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Local Harvest of Hingeback Tortoises, *Kinixys erosa* and *K. homeana*, in Southwestern Cameroon

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ABSTRACT. – **From July 1995 to June 1996, I conducted a survey of tortoise offtake by three villages in the Southwest Province of Cameroon, Africa. Two species of hingeback tortoise, *Kinixys erosa* and *K. homeana*, are locally sympatric in primary and selectively logged forest in this part of Cameroon, and both species are routinely harvested by local people. Tortoises are not actively hunted, but all individuals encountered are collected and consumed, or in the case of juveniles and neonates, kept briefly as pets. *Kinixys erosa* was collected in greater numbers than *K. homeana*, in agreement with subjective assessment of natural densities. Female *K. erosa* were taken most often, followed by adult male *K. erosa*, adult male *K. homeana*, juvenile *K. homeana*, adult female *K. homeana*, and juvenile *K. erosa*. More tortoises were harvested during the rainy season than during the dry season. *Kinixys* harvest patterns may reflect the history of forest disturbance. Estimated harvest for 85 regional villages suggests an annual harvest of almost 3000 tortoises, at least half of which are assumed to come from within nominally protected areas. *Kinixys* harvest in this small region of Cameroon illustrates the magnitude of unregulated exploitation for local consumption.**

KEY WORDS.– **Reptilia; Testudines; Testudinidae; *Kinixys erosa*; *Kinixys homeana*; tortoise; exploitation; food resource; wildlife trade; Cameroon**

In the Pidgin English vernacular of southwestern Cameroon, the hingeback tortoises *Kinixys erosa* and *K. homeana* are referred to as "corned beef," attesting both to their ubiquity in the local diet as well as the reddish color of their cooked flesh. That many African forest-dwelling peoples eat tortoises is well known (Akani et al., 1998). Schmidt (1919) reported that *K. erosa* in the Ituri is "highly prized as a titbit [sic] by the natives, and therefore is never allowed to escape." Because of their relative scarcity and the logistic difficulties of studying these reclusive species in their natural habitat, little information is available on their life histories, and, despite growing concerns over their exploitation for the international pet trade, nothing has been reported about the magnitude and consequences of their exploitation for local consumption.

The forest hingeback tortoise, *Kinixys erosa* (Fig. 1), ranges throughout Africa's humid tropical forests from Gambia in the west through Gabon, Congo, and Uganda in the east (Ernst and Barbour, 1989; Iverson, 1992). Home's hingeback tortoise, *K. homeana*, ranges from Liberia to Cameroon with additional, scattered records from eastern Zaire (Ernst and Barbour, 1989; Iverson, 1992). Both species are sympatric in the moist evergreen forests of southwestern Cameroon (Fig. 2) where they are avidly consumed by all of the various ethnic groups indigenous to the region (Lawson, 1993).

To ascertain the magnitude of *Kinixys* exploitation for local consumption, I conducted a survey of tortoise harvest in 1995–96 in three villages adjacent to nominally protected areas in southwestern Cameroon.

METHODS

Site Description. — I surveyed three villages, Baro, Ntale, and Ntenmbang, located in the Southwest Province of Cameroon (Fig. 3). These villages border the Banyang-Mbo Wildlife Sanctuary (Ntale, Ntenmbang), Nta Ali Forest Reserve (Ntenmbang), and Korup National Park (Baro).

Vegetation of the region is closed canopy, lowland forest characterized as Atlantic Biafran forest dominated by large, gregarious species of the family Caesalpinioideae (Letouzéy, 1968). Much of this forest type shows some secondary characteristics, possibly as a result of former cultivation around long-abandoned villages and/or disturbance by elephants (D. Thomas, *pers. comm.*; *pers. obs.*). Modern shifting agriculture has caused additional degradation and led to a mosaic of forest and secondary growth along and around roads and villages. Elevations near the study villages are generally below 300 m. Ntale is located near the foothills of the Bakossi Mountains and hunters from this village have access to habitats up to about 800 m. However, hunters appeared not to utilize highland habitats as much as lowland ones.

Much of the region outside the Banyang-Mbo, Korup, and Nta Ali protected areas is currently or has previously been exploited by large-scale commercial logging enterprises during the last two decades (Fig. 3). All three study villages had access to a range of habitats with disturbance regimes ranging from pristine forest to active farmland.

The local economy is primarily subsistence agriculture with small-scale cash crop production of cocoa, coffee, and oil palm. Subsistence and small-scale commercial hunting

Figure 1. Young adult female *Kinixys erosa*, collected in the vicinity of Nguti, Southwest Province, Cameroon. Photo by DPL.

are widespread. Levels of full-time commercial hunting, often conducted by non-local Cameroonians, appeared to be increasing throughout the study period and subsequently as Cameroon's economic condition has deteriorated.

Southwest Cameroon has a pseudo-equatorial climate consisting of a dry season from mid-November through late March, and an extended single wet season (Fig. 4). Monthly mean temperatures ranged from 21 to 36°C and showed little variation among months (Fig. 4).

Despite their proximity, survey villages belonged to different ethnic groups: Mbo (Baro), Banyangi (Ntenmbang), and Bassossi (Ntale). There was no subjectively discernable difference in tortoise utilization among these and/or other villages in the region.

Survey Protocol. — I hired a single resident assistant in each study village to obtain all tortoises collected for food by residents of the village. Assistants compensated individuals with tortoises at a fixed rate comparable to what 1 kg of wild-caught game brought in local markets. Because of the difficulty in locating tortoises, *Kinixys* are not actively hunted. Rather, local people collect and consume every tortoise they encounter in the course of normal activities, such as hunting (Fig. 5), farming, walking between villages, etc. Because it was not possible to systematically hunt for tortoises, and because compensation was comparable to local food market prices, the study did not appear to create additional demand for tortoises from outside each study village. In several instances, individuals in the study villages preferred to consume tortoises rather than be compensated by the study. These animals were not included in the analysis. Tortoises were retrieved every two to four weeks for use in a separate morphometric study. Sex, weight, straight-line carapace length, straight-line carapace width at the hinge, height at the hinge, and plastron length were recorded for all tortoises. Specimens were categorized as adult or juvenile based on the presence of secondary sexual characteristics and whether they had attained reproductive dimensions. For *K. erosa* males and females, maturity was attained at about 150 mm plastron length; for *K. homeana* this was usually at about 100 mm plastron length. After being measured, tortoises were individually marked by notching marginal scutes with a file. Because tortoise populations are assumed to be diminished from harvest, and for lack of alternatives, specimens were released near the border of the Banyang-Mbo Sanctuary, approximately 10 km from the nearest town or village.

Figure 2. Seven adult *Kinixys homeana* (left) and three adult *K. erosa* (right) collected near Nguti, Southwest Province, Cameroon. Note the overall similarity in appearance of these sympatric species. Three of the specimens have been outfitted with radio transmitters for a separate study.

Village assistants were active in Baro from July 1995–March 1996, in Ntale from August 1995–February 1996, and in Ntenmbang from August 1995–June 1996, for a total sampling effort of 27 village-months. Dry and rainy season sampling efforts were similar (14 dry season village-months; and 13 rainy season village-months).

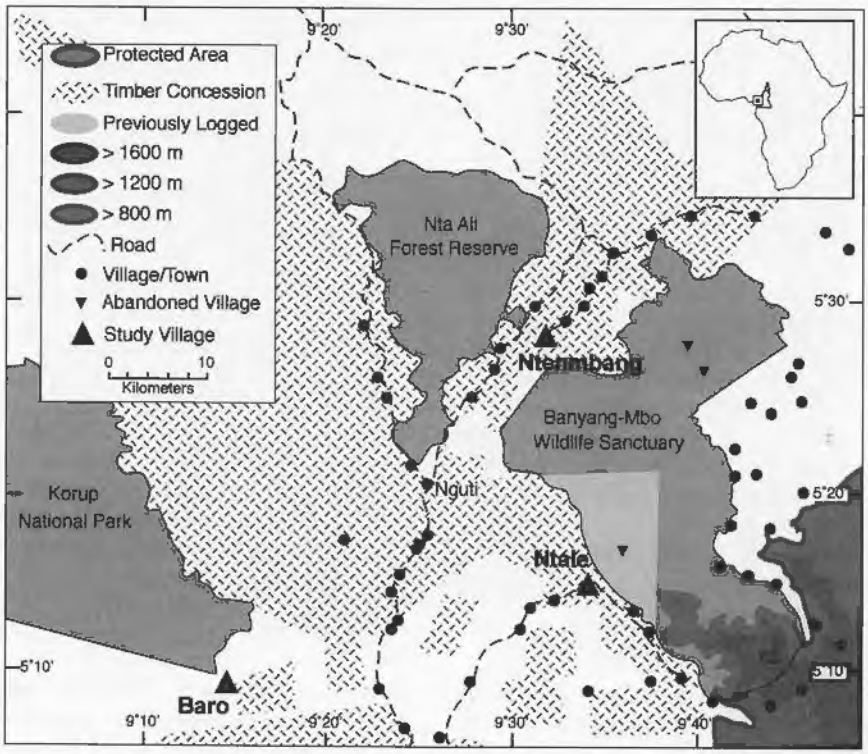

Figure 3. Map of study area in southwestern Cameroon showing three protected areas and three study villages.

Extrapolations. — To obtain an estimate of the magnitude of *Kinixys* harvest for local consumption over a broader geographic area, I extrapolated values from the three study villages to villages surrounding protected areas in southwestern Cameroon. I calculated average village harvests for a single dry and rainy season month by dividing the total number of tortoises of each class taken in a season by the number of village-months surveyed in that season. I then used these figures to calculate average annual harvest for each class for a single village by multiplying average monthly values by 5 (dry season) and 7 (rainy season) and summing the results. I extrapolated tortoise harvest from all villages within 5 km of the boundaries of the three protected areas (Banyang-Mbo, Korup, and Nta-Ali) from estimated annual

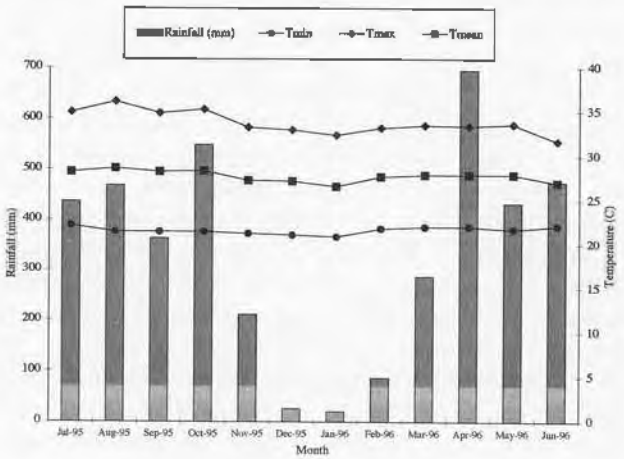

Figure 4. Monthly rainfall totals and minimum, maximum, and mean temperatures in Nguti, Southwest Province, Cameroon. Measurements by the author.

Figure 5. A hunter from Ntenmbang village returning from the Banyang-Mbo Wildlife Sanctuary where he had collected the adult female *Kinixys erosa* hanging over his shoulder by her hind legs. Hunters in this region spend one to several days at a time in the forest hunting mammal game, but will collect any sizeable reptile that is incidentally encountered. This hunter also carried dried segments of 3 m African rock python, *Python sebae*, in the bag on his other shoulder.

Table 1. Summary of *Kinixys* harvest by three villages in Southwest Province, Cameroon. Shaded areas indicate gaps in the survey.

	Baro						Ntenmbang						Ntale						
	Kinixys erosa			*Kinixys homeana*			*Kinixys erosa*			*Kinixys homeana*			*Kinixys erosa*			*Kinixys homeana*			
	♂♂	♀♀	Juv	♂♂	♀♀	Juv	♂♂	♀♀	Juv	♂♂	♀♀	Juv	♂♂	♀♀	Juv	♂♂	♀♀	Juv	Total
Jul-95		1																	1
Aug-95	3			1	1				1			2	2	2		1	1		14
Sep-95		1		1		3							1	5		1		3	15
Oct-95			2	1	1		1	3					1	1		1			11
Nov-95				1									1						2
Dec-95								1					6	2					9
Jan-96								1						1					2
Feb-96													1	1		1	1		4
Mar-96				2															2
Apr-96																			0
May-96								1		3									4
Jun-96							2	2		1	1								6
Total	3	2	2	6	2	3	3	8	1	4	1	2	12	12	0	4	2	3	70

average values for a single village. Because villages had access to both nominally protected and non-protected areas, extrapolated values were halved to create an estimate of harvest exclusively from non-protected areas adjacent to villages. For Banyang-Mbo Wildlife Sanctuary which contains an area of highland habitat, only villages and habitat area below 800 m elevation were considered in the analysis.

These projections assumed that the average annual harvest values derived from the three study villages (1) adequately reflect local variation in *Kinixys erosa* and *K. homeana* distribution on a regional scale, and (2) were a reasonable representation of the harvest pressure exerted by all villages. Individual village harvests did not support homogeneous tortoise distributions among habitats (see results below). However, the majority of villages to which these extrapolations were applied had access to similar habitats as the study villages, and village-to-village variation in species harvest is therefore both biologically relevant and accounted for in the average harvest values. *Per capita* tortoise offtake would be a better estimate of harvest pressure. Unfortunately, trustworthy census values are not available for villages in southwestern Cameroon. Study villages were not of equal size (Ntale ≥ Ntenmbang >> Baro), and therefore reflect local variation in harvest pressure attributable to human population differences.

RESULTS

Harvest Summary. — *Kinixys* harvest by village and month is summarized in Table 1. Village monitors obtained 70 tortoises over the 27 village-months surveyed. Total numbers of individuals and relative biomass of males, females, and unsexed juveniles taken of each species are

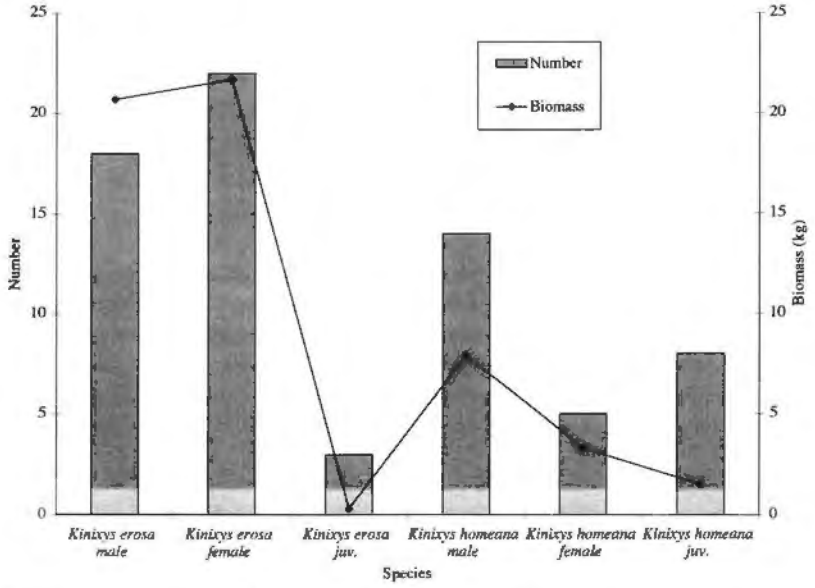

Figure 6. Species, sex, and size-class composition of *Kinixys* harvest combined from three survey villages.

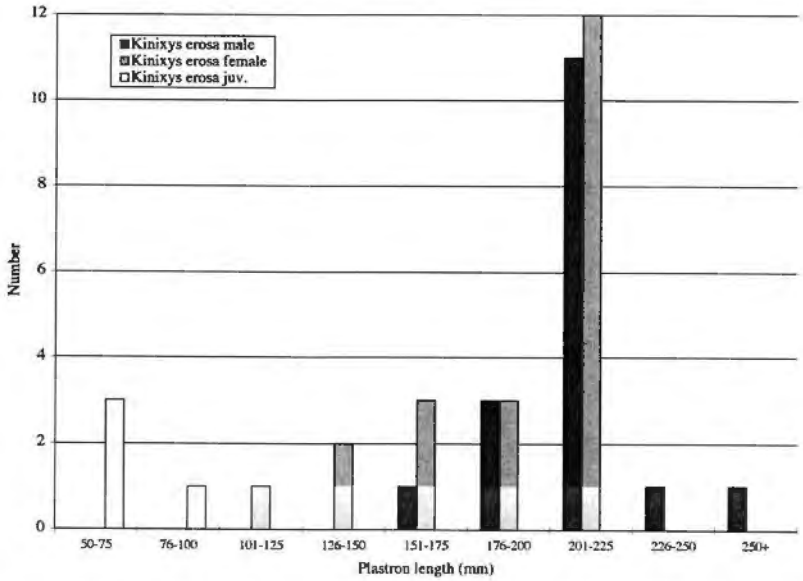

Figure 7. Size-classes of harvested *Kinixys erosa*. The juvenile category refers to individuals of indeterminate sex.

shown in Fig. 6. *Kinixys erosa* was taken more often than *K. homeana*, and more adult female *K. erosa* were taken than any other group. The relative biomass harvest of male and female *K. erosa* was nearly equal because of the greater size and weight attained by males. Male *K. homeana* outnumbered female *K. homeana* almost 3:1. Juvenile *K. homeana* were also taken more often than adult females, although this may be biased by small females being assigned to the juvenile class because of difficulties in definitively determining sex in young specimens of this species.

Harvest of adult tortoises among villages is summarized in Table 1. Baro was unique in taking more *Kinixys homeana* than *K. erosa*, and in taking more males than females of both species. Ntale took considerably more *K. erosa* relative to the total number of tortoises taken than did Ntenmbang (0.8 to 0.69). Ntenmbang was unique in taking more females than males of either species (*K. erosa*), and was responsible for female *K. erosa* being the most abundant category in the combined survey (Fig. 6).

Kinixys erosa and *K. homeana* harvest by size (plastron length) is summarized in Figs. 7 and 8, respectively. *Kinixys homeana* were more difficult to sex than *K. erosa*, and individuals of indeterminate sex were categorized as juveniles. For this reason, several *K. homeana* categorized as juveniles appear in the larger size classes. I suspect that these individuals were actually young females. For both species, adults were taken in greater quantities than juveniles. Few of the largest size classes of either species were taken. Male *K. erosa* attained larger sizes than females while female *K. homeana* attained larger sizes than males.

Seasonal variation in tortoise harvest is summarized in Fig. 9. With the exception of a pulse of *Kinixys erosa* taken

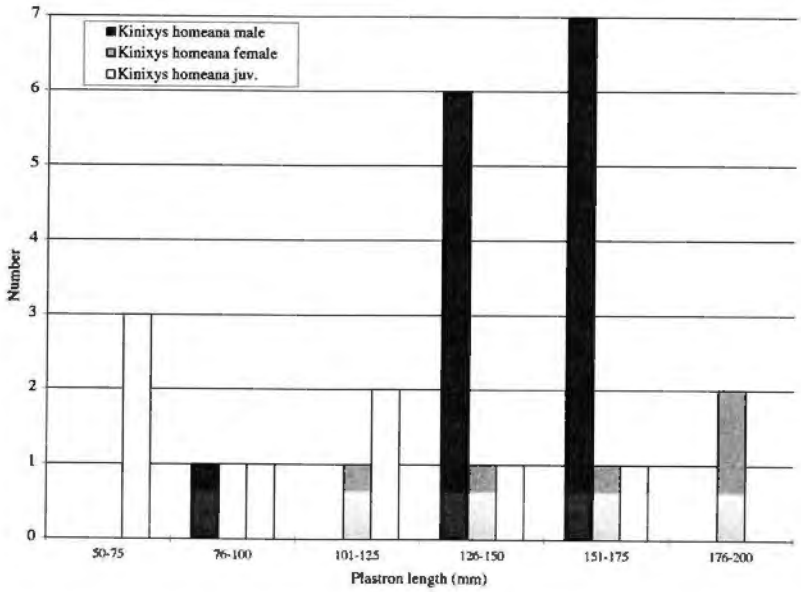

Figure 8. Size-classes of harvested *Kinixys homeana*. The juvenile category refers to individuals of indeterminate sex.

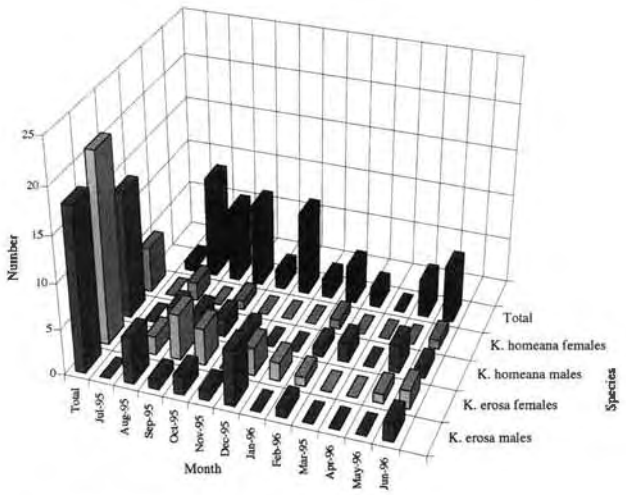

Figure 9. Seasonal variation in *Kinixys* harvest.

by Ntale in December 1995, more individuals of both species were taken during the rainy season than during the dry season. No tortoises were taken in April early in the rainy season.

Projected Exploitation. — Average dry season, rainy season, and annual harvest estimates for villages in southwestern Cameroon are presented in Table 2. Average rainy season harvest was higher than dry season harvest for males, females, and juveniles of both species (see also Fig. 9). However, average rainy season harvest of male *K. erosa* was only slightly higher than the dry season average.

Estimated annual tortoise harvest by the 85 villages within 5 km of the boundaries of Banyang-Mbo Wildlife Sanctuary, Korup National Park, and Nta-Ali Forest Reserve are presented in Table 3. These villages are estimated to harvest nearly 3000 tortoises annually, at least half of which likely come from within these nominally protected areas (Fig. 5). Estimated annual harvest of tortoise biomass is also presented in Table 3, as is harvest of individual tortoises and biomass per km² for each protected area.

DISCUSSION

More *Kinixys erosa* were harvested than *K. homeana*, reaffirming my subjective impression of their relative local abundance. *Kinixys homeana* harvest did not vary substantially among the three villages while that of *K. erosa* varied considerably. Harvest differences may be indicative of localized geographic variation in *K. erosa* abundance, perhaps as a result of recent disturbance regimes in forests surrounding villages, or a reflection of village hunting effort, or both. Ntale harvested far more *K. erosa* than did Baro or Ntenmbang. The forest surrounding Ntale was selectively logged approximately 15 years ago, and the preponderance of *K. erosa* in the Ntale sample may indicate that *K. erosa* is better able to tolerate this form of habitat disturbance than is *K. homeana*, or that *K. homeana* is at least more difficult to find in these degraded habitats. Similarly, the preponderance of *K. homeana* in the Baro sample may indicate a proclivity to hunt within the boundaries of Korup National Park (which has not been logged) rather than in the previously logged forest around the village. The ability of *K. erosa* to tolerate disturbed habitats is reflected in its broader distribution in Central and West Africa and its presence in transition habitats at the limits of the forest zone.

Tortoises were more active in the rainy season (*pers. obs.*) and this seems to render them more vulnerable to collection. The pulse of *Kinixys erosa* taken in December at the start of the dry season may correspond to increased activity for breeding and nesting at this time. Additional *K. erosa* females obtained in December from sources outside this study were often gravid. Both species tend to move little or not at all during the dry season (*pers. obs.*), and this is reflected in their absence from the local diet for much of this time.

Table 2. Dry and rainy season tortoise harvest averages per village per month, calculated annual harvest of individuals, and biomass based on a survey of three villages in southwestern Cameroon.

		Dry Season Month	Rainy Season Month	Year	Average kg	Biomass kg/yr
Kinixys erosa	♂♂	.71	0.77	8.94	1.20	10.70
	♀♀	.43	1.15	10.20	1.00	10.20
	Juv.	0	0.23	1.61	0.10	0.16
Kinixys homeana	♂♂	.29	0.77	6.84	0.56	3.80
	♀♀	.07	0.31	2.52	0.67	1.70
	Juv.	0	0.62	4.34	0.18	0.78

Conservation

The largest size classes of both species were rare in the harvest samples. While this may simply be the result of a normal size distribution in the populations, because of the large size increments (25 mm) used in this analysis, and the fact that all adults encountered are taken, the abrupt absence of very large adults indicates that the adult population may be in decline. In addition, the largest individuals seen in this regional study were considerably smaller than the reported range-wide upper size limits of 323 mm and 210 mm carapace lengths for *Kinixys erosa* and *K. homeana*, respectively (Ernst and Barbour, 1989).

This study projected an average annual harvest of 0.7 tortoises/km² for the three protected areas in southwestern Cameroon. This estimate is based on the conservative assumption that villages do half of their hunting in protected areas. Personal observations indicate that hunting activities may, in reality, be concentrated in these areas because of habitat quality, minimal enforcement efforts, and lower human densities resulting in less competition for wildlife resources. Individual *Kinixys* home ranges can exceed 0.5 km², and male *K. homeana* and probably *K. erosa* actively exclude other males from portions of their range (unpubl. data). From the perspective of the continued survival of these tortoise populations, an exploitation rate of 0.7 animals/km² must be considered dangerously high. For forests outside designated protected areas where human densities are typically much higher and there is abso-

Table 3. Estimated annual harvest of *Kinixys erosa* and *K. homeana* from three nominally protected areas in southwestern Cameroon. Estimates for each protected area = number of villages times annual average from Table 2, divided by 2. Estimated total harvest from protected and non-protected areas in each region is given in parentheses. Harvest per km² is expressed as number of tortoises and biomass for protected areas only. *Area below 800 m.

	Area (km²)	No. villages within 5 km	Measure	Estimated Annual Harvest *Kinixys erosa*	*Kinixys homeana*	Total
Korup National Park	1226	35	No. tortoises	363 (726)	240 (480)	603 (1206)
			Biomass (kg)	369 (737)	110 (220)	479 (957)
			Harvest/km²	0.3 (0.3)	0.2 (0.09)	0.5 (0.39)
Banyang-Mbo Sanctuary	582*	29	No. tortoises	301 (602)	199 (397)	500 (999)
			Biomass (kg)	306 (612)	92 (183)	398 (795)
			Harvest/km²	0.5 (0.5)	0.3 (0.16)	0.8 (0.66)
Nta-Ali Reserve	317	21	No. tortoises	218 (436)	144 (288)	362 (724)
			Biomass (kg)	222 (443)	66 (132)	288 (575)
			Harvest/km²	0.7 (0.7)	0.5 (0.21)	1.1 (0.91)
Total	2125	85	No. tortoises	882 (1764)	583 (1165)	1465 (2929)
			Biomass (kg)	897 (1792)	268 (535)	1165 (2327)
			Harvest/km²	0.4 (0.4)	0.3 (0.25)	0.7 (0.55)

lutely no regulation of hunting, the situation is likely much worse for tortoises.

Few hunting studies of the tropical African forest fauna include the numerous routinely consumed reptiles (but see Akani et al., 1998). Even though tortoises have long been a recognized component of the diet of many forest peoples, tortoise and other reptile harvest has been consistently omitted or disregarded because, (1) researchers, particularly in Africa, tend to focus on charismatic megafauna to the exclusion of most other taxa of conservation interest, and (2) reptiles constitute a small overall portion of hunting harvest (e.g., Noss, 1998). Long-term monitoring and modeling of turtle populations (e.g., Congdon et al. 1993, 1994) indicate that chelonians are extremely vulnerable to even minimal adult harvest. The magnitude of adult tortoise harvest seen in Cameroon is more than sufficient to warrant explicitly including tortoises and other reptiles in future hunting studies — preferably at the level of sex and age-class, but at the very least to species. Because tortoises are prone to over-exploitation, any study purporting to investigate the impact of hunting must take them into account despite their relatively small numbers in any particular sample.

Not surprisingly, protected areas surrounded by higher human densities (number of villages relative to area protected, Nta-Ali > Banyang-Mbo > Korup) experience higher rates of tortoise harvest. Few protected forest areas within the range of *Kinixys erosa* and *K. homeana* are inaccessible simply by virtue of their size and distance from human settlements. Despite the impracticalities of implementation and the current trend in conservation against such efforts, integral protection of some areas within the species' ranges seems warranted.

As with many turtle and tortoise species, international wild animal trade in live *Kinixys* has become a conservation issue. The status of wild *Kinixys* populations remains unknown, and *K. erosa* and *K. homeana* are listed as Data Deficient (i.e., inadequate information available to make an assessment of threatened status) by the Tortoise and Freshwater Turtle Specialist Group of IUCN-The World Conservation Union. *Kinixys* are also listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, requiring the monitoring of trade from CITES signatory countries. Most recently, the European Union promulgated a regulation (EC Number 338/97) prohibiting the importation of all wild-caught *Kinixys*. While numbers are not available for *Kinixys* exports from Cameroon during the study period (A. Rosser, *pers. comm.*), for comparative purposes, recent CITES export quotas for several other West African exporting nations are given in Table 4. Projected annual tortoise harvest by only the 85 villages bordering the three protected areas in southwestern Cameroon (2929 tortoises) exceeds the wild-caught export quotas over a two year period for the three countries for which there are recent data (2020 tortoises). Even if "ranched" specimens (a designation of dubious validity that indicates animals come from a managed population) are included, the volume of tortoises consumed by a subset of forest villages in a small section of Cameroon exceeds the yearly combined reported *Kinixys* export quotas of Ghana and Togo. Hoover (1998) provided additional trade figures for *K. erosa* and *K. homeana* from 1983–94. During this time, reported international trade in *K. erosa* ranged from a low of 102 individuals in 1983 to a high of 943 in 1990. Trade in *K. homeana* was greater and ranged from a low of 61 in 1983

Table 4. *Kinixys erosa* and *Kinixys homeana* CITES export quotas for 1997 and 1998. Information provided by the IUCN/SSC Wildlife Trade Programme based on CITES Nofication Numbers 994 and 1998/07. Note that export quotas may represent a percentage of specimens actually exported. *Not specifically reported as either ranched or wild-caught.

		1997 Ranched	1997 Wild	1998 Ranched	1998 Wild	Total
Benin	*K. erosa*					
	K. homeana	15,000		15,000		30,000
Ghana	*K. erosa*		120*		120*	240
	K. homeana		340*		340*	680
Togo	*K. erosa*	300		1,500		1,800
	K. homeana	1,000	600	2,000	500	4,100
Total		16,300	1,060	18,500	960	36,820

to a high of 6426 in 1994, and has continued to increase since that time (Table 4). Based on Hoover's data and the estimates of this study, between 1983 and 1994 every 52 villages in the forests of Cameroon would have consumed the equivalent of the average annual international trade in *K. erosa* and *K. homeana*. Consistent availability of *Kinixys* in the international pet trade over the last decade has driven prices down from over $US 100 in the early 1980s when they first became available to their low of only $US 35–45 which has held steady since the mid-1990s (Hoover, 1998). Consistent availability of *K. erosa* and *K. homeana* in the pet trade and low retail prices may be a byproduct of the abundant incidental capture of tortoises in these countries.

Unfortunately, little or no effort is currently directed toward local conservation of Africa's forest-dwelling hingeback tortoises and other herpetofauna. *Kinixys* and other species that suffer indiscriminate collection for food receive little direct benefit from the mechanisms currently in place to monitor and curtail their international trade. This is particularly true given the economic climate present in many developing nations in Africa and elsewhere. Desperately poor people have no incentive to pass up an easy meal in the form of a tortoise. For the animals they encounter, the choice is either consumption or sale to local markets. Functional protected areas are needed that explicitly include tortoises and other demographically vulnerable species in their management plans — a tall order for any country or economy. Finally, chelonian conservation efforts should address domestic consumption, when relevant, in tandem with initiatives to control trade and/or stem habitat loss.

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