Supporting Information

Reserve size, dispersal and population viability of wide ranging carnivores: the case of jaguars in Emas National Park, Brazil

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Table S1 Parameters used for the PVA models, including their sources.

Parameter	Value	Distribution	Source
INITIAL POPULATION SIZE			
Closed population simulations	10-700	Fixed	Arbitrary to suppress extinction risk to zero
Open population simulations	10-60	Fixed	This study
IMMIGRATION			
Net immigration	0-10	Poisson	Miller, 2013
Immigration sex ratio (proportion of males)	0.5 – 0.95	Binomial	Miller, 2013
INITIAL POPULATION STRUCTURE[1]			
Subadult (1-2 years)	0.24	Fixed	Desbiez *et al.* 2012; de Paula *et al.* 2010
Adult (2-9 years), female	0.33	Fixed	Desbiez *et al.* 2012; de Paula *et al.* 2010
Adult (2-9 years), male	0.33	Fixed	Desbiez *et al.* 2012; de Paula *et al.* 2010
Old (10+ years), female	0.05	Fixed	Desbiez *et al.* 2012; de Paula *et al.* 2010
Old (10+ years), male	0.05	Fixed	Desbiez *et al.* 2012; de Paula *et al.* 2010
SURVIVAL			
Juvenile (0-1 year)	0.75	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Subadult (1-2 years)	0.8	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Adult (2-9 years), female	0.93	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Adult (2-9 years), male	0.86	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Old (10+ years), female	0.10	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Old (10+ years), male	0.10	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
FECUNDITY			
Litter frequency	0.5	Binomial	Desbiez *et al.* 2012; de Paula *et al.* 2010
Litter size	2	Poisson	Desbiez *et al.* 2012; de Paula *et al.* 2010

1) Initial number of juveniles were calculated using the fecundity parameters given above

Appendix S1 Pseudo code for an age and sex structured matrix based population viability model using the R language.

```
# Basic model parameters
simn #number of simulation runs
years #number of simulated years

# Demographic parameters
jaguar.p1 #initial population size
imm #net number of immigrants
imm.sr # immigrant males, expressed as % of total net imigrants
s.juv #annual juvenile survival
s.sub #annual subadult survival
s.adm #annual adult male survival
s.adf #annual adult female survival
s.old #annual survival of old animals
litter.freq # average number of litters per female and year
litter.size # average litter size

#Summary tables
pva.table<-matrix(ncol=2,nrow=simn)
pva.sum<-matrix(ncol=7,nrow=simn,dimnames=list(NULL,c("start.j","end.j","start.ad","end.ad",
        "decl","decl.half","ext")))

#start of sim loop
N<-1
while(N<=simn){

#initial pop
Year<-2
jaguars<-matrix(ncol=21,nrow=years,dimnames=list(NULL,c("j","saf","sam","adf1","adf2","adf3",
        "adf4","adf5","adf6","adf7","adf8","adm1","adm2","adm3","adm4","adm5","adm6",
        "adm7","adm8","oldf","oldm")))
jaguar.old<-round(jaguar.p1*0.1)
jaguar.oldm<-round(jaguar.old*0.5)
jaguar.oldf<-jaguar.old-jaguar.oldm
jaguar.ad<-round(jaguar.p1*0.66)
jaguar.adm<-round(jaguar.ad*0.5)
jaguar.adf<-jaguar.ad-jaguar.adm
jaguar.sub<-jaguar.p1-jaguar.old-jaguar.ad
jaguar.subm<-round(jaguar.sub*0.5)
jaguar.subf<-jaguar.sub-jaguar.subm
jaguar.j<-round(jaguar.adf*0.5*2)

tmp<-c(jaguar.j,jaguar.subf,   jaguar.subm,rep(round(jaguar.adf/8),7),jaguar.adf-
    sum(rep(round(jaguar.adf/8),7)),rep(round(jaguar.adm/8),7),jaguar.adm-
    sum(rep(round(jaguar.adm/8),7)),jaguar.oldf,jaguar.oldm)
tmp[tmp<0]<-0
jaguars[1,]<-tmp

#start of year loop
while(Year<=years){
```

```
#juvs
if(sum(jaguars[Year-1,4:11])<1)
jaguars[Year,1]<-0
        else{
          tmp.litters<-rbinom(sum(jaguars[Year-1,4:11]),1,litter.freq)
          tmp.ls<-rpois(sum(jaguars[Year-1,4:11]),litter.size)
          tmp.ls[tmp.ls<1]<-1
          tmp.ls[tmp.ls>4]<-4
jaguars[Year,1]<-sum(tmp.litters*tmp.ls)}

#subs
if(jaguars[Year-1,1]<1){
        jaguars[Year,2]<-0
        jaguars[Year,3]<-0}
else{
        tmp.sub<-rbinom(1,jaguars[Year-1,1],s.juv)
jaguars[Year,2]<-round(tmp.sub*0.5)
jaguars[Year,3]<-tmp.sub-jaguars[Year,2]}

#ad females
jaguars[Year,4]<-0
jaguars[Year,4]<-rbinom(1,jaguars[Year-1,2],s.sub)
jaguars[Year,5:11]<-rbinom(7,jaguars[Year-1,5:11],s.adf)

#ad males
jaguars[Year,12]<-rbinom(1,jaguars[Year-1,2],s.sub)
jaguars[Year,13:19]<-rbinom(7,jaguars[Year-1,13:19],s.adm)

#old animals
jaguars[Year,20]<-rbinom(1,(jaguars[Year-1,11]+jaguars[Year-1,20]),s.old)
jaguars[Year,21]<-rbinom(1,(jaguars[Year-1,19]+jaguars[Year-1,21]),s.old)

#immigrants
imm.males<-rbinom(1,imm,imm.sr)
imm.females<-imm-imm.males
jaguars[Year,4]<-jaguars[Year,4]+imm.females
jaguars[Year,12]<-jaguars[Year,12]+imm.males

Year<-Year+1} #End of year loop

pva.sum[N,1]<-jaguars[1,1]
pva.sum[N,2]<-jaguars[50,1]
pva.sum[N,3]<-sum(jaguars[1,2:21])
pva.sum[N,4]<-sum(jaguars[50,2:21])
pva.sum[N,5]<-as.numeric(sum(jaguars[50,3:21])<(jaguar.p1))
pva.sum[N,6]<-as.numeric(sum(jaguars[50,3:21])<(jaguar.p1/2))
pva.sum[N,7]<-as.numeric(sum(jaguars[50,3:21])<2)

N<-N+1} #end of sim loop
return(pva.sum)
```