SOME THINGS ABOUT SPATIAL RELATIONSHIPS AND SOCIAL ORGANIZATION IN AMERICAN PIKAS (*Ochotona princeps*)

ANDREW T. SMITH
SCHOOL OF LIFE SCIENCES
ARIZONA STATE UNIVERSITY

PIKA LITERATURE (GENERALLY) IGNORED (SOB!)

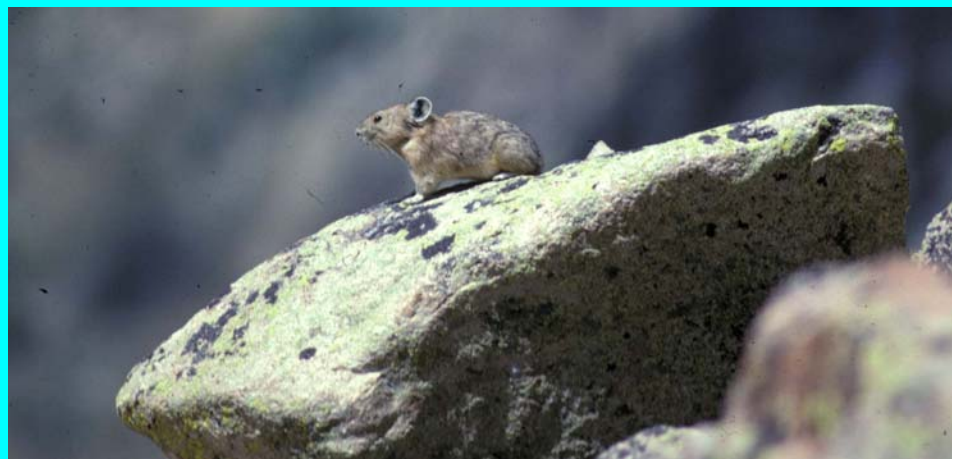
- Smith, A. T. and B. L. Ivins. 1984. Spatial relationships and social organization in adult pikas: a facultatively monogamous mammal. Zeitschrift für Tierpsychologie 66:289-308.
- Smith, A. T. and B. L. Ivins. 1983. Colonization in a pika population: dispersal versus philopatry. Behavioral Ecology and Sociobiology 13:37-47.
- Smith, A. T. and B. L. Ivins. 1986. Territorial intrusions by pikas (*Ochotona princeps*) as a function of occupant activity. Animal Behaviour 34:392-397.
- Smith, A. T. and B. L. Ivins. 1987. Temporal separation between philopatric juvenile pikas and their parents limits behavioural conflict. Animal Behaviour 35:1210-1214.

AMERICAN PIKA NATURAL HISTORY

- Reproductive dynamics
  - All adult females are reproductively equivalent
  - All females breed, initiate two litters, and litter size does not vary with age or with quality of vegetation surrounding the female's territory
  - Thus, with all females essentially equal – there is no need for males to "shop around" for mates
  - Timing of breeding – selected to occur as early as possible, and thus in relative synchrony (so males might have a difficult time having access to multiple females)

AMERICAN PIKA NATURAL HISTORY

- Behaviors that lead to spacing (the individual territoriality of pikas
  - Aggression (chases)
  - Surveillance (musing)
  - Short calls (vocalizations)
  - Cheek rubbing
  - Social tolerance (two pikas close to one another, but without a fight or a chase)



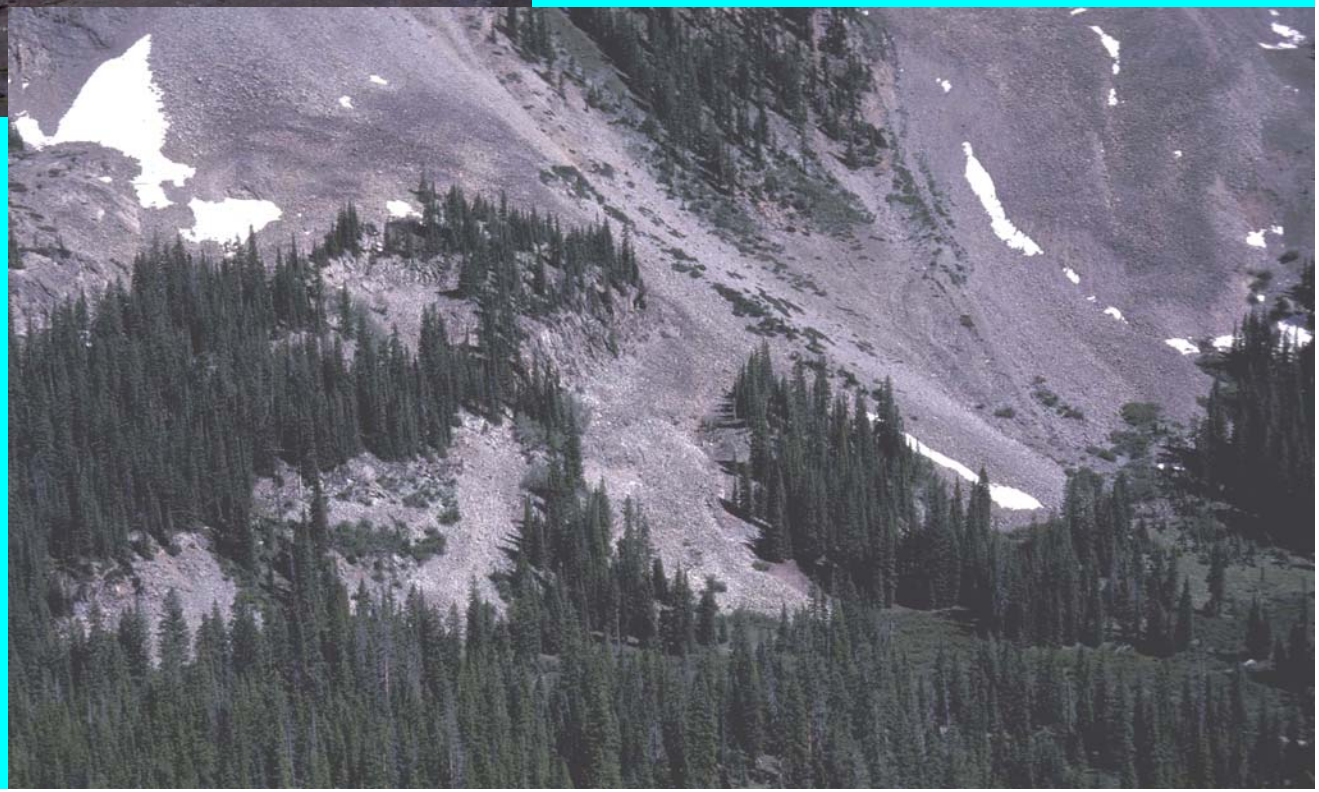
BEHAVIORS OF ADULT PIKAS

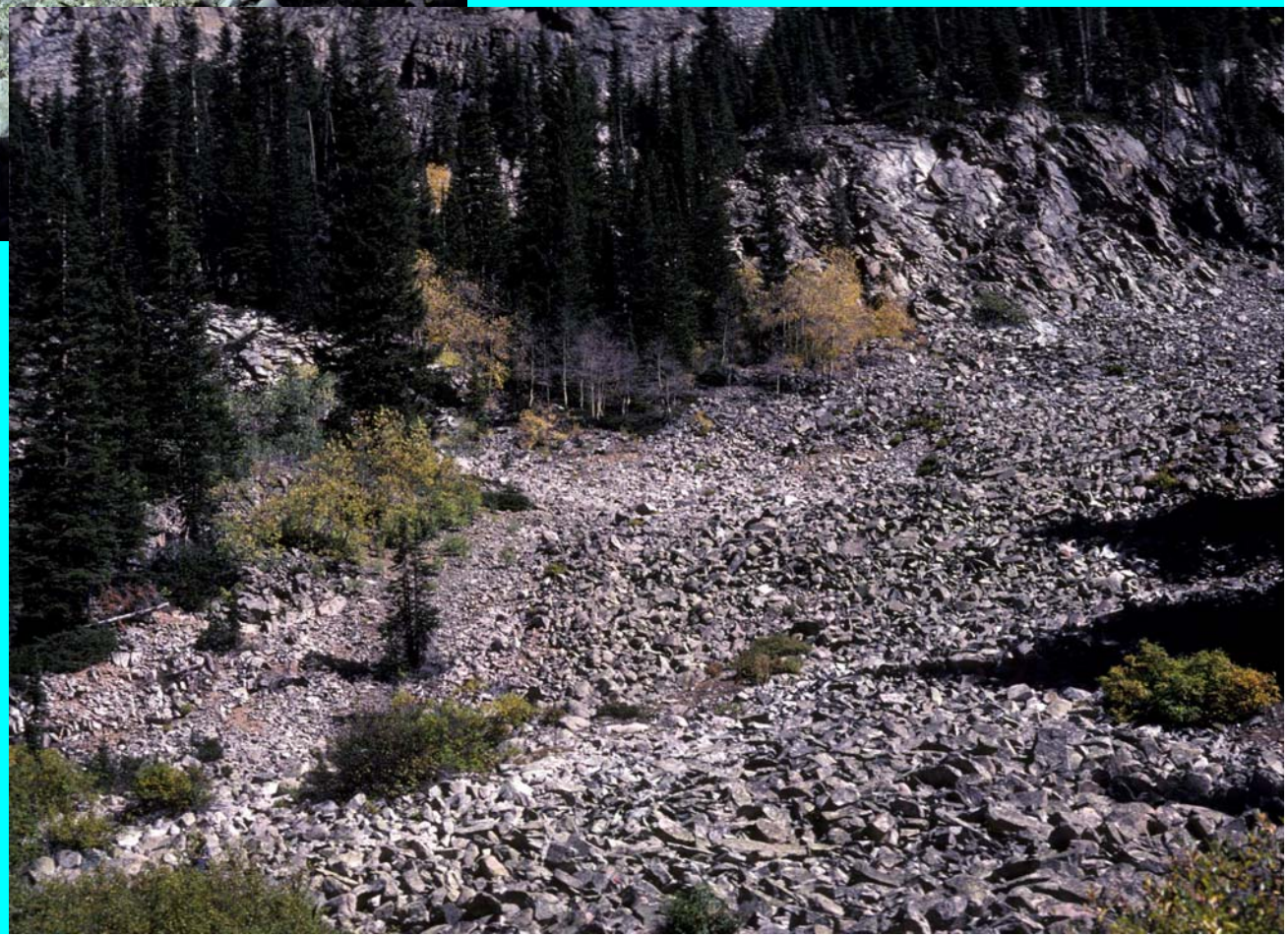
	N	May (35)	June (250)	July (650)	August (490)	Sept. (137)	Oct. (19)
Males							
Short Call	2,114	4.5	11.8	13.0	24.7	28.1	21.5
Long Call	134	66.7	20.6	2.5	2.3	3.5	4.3
Cheek Rub	225	24.0	14.4	18.9	16.9	13.1	12.6
Haying	1,937	3.1	16.3	19.5	30.3	23.2	7.6
Feeding	1,923	37.3	24.2	15.8	8.9	10.5	3.2
Musing	9,548	14.6	19.8	16.6	19.9	15.7	13.3
Females							
Short Call	2,439	6.0	5.3	14.3	30.0	30.9	13.6
Long Call	0	-	-	-	-	-	-
Cheek Rub	219	9.1	19.3	27.0	21.0	15.2	8.5
Haying	1,463	0.7	13.9	16.2	27.9	37.8	3.6
Feeding	3,457	27.4	30.9	24.9	8.7	7.2	0.9
Musing	8,335	16.4	19.0	21.1	19.6	14.6	9.3

GOTHIC, COLORADO, STUDY SITE

- Rocky Mountain Biological Laboratory (RMBL)
- Copper Creek Camp (under White Rock Mountain in the Elk Mountains Wilderness Area
- 4 Discrete Talus Patches (chosen to maximize the likelihood of observing intra-population movements)


GOTHIC
site of
The Rocky Mountain
Biological Laboratory
founded 1928
SCHOOL



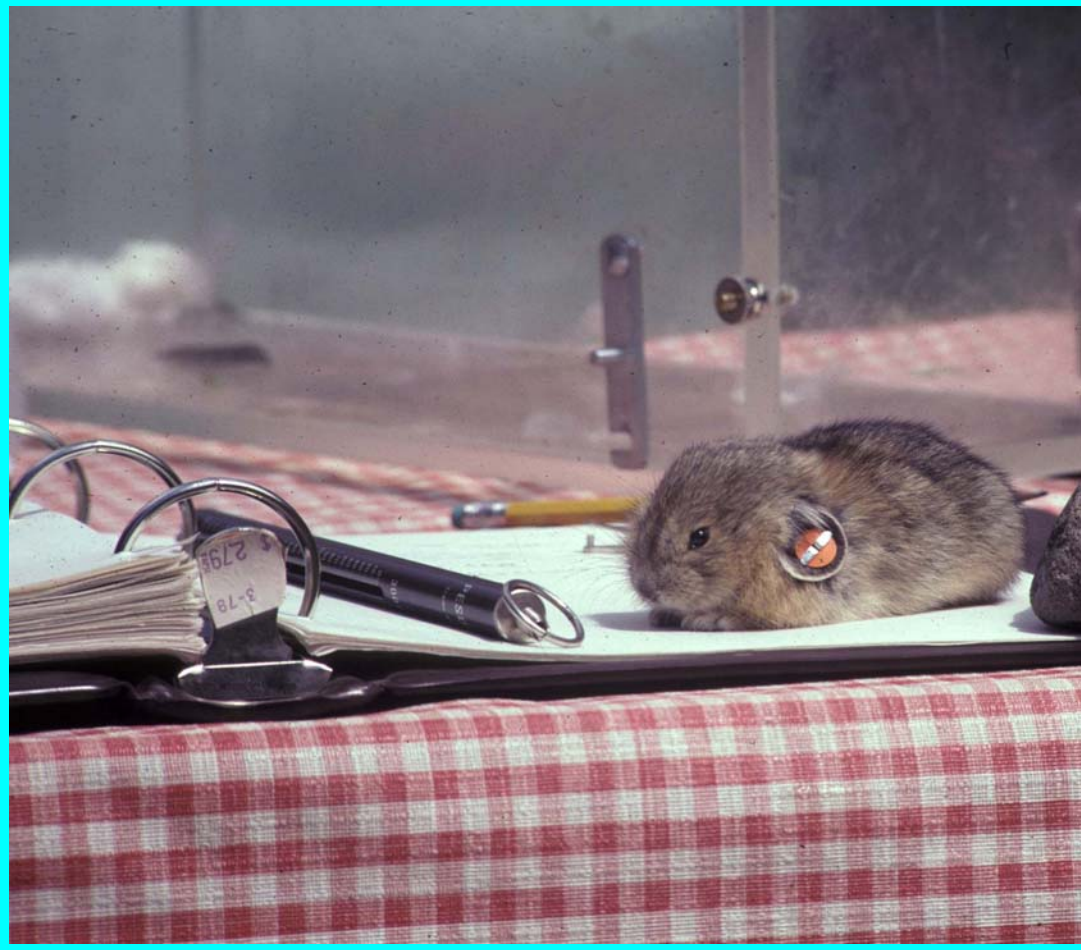


GOTHIC, COLORADO, STUDY SITE

- Gridding of talus (5 m quadrats)
- Lived on site
  - co-worker = Barbara Ivins + 10 different assistants over 3 years

STUDY ANIMALS

- All demographic patterns, including survivorship, colonization, and movements, were determined from observational data
- All animals trapped (handled following anaesthesia – weighed, sexed, examined for reproductive and general condition)
- Study population with an even sex-ratio



SAMPLING

- FOCAL and SCAN SAMPLING
  - 40 X 40 m area
  - Location and behavior of every animal, focal animals and others, noted every minute
  - 15 minute periods/focal animal
  - 1,581 hours of direct observation (not including time spent trapping)
  - Spatial / behavioral data set with almost 1,000,000 lines of data!
  - Animals habituated rapidly to observers, so all sampling accurately portrayed the behavior and spacing of the pikas.


Obs: ATS
Slope:
1 2 3 9 10 11 12 13 14 15
SC
LC

SPACING

- Three types of data were used to describe the spacing of pikas
- I = Area occupied
  - No consensus as to best methodology
  - Modified bivariate normal distribution with no trunctation of data points
  - Sum of actual quadrats occupied
- Both methods give similar results, just different magnitude of space utilization…

HOME RANGE AREAS -- MODIFIED BIVARIATE METHOD

Sex	Age	July	August	September
Males				
	Juvenile**	1,338 ± 330 (10)	1,408 ± 317 (15)	784 ± 263 (8)
		*	*	
	Adult**	2,266 ± 423 (11)	2,182 ± 330 (11)	695 ± 98 (10)
Females				
	Juvenile	1,214 ± 388 (11)	1,367 ± 240 (15)	1,198 ± 280 (11)
		*	*	
	Adult**	3,305 ± 930 (14)	1,782 ± 327 (14)	1,019 ± 279 (9)

*P < .05

**P < .01

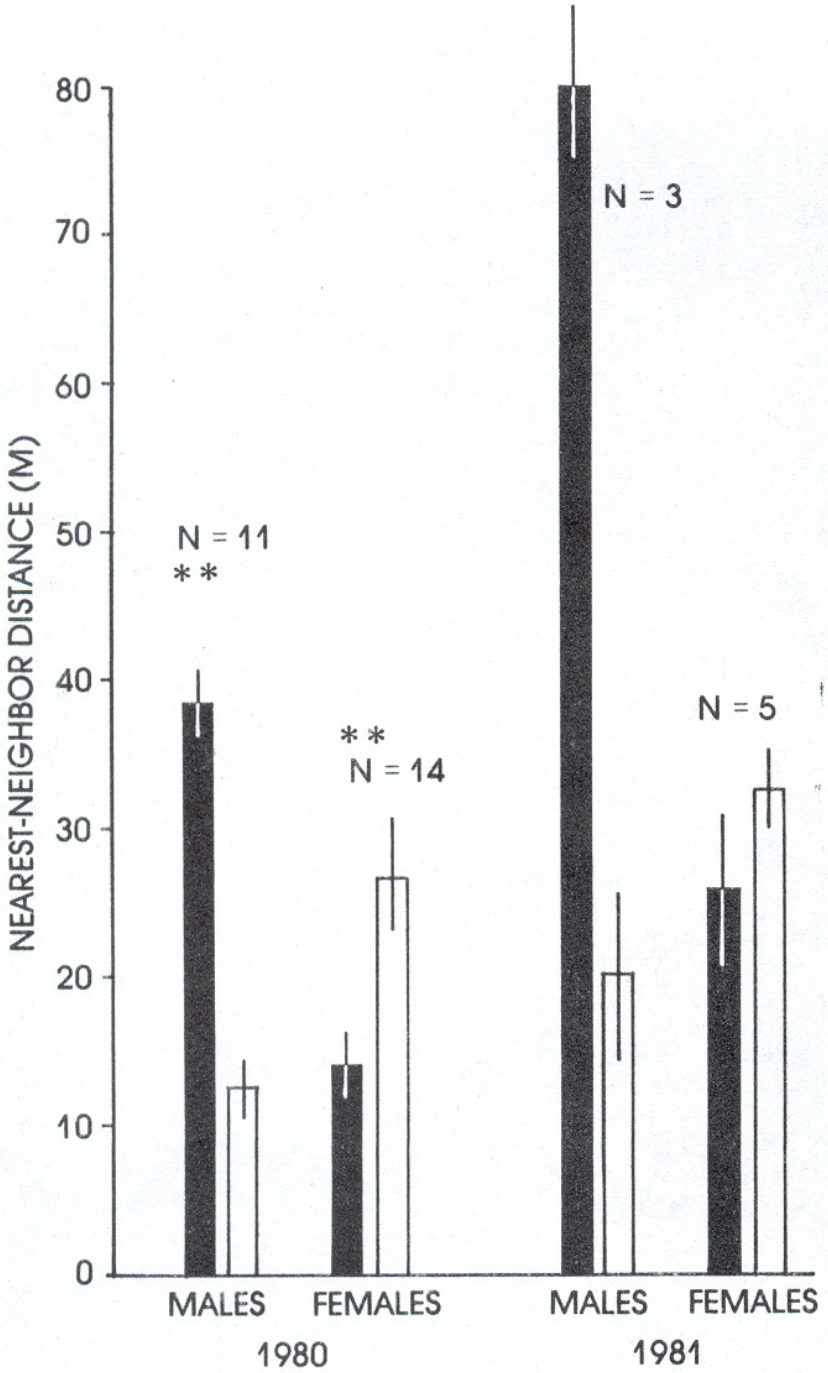
HOME RANGE AREAS -- QUADRAT METHOD

Sex	Age	July	August	September
Males				
	Juvenile**	575 ± 134 (10) **	673 ± 83 (15) **	363 ± 78 (8)
	Adult**	1,198 ± 152 (11)	1,059 ± 203 (11)	520 ± 55 (10)
Females				
	Juvenile	509 ± 94 (11) **	685 ± 91 (15) **	464 ± 58 (11)
	Adult**	1,014 ± 77 (14)	861 ± 87 (14)	528 ± 48 (9)

**P < .01

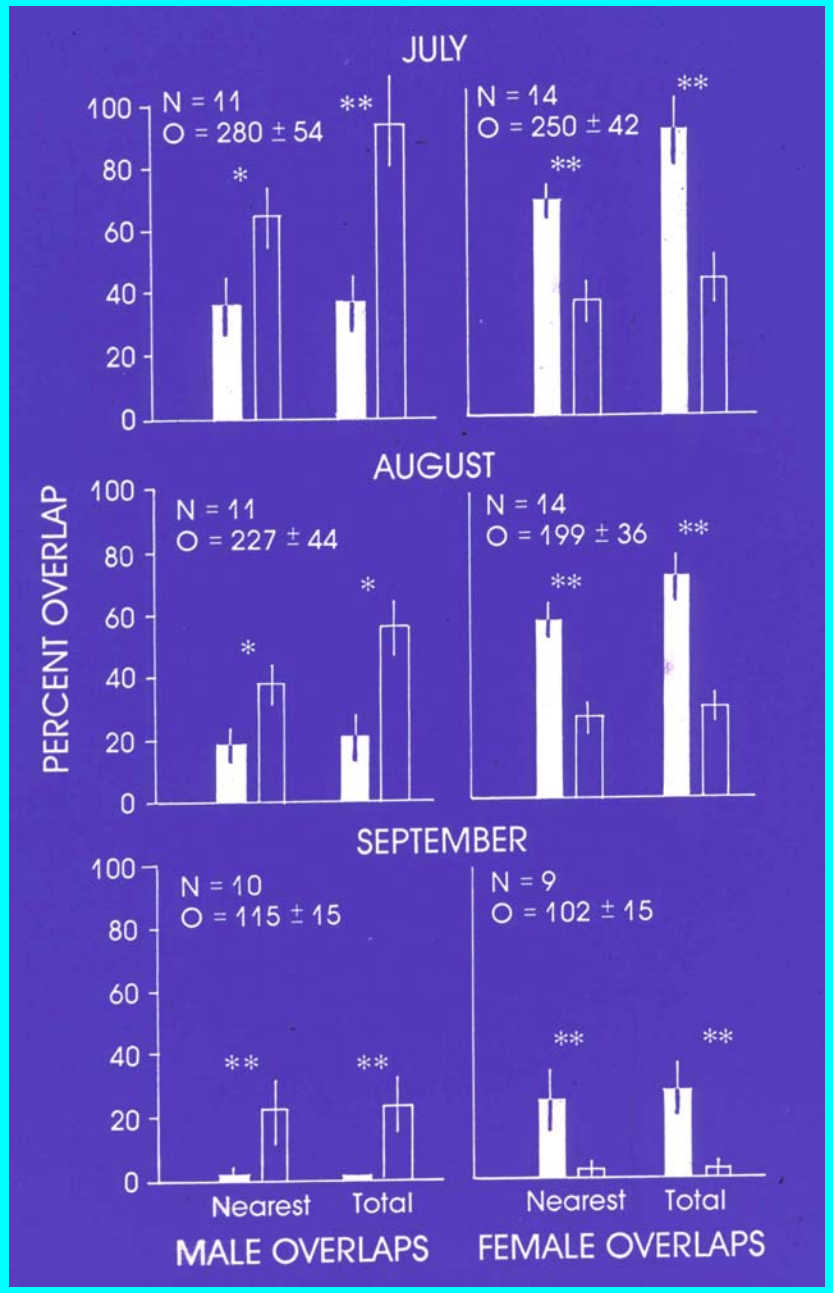
SPACING

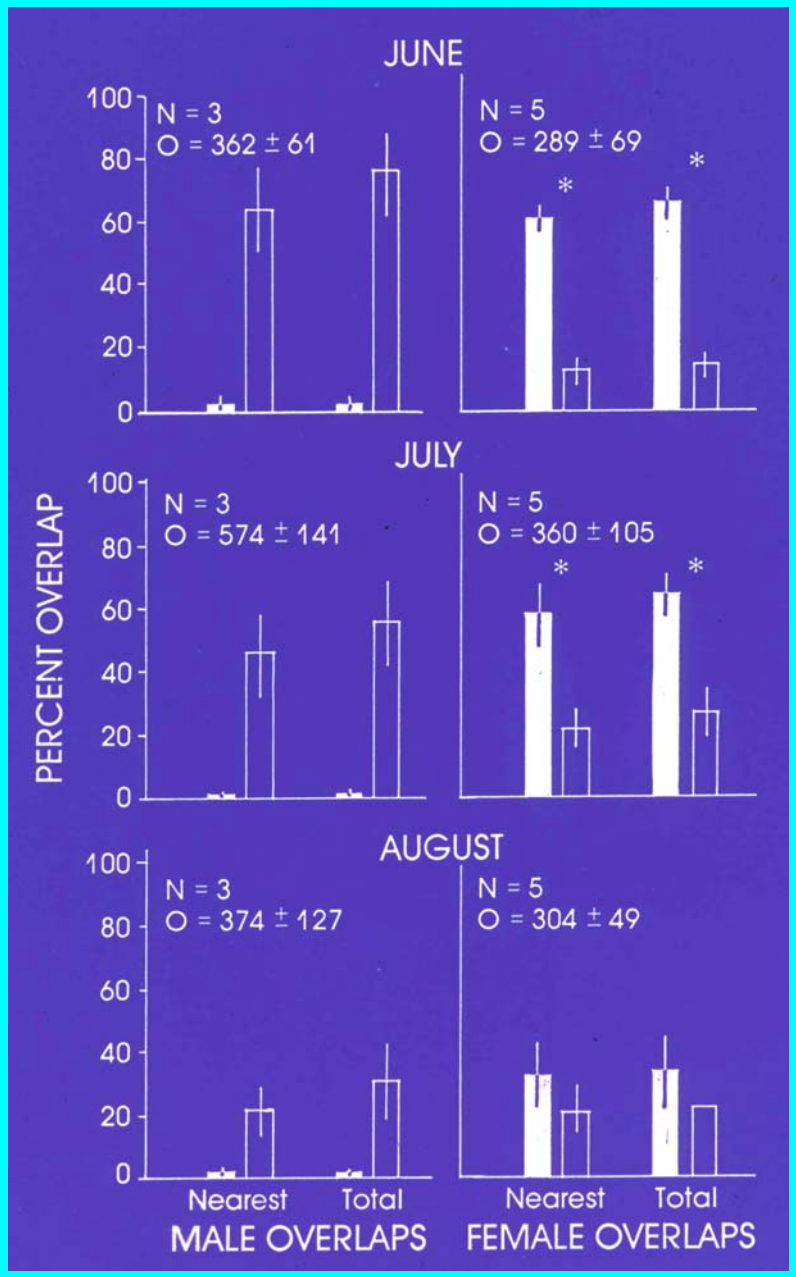
- II = Nearest-neighbor distances = a measure of dispersion
  - Calculated center of Home Range (from Bivariate program), and then measure Nearest-neighbor distances between dyads
    - shaded = males
    - unshaded = females


NEAREST-NEIGHBOR DISTANCE (M)
80
70
60
50
40
30
20
10
0
N = 11
**
**
N = 14
N = 3
N = 5
MALES
FEMALES
MALES
FEMALES
1980
1981

SPACING

- III = Overlaps
  - Weighted overlaps = sum of proportions of observations from those quadrats that were also occupied that month by the other individual in the dyad
  - [most other overlap presentations = unweighted; these are remarkably unreliable]


JULY
N = 11
O = 280 ± 54
N = 14
O = 250 ± 42
AUGUST
N = 11
O = 227 ± 44
N = 14
O = 199 ± 36
SEPTEMBER
N = 10
O = 115 ± 15
N = 9
O = 102 ± 15
PERCENT OVERLAP
100
80
60
40
20
0
Nearest
Total
MALE OVERLAPS
FEMALE OVERLAPS


JUNE
N = 3
O = 362 ± 61
N = 5
O = 289 ± 69
JULY
N = 3
O = 574 ± 141
N = 5
O = 360 ± 105
AUGUST
N = 3
O = 374 ± 127
N = 5
O = 304 ± 49
PERCENT OVERLAP
100
80
60
40
20
0
Nearest
Total
MALE OVERLAPS
FEMALE OVERLAPS

TEMPORAL COMPONENT OF SPACING

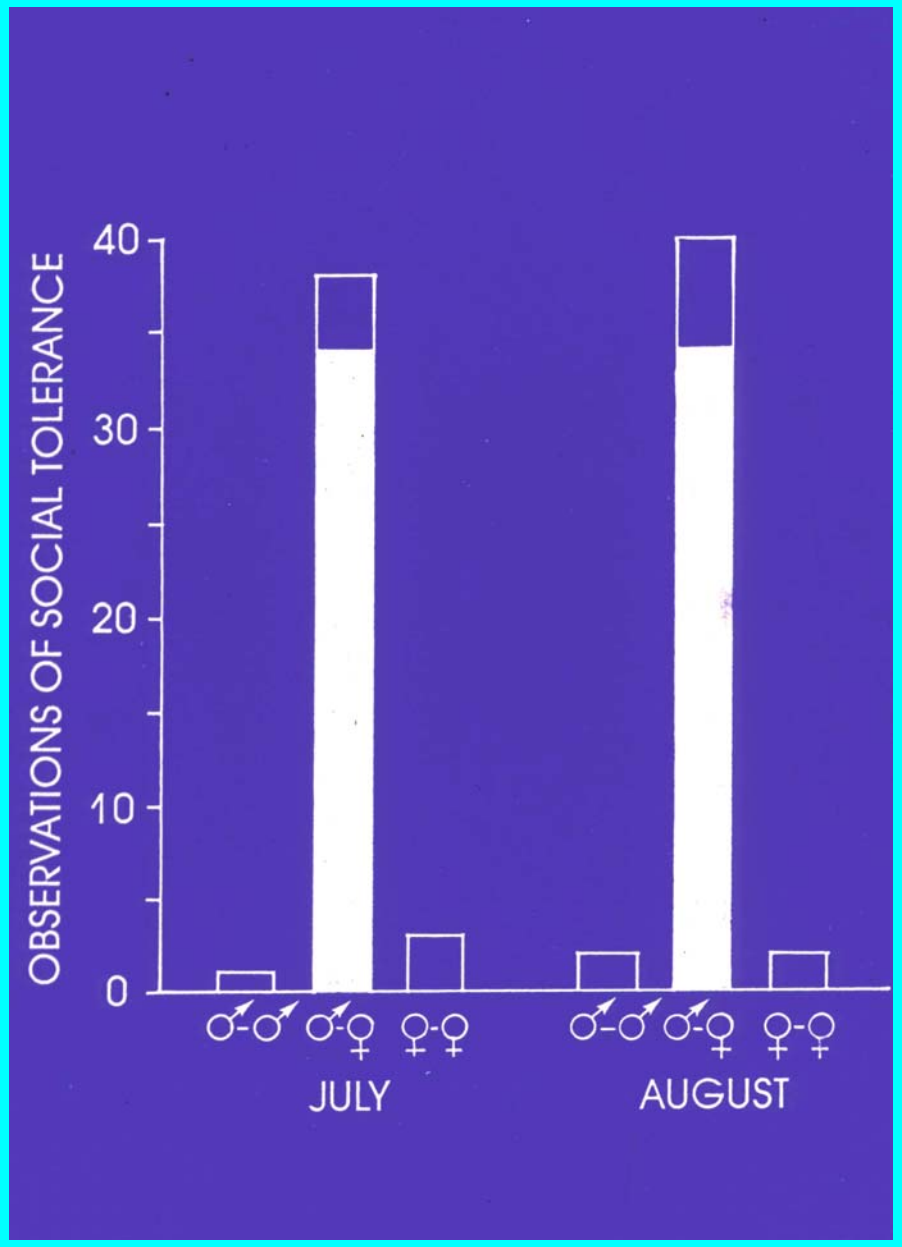
- What happens when an animal disappears and the vacant territory is available for colonization?
- We observed replacement on 22 territories
  - 9 female sites claimed directly by a female
  - 13 male sites; 11 claimed directly by a male, and 2 temporarily by a female then a male
- Thus: all replacements by members of the same gender as the previous occupant (highly non-random!!!)
- Sequential occupants had nearly identical space use centers of activity and haypiles as previous occupant.

SPACING SUMMARY

- Males and females occupy individual home ranges, yet overlap primarily one individual of the opposite gender
- There was an alternate Male-Female (paired) organization, and this persisted in time
- But, no aspect of resource distribution or abundance could predict this non-random dispersion of pikas on the talus, nor its persistence in time
- To do this, we must examine the behaviors responsible for the observed spacing patterns.

SOCIAL BEHAVIORS

- Two categories:
  - AFFILIATIVE
  - AGGRESSIVE (AGONISTIC)
- Affiliative Behavior
  - SOCIAL TOLERANCE
  - DUETS (90% heterosexual pairs; 95% Nearest-neighbors)
  - COPULATIONS (100% Nearest-neighbors)


OBSERVATIONS OF SOCIAL TOLERANCE
40
30
20
10
0
♂-♂
♂-♀
♀-♀
♂-♂
♂-♀
♀-♀
JULY
AUGUST

PIKA AWARENESS - ADULTS

- Pika locations (adult territory holders) sorted by minute
- 8,270 instances of territory intrusion by adult conspecfics
- Pikas usually waited until occupants were unavailable to defend their territory before intruding, apparently to avoid detection and repulsion by the occupant.
- Intruder avoidance of active occupants was most pronounced among same-sex dyads and non-nearest neighbors.
- Instances of territory intrusion were most frequent among nearest neighbor heterosexual dyads.
- Most cases of intrusion appeared to be related to eventual relocation of territories, deterring settlement of unfamiliar conspecifics on nearby vacant territories, and/or increasing familiarity with nearest neighbors of the opposite sex.

PIKA AWARENESS - JUVENILES

- Most juvenile pikas remain on the home ranges of their parents throughout the summer of their birth and eventually settle close to their natal home range. Because conflicts potentially exist between these philopatric young and their individually territorial parents, we tested whether periods of juvenile activity on parental territories were independent of adult activity.

- Juvenile activity on the territory of a parent was dependent on parental activity; juveniles were most likely to be active when their parents were inactive – parents and juveniles only simultaneously active 14% of the time.

- Temporal separation between parents and juveniles appears doubly advantageous in that it allows juveniles to avoid adult aggression and may facilitate their settlement nearby.

PIKA COLONIZATION

- 13 of 17 territories were colonized by juveniles born on the study area
- of the 13, 11 were philopatric
- of the 4 colonists, 3 appeared over winter, one first appeared in late summer

PIKA IMMIGRATION

- 16 immigrant juveniles appeared during summer (7 male; 9 female)
- These represented 26% of all juveniles
- 12 appeared later than mid-August
- 9 appeared in September or later
- Only 1 of these colonized successfully
- 2 yearlings immigrated in spring – neither of which became established

PIKA MOVEMENTS

- Adults
  - 35.41 (85%) sedentary
  - 6 dispersed (4 male; 2 female)
- Juveniles
  - Of 45 born and marked, 2 (4%) dispersed
  - In two years – of 33 born and marked, 21 alive by mid-September and only 1 had dispersed