

Free Roaming Cat Population Model Literature Review Matrix
as of March 2013

	Basic Attributes						Population			Demography		Breeding			Comments	
	Reviewer(s)	Study area	Seasonality (S, W, A)	Supplementation (Y, N, Unk)	Ownership (O, U, B, Unk)	Setting (R, U, S, M, Unk)	Density / population size	E/immigration	Area requirements / metapopulation structure	Mortality / survival	Sex ratio	Breeding ages	Fecundity	Breeding system / density dependence	Study description	Comments
Anderson et al. 2004	Lawler		A	Unk	U	U			50-75% juvenile survival (to adulthood?)	Even at birth	212 days @ initial breeding, 2-3 yrs avg max	1.1 - 2.1 litters / female / yr; avg litter size ~ 3.7. A given female produces 1.98 - 3.78 female kittens / yr on avg.	All males in breeding pool	Matrix model for euthanasia vs TNR		
Baker et al. 2005	Boone	England	A	Y	O	U	229 / km2								Density in this case is based purely on number of owned, self-reported cats; no field measurement	
Beaver 2003	Lloyd table	Laboratory									Male initial breeding @ 12 - 14 mo, females @ 15 - 18 mo.					
Brothers et al. 1985	Lloyd table	Macquarie Island							Monthly juv. survival 0.964			Litters / mo for March - May (or S. Hemisphere inverse?) 0.31; for off season months, 0.075. Avg litter size 3.0				
Budke et al. 2009	Lawler								Juv. survival to age 1 yr, 0.27 - 0.73; adult survival 0.55-0.78 (time unit?)	Even at birth	212-300 days @ initial breeding, mean 3 yr. max breeding age	1.1 - 2.1 litters / female / yr; avg litter size ~ 3.7		Matrix Model		
Castillo and Clarke 2003	Lloyd table	Florida							Total annual ~ 35%; monthly female ~ 0.8%; monthly male ~ 2.1 %							
Centonze and Levy 2002	Lloyd table	Florida							Total annual ~ 15%; monthly female 0.35%; monthly male 0.9 %							
Chu et al. 2009	Lawler	USA	W	Y	O	M								Telephone survey for USA owned cats; 2.24 cats/household, 80% sterilized; 82% of females never had litter	If income <35K=50% cats sterilized; > 75K 96%. If owner age > 60, 90% sterilized; age 19-39, 72% sterilized	
Danner et al. 2010	Lawler	Hawaii						Movements up to 18 km at least occasionally observed	Based on post-mortem tooth examination, annual estimated survival rates ranged from 0.61 - 0.76							
Devillard et al. 2003	Lloyd table	France							Monthly juv survival 0.921							
Devillard et al. 2011	Lawler	Kerguelen archipelago; sub-antarctic	S	N	U	R	Total population on islands 7,000; this could represent carrying capacity. Summer density 0.67 / km2; winter density 0.41 / km2.							12-yr study, 1996-2007	5 founder cats 1950s to control pests	

**Free Roaming Cat Population Model Literature Review Matrix
as of March 2013**

	Reviewer(s)	Study area	Seasonality (S, W, A)	Supplementation (Y, N, Unk)	Ownership (O, U, B, Unk)	Setting (R, U, S, M, Unk)	Density / population size	E/immigration	Area requirements / metapopulation structure	Mortality / survival	Sex ratio	Breeding ages	Fecundity	Breeding system / density dependence	Study description	Comments
Ferreira et al. 2011	Boone / Lawler	Portugal/ Spain		Y	U	R	Total of 130 cats on 39 farms; ~ 0.26 cats / km2 overall		Avg male home range 430 ha; avg female home range 87 ha. Maximum linear distances moved ~ 4 km by males, using farms as "stepping stones"		Among trapped adults, 2:1 ratio of f:m					In semi natural areas, with sporadic human footprint, density < 10 / km2, home ranges large, and cat-cat encounters less frequent. In truly natural areas or those with no human footprint, cats not found.
Finkler et al. 2011	Lawler	Tel Aviv	A	Y	U	U	3177 cats TNR'ed within 622 feeding groups across Tel Aviv; 33 groups / km2 in the north, which is more socioeconomically advantaged, and 15 groups / km 2 in south								Socioeconomic-based TNR study.	
Foley et al. 2005	Lawler	CA and FL	S	Y	U	R, S	Total est. population 240,690 in CA; 36,398 in FL					Females 8-mo @ initial breeding, median 5 yrs @ last breeding			TNR impact analysis Ricker Model	
Gunther et al. 2011	Lawler	Israel	S	Y	U	U	Group A (sterilized), 25 resident & 14 transient; group B (sterilized), 16 res & 8 trans; group C (intact), 10 res & 6 trans; group D (intact) 3 res & 4 trans	Group A, 37% immigrate, 19% emigrate; group B, 44% imm, 25% emi; group C, 19% imm, 48% emi; group D, 0% imm, 75% emi	4 distinct feeding groups	41% mortality to 6 mo (24% for groups A & B; 68% for groups C & D)					1-year post-TNR study	
Haspel et al. 1989	Lawler	New York	N	Y	U	U										Contains some home range data
Horn et al. 2011	Lawler	Illinois	S	M	M	M	11 owned (neutered) cats tracked; 16 unowned cats tracked; 213 trapped w/in same range			Survival was 92% for owned cats (over?) 596 days; 50% for unowned cats (over?) 392 days					Radio tracking study	Some home range information
Jones and Coman 1982	Lloyd table	SE Australia										Female initial breeding @ 10 - 12 mo.	Litters / mo for March - May (or S. Hemisphere inverse?) 0.271; for off season months, 0.065. Avg litter size 4.35			
Jones and Downes 2011	Slater / Boone	South Africa	A	M	U	U, close to natural areas	161 / km2, see Table 1 for details								TNR follow up, for 8 sites w/ various lengths and intensity of TNR.	Significant negative relationship between # of cats and % sterilized. Good lit review. NUMBER OF YOUNG CATS DECLINED WITH NUMBER OF CATS STERILIZED
Lacheretz et al. 2002	Slater	France	A		O	U				Rural pets mortality, 13% accident, 13% natural, 67% disease, 8% euth; urban pets, 10% accidents, 22% natural; 62% disease, 7% euth					Causes of death in owned pets, from vet data; DOGS AND CATS COMBINED	
Levy et al. 2003a	Lawler	Florida	A	M	U	R, S	Total 155 cats, 68 adults		Multiple colonies over ~ 1,400 acres						11-yr TNR study	
Levy et al. 2003b	Lawler	Florida	A	M	M	R, S	Total ~ 300 cats								Telephone survey study	90% of owned cats sterilized; 11% of unowned cats sterilized.

**Free Roaming Cat Population Model Literature Review Matrix
as of March 2013**

	Reviewer(s)	Study area	Seasonality (S, W, A)	Supplementation (Y, N, Unk)	Ownership (O, U, B, Unk)	Setting (R, U, S, M, Unk)	Density / population size	E/immigration	Area requirements / metapopulation structure	Mortality / survival	Sex ratio	Breeding ages	Fecundity	Breeding system / density dependence	Study description	Comments
Loyd et al. 2010	Lawler						Model defines small groups < 50 cats; medium groups 50 - 100; large groups 100 - 200			Model defines survival >0.8 as "high"; 0.56-0.79 as "medium"; <0.56 as "low"					TNR - TE modeling study using network model	TNR most effective for < 50 cats, TE best for > 50
Mendes-de-Almeida 2006	Lawler	Rio de Janeiro			U	U	Avg total ~ 50 cats; 80 unique cats over study period		No. immigrants < 6 mo age in 2001 = 0; in 2002, 1 m & 2 f; in 2003, 1 m & 3 f; in 2004, 1 m. No. adult immigrants in 2002, 13 m & 10 f; in 2003, 7 m & 7 f; in 2004, 2 m & 3 f. In 2002, 54% of cats were immigrants; in 2003, 35%; in 2004, 15%.		Avg 3:1 ratio f:m among adults				Mark-recapture TNR study	
Metsers et al. 2010	Boone	New Zealand		Y	O	R, S			For rural, avg female HR ~ 30 ha, avg male ~ 60 ha; for urban edge, avg female HR ~ 4 ha, avg male HR ~ 6 ha							
Miller et al. 2005	Miller	Minnesota	S	Y	U	S				Adult over-winter survival 0.6 annually up to age 4; 0.4 annually above age 4.						
Moreau et al. 2003	Slater	France			O	U				3 cats alive @ 20+ yrs; ~ 25% die of infectious disease			% of females producing litters by age: age 0-1, 95%; age 1-3, 17.9%; age 3-5, 12.9%; age 5-8, 21.4%.		Longevity study of cats, data from vets	
Natoli et al. 2006	Lawler	Rome		Y	U	U	Total 8,000 cats TNR'ed over 10 yrs. ~ 1,500 cats extant at a given time on avg.	~ 21% of cats in a given year immigrated that year	> 100 colonies at a given time						TNR study 1991-2000 103 colonies	
New et al. 2004	Boone		A	Y	O	M				8.3 deaths / 100 cats / year, over all ages			11.2 kittens / year / 100 cats, all ages; 5.7 avg litter size	Telephone survey study USA	Only abstract available, more info may be available in full text	
Nutter 2005 PhD	Nutter	North Carolina		Y	U	R, S	344 cats in 11 colonies.	See p33, Ch 5 for immigration 27 males in 39.3 colony years 9 females in 39.3 colony years	11 colonies.		Median 1.4:1 ratio f:m for adults		100% of intact females produce at least one litter annually			
Nutter et al. 2004	Lawler / Nutter / Lloyd table	North Carolina	S	Y	M	R, S	71 intact females, 9 colonies		9 colonies.	75% mortality by age 6 months; monthly juvenile survival 0.794		Females avg 8.5 mo @ initial breeding (4-13 mo range)	1.4 litters / yr / female; in March - May, 0.213 litters / mo / female; in June - Feb, 0.051 litters / mo / female. Max litter size 10 by fetus count (median 4), 6 by live birth (median 3)		TNR study of free-roaming population	
Patronek 2010	Boone	Boston	A	Unk	M	U								Animal Control data, with strong socioeconomic slant	Less relevant for free-ranging cat population dynamics	
Patronek et al. 1997	Boone	Indiana	A	Y	O	U								Telephone survey and shelter data study, focus on owned cats with sociological slant	~ 40% of owned cats allowed outside. Contains some useful data for turnover of owned pets.	

**Free Roaming Cat Population Model Literature Review Matrix
as of March 2013**

	Reviewer(s)	Study area	Seasonality (S, W, A)	Supplementation (Y, N, Unk)	Ownership (O, U, B, Unk)	Setting (R, U, S, M, Unk)	Density / population size	E/immigration	Area requirements / metapopulation structure	Mortality / survival	Sex ratio	Breeding ages	Fecundity	Breeding system / density dependence	Study description	Comments
Pontier et al. 1995	Lawler / Boone	France		Y	M	U, R	Rural density, 130 - 230 / km ² ; urban density 1300 / km ²		9-31 populations in various years, some urban, most rural.		Adult f:m ratio > 1 in rural populations			Promiscuous breeding system in urban habitat, polygynous in rural. This has implications for male strategies and survival.		Some information on genetic differentiation (?)
Risby et al. 1997	Boone	Australia	S	Y	U	R			For most cats, max movement < 500m; one had max movement of ~ 1000m					Study mainly addressing efficacy of poisoned bait	Very little useful population information	
Say et al. 2004	Lawler	France	S	Y	U	U	~ 25 males at a given time, and ~ 32 females at a given time; varied moderately over three years. Density 7 -9 cats / ha.					Females initial breeding @ 8 mo, males @ 10 mo	Mean litter size 4.6, max 6.0	All males in breeding pool. Multiple sires for ~ 80% of litters.	3-yr study of free-roaming cats	
Schmidt et al. 2007	Boone / Lawler / Lloyd table	Texas	A	Y	M	S	54 radiocollared cats, tracked 173 days on avg		For feral, 50% of use w/in 1.4 ha, 95% of use w/in 10.4 ha; for semi-feral, 50% of use w/in 0.4 ha, 95% of use w/in 5.3 ha; for owned, 50% of use w/in 0.06 ha, 95% of use w/in 0.4 ha. In general, male HRs several times larger than female	Monthly male survival 0.991; monthly female 0.961; monthly juv 0.914 (semi-feral), 0.978 (feral); avg 1.75-2.75/litter feral survived at least 12 wk. Feral survival over 14 mnts = 0.56; semi-feral = 0.90; owned = 1.0; note sample sizes			For feral, 1 litter / female / yr; for semi-feral, 1.6 litter / female / yr. Avg litter size 3.55		Ownership status has large effects on survival and movements	
Schmidt et al. 2009	Boone / Lloyd table	Texas	A		M	U, S							Avg litter size 3.55	Assumes a density-dependent reduction in natality that is linearly related to population size.	Simple simulation model study using STELLA, and testing different control scenarios	High treatment rate s (> 50%) and prevention of most immigration critical for controlling population. Limited # parameters, but worth reviewing again at later stages of our model's refinement.
Scott et al. 2002	Boone / Lawler / Lloyd table	Florida	A		U	M	5323 trapped			85% of population is adults			In March - May, 0.25 litters / female / mo; in June - Feb, 0.06 litters / female / mo. Avg litter size 3.6, ranging from 1 - 8. On avg, 19% of females pregnant at a given time, peaks at 40% March - April, low 4% in Oct - Jan.		TNR program study	
Short and Turner 2005	Boone	Australia														
Short et al. 1997	Boone	Australia	W	Y	U	R	0.1 - 0.21 cats per km of transect (nocturnal survey)								A poisoning study	Little relevant information. Density estimate is an index, not actual.
Short et al. 2002	Boone	Australia	A	Y	U	R								Primarily a trapping efficacy study	Juvenile and subadults more likely to scavenge, adults more likely to hunt.	

**Free Roaming Cat Population Model Literature Review Matrix
as of March 2013**

	Reviewer(s)	Study area	Seasonality (S, W, A)	Supplementation (Y, N, Unk)	Ownership (O, U, B, Unk)	Setting (R, U, S, M, Unk)	Density / population size	E/immigration	Area requirements / metapopulation structure	Mortality / survival	Sex ratio	Breeding ages	Fecundity	Breeding system / density dependence	Study description	Comments
Short et al. 2005	Lawler / Boone	W Australia	A	N	U	R	1.5 - 2.8 / km2								Modeling study	Worth revisiting for model refinement and validation
Trejejo et al. 2011	Boone														Survey of castration rates in owned pets seen in veterinary practice	Not very relevant
Turner and Bateson 2000	Boone						Density > 100 / km2 occurs only in urban area with abundant food; 5 - 100 / km2 in more rural areas with some food supplementation, or rich natural food sources; < 5 / km2 in rural areas with little supplementation and widely dispersed prey.		Male home ranges ~ 3x female home ranges; all home ranges inversely related to food abundance; extreme home ranges are ~ 170 ha for females, 1000 ha for males. Group living in cats is enabled strictly by artificial, or more rarely natural, concentrations of food.					Most males disperse and few reach sexual maturity in their natal group	Excellent review article, USE FOR VALIDATION	Group living cats represent true social groups rather than just aggregations based on food, especially wrt females. USE TABLES 7.1, 7.3, 7.4, 7.5 FOR MODEL VALIDATION
Van Heezik et al. 2010	Boone	New Zealand		Y	O	M			Home ranges are several ha, with few differences by sex or location.						Compared home ranges of cats near native habitat fragments vs. those in residential areas far from fragments	
Wallace et al. 2006	Lawler	USA various	S		M	M	103,643 cats TNR'ed at 7 sites			75% kitten loss to 6 mo	44.3 % male, 53.4% female		Avg 0.9 litters / female / yr. Prenatal avg litter size 4.1. 15.9% of females pregnant when TNR'ed		TNR study 1993-2004, 7 USA sites	
Warner 1985	Lawler / Lloyd table	Illinois	S	Y	M	R	Total 326 cats on avg, range 207-448 over course of study. Density 6.3 cats / ha		62 rural residences; 5.6 cats/residence on avg (range 3.5 - 8.0).	Yr 1 survival, 731/1000; yr 2, 807/1000; yr 3, 939/1000; monthly juv survival 0.878			Avg 1.6 litters / female / yr. In March - May, 0.387 litters / female / mo; in June - Feb, 0.093 litters / female / mo. Avg litter size 4.4			Predation by cats continues despite supplemental feeding. Interestign source.
Wierzbowska et al. 2012	Boone	Poland		Y	O, free-ranging	R, adjacent to natural area			HR for males ~ 0.8 km2; for females ~ 0.15 km2; maximum linear movements 1.5 km, but ~ 200 m more typical.							