ALASKA DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA

STATE OF ALASKA
William A. Egan, Governor

DEPARTMENT OF FISH AND GAME
Wallace H. Noerenberg, Commissioner

DIVISION OF GAME
Frank Jones, Acting Director
Donald McKnight, Research Chief

ELK REPORT

by

Jack E. Alexander

Volume XI
Project Progress Report
Federal Aid in Wildlife Restoration
Project W-17-3, Job 13.1R

(Printed July 1971)

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: Jack E. Alexander

Project No.: W-17-3 Project Title: Big Game Investigations

Job No.: 13.1R Job Title: Seasonal Movements of Elk

Period Covered: June 1, 1970 through July 1, 1971

SUMMARY

Twenty-four elk were captured and marked (21 with radio transmitters) on Afognak and Raspberry Islands in three days of tagging effort during June and September 1970. During these periods elk were above timberline or on summer alpine ranges which made location and capture possible. Capture success was considered poor, averaging only 1.2 elk per hour of helicopter flight time. The low capture rate is attributed to the variable effects of succinylcholine chloride on elk stressed during the pre-tagging chase.

It appears the enzyme Hyaluronidase is effective in reducing the latent period required for the absorption of succinylcholine chloride. The average induction time necessary to anesthetize 24 elk was 7.0 minutes. The dosage producing the most desirable effects on elk appears to be 35 mg. of succinylcholine chloride in 50 mg/cc solution. However, only 50 percent of the elk darted with this dosage level were immobilized.

Movement data were obtained from October 1970 through May 1971 on all of the radio-marked elk; most were located eight or nine times each. Data collected thus far from observation of marked elk are not sufficient to draw conclusions about seasonal movements or population identities.

CONTENTS

BACKGROUND

Elk (Cervus canadensis) introduced into Alaska are restricted in distribution to Afognak and Raspberry Islands, a part of the Kodiak Archipelago. They are, however, of considerable interest to a large number of Alaskan hunters. The status of elk populations has been the subject of much concern over the past several years. Much of this concern is the result of population declines on the southern portions of Afognak and Raspberry Islands. The future of this elk population is in question because the effects of proposed large-scale logging operations upon elk habitat are unknown. In order to allay public apprehension and assure habitat protection, studies that will assist in the development of progressive management plans must be conducted.

Harvest and population data have been collected and summarized by herd localities since about 1945, therefore, the following discussion and data are presented.

Malina Herd

The Malina herd (Fig. 1), as indicated by trend counts, appears to have reached its upper limit in numbers about 1961; densities at this time approximated 45 elk per square mile. This herd has steadily declined since that time, and in 1969 the hunting season was closed by emergency announcement. During the previous eight years, this herd contributed an average of 28 percent of the total harvest.

The average annual harvest and calf crop percentages during this period remained nearly constant, and a large net loss of animals, such as experienced would not be expected. This downward trend in total numbers could be the result of two factors or a combination thereof: (1) an annual harvest considerably larger than recorded; or, (2) a natural mortality rate greater then previously believed. Since range conditions were believed to be generally poor and harvest was determined by hunter interviews the decline probably resulted from a combination of both factors.

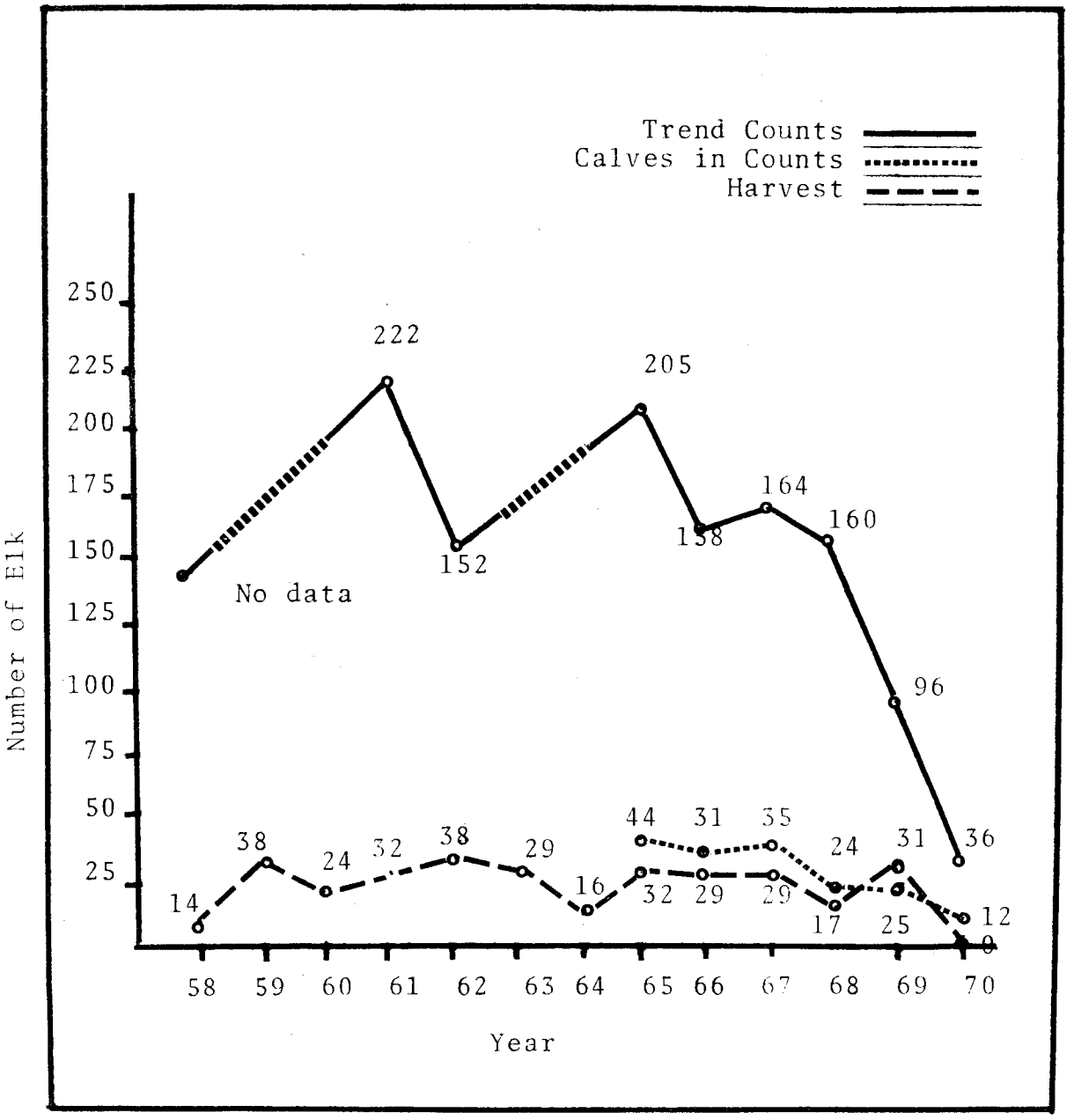

Fig. 1. Trend counts, harvest and production trends for the Malina herd, 1958-1970.

Afognak and Raspberry Strait Herd

Population data for the Afognak herd are lacking prior to 1965. Judging from harvest information (Fig. 2) collected since 1958 and results of trend counts conducted by the U. S. Fish and Wildlife Service, this herd may have reached a peak population between 1958 and 1960. Elk densities of about 29 animals per square mile were noted at that time. The long-term trend appears to be stable despite minor annual fluctuations. It is probable that an exchange of small groups of animals between this and the Malina herd could occur resulting in such annual variations. The Afognak herd contributed an average of 23 percent of the total Alaska annual harvest between 1962 and 1969.

Raspberry Island Herd

The Raspberry Island herd exhibited the most dramatic decrease in the shortest period of time (Fig. 3). This herd reached an estimated density of 35 animals per square mile in 1965, followed by a decline to almost half this density the following year. The trend continued downward until 1968 when only 10 animals were located. The recorded harvests for 1965 and 1966 were double the calf production for those years; therefore, a net loss could be expected. However, the recorded harvest could not account for the magnitude of the decline. The only plausible explanation for the reduction would be (1) a harvest more than double that recorded or (2) high mortality resulting from the severe winter weather of 1965. The high animal densities and generally poor range conditions suggest winter mortality probably contributed significantly to the decline. Harvests from this herd during the 1963-67 period averaged 32 percent of the total elk kill.

Tonki Cape Herd

The Tonki Cape herd exhibited typical population growth and subsequent decline to a point probably consistent with forage production. An estimated density of 24 elk per square mile was obtained in 1966 (Fig 4). The average annual harvest of 11 animals is the lowest recorded for any herd, and it is doubtful that harvest contributed significantly to the herd's decline. Poor range conditions have long been reported in this area and they are the probable cause of the 1967 decline.

OBJECTIVES

To delineate the various populations and sub-populations of elk inhabiting Afognak Island and determine their seasonal movements.

PROCEDURES

Elk were located and captured on alpine ranges during late September. Palmer Cap-chur equipment was used and fired from a Bell 206A Turbo Helicopter. Succinylcholine chloride (E. R. Squibb & Sons, New York) in concentrations of 50 mg/cc was used to immobilize the elk. Hyaluronidase

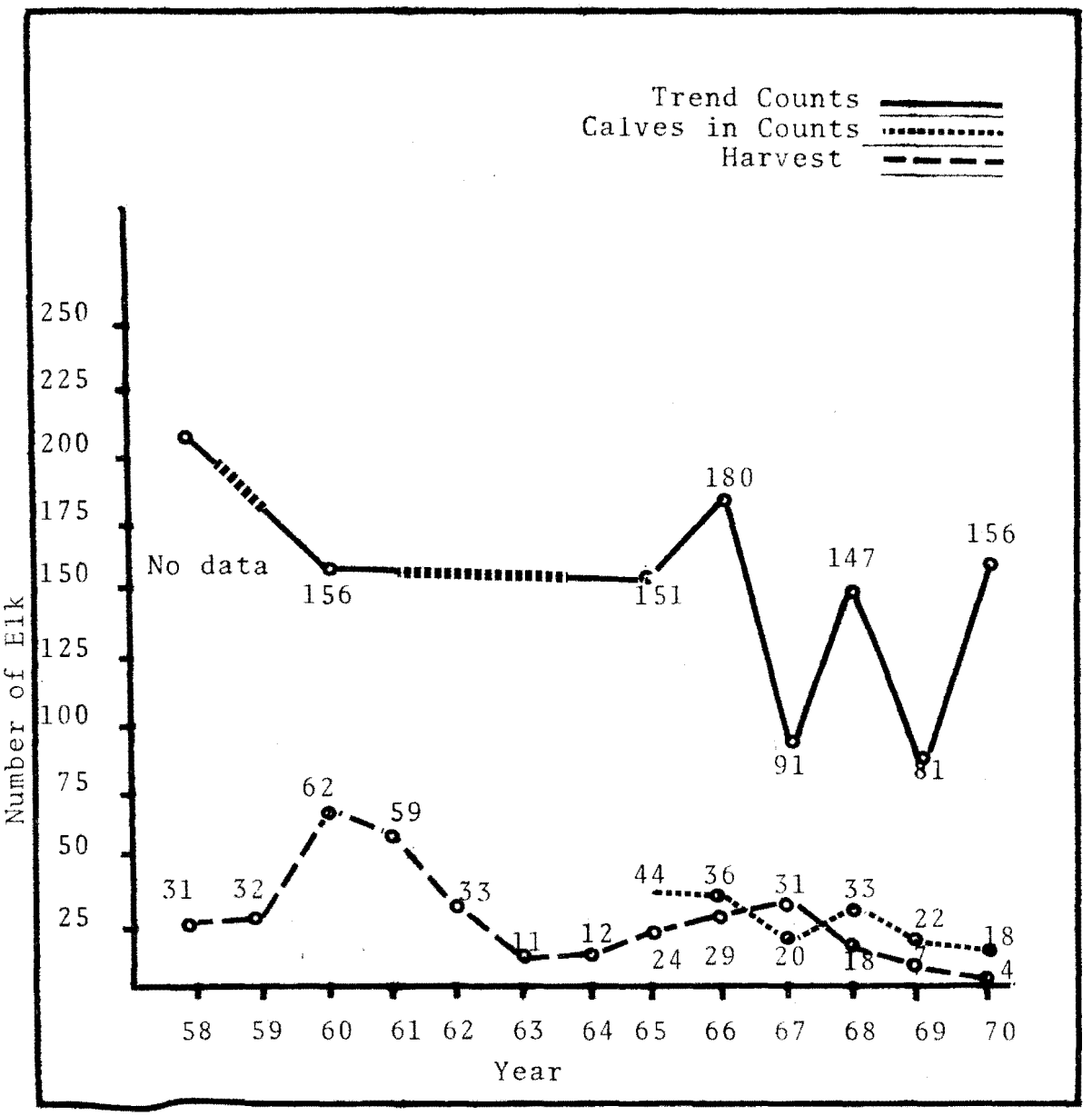

Fig. 2. Trend counts, harvest and calf production for the Raspberry Strait herd, 1958-1970.

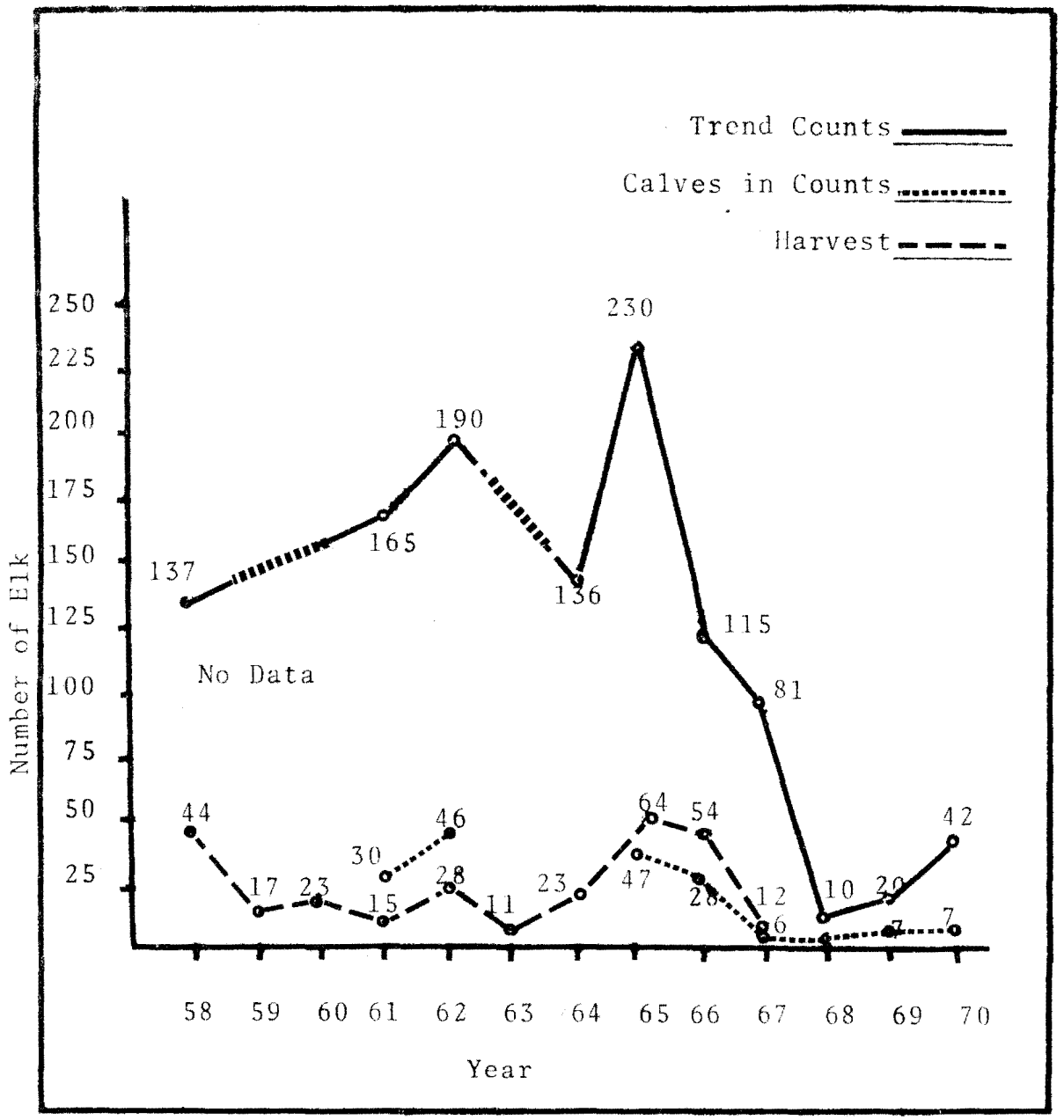

Fig. 3. Trend counts, harvest and calf production for the Raspberry Island herd, 1958-1970.

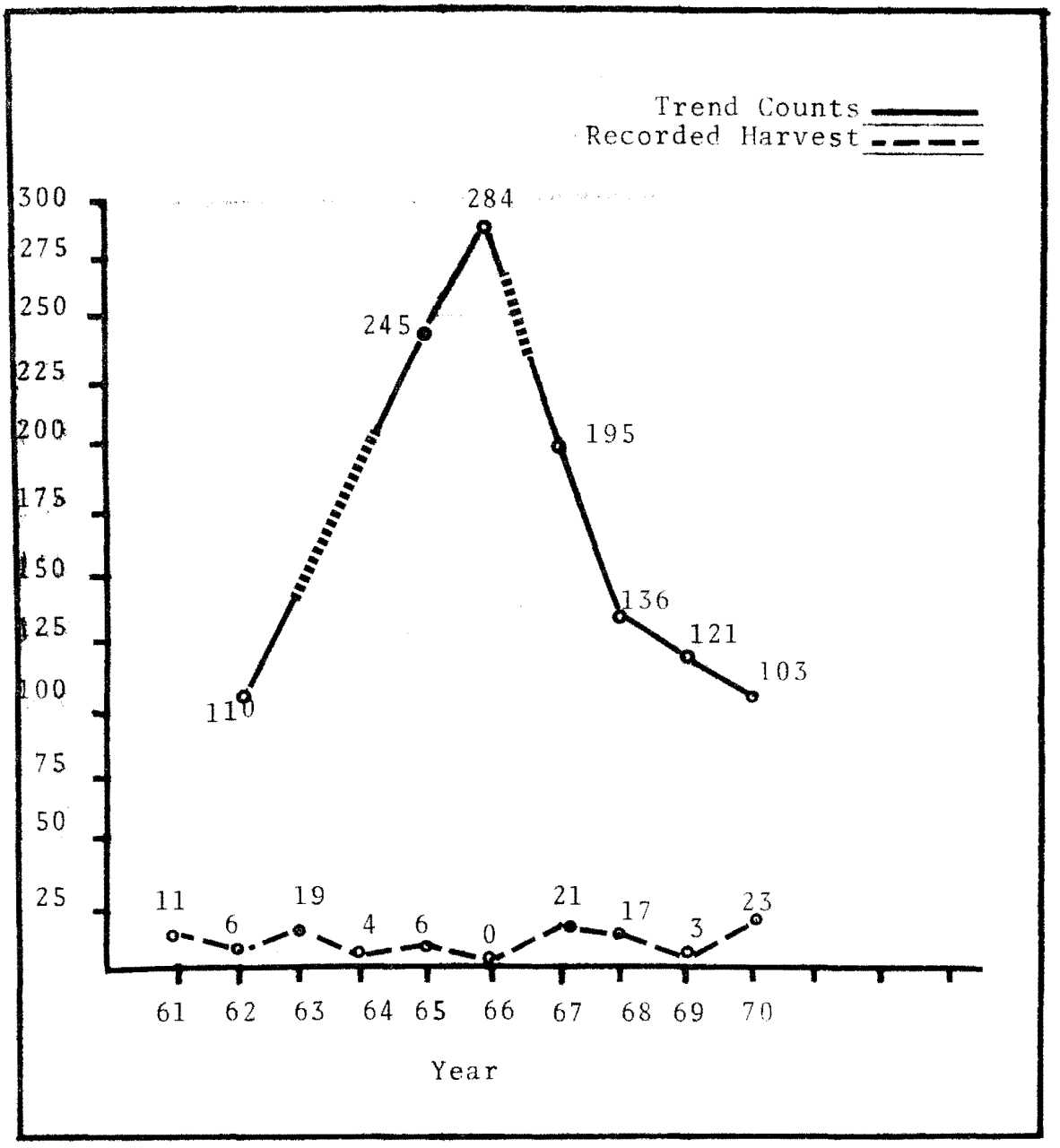

Fig. 4. Trend counts and recorded harvest for Tonki Cape herd, 1961-70.

(Haver-Lockhart Laboratories, Kansas City, Missouri) in concentrations of 150 n.f. units was used to reduce induction time, thereby reducing the latent period of the succinylcholine chloride. Adult elk were given a dosage ranging from 15 to 90 milligrams. When possible two animals were darted in rapid succession; the helicopter was then moved off a short distance and used to keep the darted elk together and in the open. Elk were weighed with a 2,000 lb. capacity scale and cargo net when and where circumstances permitted. All elk captured were ear marked with numbered metal ear tags and colored Dayglo Saflag streamers (Safety Flag Company of America, Pawtucket, Rhode Island). Elk were also marked with a four-inch wide canvas collar to which nylon flagging had been sewed for color coding (Denver Tent Company, Denver, Colorado). The collar was attached by fastening overlapping ends with a "pop" rivetool, (USM Corp., Reading, Pennsylvania). Neck collars in combination with ear tags made individual recognition from low-flying aircraft possible. Sixteen female elk, two or three from each of the major herds inhabiting the southwestern and interior portions of Afognak Island were fitted with radio transmitters.

The transmitter, a transistor-crystal-controlled oscillator is similar to that developed by Cochran and Lord (1963) and is widely used in animal tracking. Slight modifications were made to fit our particular needs. The components mounted on a circuit board and batteries were enclosed inside a one-inch continuous plastic hose. The hose was then filled with liquid styrofoam (Tital Poly-foam, Titon Chemicals, Inc., Seattle, Washington). The styrofoam set, making a rigid ring, could be slipped over the elk's head. All collared elk in the same herd were on the same radio frequency but oscillation rates were varied making it possible to recognize individuals. Tracking of elk was accomplished with aid of a military surplus R-388 receiving unit on loan from the U. S. Fish and Wildlife Service. The receiving unit was carried aboard a Cessna 185 aircraft, with external antenna mounted between the wing and tail strut. Observations were made by flying at about 1,500 feet elevation through herd areas and monitoring a selected frequency until a signal was detected. Ever-tightening circles were then flown, reducing audio gain and sensitivity of the receiver until animals were located. Once observed, the number and sex of animals in the herd were recorded. The type of habitat elk were associated with, slope and aspect were also noted.

Standard body measurements and reproductive status of each captured animal were recorded.

FINDINGS

Capture and Marking Success

On June 8 and September 27 and 28, 1970, 24 elk were captured, marked and released after collecting specific biological information. Twenty-one of these were equipped with transistorized oscillating transmitters.

The elk, generally in large herds, were located by searching alpine areas of southwestern Afognak with the aid of a helicopter. Once located,

several animals were separated from the herd, darted and prevented from rejoining the herd or entering the timber by skillful maneuvering of the helicopter. Capture success using this technique averaged only 1.2 elk per hour of flying time. Thirty-two percent of the darted elk were visibly unaffected by the drug. The low capture rate is attributed to the variable reactions of stressed elk to commercially prepared succinylcholine chloride (sucostrin). Table 1 summarizes the variety of dosages used and results. Dosages of 25 mg. in 50 mg/cc solution in the spring and 32-35 mg. in the fall produced the most desirable reaction in immobilized elk. However, this dosage resulted in immobilization of only 50 percent of the darted animals. The enzyme Hyaluronidase was used as indicated by Allen (1970) mixed with succinylcholine to reduce the latent period of this drug. This in turn reduced flying time and chances of escape. Average time to collapse was 7.0 minutes and immobilization period averaged 21.8 minutes. Often, upon approach, elk would attempt to rise and would require manual restraint in order to collar and measure the animal.

Radio Transmitting and Receiving Equipment

The system used to construct the transistor-crystal controlled transmitter is similar to that described by Verts (1963) but modified to fit elk. A diode receiver and multimeter were used to predict signal range and battery drain. Transmitters used in this project have a maximum range of about eight miles and a theoretical battery life of 12-18 months.

For reasons yet to be determined, transmitter signals could not be received after the sixth month of operation. A signal amplifier (Knight, 1970) was then constructed and proved satisfactory in locating the still operating transmitters. At this writing, at least seven of the 16 transmitters constructed in mid-September are still producing audible signals. Improvements in components and construction techniques should provide more effective transmitters, to be used in the fall of 1971.

Receiving equipment consisted of a R-388 surplus military receiving unit (on loan from U. S. Fish and Wildlife Service) mounted aboard a light aircraft. This unit proved very satisfactory and attempts are being made to secure one of these units for our use, thus making possible more frequent observations. Tracking flights were attempted at 10-day intervals or as weather permitted. Unusually severe weather existed most of the 1970-71 winter and spring seasons, permitting an average of only one tracking flight per month. Radio frequency and collar markings are listed in Table 2.

Grouping Patterns

An attempt was made to determine mean herd sizes and relate this to seasonal changes and habitat types. A definite difference was noted in male and female grouping patterns. Cow-calf groups were consistently larger than male groups (Table 3). Male groups had the largest mean group size in July and the smallest in April. Cow-calf groups reached the greatest mean size in July and declined to their smallest mean size

Table 1. Drug Dosages and Reactions of Darted Elk.

Sex	Age	Dosage	Minutes to Collapse	Minutes Immobilized	Remarks
F	Mat.	90 mg.	5	35	
M	1.5	65 mg.	5	55	Need respiration
F	Mat.	25 mg.	22	0	Had to be restrained
F	Mat.	25 mg.	5	10	
F	Mat.	20 mg.	8	25	
F	Mat.	32 mg.	5	25	
F	1.5	32 mg.	7	25	
F	Mat.	90 mg.	3	45	
F	Mat.	33 mg.	13	15	
F	Mat.	32 mg.	8	15	
F	Mat.	32 mg.	7	10	
F	Mat.	32 mg.	20	0	Had to catch & restrain
F	Mat.	35 mg.	3	30	Poor physical condition
F	Mat.	75 + 75	1	25	
F	Mat.	50 + 50	4	20	
F	Mat.	25 mg.	0	0	No effect
F	Mat.	30 mg.	0	0	No effect
F	Mat.	35 mg.	0	0	No effect
F	Mat.	35 mg.	0	0	No effect
F	Mat.	35 mg.	0	0	No effect
F	Mat.	65 mg.	5		Died
F	Mat.	90 mg.	7		Died
F	Mat.	55 mg.	3		Died, broken neck
F	Mat.	90 + 90	6		Died
F	Mat.	32 mg.	1	30	Required respiration for 10 minutes
F	Mat.	33 mg.	7	15	
F	Mat.	32 mg.	4	15	
F	Mat.	20 mg.	5	10	
M	Mat.	15 mg.	5	15	
M	Mat.	15 mg.	5	19	
F	1.0	20 mg.	20	10	
M	Mat.	25 mg.	5	10	
F	Mat.	80 mg. (2)	0	0	No effect
F	Mat.	40 mg.	0	0	No effect
F	Mat.	50 mg.	0	0	No effect
F	Mat.	35 mg.	0	0	No effect
F	Mat.	25 mg.	0	0	No effect
F	Mat.	32 mg.	0	0	No effect
F	Mat.	25 mg.	0	0	No effect
F	Mat.	32 mg.	0	0	No effect

Extremes 1 - 22 min. Extremes 0 - 55 min.
Mean - 7 Mean - 21.8

Table 2. Radio Number, Frequency and Neck Band Colors of 23 Tagged Elk, 1970.

Radio No.	Sex	Age	Date	Remarks	Repro. Status
H 30.07	F	Mat.	9/27/70	White collar, orange ear streamers	Lactating
No radio	M	1.5	9/27/70	White collar, orange ear streamers	
I 30.07	F	Mat.	9/27/70	White collar/red stripe, orange ear streamers	Lactating
O 30.05	F	Mat.	9/27/70	Orange collar/yellow tape, orange ear streamers	
N 30.05	F	Mat.	9/27/70	Orange collar, pink ear streamers	Lactating
T 30.25	F	Mat.	9/30/70	Yellow collar/red bars, lime ear streamers	Dry
U 30.25	F	1.5	9/30/70	Yellow collar, pink ear streamers	Dry
P 30.19	F	Mat.	9/28/70	Yellow collar #15	Lactating
S 30.22	F	Mat.	9/30/70	Yellow collar, orange ear streamers	Lactating
V 30.22	F	Mat.	9/30/70	White collar	Lactating
R 30.19	F	Mat.	9/30/70	Orange collar, orange ear streamers	Lactating
Q 30.19	F	Mat.	9/30/70	Orange collar	Lactating
W 30.19	F	Mat.	12/31/70	No collar	Lactating
F 30.06	F	Mat.	9/27/70	Yellow/blue stripe	Lactating
G 30.06	F	Mat.	9/27/70	Yellow/blue stripe collar w/red bars	Lactating
K 30.07	F	Mat.	9/30/70	White collar/red stripe	Lactating
M 30.23	F	Mat.	9/30/70	Collar white/red stripe	Lactating
L 30.24	F	Mat.	9/20/70	Collar white/red stripe	Lactating
B 30.19	F	Mat.	6/8/70	Radio taped red	Pregnant
C 30.24	M	Mat.	6/8/70	Blue collar	
D No radio	M	Mat.	6/8/70	Yellow collar	
E 30.19	F	1.0	6/8/70	White collar	
A 30.20	M	Mat.	6/8/70	Orange collar	
X No radio	F	Mat.	8/10/70	Blue collar	Lactating

Table 3. Mean Elk Herd Size by Month, 1970-71.

Month	Male	Female
January		41.2
February		
March		24.5
April	1.5	25.8
May	2.5	11.6
June	3.4	38.3
July	8.0	98.0
August	6.4	37.6
September		
October	5.0	37.2
November		58.0
December		

in May. Mean group size in relation to habitat types will be analyzed when more observations have been made.

Life History Information

Attempts were made to weigh and collect standard measurements from each captured elk. Difficulties were encountered when animals collapsed in dense timber or their weight exceeded lifting capability of the helicopter. A mature male captured in June and a female captured in late September weighed 860 and 660 pounds, respectively. Troyer (1960) recorded fall field dressed weights of mature males up to 1,155 pounds. Body measurements were acquired from five male and 21 female elk (Table 4). These measurements, consisting of girth, hindfoot and total length, were compared to those of Roosevelt elk on the Olympic Peninsula of Washington (Schwartz and Mitchell, 1945). Mean measurements from a limited number of animals indicate that body size of Afognak elk may be somewhat larger than their parent stock.

Of 18 females examined, 16 or 89 percent were pregnant or lactating.

Habitat Preferences

Areas used by radio-marked elk were classified into three major vegetation types: spruce, alder and alpine. The frequency and percent of time elk were observed in these categories were recorded and are presented in Table 5. Forty-eight percent of the marked elk observed between October and March were in spruce habitat. Though total observations are few, because spruce is not the dominant vegetation on much of southern Afognak Island these data suggest some preference by elk for spruce habitat. More extensive observations on habitat use will be conducted in the forthcoming year.

Movements and Herd Identities

Between October 1970 and May 1971, all elk marked were sighted, some as many as nine times. Table 6 presents tagging locations and tag numbers. Individual tagged animals and their associated herds showed extreme movements ranging from one to six miles between observations. Movements by females number 0 and V, the near maximum, were known to occur when hunters approached these herds. During the course of these observations, no tagged animals were known to have moved out of what is considered the herd area. Movements during the fall period consisted of travel to various alpine ranges within the herd area. Winter and spring movements generally consisted of travel parallel to beach fringes, but again animals appeared to have remained within the known herd area. A mature bull tagged June 8, 1970 on Tonki Cape remained near the tagging site until late August. This bull then moved approximately 10 miles to the extreme opposite edge of the herd area and was killed by hunters during early October. Movements of individual tagged elk are illustrated in Figures 5 through 11.

RECOMMENDATIONS

No recommendations.

Table 4. Body Measurement of 26 Elk, Yearlings and Older, Captured in 1970.

Number	Age	Height of Shoulder	Girth	Hindfoot	Total Length	Weight
Males	Mat.			29		1,200
C	Mat.		68	28	104	
D	Mat.		74	29	105	860
A	Mat.					
J	1.5		64	27		
MEAN			68	28.1	104.5	1,030
Females						
	Mat.	60	66	26	90	
	Mat.		64	26.75	95	
	Mat.	55	64	25.25	87	
	Mat.	61	66	25.25	96	
P	Mat.		64	25	92	660
S	Mat.		67	26	98	
V	Mat.		68	27	99	
R	Mat.		66		93	
F	Mat.		74		104	
W	Mat.			28	92	
G	Mat.		69	27	89	
K	Mat.	60	71	25	89	
M	Mat.		70		96	
L	Mat.	61	68	27	93	
U	1.5		58	23	93	
T	Mat.	56	68	26	97	
I	Mat.	54	63	26.75	99	
H	Mat.	57	71	25.50	96	
N	Mat.		66	27	96	
O	Mat.		68		105	
E	1.5	44	50	24	94	
MEAN		56.4	66	25.86	94.9	

Table 5. Frequency and Percent of the Time Elk Use the Three Habitat Categories During the October - March Period.

Elk Herd & Designation	Sex	Habitat Category			Total Observations
		Spruce	Alder	Alpine	
Afognak Herd					
B	F	1	1	1	3
F	F	5	2	-	7
G	F	5	1	1	7
W	F	3	-	-	3
					20 = 19.9
Raspberry Herd					
H	F	-	2	3	5
I	F	-	2	4	6
J	M	-	2	4	6
					17 = 16.8
Malina Herd					
K	F	1	4	1	6
L	F	1	4	1	6
M	F	2	3	1	6
					18 = 17.9
Paramanof Herd					
N	F	3	-	2	5
O	F	3	-	3	6
					11 = 10.8
Kazakof Herd					
R	F	2	2	2	6
S	F	2	-	2	4
P	F	3	-	2	5
					15 = 14.9
Duck Mt. Herd					
U	F	4	1	1	6
T	F	6	-	1	7
					13 = 12.8
Kitoi Herd					
V	F	7	-	-	7 = 6.9
Total Observations		48	24	29	101
Observations in Habitat Category %		48	24	29	

Table 6. Tag Number and Tagging Location of Elk Captured in 1970.

Number	Sex	Ear Tag Numbers Left	Ear Tag Numbers Right	Location	Remarks
	F	10920	10921	Paramanof Cape	
N	F	10919	10918	Paramanof Cape	
H	F	10910	10911	Raspberry Island	
J	M	10916	10917	Raspberry Island	
I	F	10912	10914	Raspberry Island	
T	F	10930	10931	Duck Mountain	
U	F	10934	10933	Duck Mountain	
P	F	10909		Danger Mountain	
S	F	10928	10929	N.W. Danger Bay	
V	F	10936	10935	Kitoi	
R	F	10927	10926	West Paramanof Mt.	
Q	F	-	-	West Paramanof Mt.	
W	F	10949	10950	Waskanareska	Died 2/20/71
F	F	-	-	Litnik Mountain	
G	F	10904	10905	Afognak Lake	
K	F	10906	10907	Malina Lake	Died 4/21/71
M	F	10925	10924	Steep Creek-Malina	
L	F	10922	10923	Steep Creek-Malina	
B	F	-	-	Raspberry Strait	
C	F	18		Head Danger Bay	Died 6/25/70
D	M	22	21	Head Danger Bay	
E	F	-	-	Kitoi	Died 6/12/70
A	M	25		Tonki	Killed 10/5/70
X	F			Paramanof Mt.	Killed 9/10/70

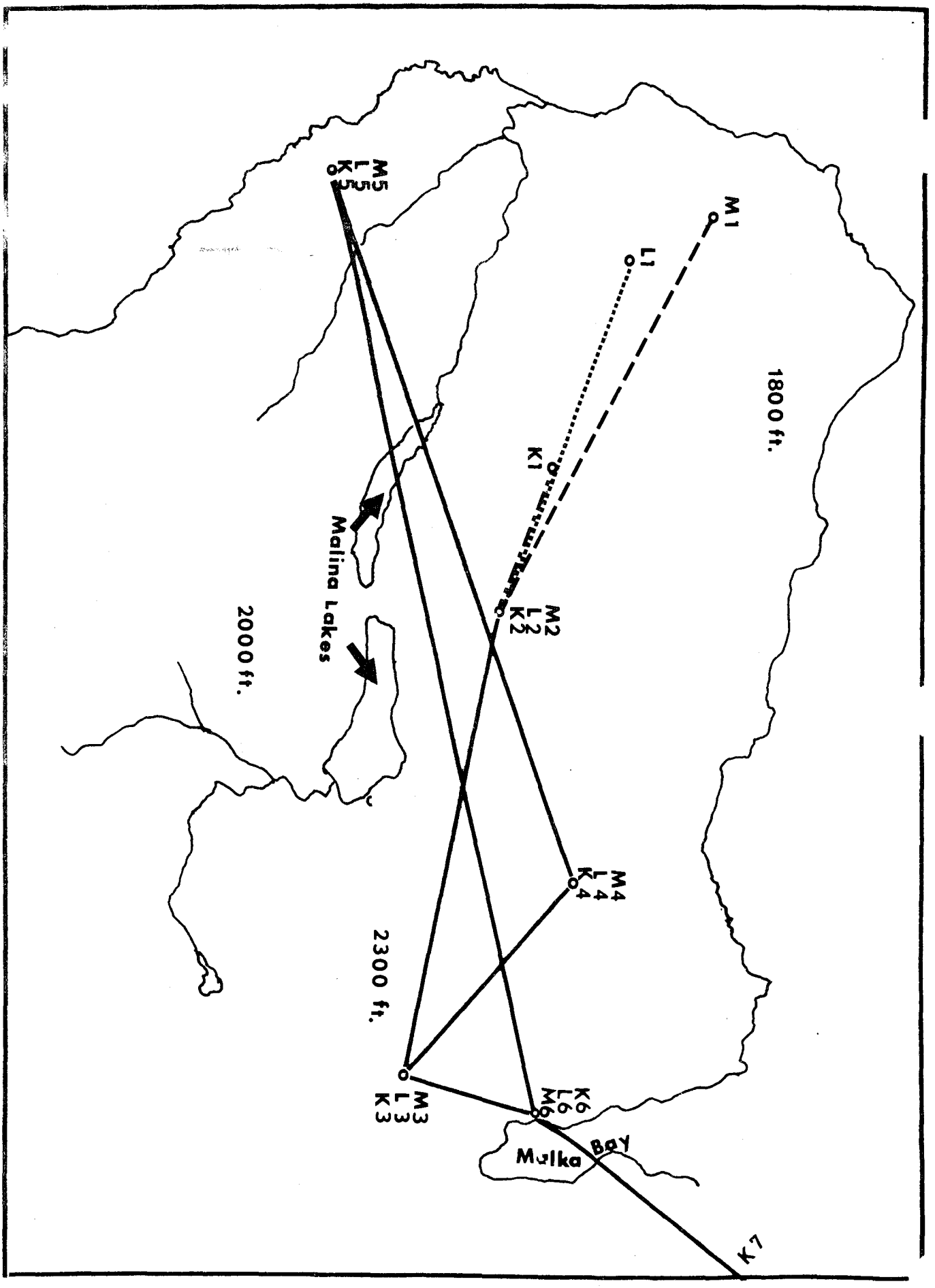

Fig. 5. October-May movements of three radio-tagged elk from Malina herd.

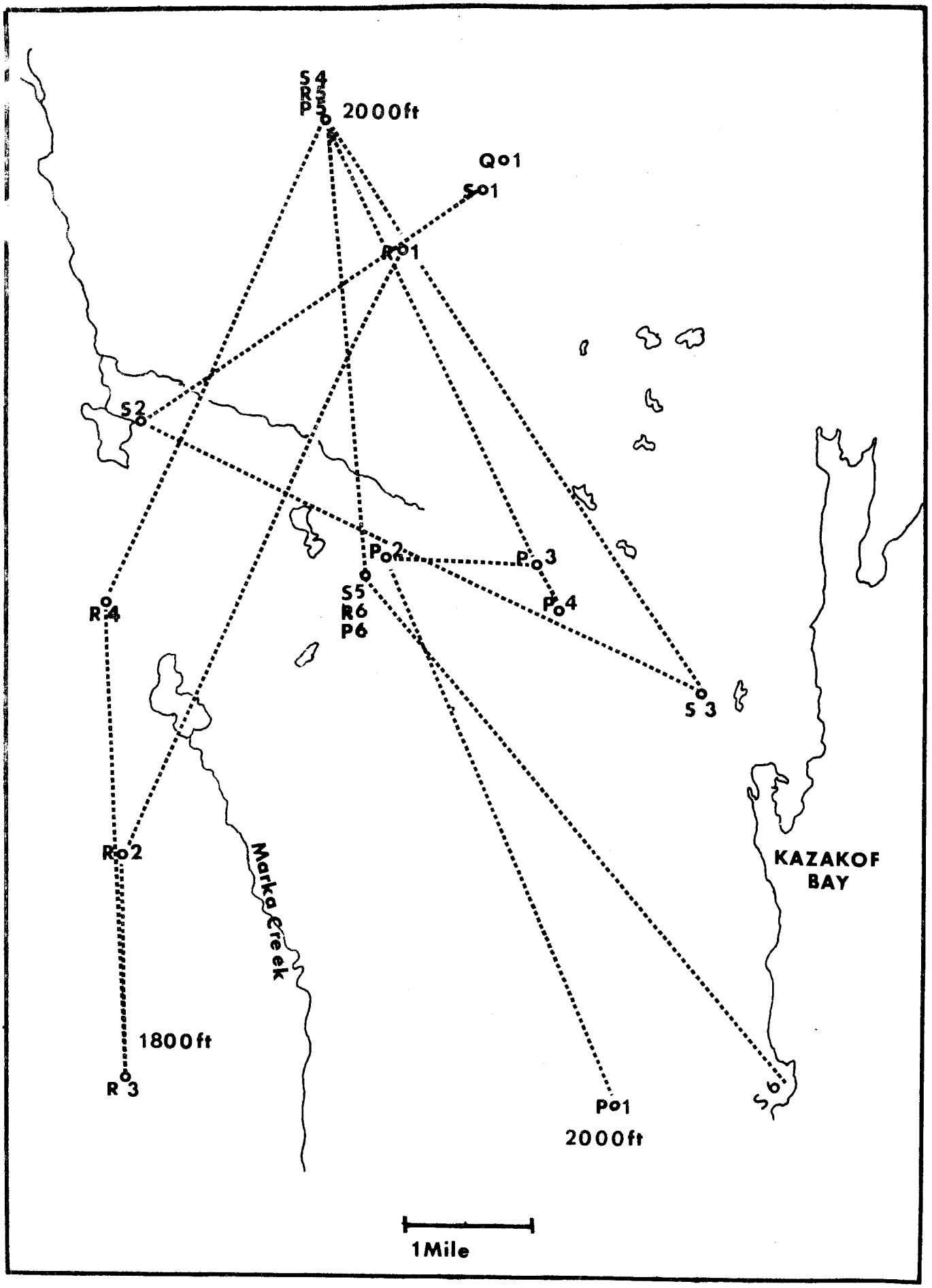

Fig. 6. October-May movements of three radio-tagged elk from Paramanof herd.

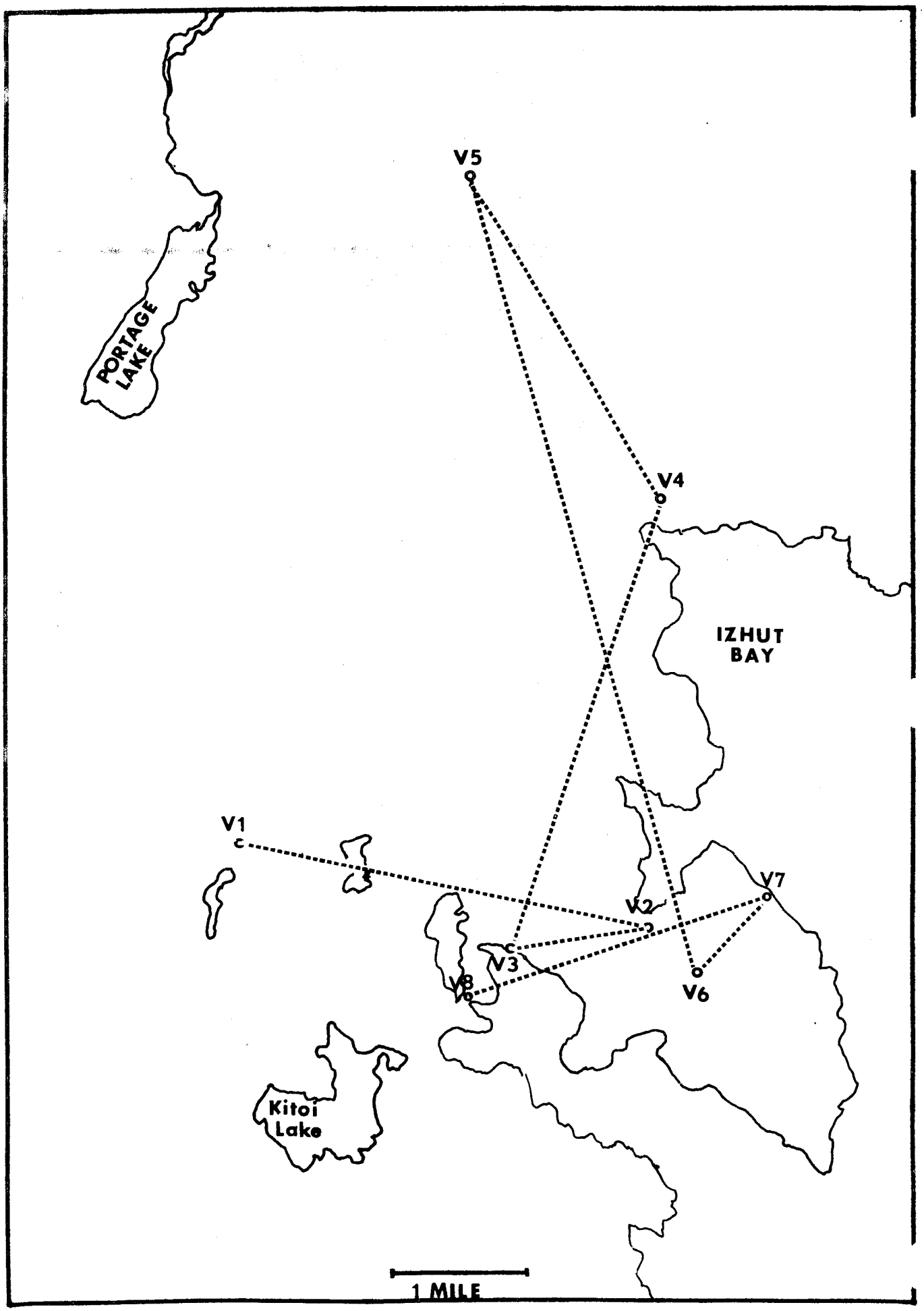

Fig. 7. October-May movements of one radio-tagged elk from Kitoi herd.

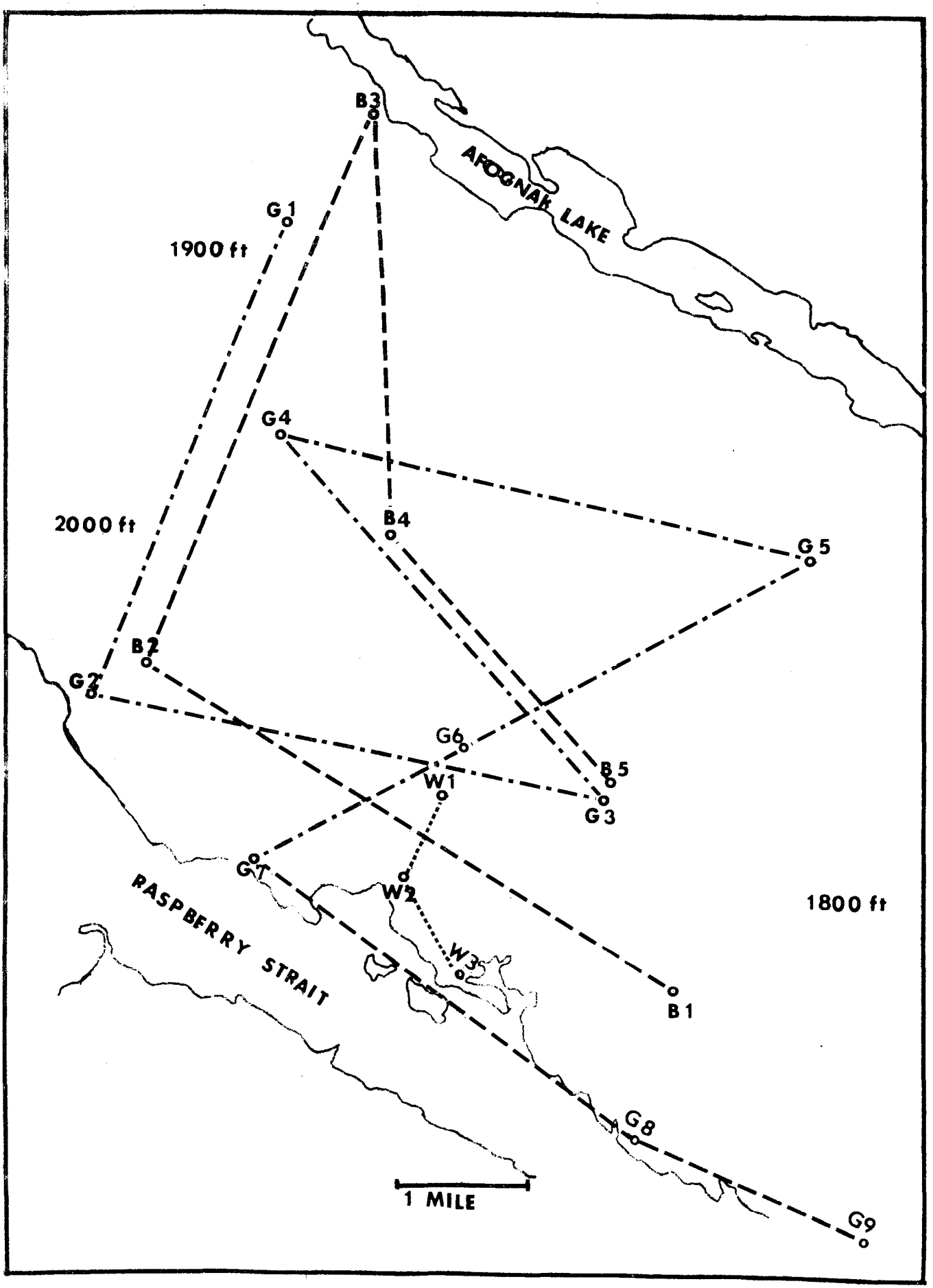

Fig. 8. June-May movement of three radio-tagged elk from the Raspberry Strait herd.

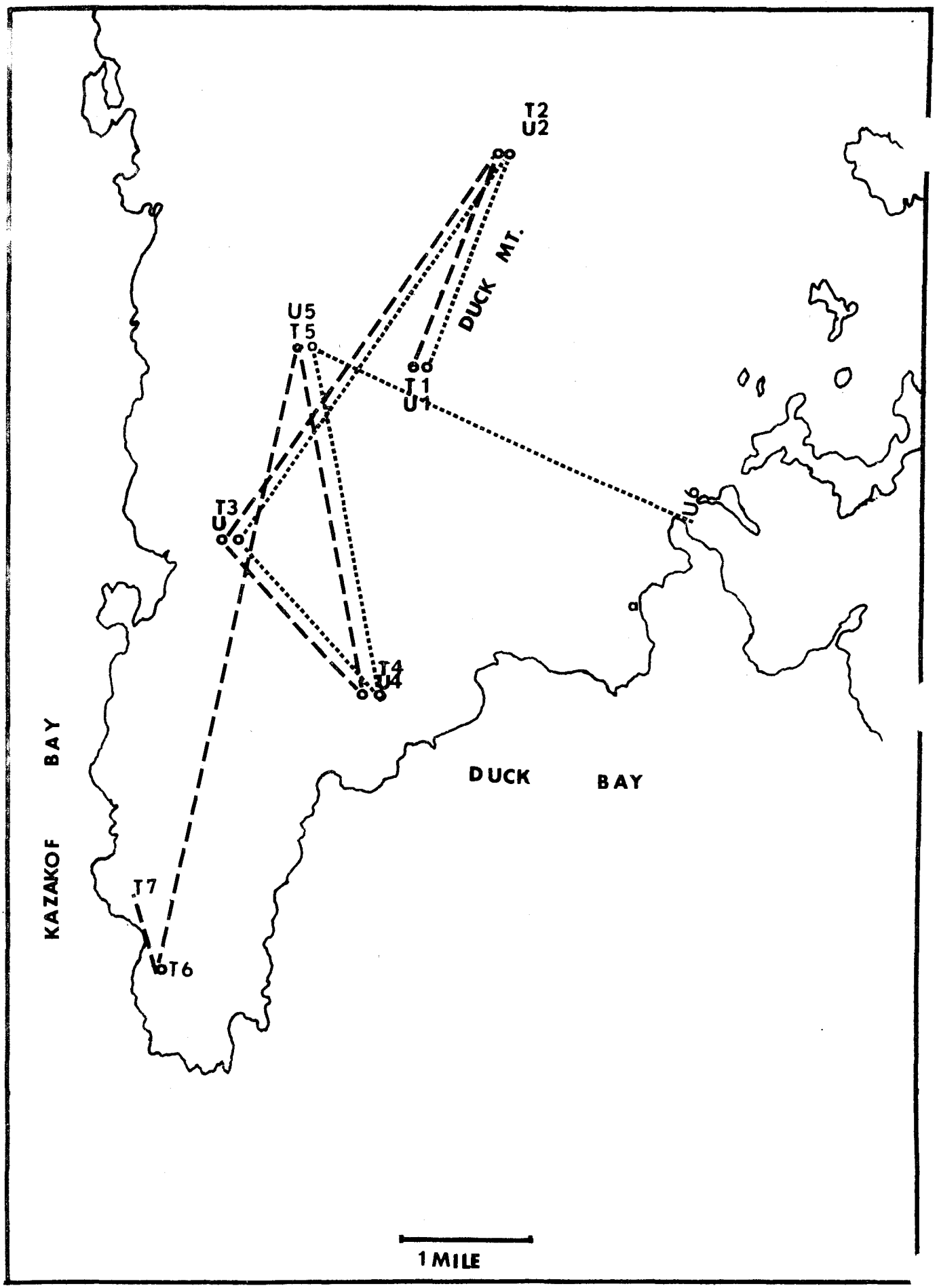

Fig. 9. October-April movements of two radio-tagged elk from the Duck Mountain herd.

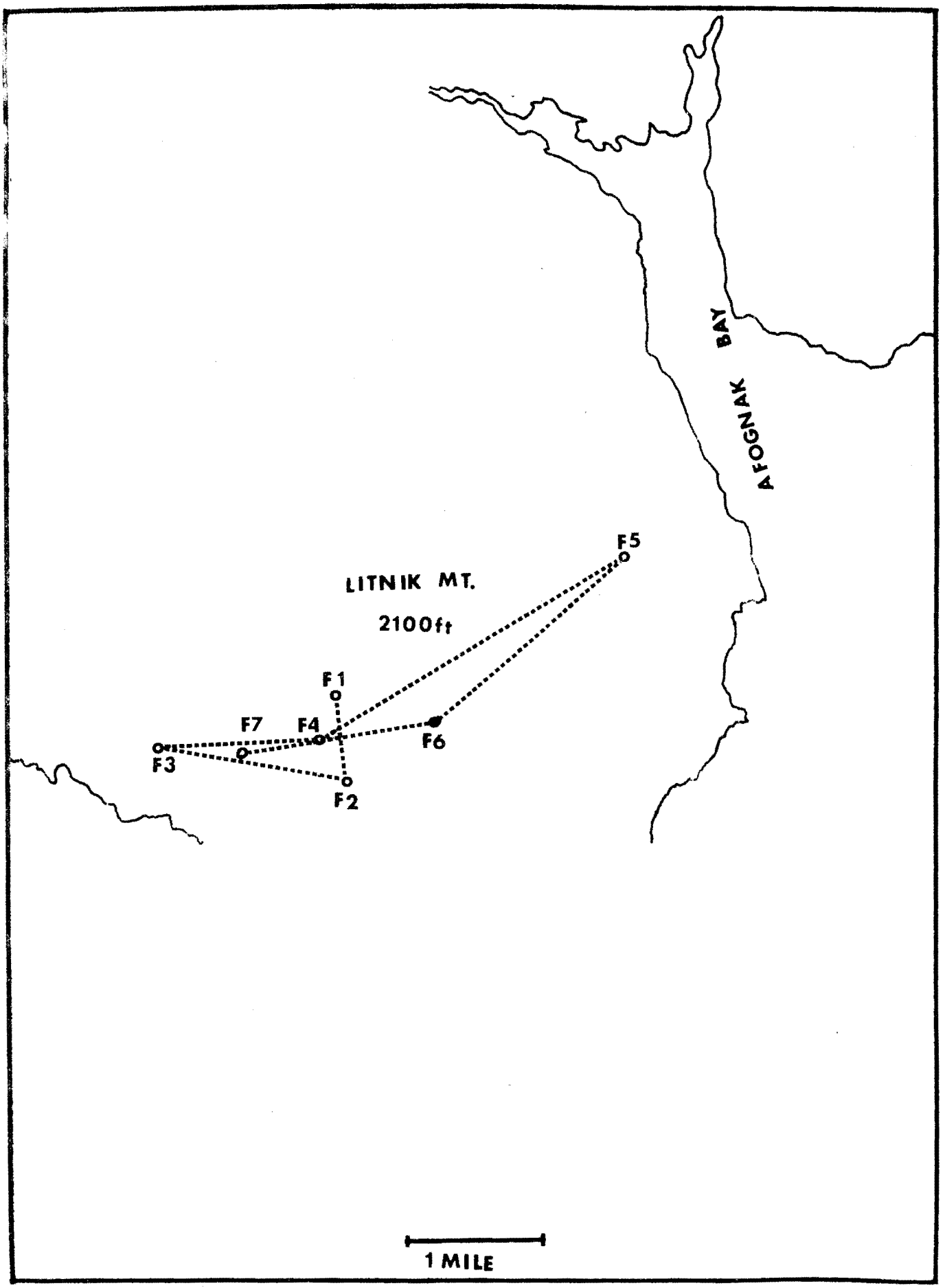

Fig. 10. October-May movements of one radio-tagged elk from the Raspberry Strait herd.

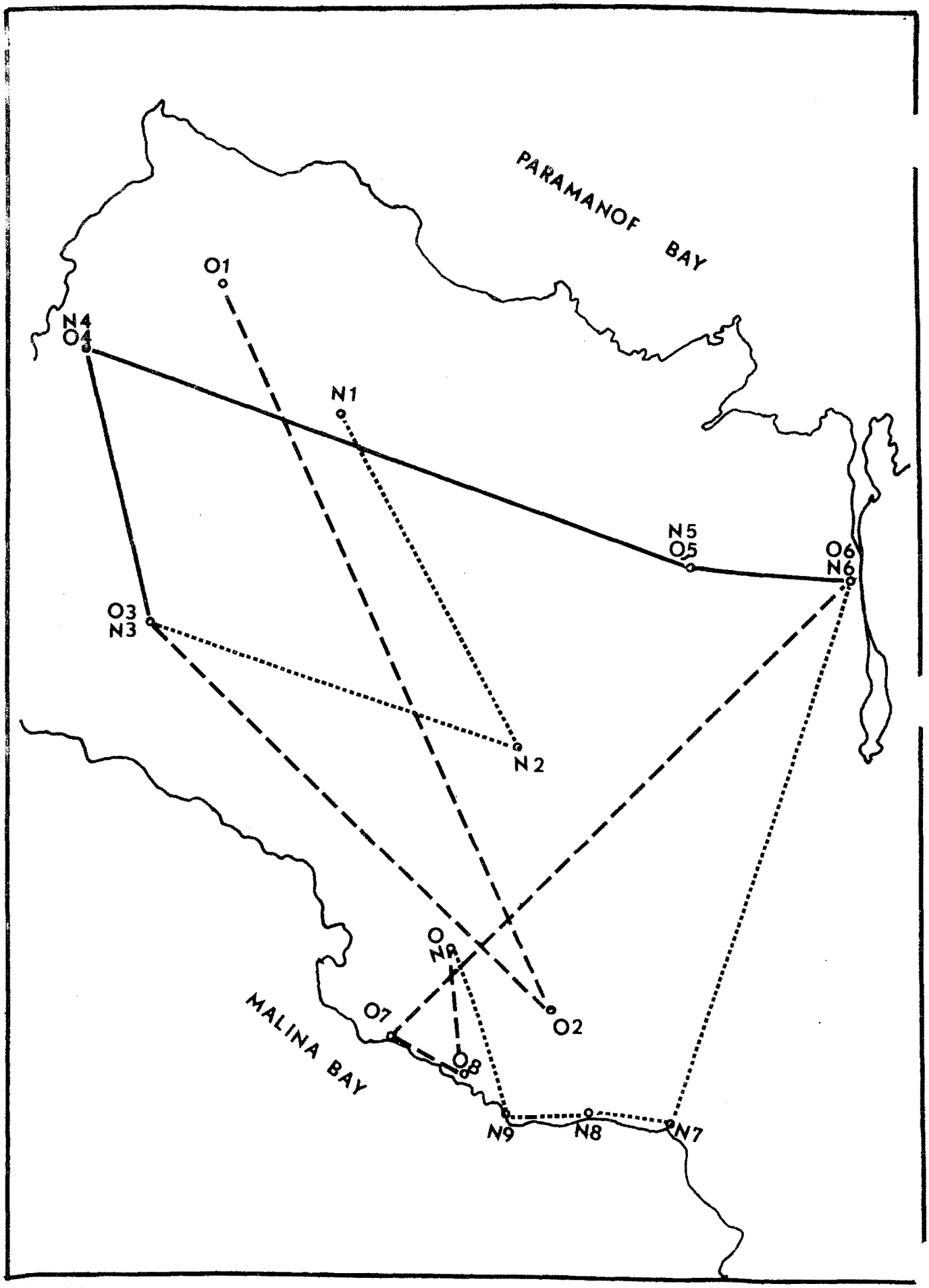

Fig. 11. October-May movements of two radio-tagged elk from the Paramanof Peninsula.

ACKNOWLEDGMENTS

Vern Berns - made available tracking equipment and technical assistance in its use.

Curland Chilton - instrumental in design and construction of transmitters.

Ben Ballenger - participated in all phases of tagging and tracking; also collecting and summarizing data.

Bob LeResche - provided assistance in tagging operations.

LITERATURE CITED

Allen, Thomas J. 1970. Immobilization of white-tailed deer with succinylcholine chloride and hyaluronidase. J. Wild. Mgmt. 34(1):207-209.

Cochran, W. W. and R. D. Lord, Jr. 1963. A radio-tracking system for wild animals. J. Wild. Mgmt. 27(1):9-25.

Knight, Richard R. 1970. The Sun River elk herd. Wildlife Monographs #23, The Wildlife Society, Inc.

Schwartz, John E., and Glen E. Mitchell. 1945. The Roosevelt elk on the Olympic Peninsula, Washington. J. Wild. Mgmt. 9(4):295-319.

Troyer, Willard A. 1960. The Roosevelt elk on Afognak Island, Alaska. J. Wild. Mgmt. 24(1):15-20.

Verts, B. J. 1963. Equipment and techniques for radio tracking striped skunks. J. Wild. Mgmt. 27(3):325-338.

PREPARED BY:

Jack E. Alexander, Game Biologist

APPROVED BY:

Donald E. McKnight

Research Chief, Division of Game

Frank Jones

Acting Director, Division of Game