Model Selection Process. We began our analyses by determining the best general model. A fully parameterized model suffered from over-fitting and many unidentifiable parameters, so our general model was constrained to have $p = c$ and a reduced number of survival parameters. We ranked 2 general models (models #18 and #19 in Table 2) that differed only in survival structure, $S(sex*e2)$ versus $S(sex*t)$ and found $\mathrm{S}(sex*e2)$ was slightly better (ΔqAICc = 0.46), so we continued with this model as our most general form (model # 18). Next, we ranked 5 models with different constraints on recapture probability (p) to determine the most parsimonious form. The top-ranked model of recapture $\{p=c(sex*t)\}$ had sex and time varying recapture rates (model # 18, Table 2). We next ranked 10 different models of temporary emigration (models #8-17 in Table 2). The top-ranked model of emigration $\{\gamma'' = \gamma'(.)\}$ had random constant emigration (model #8 in Table 2). Finally, we ranked 7 models of survival (models #1-7). The top-ranked model of survival $\{S(sex)\}$ had constant survival that differed according to sex (model #1 in Table 2).

Discussion of estimated parameter values for the Tarangire National Park giraffe population.

The use of photographic mark-recapture and the Wild-ID software enabled us to obtain estimates of population abundance and survival for the giraffes in Tarangire National Park. Since the interval between the first and last samples was approximately a single year, they should be viewed as preliminary assessments given the high inter-annual variability in east African savannas.

Our estimate of adult female annual survival (0.908) is similar to published estimates computed from return rates of known individuals that did not account for detection probabilities (0.87 in Nairobi NP, Foster & Dagg 1972; 0.91 in Tsavo NP, Leuthold & Leuthold 1978). We expected that our estimate would be higher than return rates because return rates are biased low by imperfect recapture probability. Pellew (1983) estimated adult giraffe survival as 0.949 from carcass encounter rates in Serengeti NP. Ratio-based estimates of annual adult survival from aerial and/or ground surveys gave estimates of 0.886 (Owen-Smith & Mason 2005) and 0.915 (Nje 1983).

Our estimate of male annual survival (0.521) is considerably lower than published estimates (0.743 in Leuthold & Leuthold 1978). Our estimate of male annual survival is likely biased low by permanent emigration from the study area that is confounded with mortality. Male giraffe home ranges are larger than females', and males make more long distance movements (>50 km) than females (Fenessey 2009) increasing the probability of permanent emigration from our study area. We expect that increasing our survey effort and enlarging the survey area will substantially reduce this bias.

We estimated adult and juvenile population sizes of 193 (±47) and 265 (±66) for the northern Tarangire NP male and female populations respectively at sampling occasion two in January-March 2009. Estimates based on aerial surveys in the 2001 wet season (March) estimated the TNP population at 855 (±287) individuals (TAWIRI 2001). These estimates are difficult to compare directly because the aerial survey estimate included calves in the total count and covered the entire park. Our reconnaissance of the southern two-thirds of the park during the second primary sampling occasion suggested extremely low densities of giraffe, but this will require further survey efforts to adequately document. Based on these observations we suspect the park population may be significantly smaller than the 2001 estimate. However, to rigorously evaluate this further survey efforts in the southern extent of the park are required.

The small number of observed movements between TNP and Manyara Ranch is surprising considering the small distance between the parks (Fig. 3). The intervening landscape is known as the Kwa Kuchinja Corridor and contains a major two lane paved road, scattered human settlements and agricultural development. This corridor has been the target of conservation concern (Goldman 2009) but still allows annual migration of a significant portion of the TNP wildebeest and zebra herds. The low rates of movement of giraffes may be a reflection of their non-migratory nature, and relatively small and stable home ranges. However, infrequent movement between TNP and Manyara Ranch is inconsistent with our finding of a significant transient effect and our suspicion that male survival estimates are biased by permanent emigration. Sensitivity of giraffe movement to the anthropogenic landscape features in the Kwa Kuchinja Corridor, but free movement in other directions, is consistent with these results but will require additional data to confirm.

References

Berry, P.S.M. (1978) Range movements of giraffe in the Luangwa Valle, Zambia. *East African Wildlife Journal*, **16**, 77-83.

Du Toit, J.T. (1990) Feeding-height stratification among African browsing ruminants. *African Journal of Ecology,* **28**, 55-61.

Fenessey, J. (2009) Home range and seasonal movements of *Giraffa camelopardalis angolensis* in the northern Namib Desert. *African Journal of Ecology*, **47**, 318-327.

Foster, J.B. & Dagg, A. (1972) Notes on the biology of the giraffe. *East African Wildlife Journal*, **10**, 1-16.

Goldman, M. (2009) Constructing Connectivity: Conservation Corridors and Conservation Politics in East African Rangelands, *Annals of the Association of American Geographers*, **99**, 335 – 359.

van der Jeug, H.P & Prins, H.H.T. (2000) Movements and group structure of giraffe (*Giraffa camelopardalis*) in Lake Manyara National Park, Tanzania. . *Journal of Zoology, London*, **251**, 15-21.

Langman, V.A. (1973) Radio-tracking giraffe for ecological studies. *Journal of the South African Wildlife Management Association,* **4**, 75-78.

Leuthold, B.M. & Leuthold, W. (1978) Ecology of giraffe in Tsavo-East-National-Park, Kenya. *East African Wildlife Journal*, **16**, 1-20.

Moore-Berger, E. (1974) Utilization of the habitat by the reticulated giraffe (*Giraffa camelopardalis reticulata* Linnaeus) in northern Kenya. M.Sc. Thesis, University of Nairobi.

Nje, J.N. 1983. Structure and dynamics of the giraffe population of the Waza National Park, Cameroons. *Terre et la Vie*, **37**, 3-20.

Owen-Smith, N. and Mason, D.R. (2005) Comparative changes in adult vs. juvenile survival affecting population trends of African ungulates. *Journal of Animal Ecology*, 74,762-773.

Pellew, R.A. (1983) The giraffe and its food resource in the serengeti .2. Response of the giraffe population to changes in the food-supply. *African Journal of Ecology*, **21**:269-283.

Pellew, R.A. (1984) The feeding ecology of a selective browser, the giraffe (*giraffa-camelopardalis tippelskirchi*). *Journal of Zoology* **202**, 57-81.

Pendu, Y.L. and Ciofolo, L. (1999) Seasonal Movements of Giraffes in Niger. *Journal of Tropical Ecology*,**15**, 341-353.

Table A. Model selection results for apparent survival (S), temporary emigration (γ" & γ′), and capture recapture (*p*) probabilities of giraffe in Tarangire National Park, Tanzania 2008-2009. ΔqAICc and qAICc weights are computed within each parameter type (e.g., survival, emigration, capture). Notation for model components is: sex = *sex*, time-varying = *t*, constant = ., age-like transient effect = *e2*, occasion=*occ*.

Model #	Survival models	qAICc	Δ qAICc	qAICc Wts.	Num. Par
1	{S(sex) γ"=γ'(.) p=c(sex*t)}	-1149.30	0	0.32	17
2	{S(sex+t) γ"=γ'(.) p=c(sex*t)}	-1148.20	1.11	0.19	18
3	{S(sex+e2) γ"=γ'(.) p=c(sex*t)}	-1147.14	2.16	0.11	18
4	{S(.) γ"=γ'(.) p=c(sex*t)}	-1146.64	2.66	0.09	16
5	{S(sex*t) γ"=γ'(.) p=c(sex*t)}	-1146.36	2.94	0.07	19
6	{S(t) γ"=γ'(.) p=c(sex*t)}	-1145.76	3.54	0.06	17
7	{S(e2) γ"=γ'(.) p=c(sex*t)}	-1144.61	4.69	0.03	17
	Emigration models				
8	{S(sex*e2) γ"=γ'(.) p=c(sex*t)}	-1145.13	0.00	0.31	19
9	{S(sex*e2) γ"=γ'(0) p=c(sex*t)}	-1144.10	1.02	0.19	19
10	{S(sex*e2) γ"(.) γ'(.) p=c(sex*t)}	-1143.86	1.27	0.16	20
11	{S(sex*e2) γ"=γ'(sex) p=c(sex*t)}	-1143.01	2.11	0.11	20
12	{S(sex*e2) γ"(t) γ'(t) p=c(sex*t)}	-1142.15	2.98	0.07	21
13	{S(sex*e2) γ"=γ'(t) p=c(sex*t)}	-1142.15	2.98	0.07	21
14	{S(sex*e2) γ"=γ'(sex+t) p=c(sex*t)}	-1141.31	3.82	0.05	21

15	{S(sex*e2) γ"(sex) γ'(sex) p=c(sex*t)}	-1140.00	5.13	0.02	22
16	{S(sex*e2) γ"=γ'(sex*t) p=c(sex*t)}	-1138.91	6.21	0.01	22
17	{S(sex*e2) γ"(sex+t) γ'(sex) p=c(sex*t)}	-1138.06	7.07	0.01	23
	Capture recapture models				
18	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(sex*t)}	-1135.83	0.00	0.47	24
19	{S(sex*t) γ"(sex*t) γ'(sex) p=c(sex*t)}	-1135.37	0.46	0.37	24
20	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(occ)}	-1133.22	2.61	0.13	16
21	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(sex+t)}	-1129.05	6.78	0.02	18
22	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(sex+occ)}	-1128.78	7.05	0.01	19
23	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(sex)}	-1047.15	88.68	0.00	15
24	{S(sex*e2) γ"(sex*t) γ'(sex) p=c(.)}	-1046.39	89.44	0.00	14