Cat Population Dynamics

Human Component

Bonding

Total removal effective mainly islands (isolated habitat)

Other Choices

Debates are emotional (lovers vs non-lovers of various species)
political
misunderstanding of biology (biology gets confused)
intransigence

9 – 22% households feed unowned cats – bonding is common (# studies)

Healthy residence 6+ years with human support (Levy et al 2003)
Mean longevity pet or cattery 7-8 years (Nassar et al 1984)

Levy et al JAVMA 2003

Type: Telephone Survey N=587 (0.7% of county)

Free roaming cats estimated 44% cats in county

40% of cat-feeding households owned at least 1 cat

Often multiple roaming cats

90% of owned cats sterilized

Rabies immunization estimated 14% of county cats

Finkler H et al Wildlife Res 2011

Type: Urban cat population density and socio-demographics

Photographic capture – recapture of cats

Human parameters: matriculation
employment
immigrations
computer ownership
income level

40 surveys

574 adult cats (37% sterilized) + 98 kittens

Finkler et al Wildlife Res 2011

Type: Urban cat population density and socio-demographics

Results:

Cat density Northern (more affluent) – 535 km^{-2}
Southern (less affluent) - 743 km^{-2}
[Brooklyn NY 200-488 km^{-2} - Calhoun et al 1989]

Kitten density Northern - 34 km^{-2}
Southern - 187 km^{-2}
[kitten survival no difference]

More commercial (vs residential) = higher cat density
Human density & storeys/building = no cat density effect

Strong influences on density: Human behavior
Cat popularity as pets

Socio-economic factors influence sterilization rate

Infectious diseases, weather, trauma, predation influence kitten survival

Population

Gunther et al JAVMA 2011

Type: Same urban study as Finkler Anthrozoos 2011

184 cats + 76 kittens
4 groups (2 TNR) for 1 year

Kitten survival: Overall 59%
Neutered 76%
Not neutered 32%

Intact cats immigration into neutered groups (% population)
41% into neutered vs 10% into not neutered

Less emigration by neutered group cats
22% from neutered vs 62% from not neutered

TNR campaigns need to be continuing: feed, sterilize = live longer

Schmidt et al J Wildlife Management 2007

Type: Population, urban

Radiotransmitters – 54 cats over 173 days:
- 10 owned pets
- 14 semi-feral (fed)
- 30 feral

Annual ranges:
owned < semi-feral < feral (can range up to c. 570 hectares if less urban)

Reproduction:

Litters/year	owned – sterilized		
	semi-feral	1.6	
	feral	1.0	(age, infections, less nutritional)

semi-feral:	8 litters	3.6 kittens/ltr	2.75 kittens over 12 wk/ltr
feral:	7 litters	3.5 kittens/ltr	1.75 kittens over 12 wk/ltr

Horn et al J Wildlife Mgmt 2011

Type: Radiotelemetry home ranges, habitat use, activity
Owned and non-owned free-roaming adult cats

Cats 11 owned + 16 non-owned free-roaming over 1 year, 2544 hectares of grassland, forest, light urban, dense urban, farm, row crops

Owned cats all sterilized - Non-owned cats 2 sterilized (confounding factors)

Home range: Owned smaller: Non-owned (varying to 547 hectares)
Non-owned seasonal space shifting

Activity: Owned less overall: Non-owned more high activity (energy, prey)

Survival over 16 months: 93% owned: 78% non-owned

Health

Population Health Data

Density

Food Water Shelter + urban + high fecundity = 1000 – 2500 cats km^{-2}

(Gunther et al Anim Welfare 2002)

= 2300 – 2800 cats km^{-2}

(Mirmovitch Wildlife Res 1995)

Kitten survival to 6 months

59 % Gunther et al 2011

16 % Mirmovitch 1995

9.5 % Yamane et al 1997 (10 mo) (infection cycles)

High densities = nutritional and health risk = zoonosis risk

Cats are quite mobile among adjacent-to-proximal groups

Patronek et al AJVR 2010

Type: Mapping Welfare Disparities, Boston MA

City animal control + 2 Sheltering organizations

Cat deaths/1000 people/year

City-wide shelter system	2.60
Economically poorer	2.36
Economically fortunate	0.63

Cat death correlate with premature human death $r^2 = 0.50 - 0.77$

a) Influence on modeling parameters is partly spatial

b) Premature human deaths can explain high percentage of variability among cat deaths

Finkler et al Anthrozoos 2011

Type: Urban cat population density and socio-demographics

5-year evaluation 622 feeding groups

Affluency North greater, South lesser

Feeding groups	North	South	
	392 (n)	230 (n)	
	339 (n) rabies vac	151 (n) rabies vac	($)*
	pregnant 0.60/group	pregnant 0.95/group	
	likely neutered 3.5x	likely neutered x	

* Ability to pay

Reproduction

Reproductive

USA >100 million cats, 73 million owned (Schmidt et al 2007)

Births
1.1 – 2.1 litters/year, 3 – 5 kittens/litter (# studies)

Deaths (# studies)
15 – 30% by 1 year (pet and colony)
Estimated 50 – 90% by 1 year (free-living) (infection cycles)

Most matings by dominant male (>50%): Male fertility c. 8 - 10 mo

Male reproductive life 10+ years

Queen puberty 5+ months: Queens practice some selectivity

Inbred queens 40% infertile: Outbred infertility probably 10-15%

Age 3-4 years by 1st parity = high percent sub-fertile to infertile (?)

Female reproductive life 6 – 7 years

Trap Neuter Release (TNR)

Levy et al JAVMA 2003

Type: Not owned, free-living, TNR & Adoption, 11+ years

Population Monitoring (University Campus)

N = 155: 75% feral, 25% social, 56% of originals <6 months
Initiated TNR program

Immigrants TNR quickly (immigration continued)

Results: No kittens from 4th year

47% adopted
15% on site
11% euthanasia
6% emigration
6% death
15% disappeared (emigrate, accident, disease ??)

Levy et al JAVMA 2003

Type: Not owned, free-living, TNR & Adoption, 11+ years

11 discreet colonies (feeding area + shelter)
3 – 25 per colony at start of study
1 – 5 per colony at end of study

3 colonies depleted (TNR) – without new immigrants
1 colony lost habitat

Mobility: (would involve 40% if independent)
- 24 moved locations 1 or more times
- 17 spent time in other colonies
- 11 roamed with no fixed colony
- 10 moved to perimeter woods

End of study = population of 23, compared to original 155
local mobility
83% present >6 years

Andersen et al JAVMA 2004

Type: Matrix population model, urban
TNR vs euthanasia

Parameter estimates:

Mean kittens/litter 3.6
Annual litters 1.1 – 2.1
Queen 1st conception age 212 days (7 mo = unhealthy!!)
Kittens equal male:female
1.98 – 3.78 female kittens annual
Juvenile survival 50-75%
Adult survival 2 - 3 years (no human support)
No male parameters

Andersen et al JAVMA 2004

Type: Matrix population model, urban, TNR vs euthanasia

Predictions:

- Population annual growth rate 1.84 (1.34 – 2.49)
- TNR 75% of queens = annual growth rate 1.08
- TNR 75% of all cats = annual growth rate <1.00
- Queen euthanasia 50% or higher = annual growth rate <1.00

Population growth was more sensitive to survival than fecundity

Loyd et al Ecol and Soc 2010

Type: Modeling – Decision Analysis Network

Probabilistic graphical model (Bayesian Belief Network)

Applied for feral cat control decisions:

- TNR
- TNR + kitten removal at 25%
- TTVARM (adds testing, vaccinate, return, monitor)
- TE (trap + euthanize)
- No action

Each decision = 75% capture rate

Populations: <50 each weighted equal probability
50-100
100-200

Immigration: >30%
12-30%
<12% not defined by sterilization status

Loyd et al Ecol and Soc 2010

Type: Modeling – Decision Analysis Network

Survival: >0.8
0.56-0.79
<0.56

Reproduction: >2 litters/year; >4 kittens; 3 survive
1-2 litters/year; 3-5 kittens; 2 survive
<1 litter/year; <4 kittens; 1 survives

Future population: initial size, survival, production, immigration, abandonment

Considered costing and wildlife losses

Loyd et al Ecol and Soc 2010

Type: Modeling – Decision Analysis Network

OVERALL CONCLUSIONS:

Optimum = TE for >50 (predation)
= TNR for <50
= TNR + kitten removal stabilizes smaller populations
(theoretically giving kittens homes)

Continued immigration and abandonment can compromise TNR
TNR may be unsound in ecologically sensitive areas

Nutter et al JAVMA 2004

Type: TNR Study of Intervened Feral Colonies
N=625

Queen litters/year 1.4

Fetal counts higher than full term counts (normally occurs)

Kittens/litter 3.0 at full term

75% losses through death or disappearance by age 6 months

Models require:
75-80% sterilization + immigrant sterilization + 12.8 years to extinction

Nutter et al JAVMA 2004

Type: TNR Study of Intervened Feral Colonies
N=625

Feral cats - higher prevalence of *Toxoplasma* and *Bartonella* (vs pet cats)

- similar prevalence of *Toxocara*, *Giardia*, *Cryptosporidium* (vs pet cats)

Sterilized cats lived longer than unsterilized
Home ranges managed ferals <1 ha
Cat size (x gender) main determinant of home range
1.7 – 2.6 ha urban (Haspel et al 1989)

1 hectare = 10,000 m^2

1 acre = 4050 m^2 = 0.4 hectare

Foley et al JAVMA 2005

Type: TNR

Ricker Model to describe dynamics among 26,274 semi-ferals CA & FL
CA – 11 years FL – 6 years

Goal of 1.0 population growth

High number of sterilizations required to stop population growth

Surgeries being done do not approach the projected need for surgery

Need to target resources --- realize many influences

Budke et al J Appl Anim Welfare 2009

Type: Matrix population model surgery vs non-surgical

Conditions:
- no intervention
- TNR
- 3-yr non-surgical

Assumptions:
- defined fecundity = female kittens/year/queen
- males & females in one closed breeding population
- no seasonality or carrying capacity
- 100% effective surgical and non-surgical sterilization

Life cycle critical data:
- Juvenile and adult fecundity
- Juvenile and adult survival

Large number of mathematical combinations explored

Budke et al J Appl Anim Welfare 2009

Type: Matrix population model surgery vs non-surgical

Outcomes:

0 population growth = >51% TNR juvenile + adult/year (3-year longevity)

Post-stabilization: sterilize 71% of all queens and 81% of adult queens
non-surgical 60% contraception/year with 'renewal'

Implications:

- Sizeable effort especially in large feral colonies
- Continued application and monitoring
- Long-term effort
- Continued funding-intensive

Schmidt et al Wildlife Res 2009

Type: 25-year population model TNR vs euthanasia

Parameters estimated from 43 radio-tracked cats:

Free-roaming, unmanaged, suburban
TNR vs euthanasia 25, 50, 75%
50:50 TNR – euthanasia each 12.5, 25, 37.5%
Maximum immigration 0, 25, 50, 100%
11 combinations evaluated
Queens 1.0 vs 1.6 litter/year; feral vs semi-feral
Kittens 1.75 vs 2.75/litter/year; feral vs semi-feral
Survival all unowned males 0.57/year
females 0.88/year

Schmidt et al Wildlife Res 2009

Type: 25-year population model TNR vs euthanasia

Outcomes:

Population decreases similar across TNR, euthanasia, and 50:50 implementation rates at 0 immigration

Population decreases greater for 25% euthanasia with 50% immigration

Carrying capacity was more sensitive than immigration

High implementation rates required

Immigration prevention required

Euthanasia required more effort

Schmidt et al Wildlife Res 2009

Type: 25-year population model TNR vs euthanasia

Caveats:

Time to population decrease response

Local ecological sensitivity

Effect of sterilization on survival rates

Community sentiments

Financial constraints

Low-cost spay neuter for owned pets

That’s All Folks !!!