

## List of publications: PD Dr. Christian C. Voigt (update 20.12.2011)

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### 2012 accepted or in press

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98. Ghanem, S.J., Voigt, C.C. (2012) Increasing awareness of ecosystem services provided by bats. **Advances in the Study of Behavior** accepted

*Short summary: Bats provide enormous, yet unacknowledged services to the human economy. In this paper, we have reviewed studies with a focus on the economic benefit of bats due to pollination, seed dispersal and insect consumption. Overall, many studies demonstrate a clear relevance of bats for increased seed set via pollination services, for the promotion of forest regeneration and for the consumption of herbivorous insects.*

97. Dumont, E.R., Dávalos, L.M., Goldberg, A., Santana, S.E., Rex, K., Voigt, C.C. (2012) Morphological innovation, diversification and invasion of a new adaptive zone. **Proceedings of the Royal Society London: Biological Sciences** in press

*Short summary: Within mammals, the family Phyllostomidae (Order Chiroptera) is one of the most species rich taxonomic families. Why is that? What is the key to evolutionary success? In this study, we found that the evolution of dietary breadth coincided with the emergence of highly variable skull morphologies, which is ultimately linked to bite performance. Once skull morphology provided ample opportunity to exploit new resources because of improved mechanical efficiency, niches within this adaptive zone of frugivory were rapidly filled by quickly evolving new species. This is one of the few empirical evidences of how ecological opportunity and morphological innovation opened a new adaptive zone and thus promoted diversification within a mammalian clade.*

96. Voigt, C.C., Voigt-Heucke, S.L., Kretzschmar, A. (2012) Isotopic evidence for seed transfer from successional area into forests by short-tailed fruit bats (genus *Carollia*; Phyllostomidae). **Journal of Tropical Ecology** 28:1-7.

*Short summary: In the Neotropics, fruit-eating bats are important for forest regeneration by dispersing seeds of pioneer plants. Here, we asked in what direction short-tailed fruit bats disperse seeds in edge habitats, i.e. border habitats between forests and successional areas. Based on stable carbon isotope ratios of seeds defecated by bats, we demonstrated that short-tailed fruit bats transfer seeds from mid-successional areas into forests and not vice versa. The underlying reason for this pattern may be the lack of feeding or night roosts in deforested areas. Establishing artificial roosts in deforested areas may promote forest regeneration by redirecting the seed transfer of bats (see also Kelm et al. 2008 Cons Biol).*

95. Voigt, C.C., Voigt-Heucke, S., Schneeberger, K. (2012) Isotopic data do not support food sharing within large networks of female vampire bats (*Desmodus rotundus*) **Ethology** doi: 10.1111/j.1439-0310.2011.02004.x

*Short summary: Vampire bats are one of the most prominent examples of reciprocal altruism, yet it has not been shown quantitatively whether sharing of food occurs within large or small networks. Theory predicts that individuals ought to share food only within small networks of known conspecifics. Using stable carbon isotope ratio of tissues with varying isotopic retention time (thus, integrating over various periods), we showed that*

*free-ranging vampires are isotopic specialists. This finding is consistent with food sharing in small and not large groups of females, and thus supports the theoretical expectation.*

94. Voigt, C.C., Holderied, M.W. (2012) High maneuvering costs force narrow-winged molossid bats to forage in open space. **Journal of Comparative Physiology B** doi 10.1007/s00360-011-0627-6

*Short summary: Bats of the family Molossidae are the nocturnal counterparts of swallows and swifts. They are specialised aerial hawkers that hunt insects in open spaces. In this paper, we asked whether molossids encounter higher energetic costs when flying slowly and when having to balance centrifugal acceleration in curves. We found that Molossus currentium and M. sinaloae flew relatively slowly and faced high metabolic costs when flying in a 500 m<sup>3</sup> enclosure; a volume that is typical for a forest gap. Our findings provide evidence that molossid bats are only able to forage efficiently in open space when flying at high speeds. Long and slender wings preclude molossids from foraging in more structured habitats.*

93. Popa-Lisseanu A.G., Soergel, K., Luckner, A., Wassenaar, L.I., Ibáñez, C., Ciechanowski, M., Görföl, T., Niermann, I., Beuneux, G., Myslajek, R., Juste, J., Fonderflick, J., Kramer-Schadt, S., Kelm, D.H., Voigt, C.C. (2012) A triple isotope approach to predict breeding origins of European bats. **PLoS ONE** in press

*Short summary: Some bat species are cryptic migrants, covering several thousands of km on their annual journeys. Yet, our knowledge about bat migration is poor because studies involve labour-intense banding of thousands of bats. Our aim was to establish a new method for tracking bat migration, i.e. the analysis of hydrogen stable isotopes in fur keratin. For this, we established an isoscape for European bats. We found that sedentary bats can be distinguished according to their fur hydrogen stable isotope ratios. Using three isotopes, one can even provide fine-scale geographical resolution for predicting the breeding provenance of bats. This paper is a benchmark publication for using hydrogen stable isotope ratios in predicting the breeding origin of European bats.*

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## 2011

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92. Greiner, S., Dehnhard, M., Voigt, C.C. (2011) Differences in plasma testosterone levels related to social status are more pronounced during mating- than non-mating season in the tropical bat *Saccopteryx bilineata* **Canadian Journal of Zoology** 89: 1157-1163.

*Short summary: Testosterone is an important sexual hormone that is linked to mating and territorial behaviour in mammals. In this paper, we asked how plasma testosterone levels vary seasonally in a bat species with a stable harem-polygynous mating system. Plasma testosterone levels were higher during the mating than during the non-mating season in harem males but not in peripheral males, yet differences were only small. This supports the notion that year-round stable polygynous mating systems do not promote pronounced seasonal changes in plasma testosterone levels in male mammals.*

91. Erzberger, A., Popa-Lisseanu, A., Lehmann, G.U.C., Voigt, C.C. (2011) Potential and limits in detecting altitudinal movements of bats using stable hydrogen isotope ratios of fur keratin **Acta Chiropterologica** in press

*Short summary: Hydrogen stable isotopes in keratin are increasingly used to predict the breeding provenance of bats and birds, yet we lack a thorough understanding of whether or not the isotopic approach is valid for a given biological question. Here, we investigated*

whether it is possible to use hydrogen stable isotopes to detect altitudinal movements of bats in a Central American mountain range. We were not able to detect differences in hydrogen stable isotope ratios between sedentary and potentially migratory bat species. Instead, we found a strong contrast between bat species of different feeding habits; fur keratin of insect-feeding bats was more enriched in deuterium than fruit-eating bats. This underlines that spatial variability of hydrogen stable isotope ratios in source water and trophic discrimination of hydrogen isotopes may hamper the detection of altitudinal movements in bats and possibly also birds.

90. Puechmaille, S.J., Frick, W.F., Kunz, T.H., Racey, P.A., Voigt, C.C., Wibbelt, G., Teeling, E.C. (2011) White Nose Syndrome: An emerging disease threat to temperate zone bats.

**Trends in Ecology and Evolution** 26: 570-576

*Short summary: In this paper, we reviewed our current knowledge of a devastating fungal disease that kills millions of bats in North America. In particular, we asked how this epidemic threat is linked to the occurrence of the same fungus (Geomyces destructans) in Europe. We discuss three scenarios that may explain the contrasting effect of the fungus on bat populations, a mild fungal infection in European bats with no mass mortalities and an aggressive infection in North American bat populations that causes millions of fatalities.*

89. Caspers, B.A., Schröder, F.C., Franke, S., Voigt, C.C. (2011) Scents of adolescence: the maturation of wing sac odour in greater sac-winged bats, *Saccopteryx bilineata*. **PLoS ONE** 6: e21162.

*Short summary: In studies of sexual selection, investigators mostly look at the adult phenotype of sexual signals. However, it is poorly understood how sexual signals mature during adolescence. In this collaborative work between behavioural biologists and chemists, we quantified the olfactory phenotype of subadult and adult greater sac-winged bats, and highlight which volatiles change when young males mature to adulthood.*

88. Matuszak, A., Voigt C.C., Storch, I., Bauer, H.-G., Quillfeldt, P. (2011) Depth-specific and spatiotemporal variation of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in Charophytes of Lake Constance: Implications for food web studies. **Rapid Communication in Mass Spectrometry** 25: 2089-2094.

*Short summary: Macrophytes are at the base of many lake food webs providing essential food resources for animals at higher trophic level. Our stable isotope analyses revealed seasonal and site-specific differences as well as depth-specific variations of isotopic carbon values within the littoral zone. Our results suggest that the seasonal timing of food intake (relative to turnover rates of consumers tissue) and potential depth of foraging need to be taken into account when calculating the relative contribution of energy sources to diets of consumers such as waterbirds.*

87. Kelm, D.H, Simon, R., Kuhlow, D., Voigt, C.C., Ristow, M. (2011) High activity enables life on a high sugar diet: blood glucose regulation in nectar-feeding bats. **Proceedings of the Royal Society of London: Biological Sciences** 278: 3490-3496.

*Short summary: The consumption of large quantities of sugar can be detrimental for mammals, yet nectar-feeding bats consume large amounts of sugar-rich nectar and do not experience any health hazard. In this study, we demonstrate that the immediate oxidation of exogenous sugar (Voigt & Speakman 2007) during flight reduces blood glucose levels. Therefore, a high activity is mandatory for nectar-feeding bats to avoid the negative impacts of high blood glucose levels.*

85. Voigt, C.C., Schneeberger, K., Voigt-Heucke, S.L., Lewanzik, D. (2011) Rain increases the energy cost of bat flight. **Biology Letters** 7: 793-795

*Short summary: Why do bats avoid flying in rain? Previously, it was thought that echolocation abilities of bats are hampered when bats fly in rain. We hypothesized that bats avoid rain because moistened fur might increase the thermoregulatory costs of flight. We let short-tailed fruit bats fly under three conditions: with dry fur, with moistened fur, and with moistened fur and additional rain. Bats with dry fur exhibited energetic costs for flight as predicted by aerodynamic theory. However, energetic costs of flight were elevated when fur was moistened, but did not change with additional rain. Thus, we concluded that moistened fur inflicts higher energetic costs on Chiropteran flight.*

**Media coverage: ScienceNews**

<http://news.sciencemag.org/sciencenow/2011/05/scienceshot-why-bats-dont-like.html?etoc>

84. Dehnhard, N., Voigt, C.C., Poisbleau, M., Demongin, L., Quillfeldt, P. (2011) Stable isotopes in southern rockhopper penguins: foraging areas and sexual differences in the non-breeding period. **Polar Biology** 11: 1763-1773.

*Short summary: Southern rockhopper penguins have experienced drastic population declines in recent years, yet the underlying causes for this crisis are unknown. Our stable isotope analysis provided detailed information on their feeding behaviour. Most importantly inter-annual differences in isotopic values partly correlated with sea surface temperature, suggesting that penguins moved to different regions and fed on various diets in response to changes in climatic conditions.*

83. Rex, K., Michener, R., Kunz, T.H., Voigt, C.C. (2011) Vertical stratification of Neotropical leaf-nosed bats (Phyllostomidae: Chiroptera) revealed by stable carbon isotopes **Journal of Tropical Ecology** 27: 211-222.

*Short summary: Bats are the most species rich group of mammals in tropical forests, yet it is poorly understood how they partition resources. We studied the forest strata use of Neotropical bat species in a Central and South American lowland rainforest. Based on carbon stable isotope ratios, we showed that bats foraged in distinct strata, e.g. canopy over ground level. Our data also indicates that mistnetting data alone is insufficient as a quantitative measure for forest strata use in bats, because bats commute at a lower level than they forage for food.*

82. Siemers, B.M., Greif, S., Borissov, I., Voigt-Heucke, S.L., Voigt, C.C. (2011) Divergent trophic levels in two cryptic sibling bat species. **Oecologia** 166: 69-78.

*Short summary: Cryptic species are morphologically almost identical, a phenomenon frequently encountered in Chiroptera. In this study, we investigated whether two cryptic bat species in Europe, Myotis myotis and M. oxygnathus, differ in trophic position. Our findings highlight that behavioural differences may lead to trophic separation of species, even without large morphological adaptations.*

81. Schad, J., Dechmann, D.K.N., Voigt, C.C., Sommer, S. (2011) MHC class II *DRB* diversity, selection pattern and population structure in a neotropical bat species, *Noctilio albiventris*. **Heredity** 107: 115–126.

*Short summary: Genes of the major histocompatibility complex (MHC) are central for the immune response of vertebrates. Bats are one of the most important host reservoir for zoonotic diseases, but we know virtually nothing about how variable the immune system*

*of this taxonomic group is. We investigated the variability in functionally important MHC class II gene DRB, and found a single expressed, polymorphic Noal-DRB gene in the lesser bulldog bat. Females exhibited lower levels of heterozygosity than males, which might indicate gender-specific selection on MHC variability. This study is one of the first to look at the genetic constitution of MHC in Chiroptera.*

80. Meyer, C.F.J., Aguiar, L.M.S., Aguirre, L.F. Baumgarten, J., Clarke, F.M., Cosson, J.-F., Villegas, S.E., Fahr, J., Faria, D., Furey, N., Henry, M., Hodgkison, R., Jenkins, R.K.B., Jung, K.G., Pons, J.-M., Kunz, T.H., MacSwiney Gonzalez, M.C., Moya, I., Voigt, C.C., von Staden, D., Weise, C.D., Kalko, E.K.V. (2011) Estimating species richness and detectability in tropical bat surveys. **Journal of Applied Ecology** 48: 777-787.

*Short summary: In many conservation programs, biodiversity is surveyed based on standardized techniques. Using data of 25 bat assemblages from the Old and New World, we assessed the potential for tropical bat monitoring programmes to reliably estimate trends in species richness. We found that about 75% of bat species were likely to be detected in surveys, preferably phytophagous over animalivorous bats. In general, we concluded that long-term bat monitoring programmes need to adopt an estimating scheme that corrects for variation in detectability when comparing across regions.*

79. Voigt, C.C., Lewanzik, D. (2011) Trapped in the darkness of the night: Thermal and energetic constraints of daylight flight in bats. **Proceedings of the Royal Society of London: Biological Sciences** 278: 2311-2317.

*Short summary: Bats are nocturnal mammals, but why is that? In this study, we demonstrate that daylight flight of bats involves two major physiological problems: Thermal stress because of heat absorption and elevated metabolic costs, probably because of the combined effect of increased thermoregulatory costs and altered flight behaviour. We argue that heat adsorption propensities of wing membranes are the main factor limiting the foraging activities of bats to the night.*

78. Greiner, S., Schwarzenberger, F., Voigt, C.C. (2011) Predictable estrus timing of a small tropical mammal in an almost a-seasonal environment. **Journal of Tropical Ecology** 27: 121-131.

*Short summary: Tropical ecosystems are almost aseasonal environments. How do tropical mammals trigger reproduction without or with only weak external stimuli? In this study, we show that minor changes in photoperiod and temperature are sufficient for triggering reproduction in female greater sac-winged bats; a species were females get into oestrous within a 2-week period in December.*

77. Schinnerl, M., Aydinonat, D., Schwarzenberger, F., Voigt, C.C. (2011) Hematological Survey of Common Neotropical Bat Species from Costa Rica. **Journal of Zoo and Wildlife Medicine** 42: 382-391.

*Short summary: Blood haematology varies among vertebrate species, but why? In a first effort to answer this question, we quantified the haematological parameters of common bats from Central America. Our data indicates that small bats have lower white blood cell counts than larger species, and that haematological parameters may vary with the feeding habit of bats.*

76. Hambly, C., Voigt, C.C. (2011) Measuring energy expenditure in birds using bolus injections of  $^{13}\text{C}$  labelled Na-bicarbonate. **Comparative Biochemistry and Physiology A**. 158: 323-328.

*Short summary: A promising technique for measuring metabolic rates in free-ranging animals is the  $^{13}\text{C}$ -labeled Na-bicarbonate technique. In a collaborative work with Catherine Hambly, I reviewed technical aspects of this method and the various previous applications.*

75. Voigt, C.C., Akbar Z., Kunz, T.H., Kingston, T. (2011) The origin of assimilated proteins in Old and New-World phytophagous bats. **Biotropica** 43:108-113.

*Short summary: Fruit-eating animals consume a protein-poor diet. Therefore, it has been suggested that frugivorous bats need to supplement their diet with insects as a source for proteins. In this paper, we compared nitrogen isotope ratios in Old and New World bats with different feeding habits. We show that frugivorous Old World flying foxes and New World stenodermatine bats feed exclusively on plant matter and not on animal proteins. Interestingly, these dietary specialists are able to survive on a plant-only diet.*

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## 2010

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74. Masello, J.F., Mundry, R., Poisbleau, M., Demongin, L., Voigt, C.C., Wikelski, M., Quillfeldt, P. (2010) Diving seabirds share space and time: Inter- and intra-specific segregation. **Ecosphere** 1: article 19.

*Short summary: To investigate ecological niche segregation within and among four species of diving seabirds, we used GPS-tracking and stable isotope approaches. We observed spatial segregation (diving area and diving depth) and trophic separation. The observed differences among the seabirds are best explained by a combination of optimal foraging and predator avoidance.*

73. Hölker, F., Moss, T., Griefahn, B., Kloas, W., Voigt, C.C., Henckel, D., Hänel, A., Kappeler, P.M., Völker, S., Schwoppe, A., Franke, S., Uhrlandt, D., Fischer, J., Wolter, C., Tockner, K. (2010) The dark side of light - A transdisciplinary research agenda for light pollution policy. **Ecology and Society** 15: 13-23.

*Short summary: In all human societies, artificial light has a positive connotation, but night lighting may have serious physiological consequences for humans, and ecological and evolutionary implications for animal and plant populations. In this paper, we strongly advocate for a policy shift that is based on a sound transdisciplinary understanding of the significance of the night, and its loss.*

72. Meyer, C.F.J., Aguiar, L.M.S., Aguirre, L.F. Baumgarten, J., Clarke, F.M., Cosson, J.-F., Villegas, S.E., Fahr, J., Faria, D., Furey, N., Henry, M., Hodgkison, R., Jenkins, R.K.B., Jung, K.G., Pons, J.-M., Kunz, T.H., MacSwiney Gonzalez, M.C., Moya, I., Voigt, C.C., von Staden, D., Weise, C.D., Kalko, E.K.V. (2010) Long-term monitoring of tropical bats for anthropogenic impact assessment: Gauging the statistical power to detect population change. **Biological Conservation** 143: 2797-2807.

*Short summary: We assessed the ability for long-term monitoring programs to reliably detect temporal trends in species abundance for Chiroptera; a mammal group that is*

central for many ecosystem services. We found that only long-term monitoring programs of more than 20 years will be able to detect populations of 5% per year. Also, only the most abundant species in an assemblage and those with generally low variation in abundance should be considered for detailed population monitoring.

71. Voigt, C.C. (2010) Insights into Strata Use of Forest Animals using the 'Canopy Effect' **Biotropica** 42: 634-637.

*Short summary: It is widely assumed that rainforest mammals use distinct spatial niches in order to coexist. In this commentary, I used a natural gradient of  $^{13}\text{C}$  between ground and canopy strata, caused by the so-called 'canopy effect', to quantify the forest strata use of bats based on the carbon stable isotope ratios of their exhaled breath.*

70. Greiner, S., Stefanski, V., Dehnhard, M., Voigt, C.C. (2010) Plasma testosterone levels decrease after activation of skin immune system in a free-ranging mammal. **General and Comparative Endocrinology** 168: 466-473.

*Short summary: The Folstad & Karter hypothesis predicts a trade-off between elevated testosterone levels and immune-competence. Quite often, it is assumed that males with increased testosterone levels may encounter a lower immune response; a pattern that is not necessarily supported by empirical data. In this paper, we show for a mammal species that only males with a good immune-competence were able to sustain high testosterone levels. Therefore, the direction of the interaction between testosterone and immune-competence is opposite to what has been previously envisaged, yet the hypothesis of Folstad and Karter is still valid; only immune-competent males are able to exhibit high testosterone levels.*

69. Amitai, O. Amichai, E., Holtze, S., Barkan, S., Korine, C., Pinshow, B., Voigt, C.C. (2010) Fruit bats (Pteropodidae) fuel their metabolism rapidly and directly with exogenous sugars. **Journal of Experimental Biology** 213: 2693-2699.

*Short summary: In previous work, we were able to show that phytophagous bats of the Neotropics oxidize exogenous sugars, i.e. dietary sugars, immediately and exclusively after consumption (Voigt & Speakman 2007). In a follow-up study, we asked whether Old World Pteropodid bats are similar in this physiological feature. Based on the carbon stable isotope ratio of exhaled breath, we demonstrated that flying and resting Rousettus aegyptiacus are able to fuel their metabolism immediately and exclusively with exogenous sugars. This highlights that flying foxes need to consume fruits frequently to power their nocturnal foraging trips.*

68. Wibbelt, G., Moore, M., Schountz, T. Voigt, C.C. (2010) Emerging diseases in Chiroptera: Why bats? **Biology Letters** 6: 438-440.

*Short summary: Bats carry various zoonotic diseases and have recently emerged as a major reservoir for serious pathogens and viruses. What factors make bats so susceptible for diseases. This theme was in the focus of a topical meeting, the '2<sup>nd</sup> International Berlin Bat Meeting', and in this meeting report we summarize the major contributions to this meeting.*

*Media coverage: listed as second most viewed article in **Biology Letters** for 2010.*

67. Hoffmann, A., Decher, J., Rovero, F., Schaer, J., Voigt, C.C., Wibbelt, G. (2010) Chapter 22: Field Methods and Techniques for Monitoring Mammals In: **ABCTaxa** in press

*Short summary:* In this book chapter, we reviewed the most common field techniques for capturing and studying bats.

66. Voigt, C.C., Schuller, B.M., Greif, S., Siemers, B.M. (2010) Perch-hunting in insectivorous *Rhinolophus* bats is related to the high energy costs of manoeuvring in flight. **Journal of Comparative Physiology B** 180:1079-1088.

*Short summary:* Most insectivorous bats forage on the wing but a few hunt insects while resting on a perch. We asked whether these contrasting foraging behaviours are related to the wing morphology of bat species. In rhinolophid bats that were similar in body mass but differed in wing morphology, we quantified the energetic costs of manoeuvring flight. We found that species with higher wing loading experienced higher manoeuvring costs than con-generic bats with lower wing loading. Our data underlines that wing morphology translates directly into flight energetics and foraging behaviour in bat species.

65. Voigt, C.C., Sörgel, K., Dechmann, D.K.N. (2010) Refuelling while flying: Foraging bats combust food rapidly and directly to fuel flight. **Ecology** 91:2908-2917.

*Short summary:* Flying bats experience relatively high metabolic rates compared with terrestrial mammals. How do bats fuel their metabolic requirements when foraging on the wing. In this paper, we demonstrate that free-ranging lesser bulldog bats oxidized recently ingested insect nutrients directly to fuel their metabolism. This pattern contrasts with that of terrestrial mammals, such as humans, that are not able to fuel their metabolism directly and exclusively with exogenous nutrients.

64. Quillfeldt P., Voigt, C.C., Masello J.F. (2010) Plasticity versus repeatability in seabird migratory behaviour. **Behavioural Ecology and Sociobiology** 64: 1157-1164.

*Short summary:* We studied the faithfulness of thin-billed prions, a small pelagic seabird, within and among years. According to stable isotope ratios of feathers, 90% of individuals moulted in Antarctica and 10 % in South American waters. Repeated sampling revealed that some individuals switched their migratory behaviour, suggesting that this species – and possibly also other pelagic seabirds – has a flexible migratory behaviour; probably in response to a highly unpredictable environment.

63. Rex, K., Czaczkes, B.I., Michener, R., Kunz, T.H., Voigt, C.C. (2010) Specialisation and omnivory in diverse mammalian assemblages. **Ecoscience** 17:37-46.

*Short summary:* Phyllostomid bats form some of the most species rich mammalian assemblages and encompass a dietary spectrum that ranges across several trophic levels. Based on nitrogen isotope ratios and conventional faecal analysis, we demonstrate that most phyllostomid bats are opportunistic omnivores despite their morphological specialization. Based on our diet analyses, we were not able to assign all species to meaningful feeding ensembles. Our results suggest that phyllostomids have specialized successively on distinct diets during radiation without losing their ability to exploit alternative food types in addition.

62. Bass, M., Finer, M., Jenkins, C.N., Kreft, H., Cisneros-Heredia, D.F., McCracken, S.F., Pitman, N.C.A., English, P.A., Swing, K., Villa, G., DiFiore, A., Voigt, C.C., Kunz, T.H. (2010) Global conservation significance of Ecuador's Yasuní National Park **PLoS ONE** 5, e8767.

*Short summary:* In this conservation paper, we highlight that the Yasuní area of Eastern Ecuador harbours an extraordinary biodiversity. Indeed, Yasuní is probably among the most biodiverse places on Earth, with apparent world richness records for amphibians, reptiles, bats, and trees and including a considerable number of threatened species and

regional endemics. These findings from the scientific basis for policy recommendations, including stopping any new oil activities and road constructions and creating areas off-limits to large-scale developmental activities.

61. Vos, A., Müller, T., Neubert, L., Voigt, C.C. (2010) Validation of a less-invasive blood sampling technique in rabies serology using Reduviid bugs (Triatominae, Hemiptera).

**Journal of Zoo and Wildlife Medicine** 41: 63-68.

*Short summary: Small mammals are reservoir hosts of many viral diseases, but it is often difficult or impossible to extract blood for serological surveys from these animals. We used and validated a novel approach for serological studies, i.e. blood-sucking bugs. Our data confirms that this minimally-invasive method is suitable, and even superior because of its lower impact on target animals, for serological surveys in small mammals.*

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## 2009

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60. Jewgenow, K., Braun, B.C., Göritz, F., Voigt, C.C., Martínez, F., Anaya, L., Vargas, A., Dehnhard, M. (2009) Pregnancy diagnosis in Iberian lynx (*Lynx pardinus*) based on urinary and blood plasma hormones. In: **Iberian Lynx ex situ conservation: An interdisciplinary approach** (A. Vargas, Breitenmoser, C., Breitenmoser, U. eds): Fundacion Biodiversidad/ICN Cat Specialist Group. Pp. 377 – 391.

*Short summary: The Iberian lynx is the carnivore most threatened to go extinct during the next years. We have lined up with a conservation team in Spain to improve the breeding program of this species. This paper reviews our current knowledge in predicting pregnancy in female Iberian lynx based on conventional and novel methods.*

59. Dechmann, D.K.N., John, L., Nowak, T., Voigt, C.C. (2009) Polymorphic microsatellites for the lesser bulldog bat (*Noctilio albiventris*) cross-amplify with close and distant relatives.

**Conservation Genetics Resources** 1: 167-170.

*Short summary: Here, we summarized information on several polymorphic microsatellites that we established for the lesser bulldog bat.*

58. Popa-Lisseanu, A., Voigt, C.C. (2009) Bats on the move. **Journal of Mammalogy** 90: 1283-1290.

*Short summary: This paper briefly reviews our current knowledge on bat migration. It is an introductory paper to several studies about bat migration featured during the '1<sup>st</sup> International Berlin Bat Meeting' and published in Journal of Mammalogy.*

57. Dechmann, D.K.N., Heucke, S.L., Guggioli L., Safi, K., Voigt, C.C., Wikelski, M. (2009) Experimental evidence for group hunting via eavesdropping in echolocating bats.

**Proceedings of the Royal Society of London: Biological Sciences** 276:2721-2728.

*Short summary: Why do mammals aggregate in groups? This seemingly simple question is complex in its core, because group living comes with many disadvantages such as increased parasite and pathogen transmission risk. In this study, we show that female lesser bulldog bats benefit from group living by foraging in groups. Lesser bulldog bats eavesdrop on the echolocation calls of conspecifics and respond to the high repetition rate of successfully hunting conspecifics. This is a first and direct evidence that group living can be of direct advantage for bats.*

56. Caspers, B., Voigt, C.C. (2009) Temporal and spatial distribution of male scent marks in the polygynous greater sac-winged bat. **Ethology** 115: 713-720.

*Short summary: Scent marks produced by males can either provide information to mating partners or to male competitors. We demonstrated that male greater sac-winged bats scent mark at territory boundaries when females are absent but male competitors are present. We, therefore, concluded that scent marks offer territorial intruders the possibility to assess the harem holder based on volatiles, i.e. without direct physical interaction.*

55. Voigt, C.C. (2009) Studying animal diets in-situ using portable infra-red stable isotope analyzers. **Biotropica** 41:271-274.

*Short summary: Carbon stable isotope ratios are increasingly used as dietary tracer in the study of animal ecology. Here, I review how portable stable isotope analyzers can be used to measure the carbon isotope ratio of exhaled breath to predict feeding preferences of mammals, birds, and potentially also other animals.*

54. Voigt, C.C., Cruz-Neto A. (2009) Energetic analysis. In: **Ecological and Behavioral Methods for the Study of Bats** (eds. T.H. Kunz, S. Parsons). The Johns Hopkins University Press, Baltimore. Pp. 623-645.

*Short summary: This book chapter summarizes the most important techniques to measure the metabolic rates of bats. As such, it is a helpful guide for anyone doing respirometry or doubly labelled water experiments in bats.*

53. Voigt, C.C., Kelm, D.H., Bradley, B., Ortmann, S. (2009) Dietary analysis of plant-visiting bats. In: **Ecological and Behavioral Methods for the Study of Bats** (eds. T.H. Kunz, S. Parsons). The Johns Hopkins University Press, Baltimore. Pp. 593-609.

*Short summary: This book chapter reviews techniques relevant for the study of feeding behaviour of bats. It is designed to help young students and advanced researchers to decide on which method might be best applicable for a given study species and research question.*

52. Braun, B.C., Frank, A., Dehnhard, M., Voigt C.C., Vargas, A., Göritz, F., Jewgenow, K. (2009) Pregnancy diagnosis in urine of Iberian lynx (*Lynx pardinus*). **Theriogenology** 71: 754-761.

*Short summary: We used conventional and novel applications of bleeding to assess the reproductive condition of female Iberian lynx. We show that blood-sucking bugs can be used as a minimally-invasive method to obtain sufficient blood volumes for endocrine analysis.*

51. Caspers, B., Schroeder, F.C., Meinwald, J., Franke, S., Streich, W.J., Voigt C.C. (2009) Odour-based species recognition in two sympatric species of sac-winged bats (*Saccopteryx bilineata*, *S. leptura*): Combining chemical analysis, behavioral observation and odour preference tests. **Behavioural Ecology and Sociobiology** 63: 741-749.

*Short summary: The two closely related sac-winged bats, *Saccopteryx bilineata* and *S. leptura*, occasionally share daytime roosts. Both species use volatiles from wing sacs for courtship displays. We demonstrated that olfactory profiles differ between the two species and that female *S. bilineata* prefer the odor of male conspecifics to those of male*

*S. leptura*. Thus, olfactory compounds serve as a pre-mating isolation barrier between these two related species.

50. Caspers, B., Wibbelt, G., Voigt, C.C. (2009) Histological examinations of facial glands in *Saccopteryx bilineata* (Chiroptera, Emballonuridae), and their potential use in territorial marking. **Zoomorphology** 128: 37-43.

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49. Voigt, C.C., Kretzschmar, A.S., Speakman, J.R., Lehmann, G.U.C. (2008) Female katydids fuel their metabolism with nuptial gifts. **Biology Letters** 4: 476-478.

*Short summary: Male katydids transfer large nuptial gifts, so-called spermatophores, to females during mating. We asked whether females oxidize spermatophores immediately after mating instead of using the nutrients for egg productions, which would be of higher relevance for the male donor of spermatophores. Using carbon stable isotope ratios in exhaled breath we showed that females oxidize part of the nutrients for their own and not to the male's benefit.*

48. Voigt, C.C., Baier, L., Speakman, J.R., Siemers, B.M. (2008) Stable carbon isotopes in exhaled breath as tracers for dietary information in birds and mammals. **Journal of Experimental Biology** 211: 2233-2238.

*Short summary: We reviewed all present knowledge on how carbon stable isotope ratios of exhaled breath provide information on the nutritional preference and dietary habits of vertebrates.*

47. Voigt, C.C., Rex, K., Michener, R.H., Speakman, J.R. (2008) Nutrient routing in omnivorous animals tracked by stable carbon isotopes in tissue and exhaled breath. **Oecologia** 157: 31-40.

46. Voigt, C.C., Behr, O., Caspers, B., von Helversen, O., Knörnschild, M., Mayer, F., Nagy, M. (2008) Songs, scents, and senses: Sexual selection in the mating system of the greater sac-winged bat, *Saccopteryx bilineata*. **Journal of Mammalogy** 89:1401-1410.

45. Kelm, D.H., Schaer, J., Ortmann, S., Wibbelt G., Speakman J.R., Voigt C.C. (2008) Efficiency of facultative frugivory in a nectar specialist, the bat *Glossophaga commissarisi* (Chiroptera: Phyllostomidae). **Journal of Comparative Physiology B** 178: 985-996.

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43. Voigt, C.C., Capps, K., Dechmann, D.K.N., Michener, R.H., Kunz, T.H. (2008) Nutrition or Detoxification: Why bats visit mineral licks of the Amazon Rainforest? **PLoS ONE** 3, e2011.

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39. Caspers, B., Franke S., Voigt, C.C. (2008) The wing-sac odour of male greater sac-winged bats *Saccopteryx bilineata* (Emballonuridae) as a composite trait: Seasonal and individual differences. In: **Chemical Signals in Vertebrates XI**. eds Hurst, J., Beynon, R, Müller-Schwarze D., Springer, Berlin New York, 151-160.

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38. Müller, K., Voigt, C.C., Jens Raila, Andrea Hurtienne, Marianne Vater, Leo Brunnberg, Florian J. Schweigert (2007) Levels of carotenoids, retinol and  $\alpha$ -tocopherol in plasma of six microchiroptera species. **Comparative Physiology and Biochemistry A** 147:492-497.
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