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Raptors in changing West African savannas : the impact of anthropogenic land transformation on populations of Palearctic and Afrotropical raptors in northern Cameroon

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Summary

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Raptors in West Africa's savannas have strongly declined the past four decades and many species now survive only in a few pockets of intact habitat, mostly inside protected areas, while some species are on the brink of extinction. Little is known about the processes that sustain raptor populations within increasingly human-transformed savanna landscapes, and clues to the mechanisms and causal drivers behind population declines remain little studied. Moreover, it is unclear how changing conditions differently affect the diverse assemblage of Afrotropical and Palearctic raptors, which depend on the West Africa's savannas for part or most of their life cycle, and how vulnerability, or adaptability to changing environments, relate to life-history traits such as their mobility, sex, age, body mass, and diet. The aim of this thesis is to quantify the effects of land transformation on distribution, foraging, diet, and reproductive output of Palearctic and Afrotropical raptors, both migratory and sedentary, in West African savannas, to increase the knowledge that can support conservation efforts directed at the persistence of rich raptor populations in this part of the world.

Chapter 1 starts with a description of the study area in northern Cameroon and the research questions. Chapter 2 presents a study on foraging habitat selection by Palearctic migratory Eurasian Marsh Harrier *Circus aeruginosus*, Pallid Harrier *C. macrourus*, and Montagu's Harrier *C. pygargus* on the Waza-Logone floodplain of northern Cameroon. These and other Sahelian floodplain systems are of great importance for wintering Palearctic raptors. Aim of this study was to generate insight into the role of body mass, age, and sex in foraging habitat selection by Palearctic migratory raptors. The results showed evidence of intersexual differences in foraging preference related to land use and some evidence that juveniles exploited different habitats from adults. Although only limited evidence for interspecific differentiation of foraging habitat was found, food partitioning by prey mass was related to harrier body mass and facilitated by a diverse supply of prey on human-transformed floodplains. The comparable use of natural floodplain and cultivated habitats, and diversification of food resources with development suggest that floodplain conversion for cultivation may benefit wintering harriers to some extent. However, the avoidance of newly created rice fields and dry grasslands by certain sex- and age-groups indicated that floodplain development may have important negative consequences for a proportion of the population. Loss of habitat elements can also lead to a limitation of foraging options; Box A presents the first detailed observations of the use of certain habitat elements by bird-hunting Pallid Harriers on the African winter grounds.

To further our understanding of the mechanisms underlying dramatic declines of Afrotropical raptors, the relationship between environmental conditions, nest density, reproductive parameters, and nestling growth were examined in the Afrotropical migratory Grasshopper Buzzard *Butastur rufipennis* (Chapters 3-5). Chapter 3 provides the first detailed information of the breeding biology and nestling development of the Grasshopper Buzzard. Nests were more widely spaced in transformed than natural habitat (Chapter 5), which was related to lower rodent supply and a greater proportion of the area under cultivation in transformed habitat, while nest site availability was comparable between

habitats. Nest success and productivity were positively associated with rainfall, an important food stimulus, and the canopy shielding the nest, which limits detection by avian predators. Productivity and nest success were unaffected by land use, due to opposing effects of higher predation pressure and food supply in natural habitat compared to transformed habitat. However, loss of grass cover, prey populations and loss of woodland cover is likely to depress Grasshopper Buzzard reproductive success and nest density in the future. Additionally, land use change may have rather subtle effects. Chapter 4 shows that land use was a significant predictor of asymptotic nestling weight, when potentially confounding variables such as hatch order, gender, hatch date, rainfall, or brood size were taken into consideration. This result suggests that nestlings in transformed habitat possessed an inferior condition at fledging, possibly lowering their future survival chances. Another Afrotropical migrant, the African Swallow-tailed Kite *Chelictinia riocourii*, also appears to cope with moderate land transformation (Chapter 6), but a reduction of the extent of breeding habitat might drive populations into large breeding aggregations with potentially negative effects on reproduction.

Sedentary raptors are likely to be more vulnerable to habitat change than migratory raptors, since they depend on year-round territories for food and reproduction. To examine the effect of habitat degradation on the foraging of a sedentary species, 12 ♂ Dark Chanting Goshawk *Melierax metabates* were radio-tracked to investigate their foraging efforts and gains (Chapter 7). The results showed that Dark Chanting Goshawks in natural habitats had smaller home ranges and used a larger proportion of their range for foraging than goshawks in transformed habitat. Their selection for relatively tall trees and high tree density, high shrub cover, and thick and extensive herbaceous cover appeared to be primarily related to optimization of prey biomass within hunting patches. Foraging effort and gains were comparable between natural and transformed habitats, but herbaceous layer height and tree density within ranges, both higher in natural habitat, were negatively related to prey capture rates. Woodcutting and grazing thus favored greater prey capture rates in transformed compared to natural habitat, mediating the effect of less profitable prey items in the former, but increasingly extensive loss of vegetation cover suppress prey resources to the detriment of goshawk populations in human-transformed habitats.

Chapters 8-10 report the results of studies of habitat associations of Afrotropical sedentary, migratory, and Palearctic raptor assemblages, at different spatial and temporal scales, which provide insight into the role of environmental factors in structuring raptor populations in West African savannas. Original habitat, National Parks, cultivation, and human population size shaped patterns of raptor richness at the 5-km scale, but the importance and direction of responses differed between species groups and biogeographical zones (Chapter 8). Whereas Palearctic raptor community richness was unrelated to land use, Afrotropical raptor richness was negatively related to habitat modification and human populations in the Inundation zone and Sudan zone of northern Cameroon, but peaked at moderate levels of woodland clearance in Guinea savannas. Landscape scale analyses of raptor richness and diversity indicated that protected area coverage and human exploitation influenced biogeographical distribution patterns of Afrotropical raptors in Cameroon (Chapter 10). In the relatively well-preserved Guinea savanna zone, I found evidence for greater sensitivity

to anthropogenic impact among large raptors compared to small raptors: the richness of large raptors decreased with increasing distance to the nearest protected area, whereas the richness of small raptors was negatively correlated with the extent of natural habitat. A difference was furthermore reported in relationship to species mobility in the Guinea savanna: the richness of the sedentary Afrotropical raptor assemblage decreased with human population size, whereas the richness of Afrotropical migratory raptors increased with the area under cultivation.

Road surveys conducted at a 2-km scale on the Waza-Logone floodplain (Chapter 9) confirmed that assemblages of Afrotropical raptors responded more strongly to land use than Palearctic raptors: Afrotropical raptor diversity was higher on the naturally flooded grasslands compared to the newly created cultivated habitats and desiccated grasslands, whereas the richness and diversity of Palearctic raptors was unrelated to land use. However, Palearctic raptor abundance was highest in post-harvest rice fields, demonstrating the importance of the rice fields as foraging habitat for Palearctic raptors.

Given the globally important raptor richness and immense pressure from strongly increasing human populations, West Africa's savannas should be regarded a priority region for raptor conservation efforts (Chapter 10). Chapter 11 offers a synthesis of results and includes recommendations for conservation efforts directed at protected areas networks and their important Afrotropical raptor assemblages. Buffer zone management around National Parks needs to be re-evaluated and silvicultural practices encouraged, enforced, and implemented by state and traditional authorities, which includes limitation on the expansion of cultivation and introduction of environmentally sustainable cotton production. Management of seasonally food-rich cultivated habitats, such as rice fields, for the benefit of Palearctic raptors deserves more attention than currently the case.