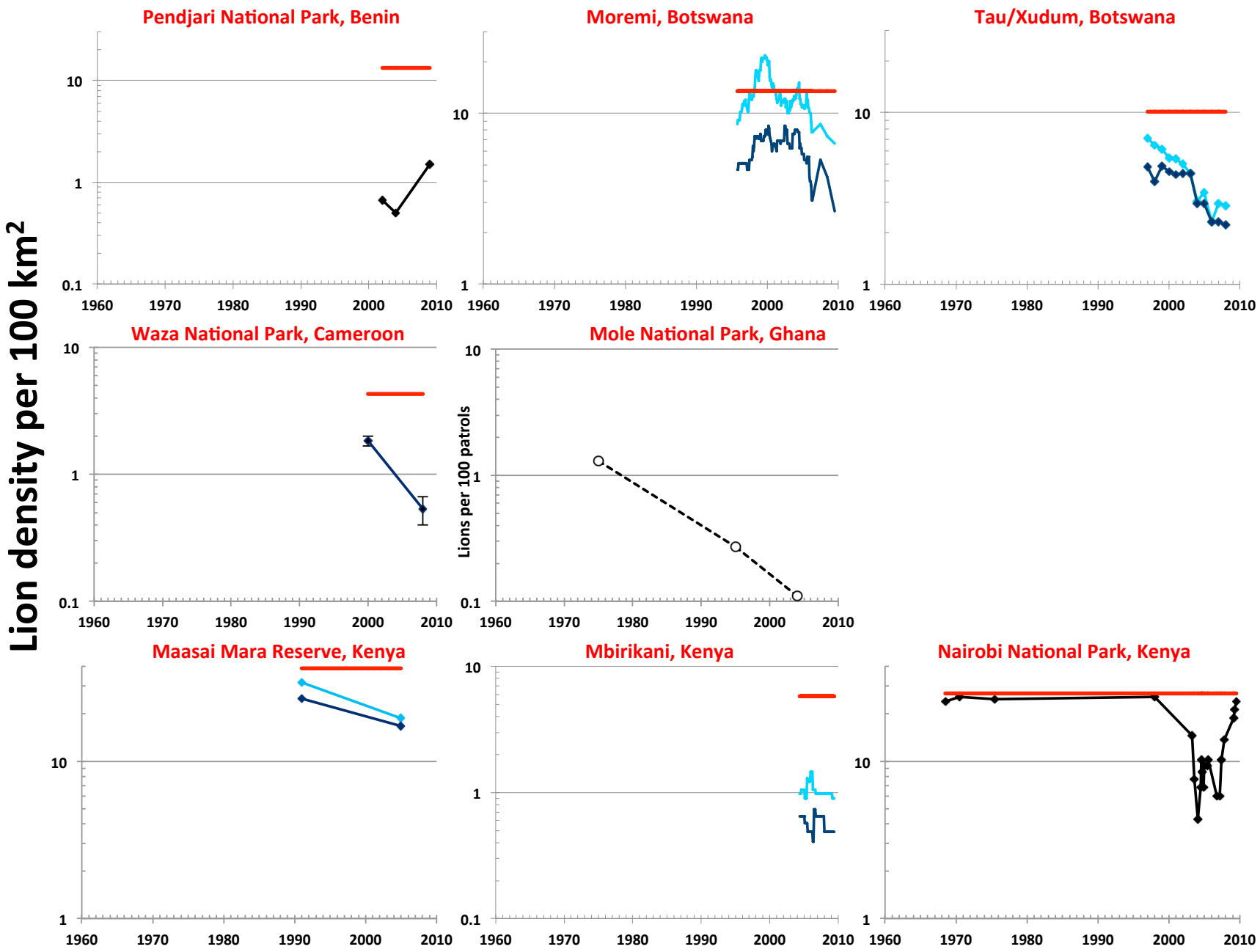
Supporting information

"Conserving large carnivores: dollars and fence."

Fig S1
Table S1
Table S2
Table S3
Table S4
Table S5


Lion density per 100 km²
Pendjari National Park, Benin
Moremi, Botswana
Tau/Xudum, Botswana
Waza National Park, Cameroon
Mole National Park, Ghana
Lions per 100 patrols
Maasai Mara Reserve, Kenya
Mbirikani, Kenya
Nairobi National Park, Kenya
10
1
0.1
1960
1970
1980
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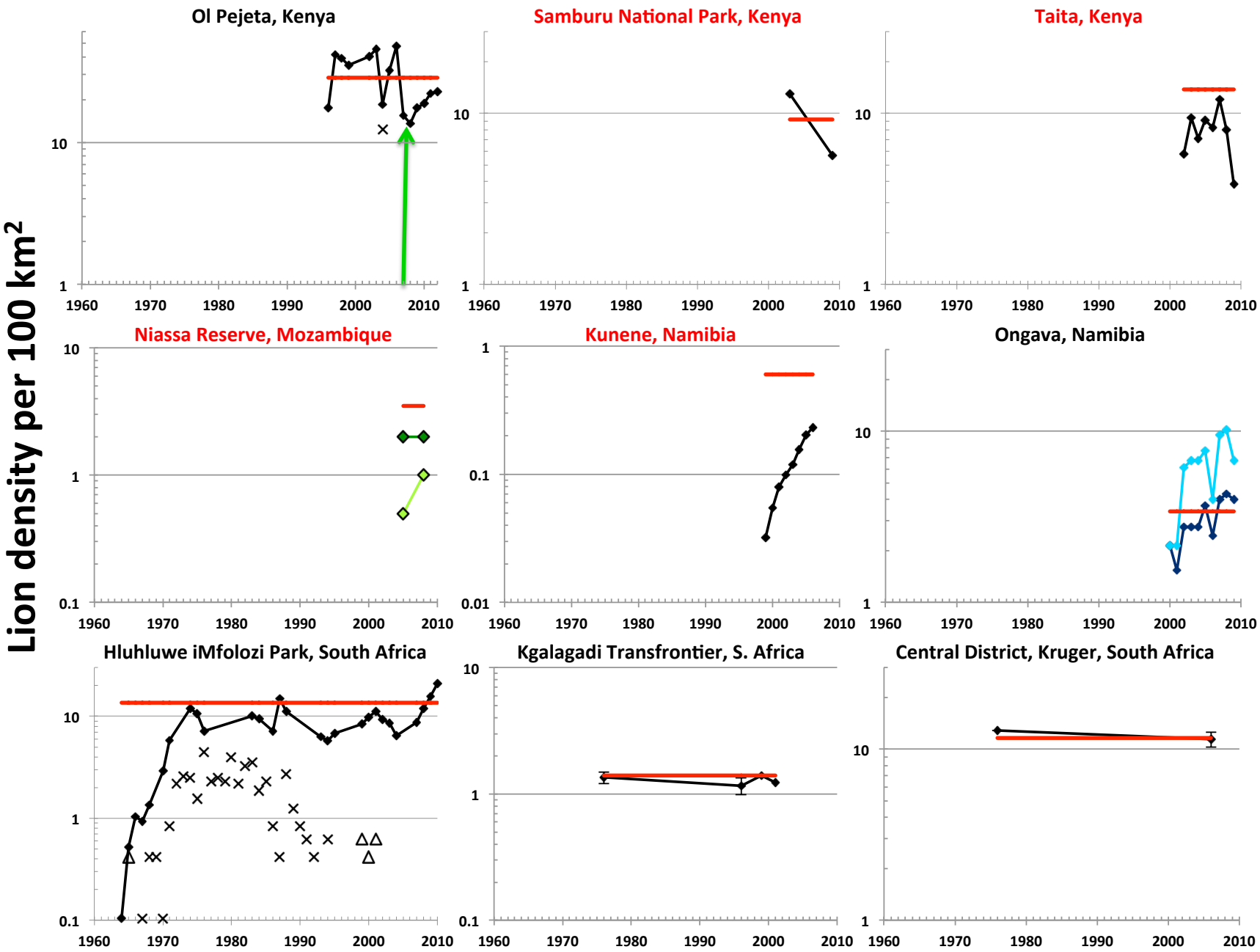
2010


Lion density per 100 km²
Ol Pejeta, Kenya
Samburu National Park, Kenya
Taita, Kenya
Niassa Reserve, Mozambique
Kunene, Namibia
Ongava, Namibia
Hluhluwe iMfolozi Park, South Africa
Kgalagadi Transfrontier, S. Africa
Central District, Kruger, South Africa
1960
1970
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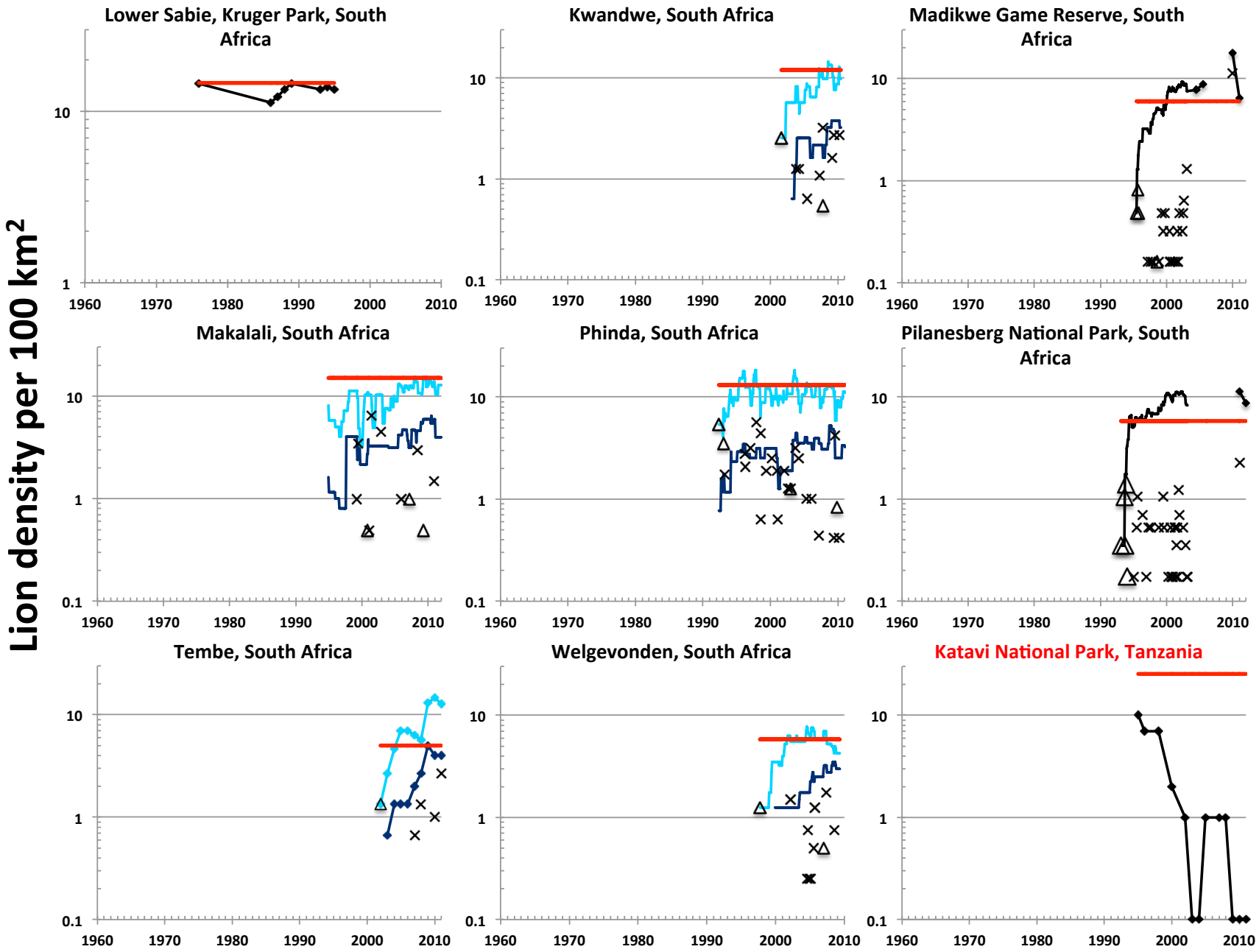
2010


Lion density per 100 km²
Lower Sabie, Kruger Park, South Africa
Kwandwe, South Africa
Madikwe Game Reserve, South Africa
Makalali, South Africa
Phinda, South Africa
Pilanesberg National Park, South Africa
Tembe, South Africa
Welgevonden, South Africa
Katavi National Park, Tanzania
10
1
0.1
1960
1970
1980
1990
2000
2010

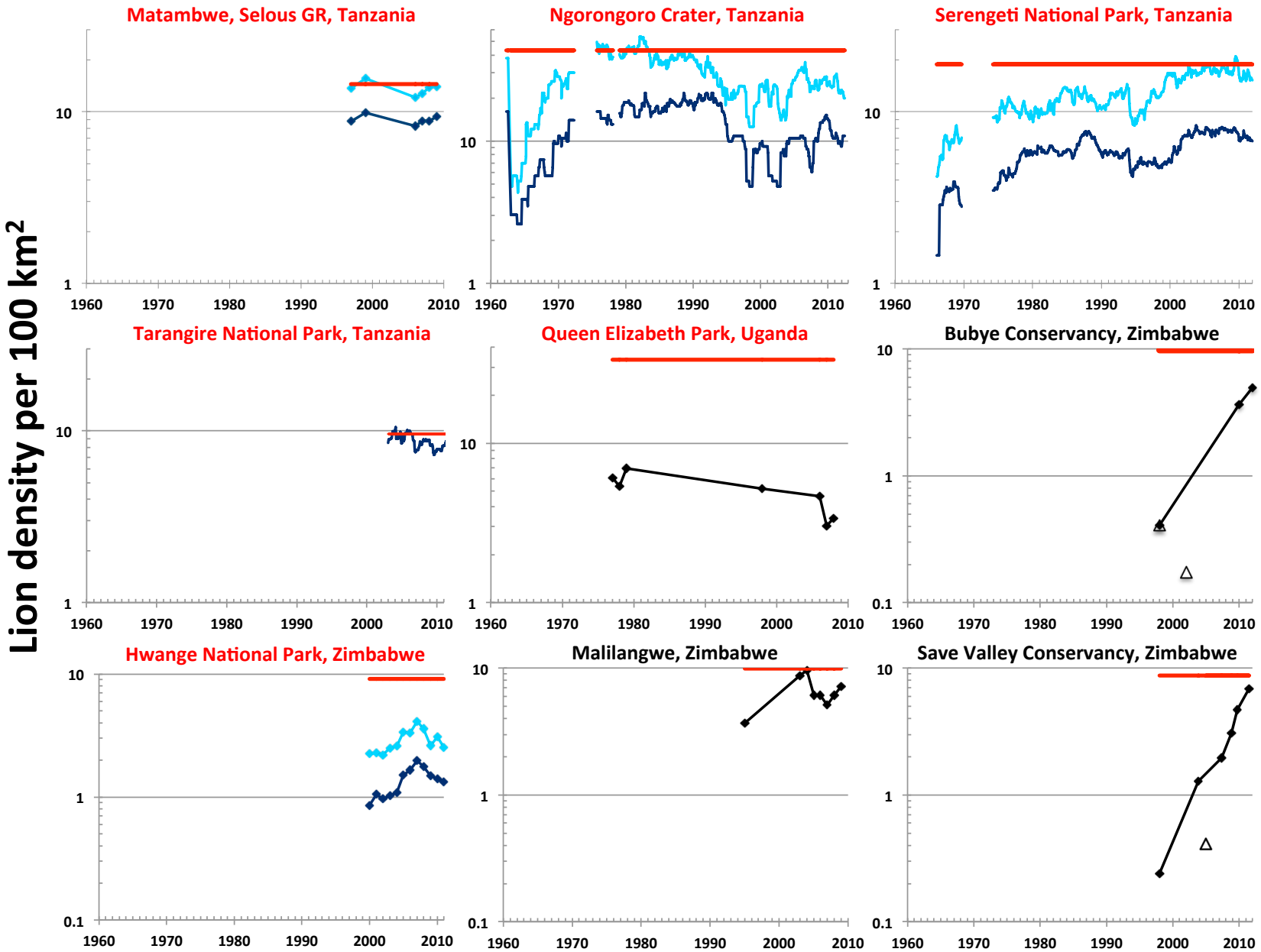


Fig. S1. Lion population sizes. Chart titles are RED for unfenced reserves; BLACK for fenced reserves. Light blue: total population; dark blue: adult population; black: total counts where age structure has not been reported. Markerless lines: monthly totals based on individual recognition. Diamonds: annual counts. Red lines: estimated carrying capacities. Crosses: removals. Open triangles: introductions. Dark green: riparian habitat in Niassa; light green: watershed habitat in Niassa. Vertical green arrow highlights the year when Ol Pejeta was tripled in size. Open circles and dotted line indicate total number of lions encountered per 100 patrols in Mole NP; no carrying capacity is provided since encounter rates cannot be converted to densities. Note that no lions have been encountered during road counts in Katavi NP, Tanzania, in five of the past eight surveys; recent densities in Katavi are arbitrarily set at 0.10 to indicate continued search effort.

Site	Country	Size of PA (km^2)	Hum. Pop. Dens.	Fence	State run	Hunt	Mgmt budget per km^2	Start of 10 yrs	Initial Dens.	Yr of latest survey	Current Density	Predicted Density	Initial/ Predicted	Current/ Predicted	Exp growth rate	Sources
Pendjari NP	Benin	4711	18.08	0	1	0	$130	2001	0.70	2009	1.60	13.0	5.38%	12.31%	0.140	EAS
Moremi GR	Botswana	5000	0.357	0	0	1	-	1999	21.33	2009	6.67	13.2	161.59%	50.53%	-0.086	KN, JWMcN
Tau - Xudum area	Botswana	5000	0.201	0	0	1	-	1999	6.09	2008	2.86	10.0	60.90%	28.60%	-0.102	C&HW
Benoue NP	Cameroon	1980	1.354	0	1	0	$7	-	-	2010	0.36	3.2	-	11.25%	n/a	HHdeI
Bouba Ndjida NP	Cameroon	2114	1.317	0	1	0	$6	-	-	2010	0.63	3.6	-	17.50%	n/a	HHdeI, HBa
Faro NP	Cameroon	3486	1.407	0	1	0	$4	-	-	2010	1.15	13.0	-	8.85%	n/a	HHdeI
Waza NP	Cameroon	1700	4.454	0	1	0	$11	2000	1.83	2008	0.53	4.4	41.59%	12.05%	-0.154	HHdeI, HBa
Mole NP	Ghana	4600	1.445	0	1	0	$43	1995	-	2004	-	7.9	-	-	-0.100*	ACB, Burton *et al.* 2011
Laikipia Dist. (private land)	Kenya	3100	20.68	0	0	0	$1,950	1999	-	2003	6.47	14.8	-	45.63%	-	LF
Maasai Mara NR	Kenya	1530	2.445	0	1	0	$10,131	1991	31.56	2005	18.69	36.6	86.23%	51.07%	-0.037	SMD, BH; Ogutu *et al.* 2011
Mbirikani Group Ranch	Kenya	1230	5.538	0	0	0	$285	2004	0.98	2009	0.89	5.9	16.61%	15.08%	-0.032	LF, SDM
Nairobi NP	Kenya	117	50.71	0	1	0	$7,414	1998	25.64	2009	23.93	25.6	100.02%	93.35%	0.012	WK
Nakuru NP	Kenya	188	492.1	1	1	0	$4,910	2001	-	2011	29.78	26.9	-	110.71%	0.124^	JO
Ol Pejeta Conservancy	Kenya	303	5.694	1	0	0	$1,426	2007@	15.51	2012	22.77	28.5	54.43%	79.90%	0.099	NG, CN
Samburu/BuffaloSprings NR	Kenya	296	3.765	0	1	0	$2,027	2003	7.09	2011	7.77	9.1	77.91%	85.38%	-0.015	SB
Taita Conservancy	Kenya	690	4.140	0	0	0	$290	2002	6.18	2008	2.25	13.5	45.78%	16.67%	-0.123	SMK,BP
Niassa - Riparian	Mozambique	42000	0.363	0	1	1	$123	2005	2.00	2008	2.00	3.6	55.56%	55.56%	0	CMB,KSB
Niassa - Watershed	Mozambique	42000	0.363	0	1	1	$116	2005	0.50	2008	1.00	3.6	13.89%	27.78%	0.231	CMB,KSB
Kunene Conservancy	Namibia	40381	0.297	0	0	1	$90	1999	0.03	2009	0.30	0.60	5.00%	50.00%	0.211	www.desertlion.org
Ongava GR	Namibia	300	0.113	1	0	0	$967	2000	2.15	2009	6.77	3.5	61.43%	193.43%	0.133	KJS
Central district - KNP	South Africa	19485	0.177	1	1	0	$446	-	-	2006	11.45	11.4	-	100.44%	n/a	PF
Hluhluwe iMfolozi Park	South Africa	960	15.91	1	1	0	$3,764	2000	9.79	2010	20.83	13.2	74.18%	157.80%	0.059	DD, RS; Grange *et al.* 2012
Kgalagadi TP	South Africa	36000	0.030	1	1	0	$510	1996	1.16	2001	1.23	15.0	77.33%	82.00%	0.016	PF
Kwandwe PWR	South Africa	185	2.406	1	0	0	$2,567	2001#	2.53	2009	13.51	12.0	21.10%	112.61%	0.165	CB
Lower Sabie - KNP	South Africa	19485	1.798	1	1	0	$6,346	1986	11.30	1995	13.48	14.3	79.02%	94.27%	0.014	PF
Madikwe - GR	South Africa	620	2.004	1	1	0	$4,839	2000#	7.74	2010	17.74	6.0	129.03%	295.70%	0.070	PN, SD
Makalali PWR	South Africa	203	5.120	1	0	0	$938	2000#	10.83	2010	13.81	15.0	72.20%	92.06%	0.062	AD
Phinda PWR	South Africa	246	4.578	1	0	0	$6,543	1999#	12.03	2009	12.28	13.1	91.80%	93.70%	0.155	GB, LH, SN, TD
Pilanesberg NP	South Africa	572	14.87	1	1	0	$3,715	2001#	10.66	2011	11.36	5.8	183.86%	195.90%	0.005	PN, SD
Tembe PWR	South Africa	300	5.337	1	0	0	$690	2002#	1.33	2010	14.67	5.0	26.67%	293.30%	0.244	CH, TB
Welgevonden PWR	South Africa	370	0.625	1	0	0	$4,215	1997#	1.25	2007	7.00	5.8	21.55%	120.69%	0.148	AB
Katavi NP	Tanzania	4471	1.903	0	1	1	$251	2000	10.00	2011	2.53	25.3	39.53%	10.00%	-0.271	TC, JS
Matambwe (Selous GR)	Tanzania	44800	1.035	0	1	0	$242	1999	15.69	2009	14.00	14.3	109.72%	97.90%	-0.015	HBr
Ngorongoro Crater	Tanzania	8288	2.546	0	1	0	$3,621	2002	24.78	2012	22.60	43.1	57.50%	52.50%	0.029	CP
Serengeti NP	Tanzania	14763	1.771	0	1	0	$780	2002	15.64	2012	15.3	18.2	85.98%	84.13%	-0.003	CP
Tarangire NP	Tanzania	2850	3.156	0	1	0	$586	2003	8.55	2010	8.2	9.5	90.00%	86.32%	-0.027	BK, JS
Murchison Falls NP	Uganda	3480	8.293	0	1	0	$318	-	-	2009	3.79	9.0	-	42.11%	n/a	EOO,AP
Ishasha –Q Elizabeth NP	Uganda	1978	37.16	0	1	0	$383	1998	5.18	2008	3.39	31.6	16.39%	10.73%	-0.043	EOO,AP
Bubye Conservancy	Zimbabwe	3440	1.647	1	0	1	$465	1998	0.41	2012	4.94	9.8	4.15%	50.43%	0.180	BL
Hwange NP	Zimbabwe	14600	0.460	0	1	1	$6	2000	1.00	2011	1.70	9.0	11.11%	18.89%	0.020	AL
Malilangwe PWR	Zimbabwe	399	2.475	1	0	1	$1,900	2005#	6.33	2011	9.76	9.8	64.59%	99.59%	0.072	BC
Savé Valley Conservancy	Zimbabwe	2439	4.802	1	0	1	$410	1998	0.24	2011	6.88	8.7	2.76%	79.17%	0.241	RG, CJJ

Table S1. Summary data. GR=Game Reserve, NP=National Park, NR=National Reserve, PWR=Private Wildlife Reserve, TP=Transfrontier Park, KNP=Kruger National Park, PA=Protected Area, SA=Survey Area. Hunt = trophy hunting allowed or known to affect population. Densities are lions per 100 km^2. * densities not available; trend based on decline from initial encounter rate. ^ current density based on total count; population trend based on recurrent transects. # trend calculated between large-scale removals by management. @Reserve size tripled in 2007; trend calculated thereafter. Sources = Initials of authors who monitored each population.

A.C. Burton, E.B. Buedi, C. Balangtaa, D.G. Kpelle, M.K. Sam & J.S. Brashares (2011). The decline of lions in Ghana's Mole National Park. African J. of Ecology, 49: 122-126.

S. Grange, N. Owen-Smith, J.-M. Gaillard, D.J. Druce, M. Moleón & M. Mgobozi (2012). Changes of population trends and mortality patterns in response to the reintroduction of large predators: The case study of African ungulates. Acta Oecologica 42, 16-29.

J.O. Ogutu, N. Owen-Smith, H.P. Piepho & M.Y. Said (2011). Continuing wildlife population declines and range contraction in the Mara region of Kenya during 1977–2009. J. Zool. DOI: 10.1111/j.1469-7998.2011.00818.x

Country	Purchasing Power Parity[1]	Corruption Index[2]	Governance measure (Principal Component 1)[3]	Political Stability[4]	Government Effectiveness[4]	Regulatory Quality[4]	Rule of Law[4]	Control of Corruption[4]	Voice and Accountability[4]
Benin	2.15	0.95	-0.13	0.44	-0.48	-0.36	-0.69	-0.65	0.31
Botswana	1.63	0.99	-3.49	0.91	0.64	0.58	0.64	0.86	0.41
Cameroon	2.15	0.94	1.93	-0.41	-0.81	-0.69	-1.07	-0.92	-1.03
Ghana	1.69	0.98	-1.57	0.16	0.06	0.12	-0.11	0.06	0.50
Kenya	2.18	0.92	1.64	-1.30	-0.66	-0.17	-1.07	-1.11	-0.32
Mozambique	1.73	0.96	-0.24	0.48	-0.34	-0.32	-0.58	-0.41	-0.07
Namibia	1.53	0.98	-2.16	0.80	0.19	0.08	0.26	0.23	0.30
South Africa	1.61	0.98	-2.14	0.02	0.51	0.42	0.06	0.10	0.56
Tanzania	1.88	0.96	-0.01	0.08	-0.42	-0.38	-0.44	-0.42	-0.14
Uganda	2.16	0.94	1.06	-1.06	-0.63	-0.17	-0.43	-0.87	-0.49
Zimbabwe	1.06	0.89	5.12	-1.44	-1.67	-2.29	-1.91	-1.49	-1.55

Table S2. Country scores for purchasing power parity, corruption index and governance measures.

1. The number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a $US would buy in the United States [UNDP (2008) 2007/2008 Human Development Report: 01 Human development index - GDP index. United Nations Development Programme. New York: USA. Available: http://unstats.un.org/unsd/mdg. Accessed 2010 July 15.]) and the real exchange rate between each country's currency and the $US (as at 14 April 2010), providing the cost of the bundle of goods that make up gross domestic product (GDP) across countries (i.e. dollars needed to buy a dollar's worth of goods in the country as compared to the United States)
2. Estimates of the money lost to corruption based on World Bank estimates of the percentage of revenues firms pay in unofficial payments per annum to public officials. As the relevant information was only available for 58 countries, the percentage of revenue scores were correlated with governance measures for the same countries using the Control of Corruption Index of the World Bank The World Bank Group (2010) Worldwide Governance Indicators. The World Bank Group. Berlin: Germany. Available: http://info.worldbank.org/governance/wgi/mc_countries.asp. Accessed 2010 July 15.]. See Garnett et al. (PLoS One paper) for details.
3. Principal component score from Principal Component Analysis of scores for Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption, Voice and Accountability
4. UNDP (2010) International Human Development Indicators. UNDP, New York: USA Available: http://hdr.undp.org/en/data/trends. Accessed 2010 July 15.