



Annual Report 2013

*Centre for Research and Conservation
Royal Zoological Society of Antwerp*



Cover image: *Ara militaris* "I've got you under my skin" (Jeroen Stevens)

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Annual Report 2013

Met een samenvatting in het Nederlands



KMDA

Koninklijke Maatschappij voor Dierkunde van Antwerpen vzw
ZOO Antwerpen | Planckendael | Koningin Elisabethzaal

Contents

MISSION STATEMENT AND CONSERVATION STRATEGY	5
INLEIDING EN SAMENVATTING	6
INTRODUCTION TO THE CRC	9
1 MAINTAINING OUR POSITION AS A CENTRE OF EXCELLENCE FOR CONSERVATION RESEARCH	10
<i>APPLIED CONSERVATION RESEARCH</i>	10
<i>APPLIED ANIMAL WELFARE RESEARCH</i>	15
<i>BASIC ZOOLOGICAL RESEARCH</i>	17
<i>SCIENTIFIC PUBLICATIONS</i>	19
2 BUILDING AND EXPANDING LINKS WITHIN THE ZOO COMMUNITY & SHARE INFORMATION / RESOURCES	23
3 FOCUSING ON INTEGRATED, SCIENCE-BASED CONSERVATION ACTIONS	24
4 TRAINING FUTURE GENERATIONS OF CONSERVATION PROFESSIONALS	27
5 EDUCATING, INFORMING AND INSPIRING THE PUBLIC, POLICY MAKERS AND OTHER STAKEHOLDERS	29
STAFF AND GOVERNANCE	30



RZSA Mission Statement and Conservation Strategy

The zoo and aquarium world is changing rapidly, and modern zoos have a huge potential to be more than just places where people can enjoy exotic animals and have a relaxed day out. The World Zoo and Aquarium Conservation Strategy, for example, calls on zoos and aquariums to convert into centres of integrated conservation, and become more involved in biodiversity conservation, scientific research and public outreach. However, from a commercial point of view, zoos and aquariums face increasing competition from new strong players in the leisure and entertainment industry. To meet these challenges the RZSA developed the Management Plan 2020, expressing where the RZSA wants to stand and what it wants to have achieved by the year 2020. The following mission statement is one of the outcomes of that exercise.

In a world where the relationship between man and nature is under constant pressure, the RZSA offers a sustainable experience of nature, aimed at arousing wonder and exoticism. This is achieved through science-based management of our animal collections, in combination with a high quality experience-based customer approach. In this way the RZSA aims to contribute to the general wellbeing of its visitors, to actively support biodiversity conservation, and to promote a lasting connection between humans and animals.

CRC Mission Statement

Using scientific research in biology and veterinary medicine as the principal tool, the Centre for Research and Conservation plays a key role in accomplishing the RZSA's mission to actively support biodiversity conservation. The CRC's Strategic Plan for Scientific Research covers a 5-year period (2012-2016) and aims to place research at the service of biodiversity conservation by focussing on research activities that contribute to the sustainable management of zoo and wildlife populations. In agreement with the RZSA mission statement, the CRC mission statement is:

Based on high quality scientific research, the CRC works towards the sustainable management of small populations in a changing world. The CRC contributes to the advancement of scientific zoological knowledge, scientific training and public education, and apply this to actively support international conservation breeding programmes; safeguard the well-being and health of zoo animals; and protect wild animals and their natural environment.

Strategic Objectives

In its Strategic Plan, the CRC has identified the following strategic objectives which will contribute to delivering this mission statement for the 5-year period covering 2012-2016.

- 1. Maintaining our position as a centre of excellence for conservation research (to guarantee high quality scientific research and to contribute to the advancement of scientific zoological knowledge)*
- 2. Building and expanding links within the zoo community and share information and resources (to guarantee high quality scientific research for providing support for international conservation breeding programmes and safeguarding the well-being and health of zoo animals)*
- 3. Focussing on integrated, science-based conservation actions (to actively support international conservation breeding programmes and protect wild animals and their natural environment)*
- 4. Training future generations of conservation professionals (to contribute to the advancement of scientific zoological knowledge and scientific training)*
- 5. Educating, informing and inspiring the general public, policy makers and other stakeholders (to contribute to the advancement of scientific training and public education.)*

Inleiding en samenvatting

Bijdragen aan het behoud van biodiversiteit maakt integraal deel uit van de missie van de Koninklijke Maatschappij voor Dierkunde van Antwerpen (ZOO Antwerpen en Planckendael). Het onderzoeksinstituut van de KMDA, het Centre for Research and Conservation of kortweg CRC, zet zich volop in om deze missie dag in dag uit waar te maken. Niet enkel om de dagelijkse werking van onze eigen dierenparken en internationale kweekprogramma's te ondersteunen, maar ook met het oog op het behoud van bedreigde diersoorten in hun natuurlijke leefomgeving.

De invulling van de wetenschappelijke missie van de KMDA is gebaseerd op een convenant tussen de Vlaamse overheid en de KMDA voor de periode 2012-2016. Die overeenkomst maakt het mogelijk de werking van het CRC voort te zetten en nieuwe innovatieve onderzoeksprojecten op te zetten in samenwerking met Vlaamse en internationale wetenschappelijke instituten. Met de steun van de Vlaamse overheid financiert de KMDA niet enkel het CRC en de onderzoeksprojecten in ZOO Antwerpen en dierenpark Planckendael, maar ook het wetenschappelijk onderzoek in het kader van de natuurbeschermingsprojecten van de KMDA in Afrika en Zuid-Amerika. Vanuit de strategische keuzes die werden omschreven in het Managementplan 2020 van de KMDA, verzekert de overeenkomst met de Vlaamse overheid de wetenschappelijke missie van de KMDA tot en met het jaar 2016.

Met de uitgebreide deskundigheid op het gebied van diergeneeskunde, diergedrag en -welzijn, conservatiegenetica, functionele morfologie en biomechanica, en gedragsecologie werken de biologen en dierenartsen van het CRC samen aan interdisciplinaire onderzoeksprojecten rond de thema's Toegepast Natuurbehoud, Toegepast Dierenwelzijn en Fundamentele Dierkunde. In het voorliggende jaarrapport over 2013 geven we een overzicht van de onderzoeksactiviteiten van het CRC in het afgelopen jaar binnen deze drie thema's.

1 - TOEGEPAST NATUURBEHOUD

De focus van het thema toegepast natuurbehoud betreft de wetenschappelijke ondersteuning van het beheer van dierenpopulaties in diertuinen en in de natuur. Met het genetisch onderzoek in de eigen laboratoriumfaciliteiten ondersteunt het CRC het beheer van de kweekprogramma's waarvoor de KMDA zich tegenover de internationale zoo-gemeenschap engageert, zoals bijvoorbeeld die van de goudkopleeuwapen, bonobo's, okapi's en monniksgieren.

Gedragsecologie van primaten is de voornaamste focus van de projecten in Brazilië en Kameroen. Door middel van fundamenteel én toegepast ecologisch onderzoek beogen deze projecten enerzijds bij te dragen aan de bescherming van primaten en hun leefomgeving. Anderzijds werken we samen met NGO's aan het bevorderen van het duurzaam gebruik van natuurlijke hulpbronnen door middel van 'community-based conservation' en 'capacity building', om zo een toekomst voor bedreigde diersoorten te garanderen.

2- TOEGEPAST DIERENWELZIJN

Het onderzoek in het thema toegepast dierenwelzijn heeft betrekking op de praktische integratie van gedragsonderzoek en diergeneeskundig onderzoek in het beheer van diertuincollecties. Binnen het CRC richt het toegepast gedragsonderzoek zich onder meer op de invloed van het ontwerp én de inrichting van dierenverblijven op het gedrag en welzijn van de dieren. Daarnaast worden korte projecten uitgevoerd om vragen of problemen die zich voordoen vanuit de dagelijkse praktijk in onze beide parken te beantwoorden. Vanuit de onderzoeksdiscipline diergeneeskunde voert de dierenarts vooral gelegenheidsonderzoek uit in de praktische

veterinaire geneeskunde, nog altijd van het allergrootste belang voor het welzijn van de dieren in onze parken.

3- FUNDAMENTELE DIERKUNDE

Het onderzoeksthema fundamentele dierkunde is erop gericht om gebruik makend van de specifieke expertise van de KMDA-wetenschappers fundamenteel-wetenschappelijke vraagstukken in de biologische wetenschappen te beantwoorden. De kern van het dierkundig basisonderzoek betreft vooral de studie van evolutionaire processen die aan de basis liggen van verschillen in sociale organisatie, voortplantingsstrategieën, sociaal gedrag en cognitieve vaardigheden van dieren. Daarnaast biedt dit onderzoeksthema de mogelijkheid om in te gaan op expliciete vragen vanuit de academische gemeenschap naar specifieke expertise van de KMDA-wetenschappers, en mogelijkheid om onderzoek te doen dat moeilijk elders uitgevoerd kan worden.

Invulling strategische doelstellingen & wetenschappelijke output

De steun van de Vlaamse overheid laat de KMDA niet alleen toe om voort te bouwen op de bestaande onderzoeksexpertise binnen het CRC, maar ook om te kunnen reageren op nieuwe wetenschappelijke uitdagingen. Wat betreft haar wetenschappelijke missie wil het CRC adequaat kunnen reageren op nieuwe wetenschappelijke en maatschappelijke ontwikkelingen, onder meer door nieuwe methoden te ontwikkelen en aan te wenden, door het aantrekken en delen van expertise, en door te investeren in nieuwe samenwerkingsprojecten met nationale én internationale partners. Het Strategisch Plan voor Wetenschappelijk Onderzoek 2012-2016 van het CRC omvat daartoe vijf strategische doelstellingen. Voor elk van deze doelstellingen, en voor de Key Performance Indicators die in samenspraak met de Vlaamse overheid werden vastgelegd, geven we hieronder een kort overzicht van de behaalde resultaten voor het jaar 2013.

Doelstelling 1: De positie van het KMDA-CRC als een excellentie-centrum voor diertuin- en natuurbehoudsonderzoek bestendigen en verder uitbouwen.

Op wetenschappelijke vlak leverde het CRC in 2013 het hoogste aantal publicaties in het twaalfjarige bestaan van het CRC, met in totaal 34 publicaties in internationaal erkende wetenschappelijke tijdschriften. Onze onderzoekers presenteerden hun werk ook in verschillende vakbladen en op talrijke internationale wetenschappelijke congressen en symposia.

Nieuwe samenwerkingsovereenkomsten werden er in 2013 getekend met onder andere het Max Planck Institute for Evolutionary Anthropology in Leipzig; het Leibniz-Institut für Zoo- und Wildtierforschung in Berlijn, de Universiteit van Helsinki, het Bicho do Mato Instituto de Pesquisa BH-MG-Brazil, en de Belgische Federale Overheidsdienst Volksgezondheid, Veiligheid van de voedselketen en Leefmilieu. Verder werden drie bestaande overeenkomsten met universiteiten in eigen land in 2013 voor 1 of 2 jaar hernieuwd.

Het wetenschappelijke hoogtepunt van 2013 was de afronding en zeer succesvolle openbare verdediging van het doctoraat van de Kameroense doctorandus Denis Ndeloh Etiendem over de socio-ecologie van Cross-river gorilla's.

Als mede-gastgever organiseerde het CRC samen met de Universiteit Antwerpen in september 2013 het vijfde congres van de "European Federation for Primatology". Met een deelname van maar liefst 250

primatologen van over de hele wereld kan deze bijeenkomst met recht de meest succesvolle en best bezochte editie van de EFP-congressen genoemd worden.

In 2013 werd de nieuwe wetenschappelijke adviesraad voor de KMDA ingesteld bestaande uit verschillende experts uit binnen- en buitenland die ieder hun sporen verdiend hebben op een of meerdere van de wetenschappelijke vakgebieden waarin het CRC actief is.

Dat het wetenschappelijk werk van de KMDA internationaal hoog in aanzien staat moge blijken uit een vermelding in een artikel over “Conservation in Captivity” in het wetenschappelijk tijdschrift *NATURE* (volume 498, 13 juni 2013). Daarin wordt “Antwerp Zoo in Belgium” genoemd als een van de dierentuinen met “robust conservation-science programmes”, naast grote kleppers als San Diego Zoo en Smithsonian Institution’s National Zoo in Washington DC in de Verenigde Staten, en London Zoo in het Verenigd Koninkrijk.

Doelstelling 2: De samenwerking binnen de internationale dierentuingemeenschap verder uitbouwen en intensiveren.

In het kader van de verdergaande internationalisering van de onderzoeksactiviteiten was het CRC ook in 2013 weer actief betrokken bij verscheidene Europese en andere internationale platforms om mee vorm te geven aan het internationale beleid betreffende zoo-onderzoek en soortenbescherming. Getuige hiervan de actieve rol binnen EAZA, de Europese vereniging van dierentuinen en aquaria. CRC stafleden zijn onder andere zeer actief binnen de ‘Executive Committee’ en de ‘Research Committee’ van EAZA. Het CRC levert bij voorbeeld de voorzitter van de Research Committee en promoot en faciliteert op deze wijze mede de uitvoering van wetenschappelijk onderzoek in Europese dierentuinen. In juli 2013 verscheen onder auspiciën van dit comité het eerste nummer van een nieuw wetenschappelijk tijdschrift voor de dierentuin-gemeenschap, het *Journal of Zoo and Aquarium Research*. Het CRC speelde verder in 2013 een belangrijke adviserende rol bij de totstandkoming van het “*EU Zoos Directive Guidance and Best Practice*” document dat in opdracht van de Europese Commissie werd ontwikkeld. De specifieke contributie van het CRC betreft de implementatie van de Europese Dierentuinwetgeving op het gebied van wetenschappelijk onderzoek en natuurbehoud. De CRC wetenschappers en andere medewerkers van de KMDA zijn bovendien nauw betrokken bij de trainingen en opleidingen voor medewerkers van collega-dierentuin in het kader van de EAZA Academy.

Doelstelling 3: Streven naar geïntegreerde conservatieacties gebaseerd op wetenschappelijk onderzoek

Natuurbehoud zit verweven in de missie van de KMDA, en het CRC levert met de conservatieprojecten in *Projet Grand Singes* in Kameroen en *BioBrasil* in Brazilië een bijdrage aan de bescherming van bedreigde diersoorten en hun natuurlijke omgeving. Voor beide projecten geldt dat we in een geïntegreerde aanpak beogen wetenschappelijk onderzoek te combineren met natuurbehoud en socio-economische initiatieven waarbij de lokale bevolking wordt betrokken bij in alle aspecten van het project.

BioBrasil

Het conservatieproject “*BioBrasil*” heeft tot doel de ecologie en het gedrag te bestuderen van goudkopleeuwapen in het Atlantische kust-regenwoud van Bahia, Brazilië. Versnippering en vernietiging van het woud vormen de grootste bedreiging voor de overgebleven wilde populaties goudkopleeuwapen. Het CRC werkt nauw samen met plaatselijke onderzoeksinstituten en universiteiten om de wetenschappelijke expertise in Brazilië optimaal te benutten en te voorzien in de training van

Braziliaanse studenten en wetenschappers. Op deze manier wil het project garanderen dat de wetenschappelijke resultaten gebruikt worden voor het uitwerken van adequate beheersplannen voor de goudkopleeuwapen en hun landschap.

In 2013 werden de onderzoeksactiviteiten in het veld weer hervat na een korte periode van intensieve analyse van reeds verzamelde gegevens en waarin de toekomstvisie voor het project werd herbekeken. Via een samenwerkingsakkoord met de Universiteit van Santa Cruz (UESC, Ilhéus) wordt het onderzoek van *Project Biobrasil* vanaf 2013 vooral uitgevoerd door Braziliaanse masters- en doctoraatsstudenten die in het kader van dit samenwerkingsverband hun opleiding krijgen onder de deskundige supervisie van Kristel De Vleeschouwer.

Daarnaast is in 2013 met het doctoraat van Nima Raghunathan onderzoek van start gegaan naar de rol van klimaatsverandering op het Atlantische kust-regenwoud. Nima bekijkt onder meer welk effect klimaatsverandering heeft op het toekomstige verspreidingsgebied van boomsoorten die noodzakelijk zijn voor het voortbestaan van de goudkopleeuwapen.

Voor de logistieke en wetenschappelijke ondersteuning van *BioBrasil* tekende het CRC in 2013 een nieuwe samenwerkingsovereenkomst met het *Bicho do Mato Instituto de Pesca* BH-MG-Brazil.

Projet Grands Singes

In 2013 werkte *Projet Grands Singes* (PGS) verder aan de invulling van de natuurbehoudsmisssie van de KMDA in Centraal Afrika. De belangrijkste doelstelling van PGS is om door middel van wetenschappelijk onderzoek populaties chimpansees en gorilla’s te beschermen in de niet-beschermde bossen in Zuidoost Kameroen. De kapconcessies, bufferzones en gemeenschapsbossen rond het *Dja* reservaat worden nog veelvuldig gebruikt voor illegale jacht en landbouw, en de populaties mensapen komen mede hierdoor steeds verder onder druk te staan. Op de lange termijn heeft het onderzoeksprogramma van PGS tot doel meer inzicht te krijgen in hoe men de bescherming van mensapen het beste kan aanpakken. Op de korte termijn draagt de aanwezigheid van een onderzoeksteam direct bij aan de bescherming van het woud, enerzijds door jagers af te schrikken, anderzijds doordat de lokale onderzoeksmedewerkers doordrongen raken van de waarde van wilde dieren en intacte bossen.

In 2013 zette het CRC de eerste stappen op weg naar de ontwikkeling van een onafhankelijke Kameroenese NGO welke op termijn het conservatieproject zal overnemen. De doelstelling is dat tegen 2017 deze NGO verantwoordelijk zal zijn voor de volledige logistieke sturing van PGS én voor de uitvoering van ontwikkelingsdoelstellingen in samenwerking met de lokale dorpen. Het CRC zal vanaf dan enkel nog de wetenschappelijke component van het project voor haar rekening nemen.

Doelstelling 4: Bijdragen aan opleiding onderwijs en training van toekomstige generaties conservatiebiologen

Net als voorgaande jaren was het wetenschappelijk team actief betrokken bij de training van jonge wetenschappers op Vlaamse en Nederlandse universiteiten en hogescholen. In 2013 werkten enkele tientallen bachelor-, master- en doctoraatsstudenten aan hun eindwerk binnen het CRC.

In PGS werkten verschillende Kameroenese Master studenten aan een thesis in het kader van de lopende onderzoeken van doctorandi en de projecten van de vaste onderzoekers. Het onderzoek van *Project BioBrasil* leidde in 2013 tot twee Braziliaanse MSc thesissen over de ecologie van goudkopleeuwapen in *cabruca*-plantages.

Verder organiseerde het CRC verscheidene Bachelor- en Master-cursussen, in het bijzonder met de Universiteit van Antwerpen (Primatologie, Conservation Genetics) en de Universiteit Utrecht (Introduction to Zoo Conservation Biology), en gaven onze onderzoekers als gastdocent regelmatig onderwijs op universiteiten en hogescholen in binnen- en buitenland.

Doelstelling 5: Vormen, informeren en inspireren van het brede publiek, beleidsmakers en andere belanghebbenden

Educatie over wetenschappelijk onderzoek en natuurbehoud is één van kerndoelstellingen van het CRC onderzoeksteam. Vanuit die optiek werden de bevindingen van onze studies regelmatig naar het grote publiek gecommuniceerd, zowel door middel van educatieve panelen en gidsen-rondleidingen in Zoo en Planckendael, in duidingsprogramma's op radio en TV, via internet, en in kranten en populair wetenschappelijke tijdschriften. De vele publicaties van het CRC op het intranet en in het personeelskrant van de KMDA "Het Wandelend Blad" dragen bij tot informeren van het KMDA personeel, evenals artikelen in het Zoo Magazine, nieuwsbrieven en op internet. Met deze informatie voorzien de zoo-gidsen én de diervorzorgers via hun 'verzorgersbabbels' weer de bezoekers van onze parken.

Onderzoeksfinanciering

In 2013 ontving de KMDA van de Vlaamse overheid een totaal subsidiebedrag van €908.000 voor het uitvoeren van de wetenschappelijke

opdracht zoals omschreven in het convenant tussen de KMDA en de Vlaamse overheid Wetenschappelijk Onderzoek 2012-2016. Daarnaast wist het CRC in 2013 een bedrag van €228.000 aan externe onderzoeksfinanciering te verzekeren. Een belangrijk deel daarvan werd als doctoraatsbeurs verworven, een deel was afkomstig van conservatie-organisaties die fondsen toekenden aan de veldprojecten in Kameroen en Brazilië.

Aan het einde van het kalenderjaar maakte de FOD Volksgezondheid, veiligheid van de Voedselketen en Leefmilieu bekend dat ze voor de komende twee jaar een bedrag van €170.000 beschikbaar maakt aan een nieuw opgericht consortium van Universiteit Antwerpen, Katholieke Hogeschool Sint-Lieven en KMDA voor de ontwikkeling van objectieve welzijnsindicatoren voor reptielen en amfibieën.

Kort samengevat leverde het CRC ook in het jaar 2013 weer een kernbijdrage aan de natuurbehoudsmisssie en de doelstellingen van de KMDA, onder andere door actief bij te dragen aan natuurbehoud, wetenschappelijk onderzoek en educatie.

Antwerpen, April 2014

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Tabel 1: De strategische doelstellingen zoals omschreven in het Strategisch Plan 2012-2016 maken integraal deel uit van het convenant tussen de KMDA en de Vlaamse overheid. Deze strategische doelstellingen worden op basis van de voorziene toelage en beschikbare middelen van de Vlaamse overheid voor de periode 2012-2016 vertaald in een aantal specifieke performantie-indicatoren (Key Performance Indicators of KPI's). In 2013 werden 3 van de 4 performantie-indicatoren behaald.

Performantie-indicatoren		Resultaten 2013
KPI 1 Wetenschappelijke Publicaties	Het aantal artikels in wetenschappelijke tijdschriften en hoofdstukken in boeken met een leescommissie (de zogenaamde "peer reviewed" publicaties), met vermelding van de impact factor van het tijdschrift waarin de publicatie verscheen. Het aantal publicaties per jaar wordt bepaald als het ongewogen lopend gemiddelde van het jaar van evaluatie en de twee voorgaande jaren. Dit gemiddelde moet elk jaar stijgen. <i>Voor 2013 zal dit gemiddelde meer dan 20 publicaties bedragen.</i>	Aantal wetenschappelijke publicaties in 2013 = 34 Gemiddelde aantal publicaties over 2011/2012/2013 = 27 publicaties
KPI 2 Actieve deelname aan Wetenschappelijke Bijeenkomsten	Het aantal wetenschappelijke voordrachten op internationale bijeenkomsten: <i>jaarlijks minstens 20 wetenschappelijke voordrachten.</i>	56 wetenschappelijke voordrachten 16 poster presentaties
KPI 3 Samenwerking en Netwerken	Het aantal formele samenwerkingsovereenkomsten (samenwerking op projectbasis, strategische partnerschappen) met binnen- en buitenlandse universiteiten, hogescholen, onderzoeksinstituten, overheidsdiensten etc. met de specifieke doelstelling gezamenlijk wetenschappelijk onderzoek uit te voeren: <i>jaarlijks minstens 2 nieuwe ondertekende overeenkomsten.</i>	6 nieuwe overeenkomsten getekend in 2013 3 overeenkomsten hernieuwd
KPI 4 Externe Financiering	De verhouding tussen de externe financiering voor wetenschappelijk onderzoek en toelage die het KMDA-CRC krachtens deze samenwerkingsovereenkomst inzake wetenschappelijk onderzoek van het Vlaamse gewest ontvangt. De doelstelling voor dit criterium is <i>30% externe financiering berekend op basis van de jaarlijkse toelage voor wetenschappelijk onderzoek.</i>	<ul style="list-style-type: none"> • <i>Doctoraats- & Postdocbeurzen</i> € 146.864 • <i>Conservatiebeurzen</i> € 64.032 • <i>Varia fondsen</i> € 17.459 + Totaal externe fondsen € 227.955 =25% van € 908.000,-

Introduction to the CRC

The RZSA has a long tradition of active research cooperation with universities and research institutions on a national and international level. In-house research activities increased significantly with the employment of a full-time researcher in 1988, and the initiation of a formal link with the University of Antwerp. In 2002 the RZSA signed a unique 5-year funding agreement with the Flemish government enabling the RZSA to establish its Centre for Research and Conservation (CRC): a designated scientific institute for zoo- and field-based conservation research. The CRC is still core-funded by the Flemish government through its department of Economy, Science and Innovation (EWI) after the initial 5-year funding agreement was renewed in 2007 and 2012. This funding agreement specifically states that the government subsidies can be used exclusively by the CRC to implement the RZSA conservation mission by means of scientific research related to nature conservation and animal welfare.

A key element in the mission statement of the RZSA is to actively contribute to the conservation of biological diversity and promote responsible stewardship of wildlife, supported by world-class scientific research. Zoo research and science-based husbandry and conservation breeding programmes managed by the CRC are one of the RZSA's main instruments to contribute to conservation, and a prerequisite to comply with the ethics and obligations for zoos and aquariums as documented in e.g. the EU Zoos Directive or the Convention on Biological Diversity (CBD), or by the International Union for the Conservation of Nature (IUCN).

The implementation of the conservation mission and the scientific assignments of the RZSA is greatly influenced by the professional communities, organisations and networks we work with and are actively involved in, like the European Association of Zoos and Aquaria (EAZA). Indeed, the RZSA is committed to working fully within the spirit and objectives of the 2005 World Zoo and Aquarium Conservation Strategy (WZACS), in which scientific research is considered indispensable for effective biodiversity conservation and zoo population management. Also the recommendations and goals of the Research Strategy of EAZA, and the research priorities of EAZA Taxon Advisory Groups and conservation breeding programme co-ordinators shape our research priorities and activities. As such, the CRC conducts scientific research in various zoological disciplines to contribute to a general understanding of wild animal and zoo populations, and to instigate, support and implement new and innovative strategies for small population management and conservation breeding.

Research and science-based working methods are the foundation for managing animal populations as effectively as possible, and requires the careful study and incorporation of ecological and evolutionary processes underlying species-specific behaviour, life histories, group dynamics, dispersal patterns, mate selection strategies, etc. To this end, the CRC performs applied and fundamental hypothesis-driven conservation research that contributes to the improvement of small population management. Science-based management of small populations of zoo animals lies at the heart of ex-situ conservation breeding, which has become the expertise and core business of many zoos and aquariums. With ongoing habitat destruction and fragmentation, and climate change looming as an additional threat to biodiversity, the knowledge and expertise that the zoo community has accumulated over the years in this field is now gradually starting to be incorporated in the management of wildlife populations and translated into effective conservation measures for small populations in wildlife reserves and natural habitats.

With its easy access to living collections of exotic animal species in Antwerp Zoo and Planckendael Animal Park, and with its research tradition and excellent in-house research facilities and laboratories, the CRC is uniquely placed to contribute to applied and fundamental conservation-related research.

Over the years the CRC research team has developed expert knowledge in different relevant fields of life-sciences research such as Veterinary Medicine, Animal Behaviour & Welfare (including animal husbandry), Conservation Genetics, Functional Morphology & Biomechanics, and Primate Ecology. Although these may seem very different research disciplines, the CRC team has gradually developed a routine of working in collaborative multidisciplinary projects, not just within the CRC, but mostly in close cooperation with scientists in the international academic and zoo communities. Capitalising on its research facilities and its specific research expertise, the CRC research team covers a broad range of research topics which are of particular relevance to the CRC's three key research themes: Applied Conservation, Applied Animal Welfare and Basic Zoological Research.

As a research centre embedded within a zoological garden, the CRC strategically chooses to focus on species with which the RZSA has a traditional link and species for which the RZSA has taken an exceptional long-term international commitment by agreeing to manage their breeding programmes or contribute to the protection of their counterparts in the wild. Species like Bonobo (*Pan paniscus*), Eurasian black vulture (*Aegypius monachus*), Okapi (*Okapi johnstoni*), Golden-Headed Lion Tamarins (*Leontopithecus chrysomelas*), and other species considered "RZSA ambassador species" are the focal species of our research activities.

The CRC aims to focus its research activities on the most relevant issues and developments in the zoo and the scientific community, thereby building on its expertise and research facilities. From an applied perspective the sustainable management of small populations is a focal study area, which is not only of great concern in relation to captive breeding in zoos, but also highly relevant to managing extensively managed populations in wildlife reserves or endangered populations in natural habitats. This emphasis is reflected in applied research projects in conservation biology and in animal welfare, which make up the core scientific activities of the CRC. Nevertheless, the CRC aims to remain flexible in setting research priorities to be able to respond to urgent conservation needs, to address fundamental biological questions by means of basic zoological research, or to react to explicit requests for expertise from the zoo community, the academic community, the government and the industry.

The financial support from the Flemish government does not only allow the CRC to further build on its solid research achievements, but also to respond to the new scientific challenges in biodiversity conservation. In our research and conservation projects we aim to respond adequately to the rapidly progressing scientific methods and techniques by investing in and adopting new research methods, by attracting novel expertise to the CRC, and by investing in new collaborative research projects. At the same time, the government funding supports the delivery of the RZSA's conservation mission, to work within the spirit of the World Zoo and Aquarium Conservation Strategy and to fulfil its requirements towards national zoo legislation and the European Zoos Directive in terms of actively contributing to conservation, research and public education.



Strategic objective 1

Maintaining our position as a centre of excellence for conservation research

Applied Conservation Research

Applied Conservation research is closely linked to dealing with intensively managed populations, either in zoos, or in conservation or reintroduction programmes (e.g. conservation breeding, small population management). Most of the CRC research projects relate to studying factors that can greatly influence zoo population structure, like mate choice, adaptation to captivity, selection processes (e.g. resistance to infectious diseases), effects of inbreeding and outbreeding etc. Detailed genetic analyses in our in-house laboratory facilities complement the conservation breeding programmes that are managed by the RZSA and help support detailed studbook analyses by the CRC. In concert with the expertise gained in the different research disciplines within the CRC we aim to work towards more efficient management and more viable or sustainable captive and wildlife populations.

The primary research topic in the RZSA field-based conservation projects in Brazil and Cameroon is primate ecology. These research-based projects contribute to the protection of primates and their habitats and to the sustainable use of natural resources by means of fundamental and applied ecological research in combination with capacity building, community-based conservation and promoting the sustainable use of natural resources.

Conservation genetics of zoo and wildlife populations

Peter Galbusera | Philippe Helsen

The management of small populations nowadays relies heavily on conservation genetics, using molecular tools to study the genetic aspects of intensively managed animal populations in captivity or in the wild. By using molecular techniques we aim to contribute to managing captive breeding programmes more efficiently and to sustainable captive and wildlife populations. Besides the routine molecular sexing of birds and comprehensive projects described hereafter, we also established smaller-scale projects that directly support captive breeding programs or field conservation projects run by the RZSA or by its partners. Examples of such projects are studies to determine the genetic diversity and population structure of Golden headed lion tamarins, Malayan tapirs, Andean bears; okapi and Military macaws in the wild and in captivity (see below).

For lion tamarins, for example we developed genetic markers and largely analysed the captive population, and we will continue to work with additional samples from the wild in collaboration

with a Brazilian lab. For Malayan tapirs, microsatellite markers were developed in collaboration with Leuven University, which will now need to be tested on a set of unrelated individuals. For okapi, the CRC is involved in a collaborative effort to investigate key aspects of population genetics and demography of the wild okapi population in the DRC. Our specific contribution is the sampling of captive individuals as well as museum specimens of okapi originating from as many localities throughout its range as possible. For the captive population these results will also be of extreme importance to keep track of parentage and to assess levels of inbreeding in comparison to the wild population.

Time line: 2002-ongoing

Partners: Filip Volckaert (KULeuven) | Adriana Grativol & Andreia Magro (Universidade Estadual do Norte Fluminense) | Tom Callens, Luc Lens (Ghent University) | Erik Matthysen (University of Antwerp) | David Stanton and Mike Bruford (Cardiff University) | Okapi Faunal Reserve | Martine Peeters (IRD, University of Montpellier), Ximena Velez-Liendo (Universidad Mayor de San Simon, Cochabamba, Bolivia), Paulina Viteri (University of Idaho USA),

Funding: CRC

Studying the genetic consequences of captive breeding through studbook analysis.

Philippe Helsen

An important topic in conserving sustainable ex-situ breeding populations is minimising the loss of genetic diversity. Minimising mean kinship based on species-specific studbooks (and more specifically the included pedigree information) is one of the main instrument to attain this goal. Besides pedigree information, many studbooks hold extra information on the individual level (e.g. general life-history, weights and seizures, husbandry and veterinary records among others). The combination of pedigree data on the one hand and this additional information on the other hand results in unique databases to study evolutionary processes.

Quantitative genetics, used to estimate the genetic architecture of specific phenotypic traits and predicting the evolutionary potential of these traits, has a long history in both wild and livestock breeding. However "Animal Models" (cf. mixed-effects models for quantitative genetic research) have only rarely been used within captive



populations of wild animals. Yet they might be useful in assessing the preservation of additive genetic variance of traits of ecological relevance, evaluate heritability, unravel potential evolutionary responses to selection in captivity, and assess covariance between traits, among others.

Conservation breeding programmes might benefit from such analysis, in that heritable changes, in reproductive traits for example, can have direct consequences on the success of specific breeding programmes and moreover might influence future reintroduction success. However the use of these models remains to be tested. Apart from evaluating the heritable basis for many traits, we therefore started a pilot project that envisages to test the use of these models in captive breeding settings

On the other hand, captive breeding programmes hold valuable information on the role of inbreeding depression. It has been argued that within wild populations demographic and environmental stochasticity will drive small population to extinction even before genetic factors come into play. However the most pressing deficiency in this debate comes with the lack of sufficient knowledge on the impact of inbreeding on the whole lifecycle in the wild. Avoidance of inbreeding has always played a central role in breeding programmes, but inbreeding levels do increase over time as such, creating interesting opportunities to evaluate the role of inbreeding in easily accessible populations for which many parameters are already available.

Time line: 2012 –ongoing

Funding: CRC

Genetic characterisation of Military macaw subspecies and its implication for the ex-situ breeding programme

Philippe Helsen

Military macaws have a discontinuous distribution range, stretching from Mexico to Argentina. Their patchy distribution range corresponds to three described allopatric morpho-subspecies (*A.m. militaris*, *A.m. mexicana* and *A.m. boliviana*) making this species interesting from a phylogeographic point of view. Taking part in the general trends of increased levels of habitat loss and illegal bird trade the species is listed on the IUCN Red List of Threatened Species and called into existence conservation breeding programmes. However due to uncertainties on subspecific variation, ex-situ species determination and/or possible hybridisation, current breeding programmes only include those birds for which initial sample locations are available. The consequence of this conservative strategy is that only a small number of confiscated macaws form the basis of the current *A. m. mexicana* breeding program, which interferes with the long-term sustainability of this population. As such resolving these taxonomic uncertainties is vital to safeguard the long-term

viability of all captive military macaw breeding programs.

As the studbook keeper of the European population of the Mexican military macaw (*Ara militaris mexicana*) we initiated a project on resolving taxonomic uncertainties for the species. To this end we use over 150-year old toe pads from historical collections of the American Museum for Natural History in New York of all described *A. militaris ssp* and its most closely related sister species (*A. ambigua*). Targeted enrichment strategies, a relatively novel high throughput sequencing method which already proved its strengths when dealing with highly fragmented DNA, will be used to evaluate genetic differentiation in the wild. In a first phase we aim to reconstruct the full mitochondrial genomes for all described subspecies (which will give us extra insight in the population genetic history of these species). Meanwhile we will scan neutral and coding nuclear regions to counteract maternally induced phylogenetic patterns and to get some first insights in functional adaptations of these different subspecies. One of the final objectives is to design diagnostic tools to characterise the current captive population, including specimens which could be used as potential founders.

Time line: 2013-2015

Funding: CRC

Genetics of mate choice in Eurasian black vultures

Katja Wolfram

The Eurasian Black Vulture, *Aegypius monachus*, a large raptor species of high conservation concern native to southern Europe and central Asia, is facing serious threats in the wild. An international conservation breeding program coordinated at Planckendael Animal Park, and reintroduction projects in southern Europe aim to maintain a stable captive population in European zoos while also producing enough young to be released into the wild each year, thereby re-establishing wild populations of this species in areas where it has been lost. However, the captive breeding programme has very limited success and preliminary behaviour studies and studbook analysis suggest that the absence of courtship behaviours and poor pair bond quality may be linked to the low breeding success rates.

In a broad scientific approach we are currently trying to understand the genetics underlying mate choice in this endangered species. In collaboration with multiple international partners to analyse mate choice criteria in *A. monachus* a special focus is set on the role of major histocompatibility complex (MHC) genes in mate preferences. Results are contrasted with information on general relationship among captive individuals and information on the birds' health condition. These

data will shed light on how MHC genotypes may impair or enhance pair bonding in captive breeding pairs, and as such possibly provide a promising tool for successful pair selection and matchmaking in the conservation breeding programme. A deep insight into the role of adaptive variation in response to how local selective constraints shape genetic differences in contemporary *A. monachus* will also be established. Understanding patterns of adaptive variation in *A. monachus* will improve the definition of conservation units for the wild population.

In addition, in close collaboration with the EEP manager and studbook coordinator for this species, Marleen Huyghe, scientifically assisted analysis of past decades of husbandry in this species aims to identify reasons for low captive breeding success. Immediate actions were also implemented, such as the construction of a "dating aviary" in Planckendael where young birds can actually choose a preferred mate, and the rematching of age-incompatible pairs resulting from these analyses including the monitoring the outcome.

Time line: PhD 2009-2014

Supervision: Peter Galbusera | Jill Shephard | Erik Matthysen (University of Antwerp) Funding: CRC (KMDA Dehousse)

Population genetics of Sulawesi ungulates

Peter Galbusera | Jill Shephard | Mia Hillyer

This project was initiated to investigate the genetic diversity of ungulate populations in situ and assess the relative diversity of ex situ breeding populations. This research encompasses the four largest endemic mammals of the Indonesian Island of Sulawesi; the anoas (*Bubalus (Anoa) depressicornis* & *B. (Anoa) quarlesi*), the babirusa (*Babyrousa babyrussa*) and the Sulawesi warty pig (*Sus celebensis*). Sulawesi Island is found in the Wallacea region of South-East Asia. This biogeographic area has been classified as one of 25 world hotspots for conservation. All four forest dwelling species are threatened by widespread habitat loss and uncontrolled hunting. Although international studbooks exist for the former three species, there are numerous uncertainties about these, preventing effective conservation breeding. Genetic analyses will increase our understanding and facilitate the management and conservation of captive as well as wild populations. To this end, a collaborative project was established with the University of Edinburgh and Bogor University, Indonesia, which was extended in 2008 with Durham University as a partner. meanwhile we completed the analysis of additional pig samples (including *Sus scrofa* from the region in order to detect possible hybridisation) and further inventoried/mapped the collection of samples and data sets. In 2013 the results were presented on several international conferences and a taxonomic revision was decided upon. Most of this work will be published in 2014.

Partners: Alastair McDonald, Sharron Ogle, James Burton, Darren Shaw (University of Edinburgh, UK) | Greger Larson (Durham University, UK) | Kristin Leus (RZSA and CBSG) | I Djuwa (IPB Bogor, ID).

Time line: 2006-2014 Funding: CRC / External

Breeding Bonobos for Diversity

Pieter Oliehoek | Zjef Pereboom

With the continuous pressure on endangered mammal species, ex-situ breeding programmes are more often implemented as a last resort for conservation. Conservation programmes have to avoid inbreeding depression and irreversible adaptation to captivity that would hinder reintroduction of endangered species. Maintaining sufficient initial genetic diversity of the captive population can avoid these complications. Since the capacity to accommodate specimens is limited, maximising genetic diversity within small populations is thus essential. In this project we aim to compare the efficacy of a breeding strategy based on Optimal Contribution Breeding with the Mean Kinship Breeding strategy using computer modelling based on real captive populations. The merit of each strategy will be exemplified using the global bonobo (*Pan paniscus*) zoo population as a model for the simulation.

The main goal of this project is to study whether using Optimal Contribution Breeding can maximise the capacity to maintain genetic diversity of endangered mammal species in captivity by using the bonobo captive population as a model species in these simulations. To achieve this we aim to: 1) Determine which diversity measures/scales are most informative in endangered animal populations in captivity; 2) Develop an algorithm to apply Optimal Contributions in practice that incorporates current progeny into the overall optimal contribution vector; 3) Compare current practices based on Mean Kinship breeding with the optimal contribution selection (OCS) algorithm developed by the diversity measures determined.

Time line: 2013-2014

Funding: CRC

Estimating demographic rates and assessing environmental effects on species survival: the use of ISIS data to conserve wild animal populations

Dalia Amor Conde | Zjef Pereboom

Habitat loss, infectious diseases, and invasive species continue to be among the key drivers of species extinction worldwide. Climate change increasingly represents an additional threat, in particular for polar and mountain species. As a result, predicting population trends for wild populations will be key to developing management programs to slow down current extinction rates. Extinction is in essence a demographic process, where mortality levels are higher than birth rates:

this eventually results in the total collapse of populations. Therefore, demography is a fundamental discipline that can inform the effective management of populations. For this, data on species demographic rates such as age at first reproduction, clutch and litter size among others are essential. To date, there are only sufficient demographic data available to parameterise population models for ~0.5% of the world's vertebrates. Without such data, Population Viability Analyses (PVA's) are limited in application and their value as a tool for informing conservation management questionable. However, ISIS (i.e. the International Species Information System) member institutions hold ~15% of the IUCN Red List threatened species, with data on these species stored in extensive ISIS databases. Such information, if properly calibrated, could substantially improve our ability to predict the dynamics of wild populations, and their response to a changing environment.

In this project we aim to use ISIS data to answer two key questions for species conservation: 1) For which types of species can we use ISIS data to parameterise PVAs and with what level of confidence, and 2) How do environmental effects influence demographic rates of species. Based on this knowledge we will be able to explore how environmental variables affect demographic trajectories using zoos as a control populations. These analyses will provide key insight for species survival analyses under different climate change scenarios. To do this we will compare species for which there is sufficient data available from ISIS-zoos and wild populations and assess if generalisations can be made for certain life history group's or/and phylogenetically related groups. This study will address one of the main limiting factors of managing species at risk of extinction: the lack of demographic data.

Timeline 2013-2015

Partners: Dalia Amor Conde, Max Planck Institute for Demographic Research, Odense, Denmark | Jonathan Wilcken, Auckland Zoo New Zealand | Nate Flesness | International Species Information System, USA

Funding: RZSA, MPI, Auckland Zoo

An evaluation of the success of historic reintroductions of European white storks

Jill Shephard | Peter Galbusera

After a dramatic population decline of European white storks (*Ciconia ciconia*) in their western and northern distribution, a number of independent reintroduction programmes were started in the mid 1950's to bring storks back to historical ranges, including a focal population based in Planckendael Wildlife Park. The population now has an extensive European breeding distribution from Iberia in the west to Russia in the east, and is bordered at the north and south by Finland and Greece respectively. Although these populations have been

monitored on a large scale, the consequences of the reintroduction programmes on population genetic structure, population dynamics, behaviour and life history traits have not been studied in detail before.

During the reintroductions, founder individuals were sourced from the eastern and western European distributions and Algeria. We used mitochondrial and microsatellite data to evaluate the impact of translocated individuals on the phylogeographic and demographic history of this species. Contrary to expectation, storks appear fairly uniform in their genetic profile throughout their European distribution; even though at the regional level there were higher levels of diversity than expected in an apparently bottlenecked species. Distinct genetic lineages in the mitochondrial data suggest geographic structure in the evolutionary past which long precedes dates associated with reintroduction activities. Additional evidence in the data suggests that populations may have been restricted to a number of refugial zones during past glaciation events. There is also strong evidence to suggest a southern-crossroads link through the Mediterranean basin that could have facilitated movement between east and west migration pools. This finding is particularly interesting as it could have played an important part in the movement of many species groups, not just European White Stork. Continued investigation is underway to study this southern-crossroads movement pathway. In 2013 we obtained and analysed samples from the Balkan region which will be included in further analyses and publication in 2014.

A second study focussed on observations suggesting that most first-winter individuals are still migrating to Africa, whereas an increasing number of adults are wintering in Europe, on or close to their breeding grounds. Using 10 years of satellite data collected from birds originating from Planckendael Animal Park we analysed migration routes to see whether there have been recent changes to migration behaviour. Data were analysed within a GIS framework to describe autumn and spring pathways, identify stopover sites, and identify differences in migration behaviour between juvenile and mature storks or between males and females. Three distinct patterns were seen in the data including full migrations to Western Africa as well as partial migrations to different focal sites in the Iberian Peninsula. Age appeared to be a significant factor in both migration distance and year to year variation. This very important work, which will be published in 2014, fills a knowledge gap with respect to this charismatic European species.

Partners: Dr O Olsson (Swedish White Stork Reintroduction Program & Lund University Sweden) | Dr Piotr Tryjanowski (Adam Michiewicz University, Poznań, Poland) | Dr Rob Ogden (Royal Zoological Society of Edinburgh) | Sam Rycken, Lenny Van Erp (HAS Den Bosch, Netherlands) | Kris Struyf (Natuurpark Het Zwin)



| Wim Van Den Bossche (BirdLife Belgium | Natuurpunt)
| Nico Verwimp (Nature and Forestry Office, Flemish Government)

Time line: 2007-2014

Funding: CRC

Investigating the role of gorillas in forest maintenance and regeneration

Charles-Albert Petre | Nikki Tagg

The role of primates as seed dispersers is widely recognised by ecologists and that of the western lowland gorilla in particular is of relevance, as this species seems to fulfil important criteria for effective dispersal, both quantitatively and qualitatively. One trait that makes it potentially unique as a seed disperser is its regular deposition of seeds in open canopy environments (which it prefers for nesting) where light will not be a limiting factor for subsequent seedling growth and survival. This may infer implications for population dynamics of dispersed plants and is relevant to timber exploiters as many timber species require a high light regime at seedling stage. Despite this importance, seed dispersal by the western lowland gorilla has not been thoroughly investigated. The present research aims to improve the knowledge of the ecological and economic functions fulfilled by the critically endangered western lowland gorilla in a logging concession at the northern periphery of the DBR. Through faecal content analysis, germination trials and monitoring of seedling emergence and growth, this study is designed to describe the diversity of species dispersed, elucidate whether or not other tight relationship exists between gorillas and plant species, and evaluate the effectiveness of dispersal directed towards nesting sites. We believe that providing an economic interest of western lowland gorilla conservation in logging concessions, i.e., quantifying the recruitment of seedlings of this timber species by gorillas, and describing how they contribute to forest regeneration and biodiversity maintenance, could be an effective strategy given that logging concessions harbour most remaining gorilla populations.

Results to date demonstrate that seeds of 57 species are consumed and passed undamaged by gorillas and one faecal clump contains, on average, 2.4 seed species and 51.8 seeds; a value which exceeds those previously reported for gorillas and confirms the unique quantitative contribution to seed dispersal of this primate species. Seeds remain in the gut on average for 54.7 hours (measured in captive gorillas), which enables their dispersal over long distances. Moreover, gut passage does not reduce the germination performances of seeds; on the contrary, half of all species tested experienced an enhanced germination success, possibly as a result of separation from the fruit pulp or abrasion of the seed coat. Furthermore, because of the preference of gorillas for nesting in open canopy areas and the

fact that half of all defaecation occurs at nest sites, most seeds are dispersed in habitats of early successional stages (62.7%), namely light gaps (23.8%) and young secondary forests (38.9%), with higher light regimes than other habitat types. The theory that gorilla-mediated seed dispersal directed at nest sites may be particularly suitable for post-dispersal seed fate has obtained support from ongoing pairwise comparison of seeds marked at nest site with seeds marked in control sites, where seedlings experience a higher survival and growth rate at nest sites. Furthermore, camera trap data demonstrate a potential; relationship between gorillas and one large-seeded commercial timber species, *Chrysophyllum lacourtianum* (Sapotaceae), whereby gorillas may play a particularly important dispersal-related role as alternative dispersers may be rare or non-existent.

Time line: PhD 2009-2015

Supervision: Nikki Tagg | Zjef Pereboom | Jean-Louis Doucet (Université de Liège, Gembloux Agro-Bio Tech) | Roseline Beudels-Jamar (Royal Belgian Institute for Natural Sciences)

Funding: CRC (KMDA Dehousse) / BelSPo (SSTC)

Project BioBrasil:

Research-based development of a conservation management plan for golden-headed lion tamarins

Kristel De Vleeschouwer

Due to continuing deforestation, the Brazilian Atlantic Coastal Rainforest with its high and unique biodiversity and one of the global conservation hotspots, has been reduced to less than 7% of its original size. The remaining forest is severely fragmented, presenting particular ecological challenges to plant and animal populations. Golden-headed lion tamarins (GHLTs) are small arboreal primates, endemic to the Atlantic Forest of Southern Bahia, and endangered as a result of habitat degradation and fragmentation. Though requiring tracts of relatively undisturbed forest, due to their specialised insect foraging methods and habit to sleep in tree holes, most populations today reside in highly fragmented and disturbed areas. The survival of Golden-headed lion tamarins (*Leontopithecus chrysomelas*) depends critically on increasing the area of protected forest, through forest linkage and corridor building. This requires information on the factors that determine carrying capacity, population dynamics, ecology and behaviour of the species in different habitats. To investigate the ecology and behaviour of the species in degraded and fragmented areas, and generate information which can be applied to develop guidelines for sustainable landscape management and recommendations for forest protection and corridor building in areas critical for connectivity, the CRC started the in-situ conservation Project BioBrasil. From 2002 through 2010, the field team worked in a degraded study area inside the Una Biological Reserve, Bahia,

Brazil. Using a combination of behavioural observations, vegetation analyses, nutritional and morphological analyses of food resources, faecal analyses and phenological follow-ups, we have so far gained detailed insight into the ecological characteristics of forest types that are suitable for GHLTs, and the factors that determine diet choice, home range sizes and seasonal range use, and the ways in which GHLTs alter their behaviour in relation to differences in forest types. The ultimate objective is to provide insight into fundamental questions on the ecological flexibility of species in response to forest fragmentation and disturbance, and provide basic information essential for the development of a conservation management and research plan in collaboration with local and international partners.

To this end field activities were re-initiated in 2013, but with a focus on forest fragments surrounded by agricultural land outside of protected areas. The new research activities aim to fill current knowledge gaps that are essential for the development of a GHLT Conservation Action Plan. The knowledge gaps are based on data analyses of the 2002-2010 period and on the conclusions of a symposium with key researchers and stakeholders in GHLT conservation organised by BioBrasil in December 2011. In addition, analysis and publication of research data and biological samples collected since 2002 continued. The following results were published or submitted for publication in 2013:

- As part of a collaboration with the Federal University of Piauí, clinical studies on faecal samples from wild GHLT populations of from different regions indicated that parasite load seems higher in protected areas, compared to samples from cocoa plantations (cabruca). This is probably related to environmental factors such as the encounter rate between GHLT groups, humidity conditions, and the amount of undergrowth in the habitat. These data were presented at the Brazilian Congress of Primatology and publication is being prepared.
- Comparison of behavioural data of GHLT groups ranging in degraded areas and cabruca plantations offered insight into the activity patterns and predator-related behaviour of the species in different habitats, including interspecific associations with De Wied's marmosets, and vertical stratum use. These data were presented at the Brazilian Congress of Primatology and various publications are being prepared or in revision.
- Data on fruit consumption were used to evaluate diet composition and fruit consumption in relation to seasonal variation in fruit availability. The results indicated GHLT diet is affected by seasonal variation of fruit availability. The results have been submitted for publication. We have also started a MSc project with the Université de Liège to evaluate home range size

variation in relation to resource abundance, based on available data.

- Demographic data collected from wild GHLTs were used to evaluate demographic models using constant versus variable mortality trajectories. The results showed that failure to account for age patterns of mortality and fertility can lead to large errors in prediction of future population dynamics. The results have been submitted for publication.

Timeline 2002-ongoing

Funding: CRC / LTBF / Mohamed Bin-Zayed Species Conservation Fund

The Ecology of Living in Small Fragments: Resource availability and feeding ecology of GHLTs groups in small fragments and the effects of matrix connectivity, hunting pressure and climate change on their long-term changes for persistence.

Kristel De Vleeschouwer

Golden-headed lion tamarins use both mature and degraded forest in addition to cabruca agroforest, the traditional form of cocoa cultivation used in Southern Bahia where cocoa is grown under the shade of native forest trees. Yet, cabruca can differ considerably in vegetation structure, which likely affects local habitat suitability and pathways for GHLTs to move between fragments. Cabruca is the principal habitat within the matrix connecting forest fragments, in addition to a variety of other landscape elements (e.g. pasture, agricultural areas) that are generally unsuitable for use as part of a group's home range but vary in suitability for GHLT movement between forest fragments. Currently very little information exists on the factors that limit GHLT movement between fragments and those that determine mortality of dispersing individuals in the matrix. Such data, however, are important determinants for the outcome of population and landscape models that test the long-term survival of wild GHLT populations given current and future changes in the landscape.

Genetic data suggest that, in the eastern part of the GHLT distribution range, gene flux is maintained in areas connected principally by mature and/or secondary forest, whereas gene flux in areas connected by cabruca alone seems compromised. This decreased gene flux is particularly important because the eastern region contains the only forest fragment large enough to sustain a genetically viable population of GHLTs. Given the extreme degree of fragmentation in the western portion of the GHLT distribution range, maintaining the integrity of the eastern forest block and its connectivity with other forest fragments in the landscape, thus ensuring gene flux, is critical for the long-term persistence of the species.

In order to develop sound conservation measures for both eastern and western populations of GHLTs, it is critical to understand ecological

pressures on individuals and groups in cabruca areas and in degraded fragments as well as factors that affect suitability and permeability of cabruca and other landscape elements. This will improve our understanding of the species' flexibility in using extremely fragmented and degraded habitat and the actual potential of the matrix for maintaining connectivity and gene flux between GHLT populations in fragments across the landscape. Such information is essential for the definition of effective landscape management scenarios compatible with the long-term persistence of self-sustaining GHLT populations in southern Bahia.

In addition to matrix permeability and the particular characteristics of the fragment in itself, additional factors acting on a larger scale (ecosystem) may affect the viability of GHLT groups in small and medium sized fragments. GHLTs, along with other frugivorous species are important dispersers of a large number of tree species. Particularly in small fragments, the disperser assembly is likely to be impoverished, both due to changes in the availability of resources to dispersers, difficulties with dispersers reaching fragments, and human activities e.g. hunting and logging or forest-degrading activities that directly impact on disperser presence and activity. Even if present in small fragments, the medium- and long term establishment of tree species that are key to GHLTs may be compromised as a result of these factors, implicating on the availability of GHLT resources in the long term. Additionally, larger scale factors such as climate change may impact on the distribution patterns of important tree species.

The current overall research program conducted by Project BioBrasil intends to study the effects of forest fragmentation on GHLTs (and possibly other frugivores) in small to medium sized fragments from several perspectives: 1) By investigating matrix permeability around small fragments considered at the limit of carrying capacity for a group of GHLTs; 2) By investigating the ecology of GHLT groups living in small fragments; 3) By investigating the factors that affect the short-, medium and long-term availability of resources in small and medium sized fragments: spatial and temporal changes in seasonality (intra- and interannually), effects of climate change on the distribution of key tree species; diversity of the disperser assembly contributing to maintaining key plant resources for GHLTs and the resources available to them in small fragments; the intensity of hunting in fragments and its impact on the disperser assembly.

In 2013 we initiated a masters project to study the impact of vegetation structure on the presence of groups of golden-headed lion tamarins (GHLTs) in forest fragments and cabruca areas in southeastern Bahia, to be implemented by Henrique Ribeiro Chagas (Universidade Estadual da Santa Cruz). The objective of this study is to verify the

relationship between vegetation structure and GHLT presence/absence in forest fragments and cabruca areas, and uses playback of vocalisations along transects and quantification of vegetation structure in areas with and without GHLTs. The results will provide information on landscape and vegetation characteristics that can be used to predict the occurrence of GHLTs, both in forest and in cabruca, useful for the definition of local landscape management actions that favour the persistence of GHLT populations.

We further established a new field site and started working with new groups of GHLTs in fragments surrounded by agricultural land use outside of protected areas. These groups will be studied as part of a doctoral study to be initiated in 2014.

Principal Investigator: Kristel De Vleeschouwer

Collaborators: Leonardo de Carvalho Oliveira, Samantha Rocha, Henrique Ribeiro Chagas, Juliana Monteiro de Almeida Rocha, Eliana Cazetta, Deborah Faria, Alexandre Schiavetti, Luciana de Castilho Costa, Nima Raghunathan, Michael de Souza Pessoa, Becky Raboy.

Timeline: 2012-2017

Funding: CRC, LTBF, Mohamed Bin-Zayed Species Conservation Fund, CAPES-WBI, CNPq, UESC

Climate change impacts on the distribution of key tree species used by endemic lion tamarins in the Brazilian Atlantic Forest: Applications to conservation.

Poornima Raghunathan | Kristel De Vleeschouwer

The aim of this study is to understand how lion tamarins and their habitat might be affected by climate change by focusing on whether and how the distribution of their key tree species might shift. In a context where future climate conditions are likely to change, whether lion tamarins' key fruiting and sleeping-site tree species could even encounter propitious conditions for growth is a first question, and whether this possible migration would be helped or hindered by natural processes of seed dispersal and regeneration is another. We will be using a dynamic vegetation model (DVM) called CARAIB to understand the tree species' response to climate change. Responding to critiques of DVMs, our objective is to improve the model to include plant-animal interactions in the form of seed dispersal by tamarins, as well as overlaying the results on land-use maps to support conservation practitioners in their efforts to conserve vital areas for tamarin conservation. All four species of lion tamarins are endangered due to severe habitat loss and fragmentation. They are also subject to pressure from hunting, with their vulnerability increasing with habitat degradation, which favours human mobility. Lion tamarins are frugivores, and sleep in tree holes. Several studies show that at least two species (golden-headed lion tamarins, *L. chrysomelas* and golden lion tamarins, *L. rosalia*) are effective seed dispersers and



disseminators. Modelling climate change impacts on the primates themselves is not possible, given their highly localised distribution, but it is possible to model impact on tree species constituting their habitat, which are vital for their survival.

Time Line: PhD 2013-2017

Supervision: Prof. Dr. Alain Hambuckers, Prof. Dr. Louis François, Kristel De Vleeschouwer, Becky E. Raboy, Leonardo C. Oliveira

Funding: FRIA (Fonds pour la formation à la Recherche dans l'Industrie et l'Agriculture, CAPES-WBI, CNPq.

Epidemiological study of yellow fever and other arboviruses in non-human primates of the Atlantic Forest of South-Bahia

Lilian Silva Catenacci | Kristel De Vleeschouwer

This project aims to investigate the occurrence and prevalence of yellow fever virus and other

arboviruses in groups of golden-headed lion tamarins (*Leontopithecus chrysomelas*) inhabiting environments with different anthropogenic pressures in the Atlantic Forest of Bahia, in order to infer about the potential risk of disease transmission to human populations. Specific objectives are 1) to evaluate the clinical status and condition of individual GHLTs, through clinical and laboratory tests, 2) determine the prevalence of yellow fever antibodies and other viruses in individual GHLTs, using virological, serological and/or molecular techniques, 3) collect entomological samples for virus research in the areas where individual GHLTs are captured, and isolate obtained viruses, 4) realise a historical survey of yellow fever cases in Bahia, 5) relate the occurrence of antibodies in animals with the environment where they live, and 6) organise

meeting with local health agencies to discuss results and develop recommendations.

Time line: 2013-2016

Supervisors: Elizabeth Salbé Travassos da Rosa, Pedro Vasconcelos (Instituto Evandro Chagas)

Collaborators: Kristel De Vleeschouwer, Leonardo C. Oliveira

Applied Animal Welfare Research

The Applied Animal Welfare research theme deals with issues related to the practical day-to-day management of zoo animals such as animal health, senescence, the effects of captivity on behaviour and anatomy, animal husbandry, and reproduction of zoo animals. Many of the projects in this research theme use a scientific approach to study and understand animal behaviour, with the ultimate goal to allow adequate husbandry of zoo populations and to guarantee a species-specific behavioural repertoire in captivity.

Veterinary medicine is an essential ingredient for the optimal management of captive animal populations and veterinary research is primarily aimed at ensuring viable and healthy animals collections through evidence based research projects, and long-term studies on the identification, screening, prevention and treatment of various infectious diseases that are prevalent in zoo populations.

Applied Ethology

Jeroen Stevens | Evelien De Groot

Applied ethology involves the practical integration of behavioural research into zoo animal management. From an evolutionary point of view, animals will adjust their behaviour to local circumstances to maximise their fitness. In zoos and other captive environments we can expect additional selection pressures, which may and may not compromise the behaviour and welfare of the animals in our zoos. Within the CRC applied welfare research focuses on 1) the influence of enclosure design; 2) presence of zoo visitors and 3) environmental enrichment. In addition, short-term projects are sometimes designed to answer husbandry questions that arise from RZSA zoo staff. In 2013, we focused on the occurrence of abnormal behaviours in the captive bonobo population in Europe, continued with previous studies on the effect of a scatter feeder on the behaviour of small carnivores, and studied the habituation of Humboldt penguins to a new and larger enclosure in Planckendael. Enclosure evaluation was also done for Eurasian black

vultures, elephants and bonobos in Planckendael. We also set up some smaller research projects around questions asked by the curators of Antwerp Zoo or Planckendael about stereotypic behaviour in Asian rhinos, and aggression in the mixed-species penguin enclosure at Antwerp Zoo.

Since 2011, several students have been collecting behavioural data on bonobos in six European zoos. These data are collected for the PhD of Nicky Staes on bonobo personality, but also yield a large amount of data that can be used for other projects. We used these data to evaluate the occurrence of abnormal behaviour in 43 bonobos. We recorded a total of 22 abnormal behaviours, and 40 individuals (93%) showed at least one behavioural abnormality, when single occurrences are included. Eating faeces was the most prevalent behaviour; followed by hair plucking, head wiping, poke anus and regurgitation. The number of abnormal behaviours in each group ranged from five to twelve and was not correlated with group size. The individual repertoire varied from 1 to 8. There was no significant difference in repertoire size between males and females. Age did not have a significant effect on repertoire size or proportion of time spent

in abnormal behaviour. Wild-born bonobos had a higher repertoire size, but did not spend more time in abnormal behaviour than mother-reared or hand reared individuals. In conclusion, the bonobos in our sample show less abnormal behaviours compared to the chimpanzees in the study by Birkett and Newton-Fisher. This may be a consequence of different background of the individuals (no bonobos in our study had laboratory backgrounds) or past and/or current management practices: including more naturalistic group sizes and group dynamics. The link between the occurrence and welfare deserves further study. At the end of 2013 we continued collecting data on the occurrence of regurgitation behaviour in the bonobos at Planckendael, as a baseline for further studies in 2014.

The scatter feeder had previously been used in the spotted hyena enclosure at Planckendael, and was set up in the raccoon enclosure of the same park in 2013, to see if scatter feeding would stimulate foraging behaviour for the raccoons and/or increase the visibility of these small carnivores for the public. We found that the level of activity did not improve in the raccoons, and only one male

responded to the feeder. It might be the case that the raccoons need more time to adapt to the scatter feeder. This learning period has to be implemented in future studies.

The Humboldt penguin (*Sphenicus humboldti*) project was seen as a baseline study, in which habituation of the penguins to their new enclosure was studied. We found that that resting behaviour increased in the weeks after transfer, possibly indicating that the penguins were settling in their new enclosure. Also, social network analyses was used to evaluate social relationships and pair bonding in this group. In 2014 the exhibit will be opened for the public and a follow up study, comparing new data with the data collected in 2013 will be possible. The data on social relationships will allow for future studies to continue monitoring pair bonding and breeding success of the colony in the coming years.

Time line: ongoing

Partners: Various zoos and Universities and Higher education schools.

Funding: CRC

Assessment of objective Welfare indicators for Amphibians and Reptiles in a captive Environment (AWARE)

Glenn Borgmans, Jeroen Stevens

In 2013 a partnership between the University of Antwerp, University College Sint Lieven and the CRC was awarded a two-year research project grant by the Belgian Federal Public Service (FPS) of Health, Food Chain Safety and Environment to ultimately develop objective welfare indicators for amphibians and reptiles in captivity in zoos and private collections. The primary objective of this project is to contribute to the development of criteria for adequate housing and to develop simple and non-invasive methods to measure stress in of reptiles and amphibians in captivity. The FPS provides funding for the first two years of a PhD position and CRC co-funding will cover the last two years.

In this study we aim to compare the stress response of reptiles and amphibians that are kept in captivity under different treatment conditions or levels of manipulation. To establish minimum requirements for housing captive amphibians and reptiles we aim to quantify the effects of terrarium dimensions, the presence or absence of enriching elements like bathing and climbing structures, and the frequency of manipulation of the animals. Stress will be measured by assessing faecal corticosterone metabolites levels, but also by appraising a range of other potential indicators. We thus hope to establish objective criteria for estimating stress in captive and wild amphibians and reptiles. The primary questions will be whether we can reliably

measure stress in reptiles and amphibians by determining hormone levels in faecal pellets and urine, by assessing leukocyte distributions in blood smears, by measuring integument colour, and from behavioural observations and body condition indices.

In addition, we will compare the basic stress level and response to acute stress between animals living in natural conditions and in captivity, and between captive-bred and wild-caught individuals born in captivity.

Finally, we aim to make an overview of the numbers of reptiles and amphibians that are held in Belgium as ornamental animals, companion animals, laboratory animals and wild animals in zoos by means of surveys and site visits.

Time Line: 2014-2017

Partners: Raoul Van Damme, University of Antwerp | Hilde Vervaecke, Adinda Sannen, University College St. Lieven

Funding: Belgian Federal Public Service (FPS) of Health, Food Chain Safety and Environment | Centre for Research and Conservation

Designing an efficient treatment protocol and defining the mechanisms of host-specificity for chytridiomycosis in amphibians

Mark Blooi

One of the key factors contributing to the current extinction crisis in amphibians is the fungus *Batrachochytrium dendrobatidis* (Bd) which causes chytridiomycosis, a lethal skin infection in amphibians. The establishment of Bd free amphibian breeding colonies has become one of the emergency measures to save threatened amphibian species from extinction. The aims of this PhD project are to improve current diagnostic techniques, design an efficient treatment protocol based on antimicrobial agents and study the mechanisms of host-specificity for chytridiomycosis in amphibians.

The first part of this project is the development of a technique that allows selective quantification of viable Bd cells. Until recently the most reliable techniques for detecting Bd cells was based on detecting and quantifying the amount of Bd DNA present in a sample, but these methods make no distinction between viable and dead Bd cells can be made. In 2012 we developed a technique based on real-time PCR (EMA PCR) which allows to distinguish between living and dead Bd cells. In 2013, EMA PCR was successfully used to demonstrate biocidal capacity of skin secretions of salamanders of the genus *Speleomantes*.

Using the same EMA PFR we were able to show a significant correlation between the abundance of

microorganisms in water samples and the likelihood of amphibians becoming infected with Bd. Rotifers and protozoa in water samples were demonstrated to filter the infectious stages of Bd from the water by predation, and thus exert a great effect on the infection dynamics of Bd in nature. These findings open up new possibilities for combating Bd in the natural environment.

A previously undescribed chytrid fungus (*B. salamandrivorans*) was isolated in 2013 from a Dutch population of fire salamanders (*Salamandra salamandra*). This new fungus is responsible for the near extirpation of the entire population in the Netherlands. A rapid diagnostic test was developed which allows to test for the occurrence of both *B. salamandrivorans* and *B. dendrobatidis*. We are currently developing a treatment protocol using various antimicrobial agents and increased ambient temperatures.

Supervision: Francis Vercammen | Frank Pasmans (Ghent University) | An Martel (Ghent University)

Time line: PhD 2011-2014

Funding: CRC (KMDA Dehousse)

Opportunistic veterinary research

Francis Vercammen

In the course of daily veterinary work with exotic animals in Antwerp and Planckendael, we are frequently, yet often at unpredictable times, confronted with rare and for science very novel findings and observations. This creates opportunities to increase our basic understanding about the biology, medicine and treatment of zoo animals and where relevant their pathogens. Projects generally concentrate on evidence-based pathology, microbiology, parasitology, haematology and biochemistry, serology, reproduction, nutrition and surgery which, when strategically chosen, can over time be combined through meta-analyses and integrated into peer reviewed scientific publications.

In addition to classical microscopy and cultivation we intend to gradually move more towards applying modern techniques, in particular molecular tools such as monoclonal antibodies and PCR, to study infectious diseases and to develop new diagnostic tools and methodologies that will help improve the management of zoo and wildlife populations. Moreover, a thorough basic knowledge of infectious agents is crucial for the adequate management of animal populations.

After the discovery of the new infectious agent, *Devriesea agamarum*, we carried out a prevalence study in our captive population. Devriesea is more frequently diagnosed as the causative organism of dermatitis in lizards, particularly in spiny-tailed lizards. Other lizard species such as bearded dragons are known as asymptomatic

carriers posing a potential threat to the healthy animals in a collection. By isolating, phenotypic identification and confirming by PCR, we found *D. agamarum* in six healthy jeweled curly-tailed lizards and in three clinical cases (two frilled lizards and a Philippine sailfin lizard) with abscesses in their beaks. It was concluded from this study that a quarantine programme for newly acquired animals is important to detect healthy carriers and prevent the spread of infection.

Another retrospective study focused on fungal agents in our captive animals, trying to evaluate their impact during the last 34 years. Fungal

infections causing dermatological or systemic disease in all 5 animal orders were demonstrated in a total of 675 samples, corresponding with an overall prevalence of 1.6%. These samples were from: 5 amphibia, 26 fishes, 49 reptiles, 150 (22%) mammals and 445 (66%) birds, in total 169 (25%) from living animals and 506 (75%) from dead animals. Fungal infection was 50% more prevalent in birds (2.2%) than in mammals (1.5%). More than half (56%) of all infections were due to *Aspergillus* species (predominantly *A. fumigatus*), of which 93% occurred in birds (i.a. 24% gallinaceous birds, 15% geese and ducks, 14% penguins, 9% songbirds, 8% parrots, 5% turacos and 4% birds of prey).

Although the overall prevalence may not seem very high, mortality due to fungi is important bearing in mind that these samples came from 25% live animals and 75% dead animals.

Timeline: Ongoing

Funding: RZSA

Basic Zoological Research

The living collections and research facilities at the RZSA provide unique opportunities for scientific research. Apart from applied conservation and animal welfare research, the CRC aims to optimally use these resources and its research expertise to contribute to the advancement of basic zoological and veterinary knowledge. This research theme accommodates basic research projects for which the CRC's research expertise and resources are specifically sought after and which are typically performed in close collaboration with academic institutions.

Social evolution and behaviour in Bonobos

Jeroen Stevens

The bonobo still remains the least understood species of great ape, and seems to hold many clues to understanding our own human evolution.

Together with chimpanzees, bonobos represent our closest living evolutionary relatives, and understanding how behavioural differences and similarities in bonobos, chimpanzees and humans may have arisen, can help us understand how humans evolved. The Centre for Research and Conservation has one of the longest outstanding research projects on bonobos in captivity and has studied bonobos in Planckendael for over 20 years. The long-term project continues to yield new insights and add to our understanding of behavioural diversity and flexibility in this species. In 2013 we organised a symposium called "80 years of *Pan paniscus*" at the 5th Conference of the European Federation for Primatology in Antwerp, bringing together international bonobo researchers to discuss current trends in bonobo research.

Following our previous studies in tolerance in this species, we investigated play behaviour in bonobos. We used data collected in six European zoos to see whether female bonobos are indeed more playful than males, as suggested by literature. When considering only play with mature partners or individual play, we did not find a significant difference between time spent playing between male and female bonobos in those two play contexts. Surprisingly we found that male bonobos spent significantly more time playing with infants,

compared to female-infant play. Interestingly we found an effect of group on the amount of social play between adults, but no group effects on play including infants or on individual play. These results suggest that female bonobos do not play more than male bonobos, but that levels of playfulness can differ between groups and that care should be undertaken to generalise about the playful nature of bonobo society.

In 2013, we started a new longer-term monitoring of infant development in bonobos. Bonobos have been described as a "paedomorphic" species, retaining infant characteristics into adulthood. This has mainly been applied to morphology, but also to behavioural aspects such as cognition and sexuality. However very little is known about the development of behaviour in mother-reared bonobos. Therefore we started a new long-term project on infant development and maternal styles. Master students from different universities will observe behaviour in a large sample of infants and juveniles in European zoos, to test hypotheses about developmental delay in this species.

We facilitated research for a number of students. In 2013 we welcomed Sumir Keenan, PhD student from the University of St Etienne (France) and the University of St Andrews (Scotland), who recorded vocalisations of bonobos in Planckendael to identify individual vocal signatures, which will be used in a further experimental play-back study in 2014.

The Bonobo Project in Planckendael has collected a large collection of bonobo urine samples over the

years. In 2011 we transported this collection of over a 1000 samples to the Max Planck Institute in Leipzig, which resulted in a publication on age-related variation in urinary levels of thyroid hormones in 96 bonobos and 100 chimpanzees ranging between one and 56 years of age. Fresh urine samples were used for hormone measurements with a commercial competitive total triiodothyronine (T3) ELISA. In both species, immature individuals had higher TT3 levels than adults and there was a marked decrease in TT3 levels between age classes. The two species differed in terms of the timing of TT3 level changes, with chimpanzees experiencing a significant decline in TT3 levels after 10 years of age and bonobos after 20 years of age. The decline of TT3 in chimpanzees appears to coincide with the time when somatic growth terminates while TT3 values in bonobos decrease much later. This temporal asymmetry in urinary thyroid hormone levels indicates heterochrony in the ontogenetic changes of the two sister species and developmental delay in bonobos. The prolongation of high TT3 levels in bonobos, which is characteristic of immatures of both Pan species may affect the behaviour of bonobos; namely, the low intensity of aggression they display. Given that developmental studies are often based on post-mortem analyses of skeletons, measures of urinary thyroid hormones offer a non-invasive tool for exploring ontogenetic changes in living wild and captive hominoids.

Time line: 2002-ongoing

Partners: Adrian Jaeggi (University of Zürich) | Gottfried Hohman, Verena Behringer (Max Planck Institute for Evolutionary Anthropology, Leipzig) | Jorg Massen (Utrecht University) | Marcel Eens (University of Antwerp) | Rudi D'Hooge (University of Leuven) | Katherine Cronin (Max Planck Institute for Psycholinguistics, Nijmegen) | Florence Levrerot, Sumir Keenan (University of St Etienne, France & University of St Andrews, Scotland)

Funding: CRC | Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany |

The role of neuropeptides as a proximate base for inter-and intra specific differences in behaviour, behavioural syndromes and personality: Comparison of two closely related sister species - bonobos and chimpanzees

Nicky Staes | Jeroen Stevens

Understanding the evolution of behavioural differences in closely related species is one of the major challenges in modern behavioural ecology. Recently, genetics have been more and more applied to understand how these differences come about. For example variation in genes coding for neuropeptide receptors in the brain has been linked to variation in social behaviour among different species. In terms of human sociality, our two closest living relatives, chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*) offer an interesting comparative framework, as they differ in key aspect of sociality. The debate on the distinctiveness of these two species reflects recent efforts to determine more proximate causes of interspecies differences and how these evolved in early hominids. Diversity in DNA-sequences could be responsible and this could be reflected on a hormonal level. In this framework neuropeptides play a central role in modern behavioural research. Neuropeptides like oxytocin, vasopressin and dopamine are important modulators in social behaviour in humans and other mammals. This study aims to investigate the relationship between the variation in DNA-sequences and behaviour in and between bonobos and chimpanzees. We look at the variation in the oxytocin receptor gene and vasopressin receptor gene 1a in both species and a possible correlation between this variation and species-specific and individual behaviour. The RZSA is the ideal location for this research as it has both species in its collection a great collection of DNA samples available. In addition the CRC has combined many years of experience in studying bonobos with managing the breeding programme for over 20 years. Since several aspects of personality in humans and animals have been linked to the occurrence of these polymorphisms in neuropeptide receptor genes, the study also includes investigations of personality and behavioural syndromes, by combining

observational and experimental data with personality ratings done by human observers.

In 2012, genetic profiles were constructed for 120 bonobos and 77 chimpanzees for polymorphisms in the oxytocin and vasopressin receptor genes that will be linked to behavioural profiles and personality. Bonobos show no genetic variation in our region of interest on the oxytocin receptor gene whereas chimpanzees do, with 5 different single nucleotide polymorphisms found. For vasopressin we were not able to find the 350bp deletion, containing the microsatellite RS3 in the promoter region of the gene that occurs in chimpanzees. In our chimpanzee sample set, this short allele had a very high prevalence of ~70%, with homozygous individuals for the deletion having the highest frequency in our captive population. This is in agreement with a previous study done on chimpanzees by Donaldson et al (2008). For those bonobos and chimpanzees without the deletion, we were able to distinguish 15 alleles differing in length of the RS3 repeat. The shorter alleles appear to be less frequent in the bonobo population. Interesting here is that long alleles are correlated with more prosocial behaviour in humans and higher bonding levels in voles. As bonobos are known for their sexual and social bonding this might explain part of the variation found compared to chimps, as they have this higher prevalence of short alleles.

In 2013 we finished collecting personality ratings for a total of 154 bonobos, spread over 16 groups from the EEP and SSP. Analyses on these ratings are done in collaboration with Alex Weiss (University of Edinburgh, UK). We found that bonobos have six personality components comparable to those found in chimpanzees, though some more closely resembled human personality components. These findings indicate that bonobo personality is a mosaic structure of human and chimpanzee personality, what resembles findings of this same structure by genomic studies that compared the bonobo genome to the human and chimpanzee genomes. We genotyped 110 of these bonobos and found a link between personality profiles and the RS3 microsatellite. Bonobo males with longer alleles are rated more "assertive" and "friendly" by their human raters. To validate the results from this rating approach, that uses questionnaires, we also collected behavioural data using observations and an experimental approach. With help of master students from different universities we were able to collect data for 50 adult and subadult bonobos from 6 different zoological parks in Europe. We did two rounds of data collection so that we can test for reliability and stability of the coded behaviour. For one zoo data collection of the second round will be finished early 2014. Preliminary results show that with the use of behavioural codings we are again able to construct a multidimensional personality structure and that

the experimental approach provides us with extra dimensions that are harder to measure with observational data alone.

Time line: PhD 2011-2015

Partners: Marcel Eens (University of Antwerp) | Jorg Massen, Annemieke Podt (Utrecht University) | Sonja Koski (Zürich University) | Leo Vorhoren (University of Nijmegen) | Alex Weiss (University of Edinburgh) | Oliver Ryder, Leona Chemnik (San Diego Zoo Institute for Conservation Research) |

Funding: CRC (KMDA Dehousse)

Animal locomotion

Kristiaan D'Août | Sandra Nauwelaerts

With our biomechanics research we primarily aim to advance the fundamental understanding of animal anatomy and locomotion, and to apply these insights to the husbandry and management practices of captive populations. Therefore, we collaborate closely with the Functional Morphology group at the University of Antwerp. Zoos provide an ideal setting not only to study normal gait in a wide range of species, but also to assess deviations from "normal" gait. In zoos, animals move about on different substrates (potentially influencing gait), and may encounter different locomotor challenges (e.g. elements in their enclosures they do not see in the wild) leading to injuries. Addressing such topics can provide basic insights into motor control, but in the case of injuries or anatomical abnormalities it has obvious relevance for the management of captive populations.

So far locomotion studies at the CRC have focused on studying various fundamental aspects of steady and unsteady locomotion in bonobos and gibbons, such as climbing, bipedal walking, brachiation and jumping (Channon et al, 2010, Vereecke et al, 2011a, 2011b, Michilsens et al, 2012). In these studies, we typically use custom built setups incorporating force plates for measuring ground reaction forces, high speed cameras for recording details of body position and movements, and pressure plates.

In addition to the line of research on primate locomotion, we have initiated studies, using a similar approach, on equids (Przewalski horses, zebras). In this study, we collect experimental data on equid gait and assess the effects of evolutionary toe reduction on locomotor energetics, control, and soft tissue loading.

Time line: ongoing

Partners: Peter Aerts (University of Antwerp) | Gilles Berillon (CNRS, France) | Evie Vereecke (University of Leuven - Kortrijk) | Julia Myatt (University of Liverpool, UK)

Funding: University of Antwerp, FWO, CRC

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Strategic objective 2

Building and expanding links within the zoo community and sharing information and resources

As a research institute within a zoological garden, the CRC works within an extensive network of zoos, zoo organisations, and zoo professionals, and as such the successes and achievements of the research team depend on collaborative initiatives. This not only refers to the collaborative management of captive breeding programs, but also to the development and promotion of science-based working methods to improve conservation breeding and the management of zoo populations. A key objective of the CRC is the development of multi-zoo research projects, and establishing collaborative links with other zoos that have built expertise in disciplines or research infrastructure complementary to the CRC. With the advent of ZIMS we strive to capitalise on the latest database and modelling software for small population management developed and provided by the zoo community and the academic community.

For improving information sharing, the CRC spearheaded the development of a new ISI-rated scientific journal for EAZA, *The Journal of Zoo and Aquarium Research*, which was first published in July 2013. The CRC played an important advisory role in the development of the "EU Zoos Directive Guidance and Best Practice" document commissioned by the EU's DG Environment, aimed at improving the implementation of the EU Zoo Directive 1999/22/EC in Europe.

Breeding programme coordination

Congo Peafowl (*Afropavo congensis*) EEP and international studbook | Steven Vansteenkiste | Peter Galbusera

Mexican military macaw (*Ara militaris mexicana*) ESB | Steven Vansteenkiste | Peter Galbusera

Golden headed lion tamarin (*Leontopithecus chrysomelas*) EEP and international studbook | Peter Galbusera

Okapi (*Okapia johnstoni*) EEP and international Studbook | Sander Hofman | Kristin Leus

Bonobo (*Pan paniscus*) EEP and International Studbook | Zjef Pereboom | Jeroen Stevens

Fischer's Turaco (*Tauraco fischeri*) ESB | Frederic Verstappen | Peter Galbusera

Staff representation

Linda Van Elsacker | EAZA Council - Member | EAZA Executive Committee - *Treasurer* |

Zjef Pereboom | EAZA Research Committee - *Chair* | EAZA Council - *Observer* | Great Ape TAG Core Group - *Member* | Associate Editor Zoo Biology | Branch Editor Belgian Journal of Zoology | Associate Editor Journal of Zoo and Aquarium Research | Advisory Board Stichting AAP - *Member* | Associate Researcher University of Antwerp | Visiting Lecturer Utrecht University | Dutch Zoo Federation Research Group - *Member* |

Kristiaan D'Août | Postdoc Researcher University of Antwerp | Advisory Board EUCOMOR

European Master Programme

Peter Galbusera | Associate Researcher University of Antwerp | Callitrichidae TAG - *member* | Branch Editor Belgian Journal of Zoology |

Philippe Helsen | Royal Belgian Zoological Society - Board member |

Jeroen Stevens | Associate Researcher University of Antwerp | Great Ape TAG Core Group - *Member* | IUCN Primate Specialist Group - *Member*

Philippe Jouk | ISIS Board member | CITES Belgium Scientific Committee - *Chairman*

Kristel De Vleeschouwer | Associate Researcher University of Antwerp | Associated Researcher IESB | Member of Strategic Accessory Group for the National Action Plan for the Conservation of Central Atlantic Forest Mammals ICMBio |

Genetic Resource Banking

The CRC stores an extensive number of cadavers and scientific samples including many from rare or endangered species. Since the beginning of 2008 animals that died in the zoo population were sampled during routine autopsy procedures, catalogued in a digital database and the cadaver sent for destruction (unless the body has been previously requested by another institution). In this way the RZSA is developing a large and diverse DNA collection for in-house research and use by other institutions given strict adherence to the RZSA Loans policy and guidelines documentation. This initiative is in line with the policies of 'The

Frozen Ark Project', the mission of which is to "collect, preserve and store DNA and viable cells from animals in danger of extinction".

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Strategic objective 3

Focussing on integrated, science-based conservation actions

A key aspect of the RZSA Conservation Strategy is its active involvement in conservation activities aimed at halting the loss of biodiversity. In its nature conservation projects, the CRC aims to contribute to the protection of wildlife and the sustainable use of natural resources, using scientific research as the primary instrument. The RZSA field conservation projects 'Projet Grands Singes' in Cameroon, 'BioBrasil' Brazil and Nature Reserve 'De Zegge' in Flanders stand for our own contribution towards conserving threatened habitats and species worldwide. In addition, the CRC is actively involved in co-developing science-based conservation actions and action plans for wild animal populations worldwide, in close collaboration with conservation and development agencies, with governments and NGOs, and with local communities and other stakeholders.

Projet Grands Singes, Cameroon

Community based conservation of great apes in non-protected areas of Cameroon

Nikki Tagg

The threats faced by populations of great apes vary across their range, but mainly comprise hunting, forest loss and fragmentation and disease epidemics. Populations of large bodied and slow reproducing species, like chimpanzees and gorillas, do not easily recover from even low hunting pressures, and rates of offtake in many cases dramatically exceed any sustainable limit. With the encroachment of humans more and more into ape habitats and the reduction of remaining forests through agriculture and logging, existing populations experience greater conflicts with people, an increased chance of virus transmission and more intense hunting pressures. Climate change is likely to compound each of the existing threats to the survival of apes, by causing vegetation shifts and reducing the suitability of habitats, and increasing the occurrence of infectious diseases, for example. People living in ape habitats are generally poverty-stricken, living hand-to-mouth below the poverty line, with few of their basic needs being met.

Cameroon is a large country, with approximately 200 000 km² of great ape habitat in the form of

tropical rainforest; only 23% of which falls into protected areas such as national parks and reserves – many of the country's great apes therefore have little official protection. The Dja Biosphere Reserve in the southeast of the country is an area of exceptional conservation priority for great apes: an area of great size and biodiversity and still harbouring healthy populations of great apes.

Animals live in and around protected areas, with ranges and territories often spanning into and beyond these more disturbed buffer zones. As part of the range-wide fight to preserve wild populations of great apes, active protection of populations living in buffer zones of parks and reserves is crucial to species' survival. In the northern buffer zone of the Dja Reserve, forest resources are heavily used by local people and logging companies alike. Hunting for bushmeat is a traditional activity, yet increased commercialisation of the bushmeat trade as a result of accessibility of firearms, the carving up of forests by logging, agriculture and human population growth and a swelling demand from towns and cities, is leading to the depletion of populations and species at local, regional and national levels.

To address these issues, the CRC runs Projet Grands Singes (PGS) in this area. The target is to promote tropical conservation and decelerate the rate of decline of great apes through a community-

based conservation and development approach. This approach respects the economic requirements of rural people, through mutually-interdependent conservation and development objectives (sustainable hunting management, the provision of incentives in conservation, environmental education, etc). It is arguably impossible to study endangered species without concerning yourself with their conservation, and on the flip side, informed conservation efforts require science-based evidence and support, strengthening the intricate link between research and conservation. In a further step, PGS uses scientific research as a conservation tool to forge a rare and important direct link between wildlife conservation and benefits for the local communities: regular employment of local people in research activities reinforces the value of living wildlife and intact forests to the community.

PGS seeks to respond to the urgent need for population estimates, surveys and monitoring of western lowland gorillas and chimpanzees across the entirety of their range—including within surrounding and connecting matrices—to help improve and devise ape conservation actions, prevent population isolation and loss of genetic variation, and to effectively manage PAs. Through long-term, hypothesis-driven, applied-conservation research in situ, PGS staff and

students investigate great ape ecology, diet and behaviour; forest structure and use by primates, the impacts of human activity on great apes, phenology, botany and food availability of the rain forest habitats; and the changing status of great apes in the site and elsewhere, for improved understanding and species conservation in the long term.

Time line: 2002-ongoing

Funding: CRC / Various funding bodies and conservation organisations

The Dja Biosphere Project, Cameroon

Nikki Tagg

PGS is involved in a consortium comprising the Zoological Society of London (ZSL), the Bristol Science and Conservation Foundation (BSCF) of Bristol Zoo Gardens and its partners: Living Earth Foundation UK and Cameroon (LEF and FCTV), The Dja Biosphere Consortium secured funding from the EAZA Ape Campaign for scientific research and community work around the Dja Biosphere Reserve in southeast Cameroon, where all partners have been active for a varying number of years. The project is shaped by the need (identified by the local communities) to address the demand for revenue-generating activities to replace unsustainable bushmeat hunting, in order for them to be able to embrace conservation efforts. The project will advantage at least 35 communities north and east of the DBR, ensuring that their livelihoods are compatible with a reduction of the impact of non-sustainable activities in the region, in particular the illegal hunting of apes, in this vast and biodiverse region.

The project will adopt the broad approach of implementing participative sustainable hunting management and anti-poaching, local rural development and provision of incentives, and conservation education; as well as considering law enforcement and anti-corruption requirements in the area, and great ape conservation in forest management, through working closely with logging companies— alongside its planned extensive scientific research programme. Mindful of the threat posed to great apes as a result of ape hunting, and the relative paucity of research undertaken to provide a detailed analysis of the key actors involved in the ape hunting “supply chain”, the project partners are commissioning an initial piece of research on “the ape hunting supply chain around the Dja Biosphere Reserve”, the findings of which will enable project partners and other stakeholders (including MINFOF’s Dja Management team) to develop appropriate strategies to tackle the illegal take of great apes.

In turn, the statuses of indicator species in these landscapes of high human pressure will be determined and monitored through regular

transect surveys to identify temporal changes in density and distribution. Forest quality and quantity will be assessed in a wide area, incorporating satellite imagery and ground-truthing techniques. Relative hunting effort within communities will be assessed, through surveys and questionnaires, and basic demographic and socio-economic information collected, in at least 35 communities. An assessment of trends in offtake of bushmeat species throughout the region, using data collected monthly by game guards and hunters at five selected bushmeat market hubs, will be conducted. Research will be carried out into impacts of logging and associated wildlife management practices on great apes in logging concessions, habitat and resource use and impacts of other human activities in community forests and protected areas.

Time line: 2012-2015

Partners: Bristol Zoological Gardens | Zoological Society of London

Funding: EAZA Ape Campaign / Bristol Zoological Gardens

Local people and Great Ape conservation in East-Cameroon: An anthropological study at the northern periphery of the Dja Reserve

Mélodie Dieudonné

Due to its large forest, the region of south-eastern Cameroon is regarded as a wildlife sanctuary, unfortunately subject to increasingly stronger pressures – massive deforestation, intensive and extensive agriculture, poaching – that threaten its natural resources. The area has thus been the target of conservation initiatives for decades. Not only do governmental measures regulate the access and use of forest resources, but many conservation and development projects keep coming and settling in the villages of the area. In spite of new approaches willing to improve relationships between local people and conservation agents, tensions and conflicts keep arising. The necessary collaboration with the locals implies a comprehensive knowledge of their conceptions and attitudes towards nature, forest and its resources. Moreover, the interactions between conservation agents and residents have unavoidable social, economic and political consequences at the local level that need to be understood and analysed.

The Projet Grands Singes, as well as great apes conservation initiatives worldwide tend to rely on a “western” perception of nature that is not universally shared. The Badjoué people living in the villages working with PGS have a long history of hunting traditions and have been consuming bushmeat for ages. Their lifestyle is inseparable from the forest as they interact with it on a daily basis and depend on it for their subsistence. However, their relation to their environment has

historically been transformed many times in many ways and their previous experiences with conservation initiatives are still influencing their current attitudes toward PGS. It is thus essential to study the relations between those people, their forest, and conservation in a historical perspective, and confront it to the conceptions of the conservation agents in the field.

The Anthropology of Nature constitutes an optimal research tool to understand and describe encounters between very different world views while the Anthropology of Conservation and Development is essential to become aware of and analyse the relationships, dynamics and changes at work in the context of conservation. This PhD research thus falls within a will to combine those two approaches in order to reach a deep and overall comprehension of the situation in 6 villages at the northern periphery of the Dja reserve. In the end, a meticulous ethnography resulting from a long-term field study will enable us to offer suggestions regarding ways of reducing tensions and conflicts, pacifying the relationships and improving the general situation of great apes conservation in south-eastern Cameroon.

The achievements of 2013 mostly concern advances in data analysis as well as a final field trip in December, which was necessary in order to collect complementary data and to answer some remaining questioning. Among other findings, we highlight the fact that local villagers have different and varied practices and conceptions of the forest, the great apes and thus of conservation. Local attitudes vary according to a range of criteria such as gender, age, education, social, economic and political status, participation in development projects, subsistence activities, relationships with PGS staff, etc. This diversity and complexity has to be understood and taken into account if conservation initiatives are to achieve their goals of protecting nature whilst empowering the locals, improving their living conditions and their active participation in the management of their environment. Our analysis and suggestions will be based on comparisons between PGS and similar conservation initiatives worldwide through a detailed study of literature. By doing so, we aim to contribute to an anthropological approach of conservation that will benefit the situation of local people as well as the conservation practices at a larger scale.

Time line: PhD 2011-2015

Supervision: Véronique Servais (Liège University) | Nikki Tagg | Zjef Pereboom

Funding: Non-FRIA University of Liège

Project BioBrasil: *Science-based development of a conservation management plan for golden-headed lion tamarins*

Kristel De Vleeschouwer

Golden-headed lion tamarins are small arboreal primates classified as endangered as the result of continuing deforestation in the Atlantic Forest. Being endemic to the Atlantic Forest of southern Bahia, they have long served as a regional flagship species. The GHLT geographic range is divided in two portions, each of which dominated by a distinct vegetation type and markedly different in terms of degree of fragmentation and disturbance. Cattle ranching is the primary anthropogenic activity in the western portion, resulting in extremely small and isolated fragments of semi-deciduous, mesophytic forest. Coastal humid forest characterises the east, and the primary forms of land uses here include shade-cocoa agroforestry (cabruca) and other agricultural activities. While forest remnants in the east are larger and less isolated than in the west principally due to the presence of cabruca, the decline in cocoa prices and a fungal disease (witch's broom) have caused many landowners to convert their shade-cocoa into pastures or other crops, increasing levels of forest degradation and fragmentation and decreasing the amount of suitable connecting matrix. Most remaining wild populations of GHLTs occur in the eastern portion of the distribution, which covers approximately 45% of the total distribution area, but contains the largest remaining continuous forest remnant, the only fragment large enough to sustain a genetically viable population of GHLTs (Zeigler et al. 2010). This eastern portion thus plays a critical role in the species' conservation, and actions that focus on maintaining forest integrity and connectivity here are doubtlessly the most effective way of securing the long-term survival of the species.

Project BioBrasil objective is to contribute to the long-term survival of GHLTs by assisting the development and implementation of a conservation action plan for the species, based on sound scientific information, ensuring the participation of key organisations and stakeholders in the process. With less than 2% of the forest in the GHLT distribution legally protected, the majority of today's remaining wild populations reside in unprotected forest on private lands. Securing the long-term survival of GHLT populations will require the collaboration and participation of local communities, and the development of sustainable landscape management guidelines compatible with the long-term persistence of self-sustaining GHLT populations in the wild, while meeting the needs of local communities.

In the past 10 years, Project BioBrasil's activities have focussed mainly on acquiring the necessary scientific/ecological information to nurture the development of science-based conservation actions, with small initiatives in the area of education and direct conservation actions. To accomplish both its

research and conservation mission, the Project's new research and conservation strategy includes the following points:

1. implementation of a multidisciplinary research program as a basis for development of a full GHLT conservation action plan, preferably in collaboration with larger projects to improve knowledge acquisition and data sharing;
2. increased strategic support (expertise, scientific information, fundraising) to promote science-based conservation strategies that benefit GHLTs and their landscape in the area of education, public politics and socio-economics
3. increased participation in planning workshops and position-taking in steering groups that address issues relevant to GHLT conservation, e.g. the participation in the National Action Plan for the Conservation of Central Atlantic Forest Mammals ICMBio.
4. increased action (research and non-research) to identify key organisations and stakeholders and ensure their participation in the development of the GHLT conservation action plan.

Timeline: 2002-ongoing

Funding: CRC / UESC (Universidade Estadual de Santa Cruz, Brazil) / CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico Brazil) / Lioan Tamarins of Brazil Fund / National Lottery Belgium

Relationships between rural residents and wildlife in the protected Forest mosaic Una-Serra das Lontras, Bahia, Brazil.

Luciana Costa de Castilho

Identifying the mechanisms that influence or promote the conservation of natural resources by local human populations is a particularly important instrument for planning management actions for wildlife species and the conservation of protected areas. The purpose of this study is to analyse the relationship between rural landowners and threatened and dispersers mammals in the protected mosaic Una-Serra das Lontras in Southern Bahia. This study will identify the level of anthropogenic pressure on the target species in areas with different legal protection strategies. Hunting pressure, conflicts between people and wildlife, attitudes and perception of landowners with respect to the conservation of fauna and protected areas will be investigated. The study area consists of the mosaic Una – Serra das Lontras, which is composed of three protected areas: the Una Biological Reserve, the Una Wildlife Refuge and the Serra das Lontras National Park. To accomplish this, two methods will be used. First, structured interviews will be conducted with landowners or workers responsible for the properties located in and around protected areas. The interviews will be organised in four parts: data

on the interviewee and the property, relationship of the person with local fauna, use of natural resources and attitudes towards conservation and the interviewee's perception on the conservation of protected areas. Secondly, a database with records of confiscations and hunting traces will be analysed to describe hunting pressure in the Una region. In this way it will be possible to identify the main threats on the targeted species and assist in developing strategies for the conservation of fauna, as well as protected areas and their buffer zones. We expect to find different degrees of threats according to each area, with greater impacts in areas with lesser legal protection.

Timeline: PhD 2012-2016

Supervisor: Alexandre Schiavetti (UESC), Kristel De Vleeschouwer

Funding: CRC / UESC (Universidade Estadual de Santa Cruz, Brazil) / CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico Brazil)



Strategic objective 4

Training future generations of conservation professionals

Training professionals for the rapidly evolving field of Conservation Biology is essential for securing a future for our natural heritage. We achieve this by fostering science education and training as part of our strategic objectives. The CRC research team contributes to the education and training of students and young researchers in biology and veterinary medicine, and is actively involved in lecturing students at universities and colleges in Belgium and the Netherlands. We provide internships and (co)supervise student projects, and offer MSc and PhD positions in conservation biology and veterinary sciences. In 2013 a total of 40 Bachelor and Masters students wrote a thesis as part of a CRC research project, and 8 PhD students worked towards the completion of their PhD degrees. In addition, the CRC invested in building scientific capacity in developing countries by providing research training opportunities for Cameroonian and Brazilian students and conservation professionals.

PhD students at the CRC

Charles-Albert Petre | University of Liège, Gembloux Agro-Bio Tech | Investigating the role of gorillas in forest maintenance and regeneration.

Denis Ndeloh Etiendem | Free University of Brussels | Feeding ecology of Cross river gorillas: An evaluation of ecological and social factors influencing Cross river gorilla survival in Cameroon.

Glenn Borgmans | University of Antwerp | Assessment of objective Welfare indicators for Amphibians and Reptiles in a captive Environment.

Katja Wolfram | University of Antwerp | Mate choice and patterns of adaptive variation in Eurasian black vultures: An assessment using MHC and olfactory receptor gene analysis

Mark Blooi | Ghent University | Chytridiomycosis in amphibians: Designing a efficient treatment protocol and defining the mechanisms of host-specificity.

Mélotie Dieudonné | University of Liège | Anthropology, Conservation and Development: Analysis of practices and representations of local populations affected by the implementation of the conservation project "Projet Grands Singes" in the Dja Reserve in Cameroon.

Nicky Staes | University of Antwerp | The role of neuropeptides as a proximate base for (pro)social behaviour: inter- and intraspecific comparison of bonobo and chimpanzee.

Nima Rangunathan | University of Liège | Factors affecting seed dispersal, tree establishment and

resource availability for endangered frugivorous primates in southern-Bahia: defaunation, matrix connectivity, and climate change.

PhD Dissertations finalised in 2013

Denis Ndeloh Etiendem | Free University of Brussels

Feeding ecology of Cross river gorillas: An evaluation of ecological and social factors influencing Cross river gorilla survival in Cameroon

The PhD thesis was completed and successfully defended on 31 October 2013

The Cross River gorilla (*Gorilla gorilla diehli*) is the northern- and western-most subspecies of gorilla, endemic to the hilly rain-forests of the 'Bight of Biafra' region in the Gulf of Guinea, and whose survival is endangered by increasing pressure from hunting and habitat loss. Few studies have ever examined the ecology of Cross River gorillas and our current understanding of these gorillas in a human-dominated lowland habitat, which is vital to conservation planning, is limited. This dissertation presents findings on wild Cross River gorilla ecology based on a two-year field study in a 43 km² unprotected forest called the Mawambi Hills and located on the southeast border of Takamanda National Park in southwest Cameroon. It also evaluates the socio-economic status of surrounding village communities and assesses how their resource extraction activities might influence the gorillas. Interviews with local

communities and measurement of encounter rates and spatial distribution of human activity signs within the forest show that the forest is heavily human-dominated. Indiscriminate hunting of medium to large sized mammals and the extraction of timber and various non-timber forest products constitute the most significant anthropogenic stressors on the habitat and represent a viable threat to the gorillas. Measurements of habitat and nest site selection show that the gorillas avoid human disturbance by selecting steep ridges over flat lowland forests, even though the latter might be richer in food resources. Analysis of faecal samples and feeding remains on trails show that gorillas have a diverse diet of fruit, pith, leaf, and bark, occasionally consuming maggots and snails. As do other gorillas, Mawambi gorillas consumed more fruit when its availability in the environment increased and resorted to non-fruit fibrous food in times of fruit scarcity. However, as a result of a prolonged dry season in their habitat and heavy monthly rainfall in the wet season, preferred fruit and herb food were unavailable during most of the year and gorillas subsisted by increasing their consumption of fibrous foods. A series of short- to medium-term conservation initiatives are recommended for the protection of this subspecies in human dominated forests, where most remaining populations of this little studied ape occur.

Time line: PhD 2009-2013

Supervision: Nikki Tagg | Zjef Pereboom | Luc Hens (Free University Brussels / VITO)

Funding: CRC / VLIR-UOS / National Geographic Society

Undergraduate & Master Students

Aerts, Justine – Université Libre de Bruxelles - Etude d'observation sur la communication sociale dans un groupe de bonobos en captivité: Role du regard et de la communication gestuelle dans les relations hiérarchiques et sociales.

Bisschop, Karen – Ghent University - Activiteitsbudget en ruimtebehoef bij bonobo's in dierentuin Planckendael

Blommaert, J. - KaHoSL - Bezoekersstudie over het gebruik van het multi-user touchscreen en bezoekersevaluatie van het mensapengebouw in de Zoo van Antwerpen.

Borger, Marloes – Utrecht University, NL - stabiliteit van bonobo persoonlijkheid.

de Boer, Renate – Utrecht University, NL - Feeding preferences and long-term habitat suitability for Rothschild's giraffe in Kigio Wildlife Conservancy

De Borgher, L. - KaHoSL - Sociale interacties bij de Mexicaanse soldatenara's (*Ara militaris*), in Agro- en biotechnologie.

De Parade, Annelies - KaHoSL - Het effect van een scatterfeeder op de zichtbaarheid en activiteit van wasberen in dierenpark Planckendael

De Wachter, R. - KaHoSL - Locatiegebruik van de Aziatische olifanten in het nieuwe verblijf van Planckendael

Geirnaert, A. - KaHoSL - Bezoekersstudie in mensapengebouw Zoo Antwerpen.

Geldof, Marjolein – KULeuven - Using an animal computer interface to study hyaena behaviour

Geleyn, L. - KaHoSL - Gedrag, verrijking en targettraining bij twee verschillende gehuisveste groepen ringstaartmakis's.

Gils, Cosette – University of Antwerp - Analyse van spelgedrag bij de bonobo *Pan paniscus*

Gybels, J. - Universiteit Gent - Invloed van omgevingsverrijking op gedrag van carnivoren in gevangenschap, in *Diergeneeskunde*. 2013.: Gent.

Huijben, Margo – HAS Den Bosch, NL - Dagbesteding, ruimtegebruik, sociaal gedrag & het gebruik van de verrijking van de okapi's in Antwerpen Zoo.

Jaasma, Linda – Utrecht University, NL - The relationship between the AVPR-1a gene and bonobo personality

Kogelenberg, Kerstin - KaHoSL objectieve stress-indicatoren in reptielen in dierentuinen.

Maes, Machteld - Karel de Grote Hogeschool – Optimising genetic sex determination protocols in birds.

Matthyssen, Steffi University of Antwerp - Analyse van abnormaal gedrag bij verschillende bonobogroepen in gevangenschap

Meijer, Bernadette – Utrecht University, NL - Effects of captivity on the success of reintroduction. Literature Review

Pirlot, Ann – KU Leuven - Using an animal computer interface to study hyaena behaviour

Podt, Annemieke – Utrecht University, NL - Personality traits and social network in captive bonobos (*Pan Paniscus*)

Renard, Lola – Université de Liège - Seed dispersal and habitat use by golden-headed lion tamarins (*Leontopithecus chrysomelas*) in the Una Biological Reserve (UBR), Brazil.

Ribeiro Chagas, Henrique – Universidade Estadual da Santa Cruz, Brazil - The impact of vegetation structure on the presence of groups of golden-headed lion tamarins (GHLTs) in forest fragments and cabruca areas in southeastern Bahia.

Rinsma, Wiebe – Utrecht University, NL - Bonobo personality: a biological approach to personality traits, morphological symmetry and consistency of behavioural patterns of captive bonobos

Rinsma, Wiebe – Utrecht University, NL - Increasing the success of great ape conservation ex situ: inbreeding avoidance through fission-fusion dynamics (Literature review)

Roelofs, Sanne – Utrecht University, NL - Assessing bonobo personality traits using naturalistic observations and group experiments

Schuitema, Cynthia - KaHoSL - Activiteitsbudget en stereotiep gedrag bij Indische neushoorns van Planckendael

Slegers, M. - HAS Den Bosch, NL - Hoe ziet het activiteitsbudget en de sociale interacties van de gehouden Humboldt pinguïn eruit?

Tedonzong, Luc – Dschang University, Cameroon – Characterisation de fruits consommés par les gorilles de plaine de l'ouest dans la périphérie nord de la Réserve de Biosphère du Dja

van 't Schip, Mark - Wageningen University, NL / Manchester Metropolitan University, UK: Quantitative genetics in Congo peafowl ex situ breeding populations

Van Dooren, F. - KaHoSL - Bezoekersstudie bij de leeuwen in de Zoo van Antwerpen.

van Gils, Elke - Wageningen University, NL - Praktische aspecten van vlooigedrag bij bonobo's (*Pan paniscus*): mutueel vlooigedrag en "gestural communication".

van Ginneken, Marjolein – University of Antwerp - Vergelijking van de sociale klimaten van twee semi-wilde chimpanseegroepen (*Pan troglodytes*, Blumenbach) in Zambia

Van Neck, Lotte – Karel de Grote Hogeschool – Optimising genetic sex determination protocols in birds

van Tienderen, Kaj – Utrecht University, NL - improving the golden-headed lion tamarin (*Leontopithecus chrysomelas*) breeding schemes by establishing founder kinship through combined microsatellite marker and pedigree analysis.

Vanden Broecke, Bram - University of Antwerp - Een verkennende studie naar heritabiliteit en variatie in overleving binnen ex-situ

goudkopleeuwaap (*Leontopithecus chrysomelas*) populaties

Vandoninck, Mellissa - KULeuven - Contagious yawning in captive bonobo's

Vaneste, Jade – KaHoSL - Werktuiggebruik bij bonobo's in gevangenschap.

Voordeckers, Seppe – Thomas More - Invloed van bezoekers op het gedrag van flamingo's en Humboldt pinguïns in een doorloopverblijf

Higher education

CRC organises and is involved in the following courses at universities and schools for higher education:

Conservation Genetics | University of Antwerp (Pereboom, Galbusera, Helsen)

Primateology | University of Antwerp (D'Aout, Pereboom, Galbusera, Stevens/Tagg)

Observing Animal Behaviour (Leren Observeren) | University of Antwerp (Stevens, De Groot, Staes, Pereboom)

Zoo Conservation Biology | Utrecht University (Pereboom)

Behavioural Ecology | University of Antwerp (Stevens)

Presentations to students

Pereboom, Zjef (2013) Captive breeding and population management. Wildlife Conservation Genetics, 28 March 2013, Wageningen University, NL

Pereboom, Zjef (2013) 20 years of Bonobo Research in Planckendael. Visit to Planckendael Wageningen University, NL - 27 April 2013,

Pereboom, Zjef (2013) Conservation biology and animal behaviour. 16 December 2013 Utrecht University, NL

Petre, C.-A. (2013) Eco-éthologie des gorilles et enjeux de conservation. 25 March 2013. Université de Namur

Petre, C.-A. (2013) Le rôle de la faune dans la dispersion des graines. 09 December 2013, Gembloux Agro-Bio Tech, Université de Liège

De Groot, E (2013) Bonobo Research in Planckendael. 19 March 2013, Biological Psychology KULeuven

Wolftram, Katja (2013) Modern-day matchmaking in a monogamous raptor species of conservation concern, the Eurasian Black Vulture, *Aegypius monachus*. University of Antwerp, 14 May 2013.



Strategic objective 5

Educating, informing and inspiring the general public, policy makers and other stakeholders

Education and public outreach become ever more important for modern zoos, and zoos are rapidly becoming major players in conservation research and education. The CRC contributes to the advancement of public understanding of science and technology and raising public awareness of biodiversity conservation issues. This is not only achieved by means of the "ZOO academy", the RZSA's education department with whom we collaborate intensively for public outreach and education, but also by taking part in national events like the Flanders Science Week "Wetenschap in de Kijker", through radio and TV programmes, and in newspapers and magazines. Our researchers are furthermore involved in promoting research-derived national and international conservation policies by informing and involving policy makers, government officials, as exemplified by the ConGRESS network, and our involvement in the Belgian Biodiversity Platform.

ConGRESS: Conservation Genetics Resources for Effective Species Survival

The CRC is a full partner in the ConGRESS consortium, a Seventh Framework Programme EU-funded collaborative network dedicated to transferring information and resources for biodiversity managers and policy makers in the nature conservation sector. The consortium's primary aim is to encourage the use of genetic data and studies on species and populations in biodiversity projects. A series of local workshops were organised to discuss the possibilities and impossibilities of using genetic tools for conservation actions.

One of the key outputs of this consortium is a community-based web portal, comprising databases on experts in conservation genetics including scientists and professional end-users, scientific publications, simulation and decision making tools and genetic data for important European species of conservation concern. The project aims to operate at a regional level with special emphasis on improving capacity and awareness in regions of Europe where it may be lacking today. By building a network of scientists, management and policy professionals, the project intends to establish a forum for the communication of ideas, experiences and to provide support which will enhance the conservation of European biodiversity and its evolutionary capacity for the future.

Ultimately, the ConGRESS consortium hopes to establish and inspire a new generation of conservation managers and policy makers who will be able to choose, apply and assess genetic information in biodiversity projects in the future. The ConGRESS portal www.congressgenetics.eu, with databases and sample planning and decision making tools is now up and running and available to anyone interested in using conservation genetics for practical species management.

Time line: 2010-2013

Partners: Ustav Biologie Obratlovcu Av Cr, V.V.I. Czech Republic; Agencia Estatal Consejo Superior De Investigaciones Cientificas, Spain; Fondazione Edmund Mach, Italy; Turun Yliopisto Finland; University Of Durham, UK; Københavns Universitet Denmark ; Universita Degli Studi Di Ferrara, Italy ; Centre National De La Recherche Scientifique France ; Stichting Nationaal Natuurhistorisch Museum Naturalis, Netherlands; Albert-Ludwigs-Universitaet Freiburg, Germany; Queen Mary and Wesfield College, University Of London, UK

Funding: 7th EU Framework Programme

Outreach Activities

On 29 November 2013 the CRC organised a public symposium in Antwerp zoo, aimed at informing scientists, students, zoo staff and the general public about the conservation and research activities by the CRC.

Within the framework European Commission Education and Training programme, RZSA vet Francis Vercammen with the zoo vet of Beekse Bergen Safaripark, Jacques Kaandorp and Matt

Hartley of Zoo and Wildlife Solutions Ltd. organised specialist workshops on zoo veterinary issues and food safety, for food safety officials of national and regional governments within the EU member states.

The CRC played an important advisory role in the development of the "EU Zoos Directive Guidance and Best Practice document" commissioned by the EU's DG Environment, aimed at improving the implementation of the EU Zoos Directive 1999/22/EC in Europe by both zoo professionals and competent authorities of the EU members states. The document provides science-based and practical information relating to zoos, in particular concerning research, training, exchange of information, captive breeding and other conservation actions, public education and awareness, accommodating animals under satisfactory conditions, preventing escape, and keeping appropriate records, as mentioned in the Zoos Directive.

Presentations to a general audience

De Vleeschouwer, Kristel (2013) Ecologie, demografie en gedrag van goudkopleeuwapen in gedegradeerde en gefragmenteerde habitats. Zoo Antwerpen, 26 June 2013.

Pereboom, Zjef (2013) BioBrasil & het Zuid-Amerika Project. Harpij workshop "klauwapen". Zoo Antwerpen, 24 October 2013.

Pereboom, Zjef (2013) Kweekprogramma's in dierentuinen: De regels van de kunst. Symposium BaDiZo, Hogeschool Gent, 12 October 2013.



Staff and Governance

Director of Research & Development

Linda Van Elsacker PhD

Vera Cuypers | PA and Administration

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