

**GENETICS AND DEMOGRAPHY OF ISLE ROYALE DEER MICE: A STUDY
OF THE IMPLICATIONS OF GENETIC ISOLATION FOR WILD
POPULATIONS**

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Leah M. Cayo
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Department of Biological Sciences
Michigan Technological University
Houghton, MI

INTRODUCTION

Inbreeding depression is the loss of fitness that a population experiences due to the mating of closely related individuals (Waser, 1993). There are two hypotheses regarding the underlying mechanism of inbreeding depression. The overdominance hypothesis states that reduced fitness is due to a loss of heterosis, the selective advantage of heterozygosity (Mitton 1993). The dominance hypothesis states that inbreeding depression occurs due to the expression of rare deleterious alleles that were masked in the heterozygotic condition (Mitton, 1993). In each case, regardless of the underlying mechanism, inbreeding depression is associated with a reduction of heterozygosity.

Primarily through laboratory studies of model species and modeling exercises, much theory has been developed regarding the demographic and genetic properties of small, isolated populations (Lande 1988, Lacy 1992, Lacy 1993, Lande 1993, Mills and Smouse 1994). Isolated populations are expected to be genetically less heterozygous than central populations due to founder effect and random genetic drift (Ridley 1993). Small population size may increase inbreeding which would further reduce heterozygosity (Charlesworth and Charlesworth 1987, Lande 1988, Lacy 1992, Lande 1993,).

Captive inbreeding studies show that inbreeding and reduced heterozygosity indeed lower fitness in laboratory mice (Bowman and Falconer 1960), *Peromyscus leucopus* and *P. polionotus* (Brewer et al 1990), and *P. maniculatus* (Ribble and Millar 1992). However, little is known about the prevalence and impact of inbreeding in wild populations (but see Jimenez et al 1994). Observed effects of inbreeding on captive populations may be inappropriately extended to wild populations (Jimenez et al 1994).

Mills and Smouse (1994) suggest that the benign conditions of laboratory experiments may underestimate the loss of fitness that would occur under the stresses of nature. Their modeling efforts highlight the importance of both survival and fecundity for the persistence of wild populations, and they stress the need for field studies connecting the genetics and demography of small, isolated populations.

Observational studies to assess the fitness of natural populations often suffer from a lack of direct knowledge about the history of population bottlenecks and level of inbreeding, as well as from lack of control and replication. Experimental, captive inbreeding studies suffer from lack of biological reality and may not be applicable to wild populations. What is needed is a better balance between experimental control and biological reality. Our research combines an observational study of small, isolated populations in nature, with a controlled, replicated experiment under semi-natural conditions.

In Summer 1995 we initiated the first efforts in a multi-year study to assess the demographic and genetic consequences of isolation in small populations in natural settings. These efforts included investigating the effects of isolation on density, summer growth rate, diet, overwinter survival, and genetics. The study area is Isle Royale National Park (ISRO), MI, an archipelago of islands in Lake Superior (48°N, 89°W) approximately 24 km south of Canada, which supports variously sized, isolated populations of deer mice (*Peromyscus maniculatus*). The deer mouse is the only small (20g) mammal present at ISRO; the red squirrel (*Tamiasciurus hudsonicus*) is the next largest mammal (225g). For comparison, a large, panmictic population of deer mice at Sleeping Giant Provincial Park

(SG), Ontario, Canada (48°N, 89°W) is also being studied. It is our intent to determine if the isolated populations are genetically less heterozygous than the mainland population, and then to assess if there is a concomitant reduction in fitness.

Other aspects of island/mainland populations that may influence spatial comparisons of heterozygosity and fitness include patterns of colonization, release from predation, and niche expansion due to reduced interspecific competition. Patterns of colonization may be revealed by genetic analysis and records of presence/absence on various offshore islets (Ashley and Wills 1987, 1989). Release from predation is expected to affect activity patterns (Brown et al 1994, Kotler et al 1994). Differences in diet could indicate niche expansion due to reduced interspecific competition (Ricklefs 1979, Dickman 1986, Brown et al 1994, Heske et al 1994).

METHODS

Indicators of fitness being measured for the SG and ISRO deer mouse populations include reproductive success, population and per capita growth rates, and over-winter survival. Over-winter survival will be estimated by comparing Fall and Spring population densities using live-trap grids. Reproductive success will be estimated by monitoring nest boxes placed in the field and counting embryos in all sacrificed animals. Population and per capita growth rates can be estimated by comparing Spring and Fall densities. As fitness may also effect morphology, size and weight measurements of animals will be recorded, and skulls will be collected for morphometric comparisons.

Live Traps. During the summer of 1995, deer mice in SG and ISRO were trapped using grids of Sherman live traps with 15 meter spacing to assess Spring and late

Summer densities. All live-trapping was done during half moon to control for possible influence of light levels on rodent activity (Halama and Dueser 1994, Kotler et al 1994, Bouskila 1995). The first trap session in SG was 21-23 May using 50 traps over an area of 1.125 hectares; the second session was 2-5 August using 100 traps over an area of 2.25 hectares, including the Spring trap site (Figure 2). ISRO populations were trapped using 64 traps over an area of 1.44 hectares at Bangsund Cabin on Isle Royale, 62 traps over an area of 1.40 hectares on Inner Hill Island, and 30 traps over an area of 0.6 hectares on Star Island (Figure 3). The first trap session in ISRO was 5-9 June, and the second was 16-20 August. Mice were ear-tagged for identification, weighed, sexed, examined for breeding condition and external parasites, and measured for ear, hind foot and tail length. A trap history was kept for each individual.

Snap Traps. Snap trap lines with 8 meter spacing, baited with peanut butter, were used at ISRO to assess presence/absence, relative densities, and to collect stomachs for diet analysis, both spatially and temporally. Mice were collected from the east end of the main island during June, July and August for temporal comparisons and from the east, west and middle parts of the main island during July for spatial comparisons. The Rock Harbor chain islands were trapped in July and August. Stomachs, reproductive organs, and abnormal livers were preserved in 95% isopropyl alcohol in glass vials (Van Horne 1982). A sample of skulls was collected from snap-trapped animals. At SG, information was gathered for both deer mice and red-backed voles (*Clethrionomys gapperi*).

Genetic Samples. Tissue samples were taken for genetic analysis from mice at each location. A small snip of ear was taken from live-trapped animals, lung and muscle

tissue from snap-trapped animals. Tissue was minced and stored in a solution of 6N NaCl with 25% DMSO (provided by Dr. Jean Dubach of Brookfield Genetics Lab) in eppendorf tubes sealed with parafilm. Equipment was flamed and cleaned with 100% alcohol between each sample.

Seed Trays and Radio Collars. Seed trays(Kotler 1994) and radio collars(Madison 1977, Mullican 1988) were used to begin to assess activity patterns, including the impact of moon phase and predation risk on rodent activity. Trays of sunflower seeds inside small cages to exclude all but rodents, and covered with plastic to protect them from moisture, were placed in SG (5 trays) and at Bangsund on the main island of ISRO (20 trays) during various phases of the moon. Trays were monitored for three consecutive nights for each moon phase. The weight of seed removed from the tray was taken as an indication of the amount of rodent activity during the night.

Two ISRO mice were fitted with 1.2g tuned-loop collar antenna SOM-2012 radio collars (Wildlife Materials, Inc.) . One was periodically located using hand-held radio telemetry equipment, while the other was monitored 24 hours daily with a Rustrack signal recorder from 2-13 August. Sample sizes are small, but these pilot studies may help determine whether further effort is warranted.

Nest Boxes. Wooden nest boxes, approximately 13cm x 13cm by 26cm with a 2.25 cm entrance hole (Morris, personal communication), were placed at SG and ISRO during the summer of 1995. If occupied, they will be monitored during the summer of 1996 to help assess reproductive success (Morris 1991). Ten boxes were placed in each of the following locations: the Bangsund-Edison trail, the Bone Cove area, Inner Hill Island

(all at ISRO), and SG. At each location, half of the boxes were placed on the ground and half fastened to trees approximately 1 meter off the ground, due to arboreal nesting behavior (Wolff and Hurlbutt 1982).

RESULTS

Presence/Absence. During the summer of 1995, deer mice were found on Isle Royale, Mott, Davidson, Inner and Outer Hill, Rabbit, Cemetery, East and West Caribou Islands (Fig 3). It was determined that mice were absent from Smithwick, Shaw, Raspberry, Bat, North and South Government Islands after no captures in 50 trap-nights at each location (Fig 3). After no captures from three separate trap grids totaling 720 trap-nights, it was determined that no mice were present on Passage Island, a 232 hectare island located 5.5km NE of Blake Point. After 300 trap-nights without capture, it was determined that no mice were present on Star Island; W. Johnson found mice on Star Island in 1969.

Relative Densities. Relative densities for the east end of the main island (Bangsund/Edison/Daisy Farm) increased from June to August (Table 1). July relative densities were lowest at the west end, intermediate in the middle, and highest at the east end of the island (Table 1). Relative densities for the Rock Harbor chain islands were generally lower in July than in August, but the effect of island size is not clear (Table 2). The combined relative density for the chain islands was 11.24/100TN in July and 20/100TN in August. Small islands were not trapped extensively to minimize impact on the populations.

Table 1. Spatial and temporal relative densities for the main island in mice per 100 trap-nights. Number of trap nights in parentheses.

	June	July	August
West		2.87(1080)	
East	1.10(2178)	10.23(215)	14.00(50)
Middle		7.4(500)	

Table 2. Relative densities for the Rock Harbor chain islands in mice per 100 trap-nights. Island area and number of trap-nights in parentheses.

Island (apprx size)	Date Trapped	Density (trp-nights)
Mott (136.5 ha)	24-26 July	12 (50)
Davidson (9.3 ha)	24-26 July	10 (30)
Outer Hill (30.6 ha)	24-26 July	10 (50)
E. Caribou (67.3 ha)	24-26 July	5.13 (39)
W. Caribou (64.5 ha)	8-10 August	30 (25)
Cemetery (2.3 ha)	8-10 August	16 (10)
Rabbit (4.9 ha)	8-10 August	20 (25)

The Lincoln-Petersen Index was used with capture-recapture data from Spring and late Summer live-trap sessions (Appendix 1) to obtain preliminary estimates of densities:

$$\hat{N} = \frac{n_1 n_2}{m_2} \quad \text{where } \hat{N} = \text{the estimate of population size}$$

n_1 = size of initial sample of animals
 n_2 = size of second sample of animals
 m_2 = number of marked animals in n_2

While Spring densities were comparable at ISRO and SG, the ISRO populations attained higher densities by August (Table 3). These preliminary estimates have been made using

just the area that the trap grid covers, unadjusted for effective grid size. Ultimately, densities will be calculated using one of the Jolly-Seber-Cormack software programs and capture histories of each individual mouse, and adjusted for effective trap grid area.

Table 3. Spring and late summer density estimates given as mice per hectare.

	Spring	August
SG	5	7
Bangsund	3.5	16
Inner Hill	5	25
Star	0	0

Growth Rates. Spring and late Summer densities were used to estimate population and per capita growth rates. Population growth rate was estimated for each population by dividing the difference in Spring and August densities by the number of days between trap sessions (ISRO=67days; SG=70days) to yield population growth rate in mice per day:

$$\frac{dN}{dt} = \frac{(Aug - Spring)}{\#daysbetweensessions} = \frac{mice}{day}$$

Per capita growth rate was estimated for each population by dividing the population growth rate by the Spring density to yield the number of mice produced per mouse per day:

$$\begin{aligned} \frac{dN}{dt} &= rN \\ r &= \left(\frac{1}{N}\right)\left(\frac{dN}{dt}\right) \\ r &= \left(\frac{1}{Spring}\right)\left(\frac{Aug - Spring}{\#daysbetween}\right) \\ r &= \frac{\#mice}{mouse \bullet day} \end{aligned}$$

ISRO growth rates appear to be an order of magnitude greater than SG growth rates

(Table 4).

Table 4. Population growth rate (dN/dt) in mice per day and per capita growth rate in mice per mouse per day.

	dN/dt	r
SG	0.03	0.006
Bangsund	0.2	0.05
Inner Hill	0.3	0.06

Morphology. Weights, ear, hind foot and tail measurements taken on live-trapped mice are shown in the capture-recapture data (Appendix 1). While data were collected for each mouse, to avoid confounding due to age, only those of adults caught in Spring were used to estimate population means here (Table 5). For ears and hind feet, the mean difference between left and right sides of each mouse is also shown. The standard error (s) is shown in parentheses below each mean. Again, sample sizes are small (shown in table below location), but results may show areas for further study.

Table 5. Average weights and measurements of adults in Spring.

	Weight (grams)	Ears (mm)	Hind Feet (mm)	Tail Length (mm)
SG (n = 4)	$X = 17.00$ (s = 1.214)	$X = 15.125$ (s = 0.582)	$X = 19.125$ (s = 1.642)	$X = 83.25$ (s = 6.551)
		$X_d = 0$ $s_d = 0$	$X_d = 0.75$ $s_d = 0.5$	
Bangsund (n = 5)	$X = 19.99$ (s = 1.176)	$X = 14.00$ (s = 0)	$X = 19.00$ (s = 1.33)	$X = 84$ (s = 3.46)
		$X_d = 0$ (s = 0)	$X = 0$ (s = 0)	
Inner Hill (n = 6)	$X = 19.47$ (s = 2.00)	$X = 14.364$ (s = 1.433)	$X = 18.833$ (s = 0.389)	$X = 71.167$ (s = 4.26)
		$X_d = 0.2$ (s _d = 0.447)	$X_d = 0$ (s _d = 0)	

Breeding. The first live-trap session at SG (21-23 May) showed no mice ($n=4$; 2 males; 2 females) to be in breeding condition. During 54 snap-trap-nights (27-29 May) at SG, one male deer mouse was caught and found to have enlarged testes, indicating breeding had likely begun (3 red-backed voles were also caught; 2 males had enlarged testes; the female did not have swollen mammary glands). The first mice caught at ISRO (6-10 June) all showed enlarged mammary glands and scrotal testes, indicating that breeding was underway. On Inner Hill Island, one juvenile female (9.7g) was captured on 6 June, suggesting that breeding had begun approximately 6 weeks prior, 24 days gestation and 21 days to reach 9.7g (Millar 1989). This suggests that breeding begins earlier at ISRO than at SG. For ISRO females found to be carrying fetuses when sacrificed ($n=24$), the mean number of fetuses per female was 4.9 ($s=0.9$). Unfortunately, none of the females sacrificed at SG were found to be carrying fetuses, so no comparison can be made.

Genetic Samples. A total of 201 tissue samples were taken for genetic analysis, including 29 from SG and 172 from the ISRO archipelago (Table 6, Appendix 2). On 16 October 1995, all tissue samples were shipped to Dr. R. Lacy's genetics laboratory at the Brookfield Zoo in Chicago, IL. Microsatellite DNA analysis to assess heterozygosity will be conducted under the direction of Dr. J. Dubach in Fall of 1996. No results are available at this time.

Table 6. Tissue samples taken for genetic analysis

Study Area	Location	# Samples
Mainland	SG	29
I. Royale- East	Daisy Farm	7
	Bangsund	18
	Daisy/Edisn	22
I.Royale- Mid	Siskiwit	17
	1936 Burn	12
	Edge of Burn	8
I.Royale- West	Windigo	31
I.Royale- North	Todd Harbor	2
I.Royale- R.H. Chain Islands	E. Caribou	2
	W. Caribou	5
	Rabbit	4
	Cemetery	3
	Mott	6
	Davidson	6
	Outer Hill	5
	Inner Hill	24
Total		201

Diet Analysis. Stomachs were collected for diet analysis from all snap-trapped mice. Included are spatial (east, west, middle) and temporal (Jun, Jul, Aug for east end) samples from the main island of ISRO, as well as samples from the Rock Harbor chain islands and from SG (Table 7). Stomachs were also collected from red-backed voles (39) and shrews (2) caught in snap traps at SG.

Table 7. Number of mouse stomachs collected.

	June	July	August
ISRO East	31	22	7
ISRO West		31	
ISRO Mid.		37	
RH Chain		19	12
SG	3		15

An M.S. student, Michelle Olson, is currently analyzing the stomach contents. While her report will be forthcoming, initial data suggest the mice prefer insects, and occasionally eat fruits.

Upon dissection to collect stomachs, many abnormal livers were noticed in ISRO mice. They were grainy and mottled in appearance rather than smooth and shiny. Several were discolored and appeared yellowish or pale. Occurrence of abnormal livers was noted (approximately 41/97) and a few tissue samples were collected. Mice from SG (n=15) all had apparently normal livers.

Activity Patterns. Since the seed tray experiments were run at different times throughout the summer, to make the results more comparable, I attempted to adjust for population density by dividing the grams of seeds taken, by the population density for that time period. There was little variation in the amount of seed taken for a given moon phase on ISRO (Table 8, Appendix 3). The amount of seed taken at SG varied, but not as expected if bright moonlight increases the risk of predation (Table 8, Appendix 3).

Table 8. Results of seed tray experiments. Values given as grams of seeds taken per mouse. Higher values indicate more activity.

	New Moon	First Half	Full Moon	Last Half
SG	1.43	4.41	2.85	- - - - -
ISRO	0.67	1.02	1.11	0.96

On 29 July, one female and one male mouse were fitted with radio collars. We located the diurnal nest site of the radio-collared female mouse approximately 33.5 meters from her original point of capture, and positioned a Rustrack recorder there to monitor her activity around the clock. Each night (2-13 Aug), regardless of moon phase, she left her nest at approximately 9:30 - 10:00 PM, and returned at 5:00 - 6:00 AM. Clear or cloudy weather did not seem to affect her activity patterns. Her active period lasted between 7 and 8 1/2 hours nightly. On several occasions she was located 47 meters from her diurnal nest site, presumable foraging, although she was not visually located. She was not recaptured during the August live-trap session (16-20 Aug) and her collar ceased to emit a signal on 14 August, 16 days after collaring.

The radio-collared male mouse was monitored intermittently using hand-held equipment, but was difficult to locate. After several attempts, we located his diurnal nest approximately 150 meters from where he was originally trapped. This distance, combined with the possibility of foraging in directions away from our grid area, made him difficult to locate regularly. He was recaptured four times, in good condition, during the August live-trap session (16, 17, 19, 20 Aug). The radio-collar, which had ceased to emit a signal, was removed on 17 Aug, 19 days after collaring.

DISCUSSION

There was a clear increase in relative density throughout the summer at the east end of the main island at ISRO; this is expected as those individuals that survive the winter enter the breeding season. Deer mouse populations are known to cycle seasonally (Galindo and Krebs 1987, Vessey 1987). July density was lowest at the west end, highest

at the east end and intermediate in the central part of the island. The relative density of the chain islands in July (11.24) was comparable to that of the east end of the main island during the same period (10.23). However, in August the chain islands had a higher relative density than did the east end of the main island (20 and 14, respectively).

While Spring densities are approximately equal on the mainland (5/ha at SG) and the islands (3.5/ha at Bangsund; 5/ha at Inner Hill), late summer densities are much higher on the islands (16/ha at Bangsund; 25/ha at Inner Hill) than on the mainland (7/ha at SG). There also appear to be order of magnitude differences in population and per capita growth rates between the island and mainland populations. There may be a difference in the fecundity of these mice or the apparent difference may be due to release of island populations from predation, allowing a greater increase in abundance. Potential predators of mice at SG include garter snakes, red fox, mustelids, hawks, and owls (Friends of Sleeping Giant fauna lists). Some of these may attain substantial numbers due to the protection of the park. ISRO has fewer predator species due to its distance from the mainland and reduced density of predators because of limited prey availability. Potential predators of mice on ISRO include the red fox and garter snake; very few birds of prey are present (R.O. Peterson, personal communication). Unless reproduction is quite reduced at SG, it is likely that the difference in densities and growth rates is due to a release from predation in the ISRO population.

The mean number of fetuses per female at ISRO (4.9) is typical of litter sizes found in the literature (Millar 1989); none of the females collected at SG were carrying fetuses, so no estimate of litter size can be made. However, if the ISRO mice do begin

breeding earlier, as initial information suggests, they may be able to reach a higher density by the end of summer (Miller and Getz 1977). It may be that there is greater variance in onset of breeding at ISRO, and thus some individuals begin sooner. There may be some biotic or abiotic constraints that influence the onset of breeding, i.e., weather conditions, amount of food cached, inter-specific competition for nest sites, predator or parasite avoidance. Estimating age by pelage color, young of the year mice from SG likely breed (no fetuses found, but enlarged mammaries). Estimating age by both pelage color and body weight (13.2g), young of the year do breed at ISRO (fetuses found).

Interspecific competition for food and/or nest sites may also affect density. SG deer mice are sympatric with several other species of small mammals: red-backed voles (RBV), shrews, jumping mice, red squirrels. During Spring, the ratio of RBV to deer mice trapped in live traps was 1:1 and in snap traps was 2:1, while in August the ratio was 1.3:1 in live traps and 1.9:1 in snaps. Deer mice and RBV may compete for nest sites, but are unlikely competitors for food; Gilbert and Krebs (1984), Galindo and Krebs (1984) and Morris (1984) found them to have little or no impact on each others population densities. Deer mice prefer insects, with some fruits or seeds, while RBV utilize mainly vegetation. A very few shrews(5) were also trapped at SG in August; these insectivores may be in competition with deer mice for food. In contrast, deer mice and red squirrels are the only small mammals at ISRO.

Mean size and weight for mice from ISRO and SG are very similar. The only characteristic of note is mean tail length, which is considerably shorter on Inner Hill Island(71.17mm) than at either Bangsund(84mm) or SG(83.25mm) Statistical tests have

little power when sample sizes are small. However, this preliminary data suggest that the mean size and weight for these populations do not differ grossly. There are too few measurements to assess symmetry. In addition, unless differences were large, it is likely that measurement error on live animals in the field would mask any asymmetry in ear or foot length. Skulls collected have not yet been processed.

Release from predation in ISRO could lead to activity patterns that differ from mainland mice. Desert rodents alter their nocturnal foraging activity, based on moon phase, because during bright moon periods they are more vulnerable to predators (Kotler et al 1994). It is unknown if boreal rodents likewise alter activity patterns with moon phase. If activity patterns differ with moon phase on the mainland, but do not on the islands, this may suggest a release from predation for the island populations. Activity patterns were investigated using seed tray experiments and radio collars.

Seed tray experiments suggest that nocturnal activity of ISRO mice is similar for each moon phase. Activity at ISRO was slightly greater during full moon, less during half moons, and least during new moon. While there was much more variability in nocturnal activity of SG mice, no clear pattern emerges from these data to suggest that activity is altered to minimize predation risk during bright moonlight. The most to least active periods at SG were first half moon (most), full moon, new moon (least). Larger sample sizes are needed, as well as simultaneous island/mainland experimentation to avoid confounding problems of weather conditions. Ideally, light levels should be measured to assure similar conditions are being compared at each location.

The female mouse at ISRO whose activity was continuously monitored showed no change in behavior during first half and full moon phases, including clear and cloudy weather; this corresponds with the seed tray results. Unlike desert rodents, she apparently did not experience an increase in predation risk with increased light levels. Unfortunately, we were unable to collar and monitor mice at SG for comparison. While the cost of transmitters and receivers limits the number of mice that can be collared and monitored, this method gives more direct information on activity than do seed tray experiments. Monitoring light levels and activity patterns during several phases of the moon at island and mainland sites would provide insight into how boreal rodents respond to light levels and whether the response differs between populations with different predation risk. Since these initial attempts at monitoring activity using seed trays and radio collars showed some correlation for the ISRO mice, perhaps both methods should be used, with enough seed trays to be statistically significant, and collars to be sure seed tray results truly correlate with mouse activity.

P. maniculatus is often cited for its arboreal activity (Eisenberg 1968, King 1968, Wolff and Hurlbutt 1982). I witnessed arboreal activity on two occasions. On 2 August, upon release after live capture, mouse tagged #45 climbed approximately 1.5m up a balsam fir tree (10cm dbh), sat on a branch, and observed us. She fell off the branch, got up and immediately climbed the same tree to a height of about 2m. After watching us for about 2 minutes, she ran down and disappeared along the ground. On 3 August mouse tagged #53 ran approximately 2m up an alder bush (5cm dbh), paused briefly, then ran down and escaped along the ground.

Most inbreeding studies use reproductive success as a measure of fitness (Bowman and Falconer 1960, Brewer et al 1990, Ribble and Millar 1992). Several researchers successfully used nest boxes to study reproduction in *Peromyscus* (Morris 1991, Wolff personal communication). We hope to estimate the number of young per litter, as well as the growth rate and survival of pups for each population by monitoring nest boxes placed at each location.

It is unknown at this time if the abnormal livers found at ISRO affect the fitness of the mice. The mottled, yellowish color and hard, grainy texture suggests that these areas may not function normally. No further investigation has been pursued to date, and the condition remains unexplained.

FUTURE WORK

The observational study of ISRO deer mice will be continued, focusing on assessing the fecundity and survival of the Bangsund and Inner Hill populations. Since mice were absent from Star Island, with permission of the ISRO National Park Service, study will be initiated on another small island. This will maintain the “small-medium-large” trend in island size across which to compare levels of heterozygosity and indicators of fitness. To complement the observational study on ISRO, a controlled, replicated experiment is being designed to investigate the effects of population bottlenecks, inbreeding, and fitness under semi-natural conditions. This will be done on the Keweenaw Peninsula (KP), in close proximity to Michigan Technological University. For logistic reasons, the study of mainland mice will be shifted from SG to KP.

In Spring of 1996, live traps will be used to estimate population densities at SG, ISRO and the Keweenaw Peninsula (KP). Density estimates from SG and ISRO will be compared to those of late Summer, 1995, to estimate overwinter survival. Trapping will be initiated on the KP to facilitate a more intensive study of a mainland population. Spring trapping on the KP will overlap Spring trapping at SG to make a smooth transition so that results are more comparable. Populations at ISRO and KP will live-trapped again late in the summer to continue monitoring growth rates and survival.

During Spring trap sessions, nest boxes in place at SG and ISRO will be monitored daily for signs of use. If occupied, reproduction will be investigated by counting and weighing pups, and recording survival. Pups and adults will be ear-tagged for identification. If nest boxes are readily used by mice, additional boxes will be built for use on the KP; if not readily used, alternate designs will be tested on the KP.

Tissue samples collected at ISRO and SG during 1995, and additional samples collected from ISRO and KP during 1996, will be analyzed for heterozygosity using Microsatellite DNA techniques in Fall, 1996. This will be done at the Brookfield Zoo Genetics Laboratory under the direction of Dr. Jean Dubach via a work/study arrangement. I expect to be in residence at the Brookfield Genetics Lab during September and October, 1996. Data will be analyzed for correlations between island size, population size, heterozygosity and fitness.

Mid-summer will be spent on the KP initiating a controlled, replicated experiment to investigate the interactions of population bottlenecks, inbreeding and fitness. Local, panmictic populations provide a ready source of stock for exposure to bottlenecks.

Population bottlenecks will be created under the advice of Dr. R. C. Lacy of the Brookfield Zoo Genetics Laboratory. Two possibilities are currently under consideration.

One possibility involves captive inbreeding using a two-factor (population size and length of bottleneck) factorial experimental design resulting in inbreeding coefficients that vary between (approximately) zero and 0.75; each level would be replicated. Inbred mice would be released into enclosures built in their original habitat, exposed to the natural abiotic environment, intraspecific competition and predation. Measures of survival and fecundity, estimated using live-traps and nest boxes, will be used to assess fitness, and tissue samples will be taken to assess heterozygosity as the population increases. A benefit of this approach is tight control on the level of inbreeding. Drawbacks include removing generations of animals from natural conditions, as well as the time and cost of captive inbreeding. In addition, it may be that those animals which survive the initial stages of inbreeding in captivity will be purged of their genetic load and show no interesting results.

A second possibility is to mimic bottleneck situations by stocking enclosures with populations of different starting size (i.e., 4, 16, 32), and letting the mice breed at will. This would more closely approximate a bottleneck situation in nature, in which population size is restricted by habitat fragmentation or temporarily reduced by a catastrophe. Animals may fare poorly during initial stages of the bottleneck, or at some population size they may be able to avoid inbreeding sufficiently to minimize loss of fitness. Again, heterozygosity, survival and fecundity would be monitored as the populations increased.

This may also serve as a better complement to the observational study conducted at ISRO.

It would also require less time and money invested in preparation of the release.

Please comment on any aspect of this study, particularly the possible bottleneck experiments. We welcome any suggestions for improvement!

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**Figure 1. Location of Isle Royale National Park (ISRO),
Sleeping Giant Provincial Park (SG) and the
Keweenaw Peninsula (KP).**

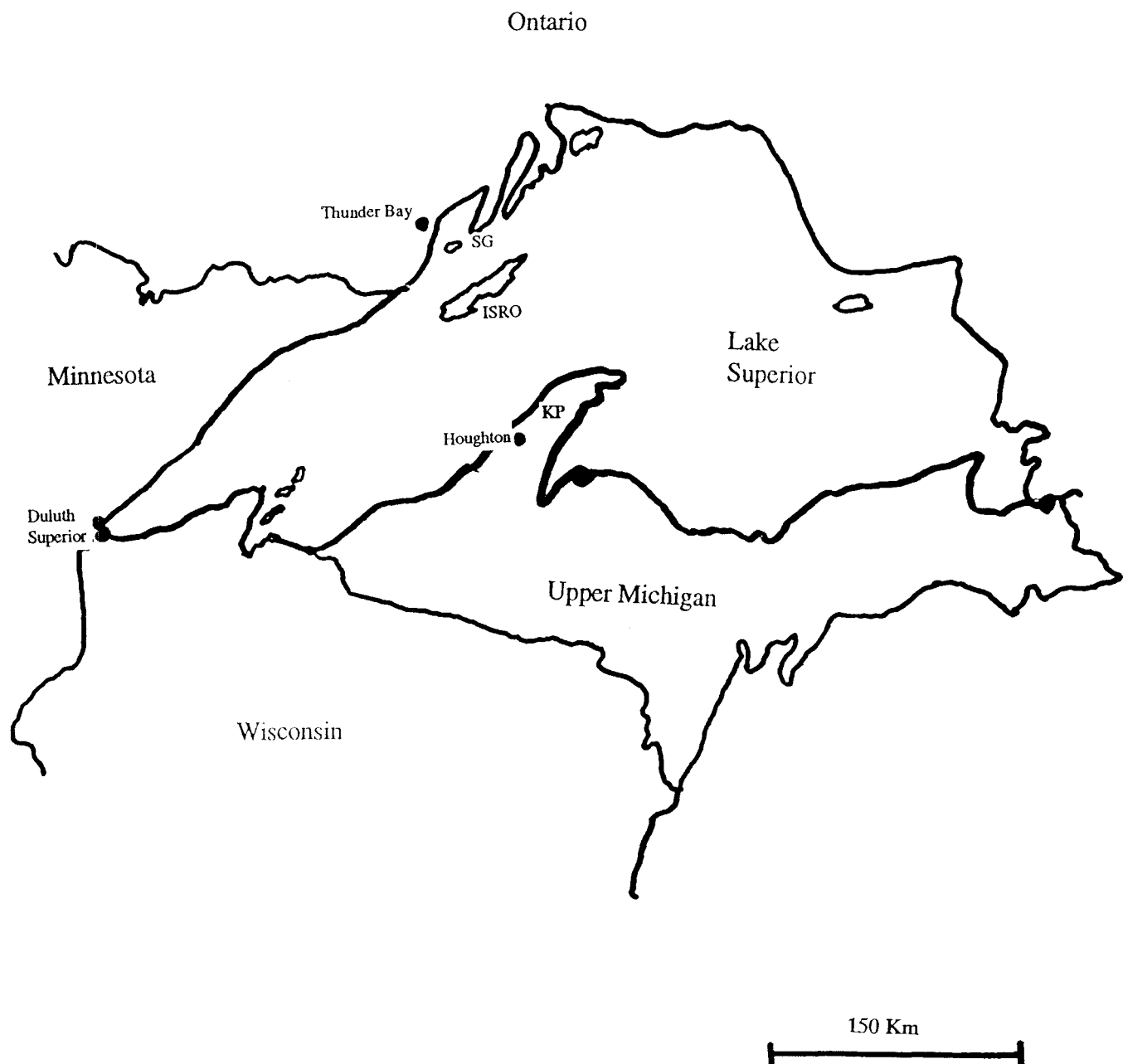


Figure 2. Sleeping Giant Provincial Park Study Area.

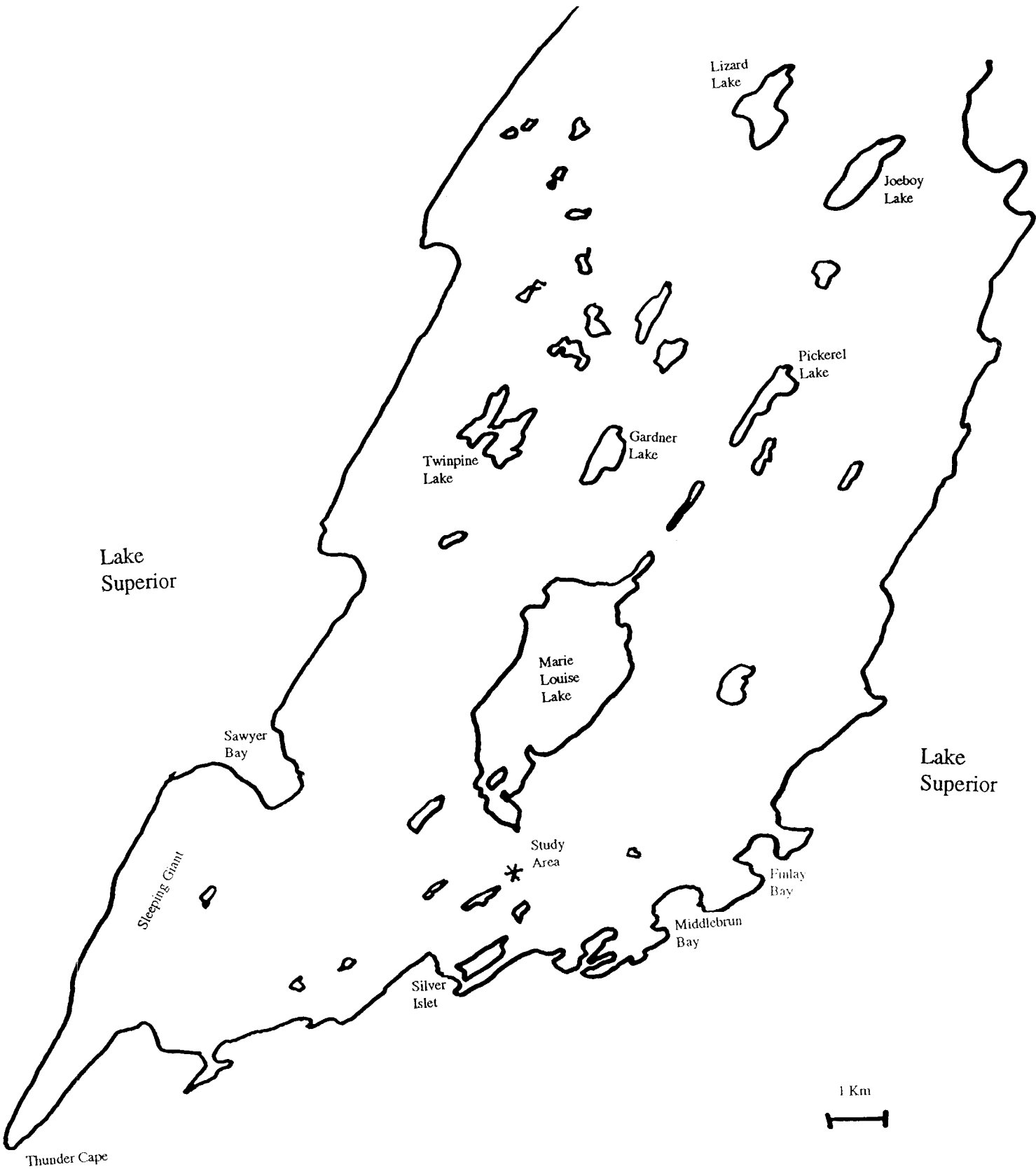
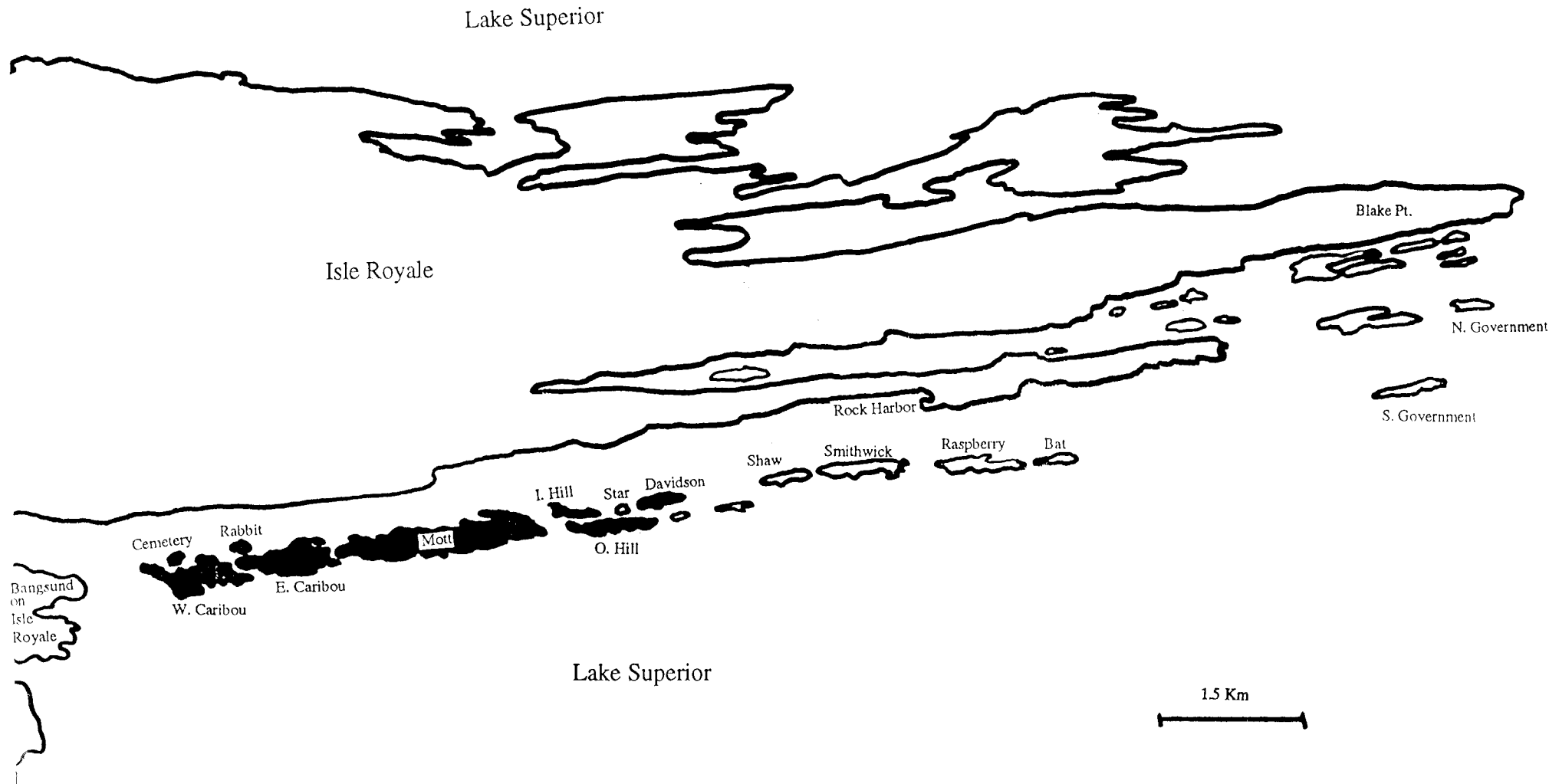


Figure 3. East End of Isle Royale and Rock Harbor Chain Islands.

All labeled chain islands were sampled. Those filled in black had mice present: Cemetery, Rabbit, E. and W. Caribou, Mott, I. and O. Hill, Davidson. Those simply outlined did not have mice present: Shaw, Smithwick, Raspberry, Bat, N. and S. Government, and Passage (not shown, 5.5km NE of Blake Pt.).



Live Trap Data

LIVE	TRAP	DATA	1995																		
x=traps no \=not appli	t set cable	0=f 1=m	0=juv 1=aj 2=adult																		
Trap Grid	E-tag#	Sex	Age	Wt(g)	1st Captr	T r a p			H i s t			L o c a t i o n			H i s t						
						S	p	r	n	g	F	a	i	l	J	u	n	e	A	u	g
SGPP	1	0	2	18	21-May-95	1	1	0	x	x	0	0	0	x	4	4\	x	x	\	\	\
SGPP	2	0	2	19.5	21-May-95	1	1	1	x	x	0	0	1	x	41	28	37	x	x	73\	\
SGPP	3	1	2	16.75	22-May-95	0	1	0	x	x	0	0	0	x	\	24\	x	x	\	\	\
SGPP	4	1	2	17.25	23-May-95	0	0	1	x	x	0	0	0	x	\	\	9	x	x	\	\
SGPP	36	1		12.25	2-Aug-95	0	0	0	x	x	1	1	0	x	\	\	\	x	x	4	23
SGPP	38	0		13	2-Aug-95	0	0	0	x	x	1	1	0	x	\	\	\	x	x	26	26
SGPP	39	0		13.6	2-Aug-95	0	0	0	x	x	1	1	0	x	\	\	\	x	x	33	15
SGPP	40	1		13	2-Aug-95	0	0	0	x	x	1	1	1	x	\	\	\	x	x	31	22
SGPP	41	1		12.75	2-Aug-95	0	0	0	x	x	0	1	0	x	\	\	\	x	x	41\	53\
SGPP	42	1		13.9	2-Aug-95	0	0	0	x	x	0	1	1	x	\	\	\	x	x	59\	48
SGPP	43	1		16.5	2-Aug-95	0	0	0	x	x	1	1	1	x	\	\	\	x	x	63	31
SGPP	44	0		14.75	2-Aug-95	0	0	0	x	x	1	1	1	x	\	\	\	x	x	65	54
SGPP	45	0		18.75	2-Aug-95	0	0	0	x	x	1	0	0	x	\	\	\	x	x	79	90\
SGPP	47	1		13.4	2-Aug-95	0	0	0	x	x	0	1	1	x	\	\	\	x	x	78\	85
SGPP	48	1		13.1	2-Aug-95	0	0	0	x	x	0	0	0	x	\	\	\	x	x	86\	\
SGPP	51	0		17.7	3-Aug-95	0	0	0	x	x	1	1	0	x	\	\	\	x	x	\	2
SGPP	52	0		10	3-Aug-95	0	0	0	x	x	1	0	0	x	\	\	\	x	x	\	12\
SGPP	53	0		14.25	3-Aug-95	0	0	0	x	x	1	0	0	x	\	\	\	x	x	\	71\
SGPP	54	0		10.5	3-Aug-95	0	0	0	x	x	1	1	1	x	\	\	\	x	x	\	82
Bangsund	6	0	2	19.1	6-Jun-95	1	1	1	1	1	1	0	0	0						25	25\
Bangsund	5	1	2	21.65	6-Jun-95	1	1	1	0	1	0	0	0	0						\	\
Bangsund	7	1	2	20.8	6-Jun-95	1	1	1	1	1	0	0	0	0						\	\
Bangsund	50	1	2	19	7-Jun-95	0	1	1	1	1	0	0	0	0						\	\
Bangsund	23	1	2	19.4	9-Jun-95	0	0	0	1	0	0	1	1	0						\	\
Bangsund	55	1	2	16	16-Aug-95	0	0	0	0	0	0	1	1	1	\	\	\	\	\	16\	4
Bangsund	57	0	1	17	16-Aug-95	0	0	0	0	0	1	0	0	1	\	\	\	\	\	20	30\
Bangsund	58	1	0	13.25	16-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	34\	\
Bangsund	59	0?	0	7.25	16-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	35\	\
Bangsund	60	?	1	16.75	16-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	40\	\
Bangsund	61	0	2	23.6	16-Aug-95	0	0	0	0	0	0	1	0	1	\	\	\	\	\	52\	51\
Bangsund	62	0	0	24.5	16-Aug-95	0	0	0	0	0	1	0	0	0	\	\	\	\	\	55	52\
Bangsund	33	1	2	21.5	16-Aug-95	0	0	0	0	0	1	0	1	1	\	\	\	\	\	61	51\
Bangsund	83	0	0\		17-Aug-95	0	0	0	0	0	1	0	0	0	\	\	\	\	\	\	64\
Bangsund	87	1	0	7	18-Aug-95	0	0	0	0	0	0	1	0	0	\	\	\	\	\	\	42\
Bangsund	34	0	2	18	18-Aug-95	0	0	0	0	0	0	1	0	0	\	\	\	\	\	\	45\
Bangsund	88	1	1	16.5	19-Aug-95	0	0	0	0	0	0	0	1	1	\	\	\	\	\	\	13
Bangsund	90	?	1	18	19-Aug-95	0	0	0	0	0	0	0	1	1	\	\	\	\	\	\	25
Bangsund	91	1?	?	8	19-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	\	30\
Bangsund	92	1	1	13.75	19-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	\	34\
Bangsund	93	?	0	7.35	19-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	\	43\

Appendix 1
Live Trap Data

Trap Grid	E-tag#	Sex	Age	Wt(g)	1st Captr	T r a p				H i s t				L o c a t i o n				H i s t			
						S	p	r	n	F	a	i	l	J	u	n	e	A	u	g	
Bangsund	94	1	1	19	19-Aug-95	0	0	0	0	0	0	1	1	\	\	\	\	\	\	\	57 58
Bangsund	103	1	1	15.8	20-Aug-95	0	0	0	0	0	0	0	1	\	\	\	\	\	\	\	4
Bangsund	104	1	0	16.75	20-Aug-95	0	0	0	0	0	0	0	1	\	\	\	\	\	\	\	34
Bangsund	105	1	1	16.5	20-Aug-95	0	0	0	0	0	0	0	1	\	\	\	\	\	\	\	55
Bangsund	\	?	0	16.25	20-Aug-95	0	0	0	0	0	0	0	1	\	\	\	\	\	\	\	59
Inner Hill	10	0	0	9.7	6-Jun-95	1	1	1	0	0	0	0	0			\	\	\	\	\	\
Inner Hill	22	0	2	18.6	6-Jun-95	1	1	1	1	1	0	0	0					\	\	\	\
Inner Hill	13	0	2	20.1	6-Jun-95	1	1	0	0	0	1	0	0					17	26	\	\
Inner Hill	37	0	2	16.75	7-Jun-95	0	1	1	1	1	1	1	1					20	21	39	31 28
Inner Hill	45	0	2	18.75	7-Jun-95	0	1	1	0	0	0	0	0					\	\	\	\
Inner Hill	26	1	2	19.95	8-Jun-95	0	0	1	1	0	0	0	0					\	\	\	\
Inner Hill	20	0	2	22.7	10-Jun-95	0	0	0	0	1	1	0	1					56	56	\	61 61
Inner Hill	64	0	1	15.6	16-Aug-95	0	0	0	0	0	?	0	1	1	\	\	\	4	?	\	2 1
Inner Hill	65	1	1	15.5	16-Aug-95	0	0	0	0	0	?	1	1	1	\	\	\	7	?	16	19 11
Inner Hill	67	1	1	12.75	16-Aug-95	0	0	0	0	0	1	1	0	1	\	\	\	9	25	17	\ 18
Inner Hill	68	?	1	20.5	16-Aug-95	0	0	0	0	0	?	0	1	1	\	\	\	15	?	\	11 8
Inner Hill	69	0?	0	11.75	16-Aug-95	0	0	0	0	0	1	0	1	1	\	\	\	14	18	\	27 25
Inner Hill	70	1	1	16.75	16-Aug-95	0	0	0	0	0	1	1	1	1	\	\	\	13	13	1	13 12
Inner Hill	71	0?	1	15	16-Aug-95	0	0	0	0	0	1	1	1	1	\	\	\	21	13	21	21 20
Inner Hill	72	1	1	14.1	16-Aug-95	0	0	0	0	0	0	1	1	1	\	\	\	22	\	23	28 33
Inner Hill	74	1	0	12.25	16-Aug-95	0	0	0	0	0	0	1	1	1	\	\	\	37	\	38	30 38
Inner Hill	75	1	1	\	16-Aug-95	0	0	0	0	0	1	1	1	0	\	\	\	36	42	37	49 \
Inner Hill	76	1	1	15	16-Aug-95	0	0	0	0	0	1	1	1	1	\	\	\	40	52	44	48 46
Inner Hill	77	1	1	14.85	16-Aug-95	0	0	0	0	0	1	1	0	1	\	\	\	43	49	40	\ 43
Inner Hill	78	1	1	15.5	16-Aug-95	0	0	0	0	0	1	1	1	0	\	\	\	53	31	46	46 \
Inner Hill	79	1	1	14.5	16-Aug-95	0	0	0	0	0	1	1	0	0	\	\	\	52	55	52	\ \
Inner Hill	80	1	1	17.1	16-Aug-95	0	0	0	0	0	1	1	1	0	\	\	\	50	51	50	50 \
Inner Hill	81	1	1	14.25	16-Aug-95	0	0	0	0	0	1	1	0	0	\	\	\	60	61	53	\ \
Inner Hill	82	0	2	20	16-Aug-95	0	0	0	0	0	1	0	1	1	\	\	\	59	60	\	59 57
Inner Hill	84	1	1	13	17-Aug-95	0	0	0	0	0	1	1	1	1	\	\	\	\	27	19	29 24
Inner Hill	85	?	0	7.25	17-Aug-95	0	0	0	0	0	1	0	1	1	\	\	\	\	33	\	32 39
Inner Hill	\	1	1		17-Aug-95	0	0	0	0	0	1	0	0	0	\	\	\	\	46	\	\ \
Inner Hill	95	0	1	?	19-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	\	23 \
Inner Hill	97	0	?	17.5	19-Aug-95	0	0	0	0	0	0	0	1	1	\	\	\	\	\	\	47 55
Inner Hill	100	1	1	14.75	19-Aug-95	0	0	0	0	0	0	0	1	1	\	\	\	\	\	\	51 49
Inner Hill	101	1	0	12.75	19-Aug-95	0	0	0	0	0	0	0	1	1	\	\	\	\	\	\	57 42
Inner Hill	102	0	1	14.75	19-Aug-95	0	0	0	0	0	0	0	1	0	\	\	\	\	\	\	60 \
Inner Hill	106	0	2	17.5	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	16
Inner Hill	107	1	1	15.7	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	31
Inner Hill	108	0	1	14.5	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	48
Inner Hill	109	0	1	14.1	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	52
Inner Hill	111	1	0	8.5	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	62
Inner Hill	112	1	0	9.8	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	61
Inner Hill	???												1								32
Inner Hill	\	1	0	13.5	20-Aug-95	0	0	0	0	0	0	0	0	1	\	\	\	\	\	\	51
Inner Hill	???												1								50

Appendix 1

Live Trap Data

									0=no 1=yes		
		Body	Meas. (mm)						Breed	Bot	Gen
Trap Grid	E-tag #	L.ear	R.ear	LH ft	RH ft	Tail	A-P	Cond	larv	#	
SGPP	1	14.5	14.5	19	19	84	4	0	0	\	
SGPP	2	16	16	21	22	91	2	0	0	29	
SGPP	3	15	15	19	18	75	12	0	0	\	
SGPP	4	15	15	18	17	83	6	0	0	\	
SGPP	36	14	14	18	18	73	7	0	0	13	
SGPP	38	12.5	12.5	19	19	\	2	0	0	14	
SGPP	39	16	16	19	19	89	3	0	0	10	
SGPP	40	14	14	18	18	76	4.5	0	0	12	
SGPP	41	14	14	19	19	74	7	0	0	26	
SGPP	42	14	14	19	19	89	6	0	0	25	
SGPP	43	14	14	19	19	89	10	1	0	15	
SGPP	44	14	14	19	19	89	2	0	0	16	
SGPP	45	13.5	13.5	18.5	18.5	94	2	0	0	\	
SGPP	47	15	15	19.5	19.5	90	5	0	0	27	
SGPP	48	15	15	19	19	88	5	0	0	\	
SGPP	51	16	16	19	19	81	3	1	0	9	
SGPP	52	\	\	19	19	\	2	0	0	11	
SGPP	53	13.5	13.5	19	19	88	2	1	0	17	
SGPP	54	\	13	19	19	84	2	0	0	18	
Bangsund	6	14	14	19	19	\	4	*		0	b3
Bangsund	5	14	14	21	21	82	17	1	0	\	
Bangsund	7	14	14	19	19	88	6	1	0	\	
Bangsund	50	14	14	17	17	82	9	0	0	\	
Bangsund	23	\	\	\	\	\	\	*		3	b11
Bangsund	55	\	\	20	20	77		0	0	b1	
Bangsund	57							0	0	b2	
Bangsund	58	\	\	19.5	19.5	\	\	0	0	b4	
Bangsund	59	\	\	17	17	57	1.5	0	1	b5	
Bangsund	60	\	\	\	\	\	\	?		1	b6
Bangsund	61	\	16	19.5	19.5	89	3	1	1	b7	
Bangsund	62	\	\	\	\	\	\	1	3	b8	
Bangsund	33	\	\	\	\	\	\	1	0	b9	
Bangsund	83	\	\	18.5	18.5	\	\	0	3	b10	
Bangsund	87	\	\	18	18	53	\	0	1	b12	
Bangsund	34	\	\	\	\	\	\	1	3	b13	
Bangsund	88	\	\	19	19	78	\	0	2	b14	
Bangsund	90	\	\	\	\	\	\	?	2	\	
Bangsund	91	\	\	17	17	\	\	0	3	b15	
Bangsund	92	\	\	\	\	\	\	0	1	b16	
Bangsund	93	\	\	\	\	\	\	0	1	b17	

Appendix 1
Live Trap Data

Trap Grid	E-tag #	Body L.ear	Meas. R.ear	(mm) LH ft				Breed Cond	Bot larv	Gen #
Bangsund	94 \	\	\	\	\	\	\	0	1	b18
Bangsund	103 \	\	\	\	\	\	\	0	1	\
Bangsund	104 \	\	\	20	20	66	\	0	4	\
Bangsund	105 \	\	\	\	\	\	\	0	1	b19
Bangsund	\	\	\	\	\	\	\	\	\	\
Inner Hill	10	11	11	17	17	57	2	0	0	\
Inner Hill	22	17	17	18	18	72	3	0	0	\
Inner Hill	13	14	14	19	19	74	3 *		0	i8
Inner Hill	37	14	14	19	19	65	3	0	0	i7
Inner Hill	45	15	14	19	19	68	3.5	1	0	\
Inner Hill	26	13 \	\	19	19	71	12.5	1	0	\
Inner Hill	20	13	13	19	19	77	3 *		0	i17
Inner Hill	64 \	\	\	19	19	71	1.5	0	0	i1
Inner Hill	65 \	\	\	19.5	19.5	71	8.5	0	0	i2
Inner Hill	67 \	\	\	19	19	62	7	0	0	i3
Inner Hill	68 \	\	\	\	\	\	?		0	i4
Inner Hill	69 \	\	\	19	\	\	2	0	0	i5
Inner Hill	70 \	\	\	\	\	\	\		0	i20
Inner Hill	71 \	\	\	19	19	57	4	0	0	i6
Inner Hill	72 \	\	\	\	\	\	\	0	0	i9
Inner Hill	74 \	\	\	19	19	\	\	0	0	i10
Inner Hill	75 \	\	\	19	19	66	5.5	0	0	i11
Inner Hill	76 \	\	\	19	19	72	7	0	0	i12
Inner Hill	77 \	\	\	\	\	\	\	0	0	i13
Inner Hill	78 \	\	\	19.5	19.5	74	4	0	0	i14
Inner Hill	79 \	\	\	19	19	\	4	0	0	i15
Inner Hill	80 \	\	\	18.5	18.5	64	5	0	1	i16
Inner Hill	81 \	\	\	19	19	73	7	0	0	i18
Inner Hill	82 \	\	\	19.5	19.5	80	\	1	0	i19
Inner Hill	84 \	\	\	18.5	18.5	67	\	0	0	i21
Inner Hill	85 \	\	\	\	\	\	\	0	0	i22
Inner Hill	\	\	\	\	\	\	\	0	0	
Inner Hill	95 \	\	\	\	\	\	\	0	0	i23
Inner Hill	97 \	\	\	\	\	\	\	\	\	\
Inner Hill	100 \	\	\	\	\	\	\	0	0	i24
Inner Hill	101 \	\	\	\	\	\	\	0	0	\
Inner Hill	102 \	\	\	\	\	\	\	0	0	\
Inner Hill	106 \	\	\	\	\	\	\	0	0	\
Inner Hill	107 \	\	\	\	\	\	\	0	0	\
Inner Hill	108 \	\	\	\	\	\	\	0	0	\
Inner Hill	109 \	\	\	\	\	\	\	0	0	\
Inner Hill	111 \	\	\	\	\	\	\	0	0	\
Inner Hill	112 \	\	\	\	\	\	\	0	0	\
Inner Hill	???	\	\	\	\	\	\			
Inner Hill	\	\	\	\	\	\	\	0	0	
Inner Hill	???									

Appendix 1

Live Trap Data

Trap Grid	E-tag #	Notes	
SGPP	1		
SGPP	2		
SGPP	3		
SGPP	4		
SGPP	36		
SGPP	38		
SGPP	39		
SGPP	40		
SGPP	41		
SGPP	42		
SGPP	43		
SGPP	44		
SGPP	45		
SGPP	47		
SGPP	48		
SGPP	51		
SGPP	52		
SGPP	53		
SGPP	54		
Bangsund	6	Jun brdg=0; Aug brdg=1; wt=23; 6mam vis	
Bangsund	5		
Bangsund	7		
Bangsund	50		
Bangsund	23	Aug brdg=1	
Bangsund	55	20Aug wt=17g	19Aug wt=17.5g
Bangsund	57		
Bangsund	58		
Bangsund	59	fleas	19Aug wt=8.1g
Bangsund	60		
Bangsund	61	preg or nursing; 6 mam vis	
Bangsund	62	6 mam vis	
Bangsund	33	Happy Harry-radio collared 29Jul; collar removed 17Aug	base of rt ear torn
Bangsund	83	1 nearly emergent bot taken as sample	
Bangsund	87		
Bangsund	34	fleas; nearly emergent bot fly larva	
Bangsund	88		
Bangsund	90	white spot on forehead; 1 old bot scar besides 2 larvae	20Aug wt=17.5g
Bangsund	91		
Bangsund	92		
Bangsund	93	fleas	

Appendix 1
Live Trap Data

Trap Grid	E-tag #	Notes	
Bangsund	94	20Aug wt=17.75g	
Bangsund	103	one bot scar in add'n to larva	
Bangsund	104	hair loss on forehead	
Bangsund	105	white dot on forehead	
Bangsund	\	escaped!	
Inner Hill	10	DOA in trap on 3rd day	
Inner Hill	22		
Inner Hill	13	Jun brdg=0;Aug brdg=1;6 mam vis	
Inner Hill	37	18Aug wt=16.25g	20Aug wt=15
Inner Hill	45		
Inner Hill	26		
Inner Hill	20	Jun brdg=0;Aug brdg=1;6 mam vis;hair loss; 20Aug in..	trap61 w/m#112
Inner Hill	64	19Aug wt=17g	20Aug wt=16.25g
Inner Hill	65	18Aug wt= 16; 19Aug wt=17.25g; 20Aug wt=17g	
Inner Hill	67	18Aug wt=14g	20Aug wt=12.5
Inner Hill	68	19Aug wt=18g	20 Aug wt=16.75g
Inner Hill	69	19Aug wt=12.25g	20Aug wt=11.75g
Inner Hill	70	in trap w/m#71-17Aug; 18Aug=13.25g; 19Aug=13.75g	20Aug=14.5g
Inner Hill	71	in trap w/m#70-17Aug; 18Aug=13.6g; 19Aug=16g	20Aug wt = 14
Inner Hill	72	bare skin under rt front leg; 18Aug=15.25g; 19Aug=16	20Aug wt=14g
Inner Hill	74	19Aug wt=13g; 18Aug=13g; 20Aug=12.3g	
Inner Hill	75	19Aug wt=13g	18Aug wt=14g
Inner Hill	76	19Aug wt=14.8g18Aug=15g; 20Aug=14.3g	
Inner Hill	77	18Aug wt=15g; 20Aug=13.75g	
Inner Hill	78	19Aug wt=14g	18Aug wt=14.5g
Inner Hill	79		18Aug wt=14.25g
Inner Hill	80	19Aug wt=16.5g; bot fly nearly emerging	18 Aug wt=15.25g
Inner Hill	81		18Aug wt=14.7g
Inner Hill	82	20Aug wt=19.0g	
Inner Hill	84	18Aug wt=12.75g; 19Aug=13.5g; 20Aug=13.6g	
Inner Hill	85	nearly dead; in trap 8-14 hrs; 19Aug=8.65g	20Aug wt=8.0g
Inner Hill	\	DOA; carcass collected	
Inner Hill	95		
Inner Hill	97	escape;no gen sample; rt ear torn	20Aug wt=18.5g
Inner Hill	100	20Aug wt = 13.2g	
Inner Hill	101	no gen sample; out of supplies	20Aug wt=11.75g
Inner Hill	102	no gen sample; out of supplies	
Inner Hill	106		
Inner Hill	107		
Inner Hill	108		
Inner Hill	109		
Inner Hill	111		
Inner Hill	112	caught in trap #61 with mouse #20	
Inner Hill	???	tagged mouse caught; escaped before data recorded	
Inner Hill	\	new mouse caught;not tagged;killed in trap door	
Inner Hill	???	recapture tagged mouse; escaped before data taken	

Appendix 2
Genetic Samples

Genetic	Sample	Data	19	95		0=fem 1=male	0=juv 1=ad/juv 2=adult		0=no 1=yes	0=norm 1=abn
Location	Sample ID#	Date	Trap	Tag#	Tissue	Sex	Age	Weight	Breeding	Liver
Sibley	Sibley#1	2-Aug-95	snap		lung/musc	0	1	15.25	0	0
	Sibley#2	2-Aug-95	snap		lung/musc	0	1	17.7	1	0
	Sibley#3	2-Aug-95	snap		lung/musc	0	1	17.25	1	0
	Sibley#4	2-Aug-95	snap		lung/musc	0	1	19.6	1	0
	Sibley#5	2-Aug-95	snap		lung/musc	0	1	19.5	1	0
	Sibley#6	2-Aug-95	snap		lung/musc	0	0	11.6	0	0
	Sibley#7	2-Aug-95	snap		lung/musc	0	0	9.75	0	0
	Sibley#8	2-Aug-95	snap		lung/musc	1	0	10.8	0?	0
	Sibley#9	3-Aug-95	live	51	ear snip	0	1	17.7	1 /	
	Sibley#10	3-Aug-95	live	39	ear snip					
	Sibley#11	3-Aug-95	live	52	ear snip	0	0	10	0 /	
	Sibley#12	3-Aug-95	live	40	ear snip					
	Sibley#13	3-Aug-95	live	36	ear snip					
	Sibley#14	3-Aug-95	live	38	ear snip					
	Sibley#15	3-Aug-95	live	43	ear snip					
	Sibley#16	3-Aug-95	live	44	ear snip					
	Sibley#17	3-Aug-95	live	53	ear snip	0	1	14.25	1 \	
	Sibley#18	3-Aug-95	live	54	ear snip	0	1	10.5	0 \	
	Sibley#19	3-Aug-95	snap		lung/musc	1	1	16.25	0?	0
	Sibley#20	3-Aug-95	snap		lung/musc	0	1	20.75	0	0
	Sibley#21	3-Aug-95	snap		lung/musc	1	0	11	0?	0
	Sibley#22	3-Aug-95	snap		lung/musc	1	0	11.1	0?	0
	Sibley#23	3-Aug-95	snap		lung/musc	1	0	11.7	0?	0
	Sibley#24	3-Aug-95	snap		lung/musc	1	0	12.8	0?	0
	Sibley#25	4-Aug-95	live	42	ear snip					
	Sibley#26	4-Aug-95	live	41	ear					
	Sibley#27	4-Aug-95	live	47	ear					
	Sibley#28	4-Aug-95	snap		lung/musc	1	1	15.75	0	0
	Sibley#29	5-Aug-95	live	2	ear					
	Sibley#30	5-Aug-95	"live"		lung/musc	0	3	19.25	1	0
ISRO-West Windigo	W#1	3-Jul-95	snap		lung/musc	0	2	26.1	0 \	
	W#2	3-Jul-95	snap		lung/musc	0	2	21	1 \	
	W#3	3-Jul-95	snap		lung/musc	1	2	18.2	0 \	
	W#4	3-Jul-95	snap		lung/musc	1	2	16.7	0 \	
	W#5	3-Jul-95	snap		lung/musc	0	0	15.5	0 \	
	W#6	3-Jul-95	snap		lung/musc	0	0	15.1	0 \	
	W#7	3-Jul-95	snap		lung/musc	1	2	20.75	1 \	
	W#8	4-Jul-95	snap		lung/musc	1	0	15.5	0 \	
	W#9	4-Jul-95	snap		lung/musc	1	0	16.7	0 \	
	W#10	4-Jul-95	snap		lung/musc	0	2	30.4	1 \	
	W#11	4-Jul-95	snap		lung/musc	0	2	20.6	0 \	
	W#12	4-Jul-95	snap		lung/musc	0	0	14.9	0 \	
	W#13	4-Jul-95	snap		lung/musc	0	2	21.9	1 \	
	W#14	4-Jul-95	snap		lung/musc	1	2	19.7	0 \	

Appendix 2
Genetic Samples

	Sample ID#	Date	Trap	Tag#	Tissue	Sex	Age	Weight	Breeding	Liver
	W#15	5-Jul-95	snap		lung/musc	1	2	21.8	0 \	
	W#16	5-Jul-95	snap		lung/musc	1	2	22.7	1 \	
	W#17	5-Jul-95	snap		lung/musc	1	2	22.2	1 \	
	W#18	5-Jul-95	snap		lung/musc	0	0	14.2	0 \	
	W#19	5-Jul-95	snap		lung/musc	0	2	24.7	1 \	
	W#20	5-Jul-95	snap		lung/musc	1	0	16.5	0 \	
	W#21	6-Jul-95	snap		lung/musc	0	2	20.9	1 \	
	W#22	6-Jul-95	snap		lung/musc	0	1	16.25	1 \	
	W#23	6-Jul-95	snap		lung/musc	1	2	20.2	1 \	
	W#24	6-Jul-95	snap		lung/musc	1	2	20.4	1 \	
	W#25	6-Jul-95	snap		lung/musc	1	2	24.2	1 \	
	W#26	6-Jul-95	snap		lung/musc	0	2	22.3	1 \	
	W#27	6-Jul-95	snap		lung/musc	0	2	24.2	1 \	
	W#28	6-Jul-95	snap		lung/musc	0	2	19.6	1 \	
	W#29	6-Jul-95	snap		lung/musc	0	0	13.2	1 \	
	W#30	6-Jul-95	snap		lung/musc	1	0	12.25	0 \	
	W#31	6-Jul-95	snap		lung/musc	1	0	8.6	0 \	
ISRO-Middle s=Siskiwit b=1936 burn e=burn edge	m1s	11-Jul-95	snap		lung/musc	1	0	15.25	0	0
	m2s	11-Jul-95	snap		lung/musc	0	2	21.5	1	0
	m3s	11-Jul-95	snap		lung/musc	1	2	19.8	1	0
	m4s	11-Jul-95	snap		lung/musc	0	0	16.5	1	0
	m5s	11-Jul-95	snap		lung/musc	1	0	13.7	0	0
	m6s	11-Jul-95	snap		lung/musc	1	2	23	1	1
	m7s	11-Jul-95	snap		lung/musc	0	2	21.2	1	0
	m8s	11-Jul-95	snap		lung/musc	1	1	17.5	0	0
	m9s	11-Jul-95	snap		lung/musc	1	2	23	1	1
	m10s	11-Jul-95	snap		lung/musc	0	2	20.5	1	0
	m11s	11-Jul-95	snap		lung/musc	0	2	25	1	0
	m12e	11-Jul-95	snap		lung/musc	0	2	21	1	1
	m13e	11-Jul-95	snap		lung/musc	0	2	23.3	1	0
	m14e	11-Jul-95	snap		lung/musc	0	2	22.5	1	0
	m15e	11-Jul-95	snap		lung/musc	1	0	15.25	?	0
	m16e	11-Jul-95	snap		lung/musc	1	2	21.75	?	1
	m17b	12-Jul-95	snap		lung/musc	0	2	23.15	1	1
	m18b	12-Jul-95	snap		lung/musc	1	2	20.6	1	1
	m19b	12-Jul-95	snap		lung/musc	1	1	21.6	?	1
	m20b	12-Jul-95	snap		lung/musc	1	1	20.4	?	1
	m21b	12-Jul-95	snap		lung/musc	1	0	15.75	?	0
	m22b	12-Jul-95	snap		lung/musc	1	0	14.2	?	0
	m23b	12-Jul-95	snap		lung/musc	0	0	17	1	0
	m24b	12-Jul-95	snap		lung/musc	0	2	25.1	1	1
	m25b	12-Jul-95	snap		lung/musc	0	0	17.2	1	0
	m26b	12-Jul-95	snap		lung/musc	1	0	16.8	?	0
	m27b	12-Jul-95	snap		lung/musc	0	0	12.5	0	0
	m28b	12-Jul-95	snap		lung/musc	1	0	12.2	?	0
	m29e	12-Jul-95	snap		lung/musc	1	2	20.5	?	0
	m30e	12-Jul-95	snap		lung/musc	1	1	18.25	?	0
	m31e	12-Jul-95	snap		lung/musc	1	2	22.25	?	1
	m32s	12-Jul-95	snap		lung/musc	1	1	16.4	?	0

Appendix 2
Genetic Samples

	Sample ID#	Date	Trap	Tag#	Tissue	Sex	Age	Weight	Breeding	Liver
	m33s	12-Jul-95	snap		lung/musc	1	0	17.5	0	0
	m34s	12-Jul-95	snap		lung/musc	1	2	23.8	?	1
	m35s	12-Jul-95	snap		lung/musc	1	0	14.5	0	0
	m36s	12-Jul-95	snap		lung/musc	0	1	20.3	1	0
	m37s	12-Jul-95	snap		lung/musc	1	0	15.3	?	0
ISRO	mott#1	24-Jul-95	snap		lung/musc	0	1	23.25	1	0
Rock	mott#2	24-Jul-95	snap		lung/musc	0	0	17	0	0
Harbor	mott#3	24-Jul-95	snap		lung/musc	0	2	27.5	1	1
Chain	david#1	24-Jul-95	snap		lung/musc	0	0	16.8	0	0
Islands	david#2	24-Jul-95	snap		lung/musc	1	1	18.8	0	1
	david#3	24-Jul-95	snap		lung/musc	0	1	19.5	1	0
	david#4	24-Jul-95	snap		lung/musc	1	0	13.2	0	0
	david#5	24-Jul-95	snap		lung/musc	0	0	15.5	0	0
	o.hill#1	24-Jul-95	snap		lung/musc	1	1	18	?	0
	o.hill#2	24-Jul-95	snap		lung/musc	0	2	21.6	1	1
	o.hill#3	24-Jul-95	snap		lung/musc	0	2	24.6	1	1
	david#6	25-Jul-95	snap		lung/musc	1	0	17	0	0
	e.caribou#1	25-Jul-95	snap		lung/musc	1	2	22	?	1
	mott#4	25-Jul-95	snap		lung/musc	0	2	34.6	1	0
	mott#5	25-Jul-95	snap		lung/musc	0	0	14.9	1	0
	mott#6	25-Jul-95	snap		lung/musc	0	0	10.8	0	0
	o.hill#4	25-Jul-95	snap		lung/musc	1	0	15.5	0	0
	o.hill#5	25-Jul-95	snap		lung/musc	1	0	15.4	?	0
	e.caribou#2	26-Jul-96	snap		lung/musc	0	2	19.6	1	1
	cemetery#1	9-Aug-95	snap		lung/musc	0	1	25.2	1	1
	cemetery#2	9-Aug-95	snap		lung/musc	0	1	25.5	1	1
	cemetery#3	9-Aug-95	snap		lung/musc	1	0	12	?	1
	rabbit#1	9-Aug-95	snap		lung/musc	0	1	23.8	1	1
	rabbit#2	9-Aug-95	snap		lung/musc	0	1	20.5	0	1
	rabbit#3	9-Aug-95	snap		lung/musc	0	1	15.8	0	0
	rabbit#4	9-Aug-95	snap		lung/musc	1	1	16	?	1
	w.caribou#1	10-Aug-96	snap		lung/musc	1	1	21.2	?	1
	w.caribou#2	10-Aug-96	snap		lung/musc	1	1	16.8	?	1
	w.caribou#3	10-Aug-96	snap		lung/musc	0	0	14.9	0	0
	w.caribou#4	10-Aug-96	snap		lung/musc	0	1	18.2	0	1
	w.caribou#5	10-Aug-96	snap		lung/musc	0	0	14.8	0	0
ISRO	daisy#1	10-Aug-96	snap		lung/musc	0	1	17.5	1	0
Daisy Farm	daisy#2	10-Aug-96	snap		lung/musc	0	1	18.5	1	1
	daisy#3	10-Aug-96	snap		lung/musc	1	0	18	?	1
	daisy#4	10-Aug-96	snap		lung/musc	1	1	20.2	?	1
	daisy#5	10-Aug-96	snap		lung/musc	0	1	18.5	0	1
	daisy#6	10-Aug-96	snap		lung/musc	1	0	14.8	?	1
	daisy#7	10-Aug-96	snap		lung/musc	1	0	14.2	?	1
ISRO										
Bangsund	b#1-b#19	info with	live	trap	data					
Inner Hill	i#1-i#24	info with	liv	trap	data					

Appendix 2
Genetic Samples

Sample ID#	Date	Trap	Tag#	Tissue	Sex	Age	Weight	Breeding	Liver
V#15	5-Jul-95	snap		lung/musc	1	2	21.8	0 \	
V#16	5-Jul-95	snap		lung/musc	1	2	22.7	1 \	
V#17	5-Jul-95	snap		lung/musc	1	2	22.2	1 \	
V#18	5-Jul-95	snap		lung/musc	0	0	14.2	0 \	
V#19	5-Jul-95	snap		lung/musc	0	2	24.7	1 \	
V#20	5-Jul-95	snap		lung/musc	1	0	16.5	0 \	
V#21	6-Jul-95	snap		lung/musc	0	2	20.9	1 \	
V#22	6-Jul-95	snap		lung/musc	0	1	16.25	1 \	
V#23	6-Jul-95	snap		lung/musc	1	2	20.2	1 \	
V#24	6-Jul-95	snap		lung/musc	1	2	20.4	1 \	
V#25	6-Jul-95	snap		lung/musc	1	2	24.2	1 \	
V#26	6-Jul-95	snap		lung/musc	0	2	22.3	1 \	
V#27	6-Jul-95	snap		lung/musc	0	2	24.2	1 \	
V#28	6-Jul-95	snap		lung/musc	0	2	19.6	1 \	
V#29	6-Jul-95	snap		lung/musc	0	0	13.2	1 \	
V#30	6-Jul-95	snap		lung/musc	1	0	12.25	0 \	
V#31	6-Jul-95	snap		lung/musc	1	0	8.6	0 \	
m1s	11-Jul-95	snap		lung/musc	1	0	15.25	0	0
m2s	11-Jul-95	snap		lung/musc	0	2	21.5	1	0
m3s	11-Jul-95	snap		lung/musc	1	2	19.8	1	0
m4s	11-Jul-95	snap		lung/musc	0	0	16.5	1	0
m5s	11-Jul-95	snap		lung/musc	1	0	13.7	0	0
m6s	11-Jul-95	snap		lung/musc	1	2	23	1	1
m7s	11-Jul-95	snap		lung/musc	0	2	21.2	1	0
m8s	11-Jul-95	snap		lung/musc	1	1	17.5	0	0
m9s	11-Jul-95	snap		lung/musc	1	2	23	1	1
m10s	11-Jul-95	snap		lung/musc	0	2	20.5	1	0
m11s	11-Jul-95	snap		lung/musc	0	2	25	1	0
m12e	11-Jul-95	snap		lung/musc	0	2	21	1	1
m13e	11-Jul-95	snap		lung/musc	0	2	23.3	1	0
m14e	11-Jul-95	snap		lung/musc	0	2	22.5	1	0
m15e	11-Jul-95	snap		lung/musc	1	0	15.25 ?		0
m16e	11-Jul-95	snap		lung/musc	1	2	21.75 ?		1
m17b	12-Jul-95	snap		lung/musc	0	2	23.15	1	1
m18b	12-Jul-95	snap		lung/musc	1	2	20.6	1	1
m19b	12-Jul-95	snap		lung/musc	1	1	21.6 ?		1
m20b	12-Jul-95	snap		lung/musc	1	1	20.4 ?		1
m21b	12-Jul-95	snap		lung/musc	1	0	15.75 ?		0
m22b	12-Jul-95	snap		lung/musc	1	0	14.2 ?		0
m23b	12-Jul-95	snap		lung/musc	0	0	17	1	0
m24b	12-Jul-95	snap		lung/musc	0	2	25.1	1	1
m25b	12-Jul-95	snap		lung/musc	0	0	17.2	1	0
m26b	12-Jul-95	snap		lung/musc	1	0	16.8 ?		0
m27b	12-Jul-95	snap		lung/musc	0	0	12.5	0	0
m28b	12-Jul-95	snap		lung/musc	1	0	12.2 ?		0
m29e	12-Jul-95	snap		lung/musc	1	2	20.5 ?		0
m30e	12-Jul-95	snap		lung/musc	1	1	18.25 ?		0
m31e	12-Jul-95	snap		lung/musc	1	2	22.25 ?		1
m32s	12-Jul-95	snap		lung/musc	1	1	16.4 ?		0

Appendix 2
Genetic Samples

	Sample ID#	Date	Trap	Tag#	Tissue	Sex	Age	Weight	Breeding	Liver
ISRO	isro36	8-Jul-95	snap		lung/musc	0	2	23.5	1	1
Daisy Farm	isro37	8-Jul-95	snap		lung/musc	0	0	17	1	1
	isro38	8-Jul-95	snap		lung/musc	1	2	19	1	1
	isro39	8-Jul-95	snap		lung/musc	0	2	20.5	1	1
	isro40	8-Jul-95	snap		lung/musc	1	2	22.5	?	0
	isro41	8-Jul-95	snap		lung/musc	1	2	21.5	?	1
	isro42	8-Jul-95	snap		lung/musc	0	1	18.5	1	0
	isro43	8-Jul-95	snap		lung/musc	0	0	14.5	1	0
	isro44	8-Jul-95	snap		lung/musc	1	0	13.5	?	0
	isro45	8-Jul-95	snap		lung/musc	0	0	17	1	0
	isro46	8-Jul-95	snap		lung/musc	1	0	13.5	?	0
	isro47	8-Jul-95	snap		lung/musc	0	0	15	0	0
	isro48	8-Jul-95	snap		lung/musc	0	0	17	1	0
	isro49	9-Jul-95	snap		lung/musc	0	2	32	1	1
	isro50	9-Jul-95	snap		lung/musc	1	0	12.5	?	0
	isro51	9-Jul-95	snap		lung/musc	1	0	12.5	?	0
	isro52	9-Jul-95	snap		lung/musc	1	2	23	1	1
	isro53	9-Jul-95	snap		lung/musc	0	2	21.5	1	1
	isro54	9-Jul-95	snap		lung/musc	1	2	19.5	1	1
	isro55	9-Jul-95	snap		lung/musc	0	0	16.5	1	0
	isro56	9-Jul-95	snap		lung/musc	1	0	12.5	0	0
	isro57	9-Jul-95	snap		lung/musc	0	0	20.5	1	0

Appendix 2
Genetic Samples

Sample ID#	H. Feet	Ears	AP	Tail	Notes		
Sibley#1	18	16	2	83	Flaccid uterus;smooth liver		
Sibley#2	18.5	16	3	99	flccd uterus;4 mam vis;smooth liver		
Sibley#3	18.5	16	3	89	flccd uterus;smooth liver;6 mam vis		
Sibley#4	19	14	3	94	flccd uterus;smooth liver;6 mam vis		
Sibley#5	19	17	4	90	flccd uterus;smooth liver;6 mam vis		
Sibley#6	18	15	1	77	undev uterus;no mam vis;smooth liver		
Sibley#7	19	14.5	2	73	undev uterus;no mam vis;smooth liver		
Sibley#8	19	14	5	76	3mm testis;smooth liver		
Sibley#9	19	16	3	81	4 mam vis		
Sibley#10							
Sibley#11	19 /		2 /		no mam vis		
Sibley#12							
Sibley#13							
Sibley#14							
Sibley#15							
Sibley#16							
Sibley#17	19	13.5	2	88	6 mam vis;ran up tree upon release!		
Sibley#18	19	13	2	84			
Sibley#19	19	16	5	86	3mm testis;smooth liver		
Sibley#20	20	16	3	93	flccd uterus;smooth liver;6 mam vis		
Sibley#21	21	16/15	4	79	3mm testis;smooth liver		
Sibley#22	22	14	4	74	3mm testis;smooth liver		
Sibley#23	23	16	6.5	79	4mm testis;smooth liver;fleas		
Sibley#24	24	16	4.5	78	3mm testis;smooth liver		
Sibley#25							
Sibley#26							
Sibley#27							
Sibley#28	19	16	6	87	can't find testes; smooth liver		
Sibley#29							
Sibley#30	29	11	2	##	8mam vis;abdom fat pads;fawn tan;jumping mouse;died in trap		
W#1	19	15	3	79			
W#2	19	14	2	76			
W#3	19	14	6	72			
W#4	19	14	9	67			
W#5	18	14	2	69			
W#6	19	14/15	2	71			
W#7	19	15	15	75			
W#8	19.5	14.5	2	71			
W#9	19	14	8.5	65			
W#10	19	15	3	74			
W#11	19	15	3	79			
W#12	17	13	2	61			
W#13	18	15	2 \				
W#14	18	15	11	71			

Appendix 2
Genetic Samples

Sample ID#	H. Feet	Ears	AP	Tail	Notes
W#15	19	15	14	78	
W#16	20	15	16	77	
W#17	19	15	11	74	
W#18	18	13	3	62	
W#19	19	16	3	82	
W#20	18	14	8	70	
W#21	19	14	2	73	
W#22	18	14	1	68	
W#23	19	15	14	71	
W#24	19	14	16	70	
W#25	19	14.5	3	77	
W#26	19	15.5	3	70	
W#27	19	14.5	2	76	
W#28	18.5	13.5	2	72	
W#29	18.5	14	2	73	
W#30	19	13	9	64	
W#31	17	11	3	55	
m1s	19	14	7	73	tiny testes
m2s	19	15	4	73	2nipples;3mmflaccid uterus
m3s	20	14.5	9	73	
m4s	19	14	3	72	3fetuses=3mm
m5s	19	13	6	65	3mm testes
m6s	19	15	14	73	10mm testes
m7s	19	notes	3	70	LE=15/RE=17; 6 nipples
m8s	20	15	7	74	2.5mm testes
m9s	19	15	13	76	10mm testes;fleas
m10s	19	15	4	70	6nipples;2mm wide uterus
m11s	18.5	notes	4	76	LE=torn/RE=14;6 lrg nipples;1mm uterus
m12e	20	15	3	83	3mm uterus
m13e	19.5	16	3	77	6nipples;5fetuses;1flea
m14e	20	15	3	75	6nip;4uterine scars
m15e	18	14.5	8	66	6mm testes
m16e	20	notes \		77	LE=torn/RE=16;Ap & testes crushed
m17b	18.5	15 \		78	AP torn;5fetuses;6mam vis
m18b	19	15 \		68	AP crushed
m19b	18	15	11	76	8mm testes
m20b	19	15 \		76	AP crushed;9.5mm testes
m21b	19	14 \		72	AP crushed;8mm testes
m22b	18	14 \	\		AP crushed;6mm testes
m23b	18	14	2	62	5 lrg fetuses; 4 mam vis
m24b	19	14	3	79	6 mam vis; flaccid uterus
m25b	18.5	13 \		68	AP crushed; 5 fetuses
m26b	19	14	9	64	8mm testes
m27b	17	16	2	61	
m28b	17	14.5	6 \		3mm testes
m29e	19	15	11	76	8.5mm testes
m30e	19	15	12	65	6.5mm testes
m31e	20	15	11	71	
m32s	19	15	11	67	7mm testes

Appendix 2
Genetic Samples

Sample ID#	H. Feet	Ears	AP	Tail	Notes		
m33s	notes	notes	7	68	LHF=20/RHF=19;LE=13/RE=15		
m34s	19	16.5	11	77	9mm testes		
m35s	19	14.5	8	62	can't find testes		
m36s	19	15.5	3 \		6 mam vis; 4 lrg fetuses + 1 resorbed?		
m37s	19	15	6	70	3mm testes		
mott#1	19	16	3	76	6mam;flaccid uterus		
mott#2	19	15	2	68			
mott#3	19	16	3	74	6lrg mam; flaccid uterus		
david#1	19	14	2	71			
david#2	19	15	8	75			
david#3	19	16	3	76	6sm mam vis; udev uterus		
david#4	17	14	5	66			
david#5	18	15	2	67			
o.hill#1	19	14	11	69	8mm testes		
o.hill#2	18	14.5	3	68	4lrg+2sm mam; flaccid uterus		
o.hill#3	19.5	15.5	3	74	6lrg mam;flaccid uterus		
david#6	19	15	7	73			
e.caribou#1	19	16	11	74	9mm testes		
mott#4	18.5	15	3	78	6 lrg mam; 6lrg fetuses		
mott#5	14.5	17	2	63	no mam vis; 4sm fetuses		
mott#6	19	14	2	64			
o.hill#4	19	13	7	64			
o.hill#5	19	15	6	67	3mm testes		
e.caribou#2	18	16	3.5	81	6 mam vis; flaccid uterus		
cemetery#1	20	16	3.5	78	flaccid uterus; 6mam vis		
cemetery#2	19	16.5	3	76	flaccid uterus; 6 mam vis		
cemetery#3	19	12	4.5	60	3mm testes; botfly larva		
rabbit#1	20.5	16.5	3	87	flaccid uterus; 6 mam vis		
rabbit#2	19.5	16	2	82	undev uterus; no mam vis		
rabbit#3	19.5	16	2	76			
rabbit#4	19.5	15	8	77	2mm testes		
w.caribou#1	21	16	12	77	5mm testes		
w.caribou#2	20	15	6	75	2mm testes		
w.caribou#3	19	14.5	2	69			
w.caribou#4	19.5	16	1.5	77	botfly larva		
w.caribou#5	19	16	1.5	74			
daisy#1	19	12 \		74	AP torn;6mam vis;flaccid uterus		
daisy#2	18.5	15	3	74	6mam vis; flaccid uterus		
daisy#3	20	notes	6	75	LE=14.5/RE=15; botfly larva		
daisy#4	20	15	9	79	6mm testes		
daisy#5	19.5	15	2	76			
daisy#6	19	147	5.5	71	2mm testes		
daisy#7	19	14	6	63	2mm testes		

Appendix 2
Genetic Samples

Sample ID#	H. Feet	Ears	AP	Tail	Notes		
isro36	20	15	4	73	4nip vis;repro tract v. reduced		
isro37	19 \		3	65	both ears damaged;6 fetuses each 5mm		
isro38	20	15	12	80	10mm testes		
isro39	20	14	4	78	4nip vis;1mmuterus;ovaries w/follicles		
isro40	20.5	15	12	78	8mm testes		
isro41	21	14	11	71	9mm testes		
isro42	19	14	4	71	2nip vis;7mm flaccid uterus		
isro43	19	14	3	61	6fetuses each 5mm		
isro44	19	14	6	61	5mm testes		
isro45	19	14	4	67	2nip vis; 5fetuses each 6mm		
isro46	19	13	8	65	5mm testes		
isro47	19	14	4	66	1mm uterus; follicles on ovaries		
isro48	20	15	3.5	74	4fetuses each 9mm		
isro49	20	16	3	82	4 teats; 3 near term fetuses + 1 resorbed		
isro50	19	13	6	68	3mm testes		
isro51	19	15	7	71	3mm testes		
isro52	20	15	11	78	10mm testes		
isro53	20	15	5	77	4nip vis		
isro54	21	15	14	75	10mm testes		
isro55	19	15	3	60	4nip vis; 5fetuses each 5mm		
isro56	20	13	7	64	3mm testes		
isro57	20 \		4 \		6 fetuses each 12mm		

Appendix 3
Seed Tray Data

1995	SEED	TRAY	DATA								
	(grams	of seed	gone)								
SGPP	New	Moon				SGPP	First	Half	Moon		
28-30	May					3 to 5	August				
Tray #	Night1	Night2	Night3	Total	Mean	Tray #	Night1	Night2	Night3	Total	Mean
1	0	0	0	0	0	1	33.2	36.4	35	104.6	34.867
2	0	0	5.95	5.95	1.9833	2	0.7	9.4	20.95	31.05	10.35
3	0	0	0	0	0	3	20.95	26.25	29.6	76.8	25.6
4	0	20.4	21.1	41.5	13.833	4	40.8	49.2	37.2	127.2	42.4
5	0	30	29.75	59.75	19.917	5	38.2	47	38.3	123.5	41.167
Total	0	50.4	56.8	107.2	7.1467	Total	133.85	168.25	161.05	463.15	30.877
Mean	0	10.08	11.36	7.1467		Mean	26.77	33.65	32.21	30.877	
SGPP	Full	Moon									
Jun12	to	14-Jun									
Tray #	Night1	Night2	Night3	Total	Mean						
1	13.6	10.3	8.8	32.7	10.9						
2	0.2	0	0.25	0.45	0.15						
3	0.2	0	0.25	0.45	0.15						
4	40.6	32.6	16	89.2	29.733						
5	39.1	37.8	38.8	115.7	38.567						
Total	93.7	80.7	64.1	238.5	15.9						
Mean	18.74	16.14	12.82	15.9							

Appendix 3
Seed Tray Data

ISRO	New	Moon				ISRO	First	Half	Moon		
27-29	July					3 to 5	August				
Tray #	Night1	Night2	Night3	Total	Mean	Tray #	Night1	Night2	Night3	Total	Mean
1	3	7.5	7.5	18	6	1	7	20	24.5	31.5	10.5
2	17.5	9	14	40.5	13.5	2	9	22	19	28	9.3333
3	4	11	15	30	10	3	12.5	15	19.5	32	10.667
4	14	17.5	18.5	50	16.667	4	19	23.5	20.5	39.5	13.167
5	19.5	20	16.5	56	18.667	5	25.5	18.5	18.5	44	14.667
6	19	9.5	21	49.5	16.5	6	17	16.5	9	26	8.6667
7	0	21.5	12	33.5	11.167	7	15	11	14	29	9.6667
8	0	1.5	21	22.5	7.5	8	---	8.5	14.5	14.5	7.25
9	0	1	2.5	3.5	1.1667	9	7.5	6.5	10	17.5	5.8333
10	0	1.5	6.5	8	2.6667	10	5	1.5	3.5	8.5	2.8333
11	1.5	1.5	3.5	6.5	2.1667	11	1.5	0.5	2.5	4	1.3333
12	1.5	4	5	10.5	3.5	12	13.5	5	2.5	16	5.3333
13	0	2.5	3	5.5	1.8333	13	5	0.5	1	6	2
14	7	4	11.5	22.5	7.5	14	26	10.5	11	37	12.333
15	3.5	16	12	31.5	10.5	15	31.5	21.5	12.5	44	14.667
16	0	0	3	3	1	16	11.5	3.5	5.5	17	5.6667
17	0	1	5	6	2	17	10	4.5	9	19	6.3333
18	1.5	9.5	12.5	23.5	7.8333	18	11.5	4.5	15.5	27	9
19	1.5	11	18	30.5	10.167	19	28.5	30.5	16.5	45	15
20	5	9	20	34	11.333	20	32.5	22.5	21	53.5	17.833
Total	98.5	158.5	228	485	8.0833	Total	289	246.5	250	539	9.1356
Mean	4.925	7.925	11.4	8.0833		Mean	15.211	12.325	12.5	9.1356	
ISRO	Full	Moon				ISRO	Sec.	Half	Moon		
9 to 11	August					17-18	August				
Tray #	Night1	Night2	Night3	Total	Mean	Tray #	Night1	Night2		Total	Mean
1	25	25.8	40	65	21.667	1	25.5	14.25		39.75	19.875
2	23.5	23.1	29	52.5	17.5	2	26	15		41	20.5
3	22	18.8	26	48	16	3	13.2	13.75		26.95	13.475
4	25.5	23.8	29.5	55	18.333	4	28	22.25		50.25	25.125
5	19	18	20.75	39.75	13.25	5	17.25	11.25		28.5	14.25
6	19	16.5	18.4	37.4	12.467	6	5.25	13.25		18.5	9.25
7	21.5	21.9	17.1	38.6	12.867	7	7.5	9		16.5	8.25
8	19.5	13	12	31.5	10.5	8	5.5	7.75		13.25	6.625
9	9	19.7	17.25	26.25	8.75	9	20.5	26.25		46.75	23.375
10	6.5	7.8	0.3	6.8	2.2667	10	3.75	7.5		11.25	5.625
11	5	7.5	1.4	6.4	2.1333	11	15.75	12.25		28	14
12	4.5	2.25	0.75	5.25	1.75	12	5.25	5.25		10.5	5.25
13	9	10.5	0.5	9.5	3.1667	13	22.7	2.25		24.95	12.475
14	12	17.5	10	22	7.3333	14	21.5	20		41.5	20.75
15	21.5	19	16.1	37.6	12.533	15	36.5	33.75		70.25	35.125
16	10.5	7.8	2.5	13	4.3333	16	5	23		28	14
17	11	9.3	3.5	14.5	4.8333	17	9	1.5		10.5	5.25
18	26	19.25	21	47	15.667	18	13	3		16	8
19	26.5	26.5	29.75	56.25	18.75	19	23.5	14.7		38.2	19.1
20	26	23.6	29.75	55.75	18.583	20	28.5	22.45		50.95	25.475
Total	342.5	331.6	325.55	668.05	11.134	Total	333.15	278.4		611.55	15.289
Mean	17.125	16.58	16.278	11.134		Mean	16.658	13.92		15.289	