



Annual Report 2012

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



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

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Annual Report 2012

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
SAMENVATTING IN HET NEDERLANDS	6
PERFORMANTIE-INDICATOREN	9
INTRODUCTION TO THE CRC	10
1 MAINTAINING OUR POSITION AS A CENTRE OF EXCELLENCE FOR CONSERVATION RESEARCH	11
<i>APPLIED CONSERVATION RESEARCH</i>	11
<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	22
3 FOCUSING ON INTEGRATED, SCIENCE-BASED CONSERVATION ACTIONS	23
4 TRAINING FUTURE GENERATIONS OF CONSERVATIONISTS	26
5 EDUCATING, INFORMING AND INSPIRING THE PUBLIC, POLICY MAKERS AND OTHER STAKEHOLDERS	28
STAFF AND GOVERNANCE	29

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 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 for the 5-year period covering 2012-2016, which will contribute to delivering this mission statement.

- 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 conservationists (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.)*

Samenvatting in het Nederlands

In 2012 ondertekende Vlaams Minister Ingrid Lieten in Dierenpark Planckendaal een nieuwe overeenkomst tussen de Vlaamse overheid en de KMDA die vijf jaar samenwerking vastlegt voor wetenschappelijk onderzoek. Met deze overeenkomst maakt de minister het mogelijk de wetenschappelijke werking van het *Centre for Research and Conservation* (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 Planckendaal, maar ook haar natuurbeschermingsprojecten in De Zegge, Kameroen en Brazilië. Vanuit de strategische keuzes die werden omschreven in het managementplan 2020 van de KMDA, verzekert deze nieuwe overeenkomst de wetenschappelijke missie van de KMDA tot en met het jaar 2016.

Om Vlaanderen te profileren als innovatieve regio zet minister Lieten in op toponderzoek en excellentie, en de financiële ondersteuning van het CRC past perfect binnen de doelstellingen en acties rond Wetenschap, Innovatie en Technologie van de Vlaamse overheid: *"In de komende jaren zal de onderzoeksafdeling van Planckendaal en de ZOO zich onder meer richten op het gebruik van de nieuwste technologieën in genetisch onderzoek. Daarnaast willen ze onderzoeksprojecten opzetten om onze kennis te vergroten over leerprocessen, cognitie en intelligentie van dieren en om de gevolgen van veroudering bij dieren te bestuderen. Die gegevens zijn niet enkel relevant voor het verzekeren van het welzijn van onze dieren, maar bovendien relevant voor ons inzicht in de effecten van veroudering bij mensen. Van deze inzichten kunnen ook andere onderzoeksinstellingen in ons land en daarbuiten meegenieten"*, aldus Vlaams Minister Ingrid Lieten. Het wetenschappelijke werk van het CRC kadert ook binnen de campagne 'Richting Morgen' waarmee de overheid wetenschap, technologie en innovatie toegankelijker wil maken voor iedereen. Volgens Minister Lieten is *"Het 'levende labo' in Planckendaal, waar je wetenschappers met de bonobo's aan het werk ziet, is voor jongeren een heel directe manier om in aanraking te komen met onderzoek. Zo maak je jongeren nieuwsgierig voor wetenschap"*.

Drie onderzoeksthema's

De kernactiviteiten van het CRC zijn gericht op onderzoeksprojecten binnen de thema's toegepast conservatieonderzoek en toegepast dierenwelzijn, daarbij optimaal gebruik makende van de bestaande onderzoeksexpertise van het huidige team wetenschappers. Toch wil het CRC flexibel blijven in het vaststellen van haar onderzoeksprioriteiten om te kunnen reageren op de vraag naar specifieke kennis over diersoorten die dringend bescherming nodig hebben, om biologische vraagstukken aan te kunnen pakken door middel van fundamenteel zoologisch onderzoek, of om in te gaan op expliciete vraag naar deskundigheid van het CRC-team vanuit de academische gemeenschap, de dierenruimgemeenschap en de bedrijfswereld. Met haar specifieke expertise in de diergeneeskunde, diergedrag (met inbegrip van dierenwelzijn), conservatiegenetica, functionele morfologie en biomechanica, en ecologie van primaten enerzijds, en anderzijds de mogelijkheid te kunnen beschikken over uitstekende onderzoeksfaciliteiten én collecties levende dieren, bevindt het CRC zich in een unieke positie om naast het toegepast welzijnsonderzoek en toegepast conservatieonderzoek ook fundamenteel-wetenschappelijke vragen aan te pakken.

Toegepast Natuurbehoud, Toegepast Dierenwelzijn en Fundamentele Dierkunde zijn de drie hoofdthema's waarbinnen het CRC in de periode 2012-2016 haar onderzoeksprojecten onderbrengt. In het voorliggende jaarrapport over 2012 geven we een overzicht van de

onderzoeksactiviteiten van het CRC in het afgelopen jaar binnen deze drie thema's.

1 - TOEGEPAST CONSERVATIE-ONDERZOEK

De focus van het thema toegepast conservatieonderzoek betreft het beheer van kweekprogramma's en genetisch onderzoek ter ondersteuning van het beheer van populaties in dierenruinen en wilde populaties. Met gedetailleerde genetische analyses in haar eigen laboratoriumfaciliteiten ondersteunt het CRC het beheer en de stamboekanalyses van de kweekprogramma's waarvoor de KMDA verantwoordelijkheid draagt. Met een brede wetenschappelijke aanpak werkten we in 2012 verder aan een doctoraatsproject om aan de hand van genetisch materiaal te bepalen welke rol partnerkeuze speelt bij monniksgieren in het Europese kweekprogramma, en in hoeverre dit kan verklaren waarom het kweekprogramma zo'n laag voortplantingssucces heeft.

Het bestuderen van de ecologie van primaten is het primaire onderwerp van de conservatieprojecten in Brazilië en Kameroen. Deze projecten dragen bij tot de bescherming van primaten en hun habitats en het duurzame gebruik van natuurlijke hulpbronnen door middel van fundamenteel en toegepast ecologisch onderzoek in combinatie met capacity building, community-based conservation en het bevorderen van het duurzaam gebruik van natuurlijke hulpbronnen.

2 - TOEGEPAST DIERENWELZIJNS-ONDERZOEK

Het onderzoek in het thema toegepast dierenwelzijn heeft vooral betrekking op de praktische integratie van gedragsonderzoek en diergeneeskundig onderzoek in het beheer van dierenruincollecties. Binnen het CRC richt het toegepast dierenwelzijnsonderzoek zich onder meer op de invloed van dierenverblijven, het effect van bezoekers, en op omgevingsverrijking op het gedrag en welzijn van de dieren in dierenruinen. Daarnaast worden korte projecten uitgevoerd om vragen of problemen die zich voordoen vanuit de dagelijkse praktijk in onze beide parken te beantwoorden. In 2012 werden studies uitgevoerd op de invloed van bezoekers op het gedrag van reuzenkangoeroes, en werd gestart met een langere termijn project om scatterfeeders in te zetten om stereotiep gedrag bij carnivoren te verminderen. Tenslotte werd een studie uitgevoerd naar de invloed van grootschalige verhuis op stressniveaus en slaapgedrag bij Aziatische olifanten

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. In samenwerking met de UGent werkten we verder aan een doctoraat om te bepalen waarom sommige soorten amfibieën minder gevoelig zijn voor schimmelinfecties, en aan de ontwikkeling van veilige en vooral meer efficiënte behandelingsmethoden voor deze dodelijke ziekte in amfibieën.

3 - FUNDAMENTEEL ZOÖLOGISCH ONDERZOEK

De kern van het zoologisch basisonderzoek betreft de studie van evolutionaire processen die aan de basis liggen van verschillen in sociale organisatie, voortplantings-strategieën, sociaal gedrag en cognitieve vaardigheden van dieren. In 2012 werkten we in het kader van de doctoraatsstudie van Nicky Staes verder rond de relatie tussen individuele verschillen in gedrag en variatie in receptorgenen voor neuropeptiden bij chimpansees en bonobo's. Bonobo's stonden verder in de kijker in het onderzoek rond sociale cognitie en wederkerigheid en er werd een nieuw onderzoek naar tolerantie en voedseldelen opgestart.

Naast toegepast onderzoek van bewegingsproblemen bij diertuindieren werkte het CRC in nauwe samenwerking met de Universiteit Antwerpen en enkele internationale partners aan fundamenteel biologische vragen over "hoe dieren bewegen". Met de lopende projecten die kaderen binnen het Europese 7e Kaderprogramma proberen we te achterhalen hoe dieren zich aanpassen aan bijvoorbeeld verwondingen of een lichamelijk gebrek.

Invulling strategische doelstellingen en wetenschappelijk output

De voortzetting van de steun van de Vlaamse overheid laat het CRC niet alleen toe om voort te bouwen op de huidige onderzoeksexpertise, maar ook om te kunnen reageren op de nieuwe wetenschappelijke uitdagingen voor de boeg. In ons onderzoek en in onze conservatie-projecten willen we adequaat kunnen reageren op nieuwe wetenschappelijke technieken door nieuwe methoden te gebruiken, door het aantrekken van externe expertise voor het CRC, en door te investeren in nieuwe samenwerkingsprojecten met nationale en internationale partners.

De toekenning van het nieuwe convenant met de Vlaamse overheid en de daarbij behorende subsidies komen voort uit het Strategisch Plan voor Wetenschappelijk Onderzoek voor de periode 2012-2016 van het CRC. Daarin omschrijft het CRC de onderstaande vijf strategische doelstellingen. Voor elk van deze doelstellingen geven we een kort overzicht van het behaalde resultaat in 2012.

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

Op wetenschappelijke vlak leverde het CRC in 2012 tientallen wetenschappelijke publicaties, zowel in internationaal erkende wetenschappelijke tijdschriften als in vakbladen. Onze onderzoekers presenteerden hun werk op talrijke internationale wetenschappelijke congressen en symposia.

Nieuwe samenwerkingsovereenkomsten werden er in 2012 getekend met het Max Planck Institute for Evolutionary Anthropology, Duitsland; de University Estadual de Santa Cruz, Brazilië, en ten slotte in eigen land met de Vrije Universiteit Brussel.

De KMDA werd in 2012 opgenomen in de lijst van slechts negen erkende wetenschappelijke CITES instellingen in België. CITES, de "Convention on the International Trade in Endangered Species", is een internationale overeenkomst die toeziet op de handel in bedreigde dieren en planten of onderdelen van planten en dieren. Het doel van deze overeenkomst is de bescherming van ongeveer 5.000 dieren en 29.000 planten die zijn opgenomen in één van de drie CITES lijsten. CITES controleert niet enkel op handel in ivoor of andere producten van dieren en planten, maar ook bijvoorbeeld de uitwisseling van stalen voor wetenschappelijk onderzoek. Deze erkenning wil niet zeggen dat het CRC vanaf nu ongecontroleerd stalen voor onderzoek kan uitwisselen, maar wel dat het veel eenvoudiger zal zijn om bijvoorbeeld materiaal voor onderzoek uit musea aan te vragen, of stalen naar andere onderzoeksinstituten te sturen. De toevoeging van de KMDA aan deze lijst kunnen we zonder meer beschouwen als een officiële erkenning voor onze inzet voor het behoud van biodiversiteit.

In 2012 werden twee doctoraten succesvol verdedigd. Het hoogtepunt in 2012 was de afronding van het doctoraat van de eerste Kameroenese doctorandus en de verdediging van het doctoraat in de Zoo van Antwerpen. Jacob Willie werkte al geruime tijd in PGS aan een studie over welke planten in het woud belangrijk zijn voor gorilla's als voeding en het bouwen van nesten, en wat we daaruit kunnen leren voor het behoud van gorilla's. Fana Michilsens, de tweede succesvolle promovendus,

onderzocht voor haar doctoraat hoe siamangs op een zo energie-efficiënt mogelijke manier kunnen armslingeren. Deze vraag is niet nieuw. Wetenschappers stelden al eerder vast dat de slingerbeweging van gibbons en siamangs heel energiezuinig is, tenminste, als ze op een rechte lijn voortbewegen. Maar tot nu toe hield niemand rekening met het feit dat in hun natuurlijke omgeving boomtakken zich op verschillende afstanden en hoogtes bevinden, en dat die takken meebuigen en terugveren als er een siamang aan hangt. Met de onderzoekopstelling die speciaal voor het siamangverblijf in de Zoo Antwerpen ontwikkeld werd, konden we onderzoeken of siamangs hun slingerbewegingen aan een dergelijke complexe structuur aanpassen, en of het energie-verbruik dan nog steeds zo efficiënt is. Siamangs blijken dat perfect te kunnen. Hun krachtige armspieren worden gebruikt om de lichaamspositie en het voortbewegingspatroon zodanig aan te passen aan de eigenschappen van de structuur waar ze aan slingeren, dat de energie-uitwisseling zo hoog mogelijk, en het energie-verlies zo laag mogelijk blijft.

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

In het kader van de verdergaande internationalisering van ons werk was het CRC in 2012 actief betrokken bij Europese en andere internationale platforms om mee vorm te geven aan het internationale beleid betreffende zoo-onderzoek en soortenbescherming op wereldniveau. Getuige hiervan is onze actieve rol binnen EAZA, de Europese organisatie van diertuinen en aquaria, en de EAZA Research Committee, een werkgroep van EAZA die wetenschappelijk onderzoek in diertuinen promoot en helpt opstarten. Daarnaast speelde het CRC een sleutelrol bij de ontwikkeling van het nieuw wetenschappelijk tijdschrift voor de zoo-gemeenschap, het *Journal of Zoo and Aquarium Research* dat begin 2013 zal verschijnen. De CRC wetenschappers en andere medewerkers van de KMDA zijn bovendien nauw betrokken bij de trainingen en opleidingen voor medewerkers van collega-diertuin 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 proberen 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 kustregenwoud 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 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. Op basis van de resultaten van een door het CRC georganiseerd symposium en de resultaten van BioBrasil's wetenschappelijk onderzoek sinds 2002, werd in 2012 een nieuw vijf-jaren onderzoeksprogramma uitgewerkt, dat de ecologische effecten van woudfragmentatie en de mobiliteit van goudkopleeuwapen in het landschap in detail zal onderzoeken, evenals de factoren die de overleving van goudkopleeuwapen op medium- tot lange termijn kunnen bepalen

(connectiviteit, jachtdruk, klimaatsveranderingen). Dit onderzoeksprogramma wordt uitgevoerd met lokale studenten en hiertoe werd een nieuw samenwerkingsverband uitgewerkt met de Universidade Estadual da Santa Cruz (UESC). Doel is om wederzijds onderzoek op het vlak van conservatie-ecologie te versterken via de onderzoeksactiviteiten van Braziliaanse MSc en PhD studenten onder supervisie van het CRC. Dit samenwerkingsverband voorziet in drie beurzen voor Braziliaanse studenten. Deze projecten kaderen binnen het grotere onderzoeksproject SISBIOTA, een Braziliaans onderzoeksnetwerk dat de samenwerking met andere onderzoeksteams, het verkrijgen van research-permits en het delen wetenschappelijk gegevens eenvoudiger maakt. Daarnaast werd ook een onderzoek gestart naar standpunten van de lokale bevolking inzake natuurbehoud en het gebruik van natuurlijke hulpbronnen. Dergelijke informatie is essentieel als aanvulling op de ecologische gegevens, als aanloop naar het uitwerken van een efficiënt conservatie-actieplan dat direct inspeelt op de noden van de lokale bevolking en hen mee in toekomstige acties betreft.

Projet Grands Singes

In 2012 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 chimpansees en gorilla's te beschermen in de niet-beschermde bossen in Zuidoost Kameroen. Deze kapconcessies, bufferzones en gemeenschapsbossen rond het Dja reservaat worden nog veelvuldig gebruikt voor illegale jacht en landbouw. De populaties mensapen die hier nog voorkomen komen mede hierdoor steeds verder onder druk te staan. Naast wetenschappelijk onderzoek en natuurbehoud is het werk van PGS van groot socio-economisch belang voor de lokale bevolking. Alle activiteiten en initiatieven in het onderzoeksgebied worden uitgevoerd met de volledige instemming en deelname van de mensen die wonen, werken, overleven, en hun geld verdienen in de wouden rond het Dja reservaat. Het gemeenschapswerk van PGS resulteerde de afgelopen jaren in de aanwezigheid van grotere en stabiele populaties chimpansees en gorilla's ondanks de toename van de jacht met geweren, een stijgende trend in de regio. De subsidies van de Vlaamse overheid aan het CRC maken het mogelijk om op een structurele manier wetenschappelijk onderzoek te doen in Kameroen. Op de lange termijn heeft het onderzoeksprogramma van PGS tot doel een beter inzicht te krijgen in hoe we het behoud van mensapen het beste kunnen aanpakken. Ook op de korte termijn draagt de aanwezigheid van een onderzoeksteam bij aan de bescherming van mensapen. Enerzijds door jagers af te schrikken, en anderzijds doordat de lokale onderzoeksmedewerkers doordrongen raken van de waarde wilde dieren en intacte bossen.

Doctorandus Charles-Albert Petre, verdiept zich in de rol die gorilla's spelen in de regeneratie en het onderhoud van het woud. Gorilla's onderhouden een nauwe band met bepaalde boomsoorten omdat ze de zaden verspreiden van vruchten die ze eten en zo een belangrijke rol spelen in het voortbestaan van het woud. Met deze kennis hoopt PGS houtkap-bedrijven die actief zijn in het gebied te kunnen adviseren, opdat zij het woud zo min mogelijk verstoren en zo bijdragen aan het behoud van mensapen. Mélodie Dieudonné, werkte verder aan haar antropologische studie naar de tradities en cultuur van de plaatselijke bevolkingsgroepen die leven in de bossen waar mensapen voorkomen. Haar doctoraatsstudie richt zich vooral op de vraag hoe lokale gebruiken, tradities en geloof het succes van conservatie-activiteiten beïnvloeden.

Natuurreservaat De Zegge

In 2012 werd het eindrapport gepubliceerd over de samenwerking tussen het CRC en de Onderzoeksgroep Ecosysteembeheer van de Universiteit Antwerpen naar de hydrologie van De Zegge in de periode 2005-2011. Uitgangspunt van deze studie was om op landschaps-ecologische schaal

inzicht te krijgen in de ecohydrologie van het zowel De Zegge als het omliggende landschap.

De studie omvatte onderzoek naar het grondwaterpeil in en om de Zegge, de waterkwaliteit van de beken die door de Zegge stromen en de plassen binnen de Zegge, en in hoeverre de waterkwaliteit en -kwantiteit van invloed zijn op de natuurwaarden in de Zegge.

Algemeen kunnen we op grond van de resultaten besluiten dat de waterhuishouding van de Zegge sterk verstoort is omdat het reservaat een eiland vormt in een intensief landbouwgebied. Daarbij is niet alleen de waterhoeveelheid maar ook de kwaliteit van het water sterk veranderd ten opzichte van de situatie van voor de grootschalige ruilverkavelingen midden 20e eeuw. Echter, wat betreft de hydrologie is de invloed van buiten De Zegge relatief beperkt. Het is essentieel ervoor te blijven waken dat dit zo blijft. In het rapport en worden er op grond van de studieresultaten aanbevelingen gedaan voor de verdere opvolging van hydrologie en natuurwaarden in en rond De Zegge.

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 2012 werkten enkele tientallen bachelor-, master- en doctoraatsstudenten aan hun eindwerk binnen het CRC.

In PGS werkten verschillende Kameroenese Master studenten aan een thesis binnen het kader van de lopende onderzoeken van doctorandi en de projecten de vaste onderzoekers. Het onderzoek van Project BioBrasil leidde in 2012 tot twee MSc thesissen, verdedigd door de Braziliaanse studenten Paula Pedreiro dos Reis en Juliana Monteiro de Almeida Rocha, voor hun onderzoek op goudkopleeuwapen in cabruca-plantages. Daarnaast gaf Kristel De Vleeschouwer ook onderwijs aan de biologie-opleiding van UESC.

Verder organiseerden het CRC verscheidene Bachelor- en Mastercursussen, in het bijzonder met de Universiteit van Antwerpen (Primatologie, Conservation Genetics) en de Universiteit Utrecht (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 onderzoeks-bevindingen van onze studies regelmatig naar het grote publiek gebracht, zowel door educatieve panelen en gidstoeren in de Zoo als in Planckendael, in duidingsprogramma's op radio en TV, via internet, en in kranten en tijdschriften zoals het populair wetenschappelijke tijdschrift EOS/Scientific American. De vele publicaties van het CRC op het intranet en in het personeelskrant van de KMDA "Het Wandelend Blad" dragen bij tot informeren van personeel en de zoggidsen, en via hen weer naar publiek.

In 2012 speelde het wetenschappelijk onderzoek van het CRC een sleutelrol in het TV-één programma "Zoo of Love", en bij de voorbereidingen van de nieuwe TV-serie "Zoo achter de Schermen". Verder namen de CRC -onderzoekers actief deel aan initiatieven voor wetenschapscommunicatie zoals de website "Ik Heb Een Vraag" en publieksevents als de Vlaamse Wetenschapsweek en Wetenschap in de Kijker.

Het ConGRESS consortium, een groep Europese conservatiegenetica-experts waaronder wetenschappers van het CRC, startte in 2012 met een webportaal dat beleidsmakers en beheerders van biodiversiteit in alle

Europese lidstaten zal ondersteunen bij het gebruik van genetisch onderzoek voor het ontwerpen van het natuurbehoudsplannen. De website www.congressgenetics.eu bevat onder andere informatie over meer dan 4000 studies over bedreigde soorten in Europa, een presentatie en folders over genetica en het belang daarvan voor effectief natuurbehoud, en een forum om contacten te leggen met wetenschappers in de eigen regio. Daarnaast biedt het portaal een *project planning tool* waarmee genetische studies ontworpen kunnen worden, en een *decision making tool die* speciaal ontworpen zijn om de interpretatie van genetische resultaten te vergemakkelijken.

Onderzoeksfinanciering

In 2012 ontving de KMDA van de Vlaamse overheid een totaal subsidiebedrag van €899.000 voor het uitvoeren van de wetenschappelijke opdracht zoals omschreven in het nieuwe convenant tussen de KMDA en de Vlaamse overheid Wetenschappelijk Onderzoek 2012-2016. Daarnaast wist het CRC in 2012 een bedrag van bijna €275.000 aan externe

onderzoeksfinanciering te verzekeren. Een belangrijk deel daarvan werd als doctoraatsbeurs verworven, en een deel was afkomstig van conservatie-organisaties die fondsen toegekenden aan de veldprojecten in Kameroen en Brazilië.

Kort samengevat leverde het CRC ook in het jaar 2012 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 2013

Linda Van Elsacker
Directeur Onderzoek & Ontwikkeling

Zjef Pereboom
Research Manager CRC

Performantie-indicatoren

De strategische doelstellingen zoals omschreven in het Strategisch Plan 2012-2016 vormen een integraal deel 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 2012 werden alle performantie-indicatoren behaald.

Performantieindicatoren		Performantie 2012
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. Voor 2012 zal dit gemiddelde 20 publicaties bedragen.	Aantal wetenschappelijke publicaties in 2012 = 23 Gemiddelde aantal over 2010/2011/2012 = 20 publicaties
KPI 2 Actieve deelname aan Wetenschappelijke Bijeenkomsten	Het aantal wetenschappelijke voordrachten op internationale bijeenkomsten: jaarlijks minstens 20 wetenschappelijke voordrachten.	32 wetenschappelijke voordrachten 11 posterpresentaties
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: jaarlijks minstens 2 nieuwe ondertekende overeenkomsten.	3 nieuwe overeenkomsten getekend in 2012: <i>Max Planck Institute for Evolutionary Anthropology, Duitsland.</i> <i>University Estadual de Santa Cruz, Brazilië.</i> <i>Vrije Universiteit Brussel, België.</i>
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 30% externe financiering berekend op basis van de jaarlijkse toelage voor wetenschappelijk onderzoek.	<ul style="list-style-type: none"> • <i>Doctoraats- & Postdocbeurzen</i> €170.620,00 • <i>Conservatiebeurzen</i> €138.007,69 • <i>Varia fondsen</i> € 15.401,50 • <i>Overdracht naar 2013</i> €-56.836,45+ Totaal externe fondsen €274.219,90 =30,5% van € 899.000,-



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. But it wasn't until 2002 that the RZSA was able to establish its Centre for Research and Conservation (CRC) as a designated department for zoo and field based conservation research, resulting from a unique funding agreement with the Flemish government. Zoo research and science-based husbandry and conservation breeding programmes managed by the CRC are now 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).

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. The implementation of the conservation mission and the scientific assignments of the RZSA through the CRC is greatly influenced by the professional communities, organisations and networks we work with and are actively involved in like EAZA and WAZA. Indeed, the RZSA is committed to work as much as possible within the spirit and objectives of the 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 the European Association of Zoos and Aquaria (EAZA), and the research priorities of EAZA Taxon Advisory Groups and conservation breeding programme co-ordinators shape our research priorities and actions. 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.

The CRC is core-funded by the Flemish government through its department of Economy, Science and Innovation (EWI). This financial support is part of a funding agreement between the Flemish government and the RZSA for the period 2012-2016, which 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.

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, Eurasian black Vulture, Okapi, Golden-Headed Lion Tamarins, 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 our 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 continued financial support from the Flemish government will 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 ahead of us. 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 fulfill its requirements towards national zoo legislation and the European Zoos Directive in terms of actively contributing to conservation, research and public education.

April 2013

Strategic objective 1

Maintaining our position as a centre of excellence for conservation

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.

For lion tamarins, for example we developed genetic markers and largely analyzed 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 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.

The importance of museum samples in resolving taxonomic uncertainties is further illustrated in the military macaw (*Ara militaris*) project. Military macaws have a discontinuous distribution range, stretching from Mexico to Argentina. This patchy distribution corresponds to earlier morphological description of three allopatric subspecies (*A.m.*

militaris, *A.m. mexicana* and *A.m. boliviana*), making this species interesting from a phylogeographic point of view. While a small number of confiscated macaws form the basis of the current *A. m. mexicana* breeding program, sustainability is uncertain. As such resolving these taxonomic uncertainties is vital to safeguard the long-term viability of all captive military macaw breeding programs. After repeatedly trying to import non-invasive samples from the current wild populations, we redirected our focus on using toe pads from historical collections of the American Museum for Natural History in New York. These samples will enable us to evaluate whether the genetics confirms morphological differentiation within these macaws. Moreover, these 150-year old museum samples will hold extra information on the history of these subspecies. The results of this phylogenetic study will be crucial in optimising the current captive breeding programme.

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

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 minimizing the loss of genetic diversity. Minimising mean kinship using 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, assess covariance between traits, among others. Conservation breeding programs might benefit from such analysis, in that heritable changes, in reproductive traits for example, can have direct consequences on the success of specific breeding programs and moreover might influence future reintroduction success.

We started an exploratory quantitative genetic research line using studbooks kept by the KMDA (e.g. Golden headed lion tamarins, Congo peafowl, Okapi) and others institutes (e.g. Edwards’ pheasant) to evaluate the use of currently available models in ex-situ breeding. In a first phase we are focusing on the genetic background of longevity, birth weight and clutch sizes, and trade-offs between early reproduction and age among others. Moreover the same studbooks will be used to evaluate the effect of inbreeding depression.

Time line: 2012 –ongoing

Funding: CRC

Genetics of mate choice 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 program 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 program. 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 2009-2013

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

Population genetics of Sulawesi ungulates

Peter Galbusera | Jill Shephard | Jeroen van den Hurk | 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. In 2012 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. Most of the results will be published in 2013 and 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

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 2012 we received additional museum samples from Italy and contacts were laid to obtain samples from the Balkan region.

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 2013, 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

Herbaceous plant community structure in south-east Cameroon: ecological drivers and use by western lowland gorillas

Jacob Willie

For a detailed description of the project see page 27

Time line: PhD 2010-2012

Supervision: Nikki Tagg | Zjef Pereboom | Luc Lens (Ghent University)

Funding: CRC / VLIR-UOS

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

Denis Ndeloh Etiendem

The focus of this PhD project is to examine the ecological factors that affect the survival of a population of critically endangered Cross River gorillas (CRG) found in a non-protected forest in SW Cameroon. Whereas many studies have been conducted on mountain gorillas, Grauer's gorillas and western lowland gorillas, very little information is currently available on the ecology of CRG, and an ecological study of this species in lowland forest has never been done. Over the last decade considerable ground has been gained in terms of conservation actions, however, to increase conservation efforts, more information on how gorillas use lowland forest sites and on how human activities within these habitats affect their ranging is essential for making informed conservation decisions.

The objectives of this project are 1) to collect data on gorilla population size and social organization; 2) to document the feeding ecology of gorillas by studying the habitat characteristics and availability of gorilla food resources; and 3) to assess the type, extent and intensity of human activities on the habitat. The majority of the results are in press or will be published in 2013.

Time line: PhD 2009-2013

Supervision: Nikki Tagg | Zjef Pereboom | Luc Hens (Free University Brussels / VITO) Funding: CRC / VLIR-UOS

Investigating the role of gorillas in forest maintenance and regeneration

Charles-Albert Petre

Amongst seed dispersers, the contribution of primates is widely recognized by ecologists as incomparable. However, the specific role of the western lowland gorilla has been overlooked. This is of particular relevance as this species seems to fulfill important criteria for effective dispersal, both quantitatively and qualitatively. One trait makes it potentially unique as seed disperser; the regular deposition of seeds in open canopy environments where light will not be a limiting factor for subsequent seedling growth and survival. This particular trait, which results from nesting habitat preference, may have important implications for population dynamics of the plant dispersed. In the context of a growing interest for African timber, this may be of particular relevance since most of timber species require high light regime at seedling stage to grow and survive.

This PhD project aims to assess the importance of ecological and economic services provided by western lowland gorillas through seed dispersal in South-East Cameroon. The seed dispersal ecology of gorillas is determined qualitatively and

quantitatively, and includes estimating the effectiveness of directed seed dispersal towards canopy gaps. The gorilla's relative economic contribution will be based on a case study of the dispersal and regeneration of a highly valuable commercial timber species, *Chrysophyllum lacourtianum* (Sapotaceae), which plays an important role in the gorilla diet. Quantification of the recruitment of seedlings of this timber species by gorillas, and how they contribute to forest regeneration and biodiversity maintenance, should ultimately lead to recommendations to forest managers to implement or strengthen ape/wildlife friendly forestry practices.

A growing body of literature recognizes that wildlife depletion will have strong impacts on the long-term structure and composition of tropical forests, which will result in a great loss of biodiversity. As a consequence, conservation strategies are now often including the ecological function of animal species in the suite of selection criteria for targeting priority species whose conservation will have positive outcomes for the whole ecosystem integrity on the long-term. Documentation of ecological services provided by gorillas will therefore not only contribute to a better understanding of Afrotropical lowland forest dynamics, but also may have positive implications for western lowland gorilla conservation.

Over the course of 2012, the effect of gut passage and fecal matter on seed germination and seedling growth has been tested on five additional species. Marking of feces at nest sites finished in March and the monitoring of seedling establishment and growth has been conducted on a monthly basis and will continue in 2013. The fruit biomass production of *C. lacourtianum* has been measured and the contribution of gorillas to seed removal will be measured in 2013. A first manuscript, reviewing the keystone role of primates in tropical forests and the implications of their decline has been submitted for publication.

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. The survival of Golden-headed lion

tamarins (*Leontopithecus chrysomelas*) depends critically on increasing the area of protected forest, through forest linkage and corridor building. To evaluate the suitability of different forest types and fragments, and consequently the allocation of priority areas for forest conservation, the location of corridors, and the choice of suitable areas for translocation of groups, the RZSA started the in-situ conservation project BioBrasil in 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 gained 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. Research activities during 2012 primarily focused on the analysis and publication of research data and biological samples collected since 2002. The following results were published or submitted for publication in 2012.

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 may be related to environmental factors such as the encounter rate between GHLT groups, humidity conditions, and the amount of undergrowth in the vegetation structure.

Comparison of behavioral data of GHLT groups ranging in degraded areas and cabruca plantations offered insight into the activity patterns and predator-related behavior of the species in different habitats. Activity budgets were very similar in both regions, although the daily distance travelled was lower in cabruca than in other habitats, probably related to differences in resource availability and distribution. Further, predation risk affected vertical stratum use and the level of association with Wied's marmosets in both habitats, but with differential effects depending on group size.

Based on these preliminary results and the conclusions of a symposium with key researchers and stakeholders in GHLT conservation organised by BioBrasil in December 2011, we proposed to focus further research activities on filling existing knowledge gaps (e.g. see the following two projects that were initiated in 2012) that are essential to develop a GHLT Conservation Action Plan, and to

expand the study area to encompass the entire GHLT distribution.

Pessoa MS, De Vleeschouwer KM, Talora DC, Rocha L & Amorim AM (2012) Reproductive phenology of *Miconia mirabilis* (Melastomataceae) within three distinct physiognomies of Atlantic Forest, Bahia, Brazil. *Biotropica* 12(2): 49-56.

Zeigler, S.L., De Vleeschouwer K.M. and Raboy, B.E. (in press) Assessing extinction risk in small metapopulations of golden-headed lion tamarins (*Leontopithecus chrysomelas*). *Biotropica*. Published online March 2013

Timeline 2002-ongoing

Funding: CRC

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 the eastern part of their distribution range and cabruca agroforest in the western part. Yet, cabrucas can differ considerably in vegetation structure, which likely affects local habitat suitability and pathways for GHLTs to move between fragments, given that cabruca is the principal habitat within the matrix connecting forest fragments. In addition to cabruca, the matrix contains various 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.

Principal Investigator: Kristel De Vleeschouwer

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

Timeline: 2012-2017



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

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

This 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 2012-2016

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

Funding: FRIFA (Fonds pour la formation à la Recherche dans l'Industrie et l'Agriculture)

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 2012, we focused on the influence of visitors on the behavior of red kangaroos in Planckendael, and started a long-term project on the influence of scatter feeders on the behavior of carnivores in zoos.

A number of studies in zoos have investigated the effect of visitors on animal behaviour in zoos.

These studies are mostly biased towards primates and large carnivores, but little is known about the effect visitors have on other taxa. In this study, we investigated the effect of visitors on the behaviour of a captive group of Red kangaroos (*Macropus rufus*) at Planckendael Wild Animal Park in March and April 2012. To improve the welfare and decrease the influence of visitors, vision screens can be used. Therefore we studied the use of vision screens by the kangaroos. Overall, the use of the screen areas varied, but the animals used the other areas (with no screens) more often. To conclude we can state preliminary that visitor numbers did not have an effect on the visibility of the animals and use of the enclosure. The vision screens were not used by the animals to hide themselves during crowded days. Therefore we conclude that the enclosure use of the red kangaroos at Planckendael is not influenced by visitor numbers, and probably visitors have no negative effect on kangaroo welfare.

We also started a joint project with the Katholieke Hogeschool Sint Lieven and the University of Ghent to investigate the influence of distributing

dog pellets in enclosures of carnivores in Planckendael. In the wild, spotted hyenas (*Crocuta crocuta*) occupy large territories, show elaborate hunting behaviour and live in very large social groups. This makes them prone to locomotor stereotypies when kept in zoos, and appropriate enrichment schemes can be necessary to reduce the occurrence of such stereotypies. We investigated the impact of enrichment on pacing behaviour in two male spotted hyenas. While preliminary results indicate that pacing was reduced in the scatter feed condition compared to both other conditions, aggression also increased after scatter feeding, probably because of restricted surface in which the dog biscuits were spread out. Research into the influence of this scatter feeder at Planckendael will be continued in 2013, to further assess the impact on the hyenas' welfare. Also, we will expand the project to other small carnivores such as raccoons.

Time line: ongoing

Partners: Various Universities and Higher education schools, Paignton Zoo, Chester Zoo

Funding: CRC

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. In captivity, as in the wild, the risks associated with zoonotic diseases have increased for both human and animal populations, emphasising the need for research projects on the identification, screening, prevention and treatment of various infectious diseases that might be of concern to the public health. A recent publication focussed on the occurrence of bacteria resistant to antibiotics in zoo animals. In contrast to the numerous reports on methicillin-resistant *Staphylococcus aureus* (MRSA) in domestic animals, which is of serious health concern, hardly any articles concerning zoo animals are documented in the literature. Our study on 93 different individual mammals housed at the Royal Zoological Society of Antwerp, reported the absence of MRSA in swabs of nostrils, skins, conjunctiva, vulva, abscess, and arm rests in public spaces.

Vercammen, F., Bauwens, L., Deken, R. D., Ph, D., & Brandt, J. (2012). Prevalence of Methicillin-Resistant *Staphylococcus aureus* in Mammals of the Royal Zoological Society of Antwerp, Belgium. *Journal of Zoo and Wildlife Medicine*

Timeline: Ongoing

Funding: RZSA

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. The most reliable techniques for detecting Bd cells are based on detecting and quantifying the amount of Bd DNA present in a sample. Although these methods can accurately detect and quantify the number of zoospores present in samples, no distinction between viable and dead Bd cells can be made. Due to this drawback developing Bd viability assays without the need for culturing is impossible. In 2012 a study was completed and published in *Fungal Biology* in which a real-time PCR based technique is described that allows fast and selective quantification of viable Bd cells. This assay was used to test the antifungal activity of the Veterinary Antiseptic F10® as an example of a possible application of this assay. It was shown that this disinfectant was capable of killing Bd zoospores within 1 minute at dilutions as low as 1:6400. This disinfectant proved to be highly toxic to amphibian larvae and post-metamorphs rendering it unsuitable as possible treatment option.

Previous research in our group showed that a species' susceptibility to chytridiomycosis is associated with the extent of skin invasion by Bd. Lungless salamanders of the genus *Speleomantes* seem to thrive in Bd infested areas. We hypothesized that skin secretions of these salamanders block skin invasion by Bd, rendering them resistant to chytridiomycosis. A screening of 921 salamanders belonging to the genus of *Speleomantes* indeed showed complete absence of Bd in these animals. This had not been encountered in any amphibian species so far. Furthermore, trials to experimentally infect these salamanders with Bd were unsuccessful. The aforementioned Bd viability assaying technique was used to demonstrate that salamanders of the *Speleomantes* genus secreted very potent and effective Bd killing

skin secretions. This study was accepted for publication in *PLOS one*.

In addition, we study the impact of freshwater microorganisms on the infection dynamics of *Batrachochytrium dendrobatidis*. The effect of exposure of Bd zoospores to water samples that were collected from different European sites was assessed again using the aforementioned technique. This method was also used to assess the effect of cultures of several freshwater microorganisms on Bd viability. Based on the results of these first experiments several microorganisms were selected for Bd zoospore ingestion experiments and for a Bd infection experiment with tadpoles in the absence and presence of microorganisms. We were able to show a significant correlation between the abundance of microorganisms and Bd zoospore persistence in the water samples. In pure culture, some but not all microorganisms were highly efficient in killing Bd. These highly effective species ingested Bd zoospores and prevented Bd colonization of tadpoles. In conclusion, environmental microorganisms dictate chytrid infection dynamics. This promising result could lead to novel strategies in attempting to mitigate Bd in the environment. The results of this study are currently under in-depth review in *Science*.

Yet another goal of this PhD project is to improve current chytridiomycosis diagnostics. Multilocus sequence typing of several chytrid strains has led to the knowledge that several genetically distinct chytrid lineages exist. These lineages differ in global distribution pattern and in virulence. The screening methods used should ideally detect all different strains to be able to ascertain definite absence or presence of the organism. Although the widely used real-time qPCR designed by Boyle et al. (2004) allows fast and reliable detection of Bd DNA, it does not detect all different chytrid strains able to cause amphibian chytridiomycosis. We developed and validated a real-time PCR able to detect all currently known chytrid strains able to cause chytridiomycosis. The results of this study are being prepared for submission.

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

Time line: PhD 2011-2014

Funding: CRC (KMDA Dehousse)

This PhD project was initiated by Mariska Muijsers

Muijsers, M., Martel, A., Van Rooij, P., Baert, K., Vercauteren, G., Ducatelle, R., De Backer, P., Vercammen, F., Haesebrouck, F.; Pasmans, F (2012). Antibacterial therapeutics for the treatment of chytrid infection in amphibians: Columbus's egg? *BMC Veterinary research*, 8 (1), 175. *BMC Veterinary Research*. doi: 10.1186/1746-6148-8-175

The influence of stress, related to environmental changes, on physiology and sleep behaviour of Asian elephants (*Elephas maximus*) in captivity.

Johan Wuyts

Preliminary analyses of data on elephant sleep behaviour, collected for several months at Antwerp Zoo before the birth of a calf, revealed that sleep of the whole herd but especially of the mother was greatly influenced by the pregnancy and the upcoming birth. These results suggest that stressful situations (like pregnancies and births) may impair the quality of elephants' sleep which in turn can compromise the animals' wellbeing. In Summer 2012 the RZSA moved its complete herd of five female elephants from Antwerp Zoo to

Planckendael animal park. This major change in the life of these animals allowed us to do an in-depth study of the impact of stressful changes on sleep behaviour and sleep quality of this herd. With the future expansion of the elephant herd in mind, detailed monitoring of the elephants' physiology and behaviour as well as a comprehensive evaluation of their wellbeing in the new enclosure is indispensable. This is especially interesting since successful breeding of elephants in captivity is delicate. In this project we aim to study the impact of stress caused by environmental changes (the unique occasion of the inter-zoo move/new enclosures) on sleep behaviour and sleep quality of zoo elephants. For ten day before and ten day after the move of the elephant herd to Planckendael daytime and nighttime behaviour was observed for

all individuals. In addition, during the same period daily dung samples were collected, and during the morning training procedure saliva samples were collected. The behavioural data are currently analysed, and the saliva samples will be processed and analysed for cortisol levels in collaboration with the Endocrinological Laboratory of Chester Zoo in the UK. The results will provide a significant contribution to both the welfare and management of elephants in zoos as well as to the research fields biology and psychology.

Time Line 2012-2013

Partners: Chester Zoo, UK

Funding: CRC / Free University Brussels

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.

Our recent work has focused very much on understanding principles of reciprocity, in so called biological markets where bonobos can exchange grooming for other commodities, such as support or access to food. Much of the debate about reciprocity in humans and other primates hinges on proximate mechanisms, or more precisely, the contingency of one service on another. While there is good evidence for long-term statistical contingencies of services given and received in primates, results for short-term behavioural

contingencies are mixed. We therefore used more naturalistic experiments to test for short-term contingencies of grooming on food sharing and vice versa in one group of chimpanzees and two groups of bonobos. Overall, we found significant effects of grooming on food sharing and vice versa, however, in the chimpanzees these effects disappeared when controlling for long-term characteristics of the dyad including services exchanged over the whole study period. In the bonobos, short-term contingencies remained significant which was likely a consequence of considerable tension surrounding monopolisable food resulting in higher rates of grooming and other affiliative behaviors around sharing sessions. We propose that longterm contingency is proximately regulated by a 'relationship score' computed through a tally of past interactions which tend to outweigh recent single events.

We elaborated on the relationship quality of bonobo groups in 5 captive groups. We found three dimensions of Relationship Quality which are very similar to those found in chimpanzees. Kin had higher relationship value than non-kin. Female-female dyads had higher scores on relationship security than male-female or male-male dyads. Furthermore we started a new range of experiments together with the Max Planck Institute

for Psycholinguistics in Nijmegen to test for tolerance around food resources.

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 first publication on adrenarche in bonobos. Adrenarche is characterized by the onset of adrenal secretions of increasing amounts of dehydroepiandrosterone-sulfate (DHEA-S). Within the primate order, adrenarche has been described only in humans and chimpanzees, but bonobos, the sister species of chimpanzees, had not yet been studied. We measured urinary DHEA-S levels to determine whether bonobos experience physiological changes that are indicative of adrenarche. Our results show that bonobos experience an increase in DHEA-S levels after 5 years of age, which is comparable with the patterns observed in humans and chimpanzees. This indicates that bonobos do undergo adrenarche and that the timing of onset is similar to that of the two Pan species. The extraction procedures described in this report demonstrate the use of urine for monitoring ontogenetic changes in DHEA-S excretion. If applicable to other species, the technique would facilitate more research on the evolutionary origin of adrenarche and other developmental processes.

Time line: 2002-ongoing

Partners: Adrian Jaeggi (University of Zürich) | Gottfried Hohman, Verena Behringer (Max Plank 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)

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

The role of neuropeptides as a proximate base for (pro)social behaviour and personality: inter- and intraspecific comparison of bonobo and chimpanzee

Nicky Staes | Jeroen Stevens

Altruism and prosociality among non-related individuals is not unique for humans but can also be found in his closest living relatives, the chimpanzee and bonobo, who split from human evolution only 5 million years ago. Altruism in apes is substantially different from that in humans and the question is how this evolved so rapidly. The origin of species- specific behaviour requires diversity in behaviour and a regulation mechanism. 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, 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 two great ape- species: the bonobo (*Pan paniscus*) and the chimpanzee (*Pan troglodytes*). Both species are closely related to each other and form the closest living relatives to humans. Although both species split very recently (1.5-2 mya), there are remarkable differences in their social organisation and behavior. Interspecific comparisons are however rare and it isn't always clear how high inter- and intraspecific variation is. As they are the closest living relatives to humans, information on the endocrinology and genetics of bonobos and chimpanzees will shed light on the mechanisms of the rapid evolution of behavioural differences. 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 200 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 in bonobos and chimpanzees, 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 later be linked to behavioral profiles and personality. Bonobos show no genetic variation in our region of interest on the oxytocin receptor gene whereas chimpanzees do, with 8 different single nucleotide polymorphisms found. For vasopressin we were not able to find the 350bp deletion, containing the microsat RS3 in the promotor 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 behavior 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.

Personality ratings were collected for a total of 154 bonobos, spread over 16 groups from the EEP and SSP. Analyses on these ratings is being done in collaboration with Alex Weiss (University of Edinburgh, UK). We also finished a first round of behavioral observations in 6 zoo's in Europe and conducted behavioral experiments in each of these groups. A second round to test for consistency of our data has been started end of 2012.

Time line: PhD 2011-2015

Partners: Marcel Eens (University of Antwerp) | Jorg Massen, Annemieke Podt (Utrecht University) | Sonja Koski (Zürich University) | Leo Vorthoren (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

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 2012, we have continued research on anatomy of gibbons (Myatt et al, 2012) and on gait transitions in the bonobo population of Planckendael. Kinematic, kinetic (force) and morphology data were combined in an inverse dynamics analysis. A similar analysis was performed on Olive baboons, in close collaboration with the CNRS (France, Dr. G. Berillon). The results show that a change from quadrupedal to bipedal locomotion is initiated in a single stride, in which the leading leg makes a very large step, bringing the hind limbs under the body's centre of mass, combined with knee flexion. This technique is comparable to what is observed in humans, albeit variation in humans is larger. Preliminary (and luckily, rare) data on injured animals suggest that the normal gait pattern is basically maintained but that the healthy side compensates for the injured side by spending relatively more time on the ground.

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 will 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) | Sandra Nauwelaerts (University of Antwerp) | Julia Myatt (University of Liverpool, UK)

Funding: FWO, CRC

LocoMorph: Morphological handicaps and gait adaptation

Kristiaan D'Août | Peter Aerts

In the framework of an international collaboration "LocoMorph" (EU project, 7th Framework Programme), we aim to understand animal

morphology and morphosis. The first means that we want to understand the influence of morphology on locomotion, and examine how various morphologies (four-footed, two-footed, with or without tails, etc.) interact with the environment (e.g. substrate) (Karakasiliotis et al, 2012). Morphosis refers to the change of morphology and how these changes are dealt with. Those changes may be unintended (e.g. an injury) or wanted (e.g. the move from quadruped to upright posture).

Moreover, animals may change gait as a response to different substrates. Animals are much better than robots in terms of morphology and morphosis, but precisely how this happens (at the level of adjustment to control movement and coordination) is largely unknown because locomotion research has usually focused on "simple" locomotion types (healthy animals, stepping straight at a constant speed). Our share of the project is to study why animals are so well able

to adapt to changes in their "morphology" (e.g. animals with one or even two legs).

Time line 2010 2013

Funding: CRC | EU 7th Framework Programme

Functional anatomy and biomechanics of brachiating gibbons (Hylobatidae): an example of locomotion in complex environments.

Fana Michilsens

For a detailed description of the project see page 26

Time line: PhD 2008-2012

Supervision: Kristiaan D' Août Peter Aerts (University of Antwerp) Evie Vereecke (Leuven University)

Funding: FWO

Scientific Publications

PEER REVIEWED PUBLICATIONS & BOOK CHAPTERS

Behringer, V., Hohmann, G., **Stevens**, J. M. G., Weltring, A., & Deschner, T. (2012). Adrenarche in bonobos (*Pan paniscus*): evidence from ontogenetic changes in urinary dehydroepiandrosterone-sulfate levels. *The Journal of endocrinology*, 214(1); 55-65. doi:10.1530/JOE-12-0103

Browne, R. K., Li, H., Wang, Z., Hime, P. M., Mcmillan, A., Wu, M., Hongxing, Z., et al. (2012). The giant salamanders (Cryptobranchidae): Part A. palaeontology, phylogeny, genetics, and morphology. *Amphibian and Reptile Conservation*, 5(4): 17-29.

Crompton RH, Pataky T, Savage R, **D'Août** K, Bennett M, Day M, Bates K and Sellers W (2012). Human-like external function of the foot, and fully upright gait, confirmed in the 3.66 million year old laetoli hominin footprints by topographic statistics, experimental footprint-formation and computer simulation. *J Roy Soc Interface* 9: 707-719. doi: 10.1098/rsif.2011.0258

Dainou K, Laurenty E, Mahy G, Hardy OJ, Brostaux Y, **Tagg** N & Doucet JL (2012) Phenological patterns in a natural population of a tropical timber tree species, *Milicia excelsa* (Moraceae): evidence of isolation by time and its interaction with feeding strategies of dispersers. *American Journal of Botany* 99(9): 1453–1463.

De Vleeschouwer, K., Oliveira, L., **Raboy**, B., **Raghunathan**, N., & Zeigler, S. (2012). Golden-headed lion tamarin research in the 21st century: Recent advances and potential areas of future research. *Neotropical Primates*, 18(2): 72-76.

Dupain, J., Nackoney, J., Mario Vargas, J., Johnson, P. J., Farfán, M. a., Bofaso, M., & Fa, J. E. (2012). Bushmeat characteristics vary with catchment conditions in a Congo market. *Biological Conservation*, 146(1): 32-40. doi: 10.1016/j.biocon.2011.11.025

Jaeggi, A.V., **De Groot**, E., **Stevens**, J. M. G., & Van Schaik, C. P. (2012). Mechanisms of reciprocity in primates: testing for short-term contingency of grooming and food sharing in bonobos and chimpanzees. *Evolution and Human Behavior*, 1-9. Elsevier Inc. doi:10.1016/j.evolhumbehav.2012.09.005

Junker, J., Blake, S., Boesch, C., Campbell, G., Toit, L. D., Duvall, C., Ekobo, A., **Petre**, C-A et al. (2012). Recent decline in suitable environmental conditions for African great apes. (M. Bode, Ed.) *Diversity and Distributions*, 18(11), 1077-1091. doi:10.1111/ddi.12005

Karakasiliotis K, **D'Août** K, Aerts P and Ijspeert AJ (2012). Locomotion studies and modeling of the long-tailed lizard *Takydromus sexlineatus*. *IEEE BIOROB2012*. 943-948

Legrain, L., **Stevens**, J., Alegria Iscoa, J., & Destrebecqz, A. (2012). A Case Study of Conflict Management in Bonobos: How Does a Bonobo (*Pan paniscus*) Mother Manage Conflicts between Her Sons and Her Female Coalition Partner? *Folia primatologica* 82(4-5): 236-43. doi:10.1159/000334818

Macdonald, D. W., Johnson, P. J., Albrechtsen, L., Seymour, S., **Dupain**, J., Hall, A., & Fa, J. E. (2012). Bushmeat trade in the Cross-Sanaga rivers region: Evidence for the importance of protected areas. *Biological Conservation*, 147(1): 107-114. doi:10.1016/j.biocon.2011.12.018

Michilsens F, **D'Août** K, Vereecke EE and Aerts P (2012). One step beyond: Different step-to-step transitions exist during continuous contact brachiation in siamangs. *Biology Open*. 15, 1(5):411-21. (doi:10.1242/bio.2012588)

Muijsers, M., Martel, A., Van Rooij, P., Baert, K., Vercauteren, G., Ducatelle, R., De Backer, P., **Vercammen**, F, Haesebrouck, F; Pasmans, F (2012). Antibacterial therapeutics for the treatment of chytrid infection in amphibians: Columbus's egg? *BMC veterinary research*, 8(1), 175. *BMC Veterinary Research*. doi:10.1186/1746-6148-8-175

Myatt, J. P., Crompton, R. H., Payne-Davis, R. C., Vereecke, E. E., Isler, K., Savage, R., **D'Aouit**, K., et al. (2012). Functional adaptations in the forelimb muscles of non-human great apes. *Journal of Anatomy*, 220: 13-28. doi: 10.1111/j.1469-7580.2011.01443.x

Pessoa, M. D. S., **De Vleeschouwer**, K. M., Rocha, L., Talora, D. C., & Aurojo Amorim, A. M. (2012). Reproductive phenology of *Miconia mirabilis* (Melastomataceae) within three distinct physiognomies of Atlantic Forest, Bahia, Brazil. *Biota Neotropicana*, 12(2): 49-56.

Raboy, B. E., Neves, L. G., Zeigler, S. L., & Oliveira, L. C. (2012). Occurrences of the Golden-headed Lion Tamarin (*Leontopithecus chrysomelas*) above 500 Meters in Southern Bahia, Brazil and Implications for Conservation Planning. *Primate Conservation* 26: 25-31

Rödel, M.-Oliver, Doherty-Bone, T., Kouete, M. T., Janzen, P., Garrett, K., **Browne**, R., Gonwouo, N. L., et al. (2012). A new small *Phrynobatrachus* (Amphibia: Anura: Phrynobatrachidae) from southern Cameroon. *Zootaxa*, 68: 54-68.

Tkint, T.; Verheyen, E.; De Kegel, B.; **Helsen**, P.; Adriaens, D. (2012) Dealing with Food and Eggs in Mouthbrooding Cichlids: Structural and Functional Trade-Offs in Fitness Related Traits. *PLOS ONE* 7(2)

Tkint, T.; De Meyer, J.; **Helsen**, P.; Van Hoorebeke, L.; Verheyen, E.; Adriaens, D. (2012) Phenotypic plasticity of feeding performance as a response to diet in cichlids: suction versus biting. *Integrative and Comparative Biology* 52 (1) E175

Uteshev, V. K., Shishova, N. V., Kaurova, S. A., **Browne**, R. K., and Gakhova, E. N. (2012). Hormonal induction of spermatozoa from amphibians with *Rana temporaria* and *Bufo bufo* as anuran models. *Reprod. Fertil. Dev.* 24: 599-607

Vercammen, F., **Bauwens**, L., Deken, R. D., Ph, D., & Brandt, J. (2012). Prevalence of Methicillin-Resistant *Staphylococcus aureus* in Mammals of the Royal Zoological Society of Antwerp, Belgium. *Journal of Zoo and Wildlife Medicine*, 43(1): 159-161.

Willie, J., **Petre**, C.-A., **Tagg**, N., & Lens, L. (2012). Evaluation of species richness estimators based on quantitative performance measures and sensitivity to patchiness and sample grain size. *Acta Oecologica*, 45: 31-41. Elsevier Masson SAS. doi:10.1016/j.actao.2012.08.004

Willie, J., **Petre**, C.-A., **Tagg**, N., & Lens, L. (2012). Density of herbaceous plants and distribution of western gorillas in different habitat types in south-east Cameroon. *African Journal of Ecology* 51:111-121 doi:10.1111/aje.12014

ORAL CONFERENCE PRESENTATIONS

Berillon, Gilles; Anvari, Zohreh; **D'Aout**, Kristiaan (2012) Investigating load-carrying in non-human primates: the case study of infant-carrying in Olive baboons. 81st Annual Meeting of the American-Association-of-Physical-Anthropologists Location: Portland, OR

D'Aout, Kristiaan; Aerts, Peter; Goyens, Jana; et al. (The transition between quadrupedal and bipedal gait in hominoid and cercopithecoid models). 81st Annual Meeting of the American-Association-of-Physical-Anthropologists Location: Portland, OR

De Groot, Evelien, Simon Van den Bergh, Jeroen M.G. **Stevens**, Kirsten Pullen (2012) Visual discrimination in hornbills: a cognitive study on the discriminative abilities and sorting strategy of captive *Tockus deckeni* and *Tockus nasutus*. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11th July 2012

Derboven, J., Annema, J., A. **Sannen**, J. **Stevens** & Geerts, D. (2012). Evaluating Touch Screen Design for Limited Audience Engagement. Paper presented at Design for Audience Engagement workshop, NordiCHI 2012, 14 October, Copenhagen, Denmark.

Dieudonné, M. (2012) Conservation des grands-singes et communautés rurales au sud-est du Cameroun : approche anthropologique de la diversité des pratiques et représentations de la nature. XXVe Anniversaire de la Société Francophone de Primatologie: "Nature, Contrat Social et Primates, 3 siècles après Jean-Jacques Rousseau (1712-1778)". 19 October 2012, Lyon, France

Dieudonné, M. (2012) Local People and the Great Ape Conservation in East-Cameroon: An Anthropological Study of the Situation at the Northern Periphery of the Dja Reserve. Great Ape Conservation: Studies on the ecology and habitat use in Chimpanzees, Gorilla's and Orangutans. 26 November 2012, Antwerp Zoo, Belgium.

Etiendem DN, **Tagg N**, Hens L, **Pereboom J** (2012). Forest use and livelihoods of communities surrounding cross river gorilla (*Gorilla gorilla diehli*) habitats: case study Mawambi hills, SW Cameroon, at the XXIV International Primatological Society Congress México.

Etiendem, Denis Ndeloh (2012) Feeding ecology of Cross river gorillas: An evaluation of ecological and social factors influencing Cross river gorilla survival at Mawabi Hills, Cameroon. Great Ape Conservation: Studies on the ecology and habitat use in Chimpanzees, Gorilla's and Orangutans. 26 November 2012, Antwerp Zoo, Belgium.

Galbusera, Peter (2012) The ConGRESS consortium: the concept, portal and progress to date. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Galbusera, Peter and Philippe **Helsen** (2012) A pilot study on the effect of inbreeding on the sustainability of *Afropavo congensis*' captive breeding program. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Huyghe, Marleen, Katja **Wolfram**, Peter **Galbusera**, Jill **Shephard**, Zjef **Pereboom**, Erik Matthysen (2012) Improving captive breeding and matchmaking in the Eurasian Black Vulture, *Aegypius monachus*. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Michilsens, Fana (2012) Functional anatomy and biomechanics of brachiating gibbons (Hylobatidae): an example of locomotion in complex environments. Primates on the move: insights from research on captive and wild populations. 12 September 2012, Antwerp Zoo, Antwerp, Belgium

Michilsens, Fana; **D'Aout**, Kristiaan; Vereecke, Evie E., Aerts, P. (2012) The pendular movement in brachiation: a simple model for a locomotion system used in complex environments. 81st Annual Meeting of the American-Association-of-Physical-Anthropologists Location: Portland, OR

Nuijten, R. and **Pereboom**, J.J.M. (2012) Evaluating Conservation and Development Success. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Petre Charles-Albert and **Willie** Jacob (2012) The Projet Grands Singes: a community-based conservation project. Journée D'étude Gestion Rationnelle Et Conservation De La Grande Faune. Gembloux (GxABT, ULg), 4th of October 2012

Petre, Charles-Albert (2012) Plant-animal mutualistic interaction: the case of the Uapaca trees and the western lowland gorilla (*G. g. gorilla*). Great Ape Conservation: Studies on the ecology and habitat use in Chimpanzees, Gorilla's and Orangutans. 26 November 2012, Antwerp Zoo, Belgium.

Petre, Charles-Albert (2012) Plant-animal mutualistic interaction: the case of the Uapaca trees and the western lowland gorilla (*G. g. gorilla*). Belgian Group for Primatology, annual conference 11th of December, KBIN, Brussels.

CONFERENCE POSTERS

Petre, Charles-Albert (2012) The Projet Grands Singes: a community-based conservation project. Journée D'étude Gestion Rationnelle Et Conservation De La Grande Faune. Gembloux (GxABT, ULg), 4th of October 2012

Raboy, B. E.; **De Vleeschouwer, K. M.**; Zeigler, S. L. (2012) Using functional connectivity and flow models to prioritize areas for reforestation in severely fragmented regions of the golden-headed lion tamarin (*Leontopithecus chrysomelas*) distribution. 35th Meeting of the American-Society-of-Primatologists (ASP) Location: Sacramento, CA Date: JUN 20-23, 2012

Shephard J.M., Ogden R, Tryjanowski P, Olsson O, **Galbusera P** (2012) Unravelling the effects of translocation history versus population decline on a widespread migrant: The case of the European White Stork. European Congress of Conservation Biology (ECB) 28 August - 1 September, Glasgow, UK

Stevens, Jeroen M.G. (2012) Bonobos on the Bandwagon. University of California Santa Barbara, Department of Anthropology

Stevens, Jeroen M.G. (2012) Observing Bonobos, Visitors and Other Animals. Noldus User Meeting, 22 April 2012, Planckendael

Stevens, Jeroen M.G. (2012) Relationship quality in captive bonobos. XXIV Congress of the International Primatological Society, August 12th-17th Cancun, Mexico

Stevens, Jeroen M.G. (2012) Results of the poll on Gorilla ethics. International Gorilla Workshop 2012, 12th June 2012, Apenheul Primate Park

Stevens, Jeroen M.G., Zjef Pereboom, Linda Van Elsacker (2012) The Bonobo Project in Planckendael (Belgium): 25 Years of Captive Breeding - 20 Years of Research. International Colloquium "from grooming to Language", University of Lisbon, 10th of September 2012

Staes, Nicky; **Stevens, Jeroen**; Weiss, Alexander; et al. (2012) Oxytocin and vasopressin receptor gene polymorphisms and personality in bonobos (*Pan paniscus*): Preliminary results. 42nd Annual Meeting of the Behavior-Genetics-Association Location: Edinburgh, Schotland, June 22-25, 2012

Sylvester, Adam D.; **D'Aout, Kristiaan**; Kramer, Patricia A GRF moment arms about the knee in AL 288-1. 81st Annual Meeting of the American-Association-of-Physical-Anthropologists Location: Portland, OR

Tagg, Nikki (2012) 10 years of conservation research on chimpanzees and gorillas in non-protected forests in Cameroon. Great Ape Conservation: Studies on the ecology and habitat use in Chimpanzees, Gorilla's and Orangutans. 26 November 2012, Antwerp Zoo, Belgium.

Vercammen F., et al (2012) Outbreak of *Pterygodermatitis nycticebi* in callitrichids of the Royal Zoological Society of Antwerp. American Association of Zoo veterinarians

Willie, Jacob (2012) Ecological drivers of herbaceous plant availability and their use by gorillas in south-east Cameroon. Studies on the ecology and habitat use in Chimpanzees, Gorilla's and Orangutans. 26 November 2012, Antwerp Zoo, Belgium.

Wolfram, Katja, Peter Galbusera, Jill Shephard, Zjef Pereboom, Erik Matthysen (2012) Modern-day matchmaking in a species of conservation concern, the Eurasian Black Vulture, *Aegyptius monachus*. European Congress of Conservation Biology (ECB) 28 August - 1 September, Glasgow, UK.

Wolfram, Katja, Peter Galbusera, Jill Shephard, Zjef Pereboom, Erik Matthysen (2012) Modern-day matchmaking in a species of conservation concern, the Eurasian Black Vulture, *Aegyptius monachus*. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

De Groot, Evelien, Nathalie Briels, Jeroen M.G. Stevens (2012) What's new? Novel object testing in Psittacine birds. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11 July 2012

De Groot, Evelien, Nathalie Briels, Jeroen M.G. Stevens (2012) What's new? Novel object testing in Psittacine birds. 19th Benelux Congress of Zoology "From ecology to molecules"- ULB Brussels, 19-20 October 2012.

De Groot, Evelien, Sam Alfaro Bernaldo de Quiros, Hilde Vervaecke, Jeroen M.G. Stevens (2012) Is Skippy Shy? A study on visitor effects on kangaroo visibility and enclosure use 14th Annual BIAZA Research Symposium, 10-11 July 2012

De Groot, Evelien "New girl on the block": social integration of a female Gorilla into a captive group at Antwerp Zoo. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11 July 2012.

De Groot, Evelien "New girl on the block": social integration of a female Gorilla into a captive group at Antwerp Zoo. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Jansen, Merel, Marie-José Duchateau, Jeroen Stevens, Zjef Pereboom (2012) Experimental Personality Research in Okapis (*Okapia johnstoni*): An Assessment of the Possibilities and Challenges. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11th July 2012

Nuijten, R. and Pereboom, J.J.M. (2012) Evaluating Conservation and Development Success. EAZA Annual Meeting, 25-29 September 2012, Innsbruck, Austria.

Petre, Charles-Albert (2012) Directed dispersal of seeds by western lowland gorillas (*Gorilla gorilla gorilla*) in nest sites in Southeast Cameroon: implications for regeneration of logged forests. XXIV Congress of the International Primatological Society, August 12th-17th Cancun, Mexico

Stevens, Jeroen M.G., Femke Geysels, Hilde Vervaecke, Evelien De Groot (2012) Using a scatterfeeder to reduce stereotypic pacing in two spotted hyenas. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11 July 2012

Stevens, Jeroen M.G., Sofie Van den Audenaerde, Jeffrey Jacobs (2012) Comparison of reconciliation in bonobos and chimpanzees. 14th Annual BIAZA Research Symposium, Newquay, UK, 10-11 July 2012

Willie, J., Tagg, N., Petre, C.-A., De La Penas, E. & Lens, L. Herbaceous plant community structure: Ecological drivers and use by western lowland gorillas. PSGB Winter meeting, 5 December 2012 ZSL, London, UK.

Strategic objective 2

Building and expanding links within the zoo community and share 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. For improving information sharing, the CRC is working with EAZA towards the development of a new ISI-rated scientific

Breeding programme coordination

Afropavo congensis EEP and international studbook | Steven Vansteenkiste | Peter Galbusera

Ara militaris mexicana ESB | Steven Vansteenkiste | Peter Galbusera

Leontopithecus chrysomelas EEP | Peter Galbusera

Okapia johnstoni EEP and international studbook | Kristin Leus | Sander Hofman

Pan paniscus EEP and International Studbook | Zjef Pereboom | Jeroen Stevens

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* |

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

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 |

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

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 |

Zoo Capacity Building

Animal Behaviour Course for Zoo Professionals (Jeroen Stevens/Zjef Pereboom) EAZA Academy, Amsterdam, March 2012

Zoo Visitor Studies Workshop (Harry Schram) EAZA Academy

Genetic Resource Banking

The CRC stores an extensive number of cadaver and scientific samples including many from rare or endangered species. To date many of the samples are stored frozen as complete cadavers. Historically these cadavers in particular have been kept as many institutions requested either samples or skeletons from particular species for scientific research. Over time the volume of these samples has increased. We are now in a position to digitally catalogue and sample various tissues from the frozen collection. 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".

Publications in specialist literature & reports

Browne, R., S. Reinsch, H. Robertson, V. Trudeau, D. McGinnity (2012) Novel biotechnologies prove winners in giant salamander conservation. *FrogLog* 105-21, 1: 12-14 (www.amphibians.org)

Wolfram, K. and M. Huyghe (2012) The difficult life of a shy giant: A review of the captive care and reintroduction of the Eurasian black vulture. *ZooQuaria* 79: 12-14

De Vleeschouwer K. and Pereboom, J.J.M (2012) Golden years: Ten years of conservation research for golden-headed lion Tamarins and the Atlantic forest are leading to a brighter future. *ZooQuaria* 80:30

De Vleeschouwer K., L. Oliveira, B. Raboy, N. Raghunathan and Sara Zeigler (2012) Setting the stage for future research and conservation activities on GHLTs. *Tamarin Tales* 11: 9-10

Rastegar-Pouyani N, Mohsen Takesh, R. **Browne** (2012) A contribution to conservation of the Kurdistan Newt in Western Iran. *AArk Newsletter* Number 21, December 2012

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 nongovernmental organisations, 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

Western lowland gorillas and central chimpanzees are heavily concerned by the massive human-accelerated biodiversity decline that the world is experiencing, with a range-wide mean of 50% of these apes already having perished due to hunting for meat, disease and habitat loss and disturbance. A large majority (approximately 80%) of remaining ape populations live outside protected areas, where human pressures are high (hunting, fishing, legal/illegal logging, etc) and threats to great ape survival real. Arguably the most serious threat to great ape survival is hunting for meat. As a result of a growing local population afflicted by an economic crisis and a predilection of the people for game meat, traditional bushmeat hunting has, over the decades, become more and more driven by economic forces. In the Dja Biosphere Reserve (DBR) all large and medium-sized mammalian species (except galagos and pottos) are hunted for human consumption; wildlife is the source of 98% of the animal protein consumed in villages and towns in the vicinity; and game meat comprises close to 80% of all meat eaten by the inhabitants—a large portion of this meat is acquired through poaching in the reserve. Great apes are highly vulnerable to such negative impacts on their populations, as they are large-bodied animals with

slow reproductive rates, and they cannot rapidly recuperate from losses.

To address these issues, the CRC set up the Projet Grands Singes (PGS) in a non-protected forest in the buffer zone north of the DBR—a priority area for great ape conservation, with high densities of chimpanzees and gorillas and high diversity of other taxa. 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). 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. An initial step will assess and document the current and past actions and successes of all conservation efforts in the region of the DBR in Cameroon, through site visits, collation of data and reports, and pilot surveys in the field. Thorough assimilation of the results of this review will enable the consortium to highlight hotspots for further elaboration of the project.

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 off-take 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 analyzed.

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 analyze 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 southeastern Cameroon.

The achievements of 2012 mostly concern theoretical progresses and advances in data analysis. The political, economic and environmental history of Cameroon is rigorously investigated, with special attention to the Dja region. Data from seven months in four villages concerned by PGS activities have been and are still being examined and analyzed. Among other findings, first observations suggest a significant connection between generation, education, and

attitudes towards conservation. Most of the elders are more susceptible to conservation than the youngest who tend to engage in lucrative activities such as poaching in order to be able to leave the village to go settling in the city. The behavior of PGS fieldworkers and the quality of the resulting relationships between them and local villagers seems to be another factor influencing the attitudes towards the project and thus towards conservation. The past experience of the locals with conservation measures and/or projects also has important consequences on their current perception of external intervention that need to be understood and taken into account. These first reflections show the complexity of the situation, the diversity of factors influencing the attitudes towards nature and conservation initiatives in the area and the necessity of studying them in a detailed and comprehensive way.

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 characterizes 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 organizations 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
4. increased action (research and non-research) to identify key organizations 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 Tecnológica 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 analyze 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 organized 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 analyzed 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 Tecnológica Brazil)

The conservation of Critically Endangered newts of Iran

Robert Browne

The Critically Endangered, Kurdistan spotted newt (*Neurergus microspilotus*) is one of the world's most endangered amphibians. This particular species lives in a small area of 80 by 120 km in eight small streams in the Zagros Mountains, Iran. As the area has dried considerably, salamander populations have become more isolated and endangered. *N. microspilotus* is already extinct in at least one stream and in the other streams the species is likely to be suffering from drought and pollution. The RZSA has received grants that will support a conservation breeding programme for this species, which includes a comprehensive field survey including all likely streams in the area, and the establishment of a conservation breeding programme at Razi University, Iran. The field survey will fill our gaps in knowledge of habitat, behaviour and disease.

The conservation breeding programme will not only secure the species from extinction, but will also provide a range of research opportunities in an academic institution. We are also extending research for *N. microspilotus* to universities in Europe, China, USA, and Russia. This includes an important collaboration between the project and Ghent University, Belgium, to address the major pathogen threatening amphibians globally, population genetic assessment through the Chinese Academy of Science at Kunming University, and the gene banking of sperm through the Institute of Cell Biophysics, Russian Federation. The *N. microspilotus* programme will provide a model for similar programmes on other amphibian species.

The activities for the conservation of Kaisers newt (*Neurergus kaiseri*) in Iran, are funded by the Mohamed Bin Zayed Single Species Conservation Fund, and by Sedgwick County Zoo, USA. This programme is implemented in concert with the CBP programme for *N. microspilotus* and we are confident that synergism between the two programs will lead to outstanding results.

Main Partners: Prof N Rastegar-Pouyani (Razi University, Iran) Belgium: Prof Frank Pasmans (Ghent University), Nate Nelson (Sedgwick County Zoo, USA), Prof. Edith Gochova (Institute of Cell Biophysics, Russia), Prof. Bob Murphy (University of Ontario, Canada), Helen Meridith (Zoological Society of London), Helena Ollsen (Parken Zoo, Sweden)

Funding: CRC / Mohamed Bin Zayed Fund for Single Species Conservation/ Sedgwick County Zoo / EAZA Amphibian Campaign Fund.



Strategic objective 4

Training tomorrow's conservation biologists

Training conservationists 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 2012 a total of 39 undergraduate and masters students wrote a thesis as part of a CRC research project in 2012, and 8 PhD students worked towards the completion of their PhD degrees. In addition the CRC invests in building scientific capacity in developing countries by providing research training opportunities for Cameroonian and Brazilian students and conservationists.

PhD students at the CRC

Charles-Albert Petre | University of Liège, Gembloux Agro-Bio Tech

Denis Ndeloh Etiendem | Free University of Brussels

Fana Michilsens | University of Antwerp

Jacob Willie | Ghent University

Katja Wolfram | University of Antwerp

Mark Blooi | Ghent University

Mélodie Dieudonné | University of Liège

Nicky Staes | University of Antwerp

PhD Dissertations finalised in 2012

Fana Michilsens

Thesis: "Functional anatomy and biomechanics of brachiating gibbons (Hylobatidae): an example of locomotion in complex environments"

PhD Defence: 12 September 2012, Antwerp Zoo

Recent literature on the biomechanics of arboreal locomotion revealed that gibbons are able to brachiate with very low mechanical costs. They do this by making pendular movements, continually exchanging potential and kinetic energy to optimally conserve energy. In addition, they must minimise their collisional energy losses by ensuring that the passage between two movements happens smoothly without abrupt changes in the path of the body centre of mass. Although the

animals appear to succeed in doing this in uniform, predictable experimental circumstances, this cannot provide satisfactory detail of the degree of co-ordination and control in more naturalistic complex surroundings with compliant and heterogeneously spaced branches

In this PhD project we used a combination of morphological, kinematical and dynamical analyses to question whether gibbons adjust their movement patterns adequately to the mechanical complexity of support structures.

The first two chapters discuss the functional anatomy of hylobatids in relation to brachiation as their primary locomotion mode. The shoulder flexors, extensors, rotator muscles, elbow flexors and wrist flexors seem shaped to contribute the most to brachiation. Particularly the elbow flexors of gibbons are more powerful compared to those of non-specialised brachiators. In addition, both elbow and wrist flexors stand out in terms of moment of force-generating capacity, compared to non-brachiating species. Siamang forelimb muscles perform at their maximum during brachiation. However, the elbow flexors may be adapted to more demanding movements, given that maximal output is reached at the stronger flexed elbow positions which are reached during brachiation in a more spatially complex setup.

In chapter 3, a kinematical study of continuous contact brachiation in a simplified environment revealed four locomotory transitions that are mainly associated with speed. The results showed

that regardless of the transition type, energy recovery is always relatively high and collision fraction relatively low.

Chapter 4 discusses the effect of spatial heterogeneity of available support structures and brachiation speed on brachiation mechanics. Energy recovery was observed to be primarily determined by brachiation speed. Furthermore, the results indicate that collisional losses seem to be avoided during all the experimental setups used in this study. The expected effect of increasing spatial complexity, however, was not found: the energy recovery is kept high in all presented situations, except when brachiating at higher speed.

Finally, chapter 5 examines the effect of a compliant support structure on brachiation. The two individuals that were studied each had a different strategy to cope with the compliant handhold. One animal consistently used continuous contact brachiation and avoided additional lowering of the body centre of mass due to spring elongation by lifting the free, swing arm and lifting the legs. The other animal avoided the compliant handhold regularly by ricocheting over the setup without grabbing the compliant handhold. However, when take-off from the previous rigid handhold was not with the right velocity or timing to ensure successful grabbing of the next rigid handhold, the compliant handhold was shortly used with a low force (and a large variance between sequences). For both strategies, the use of the compliant handhold induced a lower



energy recovery an increased collision fraction. However, for both animals, the energy recovery increased and the collision fraction decreased when the body centre of mass followed the spring elongation less.

Although the complexity of the environment seems to determine brachiation mechanics, the effective use of the powerful forelimb muscles can easily adjust the movements during brachiation, assuring contact with the next available support and in addition, keeping energy exchange relatively high and collisional losses relatively low, even in a complex environment.

Jacob Willie

Thesis: “*Herbaceous plant community structure in south-east Cameroon: ecological drivers and use by western lowland gorillas*”

PhD defence: 26 November 2012, Antwerp Zoo

Gorillas depend on herbaceous plants that constitute an important source nest-building materials and food. The ecological patterns and the use of herbaceous plants were studied in a tropical forest site of south-east Cameroon to assess the influence of ecological factors on these resources and establish a link between environmental variables and herbaceous plants availability and use by gorillas. Species diversity and stem density were determined by identifying and counting herb stems in a series of plots distributed in different habitat types. Soil fertility parameters and other abiotic variables were recorded in a set of plots, and herbaceous plants were monitored in these plots to investigate possible influences of environmental factors on their availability. Nests built by gorillas were seasonally monitored during an extended period to identify the plant species used in their construction and classify them in terms of preference. Preferred herb stems and gorilla nest sites were inventoried in different habitat types to describe the relationship between herb availability and gorilla distribution. Herbaceous plants of the families Marantaceae and Zingiberaceae were preferentially used by gorillas. Abiotic factors such as light and organic matter had stronger effects on herbs and mostly explained spatial variations in their availability. The spatial variability in the magnitude of abiotic factors translated to spatial variations in diversity and stem biomass, dispersion and density of herbaceous plants. These environmental gradients influenced gorilla ranging patterns, as they commonly built nests and harvested their herb foods in habitats with high herb species diversity, many large-size herb stems, more pronounced herb clumps and high herb stem density. Stem density and species diversity were high in the study site, and gorillas used a high diversity of plant species to build nests compared to other sites, emphasizing variability in the availability of nest building

materials and habitat differences across their range. At the temporal scale, climatic variables such as rainfall, temperature and air humidity did not appear to influence total herb density, as there were only little variations in the number of stem recorded throughout the year. As a result, temporal changes in the plant composition in gorilla nests were not important despite seasonal changes in the use of nesting habitats by gorillas. Recently disturbed forest areas and less-accessible swamps which are characterized by a limited visibility and a high density of forest herbs can play a crucial role in the ecology and conservation of gorillas as they provide abundant and clumped nest-building materials, year-round nutrient-rich herbs and natural protection from hunters. Although light appears to be an important factor of herb availability, soil properties and climatic variables potentially represent important drivers. Conservation-applied research efforts should therefore focus on issues such as climate change effects on gorilla plant resources and the impact of logging-induced alterations of canopy and forest soil properties on herbaceous plants.

Supervision: Nikki Tagg | Zjef Pereboom | Luc Lens - UGhent

Funding: CRC / VLIR-UOS / Ghent University

Willie, J., Petre, C.-A., Tagg, N., & Lens, L. (2012). Evaluation of species richness estimators based on quantitative performance measures and sensitivity to patchiness and sample grain size. Acta Oecologica, 45: 31-41. Elsevier Masson SAS. doi:10.1016/j.actao.2012.08.004

Willie, J., Petre, C.-A., Tagg, N., & Lens, L. (2012). Density of herbaceous plants and distribution of western gorillas in different habitat types in south-east Cameroon. African Journal of Ecology 51:111-121 doi:10.1111/aje.12014

Undergraduate & Master Students

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 Cosette Gils – University of Antwerp
 Elke Van Gils– Utrecht University, NL
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 Jessica Brown - Murdoch University, Australia
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 Julie Gybels – Ghent University
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 Stefanie De Vos - KaHoSL
 Thomas Bionda - Utrecht University, NL
 Wiebe Rinsma– Utrecht University, NL
 Wouter Hendryckx - KaHoSL

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))

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

Wolfram, Katja (2012) Modern-day matchmaking in a monogamous raptor species of conservation concern, the Eurasian Black Vulture, *Aegypius monachus*. Antwerp University 8 May 2012

Pereboom (2012) Captive breeding and population management. Wildlife Conservation Genetics, 29 March 2012, Wageningen University, NL

Pereboom (2012) Conservation and animal behaviour. Behavioural Ecology, 20 December 2012 Utrecht University, NL

Pereboom, J.J.M. (2012) Developing the Research potential of Zoos and Aquariums: Research and Conservation in and by Zoos. 13 January 2012. Van Hall Institute Leeuwarden, NL

Stevens, J (2012) Bonobo Research in Planckendael. 5 March 2012, Biological Psychology KULeuven

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, an FP7 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. In 2012 such a workshop was held at the Antwerp Zoo, bringing together researchers and policy makers from Flanders and The Netherlands. With our support, leaflets have been translated into Dutch and the concept of ConGRESS was also presented at the EAZA Conservation Forum in Vienna, Austria. In addition, a community-based web portal was developed, comprising databases on experts including scientists and professional end-users, scientific publications, simulation and decision 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.

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 Wesvield College, University Of London, UK

Funding: 7th EU Framework Programme

Outreach Activities

In 2012 the CRC organised two public symposia in Antwerp zoo, aimed at informing the general public about the research activity by the CRC. Both events were organised on the occasion of the public PhD defenses of the dissertations of Fana Michilsens and Jacob Willie.

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.

Popular Science Publications

De Vleeschouwer, K. (2012) Biobrasil receives grants for studying conservation attitudes in South Bahia. www.zooresearch.be 16/11/2012

De Vleeschouwer, K. (2012) BioBrasil: Overleven in kleine fragmenten. *Zoo Natuurlijk* 4: 1-2 November 2012

De Vleeschouwer, K. (2012) Project BioBrasil 10 jaar www.zooresearch.be 03/09/2012

De Vleeschouwer, K. (2012) Setting the stage for future research on and conservation of GHLTs. www.zooresearch.be 24/08/2012

De Vleeschouwer, K. (2012) Veelbelovende plannen voor toekomstig onderzoek en bescherming van GKLA's. www.zooresearch.be 17/08/2012

Galbusera, P. (2012) The CRC informs biodiversity policy makers. www.zooresearch.be 04/12/2012

Helsen, P. (2012) KMDA/CRC opgenomen in CITES lijst wetenschappelijke instellingen. www.zooresearch.be 27/11/2012



Michilsens, F. (2012) Nóg beter boomslingeren dan Tarzan. www.zooresearch.be 16/08/2012

Pereboom, J. (2012) Flemish government signs a new five-year funding agreement with the CRC. www.zooresearch.be 18/11/2012

Pereboom, J. (2012) Minister Lieten sluit een vijfjarige overeenkomst met het CRC. www.zooresearch.be 14/11/2012

Pereboom, J. (2012) Nieuwe kikkersoort ontdekt in onderzoeksgebied KMDA. www.zooresearch.be 21/08/2012

Pereboom, J. (2012) Zoo-symposium en doctoraat over onderzoek van mensapen in Kameroen. www.zooresearch.be 26/11/2012

Tagg, N. (2012) Projet Grands Singes: over de mensen die het allemaal mogelijk maken. Zoo Natuurlijk 4: 3-4 November 2012

Wolftram, K. (2012) Have you hugged a vulture last weekend? www.zooresearch.be 07/09/2012

Presentations to a general audience

Galbusera, Peter (2012) "Huwelijksbureau voor dieren in de Zoo" Wetenschap in de Kijker, 23 November 2012. ZOO Antwerpen, Belgium

Galbusera, Peter (2012) Het beheer van kweekprogramma's in de Zoo. Biodiversiteitsdag Federaal Agentschap voor de Voedselveiligheid (FAVV) 16 October Brussels, Belgium

Galbusera, Peter (2012) Huwelijksbureau voor dieren in de Zoo: duurzaam populatiebeheer. Vlaams Congres van Leraars Wetenschappen 17 November Hasselt, Belgium.

Pereboom, J.J.M. (2012) Aapjes observeren!? daar komt meer bij kijken. Wetenschap in de Kijker, 20 November 2012 ZOO Antwerpen, Belgium

Pereboom, J.J.M. (2012) Aapjes observeren!? daar komt meer bij kijken. Wetenschap in de Kijker, 22 November 2012 Planckendael Animal Park, Belgium

Pereboom, J.J.M. (2012) Amphibian Conservation Research in Zoos and Aquariums. European Parliament. 29 February 2012 Brussels, Belgium.

Pereboom, J.J.M. (2012) SCIENCE @ THE ZOO: Het Centre for Research and Conservation. Gidsenvergadering Zoo Antwerpen 18 January 2012

Stevens, Jeroen M.G. (2012) Aapjes observeren!? daar komt meer bij kijken. Wetenschap in de Kijker, 19 November 2012 ZOO Antwerpen, Belgium

Stevens, Jeroen M.G. (2012) Aapjes observeren!? daar komt meer bij kijken. Wetenschap in de Kijker, 23 November 2012 Planckendael Animal Park, Belgium

Stevens, Jeroen M.G. (2012) Competitie & Samenwerking bij (mens)apen. OCMW Trefdag Antwerpen, 22 maart 2012

Stevens, Jeroen M.G. (2012) Evaluatie van verrijking: voor wie & door wie? Nederlandse Vereniging voor Dierentuinen Workshop verrijking, Dierenpark Amersfoort, 12 December 2012

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Robert Browne | RZSA

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Francine Bellens | Volunteer

Francis De Reyck | Volunteer

Gilbert Vanbaelen | Volunteer

Jan Van de Water | Volunteer

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Ludo De Backer | Volunteer

Marcel Verbruggen | Conservator De Zegge



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The Royal Zoological Society of Antwerp wishes to acknowledge the members of the Scientific Advisory Board for their continued support, advice and quality control.

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