SEASONAL UNGULATE DISTRIBUTION AND DENSITIES ON MANYARA RANCH 2012-13

April 2013

By

Derek E. Lee, Curt Bradley, and Monica L. Bond

Wild Nature Institute

Hanover, New Hampshire and Arusha, Tanzania

©2013Wild Nature Institute

Executive Summary

- The northern Tarangire-Manyara Ecosystem in Tanzania is among the richest areas in the world for large mammal diversity and abundance, and Manyara Ranch provides crucial wildlife habitat for migratory and resident species between the Tarangire River and Lake Natron.
- This area is essential to the survival of migratory wildlife populations in the area, and sustains the ecological viability of both Tarangire and Lake Manyara National Parks, two of the highest income earning parks in Tanzania.
- We conducted ungulate surveys in Manyara Ranch in 2012 and early 2013 to determine seasonal spatial distribution, density, and abundance of wild ungulate species and livestock.
- Surveys used distance sampling methods on fixed-route road transects, and were conducted near the end of each precipitation season (vuli = short rains, masika = long rains, and kiangazi = dry).
- Most species had some seasonal variation in density and distribution.
- Species in rank order of average annual abundance were: cattle (11,271), zebra (2,393), sheep and goats (2,154), impala (1,103), wildebeest (881), dik-dik (404), Grant's gazelle (292), giraffe (242), Thomson's gazelle (166), eland (80), lesser kudu (30), elephant (14), steenbok (11), waterbuck (11), horse (4), gerenuk (1).
- Cattle densities increased 11 fold between the wet and dry seasons 2012 (1,566 to 17,131), most likely due to encroachment of local village herds.
- Any stakeholder with interest in these data or the ongoing surveys should contact the authors of this report at Derek@WildNatureInstitute.org or +255 686 037 481.

Introduction

The northern Tarangire-Manyara Ecosystem (TME; part of the Maasai Steppe) in Tanzania is among the richest areas in the world for large mammal diversity and abundance. Land management in the TME is divided among National Parks, Game Controlled Areas, village Wildlife Management Areas, and Manyara Ranch Conservancy (Fig. 1). Tanzanian National Parks conduct some wildlife population monitoring, but Game Controlled Areas, hunting blocks, and Wildlife Management Areas of the TME lack comprehensive monitoring. Reliable data are needed for guidance in order to sustain wildlife populations and wildlife-based economic benefits.

Manyara Ranch was established as a cattle ranch during Tanzania's colonial period and operated for agricultural and livestock production until 2000. It is a 17,807 ha property located within the crucial wildlife migration corridor connecting Lake Natron and the wildlife areas on the plains surrounding Mounts Gelai and Kitumbaine to the Tarangire River (Fig. 1). This corridor is essential to the survival of migratory wildlife populations in the area, and sustains the ecological

©2013Wild Nature Institute

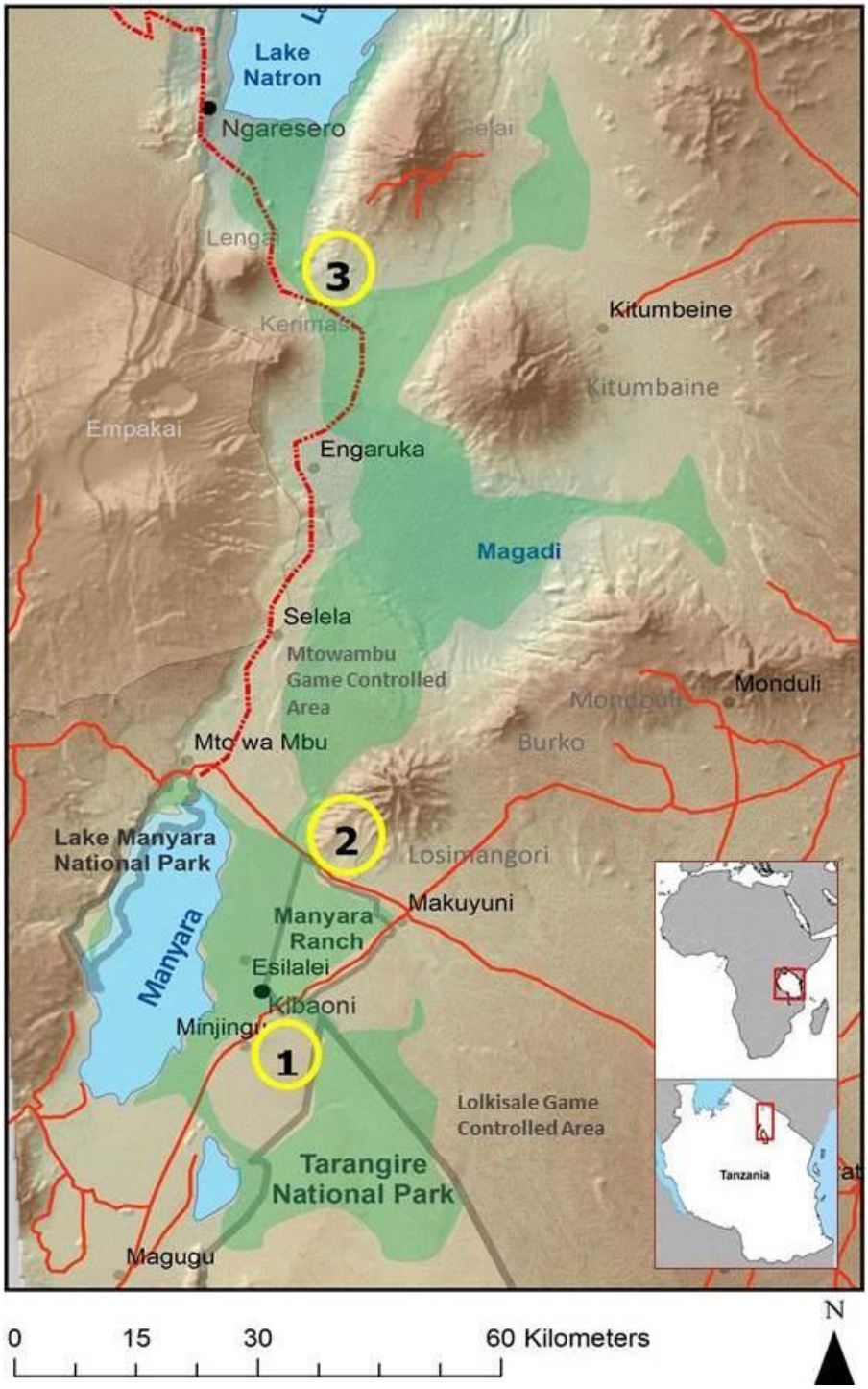


Figure 1. Northern Tarangire-Manyara Ecosystem (green shading) defined by areas used by migratory wildebeest and zebra between the Tarangire River and Lake Natron including plains around Mountains Gelai and Kitumbaine. Numbered yellow circles indicate crucial pinch points where migration route is narrow and endangered by human activities. Manyara Ranch forms most of a critical linkage between pinch points #1 and #2, but the pinch points themselves remain unprotected.

©2013Wild Nature Institute

viability of both Tarangire and Lake Manyara national parks, two of the highest income earning parks for Tanzania (Sachedina 2008). In the late 1990s, Manyara Ranch was a state-run cattle ranch, but was prioritized for privatization as part of the liberalization of the Tanzanian economy. In 2000, the African Wildlife Foundation (AWF) obtained a 99-year lease for management and conservation rights to the ranch in order to protect this wildlife habitat and critical movement corridor. AWF interest in Manyara Ranch is based on the Nature Conservancy's 'land trust' concept. Land trusts provide a mechanism to acquire lands recognized as important for conservation but are outside of the protected area system and therefore threatened by development. Manyara Ranch was the first Tanzanian Land Conservation Trust (TLCT) purchase, and is now held by the TLCT for the benefit of the local communities and Tanzania. Manyara Ranch remains an operating cattle ranch with a small herd of livestock but includes a tourism development program which offers facilities for visitors to experience the wildlife and culture in and around the area (African Wildlife Foundation 2005, Sachedina 2008).

The Tarangire-Manyara Ecosystem is experiencing losses of wildlife due to poaching and conversion of habitat to agriculture and housing. However, some wildlife populations may be increasing locally within Manyara Ranch due to changes in ranch management practices. The management of Manyara Ranch requires robust data on seasonal densities and abundances of wild ungulates and domestic livestock to quantify outcomes from management and conservation programs. We conducted seasonal ungulate surveys in Manyara Ranch in 2012 and early 2013 to determine seasonal spatial distribution, density, and abundance of wild ungulate species and livestock. Surveys used distance sampling methods on fixed-route road transects, and were conducted near the end of each precipitation season (vuli = short rains, masika = long rains, and kiangazi = dry).

Methods

We conducted daytime fixed-route road transect surveys of Manyara Ranch (MR). Driving speed was maintained between 15 and 20 kph on all transects, and all survey teams included two dedicated observers and a driver. Sampling design was a robust design with two repeated sampling events at each site during a given survey. A sampling event consisted of 1 round of driving all fixed-route road transects within the ranch. Surveys were done in late January and early February (vuli), late May and early June (masika), and late September and early October (kiangazi). While driving the fixed-route road transects (Appendix 1), we collected distance data for all large mammals visible along both sides of the road out to 500 m. Species categories we counted were: cows, sheep and goats (shoats), Kirk's dik-dik, gerenuk, Grant's gazelle, Thomson's gazelle, Masai giraffe, common impala, lesser kudu, steenbok, common waterbuck, Burchell's zebra, eastern white-bearded wildebeest, eland, and elephant.

Distance data records the group size and perpendicular distance from the road transect to each group of animals when first detected. When a group or singleton was sighted, we immediately halted the car and we recorded the GPS-position of the car, the distance to the animal(s) with a laser rangefinder, and the total number of individuals. If the sighting was a cluster of animals, the distance was defined to represent the perpendicular distance from the observers to the estimated middle of the animal group.

©2013Wild Nature Institute

Distance data were analyzed with program DISTANCE 6.0 (Thomas et al. 2009) to estimate seasonal density and abundance of animals while accounting for variation in detectability according to distance from the road transect. The detection function reflects both the decrease in detectability with distance and the lower proportion of animals that are potentially detectable (Buckland et al., 2001). We stratified surveys according to season and also computed annual averages. We discarded the farthest 5% of observations for each species and used the half-normal cosine density function (Buckland et al 2002). Some species were too rare or sparse to use DISTANCE estimators, so for those species with <30 observations we used an alternative estimator. For the alternative estimator we calculated the effective strip width as the average observation distance and computed sampling event-specific density estimates that were averaged within each survey.

Visualizations of seasonal distribution patterns were made using seasonal location data for all encounters using ArcGIS. Plots were made for each species in each survey with the size of the location marker indicating the number of adult animals present (Appendix 1).

Results

We completed four surveys in MR (two sampling events per survey). Two surveys were conducted during the vuli season, and one each in masika and kiangazi. Summary data are given in Table 1 including mean seasonal density (number of adults per km^2) and standard error (SE), as well as yearly average density and abundance. Species in rank order of average annual abundance were: cattle (11,271), zebra (2,393), sheep and goats (2,154), impala (1,103), wildebeest (881), dik-dik (404), Grant's gazelle (292), giraffe (242), Thomson's gazelle (166), eland (80), lesser kudu (30), elephant (14), steenbok (11), waterbuck (11), horse (4), gerenuk (1).

Most species had some seasonal variation in density on Manyara Ranch (Table 1), with cattle and shoats exhibiting the largest change (increase) during the sampled time period (Fig. 2). Seasonal migratory movements shifted some species distributions around the TME between wet and dry seasons. Of the migratory species, zebra, eland and Grant's gazelles were at lower densities during the dry season, while wildebeest and Thomson's gazelle were at lower densities during the wet season (Figs. 3 and 4).

The seasonal spatial distributions of animals are portrayed in maps in Appendix 1. The main wildlife migratory pathway through the western portion of the ranch is evident in wildebeest and zebra maps.

Highly variable vuli (short rains) rainfall led to high within- and among-year variation in vuli density estimates and distribution patterns. Vuli 2012 was wet and abundant forage led to distributions similar to masika (long rains). Vuli 2013 was drier and less forage led to distributions more similar to kiangazi (dry season).

©2013Wild Nature Institute

Table 1. Density (adults / km^2) and abundance estimates (# of adults) for 16 species of large herbivore on Manyara Ranch, Tanzania during four surveys in 2012-2013.

		SEASONAL DENSITY (adults / km^2)				SEASONAL SE				MEAN	MEAN
SPECIES	# of records	vuli '12	masika '12	kiangazi '12	vuli '13	vuli '12	masika '12	kiangazi '12	vuli '13	ANNUAL DENSITY	ANNUAL ABUNDANCE
COW	114	6.93	11.64	127.35	99.67	5.90	1.78	4.27	0.09	61.40	11,271
DIK-DIK	69	0.89	1.04	6.95	2.72	0.28	0.35	1.90	0.47	2.90	404
ELAND	33	0.50	0.43	0.06	0.78	0.41	0.08	0.05	0.68	0.44	80
ELEPHANT	17	0.15	0.03	0.11	0.02	0.00	0.00	0.02	0.02	0.08	14
GERENUK	1	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.01	1
GIRAFFE	118	1.24	1.53	0.74	1.46	0.45	0.22	0.09	0.51	1.24	242
GRANT'S GAZELLE	79	0.87	1.39	0.80	2.09	0.13	0.28	0.26	0.09	1.29	292
HORSE	2	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.02	4
IMPALA	132	4.73	3.83	7.53	6.93	1.62	0.07	0.06	2.29	5.76	1,103
LESSER KUDU	13	0.33	0.03	0.19	0.30	0.14	0.03	0.06	0.17	0.21	39
SHOATS	42	6.09	3.56	6.30	28.96	0.12	3.56	1.91	2.59	11.23	2,154
STEENBOK	3	0.00	0.00	0.08	0.17	0.00	0.00	0.08	0.17	0.06	11
THOMSON'S GAZELLE	63	1.16	0.76	1.40	0.47	0.09	0.04	0.22	0.17	0.94	166
WATERBUCK	7	0.00	0.03	0.17	0.04	0.00	0.03	0.11	0.01	0.06	11
WILDEBEEST	76	3.62	0.78	5.57	4.68	2.94	0.42	0.22	3.17	3.66	881
ZEBRA	320	13.27	16.74	9.90	17.34	6.40	0.07	0.34	2.89	14.31	2,393

©2013Wild Nature Institute

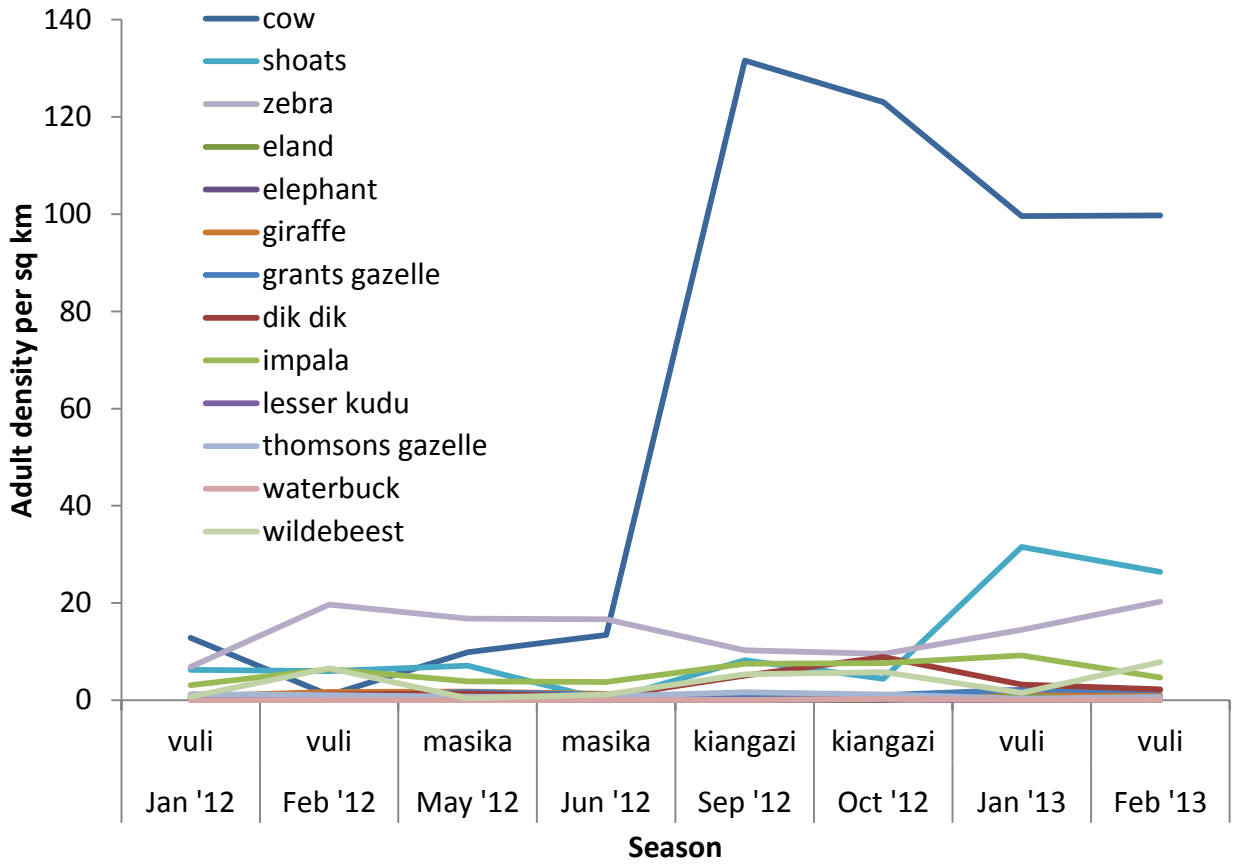


Figure 2. Survey-specific densities of large herbivores on Manyara Ranch 2012-2013 demonstrating the large increase in cows relative to all other species.

Discussion

These data are the basis of our ongoing scientific monitoring efforts for ungulate populations in the TME that we hope will benefit managers and policymakers by providing information on status and trends for economically important wildlife species.

Cattle were by far the most numerous large herbivore encountered on Manyara Ranch. This was due to the dramatic increase in cow numbers (11 fold) between masika 2012 and kiangazi 2012. Shoat densities also rose between kiangazi 2012 and vuli 2013. These dramatic increases were likely due to encroachment of local village herds seeking grazing or water during the dry season in 2012 and the relatively dry vuli in 2013. The interaction of livestock and wildlife on the Ranch, and the relative importance of wildlife and livestock to ranch profitability are core issues facing managers. In ranches where wildlife is favored, diverse and abundant wild herbivores (~1.7 t / km^2) can thrive even when sharing the landscape with a slightly higher biomass density

©2013Wild Nature Institute

of livestock (~ 2.7 t / km^2). However, where livestock is favored, only a few resilient wild species (e.g. gazelles and plains zebra) can persist (Georgiadis et al. 2007).

Wildlife densities for many species detected on Manyara Ranch compared favorably with estimates from Tarangire and Serengeti NPs (Table 2). Eland, gerenuk, giraffe, lesser kudu, and zebra had higher annual densities on Manyara Ranch than both national parks. Elephant, Grant's gazelle, steenbok, waterbuck, and wildebeest had lower annual densities on Manyara Ranch than in national parks.

Table 2. Densities (adults / km^2) of wildlife in Manyara Ranch (MR) 2012-2013 compared with Tarangire NP (TNP; from Lamprey 1964, Caro et al. 1998), and Serengeti NP (SNP; from Caro et al. 1998, East 1999). * nd indicates no data available.

Species	MR	TNP	SNP
DIK-DIK	2.90	1.55	5.00
ELAND	0.44	0.34	0.36
ELEPHANT	0.08	0.93	0.21
GERENUK	0.01	0	0
GIRAFFE	1.24	1.14	0.46
GRANT'S GAZELLE	1.29	1.40	2.50
IMPALA	5.76	20.50	4.40
LESSER KUDU	0.21	0.18	0
STEENBOK	0.06	nd	0.3 - 1.0
THOMSON'S GAZELLE	0.94	nd	0.1 - 8.0
WATERBUCK	0.06	1.79	0.09
WILDEBEEST	3.66	5.00	65.00
ZEBRA	14.31	9.12	6.5

Migratory wildlife used the western portion of Manyara Ranch when transiting between the Tarangire River and the short-grass plains to the north around Mounts Gelai and Kitumbaine. Wildlife utilize the watercourse area east of the village of Kwa Kuchinja when travelling between Tarangire NP and Manyara Ranch. North of Manyara Ranch, animals travel close to the base of Losimingori Mountain using waterholes just west and north of the Mountain (Fig 1). These pinch points should receive priority attention for additional protection in order to preserve habitat and ensure connectivity throughout the ecosystem.

We will continue to repeat our surveys 3 times per year to determine seasonal abundance patterns of each species and whether inter-annual trends are evident. Any stakeholder with interest in these data or the ongoing surveys should contact the author of this report at Derek@WildNatureInstitute.org , or +255 686 037 481.

©2013Wild Nature Institute

Acknowledgments

We are grateful to the African Wildlife Foundation, Tanzania Land Conservation Trust, and Manyara Ranch Conservancy for permission to conduct research on Manyara Ranch. We also thank Tanzania Wildlife Research Institute and the Tanzanian Commission on Science and Technology. This work was carried out under COSTECH permits 2011-106-NA-90-172 and 2012-175-ER-90-172.

Literature Cited

African Wildlife Foundation. 2005. Tarangire Manyara Ecosystem Management Regime Progress Report 1998-2005. African Wildlife Foundation, Arusha, Tanzania.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., Thomas, L., 2001. Introduction to Distance Sampling – Estimating the Abundance of Biological Populations. Oxford University Press, New York.

Caro, T.M., Pelkey, N., Borner, M., Severre, E.L.M., Campbell, K.L.I., Huish, S.A., OleKuwai, J., Farm, B.P., Woodworth, B.L. 1998. The impact of tourist hunting on large mammals in Tanzania: an initial assessment. African Journal of Ecology 36:321-346.

East, R. 1999. African Antelope Database 1998. IUCN/SSC Antelope Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 434pp.

Georgiadis, N.J., Olwero, J.G.N., Ojwang, G., Romanach, S.S. 2007. Savanna herbivore dynamics in a livestock-dominated landscape: I. Dependence on land use, rainfall, density, and time. Biological Conservation 137:461-472.

Lamprey, H.F. 1964. Estimation of large mammal densities, biomass and energy exchange in the Tarangire Game Reserve and the Masai Steppe in Tanganyika. East African Wildlife Journal 2:1-46.

Sachedina, H.T. 2008. Wildlife is our oil: Conservation, Livelihoods, and NGOs in the Tarangire Ecosystem, Tanzania. PhD Dissertation, St Anthony's College, University of Oxford. 546 pp.

Thomas, L., Laake, J.L., Rexstad, E., Strindberg, S., Marques, F.F.C., Buckland, S.T., Borchers, D.L., Anderson, D.R., Burnham, K.P., Burt, M.L., Hedley, S.L., Pollard, J.H., Bishop, J.R.B. and Marques, T.A. 2009. Distance 6.0. Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. http://www.ruwpa.st-and.ac.uk/distance/

©2013Wild Nature Institute

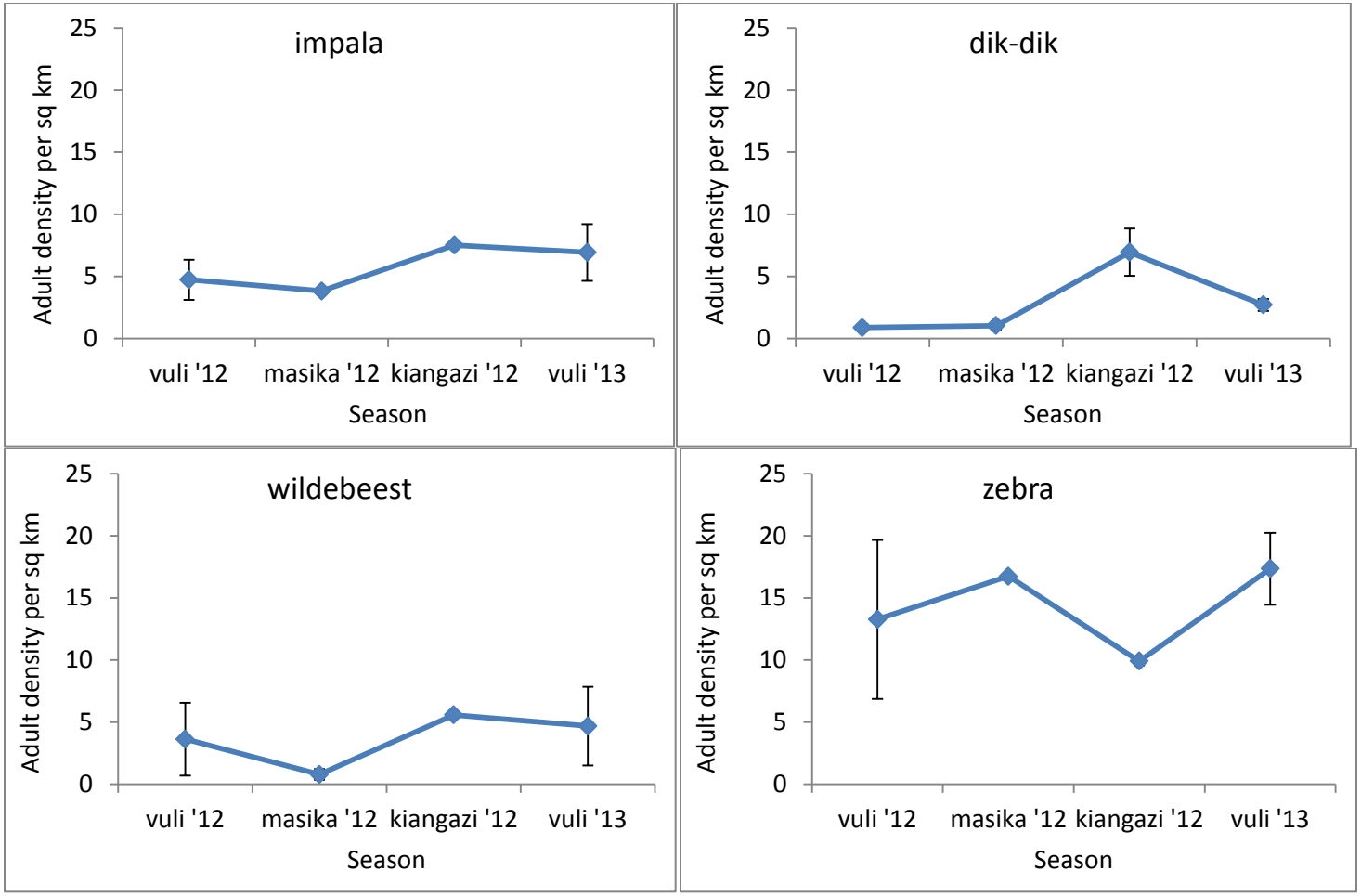


Figure 3. Seasonal densities (adults / km^2) of the four most abundant wildlife species on Manyara Ranch, Tanzania during 3 precipitation seasons. Error bars are ± 1 standard error (SE).

©2013Wild Nature Institute

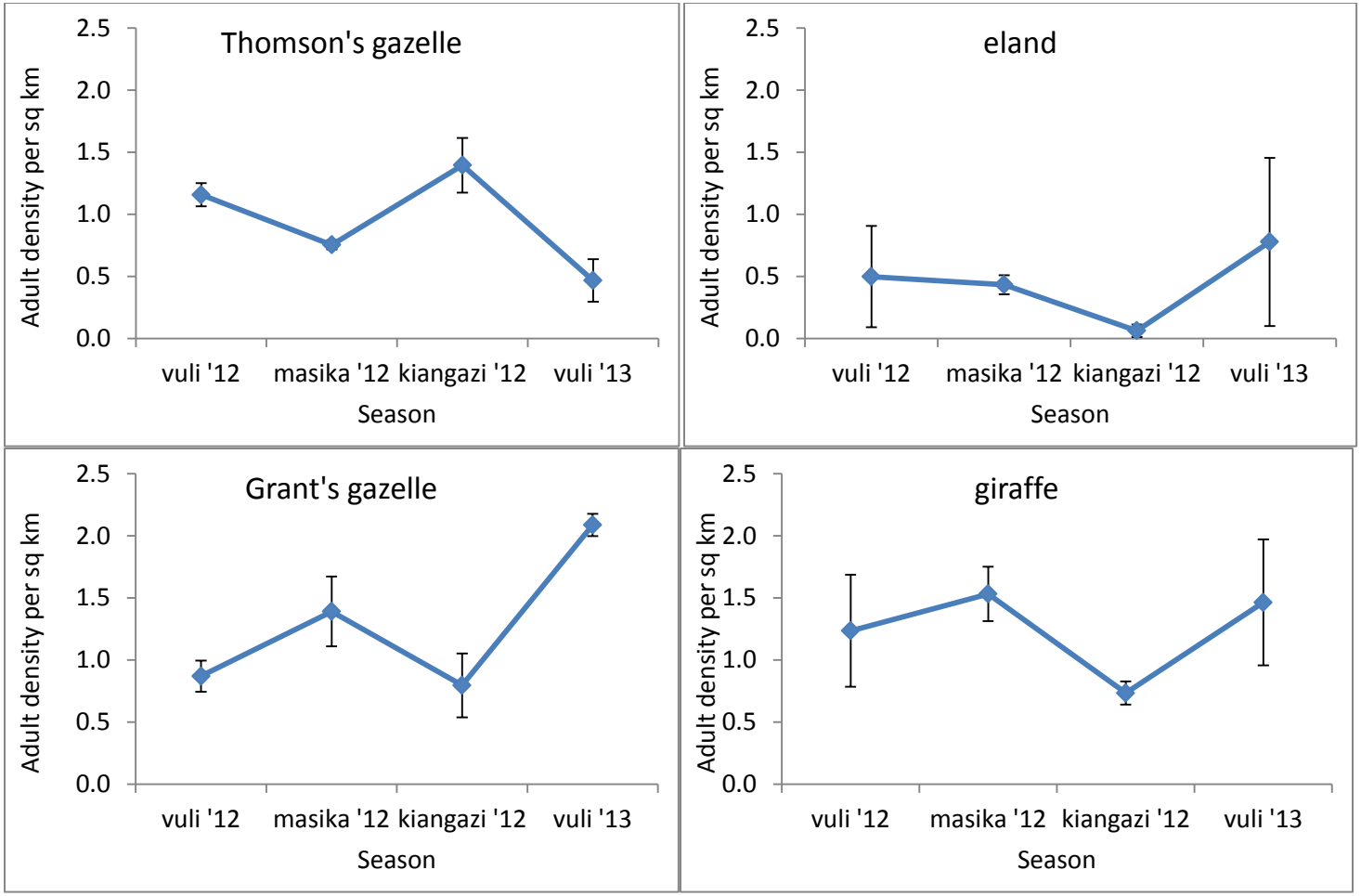
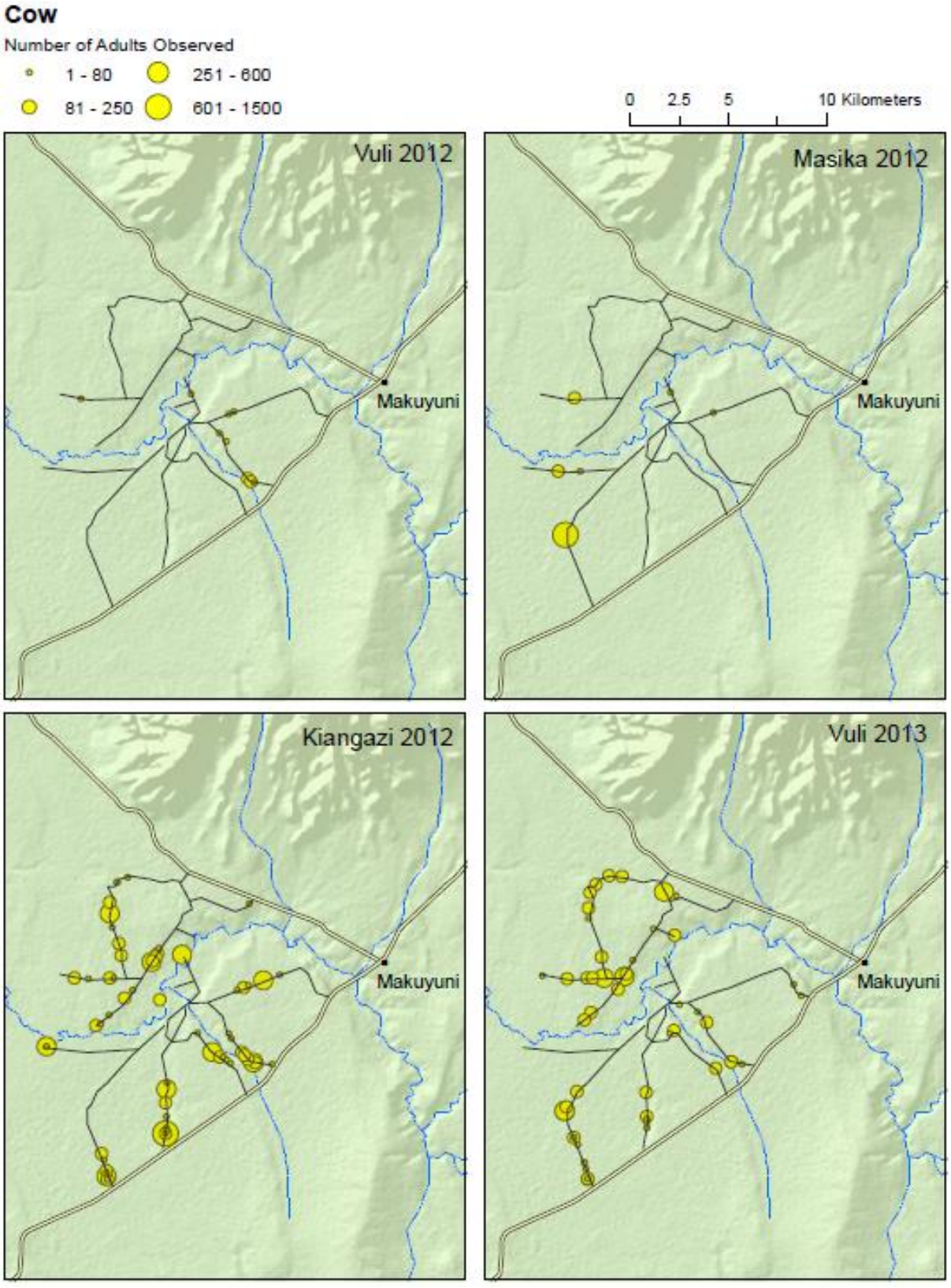


Figure 4. Seasonal densities (adults / km^2) of four moderately abundant wildlife species on Manyara Ranch, Tanzania during 3 precipitation seasons. Error bars are ± 1 standard error (SE).

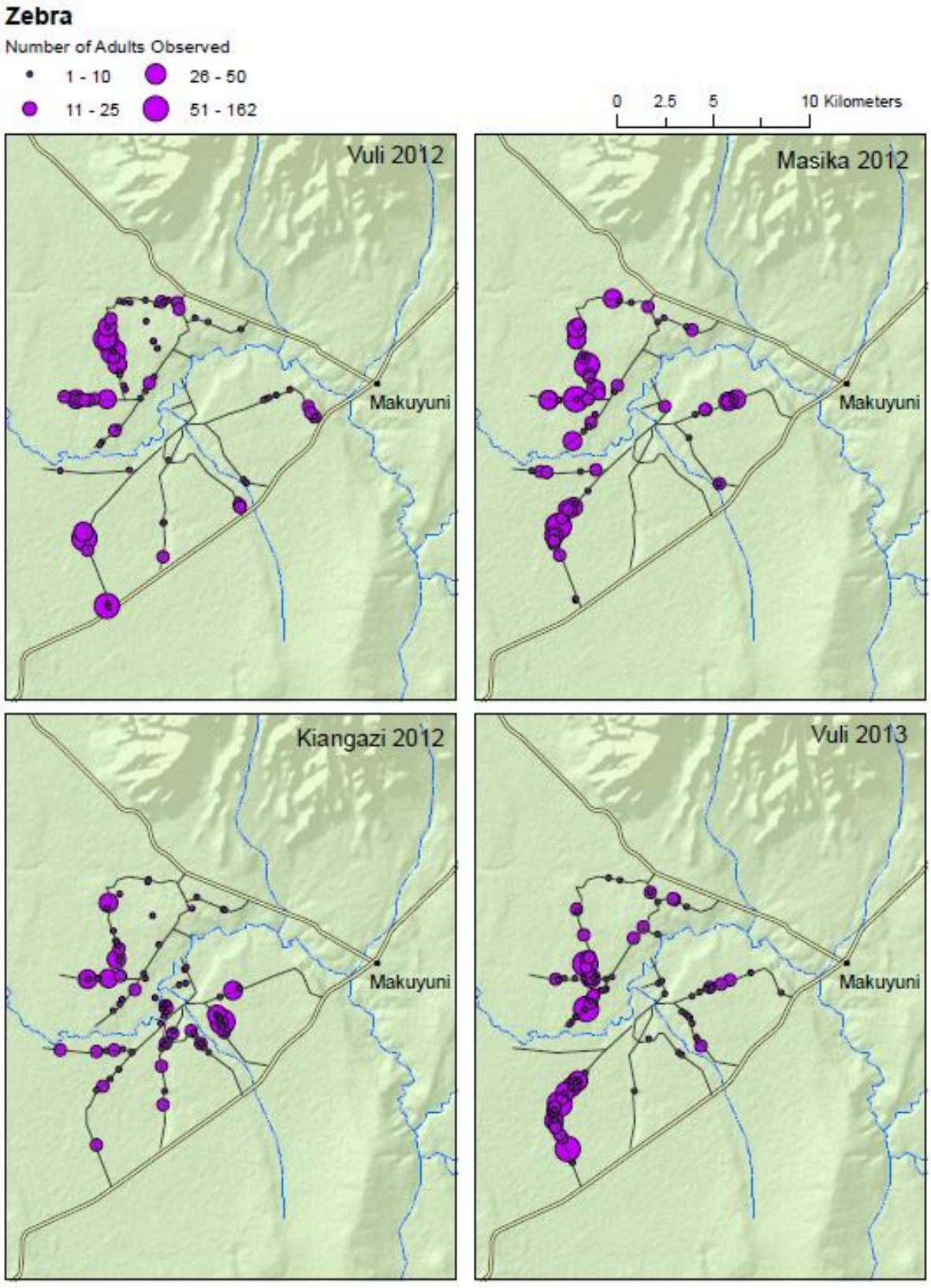
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



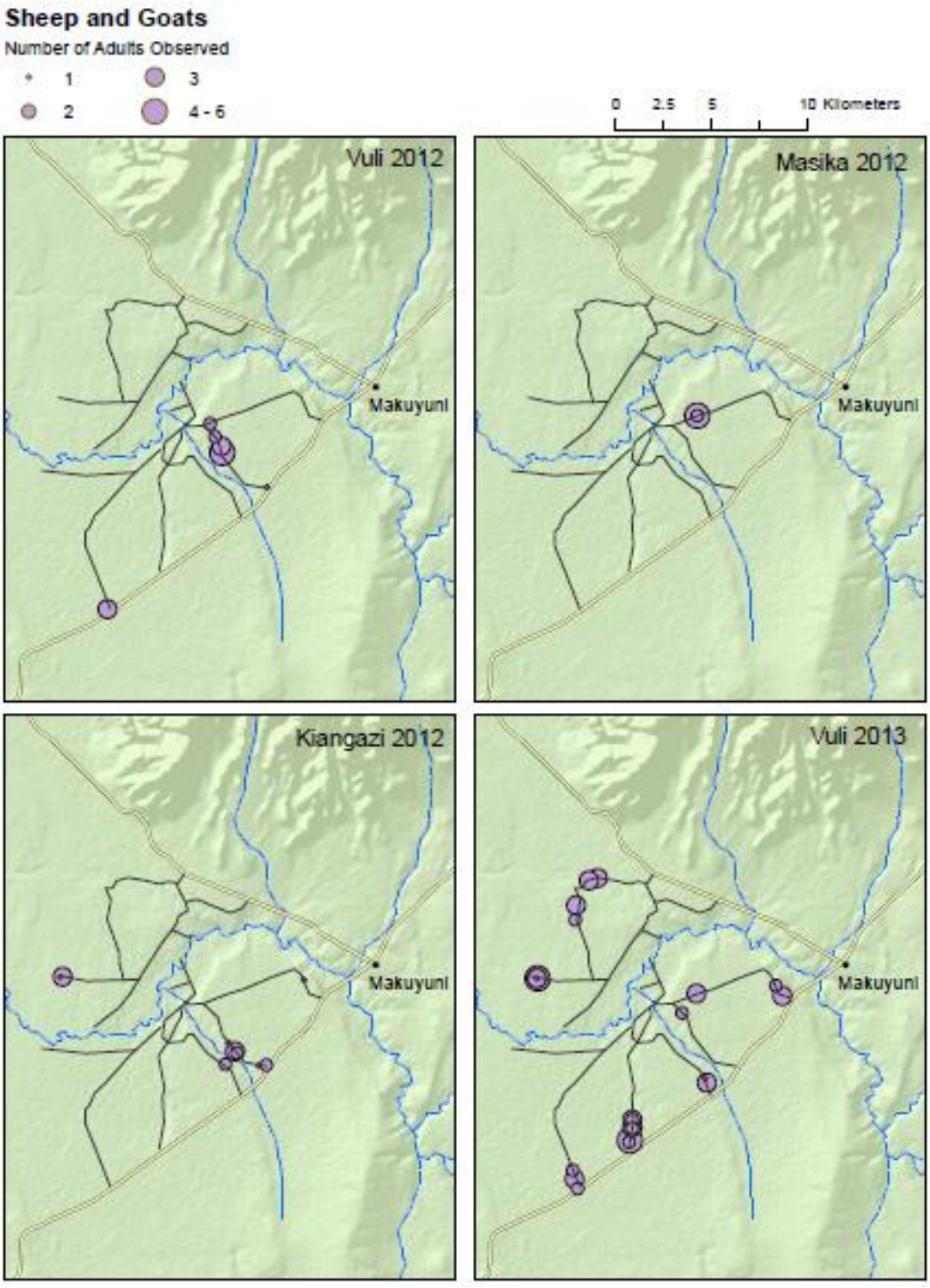
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



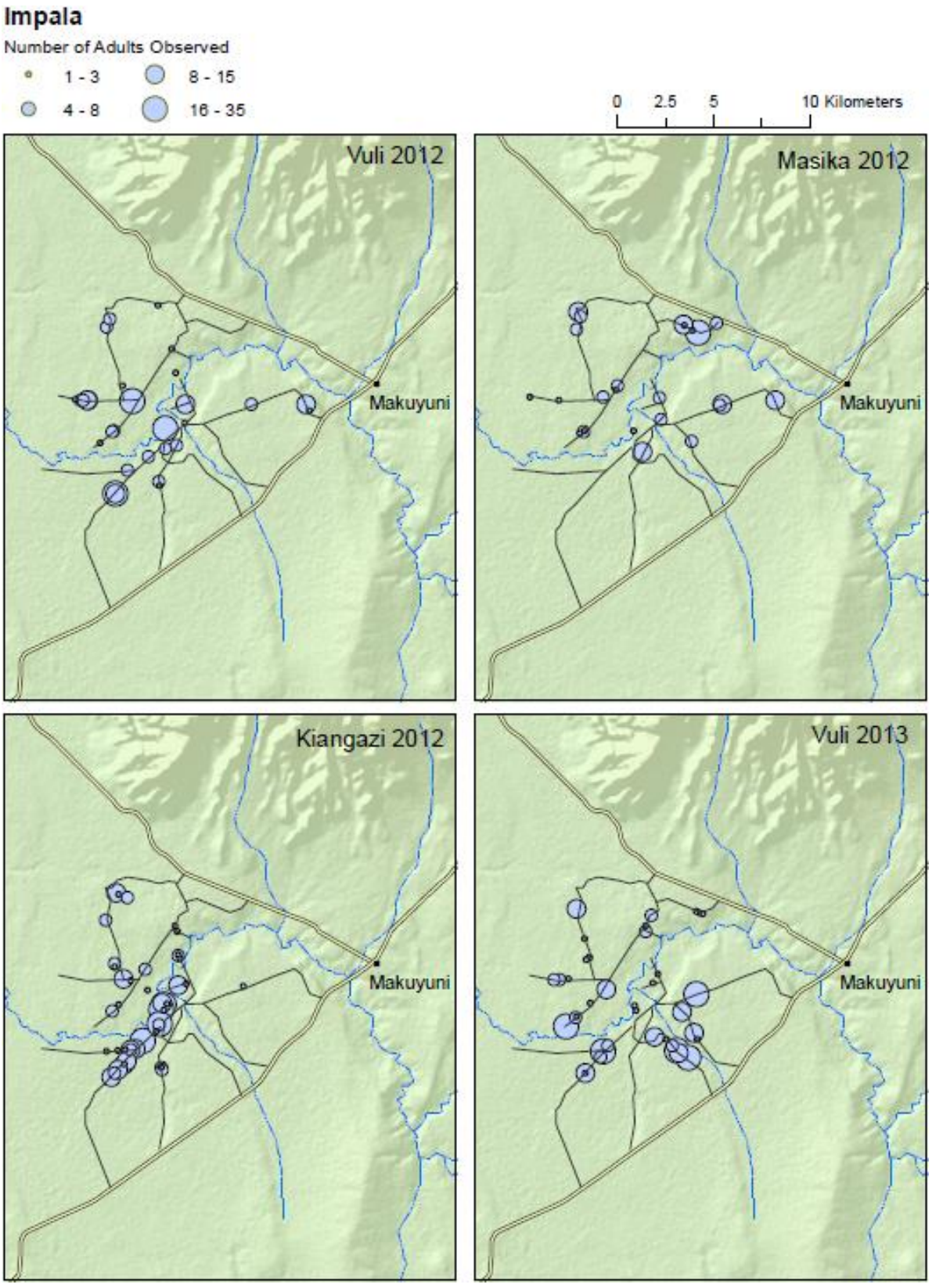
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



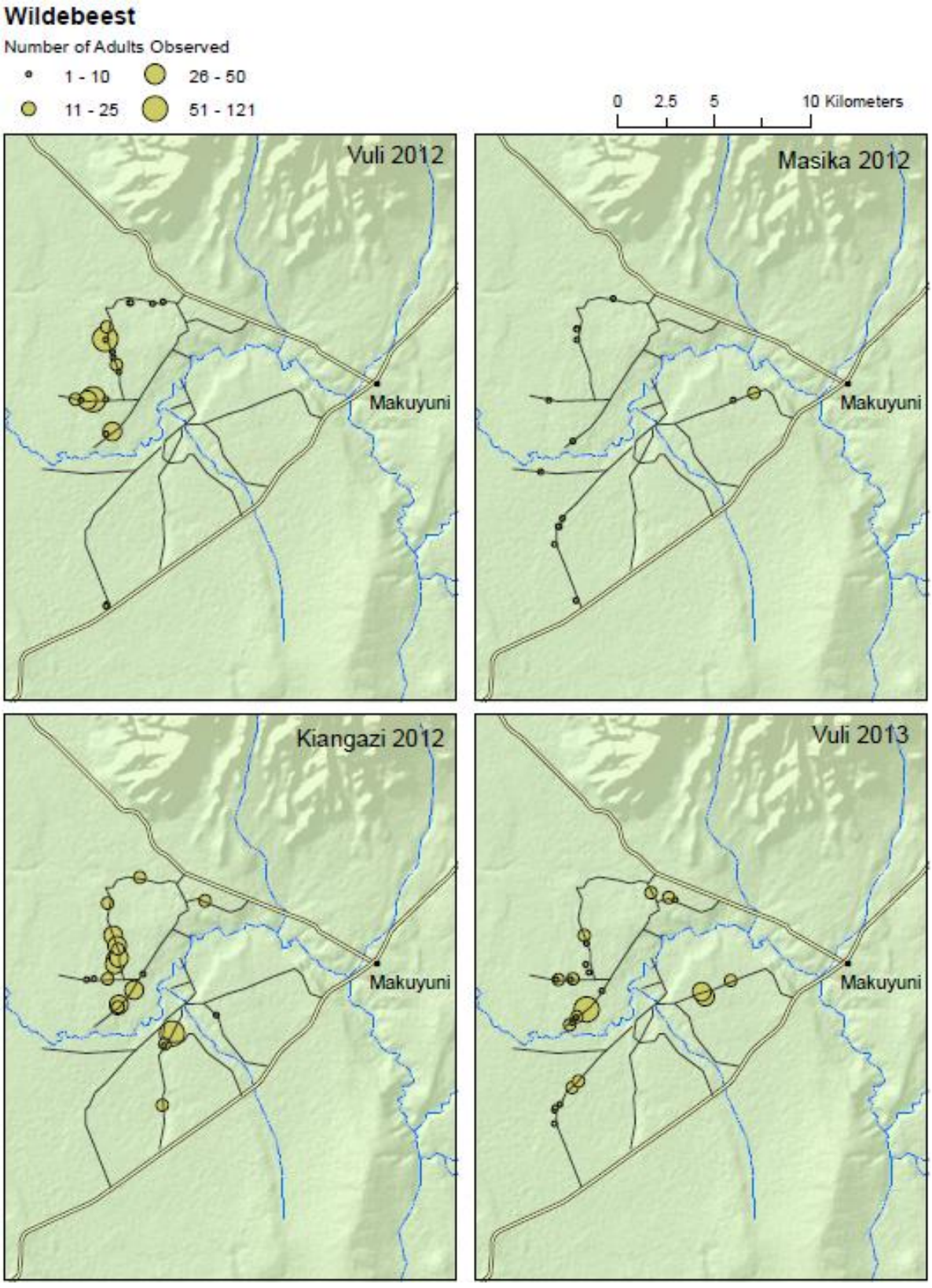
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



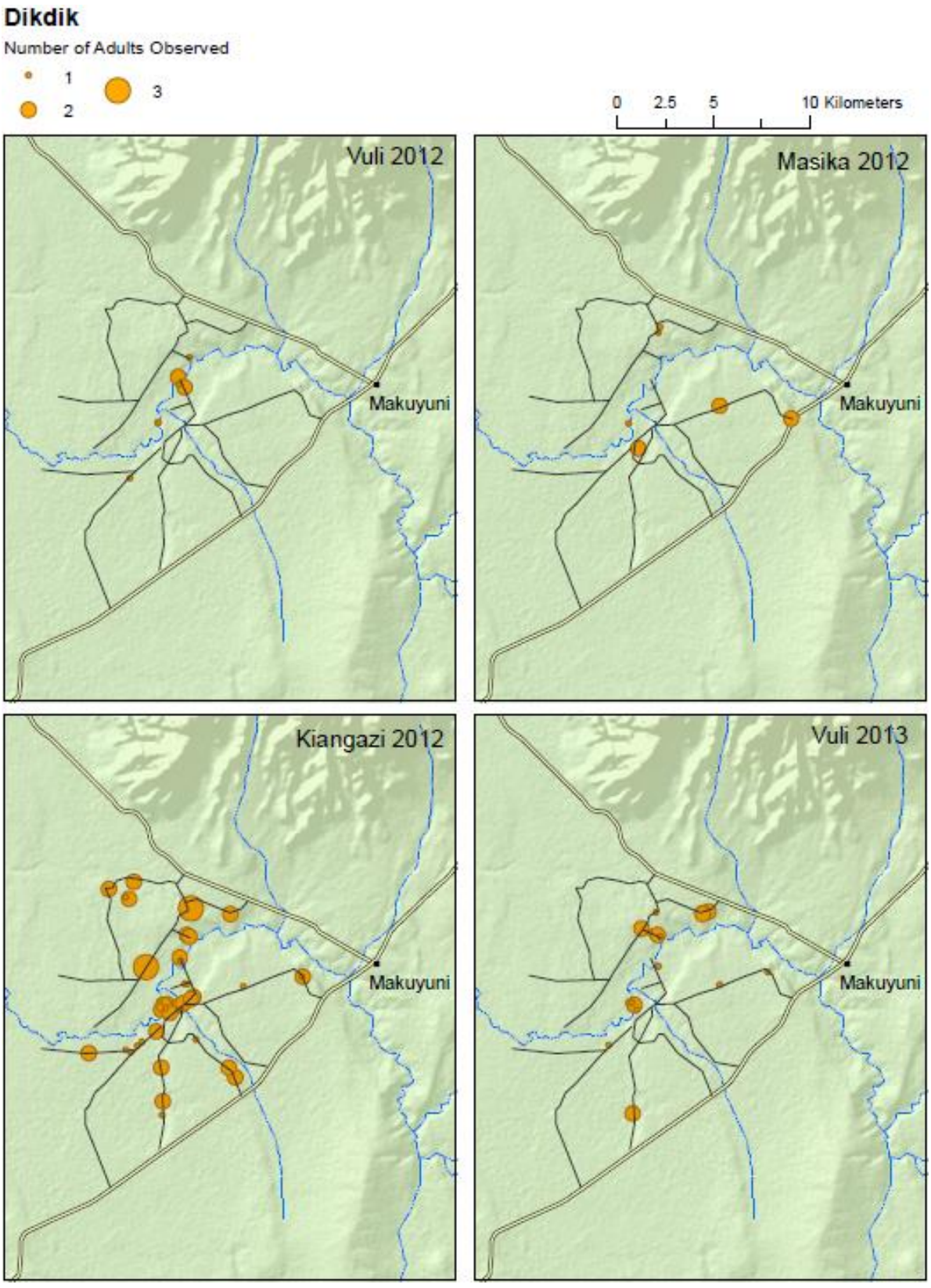
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



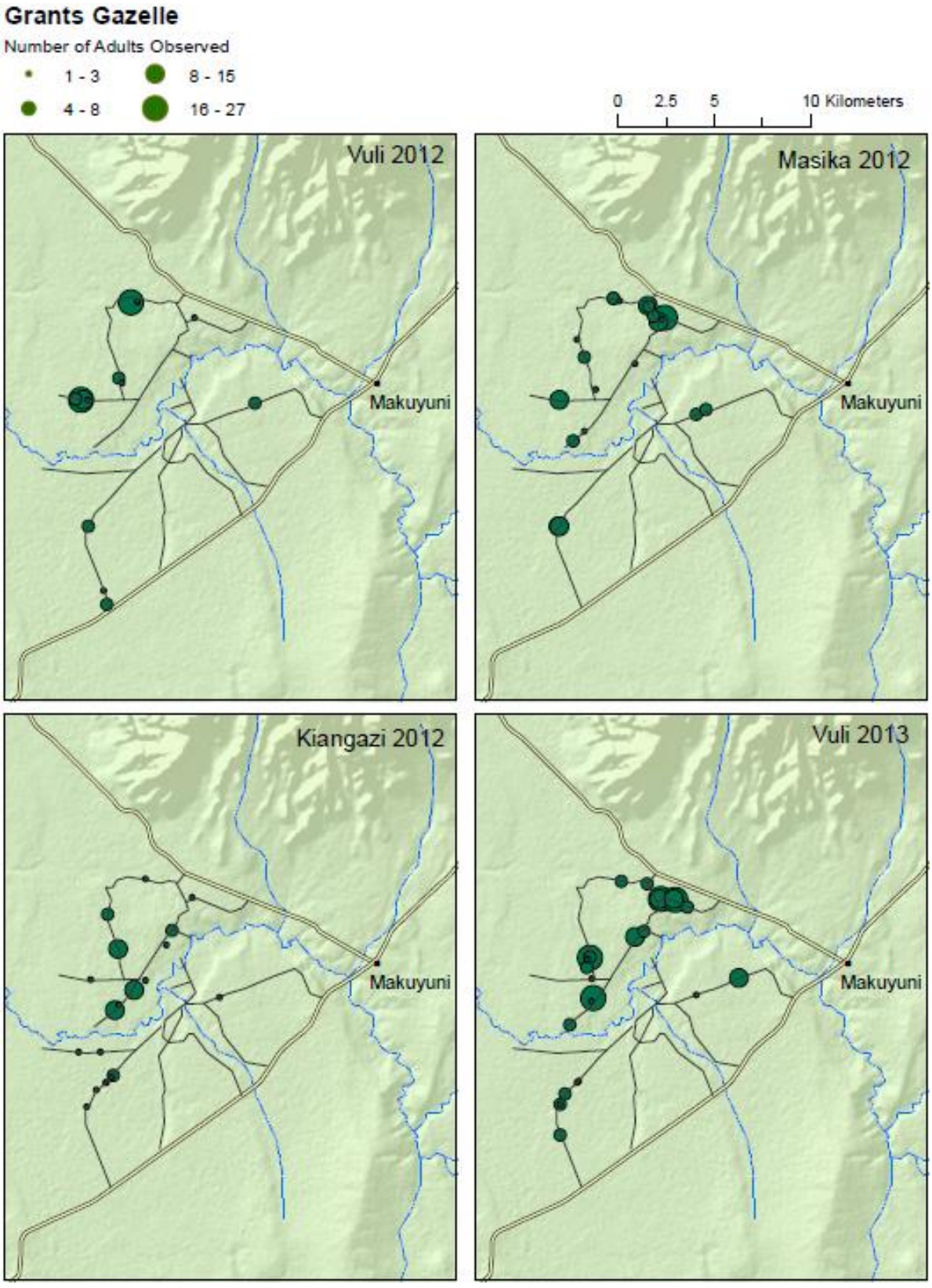
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



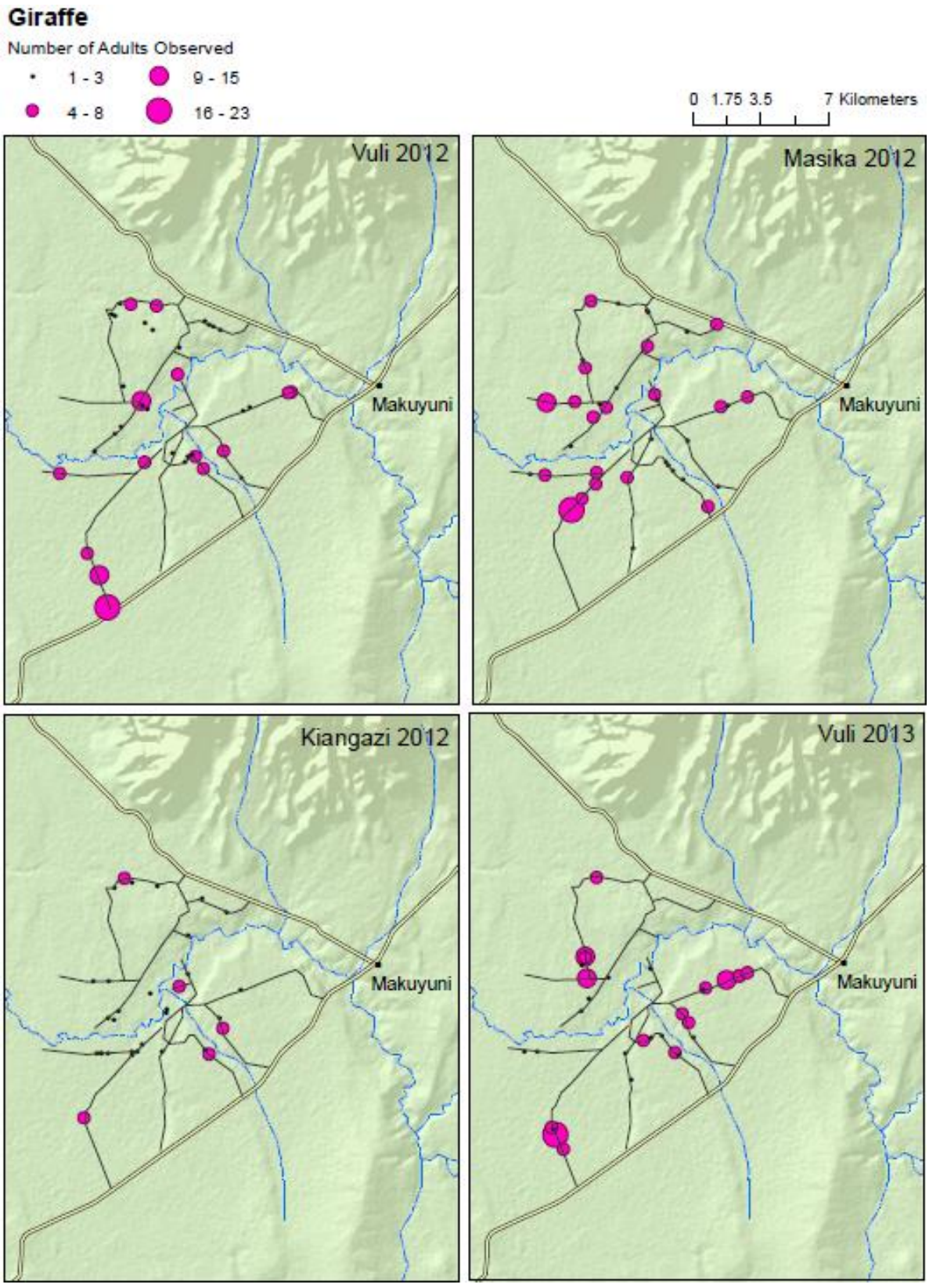
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



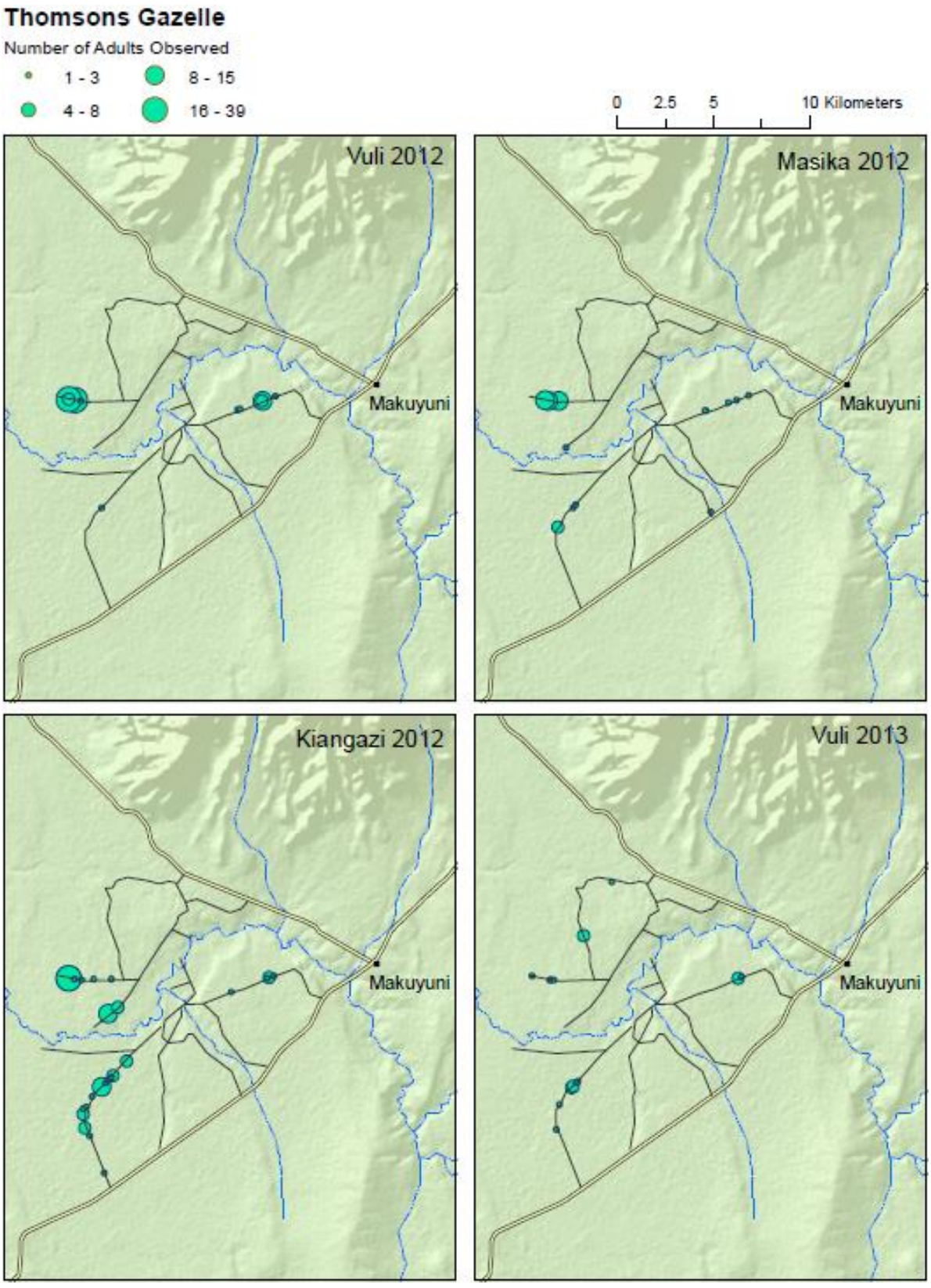
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



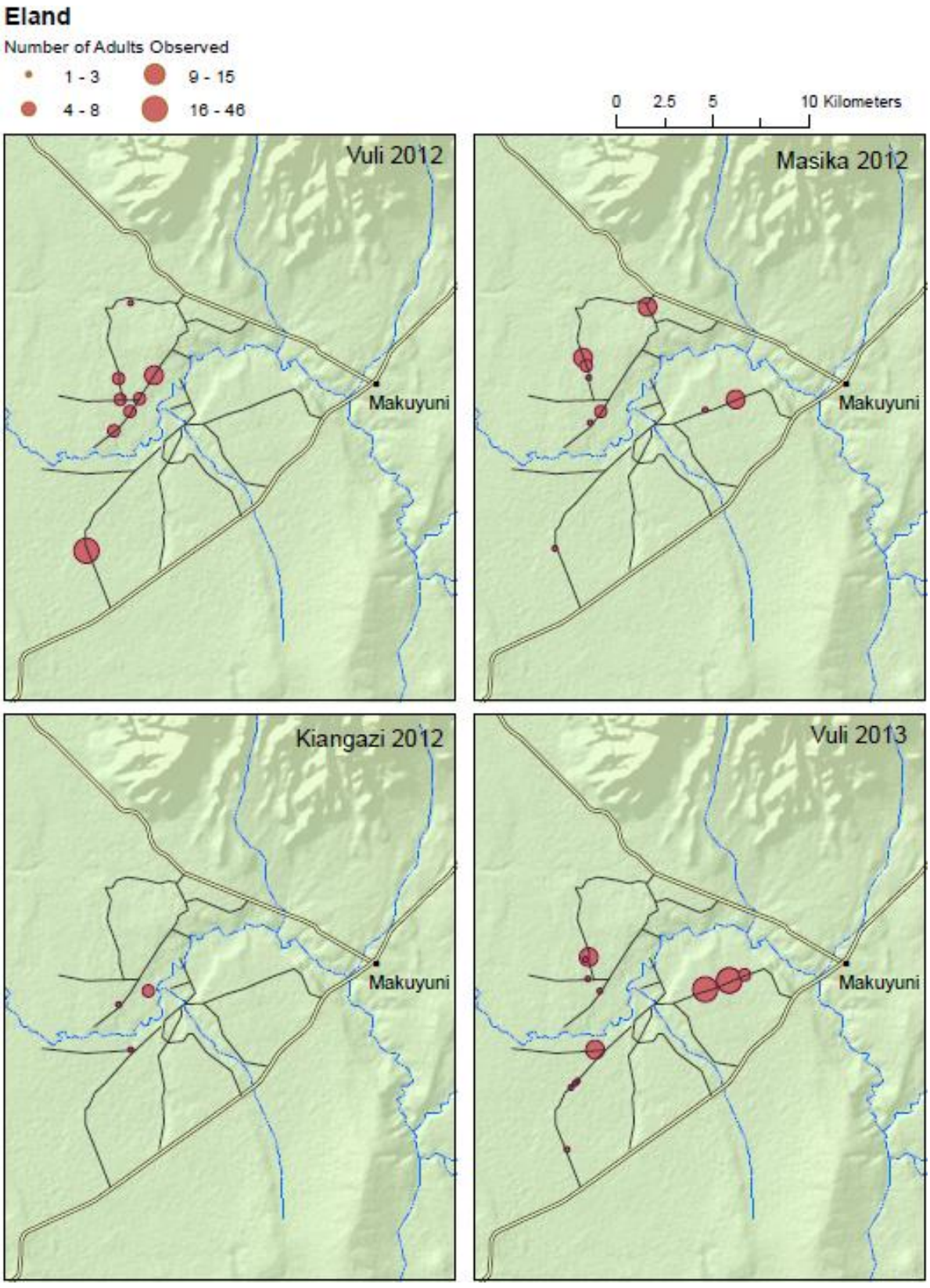
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



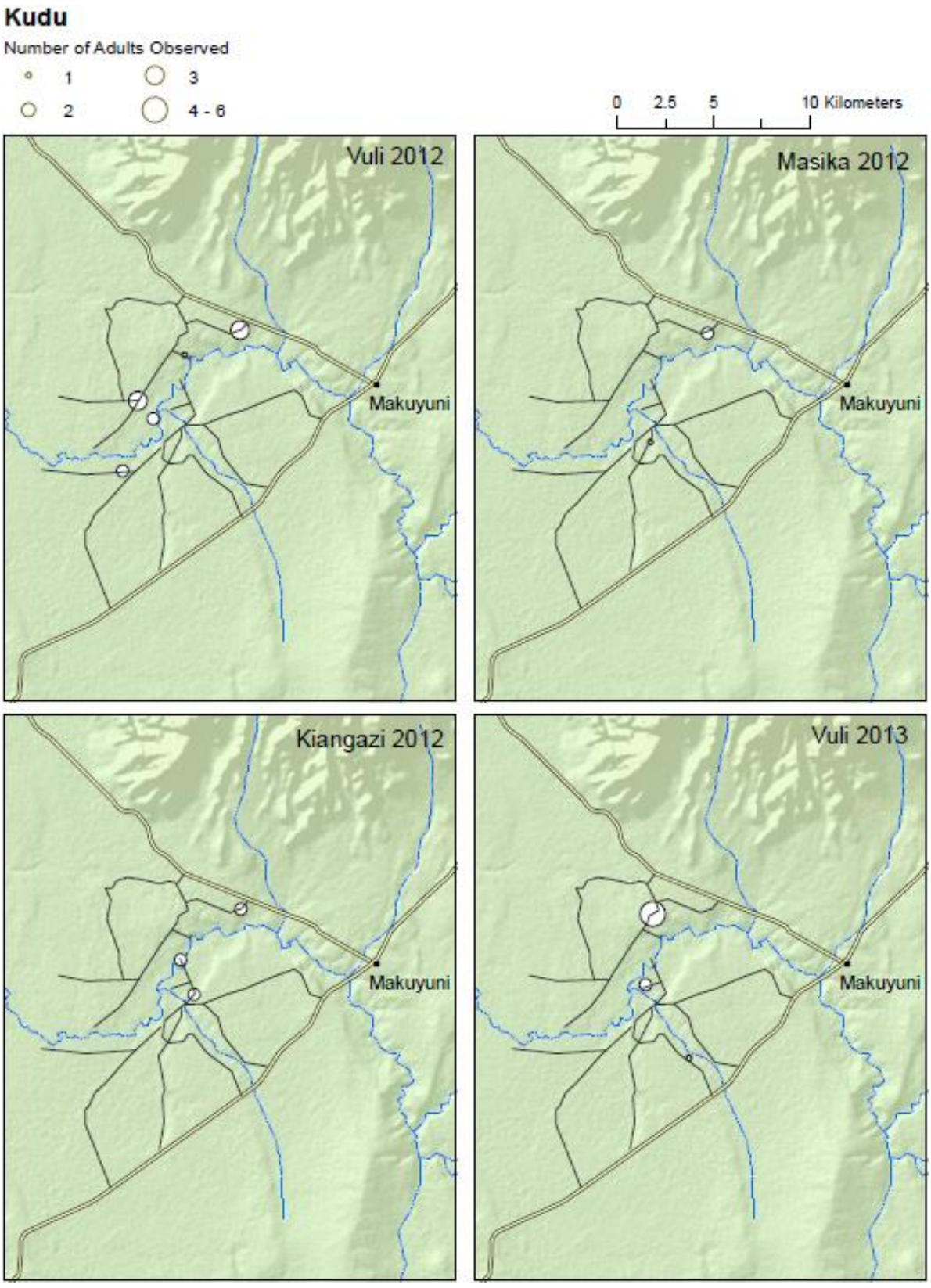
©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



©2013Wild Nature Institute

APPENDIX 1. Seasonal distribution and density maps of large herbivores on Manyara Ranch



©2013Wild Nature Institute