplify negative effects of environmental changes on foraging and social behaviour, as well as on winter survival of offspring, which is a major determinant of population dynamics in mountain ungulates.

THE ENTIRE mtDNA SEQUENCE OF THE CYPRUS MOUFLON (*OVIS GMELINI OPHION*): A NEW METHOD FOR THE STUDY OF MOUFLON AND DOMESTIC SHEEP EVOLUTION

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Sheep are among the first livestock to be domesticated within South-West Asia approximately 12 thousand years ago (KYA), and since then played an important role in human history [1]. Genetic studies on the karyotype [2,3] and genotype [4,5] of the extant wild sheep suggested that the current domestic sheep (*Ovis aries*) derive from the Asiatic mouflon (*O. gmelini*). The revised taxonomy of *O. gmelini* differentiates five subspecies. Among them is the Cyprian mouflon (*O. g. ophion*) (Fig. 1), a wild mountain ungulate found exclusively in the island of Cyprus. Since these subspecies were not subjected to modern selection strategies, they likely preserved a genetic background which may provide invaluable information about the origin of domestic sheep [6].

To better elucidate the evolutionary history of the Cyprian mouflon, as well as that of domestic sheep, the first complete mitogenome of a Cyprian mouflon was sequenced and compared to the homologue sequences obtained from samples representatives of the five domestic sheep haplogroups so far identified [7], along with samples of the extant wild and feral sheep. Analyses of the D-loop region were also performed. For the latter analyses mouflon samples from the Mediterranean islands of Sardinia and Corsica – described as remnants of the first wave of domestication that reverted to a feral state – were also included.

Phylogenetic analysis were performed by means of Bayesian and Maximum Likelihood inference. In order to detect possible disconnections between groups of individuals, a statistical parsimony network analysis was performed. Such analyses were combined with molecular dating – performed using multiple calibration points – to infer the evolutionary divergence time among *Ovis* species and providing an estimate of the coalescence time for the rise of extant sheep haplogroups.

Results suggested that urial (*O. vignei*) and argali (*O. ammon*) diverged from a wild ancestral group that gave rise to domestic sheep about 0.89 and 1.11 million years ago (MYA), respectively. The common ancestor of domestic sheep lived approximately 0.3 MYA, while the rise of the modern sheep haplogroups happened in the span of time between six and 32 KYA. Results indicate the possibility that the first domestication event might have occurred earlier than 10 KYA, based on fossil and archaeozoological evidence. Also, they suggest that the current sheep haplogroups represent the remnants of an ancient progenitor with high genetic variability which spread to Asia and Europe during the Neolithic human migrations rather than being the result of multiple, independent domestication events.

Additionally, a close phylogenetic relationship between the Cyprian and the Anatolian mouflon was detected, based on the presence in both mouflons of a rare haplotype (X). These results along with a genetic distance ranging from 0.005 to 0.011 between these taxa and the other sheep haplogroups supports the hypothesis that they might represent a haplogroup never before described.

The updated phylogenetic tree presented in this study depicts a more detailed classification of ovine species and may help to classify more accurately new mitogenomes within the established haplogroups so far identified. Also, the Cyprian mouflon was determined to belong to a distinct haplogroup, thus suggesting it as a distinct conservation unit.

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Fig. 1. Male Cyprian mouflon *Ovis gmelini ophion* fighting during the breeding season (Photo: © E. Hadjisterkotis).

REASSESSMENT OF THE IUCN RED LIST STATUS OF URIAL AND MOUFLON

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Urial and mouflon are treated as one single species *Ovis orientalis* in the most recent assessment of their conservation status in the IUCN Red List, which assigned the category Vulnerable (Valdez 2008). Considering these two taxa as distinct species *Ovis gmelini* and *Ovis vignei* would be more coherent with their past evolutionary divergence and the resulting morphological and genetic differences between them. The ongoing reassessment follows this approach. The new separate assessments of these two species have to review historical and recent data and refer them to either of the two species. The previous assessments considered as feral sheep the mouflons of the Mediterranean islands and the introduced populations of descendants from these. Consequently, most mouflons were not subject to the last assessment in the IUCN Red List. In contrast the EU Flora Fauna Habitat directive and CITES list the Cyprus mouflon *Ovis (orientalis) ophion*.

The assessment is challenged by taxonomic uncertainties, the existence of hybrid populations between the two species, difficulties to obtain reliable data on population, range areas, threats and conservation measures. The previous assessment provided population numbers by subspecies. The taxonomic status of several subspecies, their geographic distribution and the belonging of distinct populations to these are debated. Therefore, I consider assessing population sizes by countries and by geographically defined populations. So far the coverage and quality of available data is insufficient for reliable determination of population sizes and trends, extents of occurrence and areas of occupancy to assess the situation against the criteria for the Red List categories. Most population data are educated guesses or refer to small areas only. Data availability for distinct time periods is not sufficient to provide an indication of size and trends of global population size. Most map data are available in small scale only and generalization of range areas masks their actual fragmentation.

Here I present the current state of the ongoing assessment and the available data, conclusions on the current conservation status and the likely applicable Red List category. I call for the provision of additional data and supporting information. The IUCN Red List assessment of mouflon and urial shall become baseline information on the status of these species and guidance for the conservation of these species.

Sardenian mouflon ram. (Photo Credit: © Salvatore Naitana).

FUNCTIONAL ECOLOGY AND CONSERVATION OF MOUNTAIN UNGULATES IN ASIA'S SNOW LEOPARD LANDSCAPES

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Asia's high mountain ecosystems, in particular the mountain ranges such as the Himalaya, Karakorum, Pamir, Tien Shan, Kunlun Shan, and Altay, are home to the endangered snow leopard *Panthera uncia* (Fig. 1) and an impressive assemblage of at least 18 mountain ungulate species. We investigate their functional ecology based on nearly two decades of our team's work. The bulk of our understanding comes from Caprinae species such as the ibex *Capra sibirica* (Fig. 2), argali *Ovis ammon* (Fig. 3), and bharal *Pseudois nayaur*, which constitute significant prey of the endangered snow leopard. We characterize the role of mountain ungulates as consumers of plants and as prey of carnivores. We describe the contribution and influence of mountain ungulates to the diet, habitat use and abundance of snow leopards. The underlying direct (competition, predation) and indirect (apparent competition) interactions of mountain ungulates, livestock and snow leopards are examined. We interpret our findings in the context of conservation conflicts that are intensifying in large parts of Asia's mountains under changing global market forces, climate, and geo-politics.

Fig. 1. The endangered snow leopard *Panthera uncial*, Tost Mountains, South Gobi province, Mongolia. Photo Credit: Snow Leopard Conservation Foundation / Snow Leopard Trust

Fig. 2 Siberian ibex *Capra sibirica*, Tost Mountains, South Gobi province, Mongolia. Photo Credit: Snow Leopard Conservation Foundation / Snow Leopard Trust

Fig. 3. Argali *Ovis ammon* from Sarychat Ertash State Nature Reserve, Tian Shan Mountains, Issyk Kul province, Kyrgyzstan. Photo Credit: Udayan Rao Pawar

A QUEST FOR LIFE MUST BE HEARD: STRIVING TOWARDS *HANGUL* SURVIVAL

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Species rank is crucial in conservation decisions since the status of a species under the Red List is often seen as a key for prioritization of a species for conservation attention, funding allocation, development of conservation policies and national legislation. However, discriminating conservation status at the subspecies level becomes challenging in situations where many subspecies are often incorrectly lumped into a single species complex. The *hangul* (*Cervus elaphus hanglu*), the only hope of Asiatic survivor of red deer species in India is a true example of a subspecies experiencing ignorance of the conservation union. Despite the rigorous conservation efforts of the forest department in Jammu & Kashmir, *hangul* has experienced a severe decline in numbers and range contraction in the past few decades. The most recent census (2015) indicated *hangul* population in Dachigam is lowest ever recorded *i.e*. 110 to 130 individuals only reflecting *hangul* facing the worst time for its survival. We investigated the genetic variability and demographic history of *hangul* population and found a relatively low diversity estimates when compared to other red deer populations of the world. However, the *hangul* population did not exhibit any bottleneck signatures in the past, and Coalescent Bayesian Skyline plot analysis revealed that the population had not experienced any dramatic changes in the effective population size over the last several thousand years. In this study, we discuss the phylogenetic status of *hangul* for the first time and highlight the necessity to upgrade *Cervus elaphus hanglu* to a species level in the red deer species complex of the IUCN Red list of threatened species. This assessment would certainly help to call immediate attention to the conservation and management of this precarious subspecies of red deer at local and international level.

DISTRIBUTION AND BROAD-SCALE RESOURCE UTILIZATION PATTERNS OF MOUNTAIN UNGULATES IN BHAGIRATHI BASIN, UTTARAKHAND, INDIA

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We assessed the distribution and broad-scale resource utilization patterns of mountain ungulates in Bhagirathi basin (ranging from 500m to 5000m) of Uttarakhand, India. Camera traps were deployed at 106 sites for five months (Oct 2015 to May 2016). Scanning from vantage points (n=17, 30hrs) and trail sampling (n=15, 228km) were carried out in alpine and sub alpine habitats. A total of eight ungulates species were captured (1197 photographs) in 10,167 trap nights effort. Barking deer *Muntiacus vaginalis* (11.27 ±3.79) was the most photo-captured (#/100 trap nights) ungulate followed by sambar (*Rusa unicolor* (9.35± 2.20), wild pig *Sus scrofa* (5.35±2.27), goral *Naemorhedus goral* (3.37 ±1.35), musk deer *Muscus spp*. (1.15±0.53), Himalayan tahr *Hemitragus jemlahicus* (0.71±0.34), blue sheep *Pseudois nayaur* (0.69 S.E= 0.24) and Himalayan serow *Capricornis thar* (0.34±0.21). During trail sampling and scanning, 38 groups (399 individuals) of blue sheep and 7 groups (111 individuals) of Himalayan tahr were encountered. Encounter rate of blue sheep was 2.01±0.93/km (n=29, individuals=304, mean group size 10.48±1.98). Use and availability analysis of altitude and slope showed that barking deer (n=25) used steep slopes (30-40°) in lower and middle elevation (500 m- 2,800m).Goral (n= 20) used steep slopes and sambar (n=31) used gentle slopes (20-30°) in both lower and middle altitudes (2,000m-3,500m). Serow (n=6) captures were from gentle and steep slopes only in middle elevation areas (2300 to 2900m). Musk deer (n=10) and blue sheep (n=20) both used high altitudes (3300 to 4,000m). Blue sheep evidences were found in flat areas (10-20°), however few observations were made in very steep slopes (40-50°). Musk deer evidences were found only on steep slopes. Tahr (n=7) used very steep middle and high elevation areas (2300 to 3700). Wild pig (n=25) used gentle slopes of wide altitudinal classes (900 to 3300m). Ungulate diversity was more in temperate forests (n=7). This survey revealed presence of several threatened mountain ungulates in landscapes under high anthropogenic use. Evidence of livestock grazing, presence of stray dogs, habitat destruction and poaching was encountered which may pose threat to the survival of mountain ungulate populations.

BALKAN CHAMOIS IN GREECE: INCREASING POPULATION TREND, THREATS AND CONSERVATION PRESPECTIVES

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The Balkan Chamois national population size in Greece exhibits an overall substantial population increase (100%) during the last decade, currently reaching 1289 to 1677 individuals (24 populations). The four largest populations include 100 to 400 individuals and thirteen populations include 15 to 90 individuals. A further of seven populations are probably close to extinction (less than 15 individuals) as remnants of formerly larger populations, and finally nine populations are currently considered extinct, but with signs of recent natural recolonization in two cases. Balkan Chamois populations seem to form six metapopulations. The population block in Olympus Mt is clearly considered geographically isolated for a long period, but on the other hand a limited genetic flow possibly exists between the Northern and Central/Southern Pindus population blocks.

Although the Balkan chamois is strictly protected under Greek legislation prohibiting its hunting since 1969 and most of its range (80%) falls within a network of protected areas (Natura 2000 sites, National Parks, Wildlife Sanctuaries), poaching still remains the main threat for the species, enhanced by the mountainous road network that renders chamois habitats accessible to poachers. Global warming is considered a new threat for the species, as indicated by a comparative seasonal range analysis of the population in Giona Mt (the southernmost limit of chamois distribution) with that of Timfi Mt (N. Greece). The seasonal range pattern in Timfi Mt presents a minimum in winter and a maximum in summer, as the species aggregates into suitable warmer micro-habitats during winter to avoid harsh climatic conditions. This well-known "typical range use pattern", encountered also in Central and Western Europe, is inverse to the newly emerged "Mediterranean pattern" observed in Giona Mt. The species exhibits a strong aggregation pattern in the summer (minimum range and core area) and a more dispersed distribution in the spring (maximum range) and winter (maximum core area), indicating that in this case summer is considered the stress period of the species. Global warming is then a new threat for southern populations, as they already occupy the highest summits during summer and no more upward movement would be possible to overcome drought stress in the near future.

Although the last decade the conservation status of the species is improving due to public awareness activities and reducing poaching incidences, its overall population size is still considered very low and urgent conservation action is required to guarantee its long-term survival. Public awareness activities in areas close to chamois habitats should be supported, road accessibility in crucial chamois habitats should be banned or severely controlled, and an effective national ranger body should be established in order to eliminate poaching. Conservation oriented research is required, focusing in particular in population demography, conservation genetics and threat elimination. Furthermore additional aspects, as global warming, must be taken into consideration in future conservation actions.

THE ITALIAN MOUFLON (*OVIS MUSIMON*): SHORT HISTORY OF HIS PARASITES IN THE LAST 45 YEARS

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In the last decades, the interest in wildlife has remarkably increased amongst veterinarians, and mouflon parasites and parasitic diseases were amongst investigated topics. In Italy, mouflon is widespread in the Alps, in Central-North Apennines, and in Sardinia. Population size was estimated at 15.000 individuals in 2009. However, mouflons are currently on the decrease in the Alps due to wolf predation and high hunting pressure to anticipate competition with native Caprines (*Rupicapra rupicapra* and *Capra ibex*).

Veterinary parasitologists largely contributed to the understanding of pathogens and their ecological interactions amongst native and introduced mouflons in Italy. Their work, including "grey" literature, was collected for the first time in the 1990s, on a floppy disk. A second update appeared in the first decade of the new century. Along these lines, we revisited and collected data concerning the last 20 years, thus creating a website (http://www.parasitepub.altervista.org) which can be consulted virtually and universally.

To create our database, we searched and classified the publications retrieved from annals of academic departments, journals, conference proceedings, university libraries, and on-line data banks. Our database aims to be as up-to-date as possible and as updatable as possible. The bibliographic material was organized on the basis of host species, year, sites of interest, and research field on Parasitology. Then, contributions were classified according to the following four interpretative levels: **Level 1** – basic knowledges, pathogens' isolation, serological positivity; **Level 2** – study and description of biological cycle, prevalence, incidence, abundance, mean intensity, richness, importance index and seasonal behavior; **Level 3** – Quantitative study of the interactions between host population and parasite, frequence distribution; **Level 4** – Guidelines for control or eradication of parasites' infections in wildlife. Our search resulted in retrieval of 48 papers from 1970 to 2015, with 4 peaks of five, four, four and three papers in 1988, 1990, 1996 and 2006 respectively. The studied mouflons originated mainly from Northern Italy (57%), followed by Central Italy (28%) and Sardinia (15%). Papers referred to nine regions, mirroring current distribution of this ungulate. Among parasite groups, nematodes were the most frequently studied (in 44% of papers) followed by arthropods (15%), protozoa (12%), trematodes and cestodes (11%) and dermatophytes (7%). The analysis of ecopathological levels revealed the predominance of the first (56%) followed by the second (23%), the third (18%) and the fourth (3%). The newly created website is intended as an easy-to-use bibliographic tool to support investigation on parasites and parasitic diseases in free-ranging wildlife in Italy.

IS GENETIC STRUCTURE UNDER INFLUENCE OF SOCIAL STRUCTURE OF PAST INTRODUCTIONS IN MEDITERRANEAN MOUFLON POPULATIONS?

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Social and spatial behaviours of individuals are thought to determine the fine scale genetic structure of populations. In several wild ungulate species, gene flow is expected to be mainly mediated by dispersal and reproductive excursions by males, philopatry being much more marked in females. Here, we investigated whether socio-spatial organisation determines the genetic structure in a Mediterranean mouflon (*Ovis gmelini musimon* x *Ovis* sp.) population that grew from nineteen individuals introduced in the Caroux-Espinouse massif (Southern France) during the 1950's. We used a complementary approach combining spatial data obtained from visual resightings of marked individuals (n=670) and genetic data obtained from hair samples collected during trapping sessions between 2010 and 2014 (n=228 individuals genotyped at sixteen microsatellites loci).

Our spatial analyses revealed six socio-spatial groups of individuals in this population with no or few spatial overlap. Genetic analyses showed significant but low genetic differentiation between these spatial groups. Multivariate and Bayesian clustering analyses performed without any a priori spatial information revealed the presence of two or three genetic clusters. The socio-spatial structure revealed did not match this genetic structure, suggesting that the former was not the main driver of the latter. Instead, individuals from the north and from the south of the study area were grouped within the same genetic unit, while individuals from the central part were grouped in another one, a pattern also supported by spatial principal component and isolation by distance analyses.

The different introduction events that occurred within the study area might explain the spatial genetic structure reported here. Indeed, individuals from the same origin were released in the north and in the south of the study area, while individuals from other origins were released in the central part. Genetic signature of past introductions would thus be still detectable more than fourteen generations after introduction. Our findings also suggested that dispersal and reproductive excursion by males contribute to homogenize the genetic variability across the study area despite a strong socio-spatial structure.

PREDICTING POTENTIAL HABITATS FOR THE LAST SURVIVING POPULATION OF KASHMIR RED DEER (*CERVUS ELAPHUS HANGLU*) IN HIMALAYAN LANDSCAPE, INDIA

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The *hangul* (*Cervus elaphus hanglu*) is the only red deer species surviving in Indian subcontinent and of top conservation priority with global importance. Unfortunately, it has lost much of its historic distribution range and now is confined to Dachigam landscape only, few individuals left in the wild with absolutely no captive stock. Taking in cognizance, the Government of India has initiated a recovery plan in 2008 to expand their numbers through ex-situ conservation programmes. The aim of our study is to identify potential *hangul* habitat in Kashmir valley in order to propose release/reintroduction sites of captive bred animals at later stages. The species distribution models have been widely used in mapping geographical distribution and identifying potential habitat of species. We attempted Resource Selection Function based modeling to predict potential *hangul* habitats, using the predicting variables related to topography, landscape structure, anthropogenic disturbance and habitat type. We predicted that conifer and broadleaf mixed forest with high patch cohesion at gentle slopes located in north and north-eastern aspects was most suitable for *hangul*. Conversely areas close to roads, trails and human habitation are not suitable. Out of the total study area of 9669 km^2 about 30% was found suitable, out of which about 7.9% (772.5 km^2) was highly suitable, followed by 10.96% (1057 km^2) moderate and 11.14% (1077 Km^2) was marginally suitable. Our results demonstrated that *hangul* is an ecological specialist and it is challenging for *hangul* to negotiate anthropogenic disturbance. We predicted potential *hangul* habitats in Kashmir valley where reintroduction can take place after conservation breeding.

CONTRIBUTION OF SARDINIAN MOUFLON TO DOMESTIC SHEEP MILK PROTEINS

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In ruminants, milk protein genetic variability is well known and it has been shown to affect milk composition and technological quality (Pirisi et al. 1999). Casein genetic polymorphisms are important and well known due to their effects on quantitative traits and technological properties of milk (Ceriotti et al. 2004). Since European mouflon was found closely related to one of the five haplogroups identified within domestic sheep species (Sanna et al. 2015), the aim of this work was to assess milk protein pattern differences between sheep and Sardinian mouflon and its genetic contribution to current sheep milk proteins. Raw milk from sheep and mouflon was skimmed after centrifugation at 3500 g for 10 minutes. The skimmed milk proteins were submitted to 12% SDS Poly Acrylamide gel electrophoresis (PAGE) and 2-D PAGE using a 4-6 pH gradient IPG followed by 12% SDS-PAGE electrophoresis. Gels were stained by brilliant blu G-250 and silver stain.

Genomic DNA was extracted from 3 ml of seven mouflon blood samples by the 5Prime kit. The complete CSN1S1 gene was directly amplified by PCRs using 27 pairs of primers. We also analyzed a 520 base pair (bp) region of CSN3 gene, including the complete sequence of the exon 4 where all the polymorphisms described so far were identified by using the KF/KR primers. Sequence reactions were performed by means of the BigDye Terminator kit (v1.1, Applied Biosystem) and products were sequenced using an ABI PRISM 3130xL Genetic Analyzer. High quality profiles were aligned by the Lasergene SeqMan software with Reference Sequences in GeneBank.

Results showed a different 2D electrophoretic pattern between proteins of sheep and Sardinian mouflon. Differences in weight and isoelectric points has been evidenced in the α-s1 and α-s2 and in the β-casein clusters but not in the k-casein. To characterize coding DNA sequence (CDS) of the casein genes in Sardinian mouflons we sequenced 17 exons of the CSN1 (α-s1 casein) and CSN3 (k-casein) compared it with sheep and European mouflon homologue sequences. We identified a SNP within the CSN1 gene located in the position 137 of the exon 17 where C in sheep and European mouflon sequences was replaced by T in the 7 Sardinian mouflons. This substitution (ACT-->ATT) resulted in an aminoacid change from Threonine, a polar aminoacid, to Isoleucine, an hydrophobic apolar aminoacid. The Sardinian mouflon CSN3 gene evidenced a polymorphism in the nucleotide 78 of the exon 4 where a C was changed with T. The codon 58 changed from TAC in sheep to TAT which are both codifying for the aminoacid Tyrosine, and then do not alter the primary structure of the k-casein.

Overall, our data evidenced different electrophoretic protein patterns between Sardinian mouflon and domestic sheep milk. Some of these differences could be due to genetic differences as showed for α-s1 casein polymorphism which modify the isoelectric point of this protein. Based on these results Sardinian mouflon could have contribute to the polymorphism of sheep milk proteins in accordance with its role of possible ancestor of domestic sheep carrying the B HPG. Further studies on other milk protein genetic

sequences such as β, α-s2 casein, lactoglobulins or lactalbumins are needed to improve and confirm these outcomes.

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Sardinian juvenile mouflon (Photo Credit: Salvatore Naitana)

HABITAT FRAGMENTATION CAUSES GENETIC DIFFERENTIATION OF SARDINIAN MOUFLON

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Native European Mouflon populations *Ovis gmelini musimon* live in natural state only in Sardinia and Corsica, but in the last decades direct and indirect human activities determined habitat fragmentation and their isolation in few isolated areas.

Our aim was to investigate whether population fragmentation and isolation determine genetic structuring in Sardinian mouflon using both nuclear and mitochondrial molecular markers.

The current Sardinian mouflon populations are mainly located in the central area of the island. We collected blood samples from individuals coming from three distinct sites of this area: at the North (N; n°=22) where mouflons were reintroduced 40 years ago; in the middle (C; n=13) and at the South Est (S; n=18) where still live native free mouflon populations.

We assayed 16 microsatellite loci length and the mitochondrial D-Loop region polymorphisms to genetically characterize each group and to clarify the genetic relationships among them.

To genotype microsatellites, DNA fragments containing the polymorphisms were amplified by PCR according to standard protocols. Microsatellite products were analysed on a ABI PRISM 3100 DNA Analyser (Applied Biosystems) and data were processed by GENESCAN v3.1 and GENOTYPER v2.5 software. Standard intra-population indices, such as allele frequency, gene diversity and deviation from Hardy-Weinberg Equilibrium (HwE), were tested with the software package Arlequin 1.1 (http://lgb.unige.ch/arlequin/). Genetic differentiation (Fst) and the test of genotype assignment have been chosen as inter-population indices to assess the relationships among the three sample groups. The whole D-loop region of the mitochondrial DNA was amplified by standard PCR. PCR product was sequenced by Dye-terminator chemistry and sequencing reaction was run on ABI PRISM 3100 DNA Analyser (Applied Biosystems). Clustal X software was used for the sequence multi-alignment. Phylogenetic analyses were conducted using DnaSP, Tree Puzzle, MEGA and Network softwares.

Fourteen of the sixteen genotyped microsatellite loci are polymorphic in at least one of the three groups with a mean of four alleles/locus (7 to 9). The observed heterozigosity shows, for every marker, high variability among the three populations. Five microsatellite loci deviated from HwE in at least one mouflon group due to heterozygote deficiency. The exact test for population differentiation (Fst) revealed strong genetic differentiation among the three populations, since almost all the relative P values are significant ($P<0.05$). The high Fst values are largely due to private alleles (12 loci had private alleles). The test of Genotype Assignment affirmed the effective belonging of every individual to the population it was originated and

individuals in each population appeared clustered separately from the other two populations.

A total of 11 single-nucleotide polymorphism (SNPs) at the level of the hyper variable domain I of the mitochondrial D-loop region were detected. Based on maximum likelihood and neighbor joining tree analysis, sequences were grouped in three distinct clusters specific to each geographic area where samples were collected. The highest genetic variability was detected within the clade including all the individuals from the C population, as confirmed by the occurrence of three distinct haplotypes. In addition, two individuals from the C population were located in a central position, as inferred by the network analysis, likely representing the ancestral type who gave rise to all the current populations.

Our results evidence a clear phylo-geographic structuring among the samples analyzed and support the hypothesis that the mouflons currently living in the C area could represent the remnant of the native Sardinian population. The loss of genetic variation detected into the N and S populations could be the results of a founder effect or a population bottleneck. Furthermore, the genetic differentiation observed among the mouflons living in the three different areas could be due to the fragmentation of the original genetic pool caused by long term isolation.

This study permits the reintroduction of this species into new habitats, taking into consideration the selection of the best genotypes, to minimize founder effect and to maximize genetic diversity.

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Sardinian mouflon (Photo Credit: Salvatore Naitana)

FORAGE AND DIET QUALITY PATTERNS OF MID-ELEVATION UNGULATES IN SIKKIM HIMALAYA, INDIA

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Environmental variability, especially temperature and precipitation becomes more pronounced as we move away from the equator and sea level. The vegetation adapts to such seasonality by its phenology. These variations have major implications on the forage availability to the mountain ungulates and their dietary patterns. The endeavour of this study was to record the patterns of variation in the quality of forage available and diet of mountain ungulates viz. Himalayan musk deer (*Moschus chrysogaster*), and Himalayan goral (*Naemorhedus goral*) inhabiting a subalpine habitat in Sikkim Himalaya, India. We carried out the study in Kyongnosla Alpine Sanctuary in the East district of Sikkim between April 2013 and March 2014. We classified the entire year into four major seasons i.e. winter (January – March), spring (April – June), summer (July – September) and autumn (October – December) and the entire elevation range (3000 – 4200 m) into four zones of 300 m each (Zone I – 3000 – 3300 m; Zone II – 3300 – 3600 m; Zone III – 3600 – 3900 m; Zone IV – 3900 – 4200 m). We marked two 600 m long permanent trails within each of these zones. Following this, we laid seven 10 m × 10 m permanent plots on each of these trails which were further divided into 100 subplots of 1 m × 1 m each. Every fortnight, we sampled one randomly selected subplot to assess the quality of available forage upto species level. We used Carbon to Nitrogen ratio (C:N – inversely related to quality) as an index of quality and analyzed the plant samples for the same using CN analyzer. We used lagged correlation analysis to examine the relationships between the seasonal patterns of mean forage quality at different elevation zones. In all, we sampled more than 900 subplots and collected nearly 3000 plant samples for C:N analysis. The overall forage quality was the highest (lowest C:N ratio) in the month of June. The C:N ratio at the lower elevation zones (I & II) increased gradually across months as compared to that on higher elevation zones (III & IV) where it changed abruptly within a short duration. Patterns of C:N ratio also varied for different growth forms i.e. forbs, grasses, sedges and ferns. The lagged correlation analysis showed that the forage quality at lower elevation zones leads that at higher elevation zones by nearly a month. This can be attributed to later snowmelt at higher elevation zones. Furthermore, the diet quality of both the ungulate species peak in the month of June and clearly follows the pattern of the available forage during different seasons. Though the forage availability varies seasonally and elevationally in the area, our preliminary study shows that the inhabiting ungulates do not move elevationally and rather use different aspects.

IMPORTANCE OF SPORT HUNTING FOR PROMOTING NATURE CONSERVATION

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Given the necessary economic incentives, private and communal landowners have shown that wildlife programs can be integrated and even prioritized in multispecies management schemes that economically benefit landowners, wildlife populations, and wildlife habitats. The economic benefits of wildlife are evident in the wild sheep and goats hunting programs in Asia and North America. In many instances, land managers formerly dependent on the livestock industry which was not economically viable, especially in arid regions, now gain greater profits from wildlife than livestock. I examine whether sport hunting improves the status of wild sheep and goats and whether hunting conservation is an economic asset to local communities. I concentrate on three hunted populations, two in Asia (Marco Polo sheep in Tajikistan and Sulaiman wild goat in Pakistan) and one (desert bighorn on Carmen Island) in Mexico, where I examine the effect hunting conservation programs have had on the status of wild goat and sheep populations. Populations of Marco Polo sheep (MPS) were formerly greatly reduced but there are now 100 hunting permits issued for MPS sheep at $40,000 per permit. The number of rams harvested are a small percentage of the total available mature males. The Sulaiman wild goat was reduced to <100 but because of the economic incentives, the local tribal community now protects this population, which has grown >3000 animals. The profits from this hunting program provided for emergency drought relief, water development projects, medical and educational facilities and the employment of game guards. In Mexico, wild sheep from Baja California Sur were introduced into a private island where they now number 500. This doubled the number of Weems' desert bighorn sheep (only 500 remain in Baja California Peninsula). The status of these three ungulate populations would not have improved if sport hunting programs and their consequent conservation interventions had not been initiated. Sport hunting has been the primary economic motivation for increasing wild ungulate populations in some regions. Without hunter conservation programs, the status of the three caprine populations would have remained perilous and probably would have deteriorated. Conservation hunting is making a vital difference to improving trends in biodiversity and its sustainable use. At the socio-economic level, formerly marginalized communities have benefited.

POSTERS

STATUS OF MOUNTAIN UNGULATES IN NANDA DEVI NATIONAL PARK, INDIA: AN ASSESSMENT OF CHANGES OVER THREE DECADES

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We assessed the changes in the status of mountain ungulates in the Nanda Devi National Park (NP), Uttarakhand, India from 1993 to 2015. The Nanda Devi NP is inscribed as a natural World Heritage Site by UNESCO and has remained closed for humans use since 1983 with the exception of very limited and regulated ecotourism, and decadal monitoring exercises (1993, 2003, 2015) conducted by research institutions and the State Forest Department. To assess the changes in status and distribution of mountain ungulates, we used rapid assessments along trails (n=9), scan counts for blue sheep (*Pseudois nayaur)* from vantage points (n=6), silent drive count (n=1) for musk deer (*Moschus* spp.) and camera trapping (n=15, only in 2015). The encounter rates (number/km) of mountain ungulates based on direct and indirect evidences from different segments of the surveyed trails were compared between 1993, 2003 and 2015. The most recent (2015) encounter rate estimates for blue sheep was 8.02±3.67 individual/hr (range 0-38 individuals/hr), for musk deer, it was 1±0.53/km, and for serow (*Capricornis thar*), it was 0.5±0.24. The status of blue sheep, musk deer and serow has significantly improved in 2015 when compared to 2003 and 1993. Comparison of encounters (direct and indirect evidences) of mountain ungulates in Nanda Devi NP between 1993 and 2003 and between 2003 and 2015 shows that the status of blue sheep, musk deer and serow has considerably improved (n= 9; p= 0.018 for blue sheep and musk deer and n=9; p=0.046 for serow; Wilcoxon sign ranked test). There is a likely increase in proportion of sites used by snow leopard (*Panthera uncia*) and their principal prey, blue sheep, which may be a result of more availability of suitable disturbance-free high-altitude alpine areas. Maintaining the inviolate status of Nanda Devi NP has led to substantial improvement in the status of mountain ungulates and other wildlife and acts as a control site for future monitoring.

PUTTING A FACE ON CAPRINAE SPECIES

Ralf Bürglin, biogeographer (Dipl.), journalist, wildlife photographer

Many species of wild goats, sheep and relatives *(Caprinae)* are comparatively poorly documented. There are very few illustrated books that show the species on the basis of drawings or photos of live animals. Literally all websites dealing with the subject are incomplete and so are the photo archives. Furthermore, labelling of photos with species names are often mixed up. For these reasons it is hard for the public as well as for scientists to get at properly illustrated information on various Caprinae species. However, without proper illustrations the species remain without identity.

Why are we not able to visualise certain Caprinae species clearly?

1. There are just a few or no images of proper quality available.
2. Nomenclature of species changes and hence photo labelling of these species are mixed up.
3. We use images to describe species, which do not qualify.

1. Why are there no photos of certain species available?

   a. Photographers have no motivation to take pictures, because people are not interested since they do not know that the species exists - and/or
   b. Some of the species live in very inaccessible habitats - and/or
   c. Some of the species are extremely shy.

2. Labelling of photos

Scientific names for species do change. New species can be designated on basis of existing species (e.g.: "Naemorhedus goral" was once used for the Chinese Goral and is now the Himalayan goral). Therefore, corresponding images can be found with differing names. In parallel with the name confusion in scientific publications there is also no consistency concerning the labelling of species in zoos. In some cases outdated names are used. Visitors at zoos take pictures of animals and label them according to the information boards, put them online or give them to photo databases. As a result, the labelling of say gorals is mixed up, no matter where you look: wikipedia, zooinstitutes.com, ultimateungulate.com ...

3. We use images to describe species, which do not qualify. In most Caprinae species morphologically relevant differences to distinguish closely related taxa show up clearly only in mature males. In immature males, females and juveniles these differences are not patent. Therefore it makes no sense to use images of these individuals to depict species. But people do.

New approach

To help to visualize Caprinae species, a new website has been initiated on the basis of profound scientific knowledge:

www.wilddocu.de/category/allgemein/caprinae-world

The website will function as an online catalogue that eventually presents illustrated information about wild goats, sheep and related species. It is meant to give Caprinae species an identity and hence bring them closer to people.

Caprinae World by Ralf Bürglin

Two male Victoria Ibex (*Capra p. victoriae*) in a hierarchy contest before the onset of the rut (the older male is on the left). © Daniel Sanchez Enjuto from Damm & Franco 2014 CIC Caprinae Atlas of the World

MOLECULAR CHARACTERIZATION OF SHEEP REMAINS FROM THE MEDIEVAL SITE OF SIPONTO (APULIA, SOUTHERN ITALY): PRELIMINARY RESULTS

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The archeological site of Siponto is located on the shore of the Gulf of Manfredonia, south of the Gargano promontory (Apulia, Southern Italy). The site hosts the remains of a town abandoned around the middle of the XIIIth century as a consequence of an earthquake. Excavation campaigns were carried out from 2000 to 2009, revealing several ovine bones located in the treading floors and within a silo/pit of a peripheral urban area, belonging to the last housing phase of the ancient town (dated mid XIIIth century). Such remains significantly predate the hypothetical introduction of Spanish merino rams claimed by King Alphonse I of Napoli (mid XVth century) and may represent the ancestral gene pool of local southern Italian sheep populations before the onset of the so-called “merinization” process. With the aim of exploring such intriguing hypothesis and characterizing the molecular variation of this ancient sheep population, a DNA extraction was carried out on 33 bone and teeth remains from the site of Siponto, following stringent protocols for ancient samples within the dedicated lab facility of the BioDNA Research Centre. For ten samples, 311 base pairs of the mitochondrial control region were characterized through: PCR amplification, cloning and direct sequencing. Further, the four best-performing DNA samples were used for the construction of genomic libraries and subsequent high-throughput sequencing. The analysis of mtDNA data highlighted the presence of eight different haplotypes all belonging to haplogroup B, the most frequent in Europe. Ancient DNA-specific bioinformatics pipelines were applied to analyze the resulting high-throughput sequencing data, allowing to retrieve ~0.3% of endogenous sheep DNA. A preliminary variant calling investigation identified 1,787 variants, nine of which are predicted to have a major impact on protein structure and functioning.

FOX PREDATION ON CYPRIAN MOUFLON AND MARINE TURTLES ON CYPRUS

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Mouflon. The only wild predator on the island of Cyprus is the red fox (*Vulpes vulpes*) (Fig. 1 and 2). The predatory effect of red fox on Cyprus mouflon, particularly at lambing sites when the lambs were small and vulnerable to predation, were studied by Hadjisterkotis (1993, 1996). In 140 days of observations at two lambing grounds (areas with sharp cliffs) red fox made five attempts to capture lambs. All attempts failed because the ewes protected their lambs by moving them to steeper parts of the cliffs, and defending the lambs by standing between the lambs and the fox, defending the lamb. Four other cases were reported by foresters who observed foxes entering lambing grounds but in all cases the foxes failed to capture lambs. There are no direct observations of foxes killing adult mouflon, although there are observations of foxes following mouflon from safe distance, as well as a report of a ram fatally injuring a fox. Foxes are the major scavenger of dead mouflon. More direct killings were reported by stray dogs than foxes (Hadjisterkotis and Bider 1992; Toumazos and Hadjisterkotis 1997; Hadjisterkotis 2002). A mouflon carcass can provide a fox with food for several days. Hadjisterkotis also reported two cases where foxes were observed killing juvenile mouflon away from cliffs. **Turtles**. Observations by C.G. on marine turtles during the nesting season at Lara Beach in Pafos district, revealed that a considerable number of nests were depredated by foxes. During the night, foxes were able to dig underneath the wire baskets which were placed over the nest by the Department of Fisheries and Marine Research or volunteers to protect the nest from predators, and to dig out the eggs. We recommend a new design of basket which can be inserted partly in the sand, to prevent foxes from digging under the baskets.

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Fig. 1. Red fox, the largest predator on Cyprus (photo: G. Constantinou).

Fig. 2. Red fox, Pafos Forest (photo: G. Constantinou).

CURRENT DISTRIBUTION OF MOUFLON IN SARDINIA: A SUM-UP

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The origin of mouflon *Ovis gmelini musimon* (Pallas 1811) in Sardinia dates back to 8000-6000 B.C., Neolithic age, when ancient breeders, coming from the East, brought its ancestors: only partially domesticated sheep that returned to wildness.
Until the beginning of 20th century the species was common in the island, but, because of hunting, loss of habitat, fires and competition with domestic sheep, it faced a strong decline: during the Seventies only 300 individuals were estimated. Thanks to the new protection measures and a new awareness, in addition to the institution of specific natural reserves, from the Eighties numbers increased and in 1983-1985 around 1100-1600 individuals were estimated. Nowadays, Sardinian mouflon is considered "vulnerable" by IUCN Red List and it is protected under national (n.l. 257/92) and European legislations (Bern Convention and EEC directive 43/92) and strictly protected under regional law (n. 23/98).
In Sardinia, there are currently close to 6000 mouflons, most of them living in the central-eastern part of the island in Ogliastra region, on Gennargentu mountains and Supramonte massif (these are the largest concentrations) and on Monte Albo, and in the central-western part, on Montiferru. Other groups are present in other smaller areas under the control and management of the Sardinian Forestry Agency. Mouflons have also been reintroduced on Asinara Island, currently a national Park, and in Capo Figari in the north-east. Some groups are also present in the south of Sardinia (Sarrabus-Gerrei region) and in the province of Cagliari (Burcei, Villacidro mountains), mainly in enclosures managed by the Forestry Agency. Another important project of reintroduction of mouflon, run by the Forestry Agency and Olbia-Tempio province, concerns Monte Limbara, in the north-east part of Sardinia. After almost 60 years of absence, 12 individuals were released during May 2016. They originated from a breeding enclosure built in 1975 by the municipality of Tempio.. The first individuals, 5 females and 3 males, arrived in the centre during December 2008. Today the centre hosts 53 mouflons.
Although Sardinian mouflons do not face extinction problems any more, and the factors negatively affecting their population dynamics have been substantially controlled, some critical elements for their conservation on the island still remain. In fact, mouflon colonies occupy only a part of suitable territories in fragmented habitat. Moreover, mouflons are still threatened by illegal hunting, competition with domestic sheep and attacks by stray dogs. Together with Sardinian red deer, another flagship species in the island, mouflons are still in need of constant conservation and management measures.

SEXUAL DIMORPHISM IN HIMALAYAN TAHR

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In Himalayan tahr *Hemitragus jemlahicus*, adult males are 110-120% larger than adult females (Forsyth *et al*. 2005; Garel *et al*. 2011). They have a prominent neck ruff, ranging in colour from golden to dark brown, as a rank signal. Colour patterns have been suggested to be homologous to ritualised weapons: paler ruffed younger adults dominate over darker, older ones. Conversely, horn size and body mass do not seem so important in male tahr competition with respect to other *Caprinae*. Here we report on differences in horn size and body mass of male and female tahr, in relation to age, in the Mt. Everest Nat. Park (Nepal).

Horn length and horn girth were greater in males than in females (39%, 31%, respectively). We used the "horn length/horn girth" ratio as an approximate index of horn shape. Tahr showed no sexual dimorphism as to horn shape. Yet, body mass dimorphism is at least *c*. 3 times greater than that concerning horn size. Horn length, horn shape and body mass showed a non-linear trend over age, both in males and females, whereas horn girth varied little through age. Yet, while variation of horn shape and horn length showed the same trend in males and females, body mass grew significantly faster in males than in females.

Our results suggest that Himalayan tahr is mildly dimorphic as to horn size, but monomorphic-horned as to horn shape (i.e. "horn length/horn girth" ratio). In the Himalayan tahr, intrasexual male competition does not appear to have changed weapon shape, as in most other *Caprinae*, but ruff colours are apparently used to signal rank and dominance. Moreover, the different rate at which body mass grows between sexes may suggest it to be more important in male tahr competition than to females. The unritualised fight manner of male tahr may explain the relevance of body mass: a heavy weight may be harder to push over a ledge and it may also help to lift up an opponent.

PASTURE DEPLETION AND SOCIAL STRESS IN APENNINE CHAMOIS

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Vegetation changes have been recently documented on the upper meadows of the central Apennines, with a local reduction of pasture quality for wild herbivores. This reduction has led to depletion of food availability, resulting in kid winter mortality, for the vulnerable Apennine chamois *Rupicapra pyrenaica ornata* (Fig. 1) in the core of its distribution (Abruzzo, Lazio and Molise Nat. Park; ALMNP). The negative effects of temperature rising on the cold-adapted vegetation grazed by chamois, as well as the interspecific competition with red deer *Cervus elaphus*, have been suggested as factors underlying pasture depletion.
We examined behavioural and hormonal stress indicators of female chamois in sites with different resource availability, to test whether pasture quality may have an effect on social stress. We also assessed ambient temperature at which each site was exposed, to test whether pasture quality may be related to temperature.
Sites with poorer resources were exposed to significantly greater temperatures. Aggressive and vigilance behaviour of female chamois increased significantly in sites with a lower pasture quality. Levels of cortisol raised accordingly.
Intraspecific competition between chamois, in turn social stress, increased where resources were scarce and/or less nutritious.

Fig. 1. Apennine chamois kid (Photo: © F. Ferretti).

IMPACT OF MIGRATORY LIVESTOCK GRAZING ON RANGELAND VEGETATION AND WILD-UNGULATE IN THE INDIAN TRANS-HIMALAYA

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Impact of livestock grazing on rangelands and wild-ungulate populations is a long-standing conservation concern globally. Livestock grazing can lower forage availability and reduce density of wild-ungulates in low-productivity rangelands. Livestock grazing is widespread in the Indian Trans-Himalaya and often resident and migratory livestock (sheep-goat) compete with native wild-ungulates (Fig. 1). While impacts of resident livestock grazing on rangeland and wild-ungulates have been documented, effects of migratory livestock grazing is poorly understood and remain socio-politically contentious. We examined the ecological impacts of migratory livestock grazing on rangeland vegetation and Asiatic ibex (*Capra sibirica*) (Fig. 2) in Pin Valley National Park, Himachal Pradesh, India.

Within Pin Valley, we selected two areas, one with a history of migratory grazing and another with no history of grazing. We estimated livestock (sheep – goat) density in grazed area (63 livestock km^{-2}) using resource maps. Sampling for vegetation and ibex was carried out before the arrival of migratory herders (before grazing), during their presence (during grazing) and after their departure (after grazing). Across grazed – ungrazed areas, and the three time periods, percent vegetation cover and biomass were estimated from 1,001 and 496 randomly laid 1m X 1m plots, respectively. Population density of ibex was estimated through repeated double-observer surveys accounting for imperfect detection across before-during-after grazing and grazed-ungrazed areas.

Mean graminoid biomass for 'during grazing' in ungrazed and grazed areas were 62.84 gm m^{-2} (± SE 5.14 gm m^{-2}) and 11.96 gm m^{-2} (± SE 1.49 gm m^{-2}), respectively. Analysis of variance showed 'treatment' and 'time-period' had statistically significant effect on graminoid biomass ($F_{Treatment} = 16.05$, $P < 0.001$; $F_{Time} = 7.20$, $P < 0.001$) and herb biomass ($F_{Treatment} = 22.75$, $P < 0.001$; $F_{Time} = 43.25$, $P < 0.001$). 'Before grazing' ibex density in ungrazed and grazed areas were 0.22 ibex km^{-2} (95% CI 0.17 – 0.28 km^{-2}) and 0.05 ibex km^{-2} (95% CI 0.03 – 0.08 km^{-2}), respectively; 'during grazing' were 0.07 ibex km^{-2} (95% CI 0.06 – 0.10 km^{-2}) and 0.01 ibex km^{-2}, respectively; while 'after grazing' were 0.15 ibex km^{-2} (95% CI 0.09 – 0.20 km^{-2}) and 0.08 ibex km^{-2} (95% CI 0.05 – 0.11 km^{-2}), respectively.

Our results show significant reduction in graminoid and herb availability in response to migratory livestock grazing. Ibex population was very scattered and density consistently much lower in grazed than ungrazed area. Ibex is a primary wild-prey of snow leopard, the top-predator and 'flagship' for wildlife conservation of the Indian Himalaya. Abundance of snow leopard depends on density of wild-ungulates such as ibex. This study suggests prevalence of exploitative competition between migratory livestock and ibex.

Fig. 1. Trans-Himalayan rangelands face intense grazing pressure.

Fig. 2. Asiatic ibex (*Capra sibirica*) faces competition from migratory livestock in Indian Trans-Himalaya**.**

INNOVATIVE INQUIRY-BASED EDUCATIONAL INTERVENTION ON THE CYPRUS MOUFLON: NATIONAL RESULTS ON CONCEPTUAL UNDERSTANDINGS AND ENVIRONMENTAL ATTITUDE

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Trophic relationships, and the related concepts of a food-chain and a food-web, are among the most important topics in the field of ecology and consequently important for students to learn. The present study investigated the impact of an innovative inquiry-based educational intervention on the Cyprus Mouflon (*Ovis gmelini ophion*) targeting seventh grade students' ecological understandings of trophic relationships and environmental attitudes regarding the preservation and utilization of nature. Participants were 7098 seventh grade students from 74 middle schools, representing almost the entire student population on the island of Cyprus in this grade. The educational intervention lasted eight 45-minute instructional periods. Students were challenged to solve an authentic local environmental problem related to the conflict among the inhabitants of a village near a forest ecosystem resulting from the agricultural damages created by the endemic mouflon. The students' mission was to help an ecologist explain to the inhabitants the effects of removing the mouflon from the forest ecosystem while suggesting alternative measures. For the purpose of this study, we used the 2-MEV Scale to measure students' environmental attitudes. For purposes of validity, a Confirmatory Factor Analysis verified the structure of the 2-MEV before the data analysis. In addition, an Ecological Test, specifically designed for this learning intervention, was used to measure students' ecological understandings. Both instruments were applied before and after the educational intervention. A pair-samples t-test analysis revealed a statistically significant increase in students' understandings of ecological concepts, with almost 60% gain. Similarly, there was a significant change in students' environmental attitudes, for both factors of Preservation and Utilization as well as all five sub-factors (Intent of Support, Care with Resources, Enjoyment of Nature, Altering Nature and Human Dominance). While students' attitudes appear to be pro-environmental before the intervention, those became even more pro-environmental after the intervention. Effect sizes were small, however, considering that attitudes are hard to change, this was a successful intervention. The results reflect the impact of recent educational changes in biology, based on the philosophy and content of the new national curriculum, and can be used as a point of reference for future comparisons. In addition, the success of the specific instructional intervention can be used as a model for other similar studies.

THE EFFECT OF MOUFLON ON CYPRIOT ART THROUGH THE AGES AND THE CONSEQUENCE OF THE RECENT FINANCIAL CRISIS ON ART AND CULTURE

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Fig. 1. Cypriot-Archaic bronze bowl decorated with an embossed and engraved figured composition portraying hunting a herd of gazelles, a stag and mouflon (Nicosia Museum).

The oldest artistic finding with mouflon (*Ovis gmelini ophion*) is a decorated bronze bowl from Armou village in the Paphos district, found in a tomb on the northeastern outskirts of the village, dated from the Cypriot-Archaic I-II period (Fig. 1). It is now in the Cyprus Museum Inv. No. 1980/XII-18-2. The inside of this bowl is decorated with an embossed and engraved figured composition around a multi petalled rosette at the bottom of the bowl.

The figure is depicted in broad zone and consists of an archer to the right, hunting a herd of gazelles, a stag and mouflon. During the Hellenistic period (2000-50 BC) as well as the Roman Period (50BC – 330 A.D.) an impressive mosaic from the house of Dionyssos in Paphos, (second half of the 3rd cent. A.D.), depicts a hunting scene with a dog chasing a mouflon (Fig. 2). During the middle ages and the Ottomans occupation, there are no such art depictions. In modern times, the Cyprus mouflon became the national emblem of Cyprus. It became the emblem of the national air carrier, Cyprus airways. It was the logo of the 3rd Games of the Small States of Europe (GSSE), which were held in Cyprus in 1989. Numerous sponsored products were produced to support and commemorate the Games, such as Coca Cola, Keo Beer, etc. The Cyprian mouflon appeared three times on Cypriot stamps. The most important, perhaps, were a four stamps of a commemorative issue in 1998. During this issue, 4.000.000 stamps of 25 Cents, i.e. 1.000.000 sets (quartblocks), were published. The text on the commemorative cards of this issue was prepared in cooperation with Dr E. Hadjisterkotis and the Forestry Department of Cyprus. Something which brought the Cyprus mouflon in the hands of every Cypriot was the issue of the 100 mills coin in 1963 by the Central Bank of Cyprus, depicting a galloping male mouflon. The last issue of this coin was in 1982. In 1986 a one pound coin was issued for the World Wildlife Fund, depicting a male and a female mouflon standing in their natural habitat. The Central Bank also issued a CY£10 (series 1997) depicting a composition of endemic birds, a green turtle (*Chelonia mydas*), an endemic butterfly, the Cyprus mouflon, the Cyprus tulip (*Tulipa cypria*) and an endemic cyclamen (*Cyclamen cyprium*). Euro banknotes and coins were put into circulation on 1 January 2002. Three euro coins were issued: 1, 2, and 5 cents, depicting mouflon on one side. During the last 50 years the

figure of a mouflon and its name in Greek – Agrino– appeared on numerous products, such as two brands of matches, various post cards, on ice cream, on cheese, on the emblem of the Game and Fauna Service, on bookshops (The mouflon Bookshop), on six series of lottery tickets of the Republic of Cyprus, as the emblems of festivals organized by the Cyprus Broadcasting Corporation (The Golden Agrino Festival 1989), and on paintings by Cypriot artists (Antonios Kallas). The Cypriot mouflon became particularly popular in silver and bronze art, engraved on silver and bronze/copper plates and other items. Thousands of silver decorative plates of all shapes and sizes, as well as copper and bronze, were used as wedding gifts and other types of gifts and commemorative items for tourists. However, the recent financial crisis impacted a number of northern European countries of the North, as well as Cyprus after closing down Laiki Popular Banks, and the confiscation of people's savings, which bankrupted thousand of Cypriots. Many people in order to survive began selling their valuables in silver and gold for a fraction of their original price. Many of these items were old valuable antiques, irreplaceable pieces of silver art (Fig. 3), that vanished forever in the crucibles of the goldsmiths workshops, turning them into blocks of silver for export. This was a blow to public wealth and on Cypriot art and culture, inflicted on the public as part of the destructive policies and greedy bankers.

Fig. 2. Hunting scene with a dog chasing a mouflon - second half of the 3rd cent. A.D. (Photo: E. Hadjisterkotis).

Fig. 3. Modern silver plates just before destruction, depicting mouflon (Photo: E. Hadjisterkotis).

A CASE SERIES OF SYSTEMIC CRYPTOCOCCOSIS IN THE CYPRUS MOUFLON

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The Cyprus mouflon or agrino (*Ovis orientalis ophion)* is a wild sheep subspecies endemic and unique to Cyprus.

Cryptococcus spp. are saprophytic and opportunistic fungal pathogens that are known to cause severe disease in immunocompromised animals, though *Cryptococcus gattii* is known to cause disease in immunocompetent animals as well.

Two male, 3 and 10 years old and two female, 6 and 7 years old mouflons, were found dead, from 2007 to 2013. The first three, were free ranging animals from the Pafos forest. The last case involved a captive animal from the Pafos zoo.

Gross pathology, histopathological, and molecular analyses were performed.

1st Case-Male 1. The animal was cachectic and had a 3-cm³ swelling on the right maxillary area. Large quantities of whitish tumour-like tissue occupied most of the nasal cavity. Similar nodules were multifocally observed throughout the lungs.

2nd Case-Male 2. A single, 3-cm³ whitish tumour-like nodule, was observed on the left lung .

3rd Case-Female 1. A single 0.5-cm³ whitish tumour-like nodule was observed on the mucosa of the left nasal cavity. Similar nodules were observed throughout the lungs. Severe turbidity of the meninges was noted.

4th Case-Female 2. Large quantities of whitish tumour-like nodules throughout the lungs and severe turbidity of the meninges were observed. Lesions indicative of parasitic pneumonia were also present in cases 1, 2 and 3.

Microscopically, in all cases, the lesions contained large clusters of thin-walled fungal organisms, surrounded by a wide halo. India Ink and Nigrossin stained smears, showed spherical yeasts surrounded by a thick unstained capsule. In Mucicarmine stained sections, the fungal capsule, not visible in HE sections, was stained pink or red, a finding diagnostic of *Cryptococcus* infection, a basidiomycetous encapsulated yeast that may cause life-threatening infections. The diagnosis of severe, multifocal cryptococcal rhinitis, pneumonia and meningitis was established. Sequence and phylogenetic analysis of partial genomic regions from a capsule associated gene CAP59, classified the strains for cases 1 and 3 as *Cryptococcus neoformans* and for cases 2 and 4 as *Cryptococcus gattii*.

This report describes a series of systemic cryptococcal (*C. neoformans* and *C. gattii*) infections in mouflons, the first in this species worldwide, and raises the question of whether this specific species, or only immunocompromised individuals, are vulnerable to the disease.

POPULAR BELIEFS AND LEGENDS ON THE FOSSIL BONES OF THE LARGE PREHISTORIC UNGULATES OF GREECE, ROME AND CYPRUS

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In ancient Greece and Rome the discovery of the fossilized remains of large mammals, including ungulates, gave rise to the Greek mythology, creating legends of fantastic creatures, such as Griffins, Cyclops, Satyrs, mythical wild boar, and giant heroes (Mayor 1985, 2001). In Cyprus there were no such large prehistoric animals and therefore, no such legends. Archaeological findings in Cyprus revealed that the first large ungulates found on the island were suids (*Sus scrofa*), goats (*Capra aegagrus*/*hircus*) and cattle (*Bos primigenius*/*taurus*). It was assumed that these species would have been introduced between the end of the Late Glacial and ca. 10,400 cal. B.P. The first sheep (*Ovis gmelini*) appeared in the archaeological record of Cyprus during the 10th millennium, with Persian fallow deer (*Dama d*. *mesopotamica*), plus perhaps a new domestic lineage of pigs. The only large mammals found on the island of Cyprus before the arrival of humans were pygmy elephants (*Elephas cypriotes and E*. *xylophagou)* and pygmy hippopotamus *(Hippopotamus phanourios)*. With the exception of pygmy hippopotamus and pygmy elephants, there are no natural fossil deposits of the above ungulates, except one case of *Dama dama mesopotamica* near Xylophagou and Ormidia villages (Kassapis *et al*. 2005).

In ancient Greece and Rome, it was a common practice to display gigantic fossils in sacred places. Although the ancient Greeks and Romans recorded their discoveries and interpretations in writings that survive today, but on Cyprus, where there are no such giant fossils, there are no such ancient writings on the fossils of Cyprus, or any evidence that such bones were displayed in sacred places.

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TROPHY HUNTING AND CONSERVATION OF WILD MOUNTAIN UNGULATES BIODIVERSITY

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Hunting tourism is constantly developing over the last years. Trophy hunters travel all over the world in search of new game and participate in hunt on different animal species. Wild mountain ungulates can be labeled as a segment of elite game resource. They inhabit remote high-altitude areas and have limited ranges; moreover, their numbers are low and some species or subspecies are banned for hunting. All this highlights exclusiveness and complexity of this particular hunting and challenges the hunter. As a consequence of the unique status and endemism of wild mountain ungulates, the hunting quotas are low. The number of licenses is in inverse relationship to the price of the hunt. For example, annual quota for *Ovis ammon polii* in Kirghizia is 50-60 individuals and the price of the hunt is 25000-30000 USD, whereas permitted bag of the neighbor species *Capra sibirica* reaches 400 individuals and the price of the hunt is much lower (4000-7000 USD). The hunt on argali in Mongolia is estimated at 120000 USD due to the quota of 3-5 individuals per year. Despite high fares, the demand always exceeds the offer of these game.

It is important to highlight that current scarcity of several mountain ungulates justifies protective measures and hunting bans. Nevertheless, long-term practice of limited bags under strict governmental and international monitoring in many countries proved its right of existence.

Reasonable organization of hunting process concerning these rare species gives much more advantages than total hunting ban. The basic positive aspects are:

- reliable and stable source of protection for animals;
- governmental and international control by nature protection organizations, and constantly updated information on species and populations status;
- official taxes to budgets at different levels;
- local employment during hunting organization and its maintenance;
- collection of biomaterial for scientific investigation and museums.

A clear example of well managed process of restoration of almost extinct mountain ungulates is «Torghar Conservation Program», which included strictly limited hunting on straight-horned markhor, *Capra falconeri*. The profit from legal hunt reversed the attitudes of local communities and tribes from poaching to nature conservation. The income from one trophy markhor is several orders higher than the price of meat during illegal hunt (in addition, meat is left locally, since hunters are only interested in trophies and pelt).

In 1984 the population of straight-horned markhor) reached only 200 individuals and was close to the edge of extinction. Currently the numbers of these mountain ungulates is about 4000 and the species status was changed from «endangered» to «vulnerable». This became possible with strictly limited trophy hunting on old males.

Positive experience of hunting allowed forming the position endorsed by the working group on hunting in Eastern Europe and Asia at FAO (Praga, 2015).

Wild mountain ungulates are a unique natural renewable resource whose rational use will allow both restoring the existing populations and providing conservation of their habitats, and with it of total biodiversity. There is a need for genetic and molecular studies of Snow Sheep in Russia. These studies are necessary to determine the validity of Snow Sheep subspecies in Russian Northern Asia.

Two mature Putorana snow sheep rams on the Putorana Plateau, Putorana Nature Reserve, Krasnoyarrsk Krai, Russian Federation (anonymous photographer) from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

HUNTING OF WILD MOUNTAIN UNGULATES IN RUSSIA

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Currently there are 8 species of mountain ungulates in Russia. Five species are hunted, while 3 species and 2 subspecies of snow sheep are included in the Red Book of threatened species (**Table 1**).

Table 1. Species, numbers, and hunting bag of mountain ungulates in Russia.

Species and subspecies	**Quantity, individuals**	**Annual hunting bag, individuals**
Ghoral *Nemorhaedus caudatus* Milne-Edwards, 1867	700-900	The Red Book of Russia
Chamois *Rupicapra rupicapra caucasica* Lydekker, 1910	5000-6000	42-58
Bezoar goat *Capra aegagrus* Erxl., 1777	1300-1500	The Red Book of Russia
Siberian ibex *Capra sibirica* Pall, 1776	11000	135-184
Caucasian tur *Capra caucasica* Gueld. Et Pall., 1783	50000	142-150
East Caucasian tur (*Capra cylindricornis* Blyth., 1841		
Argali - *Ovis ammon* L.,1758	600-800	The Red Book of Russia
Snow sheep *Ovis nivicola* Eschscholtz, 1829 and its subspecies: kamchatsky - *O. n. nivicola*, dzhugdzhursky - *O. n. alleni*, koryaksky - *O. n. lydekkeri*, (Chukotka population) putoransky - *O.n. borealis*	50000-58000	178-181 The Red Book of Russia The Red Book of Russia
koryaksky - *O. n. lydekkeri*, (Chukotka population)		The Red Book of Russia
putoransky - *O.n. borealis*		The Red Book of Russia

In the past these species were hunted for meat, now are hunted for trophies. Recently, the association Rosokhotrybolovsouyuz started to nominate hunters who bag mountain ungulates for "Russian Mountain Five" award, to make trophy hunting more popular. The award winners are hunters who bagged at least one of each of the five trophy species authorized for hunting. The demand for trophy hunting is growing, and thanks to the state game management authorities, nature protection, and scientific organizations, valuable biological material and reliable data on the status of species and populations are available, which are used for managerial decisions and proper game management and conservation. For example, analyses proving the stability of Siberian ibex and chamois populations, suggesting that current use of these resources does not

exceed their breeding potential nor is conducive to negative population trends due to overhunting on the breeding stock, were conducted on the basis of hunting trophy database (n=1185) collected in the Russian Research Institute of Game Management and Fur Farming (VNIIOZ). However, the slightly negative trend of the trophy measurements of Caucasian tur and snow sheep is interpreted as a warning sign, possibly related to the increased interest in these species and the related rise of hunting quotas. A recent evaluation of the East Caucasian tur trophies revealed that there have been no trophies reaching CIC gold medal level during the last 30 years. This is perhaps due to degradation of the population fitness or wrong determination of trophy medal evaluation medal limits. More research is necessary to clarify the causes.

Mid-aged and young Kamchatka snow sheep male in Kronotsky Biosphere Reserve (August 2012), Kamchatka Peninsula, Russia. Photo Credit: © Yuri Yarovenko from CIC Caprinae Atlas of the World, Damm & Franco, 2014.

POPULATION DYNAMICS AND MODERN STRUCTURE OF THE ARABIAN TAHR HERD IN THE UAE

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Field work to investigate the number of Arabian tahr (Fig. 1 & 2) and their herd structure on the Jebel Hafeet massif within the period from 2005 till 2012 accounted to 179 days. In addition, since the middle of 2015 until the present time, 16 days were spent to point out signs of the presence of tahr in the Fujairah mountains. In addition, we performed research on tahr ecology and the limiting factors affecting recovery these rare animals. The main limiting factors identified were the absence of accessible water sources, poaching, overgrazing by excessive livestock, presence of feral goats, excessive number of foxes, uncontrolled tourism frightening animals, and several other factors which usually have an anthropogenic origin.

Fig. 1. Arabian tahr in the UAE.

At the end of 2005, only 4 tahrs were identified on the Jebel Hafeet massif by phototrapping– namely, an adult female with her daughter and two males of 8 and 5 years old. Following our proposals, the local authorities and administrative bodies operated with us to eliminate the main limiting factors or decrease their impact; in addition four artificial drinking places were made available, with adjoining areas with natural irrigated vegetation. The herd achieved 9 individuals at the end of 2007 – (♀adult+j) + ♂adult + (♀young+j) + ♂young + 3♀♀adults. Theoretically, the maximum herd size on the Jebel Hafeet massif in 2012 could have amounted to 51 individuals. Simultaneously, since the first days of field work on the mountains and routes, we registered the number of animals, their sex and the composition of groups. Results show a steady growth of tahr numbers in each day of observations – from 0.34 in 2005 to 2.54 in 2012. Taking the number of animals identified in 2005 as the basis, and considering the number of animals met during a day of observation since 2005 until 2012, we estimated the minimum population size at 30 individuals. The growth and correspondingly increase in density, especially in recent years results in the appearance of female groups with kids after lambing and before the rutting period, as well as curiously enough, of groups of males after the rutting period. It is possible to meet up to 9 tahrs simultaneously near drinking places during the summer period; however, this is not a herd, rather individual animals which disperse after sequential drinking and appeasement. Mostly, individual males (42%) and females with a kid (32.8%) are met.

Individual females just before the rutting time and after it (10.9%) are met less frequently, and encounters of a male with a female is basically registered during the rutting period (3,4%). Sometimes, males are met in pairs (8.4%) out of the rutting period.

We could not observe tahrs on the Fujairah mountains, though they were successfully hunted here no later than 25 years ago. Nevertheless, we found indirect evidence of their possible presence. According to available data, 420 tahrs leave in various nurseries in the UAE.

The example of tahr increase in the territory of Jebel Hafeet following the implementation of elementary standards of environmental management, to fulfill vital ecological and physiological requirements of these animals, in parallel with a reasonable problem-solving approach, permit to look with more optimism to successful conservation and restoration of natural populations of Arabian tahrs in the UAE.

Fig. 2. Arabian tahr feeding (Photo: Vladimir Korshunov).

THE CHALLENGES AND OPPORTUNITIES OF LONG-TERM POPULATION MONITORING OF MOUNTAIN UNGULATES IN THE HIMALAYA

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Asia's high mountains are home to many endemic ungulates. However, our understanding of the size, distribution and dynamics of their populations is limited. Scientific monitoring of mountain ungulate populations in Asia has been difficult due to the remoteness of the region, lack of expertise and capacity, and limited logistic and financial resources. Robust scientific monitoring of mountain ungulate population is urgently needed as threats due to illegal hunting, livestock grazing, predation by feral dogs and large development/infrastructure projects are on the rise.
We monitored three and two populations of blue sheep (*Pseudois nayaur*) and ibex (*Capra sibirica*) respectively for seven years from 2010 to 2016 using the double observer survey in the Spiti valley, Himachal Pradesh India. We also monitored one population of ibex and argali (*Ovis ammon*) in the Tost Nature Reserve in Mongolia for three years from 2011 to 2014. We analyzed the data using recently developed Bayesian models of analyzing capture-mark-recapture techniques. We compare the population estimates obtained using different models of mark-capture-recapture methods. We identify the trend in the population of the three species across the six landscapes. We also assess the demographic dynamics of the three species using data on the age-sex classification.
We discuss trends in the long-term population dynamics of the blue sheep and ibex from the point of view of top-down verses bottom-up control of mountain ungulate populations. We discuss the training needs and logistic support of implementing long-term population monitoring initiatives in Asia. We also discuss the challenges and opportunities in sustaining long-term population monitoring initiatives in Asia.

MOUFLON (*OVIS MUSIMON*) INTRODUCTION TO THE NATURAL WILDLIFE PARK "OLENIY"(LIPETSKAYA PROVINCE, RUSSIA)

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Programs of the European Mouflon acclimatization within the territory of the former Russian Empire have been started in the late nineteenth century, when in 1894 the Askania Nova Zoo imported three specimens of these animals. In 1913, about a dozen of mouflons from Askania Nova were settled in the Crimean mountains. Initially, the animals were kept in an enclosure, and then in 1917 released into the woods, where they live up to the date. More mouflons were acclimatized in different regions of Ukraine.

In modern Russia acclimatization of European Mouflon has been started in the late of XXth century in the southern portion of Rostov province. To date, the overall population, inhabited 5 Russia provinces is estimated up to 1000 individuals. Given the anonymous importations of animals in a number of commercial farms, there is reason to assume that the current population of the species in the European part of Russia is close to 1500 individuals.

Natural Wildlife Park "Oleniy" is about 400 kilometers south of Moscow, in the northern part of the Lipetskaya province. Its total area covers over than 11 thousand hectares. The territory of the Park is represented by fields with different crops, framed by strips of woodland and interspersed by forest islands. A significant part of the territory of the park covers an extensive ravine system.

The main objective of the Park is to protect the entire ecosystem of feather-forb steppes of the northern part of the Central Black Earth region. And instruments for the successful solution of this objective are environmentally conscious farming, conservation of floristic and faunal complexes on a scientific basis, reacclimatization of previously lost animal species, due to various reasons, as well as the new naturalization.

The introduction of mouflon in the Natural Park Deer had two stages. In 2012, 20 animals were brought from the Rostov region; two years later - 74 individuals from the Czech Republic. After overexposure in quarantine, the animals were released into the aviary area of 1,200 hectares along with Sika Deer.

In the fall of 2014, before the rut, the total population of mouflon in the Park was estimated at 109 individuals. Herd had the following sex/age structure: males at the age of 2 years and higher - 27, females older than 2 years - 55 individuals, males up to 1 year - 13 individuals, females up to 1 year - 14 animals. From September 2014 to March 2015 the death of 8 animals was recorded: 1 male older than 2 years, 2 females older than 2 years, 3 males and 1 female 2 years and up to 1 year. Thus during the lambing period structure was as follows: 26 males older than 2 years, 10 males to 1 year and 53 females older than 2 years, 12 females to 1 year.

In June 2015 the count of a mouflon herd numbered 145 individuals and consisted of 26 males older than 2 years, 10 males older than 1.5 years, 20 males to 1 year, 53 females older than 2 years, 12 females older than 1 5 years, 24 females to 1 year. In June 2016 mouflon population was 207 individuals.

The data provides information on the biology and ecology of mouflon in the conditions of the Natural Park of the Deer.

ALTITUDINAL MOVEMENTS OF HIMALAYAN TAHR AND TEMPERATURE: PREDATION MAY COUNTERACT EFFECTS OF CLIMATE CHANGE

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Temperature variations are expected to be important determinants of altitudinal movements of mountain ungulates. In turn, movements of their predators, i.e. large carnivores, should follow those of ungulates, but relevant information is scarce. In an area of Central Himalaya (Sagarmatha, i.e. Mt. Everest, National Park, Nepal), in 2006-2010, we analysed relationships between temperature, altitude used by the Himalayan tahr *Hemitragus jemlahicus* ("vulnerable", *sensu* IUCN) and that used by its main predator, the snow leopard *Panthera uncia* (Fig. 1) ("endangered", *sensu* IUCN). Although we expected that tahr moved to higher altitudes in response to greater temperatures, we observed no significant relationship between altitude of tahr sightings and temperature. Furthermore, the mean altitude of tahr sightings decreased by *c*. 200 m throughout our study. As expected, snow leopard movements tracked those of tahr, but the core area of this large cat did not move downwards. Throughout our study, tahr was the staple of the snow leopard diet. Most likely, the former did not move upwards in reaction to higher temperatures to avoid encounters with the latter. We suggest that snow leopards did not shift their core area downwards to avoid encounters with the larger common leopard *Panthera pardus*. We suggest that interspecific interactions (predation; competition) influenced movements of Himalayan tahr and snow leopards more than climatic variations and that intensity of predation by a "specialist" carnivore may counteract effects of climatic changes on altitudinal movements of mountain ungulates.

Fig. 1. Snow leopard *Panthera uncial*, Tost Mountains, South Gobi province, Mongolia. (Photo Credit: Snow Leopard Conservation Foundation / Snow Leopard Trust)

GENETIC DIVERSITY OF THE ENDANGERED NILGIRI TAHR (*NILGIRITRAGUS HYLOCRIU*S) ACROSS ITS RANGE IN WESTERN GHATS, INDIA

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The Nilgiri tahr *Nilgiritragus hylocrius*, a mountain ungulate endemic to the southern Western Ghats of India, is endangered due to population decline and decreasing range size. Approximately 3000 individuals survive in the wild and majority of the populations are small and fragmented. Planning conservation and management strategies to revive or rehabilitate the species will require information on its population status and genetics. To determine whether genetic problems like low levels of heterozygosity and inbreeding depression further endanger the population, we collected fresh faecal pellets from herds in sites across the Western Ghats including large populations from Eravikulam and Nilgiris, and small, isolated populations in Agastyamalai range. We identified a panel of seventeen polymorphic, cross-species microsatellite markers suitable for Nilgiri tahr, and are testing the hypothesis that small and large populations do not differ significantly in levels of heterozygosity.
Our preliminary results for the two largest populations in Eravikulam and Nilgiris, show varied levels of polymorphism (2-11 alleles) and heterozygosity (0.0625-0.9231). Overall observed and expected heterozygosities were H_o=0.4338±0.2416 and H_e=0.4493±0.2316 in Eravikulam and H_o=0.4008±0.3097 and H_e=0.4106±0.2626 in the Nilgiris.
Nei's unbiased mean heterozygosity for Nilgiri tahr was 0.4371(Eravikulam) and 0.3932 (Mukurthi, Nilgiris), falling in the same range as other endangered Caprinae species: Korean goral (0.356), Alpine ibex (0.44), Spanish ibex (0.52) and Siberian ibex (0.69).
This study is the first to estimate genetic diversity of the endemic, endangered Nilgiri tahr and shows that low levels of genetic variation can be an added threat to the extant populations.

MALE COURTSHIP BEHAVIOUR AND FEMALE RESPONSE IN HIMALAYAN TAHR (*HEMITRAGUS JEMLAHICUS*) IN EASTERN CANTERBURY, NEW ZEALAND.

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New Zealand's population of Himalayan tahr (*Hemitragus jemlahicus*) provides an opportunity to investigate polygynous mating systems. Although little is known about the tahr mating system, observations suggest that dominant males tend single oestrous females and drive away competing males with a spectacular display of body postures and threatening poses. Horn length and body size may be important in determining mating success alongside as other characteristics, such as coat and ruff colour.

Himalayan tahr are possibly one of the least-studied ungulate species. That is not surprising, given their distribution and declining populations in the Himalaya's and the difficulty of accessing much of their habitat in New Zealand. Most previous research on tahr in New Zealand has been undertaken as part of monitoring tahr populations for wild animal control. Tahr have been culled to control their numbers as populations have grown to pest status. The newly formed NZ Game Animal Council has provided an impetus to manage Himalayan tahr as a sustainable game animal resource. This provides an opportunity to study a sexually dimorphic mountain ungulate with large weaponry and body size and aims to better understand tahr biology.

We studied tahr mating systems in different habitats or situations (e.g. free range versus managed). Our research explores potential relationships between age, sexual size dimorphism, horn size and mating tactics and assesses the costs and benefits associated with mating behaviour to provide information on reproductive effort and mate selection, particularly of males by females.

PAST AND PRESENT DISTRIBUTION AND ABUNDANCE OF THE CYPRUS MOUFLON

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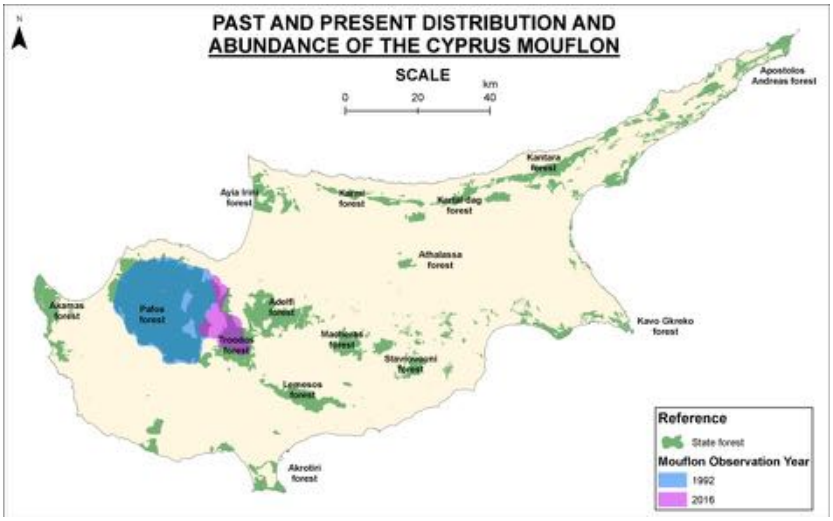

Fig. 1. Past and present distribution of the Cyprian mouflon *Ovis gmelini ophion*

The Cyprus mouflon (*Ovis gmelini ophion*) is endemic to Cyprus and is on the list of the IUCN endangered species. In the Middle Ages, the mouflon was plentiful in nearly all parts of Cyprus and was hunted by the aristocracy using hounds and coursing them with cheetahs. By 1878 mouflon were only found in the Troodos Mountains in the western part of the island. At the time of the British occupation, mouflon had been extirpated with the exception of a single flock of 25 animals and a ban was placed on their hunting. By 1884 their numbers were thought to be increasing. In 1930 there was a flock of 20 or more in the Troodos Forest and a similar number in the Pafos Forest. By 1937 the population of the Pafos Forest was thought to have been reduced to 15 animals through continuing poaching, although due to the limited number of roads and unreliable observations, this is questionable. In 1970 there were about 200 animals. The population was restricted to the Pafos Forest, due to extensive poaching by Turkish Cypriots possessing military rifles, living in villages adjacent to Pafos forest and not under the control of the Republic of Cyprus. After the Turkish invasion in 1974 and the forceful translocation of these people to the northern part of the Island occupied by the Turkish Army, poaching was reduced and mouflon expanded their range into the adjacent agricultural areas and open pastures. In 1983, the Department of Forestry estimated the mouflon population to be 500-600 animals. In 1992, under the direction of Prof. Roger Bider from McGill University, in cooperation with E. Hadjisterkotis, using a helicopter count, they estimated the population to be 900-1500 animals based on a helicopter count. Thirty percent of the population were living inside Pafos Forest and 70% were found at the periphery of the forest. During the last few years we have been collecting data to develop GIS-based information to map the distribution of the Cyprus mouflon, which expanded its range towards the Troodos National Park. The map (Fig. 1) depicts the current mouflon distribution and distribution during the 1990's. The distribution maps were created based on visual observations using a four wheel drive car in all known roads of the Troodos National Park and Paphos Forest, walking nature trails, mountain ridges, and observations made from high points. In addition, information was provided by foresters, hunters and Farmers. This is the first time that a stable mouflon population, about 200 animals, is present in Troodos National Park, after an absence of several decades.

PAFOS FOREST, A BIODIVERSITY "HOTSPOT" AND CENTER OF ENDEMISM: MEASURES FOR PREVENTING FOREST FIRES FOR THE CONSERVATION AND MANAGEMENT OF MOUFLON

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Pafos Forest, the natural habitat of the Cyprus mouflon (*Ovis gmelini ophion*), is the most extensive forest complex in Cyprus, covering an area of 600 km^2. It is situated in the northwestern part of the Troodos mountain range and it is managed by the Department of Forests of the Ministry of Ministry of Agriculture, Rural Development and Environment. This area is a centre of endemism for plants, birds, insects and mammals. Fourteen European natural habitat types that are listed in Annex I of the Habitats directive 92/43/EEC, have been identified in Pafos forest. Three are priority habitats, and three are new Cypriot habitat types which have been added to Annex I, two of which are priority habitats. In this forest, there are 619 native plant species and subspecies, 61 (10%) of which are endemic. Of these taxa, 28 (4.5%) endemics and other rare and important plants are listed in the Red Data Book of the Flora of Cyprus, such as the *Arabis kennedyae*, *Phlomis cypria subsp. occidentalis*, *Erysimum kykkoticum* και *Ranunculus kykkoensis*. 96 species of birds were recorded, (5 of which are endemic), and 24 mammalian species, including 15 bat species and the only wild caprine on the island, the Cyprus mouflon. There are also numerous insect species, many of which are endemic, including the beetle *Propomacrus cypriacus* and the Rhodes butterfly (*Callimorpha quandripunctaria*), which are protected by the Habitats Directive.

Cedar Valley (Fig. 1), located in the centre of the forest, is a very important area of the forest, and is home to the endemic Cyprus Cedar (*Cedrus brevifolia*). The imposing Tripylos Peak (1,400 m asl) is a unique habitat, hosting many endemic species, such as the Cyprus mouflon, the Golden Oak , the Cedar of Cyprus, the Cypriot Coal Tit, the Cyprus Jay, the Cyprus Tree Creeper, the Cypriot cross beak, and the Cypriot Scops Owl. Because of the above, is a "biodiversity hotspot", a Natura 2000 site, a Special Protection Area (SPA) for the conservation of its avifauna and Site of Community Interest (SCI) for the protection of flora and fauna species and the habitat types it hosts.

It is also important for hydrology, as it includes the water catchment areas of 11 important water dams, functions as the largest carbon sink in Cyprus, produces various wood and non-wood forest products, forest recreation and includes important natural landscapes and cultural or natural monuments.

The main threat to the forest is fire, which may cause substantial degradation and destroy the unique habitat of the Cyprus mouflon. During the period of 1960-2009, 370 forest fires were recorded (7.4 fires/year) in the Pafos forest, burning 29.309 ha of forest, requiring implementation of fire protection measures in and around Pafos Forest. After the great fire which burned the entire forest of Argaka (adjacent to Pafos forest) on the 19th of June 2016, we attempted to review and evaluate the protection and management measures of the Department of Forests, by mapping and computing the distribution and abundance of forest stations, roads, firebreaks, fire lookout points, hydrants, water reservoirs, water tanks, and dams, as well as the number of fire trucks, vehicles and personnel that could be used for firefighting. Based on data provided by the Department of Forests, there are seven forest stations distributed throughout the forest. There are seven permanent fire lookout points, operating for 24 hours a day during summer. These fire lookout stations are located in positions from which there is oversight over a large area of forest. One such lookout point is located on top of mount

Tripylos at the center of the forest. The total length of forest roads is 2.099 km. The total length of the fire breaks amounts to 342km. 71.6% of the fire lanes are accessible by fire trucks. To supply the fire trucks with water, there are 55 reservoirs, nine available dams and 93 hydrants. There is an extensive telecommunication network and 35 helipads for the landing and fueling of firefighting helicopters. During the summer season, forest officers remain on guard rotation, supervising the forest firefighting personnel. To reduce the risk of fires, the Department of Forests implements visitor control within nature reserves, such as on mount Tripylos, by blocking road access, and by concentrating visitors in organized recreation areas. In the 11 picnic sites, there are sufficient fire hoses and other firefighting equipment. Finally, the Forestry Department is taking measures to reduce biomass along roads by reducing the number of young trees to limit forest density. The above management measures are expected to improve with the recent approval of a LIFE+ project, and its implementation by the Department of Forests, aiming mainly at the conservation of the Cedar valley, and consequently its main inhabitant, the Cyprus mouflon.

Fig. 1. Cyprus cedar, Cedar Valley (Photo: E. Hadjisterkotis).

THE ARRIVAL OF THE FIRST UNGULATES ON THE ISLAND OF CYPRUS DURING THE PREHISTORIC PERIOD: AN EPIGRAMMATIC REVIEW

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A team of French archaeologists (Muséum National d'Histoire Naturelle, CNRS,EHESS, INRAP, and the University of Toulouse II-Le Mirail) working in Cyprus, recently discovered the oldest agricultural settlement ever found on a Mediterranean island. Previously it was believed that, due to the island's geographic isolation, the first Neolithic farming societies did not reach Cyprus until a thousand years after the beginning of agriculture in the Middle East (ca. 9500 to 9400 BCE). The discovery of a Neolithic village at the locality Klimonas, that dates nearly 9000 years B.C, provided evidence that early cultivators migrated to Cyprus shortly after the emergence of agriculture in the Middle East, bringing with them cultivated wheat as well as dogs and cats. An analysis of the bone remains found on the site has revealed that the meat consumed by these villagers came from the hunting of a small wild boar indigenous to Cyprus (the only large game on the island at the time), and that small domestic dogs and cats had been already introduced from the continent. This lead the researchers to believe that a small size wild boar was present on the island perhaps during the same time period with the pygmy elephants elephants (*Elephas cypriotes* and *E. xylophagou*) and pygmy hippopotamus (*Hippopotamus phanourios*) (Hadjisterkotis and Reese, 2008). The discoveries of the French team at Klimonas indicated that these people were sedentary villagers. The research of the French team on Klimonas was completed on 4 June 2016.

Fig. 1. Parekklishia- *Shillourokampos* (Photo: E. Hadjisterkotis)

Almost 1000 years later after the intitial settlement, a new Neolithic village was established near the modern village of Parekklishia- *Shillourokampos* (Fig. 1), with the first mountain ungulates ever found on the island. According to detailed archaelogical data established recently (Guilaine 2003 ; Guilaine & Briois, 2007 ; Guilaine *et al*., 1995 ; Vigne *et al*., 2011a), the long period of settlement at *Shillourokampos* can be divided into four main phases from 8.400 to 7.000 B.C. During the period of 8.400-8.100 B.C, there is evidence of wheat cultivation and legumes, and the presence of a small sized wild boar. This led researchers to conclude that the wild boar was the first large animal species that existed in Cyprus after elephants and hippos.

After a brief abandonment of the site, or a gap due to erosion in the period of 7.900-7.600 B.C., archaeological findings revealed a reduction in the numbers of wild boar, and for the first time there were mouflons (*Ovis gmelini*/*aries*), fox (*Vulpes vulpes*) and Persian fallow deer (*Dama dama* m*esopotamica*). The supply of meat was based mainly on sheep, rearing of pigs and cattle and hunting of wild goats, wild boar and Persian fallow deer.

During the period of 7.600-7.400 B.C., there was a reduction in domestic sheep bones suggesting a collapse or a failure in sheep production (Vigne et al. 2014). This

collapse forced the inhabitants of *Shillourokampos* to introduce new sheep breeds for meat production, perhaps from the mainland, or from other unknown Cypriot Neolithic sites, or perhaps from feral sheep present on the mountains, not yet found in any fossil sites (Sanna *et al*. 2015). The Cypriot wild goat was locally domesticated (Vigne *et al*., 2014), pig farming increased, while the importance of cattle decreased.

Fig. 2. The Neolithic site of Khirokitia (Photo: E. Hadjisterkotis)

During the period of 7.400-7.000 B.C., archaeozoological data revealed a specialization in the exploitation and sheep and goats husbandry. Sheep were bred for meat, while goats were bred for milk. In the seventh and early sixth millennium, there were numerous Cypriot villages that belonged to the Neolithic Chirokitia culture (Fig. 2), with stone tools but without ceramics. The people of Choirokoitia hunted deer and bred sheep and goats (Le Brun and Le Brun 2003 ; Davis, 2003). Captive bred sheep did not differ from the current Cyprian mouflon (*Ovis gmelini ophion*), except for the size of the mouflon/sheep of Choirokoitia which was approximately 15% to 18.4% larger than the modern Cyprian mouflon (Hadjisterkotis, 1993). Presently, the only mountain ungulate that survives in Cyprus is the Cyprus mouflon. Fallow deer was present in the wild until the middle ages.

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NEW SUBSPECIES OF SNOW SHEEP IN RUSSIAN NORTHERN ASIA

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Petrovsky Academy of Sciences and Arts, St.-Petersburg, Moscow, Russia

Distribution: The North Asian mountain ranges, with the following coordinates: towards the North up the coast higher than latitude 48°N and towards the West up to longitude 90°W, and towards the East as far as the end of Chukotsky Peninsula.

As of 1990, in Russian Northern Asia, 5 subspecies of extant Snow Sheep have been described: **1**- *Ovis nivicola nivicola* Eschscholtz, 1829, Kamchatsky Snow Sheep. Locus classicus: Kamchatka; **2**- *O. n. lydekkeri* Kowarzik, 1913, Yakuts Snow Sheep. Locus classicus: Verkhojansky Range. **3**- *O. n. alleni* Matschie, 1907, Okhotsky Snow Sheep. Locus classicus: Okhotsky Mountains. **4**- *O. n. borealis* Severtzov, 1873. Putoransky Snow Sheep. Locus classicus: Putoran Mountains. **5**- *O. n. koriakorum* Tehernyavsk, 1962. Koryak Snow Sheep. Locus classicus: The Upper reaches of the Achai-Vajam River (Koriaksky upland). **6**- In 1990 I described a new subspecies: *O. n. tschuktschorum spp. n.* ZHELEZNOV 1990. Chukotsky Snow Sheep (Zheleznov, 1990, Zheleznov, 1999; Zheleznov-Chukotsky, 1994). Locus classicus: Anuisky upland (Chukotka), Anadyrsky Plateau (the middle of the Enmyvaam River). Holotype: Skull № 28835, KZMAN, and skin of female 7 years old, KZMMU.

Diagnosis: Sheep are large. The total body length of males is 178-188 cm, and that of females is 169-179 cm. The male height at withers is 102-106 cm, and female up to 87-100 cm. The oblique body length for males is 95-100 cm; for females it is 85 to 96 cm. Maximum male skull is 275-280 mm; longest female skull is 265-270 mm. Muzzle length of males is 160 mm, and the largest skull is 166 mm. The male horn girth at the base is 34 cm. The bone pivot height is up to 20 cm, and their girth is 30 cm. The horn spread is 81 cm.

The coloration is variable: brown to dark-brown and from light-grey to light-brown. The head is of medium width, short, and grey. The nose is aquiline. Males and females have a white spot between their horns. The belly is white, the posterior portion of the legs is also white. The rump patch is white. There is a dark line on the back. Male ears are short (up to 10 cm), rounded, and those of females are as long as 9 cm.

Distribution: Chukotka in major mountain ranges: Pekulnei, Ushurekchen, Oloisky, Iskaten; uplands: Anuiisky, Chukotsky; Anadyrsky Plateau and mountain chains of the Chukotsky Peninsula.

In 1994 D.G. Medvedev described new subspecies of a Snow Sheep as *Ovis nivicola kodarensis* Medvedev, 1994 from northern Transbaikalia, east of the Stanovoi Range. Thus there are 7 subspecies of Snow Sheep in Russia. There is a need for genetic and molecular studies of Snow Sheep in Russia. These studies are necessary to determine the validity of Snow Sheep subspecies in Russian Northern Asia.

ORGANIZING COMMITTEE:

Mr. Andreas Varnava, Administrative Officer, Ministry of the Interior, Nicosia
Dr Eleftherios Hadjisterkotis, Environment Officer, Ministry of the Interior, Nicosia Cyprus (Congress Chairman)
Prof. Sandro Lovari, U.R. Ecologia comportamentale, Etologia e Gestione della fauna, Dipartimento di Scienze della Vita, Università di Siena, Italy (Former chairman of Caprinae Specialists Group)
Prof. Bruno Masala, Department of Biomedical Sciences, University of Sassari, Italy
Dr. Constantinos Kounnamas Researcher - Frederick University (Nature Conservation Unit)
Dr. Marios Andreou Researcher - Frederick University (Nature Conservation Unit)
Dr. Nicolas - George Eliades Researcher - Frederick University (Nature Conservation Unit)
Mr. Ieronymos Hadjisterkotis, Frederick University, School of Medicine, Department of Nursing, Nicosia, Cyprus.
Miss Andreani Hadjisterkoti, Academy ARTE, Nicosia
Miss Elena Yerolemou, B.Sc., M.Sc. Biological Sciences, (Uclan, Queen Mary University, London, Geri, Nicosia

Members of the Organizing Committee during registration (Mr. IERONYMOS HADJISTERKOTIS, Miss ANDREANI HADJISTERKOTI, Miss ELENA YEROLEMOU and Dr. CONSTANTINOS KOUNNAMAS)

SCIENTIFIC COMMITTEE FOR THE 6th WORLD CONGRESS ON MOUNTAIN UNGULATES

Prof. Marco Festa Bianchet, Départment de biologie – Université de Sherbrooke, Canada, Chaiman of the IUCN Caprinae Specialists Group.

Prof. Sandro Lovari,U.R. Ecologia comportamentale, Etologia e Gestione della fauna, Dipartimento di Scienze della Vita, Università di Siena, Italy (Former chairman of Caprinae Specialists Group).

Dr Raul Valdez, Department of Fishery and Wildlife Science, New Mexico State University, USA.

Dr. Gerhard R. Damm President, Applied Science Division, International Council for Game and Wildlife Conservation CIC, South Africa and Hungary.

Dr. K.E. Ruckstuhl, Associate Professor, Biological Sciences, University of Calgary, Calgary, Alberta, Canada.

Prof. Juan Herrero, Area of Ecology, Department of Agrarian and Environmental Sciences, Technical School of Huesca, University of Zaragoza, Spain.

Dr Jean-Michel Gaillard, Directeur de recherche – CNRS, "Biométrie et Biologie Évolutive" UCB Lyon, France.

Dr. Charudutt Mishra, Science and Conservation Director, Nature Conservation Foundation of India.

Dr. Francesco Ferretti, R.U. Behavioural Ecology, Ethology and Wildlife Management, Dept. of Life Sciences, University of Siena, Siena, Italy.

Dr. Luca Corlatti, Department of Biodiversity Research, Institute of Wildlife Biology and Game Management, University of Natural Resources and Life Sciences, Vienna, Austria.

Prof. Igor Domsky, Dr. of veterinary science, Director of the GUN All-Russian Institute of Game Management and Fur Farming, Kirov, Russia.

Prof. Steeve D. Côté , Département de biologie & Centre d études Nordiques, Universite Laval, Canada.

Dr. Eleftherios Hadjisterkotis, Environment Officer, Ministry of the Interior.

Dr. Luca Rossi, Department of Veterinary Sciences, University of Torino, Italy.

Members of the Scientific Committee discussing the results of the congress

SCIENTIFIC COMMITTEE FOR THE 5th INTERNATIONAL SYMPOSIUM ON MOUFLON

Prof. Bruno Masala, Institute of General Physiology and Biological Chemistry, University of Sassari Italy.

Prof. Náhlik András, University of West Hungary, Hungary

Dr. Gerhard R. Damm President, Applied Science Division, International Council for Game and Wildlife Conservation CIC, South Africa and Hungary.

Dr. Walburga Lutz, Institute of Wildlife Research, Bonn, Germany; Special Advisor to the Chief Editor, European Journal of Wildlife Research.

Prof. Salvatore Naitana, Department of Veterinary Sciences, University of Sassari, Italy.

Dr Eleftherios Hadjisterkotis, Environment Officer, Ministry of the Interior, Nicosia, Cyprus.

Paolo Mereu, Institute of General Physiology and Biological Chemistry, University of Sassari, Italy.

Prof. Sandro Lovari,U.R. Ecologia comportamentale, Etologia e Gestione della fauna, Dipartimento di Scienze della Vita, Università di Siena, Italy (Former chairman of Caprinae Specialists Group).

Dr Raul Valdez, Department of Fishery and Wildlife Science, New Mexico State University, USA.

Dr Giovanni G. Leoni, Dept. of Physiological, Biochemical and Cell Sciences Faculty of Veterinary Medicine, V. Vienna 2, 07100 – Sassari. Italy.

Two Rocky Mountain Goat (*Oreamnos americanus*) females with kids.
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PHOTO GALLERY

Registration

Registration team: Miss ANDREANI HADJISTERKOTI,Miss ELENA YEROLEMOU and Dr. CONSTANTINOS KOUNNAMAS.

Registration of Dr. VLADIMIR KORSHUNOV and Prof. RAUL VALDEZ

Registration team: Dr. CONSTANTINOS KOUNNAMAS and Dr. NICOLAS - GEORGE ELIADES

Registration, Miss ELENA YEROLEMOU, Cyprus and Ms. ANDREA LUIS, India.

Arrival of the participants for registration

Miss ANDREANI HADJISTERKOTI, Miss ELENA YEROLEMOU and Dr. MARIOS ANDREOU

Participants of the 6th World Congress of Mountain Ungulates and the 5th International Symposium on Mouflon

Participants and members of the Scientific Committee during the opening ceremony. Panel, from left to right: Prof. SANDRO LOVARI, Italy, Prof. SALVATORE NAITANA, Italy, Prof. JUAN HERRERO, Spain, Prof. RAUL VALDEZ, USA, Mr. GERHARD DAMM, South Africa, Dr ELEFTHERIOS HADJISTERKOTIS (congress chairman) Cyprus, Prof. IGOR DOMSKIY, Russia, Dr. PAOLO MEREU, Italy, Prof. BRUNO MASALA, Italy, Prof. ANDRÁS NAHLIK, Hungary

From left to right: Dr CHARUDUTT MISHRA, India, Dr STEFAN MICHEL, Germany, Mrs. CONY DAMM, South Africa, Mr GERHARD DAMM, South Africa, Dr PAOLO MEREU, Italy, Prof. BRUNO MASALA, Italy, Dr ELEFTHERIOS HADJISTERKOTIS (standing) Cyprus.

The Pernanent Secretary of the Ministry of the Interior Mr. Constantinos Nicolaides during the opening seremony and some of the Members of the Scientific Committee. From left to right: Prof. SANDRO LOVARI, Italy, Prof. SALVATORE NAITANA, Italy, Prof. JUAN HERRERO, Spain, Prof. RAUL VALDEZ, USA, Mr. GERHARD DAMM, South Africa, Dr ELEFTHERIOS HADJISTERKOTIS (congress chairman) Cyprus, Dr. PAOLO MEREU, Italy, Prof. BRUNO MASALA, Italy, Prof. ANDRÁS NAHLIK, Hungary (Photo: V. Korshunov)

(Photo: V. Korshunov)

Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy, Dr. LUCA CORLATTI, Italy, Dr. FRANCESCO FERRETTI, Italy, Ms LYNE MCFARLANE, New Zealand, Ms MICHELLE GROSS, Germany, Ms ANTONELLA COTZA, Italy.

Mr. ABISHEK GOSHAL, India, Mr. RIYAZ AHMED, India, Dr. STEFAN EKERNAS, USA, Dr. KULBHUSHANSINGH SURYAWANSHI, India, Prof. IGOR DOMSKY, Russia

Prof. JUAN HERRERO, Italy, Dr. FRANCESCO FERRETTI, Italy and Prof. SANDRO LOVARI, Italy

Mr. HARIS NIKOLAOU, Cyprus, Mr. IRODODOS KAKOURIS, Cyprus, Ms. LEONIE VIALE and Ms CHRISTINA BALDWIN

Ms. ANTONELLA KOTZA and Nikolo Fattorini

Prof. BRUNO MASALA, Italy

From left to right: Mrs. CONY DAMM, Mr. GERHARD DAMM, Dr. VLADIMIR KORSHUNOV and Dr STEFAN MICHEL.

Dr. CHRISTOS ARISTIDOU, Cyprus and Prof. ANDREAS POLYVIOU, Greece

ORAL PRESENTATIONS

Dr ELEFTHERIOS HADJISTERKOTIS, Cyprus (Photo: Vladimir Korshunov)

Prof. SANDRO LOVARI, Italy and Dr CHARUDUTT MISHRA, India

Dr NIKICA ŠPREM, Croatia and Prof. RAUL VALDEZ, USA

Mr ARASH GHODDOUSI, Iran

Dr KLEMEN GERINA, Slovenia

Mr. GERHARD DAMM, South Africa

Dr CHARUDUTT MISHRA, India

Prof. RAUL VALDEZ, USA

Dr ZURAB GURIELIDZE, Georgia

Prof. SANDRO LOVARI, Italy

Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy and Dr. CHARUTUTT MISHRA, India

Dr Vladimir Korshunov. Photo: Mikhail Korshunov

Prof. Sandro Lovari and Prof. Juan Herrero

Dr LUCA CORATTI and Prof. SANDRO LOVARI

Dr RAUL VALDEZ presenting the CIC Caprinae Atlas of the World and Dr ELEFTHERIOS HADJISTERKOTIS Photo: I. Hadjisterkotis

Dr. STEFAN MICHEL, Germany. Photo: V. Korshunov

Dr. ARASH GHODDOUSI and
Dr. NICOLAS-GEORGE ELIADES

Prof. ANTONIO SCALA, Italy

Dr. HARITAKIS PAPAIOANNOU, Greece

Dr. ALKIVIADES GESKOS, Greece

Ms ANDREA LUIS, INDIA

Dr. FRANCESCO FERRETTI, Italy

Prof. ANDRAS NAHLIK, Hangury

Mr. VLADIMIR KORSHUNOV, UAE

Mr. ABHISHEK GHOSHAL, India

Mr. NIKOS KASINIS, Cyprus and Mr. FRANCESCO FERRETTI, Italy

Mr. Arsen Dotsev, Russa.
Photo: Vladimir Korshunov

Mr. MIKHAIL KORSHUNOV, UAE. Photo: E. Hadjisterkotis

Poster session

Prof. BRUNO MASALA, Italy, NICCOLÒ FATTORINI, Italy and MIKHAIL KORSHUNOV, UAE

Dr VASSILIKI KATI with her poster during the poster session, with ALKIVADES GESKOS and Dr. E. HADJSITERKOTIS

Mr. GERHARD DAMM, South Africa, Prof. RAUL VALDEZ, USA, Dr. STEFAN MICHEL, Germany, Dr. ARASH GHODDOUSI, Iran and Mr. ABHISHEK GHOSHAL from India discussing taxonomy of wild sheep

Prof. IGOR DOMSKY and ANDREANI HADJISTERKOTI

Poster session. Prof. GIOVANNI POGLAYEN, Prof. ANTONIO SCALA, Prof. SALVATORE GIANNETTO, Italy (photo: V. Korshunov)

Coffee break

Prof. SALVATORE NAITANA, Italy, Dr. LUCA CORLATTI, Italy, Mrs. ANDRI GAITANI, Cyprus, Dr VASSILIKI KATI, Greece and ANTONELLA COTZA, Italy.

Dr. STEFAN MICHEL, Gernany. At the background Prof. BRUNO MASALA (Photo: E. Hadjisterkotis)

Prof. BRUNO MASALA, Italy and Mrs. MICHELLE GROSS, Germany

From Left: Mrs. ANDRI GAITANI, Dr. LUCA CORATTI, Italy, Prof. SALVATORE NAITANA, Italy, Mrs MICHELLE GROSS, Germany and Dr. MONICA GUERRINI, Italy, Miss LEONIE VIALE, Germany, Miss ANDREA LUIS, India and Mr. HARIS NIKOLAOU Cyprus (Photo: E. Hadjisterkotis)

Dr. LUCA CORLATTI, Italy, Mrs. ANDRI GAITANI, Cyprus, Dr CHRISTOS ARISTIDOU, Cyprus

Ms. LEONIE VIALE, Germany, Ms. CHRISTINA BALDWIN, Cyprus, Mr. HARIS NICOLAOU, Mr. COSTAS NICOLAOU, Cyprus and Mrs. RANJANA PAL, India

Mr. L. STEFAN EKERNAS, USA, Prof. SANDRO LOVARI, Italy, Prof. ANTONIO SCALA, Italy, Prof. BRUNO MASALA, Prof. SALVATORE NAITANA, Dr. LUCA CORLATTI, Mrs. ANDRI GAITANI and Dr. CHRISTOS ARISTIDOU, Cyprus

Dr HARITAKIS PAPAIOANNOU, Greece and Mr. ARASH GHODDOUSI, Iran

Mr. ARASH GHODDOUSI, Iran, Dr HARITAKIS PAPAIOANNOU, Greece, Mrs VASILIKI KATI, Greece

Meeting of the Scientific Committee

Prof. GIOVANNI G. LEONI, Prof. RAUL VALDEZ, Dr PAOLO MEREU, Dr. E. HADJISTERKOTIS, Prof. JUAN HERRERO, Prof. SANDRO LOVARI, Dr. LUCA CORLATTI, Prof. SALVATORE NAITANA (standing), Dr. FRANCESCO FERRETTI, Dr. CHARUTUT MISHRA and Prof. ANDRÁS NAHLIK (Photo: I. Hadjisterkotis)

Working dinner of the Scientific Committee

Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy, Dr. F. FERETTI, Mrs. TATIANA DOMSKAYA, Russia, Prof. ANDRAS NAHLIK, Hangury, Prof. Giovanni Leoni, Italy, Dr PAOLO MEREU, Italy, Prof. SALVATORE NAITANA, Italy, Prof. BRUNO MASALA, Italy, Prof. IGOR DOMSKIY, RUSSIA, Dr CHARUDUTT MISHRA, India, Dr LUCA CORLATTI, Italy, Mr. I. HADJISTERKOTIS (standing), Cyprus

Prof. SALVATORE NAITANA, Italy, Prof. BRUNO MASALA, Italy, Prof. IGOR DOMSKIY, Russia, Mrs. TATIANA DOMSKAYA, Russia, Prof. ANDRAS NAHLIK, Hangury, Prof. GIOVANNI LEONI, Italy

Dr CHARUDUTT MISHRA, Dr. LUCA CORLATTI, Italy, Dr E. HADJISTERKOTIS Cyprus, Prof. RAUL VALDEZ, USA and Prof. SANDRO LOVARI, Italy

Prof. GIOVANNI LEONI, Italy Prof. SALVATORE NAITANA, Italy, Prof. BRUNO MASALA, Italy, Prof. ANDRAS NAHLIK, Hangury, Dr E. HADJISTERKOTIS, Prof. IGOR DOMSKIY, Russia

Dr. E. HADJISTERKOTIS, Cyprus, Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy, Dr. FRANCESCO FERETTI, Italy

Prof. RAUL VALDEZ, USA, Dr. E. HADJISTERKOTIS, Cyprus, Prof. JUAN HERRERO, Spain, Prof. SANDRO LOVARI, Italy

Lunch break

Dr ZURAB GURIELIDZE, Georgia, Mrs. RANJANA PAL, India, Cyprus, Miss ANDREANI HADJISTERKOTI, Cyprus, Mr. IRODOTOS KAKOURIS, Cyprus

Dr. KULBHUSHANSINGH SURYAWANSHI, India and Mrs. RANJANA PAL, India

Mrs. RANJANA PAL, India, Miss ANDREANI HADJISTERKOTI, Cyprus, Mr. IRODODOS KAKOURIS, Cyprus

Prof. GIOVANNI POGLAYEN, Prof. ANTONIO SCALA, Prof. SALVATORE NAITANA, Italy, Prof. SALVATORE GIANNETTO, Italy, (photo: E. Hadjisterkotis)

ANDREANI HADJISTERKOTI, Cyprus

Visit at the Photos Photiades Foundation – Museum of Natural History

Visit at the Photos Photiades Foundation – Museum of Natural History (photo: I. Hadjisterkotis)

At the mouflon exhibit, Photos Photiades Foundation – Museum of Natural History

Visit at the Photos Photiades Foundation – Museum of Natural History. Dr E. HADJISTERKOTIS discussing the age of the cyprian mouflon, based on horn rings (Photo: I. Hadjisterkotis).

Prof. JUAN HERRERO, Dr. MIKHAIL KORSHUNOV, Dr. VlADIMIR KORSHUNOV, UAE, ELEFTHERIOS HADJISTERKOTIS, Cyprus

Dr. VlADIMIR KORSHUNOV, and Mrs. ANDRI SAOUROU, Cyprus

At the mouflon exhibit at the Photos Photiades Foundation – Museum of Natural History (Photo: I. Hadjisterkotis)

Mr. Mikhail Korshunov, UAE and Mr. Gerhard Damm, South Africa admiring a Canadian Bear at the Photos Photiades Foundation – Museum of Natural History

Photos Photiades Foundation – Museum of Natural History. (Photo: V. Korshunov)

Supper at the Photos Photiades Foundation – Museum of Natural History

Prof. SALVATORE GIANNETTO, Italy, Prof. ANTONIO SCALA, Italy, Prof. GIOVANNI LEONI, Italy, Prof. SALVATORE NAITANA, Italy, Prof. BRUNO MASALA, Italy, Dr. PAOLO MEREU, Italy, Dr MARIO BARBATO, Italy, Prof. GIOVANNI POGLAYEN, Italy (photo: E. Hadjisterkotis)

Mrs. RANJANA PAL, India, Dr HARITAKIS PAPAIOANOU, Greece, Dr. ARASH GODDOUSI, Iran, Dr. KLEMEN GERINA, Slovenia, Prof. ANDRAS NAHLIK, Hangury.

Ms. LYNE MCFARLANE, New Zealand, Mr. RIYAZ AHMED, India, Dr. STEFAN EKERNAS, USA, Dr. STEFAN MICHEL, Germany and Dr. CHARUTUTT MISHRA with his wife Mrs. APARAJITA DATTA

Prof. IGOR DOMSKY, Mrs. TATIANA DOMSKAYA, Russia, Mr. ARSEN DOTSEV, Russia, Dr. CHRISTOS ARISTIDOU, Cyprus, Prof. ANDREAS POLYVIOU, Greece, Dr. E. HADJISTERKOTIS, Cyprus, Dr. VLADIMIR KORSHUNOV, UAE, Mr. EVGENII LIKHATSKII, Russia, Mr. IGOR DOLGOPOLOV, Russia

Visit at Kykkos Holy Royial Monastery

Photo: Ieronymos Hadjisterkotis

Photo: Vladimir Korshunov

Excursion at Cedar valley

Cedar Valley. (Photo: Vladimir Korshunov)

Arrival at Stavros tis Psokas Forest Station

Prof. JUAN HERRERO, Spain, carrying a case of Vouni Panayia Agrino wine, followed by Prof. ANDRÁS NÁHLIK, Hungary, Prof. BRUNO MASALA, Italy, Dr. STEFAN AVRAMOV, Bulgaria, Ms. LYNE MCFARLANE, New Zealand, Prof. FILIPPO BARBANERA, Italy, Mr. EVGENII LIKHATSKII, Russia, Mr. IGOR DOLGOPOLOV, Russia, Dr. VLADIMIR KORSHUNOV, MIKHAIL KORSHUNOV, Russia, Mrs. TATIANA DOMSKAYA, Russia, etc.

Ms. MICHELLE GROSS, Germany, RALF BÜRGLIN, Gernany, Dr KLEMEN GERINA, Slovenia, Mr. ARASH GHODDOUSI, Iran, Dr. STEFAN MICHEL, Germany

Prof. JUAN HERRERO, Spain and Prof. SANDRO LOVARI, Italy, Ms. ANTONELLA COTZA, Italy

Prof. SANDRO LOVARI AND ELEFTHERIOS HADJISTERKOTIS (Photo: RalfF Bürglin)

Pafos Forest

Prof. BRUNO MASALA, Dr. PAOLO MEREU, Dr. MARIO BARBATO, and Prof. SALVATORE NAITANA

Prof. ANDRÁS NÁHLIK, Hungary, Prof. IGOR DOMSKIY, Russia, and TATIANA

Prof. ANDRÁS NÁHLIK, Hungary , Prof. IGOR DOMSKIY, Russia, Dr. STEFAN MICHEL, Germany, RALF BÜRGLIN, Gernany and Ms. MICHELLE GROSS, Germany.

Stavros tis Psokas Forest Station with LEON Beer and wine Agrino - Vouni Panayia Winery. From the left: Prof. FILIPPO BARBANERA, Dr. MONICA GUERRINI, Mr. STAVROS IRAKLEOUS, Mrs. OLYMPIA POLYVIOU, Prof. ANDREAS POLYVIOU, Dr. EKATERINI ARISTIDOU and Dr. CHRISTOS ARISTIDOU.

(Photo: Vladimir korshunov)

From left to right: ARSEN DOTSEV, Russia, EVGENII LIKHATSKII, Russia, STEFAN AVRAMOV, Bulgaria, VLADIMIR KORSHUNOV,UAE, IGOR DOLGOPOLOV, Russia

Cyprus mouflon at Stavros tis Psokas Forest Station

Three male Cyprus mouflon resting at Stavros tis Psokas Forest Station

Female Cyprian mouflon

Ieronymos Hadjisterkotis walking towards the enclosure of the Cyprian mouflon at Stavros tis Psokas Forst Station

At the enclosure of the cyprian mouflon. Prof. ANDRÁS NÁHLIK, Hungary, Prof. RAUL VALDEZ, USA and Dr. KLEMEN JERINA, Slovenia, in search of cyprian mouflon

Farewell dinner – 1st of September 2016

Elena Yerolemou, Cyprus, Prof. ANDRÁS NÁHLIK, Hungary and Mrs. CONNY DAMM, South Africa

Dr Riyaz Ahmad, India, Ms Elena Yerolemou, Cyprus, Dr. MARIOS ANDREOU, Cyprus, Prof. ANDRÁS NÁHLIK, Hungary, Mr. IERONYMOS HADJISTERKOTIS, Mr. GERHARD DAMM, South Africa

Dr Dr CHARUDUTT MISHRA, India, Mrs. CONNY DAMM, South Africa, Dr. KULBHUSHANSINGH SURYAWANSHI, India, and Mrs. MARIA THEOCHAROUS, Cypruis

Prof. ANDRÁS NÁHLIK, Hungary, Mr. IERONYMOS HADJISTERKOTIS, Cyprus, Mr. DIMITRIS THEOCHAROUS Cyprus and Miss ELENA YEROLEMOU, Cyprus

Mrs. MARIA THEOCHAROUS, Cyprus and Prof. ANDRAS NAHLIK, Hangury, Mrs. CONNY DAMM, South Africa

Dr. KULBHUSHANSINGH SURYAWANSHI, India, Mrs. MARIA THEOCHAROUS, Cyprus and Prof. ANDRÁS NÁHLIK, Hungary

Dr. KULBHUSHANSINGH SURYAWANSHI, India

Prof. ANDRAS NAHLIK, Hangury, CONNY DAMM, South Africa, Mr. GERHARD DAMM, South Africa, Prof. RAUL VALDEZ, USA, Mr. DIMITRIS THEOCHAROUS, Cyprus, Mrs. MARIA THEOCHAROUS, Cyprus and Dr. ELEFTHERIOS HADJISTERKOTIS, Cyprus

Prof. ANDRAS NAHLIK, Mrs. CONNY DAMM, Mr. GERHARD DAMM, Prof. RAUL VALDEZ, Mr. DIMITRIS THEOCHAROUS and Mrs. MARIA THEOCHAROUS

Prof. BRUNO MASALA, Italy, Dr. PAOLO MEREU, Italy, Dr. MARIO BARBATO, Italy, Dr ELODIE PORTANIER, France, Dr. ALKIVIADES GESKOS, Greece, Prof. GIOVANNI LEONI, Italy, Prof. SALVATORE GIANNETTO, Italy and Prof. SALVATORE, NAITANA, Italy.

From the left: Mrs. RANJANA PAL, India, Mr. RIYAZ AHMED,India, Dr. KULBHUSHANSINGH SURYAWANSHI, India, Dr. STEFAN EKERNAS, USA, Dr ABHISHEK GOSHAL , India, Dr. CONSTANTINOS KOUNNAMAS, Cyprus, Dr MARIOS ANDREOU, Cyprus, and Dr. NICOLAS-GEORGE ELIADES, Cyprus

Prof. SANDRO LOVARI, LUCA CORLATTI, Ms. ANTONELLA COTZA, Dr. MONICA GUERRINI, Prof. FILLIPPO BARBANERA, Mr. PANIKOS PANAGIDES and NICOLO FATORINI. Italy

ANDREA LUIS, India, MIKHAIL KORSHUNOV, UAE, KLEMEN GERINA, Slovenia, ARASH GODOUSHI, Iran, Dr CHARUDUTT MISHRA, India, Mr. SHASHANK ARYA, India and ANDREANI HADJISTERKOTI, Cyprus

Dr ELEFTHERIOS HADJISTERKOTIS introducing the folkloric dancing group Akrites Geriou

Akrites Geriou dancing the dance of the Shepherds, a Cypriot traditional dance with archaic roots.

Participants of the congress relaxing, admiring and dancing traditional Cypriot dances. On the left lower picture: ANTONELLA COTZA, MONICA GUERRINI and ANDRÁS NAHLIK. Lower right: Prof. BRUNO MASALA

THE END OF THE SHOW

Dr CONSTANTINOS KOUNNAMAS, Miss ANDREANI HADJISTERKOTI and Miss ANDREA LUIS

Dr ELEFTHERIOS HADJISTERKOTIS, Prof. RAUL VALDEZ, Mr. GERHARD DAMM and the winner of the CIC Caprinae Atlas of the World GEORGIOS SPYRIDAKIS from Cyprus. The Atlas was a contribution of Prof. RAUL VALDEZ.

After the congress…..

With Prof. ANDREAS POLYVIOU studying the biodiversity of Alona village, a Natura 2000 site, part of Troodos massif.

Professor BRUNO MASALA, Italy and Mr. PANAYIOTIS PETROU, Cyprus. Athalassa National Park Environment Center, Department of Forestry, Nicosia.

LIST OF PARTICIPANTS

	Country	**No of participants**	**No of co-authors**
1	Austria		1
2	Australia		2
3	Bulgaria	1	
4	Canada	2	1
5	China		1
6	Croatia	2	4
7	Cyprus	47	2
8	France	1	6
9	Georgia	1	1
10	Germany	5	6
11	Greece	5	3
13	Iran	1	3
14	Hungary	1	1
15	India	11	18
16	Italy	15	23
17	Mongolia		1
18	New Zealand	1	3
20	Norway		1
19	Pakistan		14
20	Portugal		1
21	Russian Federation	5	11
22	Slovenia	1	
23	South Africa	2	
24	Spain	1	10
25	Unided Arab Emirates	2	
26	UK	1	4
27	USA	2	6
		105	**123**
Total number of participants			**228**

Number of participants

A/A	Name and address	Country
1	**Dr Stefan Avramov** Protected Areas and Species Expert, Bulgarian Biodiversity Foundation, P.O.Box 130, Haskovo 6300, Bulgaria mobile: ++359 877 511 577 email: sga@escom.bg skype name: stefanavramov www.facebook.com/stefan.avramov www.bbf.biodiversity.bg	Bulgaria
2	**Prof. Marco Festa-Bianchet** Département de biologie, Université de Sherbrooke Sherbrooke, Québec J1K 2R1 Canada Tél +1 (819) 821-8000 poste 62061 Fax (819) 821-8049 http://marco.recherche.usherbrooke.ca/ E-mail: Marco.Festa-Bianchet@USherbrooke.ca	Canada
3	**Prof. K.E. Ruckstuhl** Associate Professor, Biological Sciences, University of Calgary, Calgary, Alberta, Canada.	Canada
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