

Rolf O. Peterson, Kenneth L. Risenhoover,  
and Richard E. Page  
Department of Biological Sciences  
Michigan Technological University  
Houghton, Michigan 49931

December 1984

## ISLE ROYALE WOLF-MOOSE ECOLOGY

### SUMMER REPORT, 1984\*

Summary: During 1984-86 study efforts at Isle Royale National Park will concentrate on wolf-moose and moose-vegetation interactions. During the 1984 summer field season reproduction was confirmed in two of the three existing wolf packs on the island. From this level of reproduction we expect no substantial increase in wolf numbers in winter 1985. In 1984 moose calf production and recruitment declined slightly from the levels of 1982 and 1983, so only slight increase in the moose population is possible in 1985. Moose and beaver each constituted about half of the remains identified in summer wolf scats. The beaver population continued to increase during 1982-84 after reaching a low level during the peak in wolf numbers in 1980. During spring 1984 14 moose were immobilized and outfitted with radio-transmitter collars. These animals will be the focus of a study of moose foraging behavior which will be completed during the next two years. In 1984 individual summer home ranges of these moose encompassed 5-10% of Isle Royale, including long-distance movements to mineral springs in many cases. Remote activity-monitoring between July and October indicated that moose were moving and/or feeding about 50% of a 24-hr day. Recruitment of moose calves now exceeds adult mortality by about 5%; at that rate the moose population will double by the late 1990's.

## INTRODUCTION

During its 27th year this study remained focused on wolf-moose interaction, with an additional long-term goal of understanding the link between moose forage levels and population dynamics. Thus we are involved in three levels of this ecosystem: carnivore, herbivore, and vegetation. In 1984 we continued data collection on wolf and moose populations in order to evaluate the status of this predator-prey relationship. Since 1980 the moose population in Isle Royale National Park has been subject to predation by a much-reduced wolf population, which declined from 50 to 14 individuals in 1980-82. We previously

---

\*Funded by the Boone and Crockett Club, Charles Ulrick and Josephine Bay Foundation, National Geographic Society, National Rifle Association, and Resources for the Future. Logistical support from the Isle Royale National Park.

predicted that the wolf population should stabilize for many years near its long-term level of 20-30 animals. Simultaneously, the moose population should once again increase until moose vulnerability to wolf predation rises. Increased predation and a lower rate of reproduction will limit population growth. Further, we have suggested that moose and wolf populations may cycle at intervals of 30+ years. It is now evident that the moose population rate of growth is low enough to cause the increase phase to last more than a decade. It appears that wolf predation will slow down but not prevent continued growth in moose numbers.

At peak moose population levels we documented declines in vigor and reproduction that appeared linked to deteriorating forage. In order to clarify the moose-vegetation link in this ecosystem, we have begun a series of studies of moose foraging behavior and forage abundance patterns. Initial studies required the radio-collaring of moose for intensive study by Ph.D. student Risenhoover. He will concentrate on winter foraging behavior of moose in 1985 and 1986.

#### PERSONNEL

We acknowledge the help in the field of an unusually large number of people, primarily associated with the collaring and monitoring of moose. The following individuals were responsible for field work in summer 1984:

|                        |                                 |
|------------------------|---------------------------------|
| Rolf O. Peterson       | 21 May-11 July                  |
| Kenneth L. Risenhoover | 27 May-10 August, 20-27 October |
| Edith N. Greene        | 21 May-15 August                |
| Timothy G. Laske       | 21 May-15 August                |
| M. Lynn Jebson         | 27 May-30 August                |
| Mark S. Cramer         | 24 August-23 October            |
| Noel K. Hanson         | 6-23 August                     |
| Patrick R. Charmley    | 21 May-20 June                  |
| Tina L. Dorsey         | 21 May-20 June                  |

Additional personnel assisting with the moose collaring effort were: Ullyses S. Seal, Mary Alice Seal, Steve M. Schmitt, and Daniel H. Monson. We are particularly grateful for the assistance with experimental drugs provided by Drs. Schmitt and Seal during moose-collaring.

#### WOLF ECOLOGY

Studies of Isle Royale wolves in summer were largely limited to food habits analyses from scats and assessment of reproduction in each pack. Three packs reproduced last year (1983) and these same three packs persisted as identifiable groups in winter, 1984. We consider that the present food base is sufficient for

no more than two packs. The Harvey Lake Pack (HLP) has the poorest food base, no exclusive territory, and has been attacked by both neighboring packs. The reproducing alpha female in the HLP was killed by the West Pack in February, 1984, so we expended considerable effort during the summer to determine if this pack reproduced. A careful field check of all known summer homesites used by this pack for several years revealed no den or other evidence of reproduction in the Harvey Lake Pack. On the other hand, we obtained visual confirmation of at least 2 pups in the East Pack and documented use of a traditional summer homesite by the West Pack. From this we expect the West and East packs to persist, but the future of the Harvey Lake Pack is in doubt. These events reflect continued adjustments that will bring the wolf population in line with its food supply.

Summer prey of Isle Royale wolves continued to be moose and beaver. Each species occurred with equal frequency in summer scats in 1984, but since small prey are over-represented in this type of analysis the data indicate primary reliance on moose (Fig. 1). Adult moose hair constituted 45% of the moose remains in scats, a departure from the usual predominance of calves. This may reflect significant reliance on relatively abundant yearlings in summer.

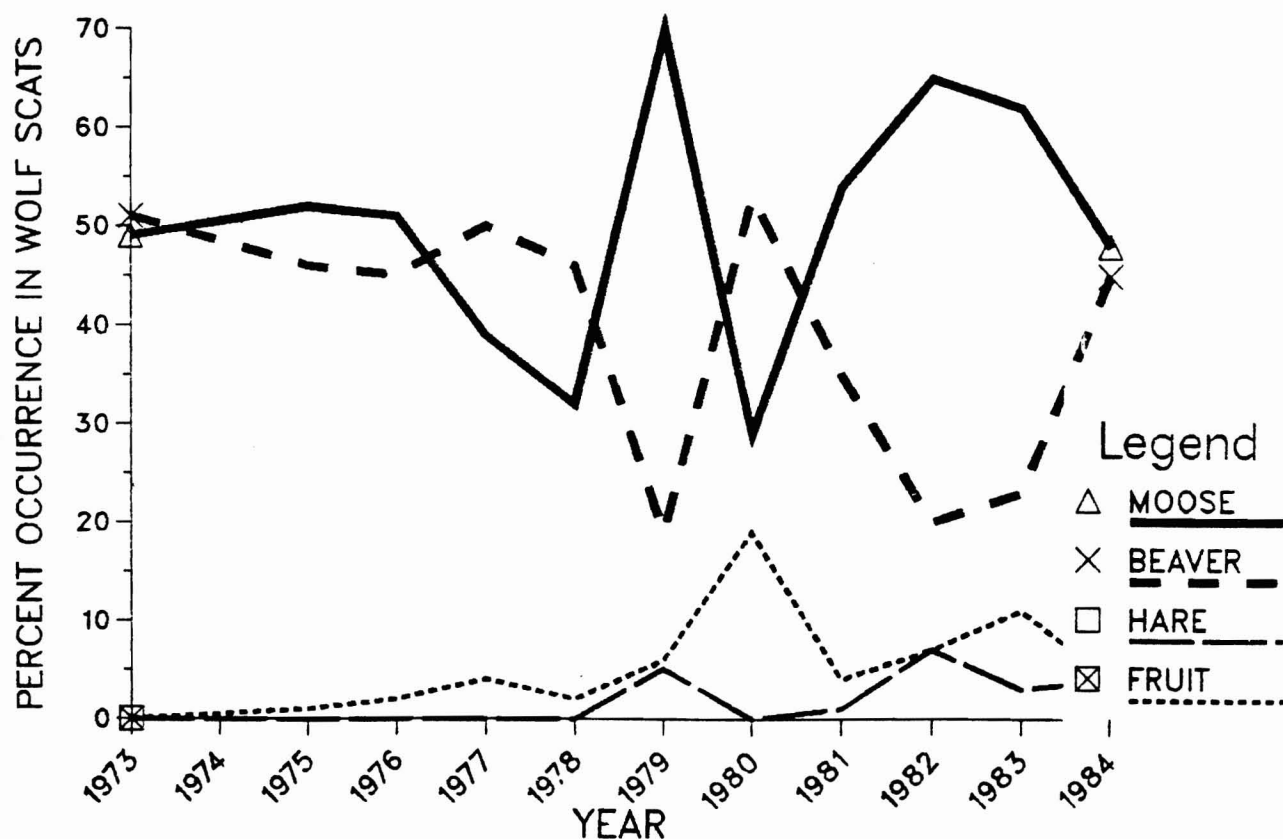


Fig. 1. Percent frequency of occurrence of prey species in summer wolf scats, 1973-84.

Colleague Philip C. Shelton (Univ. Virginia) counted all beaver colonies from aircraft in October, a procedure he has continued regularly since 1974. A complete report on Shelton's findings will be included in the 1984-85 Annual Report. He documented a 75% reduction in beaver numbers during 1974-80. During 1980-84 beaver have increased, lending support to the idea that beaver numbers were heavily influenced by wolf predation in the last decade.

We are cooperating with U.S. Fish and Wildlife Service biologist L. David Mech in assessing evidence of parvovirus in Isle Royale wolf scats. As explained in the 1983-84 Annual Report, there is circumstantial evidence that this disease may have triggered the decline of wolves in 1980-82. Analysis techniques are still being worked out and no data from Isle Royale are yet available.

#### MOOSE ECOLOGY

Moose observed during 907 miles of ground coverage (741 miles on-trail, 166 miles off-trail) suggested only moderate recruitment of moose calves in 1984, as only 33 calves/100 cows were tallied during June-August. This was confirmed during an aerial survey in October. Other field work precluded a normal pattern of ground coverage that has in the past provided an index to moose abundance. In 1984-85 we will rely on the stratified plot census and aerial index in winter to estimate moose numbers.

During winter and summer field work in 1984 we examined remains of 32 moose, including 26 that died in 1984. This brings the total moose remains examined to 1701 since the study began in 1958. We have now completed the computerization of all mapped locations for these moose with the help of Michigan Tech students Michael B. Larson and Jacqueline Wilcox (Fig. 2). We have also computer-mapped all moose observed by ground personnel in summer, all locations of radio-collared moose, and topographical features

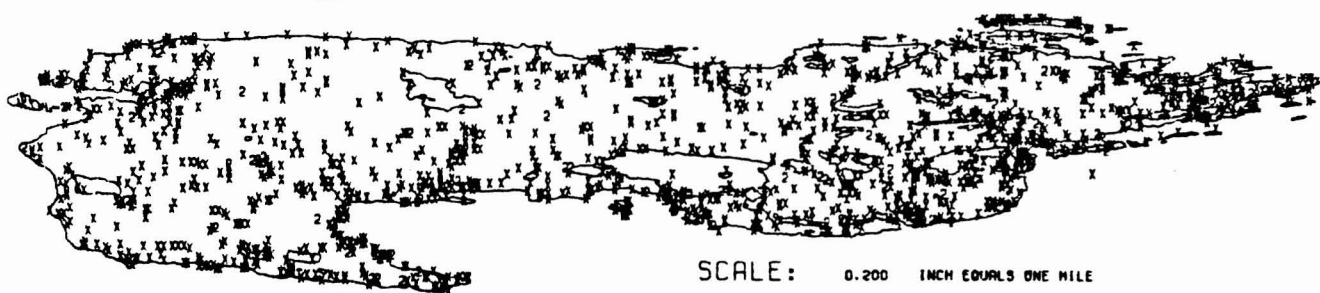


Fig. 2. Distribution of 1701 moose carcasses examined on Isle Royale, 1958-84.

such as vegetation, slope, aspect, elevation, and distance from water, and we now have the ability to analyze variations in distribution of Isle Royale moose in relation to sex, age, time, and island physiography. We have already detected distinct behavioral strategies of cow and bull moose, reflected in their spatial distribution, plus differences among cows that are linked to the presence or absence of a calf. As the moose population declined during the 1970's, it was segregated into two concentrations located at each end of the island, raising the possibility that these subpopulations may exhibit distinct population characteristics. We can now effectively examine these possibilities.

In summer 1984 most of our field efforts related to the radio-collaring and monitoring of moose at the SW end of Isle Royale. Capture efforts in late May were centered at mineral springs in this area, where we immobilized 14 moose with tranquilizer darts and outfitted them with transmitter collars (Telonics, Mesa, AZ) designed to last 2 years. In June we experimented with a variety of antenna configurations in an attempt to obtain accurate triangulation "fixes" for these moose. We finally erected a satisfactory double-antenna system on two National Park Service towers that provided excellent data on moose movements in the SW third of Isle Royale, plus automatic monitoring of moose activity patterns.

A major effort will be made to document winter activity patterns in 1985 and 1986, utilizing the remote monitoring system installed in 1984. This will provide data useful in estimating energy expenditure in moose. Winter data will be contrasted with summer data from 1984 and 1985. Though sample size is still small, the 1984 data indicate that moose were active (feeding and/or moving) for an average of 50% of a 24-hr period (Fig. 3).

Home range data for Isle Royale moose have never before available, so summer movements of collared moose in 1984 are of immediate interest. Collared moose were well-distributed in the SW third of Isle Royale (Fig. 4). There was no evidence of

movement between concentrations of moose at each end of the island. All locations obtained for these moose in 1984 are provided in a series of maps in Appendix 1. Preliminary analyses suggest that summer home range size was about  $40 \text{ km}^2$  for females and about  $50 \text{ km}^2$  for males, or on the order of 5-10% of the land area of Isle Royale. Movements of 2 collared yearlings generally exceeded those of older moose.

It was clear that many moose traveled outside their normal home range to visit mineral licks in late May and early June. Moose did not restrict these movements to licks located closest to their home range. It is likely that moose learn lick locations during their first year while accompanying their mothers; possibly they maintain this basic pattern throughout life.

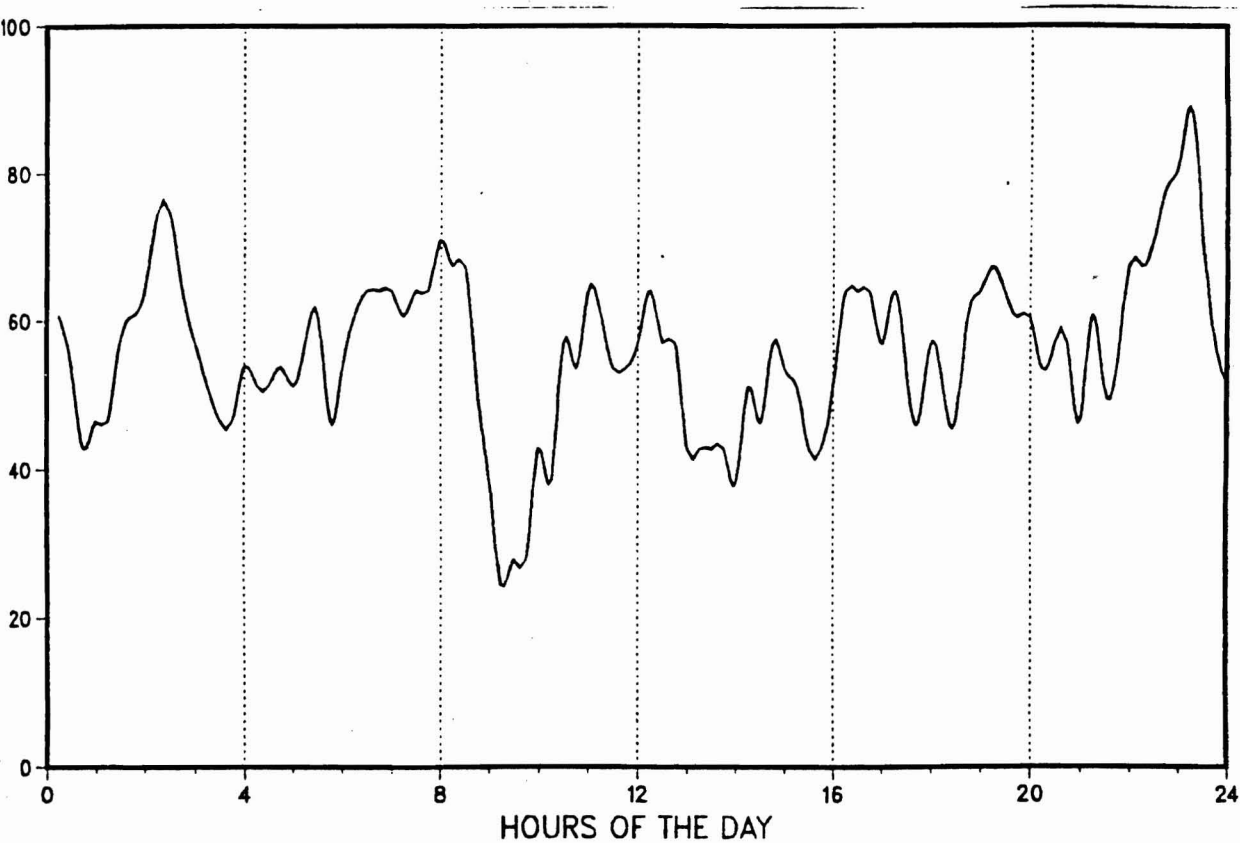


Fig. 3. Activity patterns of radio-collared moose, July 1984.

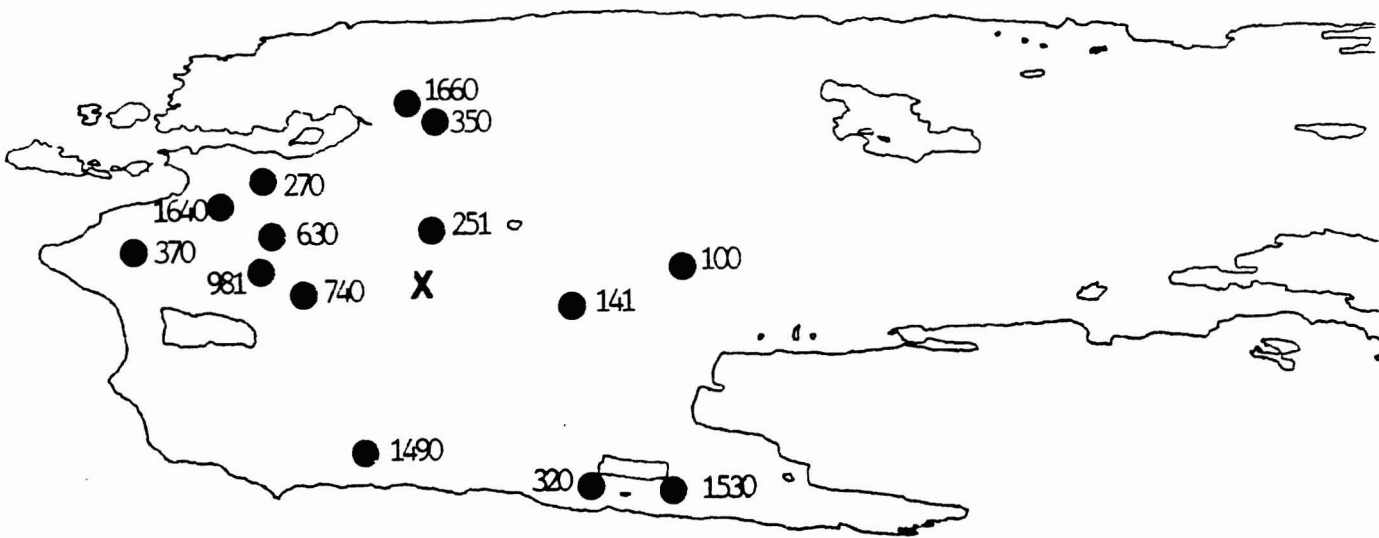


Fig. 4. Distribution of radio-collared moose in late October 1984. "X" marks the point of capture for all moose.

Regular observations totaling 180 hours at one mineral lick revealed a high frequency of use in June and early July. Thereafter moose use declined somewhat and was restricted to cooler night-time periods. We now have sufficient data to estimate the amount of sodium (the apparent attractant) that moose can obtain from licks. This has been disregarded by other researchers, leading to the claim that sodium is available only from aquatic plants and that sodium levels limit moose density on Isle Royale.

Risenhoover conducted an aerial survey of moose during 24-26 October in order to determine age and sex composition of the population. Tom Wunderlich piloted the survey Super Cub on floats. This sample of 131 moose indicated 30 calves/100 cows and approximately 14 yearlings/100 cows. Calf abundance was slightly lower than in recent years but still higher than the prevailing level during the 1970's (Fig. 5). Current recruitment of calves exceeds population mortality by about 5% (13% vs. 8%), indicating modest growth potential which, if maintained, would bring the population back to peak level (ca.1,400 moose observed in the 1960's) by the late-1990's.



Fig. 5. Moose calf abundance determined from aerial surveys in October, 1972-84.

In the last three years wolf predation on calves has been markedly lower than at any other time during the history of this study. Since 1982 the frequency of calves among wolf-kills has been similar to or lower than the calf proportion in the population (Fig.6). Previously wolves killed calves in winter at a rate 1.5-3.5 times higher than occurrence. We suggested in the last annual report that reduced predation on calves may reflect lower vulnerability in recent cohorts. We now acknowledge an alternative explanation, namely that decreased pack size and low hunting proficiency among the young wolves in the "reorganized" population may have adversely affected hunting success. In effect, wolves may be limited to only the most vulnerable adult members of the prey population. At present this idea is mere speculation, but it seems to more adequately explain the abrupt change in predation on calves.

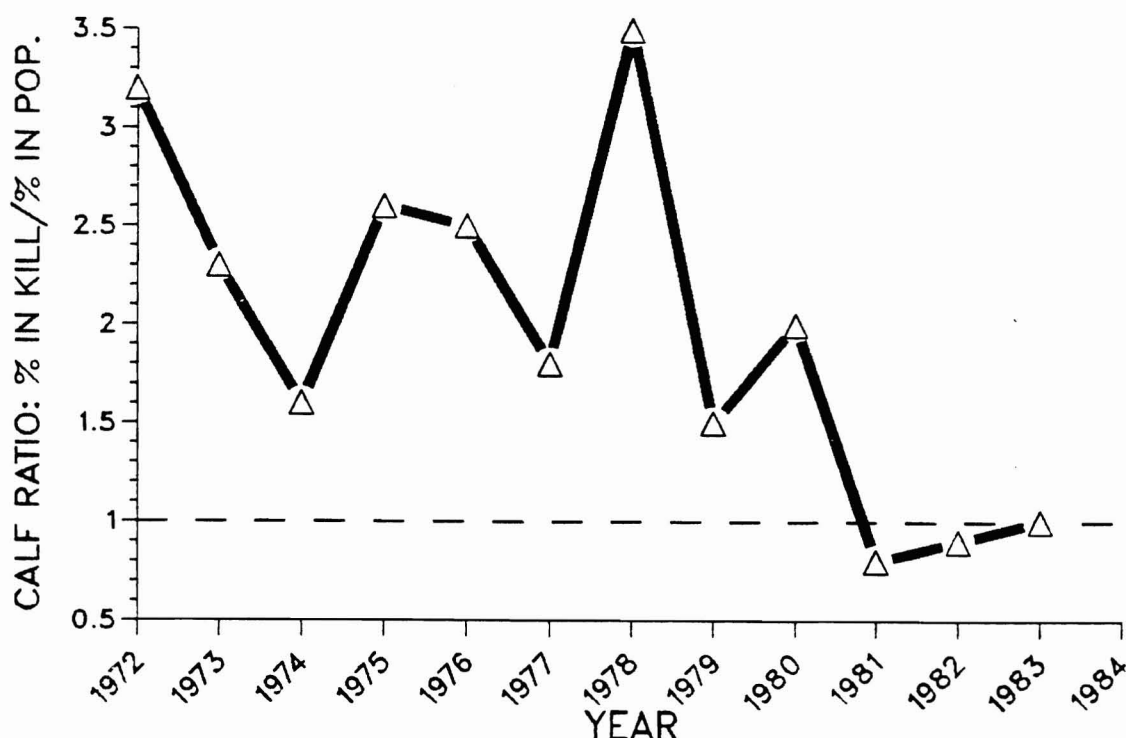


Fig. 6. Frequency of moose calves among winter wolf-kills compared to frequency in population, 1972-83.

#### PUBLICATIONS

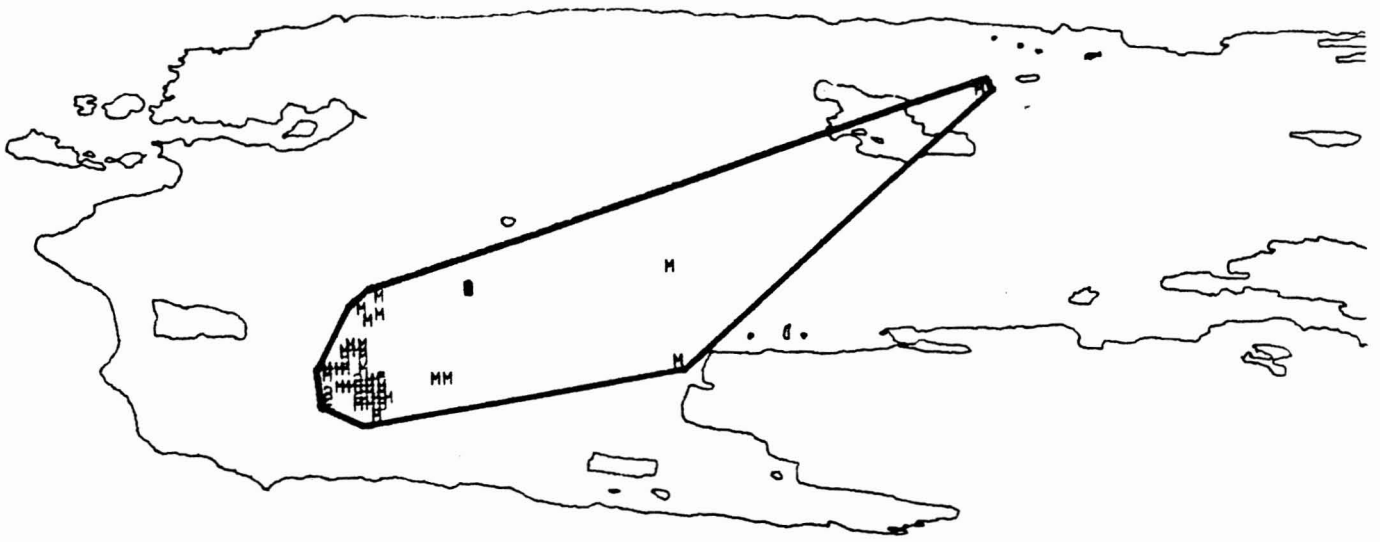
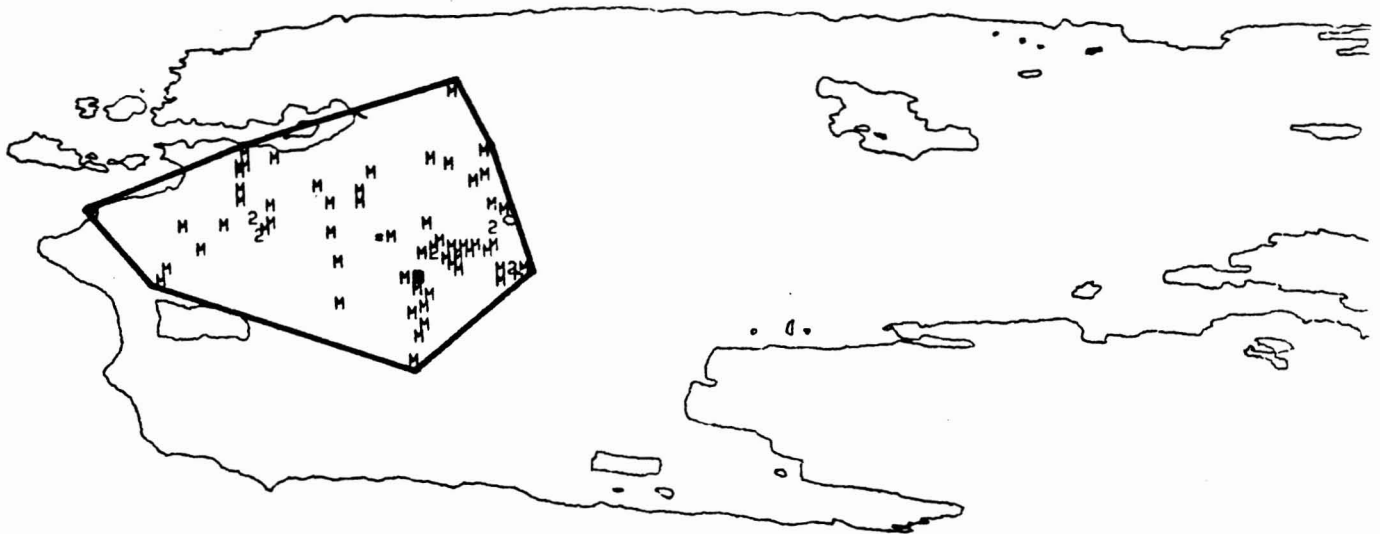
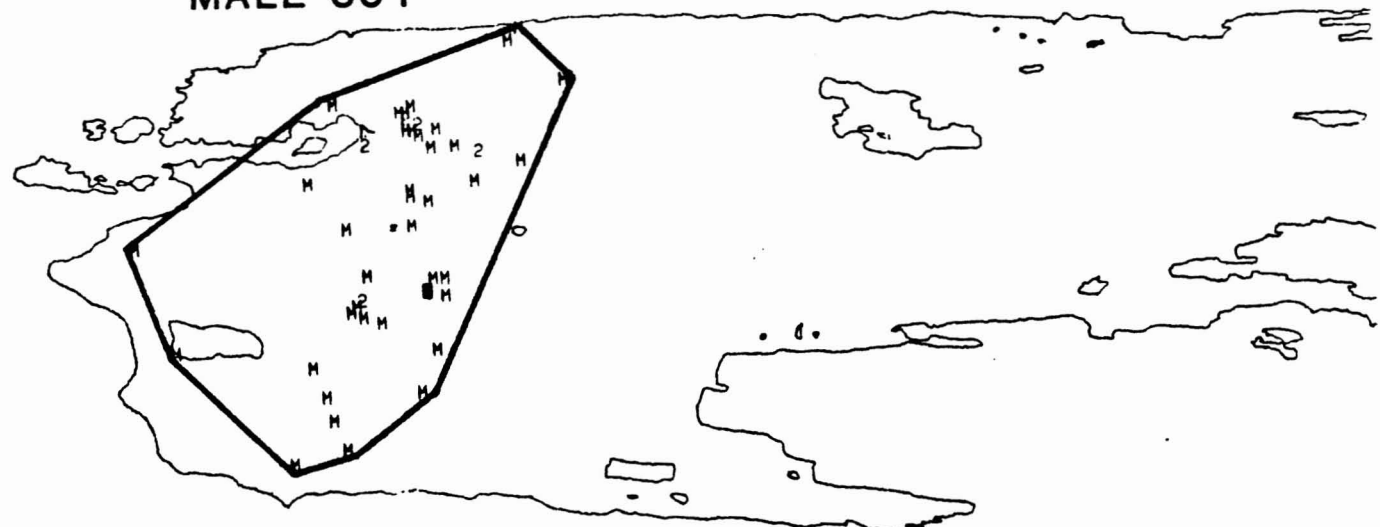
The most important outlet for our research findings is found in scientific journals. Following are articles published or in preparation since the last Annual Report:

- Peterson, R. O., R. E. Page, and K. M. Dodge. 1984. Wolves, moose, and the allometry of population cycles. Science 224:1350-1352.
- Stephens, P. W. and R. O. Peterson. 1984. Wolf-avoidance strategies of moose. Holarctic Ecology 7:239-244.
- Seal, U. S., S. M. Schmitt, R. O. Peterson. 1984. Carfentanil and xylazine for immobilization of moose on Isle Royale. J. Wildlife Diseases (in press).
- Page, R. E. 1984. Models of moose population dynamics applied to management. Swedish Wildl. Res. (in press).
- Peterson, R. O. and R. E. Page. 1984. Does wolf density determine kill rate?. Swedish Wildl. Res. (in press).
- Risenhoover, K. L. and R. O. Peterson. 1984. The importance of natural mineral licks to moose on Isle Royale. Swedish Wildl. Res. (in press).
- Risenhoover, K. L., L. A. Renecker, and L. E. Morgantini. 1985. Effects of secondary metabolites from balsam poplar and paper birch on cellulose digestion. J. Range Manage. (in press).
- Risenhoover, K. L., S. A. Maass, and M. Smith (in prep). Effects of moose on the structure and composition of Isle Royale forests.
- Risenhoover, K. L. and R. O. Peterson (in prep). Immobilization of moose at natural mineral springs on Isle Royale.
- Risenhoover, K. L., R. O. Peterson, and M. L. Risenhoover (in prep). An assessment of the ecological significance of natural mineral springs to moose on Isle Royale.
- Peterson, R. O. and R. E. Page (in prep). The rise and fall of Isle Royale wolves, 1975-84.
- Peterson, R. O. and V. VanBallenberghe (in prep). Prey capture rate for wolves feeding on moose in winter.
- Thompson, I. D. and R. O. Peterson (in prep). Does wolf predation limit moose? - a critique.

## RESEARCH PLANS

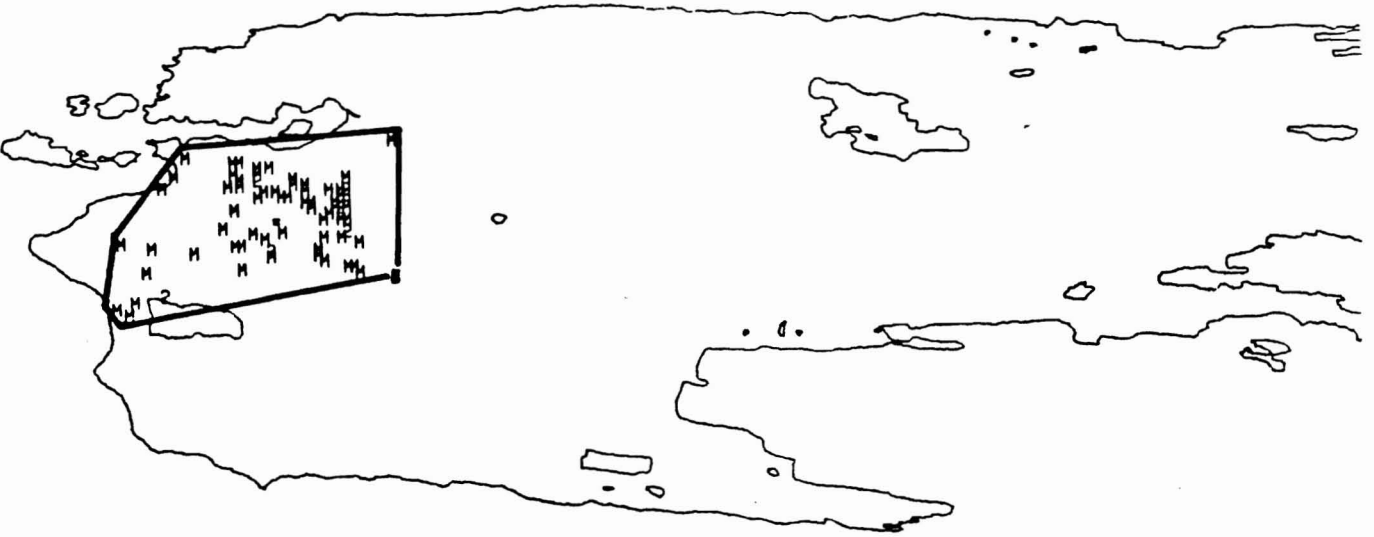
The two principal areas of research during 1984-86 will be the interactions between wolves and moose and between moose and vegetation on Isle Royale. These subjects serve as the focus for Ph.D. students Page and Risenhoover. Field work in 1985 will be conducted from January through October. In summer 1985 we expect M.S. student Thomas A. Brandner to conduct a study of the influence of moose feeding on the growth and survival of balsam fir, a major boreal tree species on Isle Royale. An additional M.S. student will be studying summer activity patterns of the radio-collared moose. Work will continue on all publications now in preparation.

Appendix 1. All locations of radio-collared moose on Isle Royale during June-October. Solid square indicates capture location.

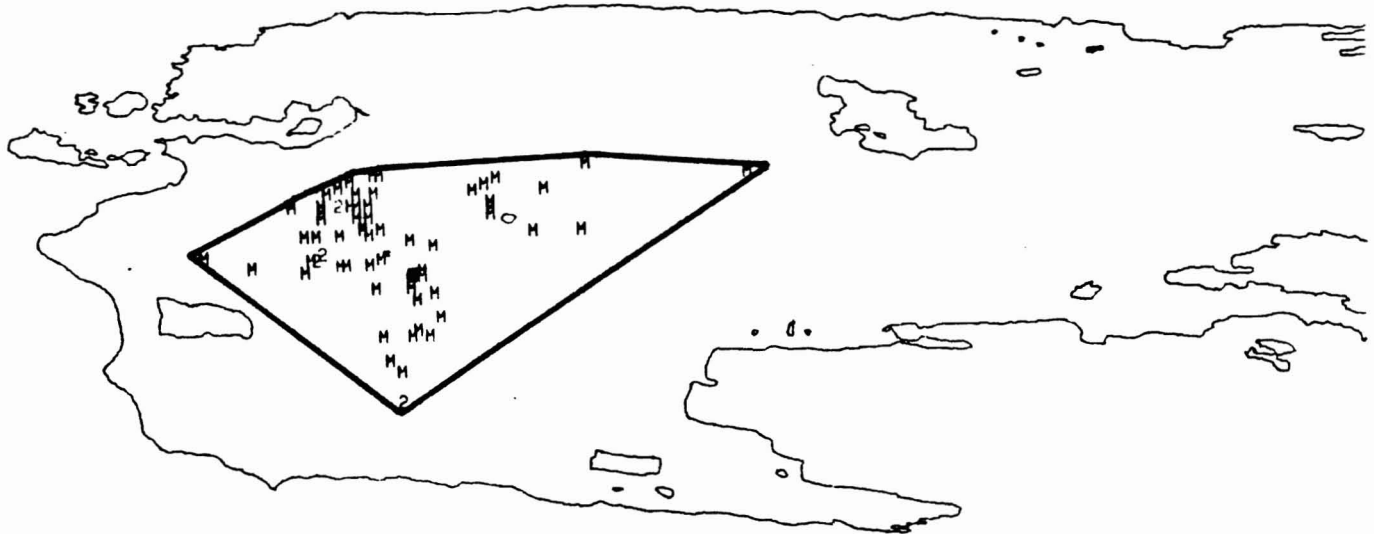
**MALE 100****MALE 251****MALE 351**

Appendix 1 (cont'd)

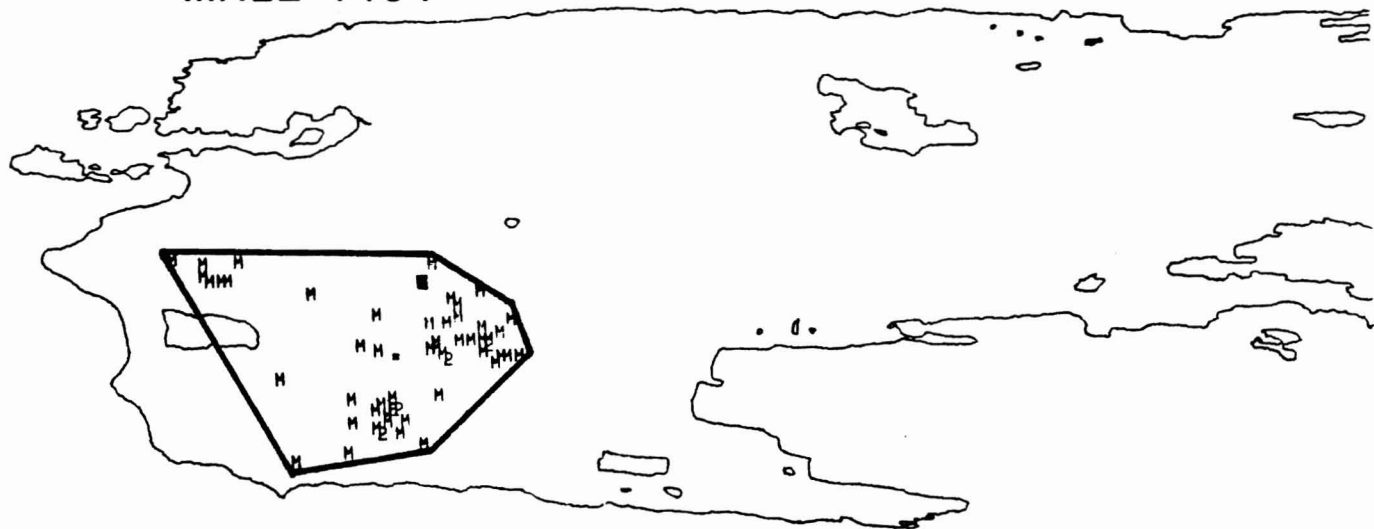
**MALE 370**



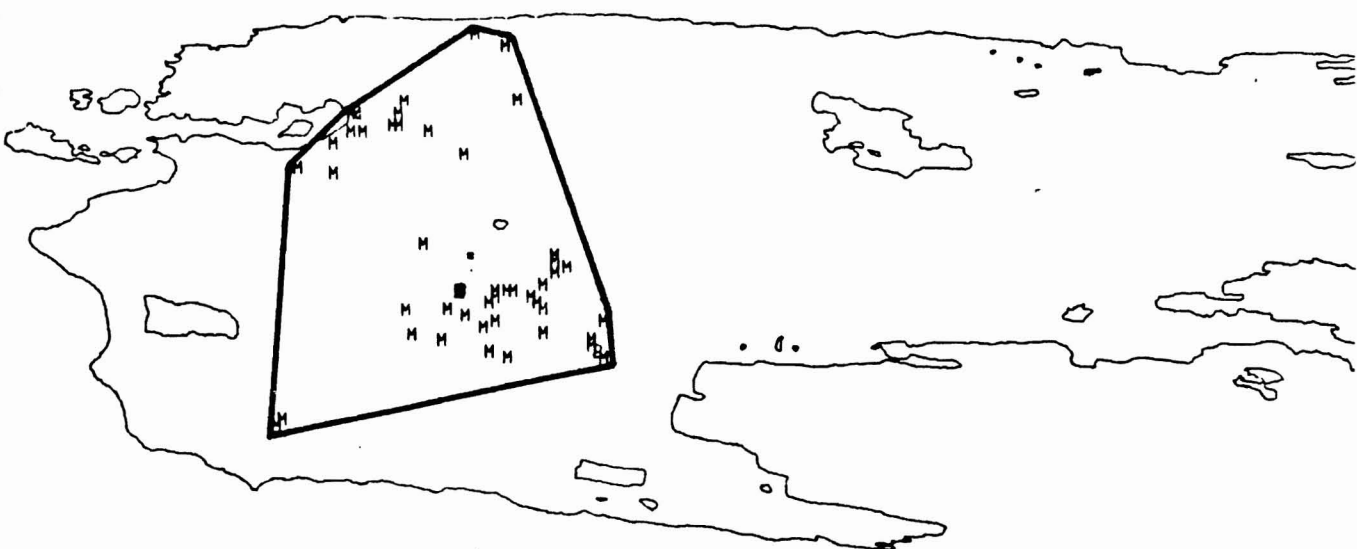
**MALE 739**



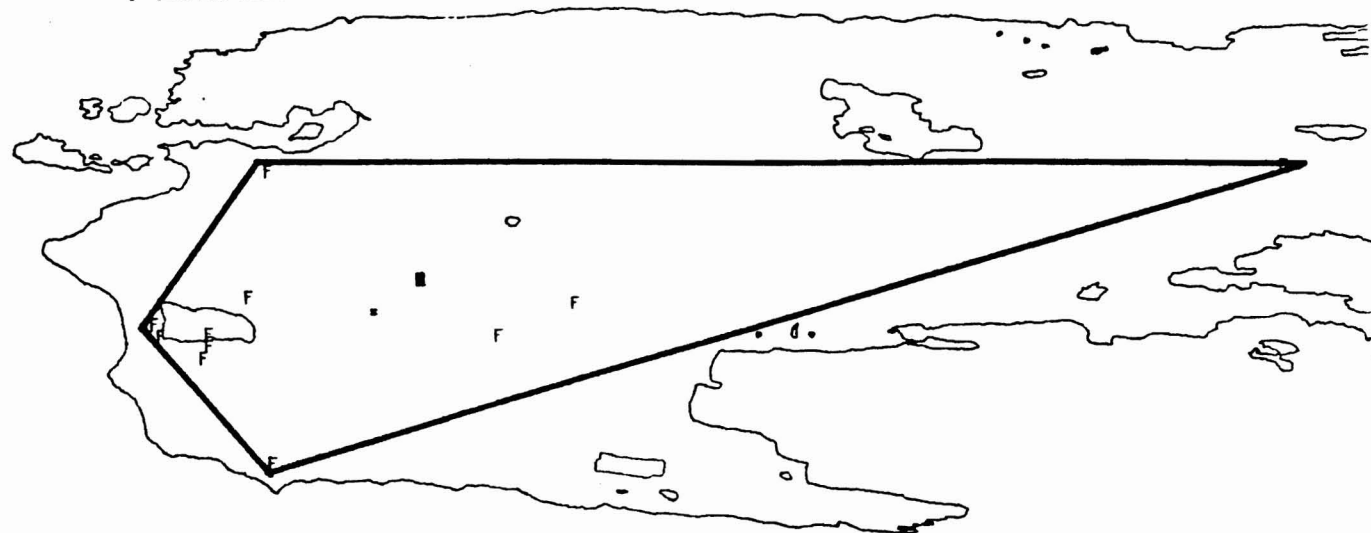
**MALE 1491**



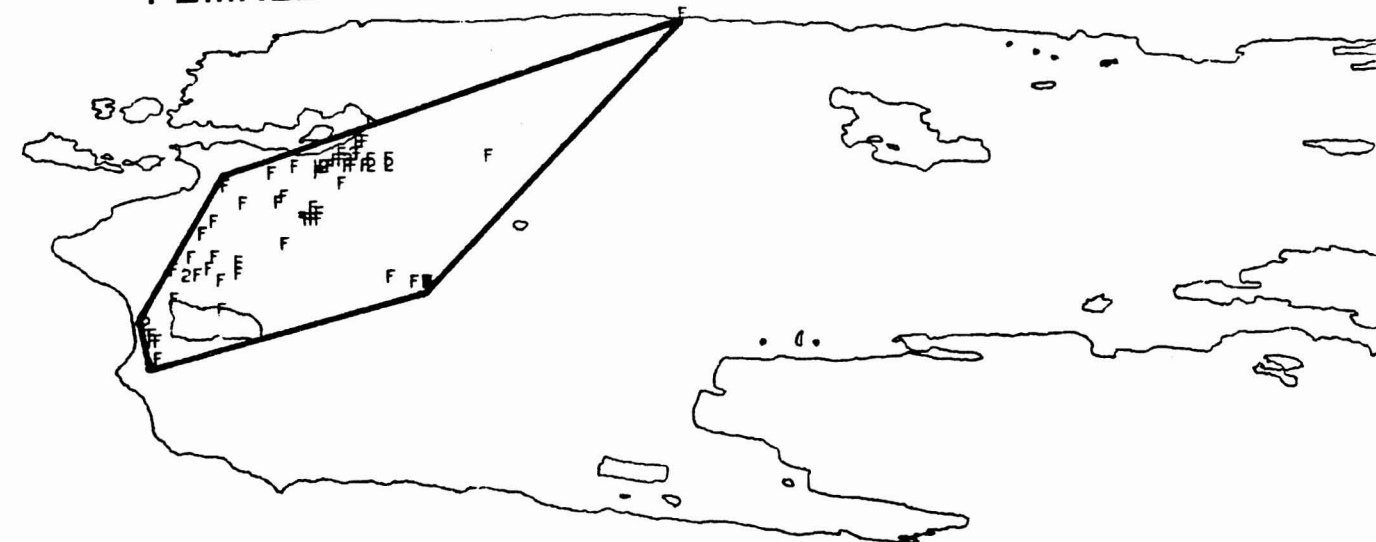
MALE 1660



FEMALE 141

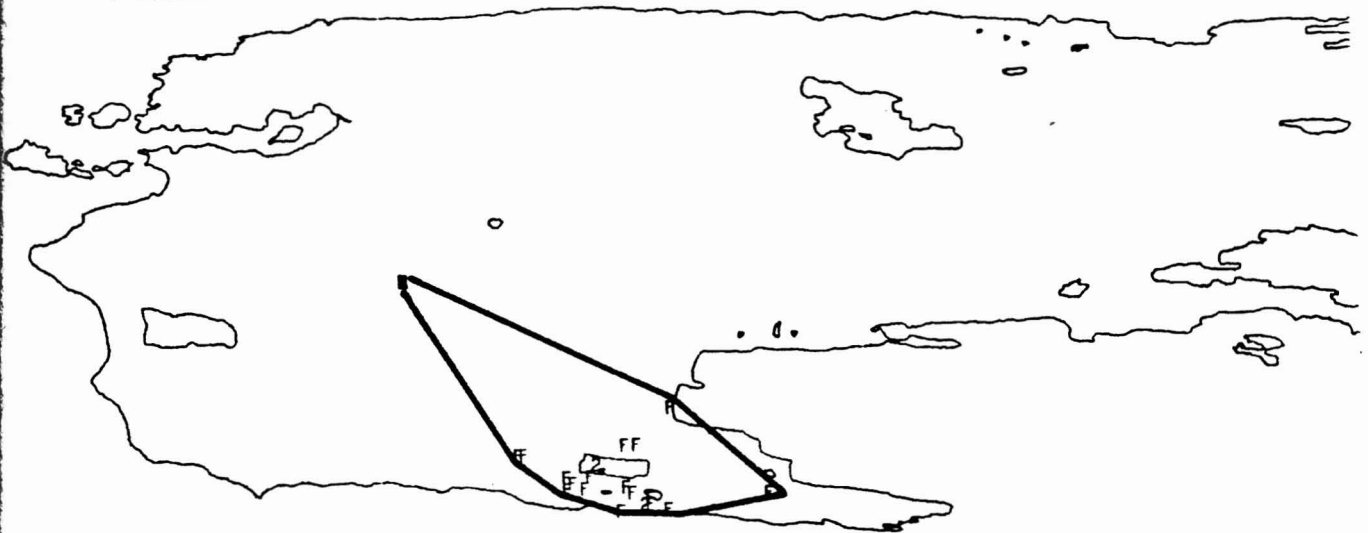


FEMALE 270

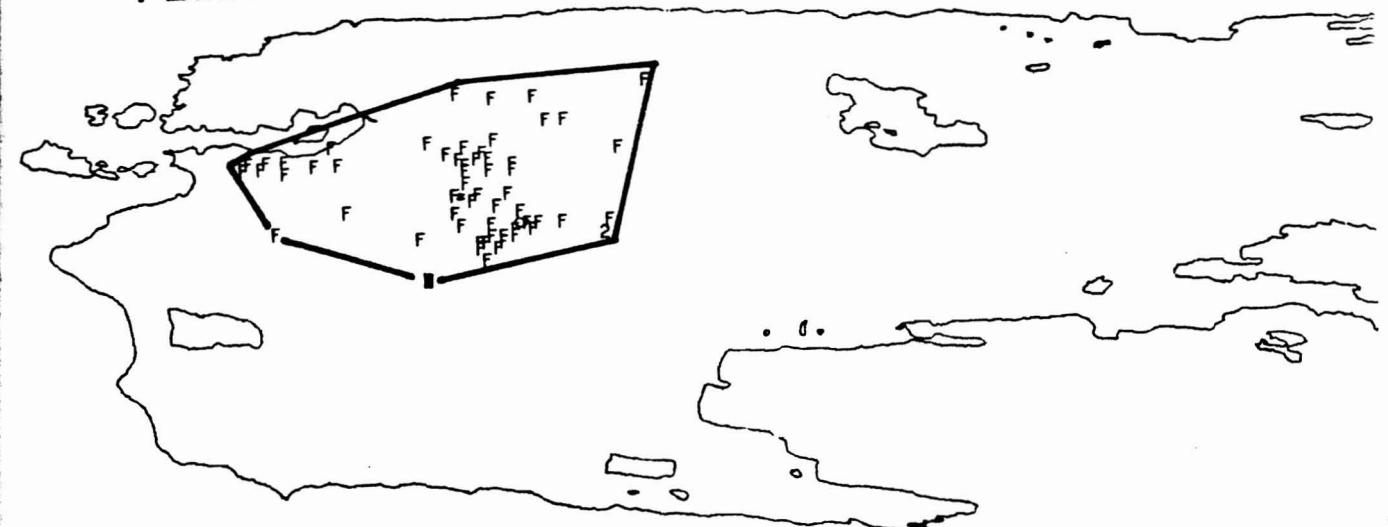


Appendix 1 (cont'd)

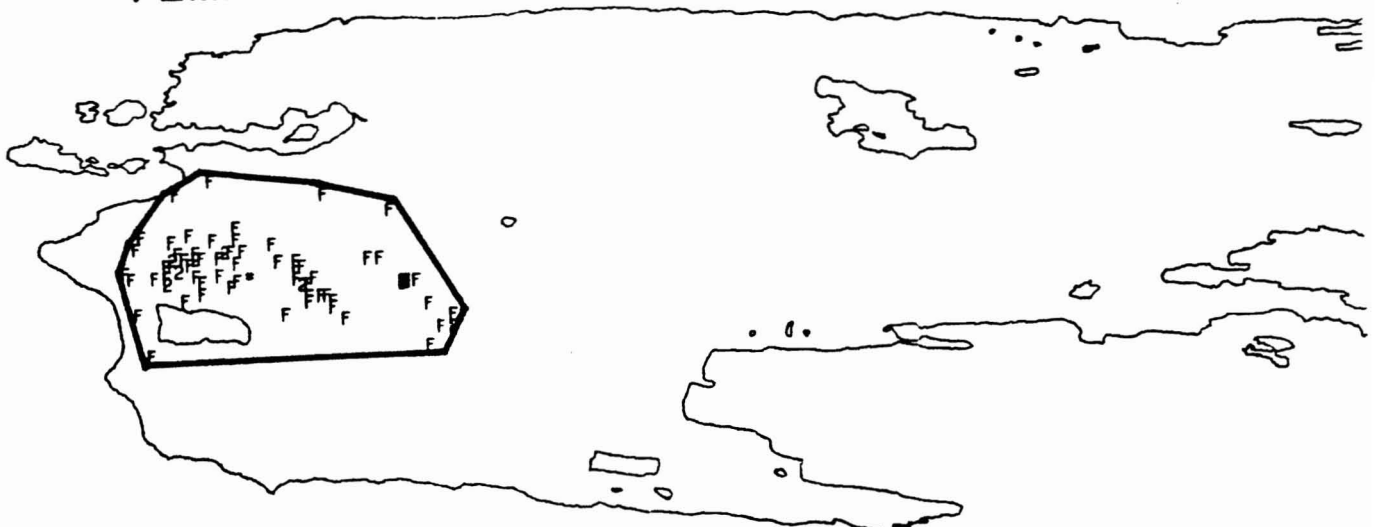
FEMALE 320



FEMALE 630

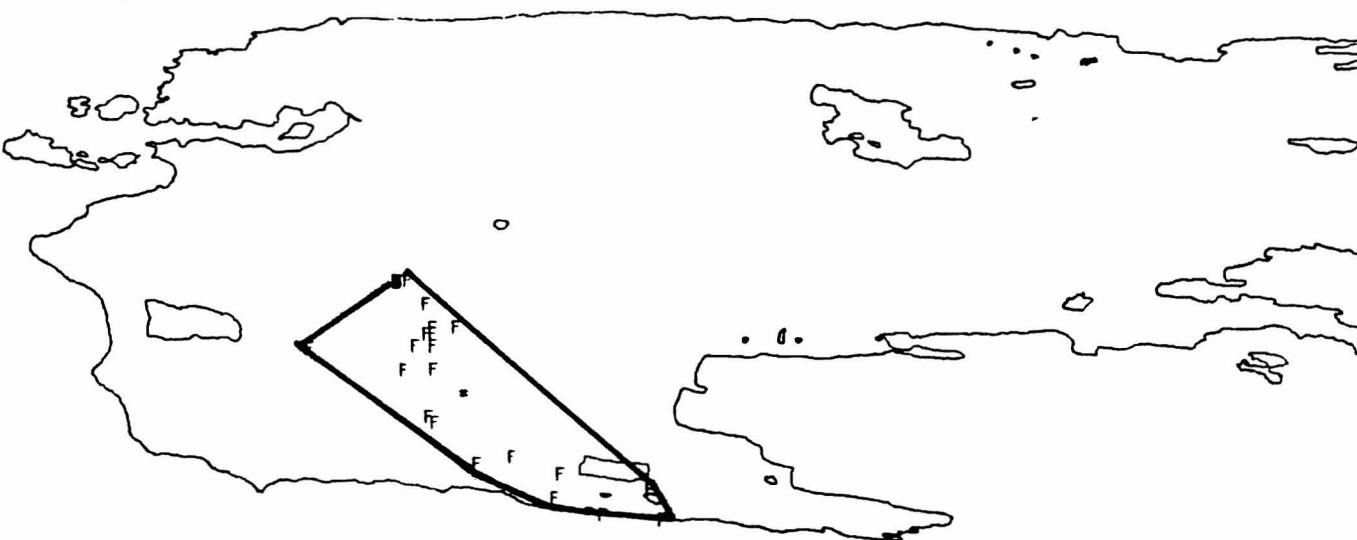


FEMALE 981



Appendix 1 (cont'd)

**FEMALE 1530**



**FEMALE 1641**

