A COMPARISON OF THE ACTIVITIES OF THE RIVER OTTER (LUTRA CANADENSIS) IN TWO TYPES OF ECOLOGICAL HABITATS

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I N T R O D U C T I O N

The American River Otter, Lutra canadensis Schreber, has long been regarded in popular opinion, as the "gay blade" of the wild northland. He has been described countless times in popular literature as a carefree playboy spending most of the summer sliding down grassy banks to disappear swiftly into deep crystal clear pools and emerge with a dripping trout clenched in his jaws.

In winter, the animal also is reported to spend his time at play, now chasing another otter or being chased in a playful game of tag, now sliding swiftly across snow-covered slopes or across the frozen pools. Again he is observed to dart quickly beneath the ice, and again he emerges with a huge trout for his meal.

Always he is pictured in the beauty of the forest as a symbolic Pan, Greek god of Nature. His prey is always the fleeting trout, a symbol of the lithness, grace, and agility which are so much a part of his image. How strange it seems that a member of the weasel tribe should be so elevated while other members are often depicted as villainous and insatiable murderers.

This inconsistancy immediately stimulates a question concerning the accuracy of popular belief about the otter. This question, coupled with the value of the animal as a furbearer and its esthetic value to the general public, form the foundation for this research.

REVIEW OF THE LITERATURE

Literature concerning the ecology of the river otter is sparse. By far, most published accounts have to do with the otter as a possible predator on sport fishes. The results of examinations of the contents of digestive tracts and/or scats have been published for otters in North Carolina (Wilson, 1954), Montana (Greer, 1955), Massachusetts (Sheldon and Toll, 1964), Michigan (Lagler and Ostenson, 1942; Ryder, 1955), New York (Hamilton, 1961), and in Wisconsin, Minnesota, and Michigan (Knudson and Hale, 1968). These investigations showed that otter largely eat fish, lesser amounts of invertebrates (crayfish and insects), some amphibians, and an occasional mammal. Most of these workers concluded that otter, while being primarily a fish eater, concentrated upon the species which was most abundant and most easily obtainable.

An infrequent topic of discussion in the literature is the extent of winter travel in which these animals participate. Emil Liers, in his classic 1951 paper, states that the animals usually travel "fifty to sixty miles of stream course in a year," but says that normally they only travel some three to ten miles in one season. He also cites instances where a male in breeding season traveled some three and six miles on two separate occasions. He fails, however, to state the effect of snow cover on travel.

Concerning travel in snow, Ognev (1962), Novikov (1956), and Seton (1926), generally state that the animal is rather inept at travel in snow, and therefore makes few overland movements during winter. Seton further suggests that these mustelids seldom, if ever, come out of the water in winter, but remain in underwater burrows and stay under the ice.

All of these works deal with some aspect of the classical ecological concept of the niche of the otter. None of them, even in combination with other works, comes any closer than a vague description of the habits of this species during the winter season. From the dietary studies previously described, a theory might be supported that these animals are primarily opportunistic feeders, but concentrate mainly upon fish. This immediately raises the question concerning the consequences of the severe winter in which all water bodies freeze solidly. Is the otter frozen beneath the surface and relegated to a diet of solely fish, or is he trapped above the ground and forced to turn scavenger or to hunt terrestrial mammals and birds?

Secondly, the information available advances the theory that otters are not exceptionally adept in traveling long distances in the snowy conditions of a severe winter. This would necessarily restrict their ability to hunt for food on land, or to travel between water courses. Such limited mobility, if it does exist, would severly hamper a carnivore which is primarily a resident of north temperate or boreal climates.

The following study was proposed as an effort to describe the winter activity patterns of these furbearers. Specific emphasis is directed toward their ability to travel in snow, and the activities engaged in during these periods of travel. Further, an attempt was made to correlate the types of winter food consumed in two areas of differing habitat types.

STUDY AREA

The study area in which this research was carried out is located in the north-central part of Michigan's Upper Peninsula, within portions of

Alger and Schoolcraft counties. The northernmost region of the study area was the Mosquito River approximately one-half mile south of Lake Superior. The southernmost region was a small nameless creek, which for convenience will be called Steuben Creek, just outside of the village of Steuben. The west branch of Prairie Creek, slightly over one mile west of Shingleton marked the western boundary of the area, and the eastern limit was the M-77 state highway.

This overall area was subdivided into two sectors of dissimilar habitats. Sector A consisted of several shallow pools which were generally bordered by or partly covered with cattails (Typha sp.) and sedges (Carex sp.), and can be generally associated with Units I and II of the Seney National Wildlife Refuge. These pools were all artificially fashioned through the construction of earthen dykes to block the natural flow of drainage. All are more than fifteen years old and have become a part of the natural ecosystem. This sector is also interspersed with several marshy areas containing clumps of red-oosier dogwood (Cornus stolonifera), bog birch (Betula pumila), and tag alder (Alnus rugosa).

Sector B has no specific boundaries, but is restricted chiefly to streams and the wooded or cut over land area on either side of or separating them, as opposed to open marshy areas and standing water of any type. The streams included in this sector are: East Branch Fox River, Pine Creek (Schoolcraft County), Driggs River, Marsh Creek, Ducey Creek, Pine Creek (Alger County), Commencement Creek, Star Creek, Prairie Creek, Hickey Creek, Stutts Creek, and Chapel Creek.

This part of Michigan commonly has rather heavy snow falls, often measuring up to 64 inches per month from December through March. The temperature frequently drops to less than $-10^{o}F$ during this period.

METHODS

This study has been designed to investigate the activity of river otters in winter conditions, and travel is primarily emphasized. For this reason, and because of the secretive habits and relative inaccessability of these animals, direct observation of them was impossible. Instead, the trails left in the snow as a result of their movements were followed, and their actions were interpreted in a manner similar to the methods used for other carnivores by Murie (1936), Arnold (1956), and Ozoga and Phillips (1964). This tracking was accomplished between December 12, 1968 and March 11, 1969. In total, trails were followed for 73.7 miles, of which 31 miles were in sector A, and 42.7 miles were in sector B.

In addition, all scats found along trails were collected for analysis of content. The locations of these collections were recorded, and special effort was made to interpret (from tracks, habitat, and other signs) the activities of the animal responsible for each scat.

Finally, the temperature and snowfall for each day were obtained from the weather station maintained at the headquarters of the Seney National Wildlife Refuge. Since no accurate information could be collected in any other part of the study area, these data from Seney were generalized to include the entire area. It is certain that some discrepancies exist, especially along the more northern streams of sector B, since they are as much as forty miles from the weather station. These weather data were also correlated with the recorded activities of otters and with the contents of scats. This provided an estimate of the effect of weather upon both diet and activity patterns of the otters.

RESULTS

Locomotion in Snow

The collection of data was accomplished by using a snowmobile to gain access to the study areas to be investigated, and then following on snowshoes any otter trail encountered. The trail was initially followed in the same direction the otter was traveling, to its end. This terminal point usually was at a place where the animal entered some water course, but occasionally was merely the place where the wind and snow had covered the tracks. At this point, the trail was retraced, and then backtrailed to the point of its origin. The distance was measured with a U.S. Army "tally-whacker", or manual event counter which recorded the number of paces taken while following the trail. A previous experiment determined that the investigator's pace length while on snowshoes was approximately 1006 per mile. For the sake of convenience, this was rounded off at 1000 paces per mile.

The continual trailing of these animals, coupled with four visual observations, resulted in the recognition of a characteristic gait utilized a majority of the time. Normally, while traveling on land, the otters run in bounds of from 15 to 28 inches for 2 to 4 steps. This is then followed by a 5 to 15 foot slide with the belly dragging and the legs trailing backward. The pace of these animals is rather slow in snow because of the short legs and low, dragging body. When frightened, they are quite capable of outrunning a man on snowshoes rather handily, at least for a short distance.

These are at least two modifications of this gait. The most common of these occurs in group play. Here the otters simply leave their front legs folded back beneath their bodies and propel themselves by pushing

with their hind legs. From visual observations, they are quite capable of pushing themselves up at least 15 yards of a 20 to 25 degree grade in this manner.

The second modification occurs in the deliberate hunting of small mammals. On two occasions, tracks were observed where an otter stopped the bounding and sliding gait and stalked clumps of grass. The feet were moved in steps of about five inches, either one at a time, or else one hind and one fore leg worked simultaneously. At a distance of about two feet from the clump of grass the otter jumped on it, probably in much the same manner as a fox catching mice, and in at least one case a mouse was captured as evidenced by the blood stains remaining on the snow.

One playful movement popularly attributed to these animals was encountered only once in more than 73 miles of trails followed during this 3 month period. This was an otter "slide" on Hickey Creek, and involved two otters who slid down a 20 foot bank into water at least three times each. In contrast, on each of four other occasions, groups of from one to five animals chose to walk down steep banks rather than slide recklessly into the open water. On several occasions the tracks indicated that they often slide down a slope while engaged in overland travel. Apparently this action is routine in traveling and is not really play behavior.

There was also evidence that these animals will follow packed trails in the snow made by other animals, especially deer and snowshoe hares. Due to their short legs, otter undoubtedly are able to travel more easily on packed snow than on the fluffy powder. They also travel single file when there are more than one traveling together. The first

animal "breaks trail" for the others in the troupe, with the others simply following in his tracks. The trails also show that they switch positions occasionally, so that each takes his turn at going first.

Otters make their trips on land most frequently alone, but occasionally in groups of from two to five animals (see Table I). There does appear to be a significant difference in group size between sectors A and B (t is significant at .05). The animals in sector A, which is primarily covered with cattail marshes, seem more prone to travel singly than in groups, while in the stream area (sector B) otters appear more prone to travel in pairs. In total, by far the majority of overland traveling was done either by single animals, or by pairs. In 38 observations there were 16 single and 14 pairs of animals trailed. These made up 42 and 37 per cent of the total respectively. These animals traveled distances of from about .13 miles to about 3.2 miles overland. The average distance traveled was .83 miles for single animals, 1.14 miles for pairs, 1.3 for trios (two observations), 1.03 for groups of four, and .97 for groups of five animals. These are, however, not significantly different statistically.

Activities -- Sector A

During their normal movements, the otters in sector A tended to travel at random from pool to pool, but usually went through cattail marshes which separated most of the pools. In most cases they kept within 400 yards of a pool, even though during the colder stages of winter, these were usually frozen over.

The cattail marshes through which the otters traveled were nearly always open to some extent, and had from 2 to 15 inches of water in them. These were kept open both by spring action, and apparently by the

otters themselves. Dozens of places were found where they had dug and chewed through up to 6 inches of ice both in the marshes and on the pool surfaces, probably in search of food. In several instances the animals went through clumps or swales of tag alder while traveling between pools, and in some cases, they entered a large area covered primarily by bog birch and red-oosier dogwood. Again, these areas were never more than some 400 yards from one of the pools.

Sector B

The animals in sector B, on the other hand, ventured further from water. There was an instance when one pair traveled overland through hardwoods, pine, and frozen sedge marshes for 3.2 miles between the Driggs River and Pine Creek. Another pair went from Walsh Creek primarily through spruce and pine stands to Ducey Creek marsh for some 2 miles, and a third instance when 5 animals migrated from Chapel Creek to the Mosquito River for one mile through a white-cedar (Thuja occidentalis) swamp. On still another occasion, 5 animals followed a large circular path through red pine and spruce stands for .9 miles while leaving and returning to Pine Creek.

In following a stream, however, otters almost invariably either swam in the open water or under the ice, or else they walked on the ice. Only in two cases was evidence found showing that otters had followed the bank parallel to the stream, and both of these were for distances of less than 200 yards. In addition, they never strayed more than 20 yards from the stream bank.

By far, the most common occurence was for the animals to swim beneath the ice and come up at breathing holes from 50 to 300 yards apart along the stream course.

There was no dominant type of vegetation through which the animals traveled in sector B. They simply entered and traversed any area they came upon in their overland jaunts, including stands of jack or red pines. However, in sector A, the major habitats through which the otters traveled were covered with the conspicuous cattail.

Effects of Temperature and Snowfall

The temperature and amount of snow seemed to have no effect upon either the frequency of overland movements or the distances traveled by the otters. One animal was followed between two pools for .9 miles on January 10, 1969. He was going diagonally into a 15 mile per hour wind during the height of a snowstorm which deposited 15 1/2 inches of snow in 24 hours. The temperature at the time was about $15^{o}F$ and there was at least a foot of fresh snow, but he completely disregarded the shelter of dense pine and spruce stands, merely crossing through them as he encountered them. He continued on his way across completely unsheltered sedge and cattail marshes which were almost buried beneath the snow. The time of this journey was between 11:00 A.M. and 1:00 P.M. On two other occasions nearly identical movements were recorded during similar storms. One of these, on January 17, was in mid-morning, the other, on February 1, occured during the preceeding night. From these observations, it would seem that neither the weather nor the time of day have a significant effect upon the movements of this species. A trend toward decrease in the average distance traveled by animals may be indicated when compared with snowfall (Figure 1 and Table I), but an insufficient number of observations were recorded to demonstrate any significant difference (t not significant at .05).

Interactions with Coyotes

Occasionally in their travels, otters apparently have interactions with coyotes (Canis latrans). For example, on February 7, 1969, three coyotes were observed to follow the trail of three otters as they went overland between Pine and Commencement Creeks, and again as they traveled on the ice of Commencement Creek. The coyotes trailed the otters for about .75 miles in total, during which time they chewed up a scat pile deposited by the otters. From the evidence left in tracks, the two groups never came within sight of each other.

Hunting

Deliberate foraging behavior was observed several times from the tracks followed within sector A. Several areas were found in cattail marshes where otters had dug through the snow and ice, then down into the bottom sediments. The animals obviously rooted around in the mud, probably digging out and devouring crayfish, frogs, and an occasional large aquatic beetle or belostomatid. The eating of these foods was later verified by scat analysis.

On February 21, 1969, a lone female otter was observed while fishing through the ice on one of the pools on the Seney Refuge. She dived several times through a hole in the ice and in times ranging from one minute 8 seconds to 4 minutes 23 seconds she re-emerged with small fishes. These were promptly swallowed whole. She was then observed to enter an adjacent cattail marsh where she began to dig in the mud as described above. Here she caught a crayfish which she chewed and swallowed with much loud smacking and crunching.

In addition to this digging in the mud, several instances were recorded where otters deliberately stalked clumps of grass and pounced

upon them to attempt capture of a mouse or vole. On several other occasions there was evidence to demonstrate that the otters had dug into the grass tunnels of the meadow vole, Microtus pennsylvanicus, and on at least two of these occasions, one or two drops of blood remained to verify that a capture (presumably of a meadow vole, see Hamilton, 1961) by the otter had resulted. Seven scats also contained traces of small microtine rodents, either Microtus or Cleithrionomys gapperi.

On February 17, 1969, the trail of a pair of otters was followed into a marshy area which contained several small clumps of red-oosier dogwood and bog birch. This marsh which encompasses approximately three acres, was marked by the trails of at least a dozen otters, and along each trail were a series of holes dug in the snow. The pair of animals which was being followed at the time dug into the snow at the bases of birch and dogwood clumps 25 times within a distance of 300 yards. About five minutes later one of these animals was surprised while digging one of the holes and immediately ran for safety. Scats collected in that area later revealed skeletal parts of both Microtus and Clethrionomys, along with the exoskeletons of some insects.

Temperature and snowfall fluctuations seem to have no more limiting effects upon the hunting procedures than on travel of the otters. On almost every day, fresh diggings were found in the marshes, and in early December, an otter was trailed while stalking mice during a three inch snowfall. On a number of occasions throughout the winter, holes were found extending through at least two feet of snow to intercept rodent tunnels in subsnow grass.

The otters in sector B showed different movement patterns. Since their tracks were not often seen in marshes, they were never observed to dig for frogs or stalk small rodents. Scat analysis showed crayfish

present only 60 per cent of the time as opposed to 84 per cent of the time in scats taken in sector A. Frogs were not found in the scats from sector B. This shows a significant difference in diet of otters in these areas, which is almost certainly the result of the greater availability of both crayfish and rodents in sector A.

Perhaps in place of Microtus in sector B, the otters frequently tracked snowshoe hares (Lepus americanus). On nearly all of the overland travels by either single animals or groups, the trails would lead beneath brush piles, windfalls, snowcovered lower branches of spruce and pine trees, and similar places frequented by snowshoe hares and usually containing their tracks. On two occasions otters were found, from track evidence, to give chase to hares which they came upon suddenly. On February 28, conclusive evidence in the form of tracks, blood stains, and hair was found to substantiate the capture of a hare by a pair of otters. The carcass was completely devoured, and nothing remained but tufts of hair.

Scavenging by Otters

It has been hypothesized (Elsworth Harger and John Ozoga, personal communication) that otters may act as scavengers on deer carcasses. In order to determine the extent to which this might occur, two road-killed whitetailed deer (Odocoileus virginianus), autopsied previously and opened up to afford a maximum amount of scent from the fresh venison, were placed in the field.

The carcass of a juvenile male was deposited in sector A on January 31, beside an open water ditch which was frequented by otters. It was not molested by otters on February 1, 6, 9, 16, 17, and 21; although on

February 17, fresh tracks showed that two otters had passed within 25 feet of the carcass, but in passing had not detoured either toward or away from it.

A second carcass which had been similarly treated was placed on the bank of Stutts Creek in sector B. On February 18, after a week during which otters were not attracted, the carcass was discovered and devoured by ravens.

Incentives for Overland Travel

There are several possible reasons for overland travel by otters, but this study has shown only one to be important. This is for the purpose of hunting terrestrial foods -- chiefly small mammals. A great deal of the overland travel which is recorded here was in the form of short trips (a few hundred yards), presumably in search of food. Increased movements resulting from the mating urge in late winter and early spring, as stated by Liers (1951), was not in evidence in the present study. There was no significant increase in length of trails or frequency of movements in late winter, at least through March 3.

Scat Analysis

Each scat collected was crumbled and qualitatively examined under a stereomicroscope to determine the content and relative undigestible proportions of each species of animal remains. The scats collected in sector A (see Table II) contained primarily forage fish, with the species Umbra limi being dominant in quantity as well as frequency. Several game fish, mostly Lepomis sp., were also present. Nearly all fish were less than six inches in length. There was also a high frequency of crayfish occuring in the scats from this area. Frogs and mammals also

appeared several times, thus offering evidence that otter diggings in marshes were not without success.

In contrast, the scats taken from the stream area (sector B) have a similar incidence of forage fish and game fish, but a much lower rate of crayfish, amphibians, and especially mammals (see Table II). The fish taken are about the same as those in sector A. The only noticeable difference in the frequency recorded for various species is a slight increase of Lepomis sp. in streams and the slight decrease of cyprinids and U. limi in the stream area as compared with the pool area of sector A.

Of the 47 scats obtained, only 10 (21 per cent) were taken along the 42.7 miles of trackways followed in sector B, or one for every 4.3 miles, whereas, 37 (79 per cent) were picked up along the 31 miles in sector A or one for every .8 miles. The reason for this difference in scat finds in the two sectors is unclear; in fact, more trails in sector B were made by two or more otters than in sector A. Even so, more droppings were deposited in sector A and these also averaged larger (7.6 ± 3.6 grams as compared with 4.2 ± 1.6 grams with 66% C.L. for those taken in sector B).

These data indicate that otters in sector B, as compared with those in sector A, moved around in larger groups and produced fewer and smaller scats. This can probably be interpreted to indicate that the type of food ingested in stream habitats had a higher coefficient of digestibility than that captured in marshes. This is exemplified by comparing the residue left after the digestion of a fish with that remaining after digesting a crayfish.

CONCLUSIONS

From the results of these observations, several conclusions can be drawn about the habitats of otter in this region.

Much of the popular opinion regarding both the food habits and the playful antics of these animals either stems from isolated occurences or is primarily myth. There appears to be very little evidence, at least from this study, that any more than a minute percentage of their time is taken up with repetitive sliding, tag, or similar playful activities. On the contrary, the majority of their time appears to involve such necessities as hunting for food or in traveling between water bodies, perhaps in search of a better supply of food.

This collection of data also points toward the idea that otters may work together in pairs or small groups more efficiently than singly to capture food. The specific factors contributing to this conclusion are the facts that otters in the predominently open marsh area tend to hunt and travel alone, while those in isolated stream areas tend to work more frequently in groups. This, coupled with the fact that frogs, crayfish, and small mammals such as Microtus are more abundant and consequently more easily captured in the marshes, would lead one to believe that hunting is more successful in these open areas. Also, fish are probably more easily captured in shallow pools with essentially smooth bottoms than in the turbulent waters of a trout stream. For these reasons, it may well be that otters have developed the method of working as a team to catch fish and mammals such as the snowshoe hare captured on February 28, 1969.

Another aspect of travel which is illuminated by this research is the mobility of these animals in fresh, deep snow. Although their movements seemed slow, they did not hesitate to strike out overland under extremely adverse conditions, as evidenced especially by the observations on January 10, January 17, and February 1. In short, there seems to be no correlation between the amount of fresh snowfall and the movements of these animals.

It has been demonstrated, however, that given a choice, otters seem to take the easier route of travel, e.g. it appeared that they would rather swim in open water or under the ice on frozen streams than walk along the stream bank in deep snow. In addition, if they are traveling overland in deep snow, they seemed to take advantage of any well-packed areas such as deer trails, snowshoe hare runs, or the packed-down tracks of their cohorts in the traveling troupe. These findings also complement the observations of Formozov (1946).

This ability to travel in snow, which somewhat contradicts the reports of Seton, Ognev, and Novikov, is probably of survival value to otters. It enables especially those living in wooded stream areas to travel between separated water courses in search of food. As further evidence that winter food for otter in wooded stream areas (as in sector B) may be in short supply is the fact that otter (more commonly in groups) moved around a great deal and deposited only a few, small scats as compared with the otter in open marshes of sector A.

In summation, it is the conclusion of the author that the river otter is not accurately described when he is conceptually regarded as a "carefree clown" of the northland. The majority of his time, at least in winter, seems to be spent in gathering food. Although on occasion

there is evidence of "playful" behavior, it is probably in the context of learning between young animals, or between young animals and their parents. From the data presented here, however, it must be concluded that this behavior occurs little during the severe winter season, when groups of otters apparently become efficient teams of hunters, and probably do not have either the time or presumably the desire to engage in idle play.

On the basis of this research, it can also be concluded that otters which winter in wooded stream areas probably have less food available to them than those which winter in open marshland. Therefore residents of the former travel more frequently and for greater distances, and also occasionally work as hunting teams.

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TABLE I

RELATIONSHIP OF OTTER GROUP SIZE TO STUDY SECTOR

GROUP SIZE	OCCURENCES SECTOR A	SECTOR B
1	11	5
2	6	8
3	0	2
4	2	2
5	0	2
TOTAL OBS.	19	19
MEAN OF ANIMALS PER GRP.	1.6	2.4

TABLE II

CONTENTS OF UNDIGESTIBLE MATERIALS IN COLLECTED OTTER SCATS

SECTOR	MONTH	NO. of SCATS	FORAGE FISH									GAME FISH				CRAYFISH	MAMMALS		FROGS	OTHER	
			Umbridae	Gasterosteidae	Cyprinidae	Percidae	Amiaidae	Ictaluridae	Cottidae	Sciaenidae	Catostomidae	Lepomis	Micropteris	Salmonidae	Perca flavescens		Clethrionomys	Microtus		Insects	Snails
A	DEC.	2	1	1	2	--	2	--	-	-	-	1	-	-	-	1	-	--	1	1	-
A	JAN.	9	8	8	9	7	7	2	1	-	-	6	7	-	-	5	-	--	1	-	1
A	FEB.	26	23	9	25	24	9	20	-	1	6	10	6	1	7	26	3	11	4	-	-
B	JAN.	4	1	3	4	3	-	1	-	-	-	4	3	1	4	3	-	--	1	-	-
B	FEB.	6	6	6	--	6	-	4	-	-	-	4	-	1	6	1	-	--	-	1	-

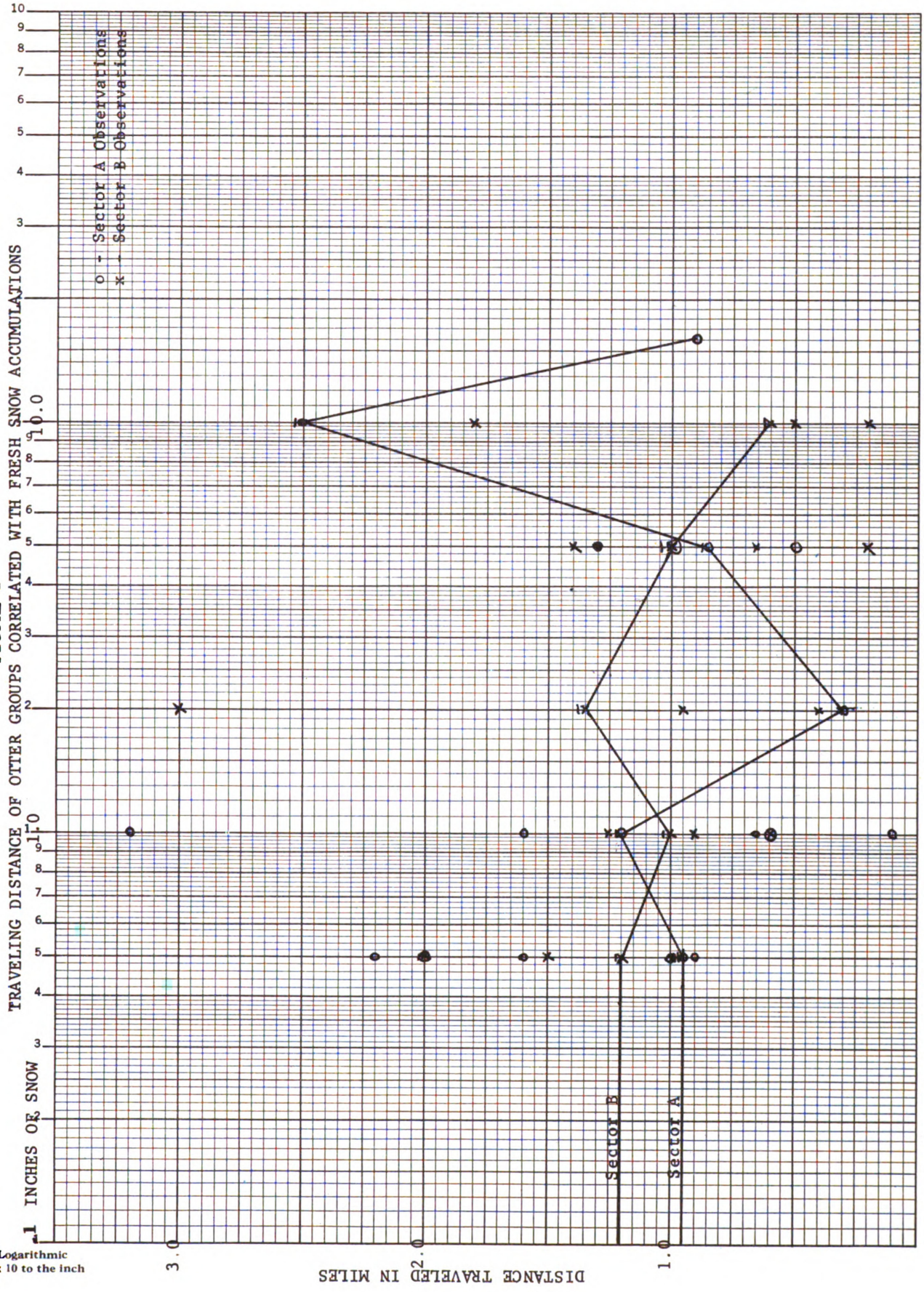
o - Sector A Observations
x - Sector B Observations
TRAVELING DISTANCE OF OTTER GROUPS CORRELATED WITH FRESH SNOW ACCUMULATIONS
INCHES OF SNOW
DISTANCE TRAVELED IN MILES
Sector B
Sector A
Semi-Logarithmic
3 Cycles x 10 to the inch

FIGURE 1