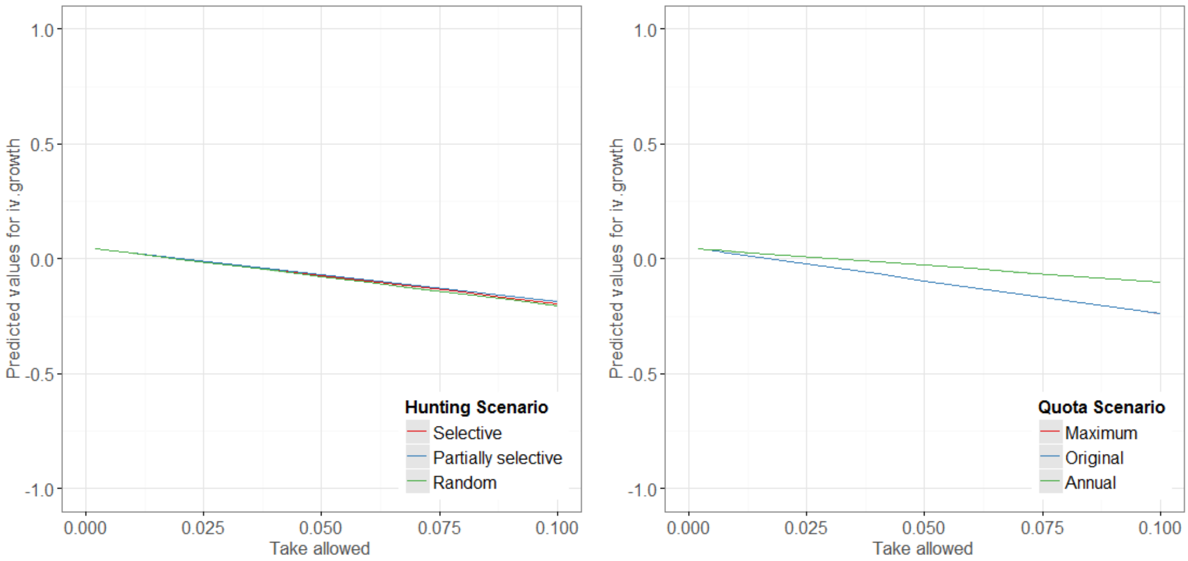

Figure S1. Predicted change in the growth of the harvest (iv.growth) over 100 simulated years depending on take allowed (proportion of the stock) and quota and hunting scenarios. Bands are 95% confidence intervals. Figure S1 is related to Figure 2.

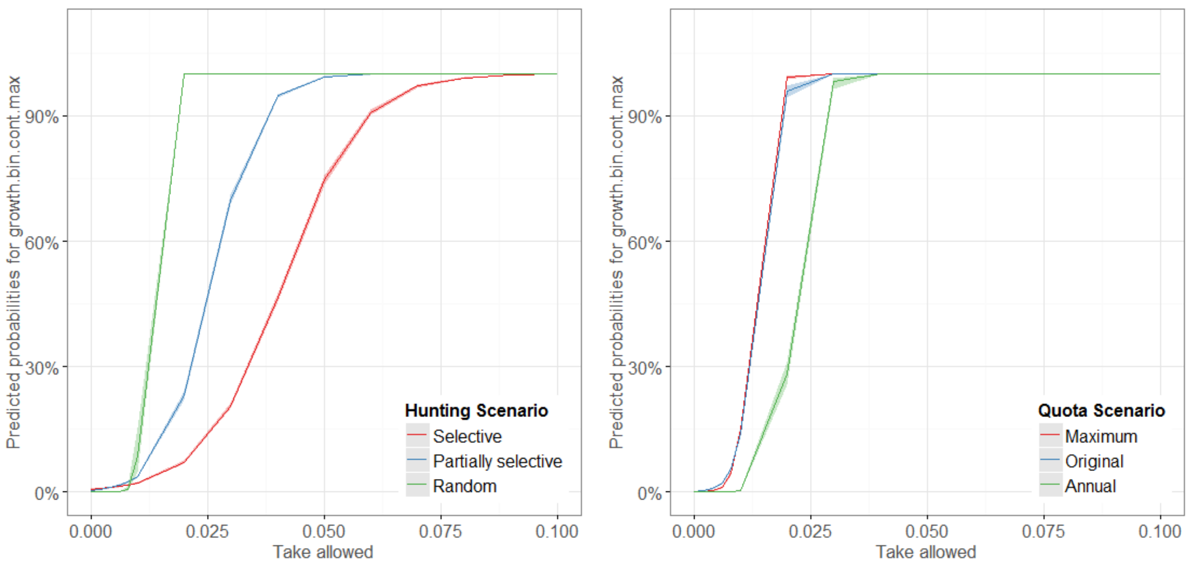

Figure S2. Predicted change in the probability that the population trajectory was significantly reduced (growth.bin.cont.max). Bands are 95% confidence intervals. Figure S2 is related to Figure 2.

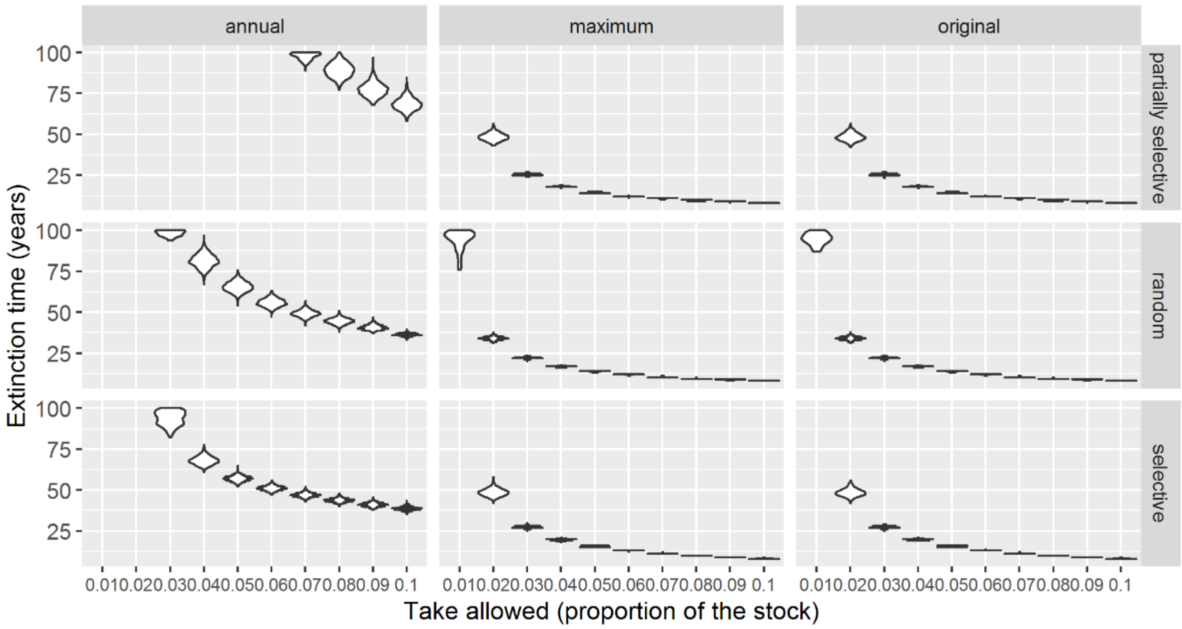

Figure S3. Distribution of observed time it takes populations to go extinct for each hunting (Partially selective, Selective, and Random) and quota (Annual, Original, Maximum) scenarios and allowed take level. Figure S3 is related to Figure 2.

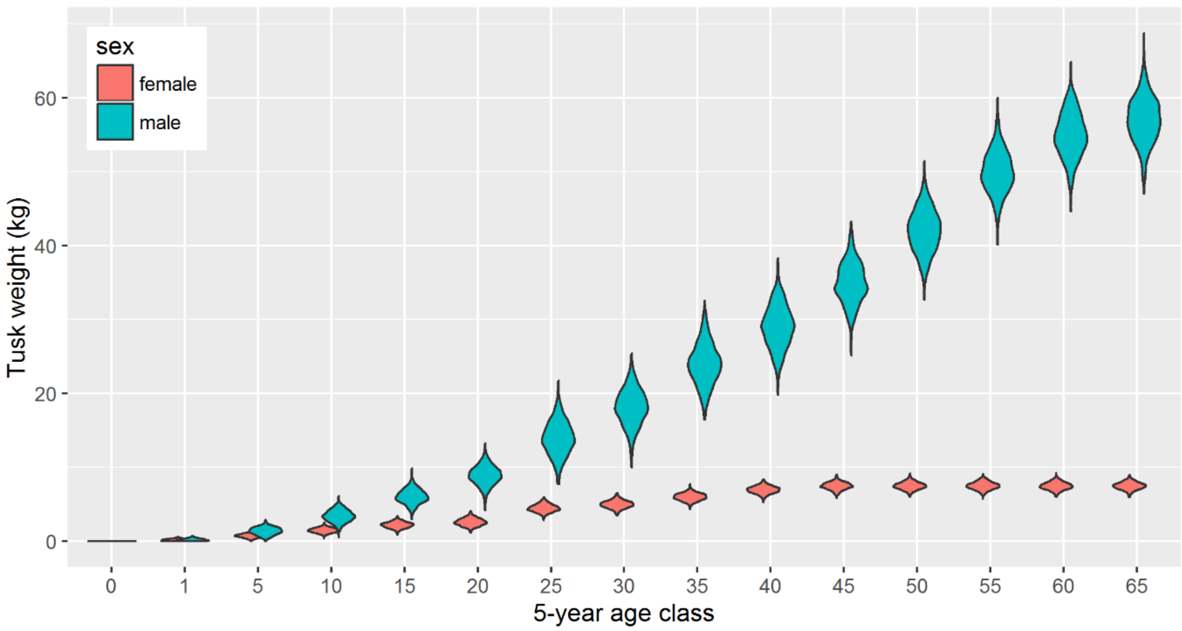

Figure S4. Distribution of simulated tusk weight from which harvested tusks were randomly drawn for each age/sex class. For each age/sex class tusk weight was drawn from a normal distribution with mean and variance estimated from [S4]. For each kill, we retrieved 1.8 times this tusk weight to account for two tusks per individual as well as breakage (e.g., see Figure 1B). This is a conventional correction factor. Figure S4 is related to Figure 1.

Table S1. Fitted general linear model details used to predict ivory harvest growth over 100 simulated years. Table S1 is related to Figure 2.

Factor	Deviance	df	F	P
Take	802.2	1	829623	<0.0001
Quota definition	111.2	2	57525	<0.0001
Hunting strategy	1.1	2	560	<0.0001
Take : Quota definition	66.4	2	34332	<0.0001
Take : Hunting strategy	0.9	2	435	<0.0001
Quota definition : Hunting strategy	19.4	4	5005	<0.0001
Take : Quota definition : Hunting strategy	19.4	4	5018	<0.0001

(R^2=0.89, n=135000, 1000 samples for each combination of take level, quota definition and hunting strategy). ':' denotes an interaction term.

Table S2. Fitted generalised linear model (binomial error distribution) details used to predict the probability that the population trajectory was significantly affected by the harvest. Table S2 is related to Figure 2.

Factor	Deviance	df	X^2	p
Take	119411	1	67356	<0.0001
Quota definition	138	2	67219	<0.0001
Hunting strategy	149149	2	52270	<0.0001
Take : Quota definition	2479	2	49791	<0.0001
Take : Hunting strategy	11254	2	38537	<0.0001
Quota definition : Hunting strategy	613	4	37923	<0.0001
Take : Quota definition : Hunting strategy	140	4	37783	<0.0001

Measured as the likelihood that the upper 95% confidence interval of achieved population growth over 100 simulated years for a given take level is lower than the lower 95% confidence interval of achieved population growth over 100 simulated years when no harvest was taking place (R^2=0.72, n=135000, 1000 samples for each combination of take level, quota definition and hunting strategy). ':' denotes an interaction term.

Table S3. mean and sd survival estimates for each sex-age class. Table S3 is related to Figure 1.

	0	1-5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+
Male															
Survival															
$mean_{surv}$	0.837	0.832	0.943	0.963	0.9188	0.927	0.928	0.893	0.882	0.831	0.787	0.895	0.800	0.429	0.300
sd_{surv}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fertility															
$mean_{fert}$	0	0	0	0	0	0.1	0.75	2	3	4	4	3	3	3	3
sd_{fert}						0.01	0.4	0.75	1	1.5	1.5	1.5	1.5	1.5	1.5
Female															
Survival															
$mean_{surv}$	0.897	0.967	0.954	0.969	0.957	0.964	0.926	0.912	0.855	0.789	0.748	0.678	0.680	0.647	0.333
sd_{surv}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fertility															
$mean_{fert}$	0	0	0.003	0.135	0.207	0.200	0.221	0.200	0.201	0.204	0.183	0.177	0.149	0.039	0
sd_{fert}			0.006	0.075	0.017	0.019	0.038	0.009	0.023	0.030	0.057	0.072	0.058	0.068	

SUPPLEMENTAL EXPERIMENTAL PROCEDURES

Population matrix model

We used a population matrix composed of 15 female age classes and 15 male age classes to determine the abundance of the elephant population at time t+1 ($\mathbf{n}_{t+1}$) given its abundance at time t. Abundance, **n,** is a vector of 30 elements each representing counts for each age-sex class. We separated the first year as a class because of the differential in survival, so that the second age class had 4 years. Transition probabilities for those age classes were changed accordingly.

$$\boldsymbol{n_t} = \begin{pmatrix} m_0 \\ m_1 \\ m_5 \\ m_{10} \\ m_{15} \\ m_{20} \\ m_{25} \\ m_{30} \\ m_{35} \\ m_{40} \\ m_{45} \\ m_{50} \\ m_{55} \\ m_{60} \\ m_{65} \\ fe_0 \\ fe_1 \\ fe_5 \\ fe_{10} \\ fe_{15} \\ fe_{20} \\ fe_{25} \\ fe_{30} \\ fe_{35} \\ fe_{40} \\ fe_{45} \\ fe_{50} \\ fe_{55} \\ fe_{60} \\ fe_{65} \end{pmatrix}_t \text{ and } \boldsymbol{n_1} = \begin{pmatrix} 48 \\ 111 \\ 120 \\ 119 \\ 68 \\ 65 \\ 20 \\ 16 \\ 16 \\ 9 \\ 9 \\ 9 \\ 2 \\ 1 \\ 0 \\ 44 \\ 104 \\ 127 \\ 127 \\ 84 \\ 80 \\ 42 \\ 41 \\ 41 \\ 13 \\ 12 \\ 12 \\ 12 \\ 5 \\ 2 \end{pmatrix}$$

taken from the pre-drought 2006 census for the Amboseli population, a period when the population was in very good demographic health.

The population was projected for 100 years:

$$
n_{t+1} = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0.5f_{m,20} & 0.5f_{m,25} & 0.5f_{m,30} & 0.5f_{m,35} & 0.5f_{m,40} & 0.5f_{m,45} & 0.5f_{m,50} & 0.5f_{m,55} & 0.5f_{m,60} & 0.5f_{m,65} & 0 & 0 & 0.5f_{f,5} & 0.5f_{f,10} & 0.5f_{f,15} & 0.5f_{f,20} & 0.5f_{f,25} & 0.5f_{f,30} & 0.5f_{f,35} & 0.5f_{f,40} & 0.5f_{f,45} & 0.5f_{f,50} & 0.5f_{f,55} & 0.5f_{f,60} & 0.5f_{f,65} \\
t_{m,0} & s_{m,1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & t_{m,1} & s_{m,5} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & t_{m,5} & s_{m,10} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & t_{m,10} & s_{m,15} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & t_{m,15} & s_{m,20} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & t_{m,20} & s_{m,25} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & t_{m,25} & s_{m,30} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,30} & s_{m,35} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,35} & s_{m,40} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,40} & s_{m,45} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,45} & s_{m,50} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,50} & s_{m,55} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,55} & s_{m,60} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{m,60} & s_{m,65} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0.5f_{m,20} & 0.5f_{m,25} & 0.5f_{m,30} & 0.5f_{m,35} & 0.5f_{m,40} & 0.5f_{m,45} & 0.5f_{m,50} & 0.5f_{m,55} & 0.5f_{m,60} & 0.5f_{m,65} & 0 & 0 & 0.5f_{f,5} & 0.5f_{f,10} & 0.5f_{f,15} & 0.5f_{f,20} & 0.5f_{f,25} & 0.5f_{f,30} & 0.5f_{f,35} & 0.5f_{f,40} & 0.5f_{f,45} & 0.5f_{f,50} & 0.5f_{f,55} & 0.5f_{f,60} & 0.5f_{f,65} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,0} & s_{f,1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,1} & s_{f,5} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,5} & s_{f,10} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,10} & s_{f,15} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0t_{f,15} & s_{f,20} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,20} & s_{f,25} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,25} & s_{f,30} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,30} & s_{f,35} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,35} & s_{f,40} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,40} & s_{f,45} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,45} & s_{f,50} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,50} & s_{f,55} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,55} & s_{f,60} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & t_{f,60} & s_{f,65}
\end{pmatrix} \cdot \begin{pmatrix} m_0 \\ m_1 \\ m_5 \\ m_{10} \\ m_{15} \\ m_{20} \\ m_{25} \\ m_{30} \\ m_{35} \\ m_{40} \\ m_{45} \\ m_{50} \\ m_{55} \\ m_{60} \\ m_{65} \\ fe_0 \\ fe_1 \\ fe_5 \\ fe_{10} \\ fe_{15} \\ fe_{20} \\ fe_{25} \\ fe_{30} \\ fe_{35} \\ fe_{40} \\ fe_{45} \\ fe_{50} \\ fe_{55} \\ fe_{60} \\ fe_{65} \end{pmatrix}_t
$$

Where $s_{sex,age}$ is the fraction of surviving individuals from an age-sex class staying in that age-sex class and $t_{sex,age}$ is the proportion of surviving individuals from an age-sex class growing to the new age class. $f_{sex,age}$ is the fertility of surviving individuals from an age-sex class. Sex-ratio at birth was estimated to be 50:50 [S1] hence each age-sex class contributed 0.5 $f_{sex,age}$ to female and male 0-age class.

Each year demographic rates were drawn from their distributions. Beta distributions for transition and survival probabilities:
$t_{sex,0} = B(mean_{surv\ sex,0}, sd_{surv\ sex,0})$
$s_{sex,1} = 0.75 \cdot B(mean_{surv\ sex,1}, sd_{surv\ sex,1})$; $t_{sex,1} = 0.25 \cdot B(mean_{surv\ sex,1}, sd_{surv\ sex,1})$
$s_{sex,age>1} = 0.8 \cdot B(mean_{surv\ sex,age}, sd_{surv\ sex,age})$; $t_{sex,age} = 0.2 \cdot B(mean_{surv\ sex,age}, sd_{surv\ sex,age})$

where B is a Beta distribution defined by survival probability means and standard deviations (sd) estimated from the Amboseli population (Table S3).

We used density-dependent birth functions to estimate the fertility rates [S2,S3]:
Fertilities were first drawn randomly each year from a beta (for females) and lognormal (for males) distributions with parameters estimated from the Amboseli population (Table 1):

$$F_{f,age} = B\left(mean_{fert\ f,age}, sd_{fert\ f,age}\right)$$
$$F_{m,age} = log\mathcal{N}\left(mean_{fert\ m,age}, sd_{fert\ m,age}\right)$$

We used a per capita harmonic function [2,3] which also accounted for differences in fertility between age classes so that our fertility rates were:

$$f_{f,age} = F_{f,age} \cdot \frac{\sum_{i=20}^{65} F_{m,i} m_i}{\sum_{i=20}^{65} F_{m,i} m_i + \frac{\sum_{i=5}^{60} F_{f,i} fe_i}{\frac{\sum_{i=20}^{65} F_{m,i} m_i}{\sum_{i=20}^{65} m_i} \Big/ \frac{\sum_{i=5}^{60} F_{f,i} fe_i}{\sum_{i=5}^{60} fe_i}}}$$

$$f_{m,age} = F_{m,age} \cdot \frac{\sum_{i=5}^{60} F_{f,i} fe_i}{\sum_{i=20}^{65} F_{m,i} m_i + \frac{\sum_{i=5}^{60} F_{f,i} fe_i}{\frac{\sum_{i=20}^{65} F_{m,i} m_i}{\sum_{i=20}^{65} m_i} \Big/ \frac{\sum_{i=5}^{60} F_{f,i} fe_i}{\sum_{i=5}^{60} fe_i}}}$$

Simulations were implemented in R. Beta distributed random number were drawn using mean and sd estimates using the beta distribution function in the `popbio` library [S5]

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