

**DISTRIBUTION AND ECOLOGY OF RIVER OTTER
ON EASTERN MOUNT DESERT ISLAND, MAINE**

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ABSTRACT

Twelve watersheds on Mount Desert Island were surveyed by foot during the winter of 1992 to determine river otter distribution. A model predicting suitable river otter habitat designed by Dubuc et al. (1990) was applied to the known distribution of river otter in the study area. Twenty variables, describing some of the ecological factors that comprise river otter habitat, were compared between watersheds used by river otters and watersheds unused by river otters. Factors found to influence river otter distribution in the study area were compared with factors believed to determine river otter distribution by Dubuc (1987).

INTRODUCTION

The North American river otter (*Lutra canadensis*) is distributed throughout North America, inhabiting 45 states and all Canadian Provinces except Prince Edward Island (Melquist and Dronkert 1987). One of the most aquatic members of the Mustelid Family, otters can survive in both marine and fresh water, thereby adapting to coastal as well as mountainous habitats. Hunt (1986) reports that river otters are abundant and widespread throughout the state of Maine.

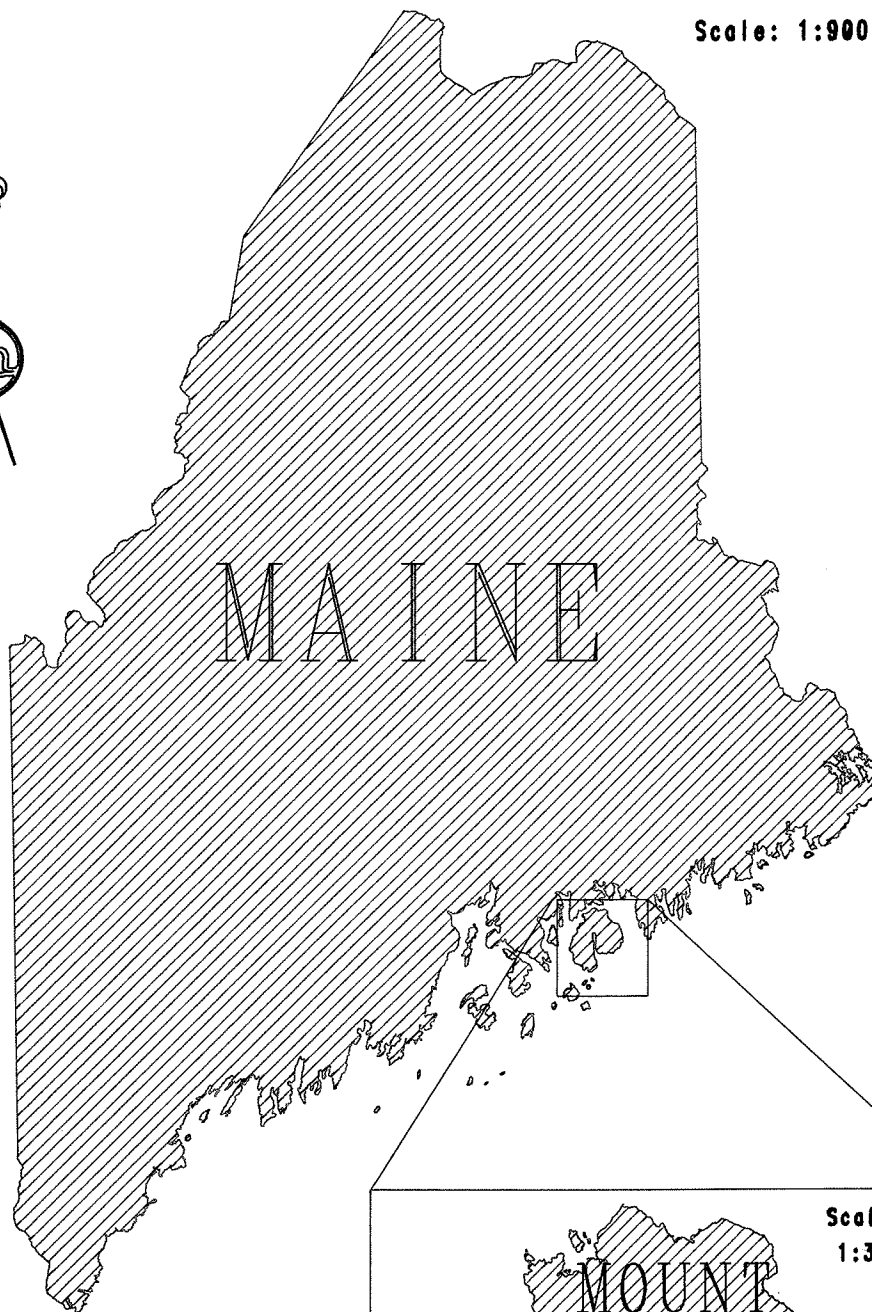
Mount Desert Island (MDI) is located in the Gulf of Maine (see Figure 1). Total land area of MDI is approximately 281 km², of which 122 km² (43%) Acadia National Park comprises. Eighteen out of 39 watersheds surveyed on MDI during 1985-87 were regularly or occasionally used by river otters (Dubuc 1987).

Factors believed to influence the distribution of river otters on MDI include food resources, beaver activity, stream length, and shoreline diversity.

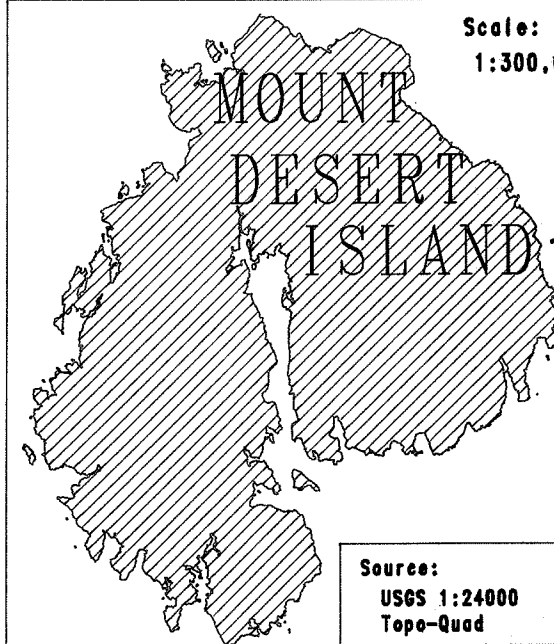
The predominant food resource of river otters throughout their range are fish (Ryder 1955, Sheldon and Toll 1964, Knudson and Hale 1968, Chanin 1985). During the winter, otters on MDI

Figure 1. Mount Desert Island, Maine

Scale: 1:900,000



**Scale:
1:300,000**



**Source:
1986 Rand McNally road map
9 mi/inch
by Glen Mittelhauser**

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**Source:
USGS 1:24000
Topo-Quad**

prey largely on fish species such as banded killifish and mummichogs (*Fundulus* spp.) found in both marine and fresh water, and cunner (*Tautogolabrus adspersus*), which is restricted to marine environments (Dubuc 1987). Bays and streams are the essential foraging habitat for otters during winter. As lakes and ponds become more productive with the coming of summer, otters shift from foraging in bays and streams to foraging in lakes, ponds and streams. During the summer months, amphibians and reptiles are preyed on most frequently, followed by fish, frogs and crayfish. A negligible amount of birds and mammals are taken throughout the year (Dubuc 1987).

A model predicting suitable river otter habitat was designed by Dubuc *et al.* (1990) incorporating the presence of beaver (*Castor canadensis*), stream length, shoreline diversity, and percentage of mixed hardwoods-softwoods present in a watershed. Dubuc (1987) found a high correlation between beaver (active or inactive sites) in a watershed and the presence of otters. Beaver alter the aquatic environment by stabilizing waterflow and creating ponds rich in prey items taken by otter during the summer. Toweill and Tabor (1982) have described river otters inhabiting inactive beaver lodges, using them for dens as well as resting places.

A second factor that influences river otter distribution on MDI is stream length. Mount Desert Island is a mountainous island characterized by steep gradients and relatively short drainages (3-5 km). In Sweden, adult male otters are known to

travel an average of 9 or 10 km per night (Erlinge 1967).

Melquist and Dronkert (1987) believe that the length of an otters home range is governed by the length and shape of the watersheds which they inhabit. Given the steep topography of MDI (0 - 1,528 feet) watersheds having the longest overall stream length provide the most desirable habitat for otters.

A third factor which Dubuc found to influence the distribution of otters on MDI was the amount of shoreline diversity. The shoreline diversity is a measure of the complexity of the shoreline in respect to the overall size of water bodies. A convoluted shoreline provides shallow waters in which otters can prey on slow-moving, shallows dwelling fish. This type of shoreline also provides habitat for other otter prey such as amphibians, reptiles, insects and waterbirds. Otters are thought to inhabit watersheds having a high shoreline diversity as a result of the plentiful food resources provided.

A negative factor used in the model predicting suitable river otter habitat is the percent of mixed hardwood-softwoods found within a drainage. This type of forest stand is characteristic of headwater systems having steep gradients and low productivity. Such habitat does not fit the foraging nor building needs of beaver. Because otters benefit from watersheds altered by beaver, they do not inhabit watersheds having a high percentage of mixed hardwood-softwoods (Dubuc et. al. 1990).

The purpose of this study was to document the current distribution of river otters on as much of MDI as good tracking

conditions would allow. A model derived by Dubuc *et al.* (1990) from a discriminant analysis performed on 39 variables was tested against the known distribution of otters in my study area. This model was derived from a discriminant analysis performed on 39 variables. In addition to testing this model, twenty variables representing elements of otter habitat structure and composition were compared using a discriminant analysis. Factors that best described otter distribution in my study were compared with those factors found to influence otter distribution discussed by Dubuc (Dubuc 1987, Dubuc *et al.* 1990).

METHODS

WINTER TRACKING

Melquist and Hornocker (1983) found that the home range of river otters tend to follow drainage patterns; therefore watersheds are the unit of classification used in evaluating river otter distribution. A total of 26 surveys were conducted on foot between January 6, 1992 and March 1, 1992 to determine the presence or absence of river otters along twelve watersheds on MDI. Watersheds include all deep water habitats, wetland habitats, and streams within a given drainage. A watershed was classified as used if otter sign was found; watersheds were classified as unused if no otter sign was found.

Otter sign included: tracks, snow slides, holes in the ice covering lakes and ponds, scat, latrines, direct observation, and one roadkill (2 months prior to winter tracking). With the exception of direct observation and one roadkill, a combination

of at least two of the remaining criteria (tracks, slides, holes in the ice, scat and latrines) were necessary for confidently classifying a watershed as having otters present.

Confidence in correctly identifying scat was gained by bringing all "questionable" scat into the laboratory for analysis. The procedure for analysis follows that described in Dubuc (1987). River otters feed primarily on marine and fresh water fish during the wintertime, therefore fish scales and bones proved to be good initial indicators of otter scat. The presence of fish scales in scat, in combination with the overall size, shape and strong musk odor served as the basic indicators of otter scat. Once otter scat could be recognized in the field, it was no longer necessary to collect it for analysis.

The amount of snow and type of tracking conditions governed the days in which watersheds were surveyed. After a heavy snowfall, one to two days were allowed to pass allowing otter movement to occur before searching for otter sign. If, during this waiting period, the snowpack crusted at the surface, tracking conditions were poor. However, under good tracking conditions, tracks and slides were obvious in the snowpack. Using baseline data collected by Dubuc in 1985-87, watersheds regularly used by otters in the past were surveyed on days in which tracking conditions were poor. Otter scat and holes in the ice were good indicators of activity regardless of snowcover. If otter sign was found along portions of a watershed, the remainder of the watershed was not necessarily walked in its entirety.

When sign found under poor tracking conditions was not clearly otter sign, the drainage was surveyed again until I was confident of otter presence or absence. Watersheds ultimately classified as not used by otters were walked in their entirety under good tracking conditions.

STATISTICAL PROCEDURES

Dubuc, Krohn, and Owen (1990) developed a model predicting river otter presence or absence in watersheds on Mount Desert Island. In predicting suitable river otter habitat, this model combined a negative correlation with mixed hardwood-softwoods (MHDSFT), and a positive correlation with beaver (ALLBEAV), total stream length (TOTL), and shoreline diversity ((MIRREG) see Table 1). The discriminant function of the model took the following form:

$$y = -5.40 - 11.941\text{MHDSFT} + 5.08\text{ALLBEAV} + 4.75\text{TOTL} + 2.09\text{MIRREG}.$$

A negative value for y describes a watershed not used by otters and a positive value for y describes a watershed used by otters. The ability of this model to predict the presence or absence of river otters in a watershed was tested against the known distribution of otters in my study.

Table 1. Variables used in applying the model developed by Dubuc, Krohn and Owen (1990) predicting river otter presence or absence

Mnemonic	Variable Description
TOTL	Total stream length over all stream orders
MHDSFT	% of forested land composed of mixed hardwood-softwood
ALLBEAV*	% of wetland with active or inactive beaver sign
MIRREG+	Mean shoreline diversity index

*Data derived from personal observation as well as Collins 1990

+Sum of water body perimeters divided by their area

Twenty-one variables representing habitat structure and composition (see Table 2) were analyzed to describe suitable river otter habitat within my study area. Excluding BEAV, all variables were obtained using data available in digital form from College of the Atlantic's Geographic Information System database. Watersheds were outlined on topographic USGS 1:24,000 maps based on elevation. Once the outlined watersheds were digitized, they were over-laid with maps containing the desired data. Variables regarding stream length and water body dimensions were obtained from digitized 1:24,000 USGS (1983) maps. Variables depicting vegetation were obtained from a digitized map (1:24,000) derived from infrared aerial photos taken by the U.S. National Park Service in August 1979 and partially groundtruthed in Summer 1980. (College of the Atlantic, GIS Laboratory, Bar Harbor, Maine). While surveying watersheds for otter sign, the presence and activity of beaver lodges (BEAV) were noted.

Discriminant analysis was used to extract variables that could discriminate between used and unused watersheds. Because this type of multivariate analysis assumes that all variables are normally distributed, a Lilliefors test was run to test for normality. Three types of transformations were performed on each variable--arcsine [$\arcsine (X^{1/2})$], square root [$(x + 0.5)^{1/2}$], and logarithmic [$\log_{10} (x + 1)$] (Dubuc et al. 1990, Zar 1974:220-221). Within each variable, the transformation producing the highest P value was retained. Once again, a Lilliefors test was run on the transformed data to test for normality. Eight of the 21 variables did not have a normal distribution after transformation ($P < .05$); therefore they were eliminated from further analysis (see Table 2). The variable BEAV, a measure of beaver presence or absence, could never demonstrate a normal distribution. It was, however, used in the analysis.

Table 2. Variables measured to determine otter habitat, by watershed.

Mnemonic	Variable Description
OR1L	Total length of all first-order stream segments
OR2L	Total length of all second-order stream segments
TOTL	Total stream length over all stream orders
TOTFOR	% of forested land area within a watershed
MSFT*	% of forested land composed of mixed softwood (Spruce-Fir, Hemlock, White/Red Pine, Pitch Pine)
BASP	% of forested land composed of birch-aspen (birch-aspen forest, birch-aspen scrub, alder scrub)
MHDSFT*	% of forested land composed of mixed hardwood-softwood
NWCBLK	of forested land composed of "wetland softwood" (Northern White Cedar, Black Spruce-Tamarack Swamp)
NHDWD*	% of forested land composed of northern-hardwoods (Red Oak, Red Maple)
MEAD	% of forested land composed of old field and meadows
ROAD	Total number of major roads, park roads, and paved roads crossing the watershed
BEAV*	Presence or absence of beaver activity (active and inactive)
SPERIM	Sum of the perimeters of all water bodies
SAREAREA	Sum of the area (ha) of all water bodies
SOW*	Sum of all open water areas of all water bodies
SFLEAF*	Sum of the areas of all water bodies characterized by floating-leaf vegetation
SEMER	Sum of the areas of all water bodies characterized by emergent herbaceous vegetation
SERIC*	Sum of the areas of all water bodies characterized by ericaceous vegetation
SALWIL*	Sum of the areas of all water bodies characterized by alder-willow
EMERAREA*	SEMER/SAREAHA
MIRREG	Mean shoreline diversity index (SPERIM/SAREAHA)

*Variables whose data distribution did not fit a normal distribution. With the exception of BEAV, these variables were not used in discriminant analysis.

The ability of the remaining 13 variables to discriminate between used and unused watersheds were tested using a discriminant analysis. Those variables able to discriminate between used and unused watersheds were tested using a T-test. The T-test was applied to test for significant differences between means of used and unused watersheds within each variable.

RESULTS

Out of the 12 watersheds surveyed, 7 watersheds were used by otters and 5 watersheds were unused (see Figure 2, and Table 3). With the exception of Schooner Head, otter distribution on MDI for these 12 drainages coincided with the otter distribution documented by Dubuc in 1985-87. No river otter were found to inhabit the Schooner Head watershed during this study; Dubuc found otter here in 1985-87.

The discriminant analysis performed on the variables was successful in correctly classifying otter distribution on all of the watersheds when a combination of six variables were used. These 6 variables included: wetland softwood (NWCBLK), birch-aspen (BASP), emergent herbaceous vegetation (SEMER), area of all water bodies in a watershed (SAREAREA), perimeters of all water bodies in a watershed (SPERIM), and shoreline diversity (MIRREG). Collectively, these variables are capable of correctly identifying each watershed as used or unused by otters. The shoreline diversity index (MIRREG) was the only variable helpful in classifying watersheds in my study as well as in the study

conducted by Dubuc. Within each variable, means of used and unused watersheds were tested using a T-test; none proved to be statistically different ($P > .05$, see Table 4).

Dubuc's model predicting river otter distribution was tested for the 12 watersheds in my study; it correctly classified 5 (41%) of these watersheds as being used or unused (see Table 3). The 7 watersheds (59%) that were incorrectly classified included 4 watersheds used by otters, and 3 watersheds that were not inhabited by otters.

Figure 2. River Otter Distribution on Eastern Mt. Desert Island, ME. Winter 1992.

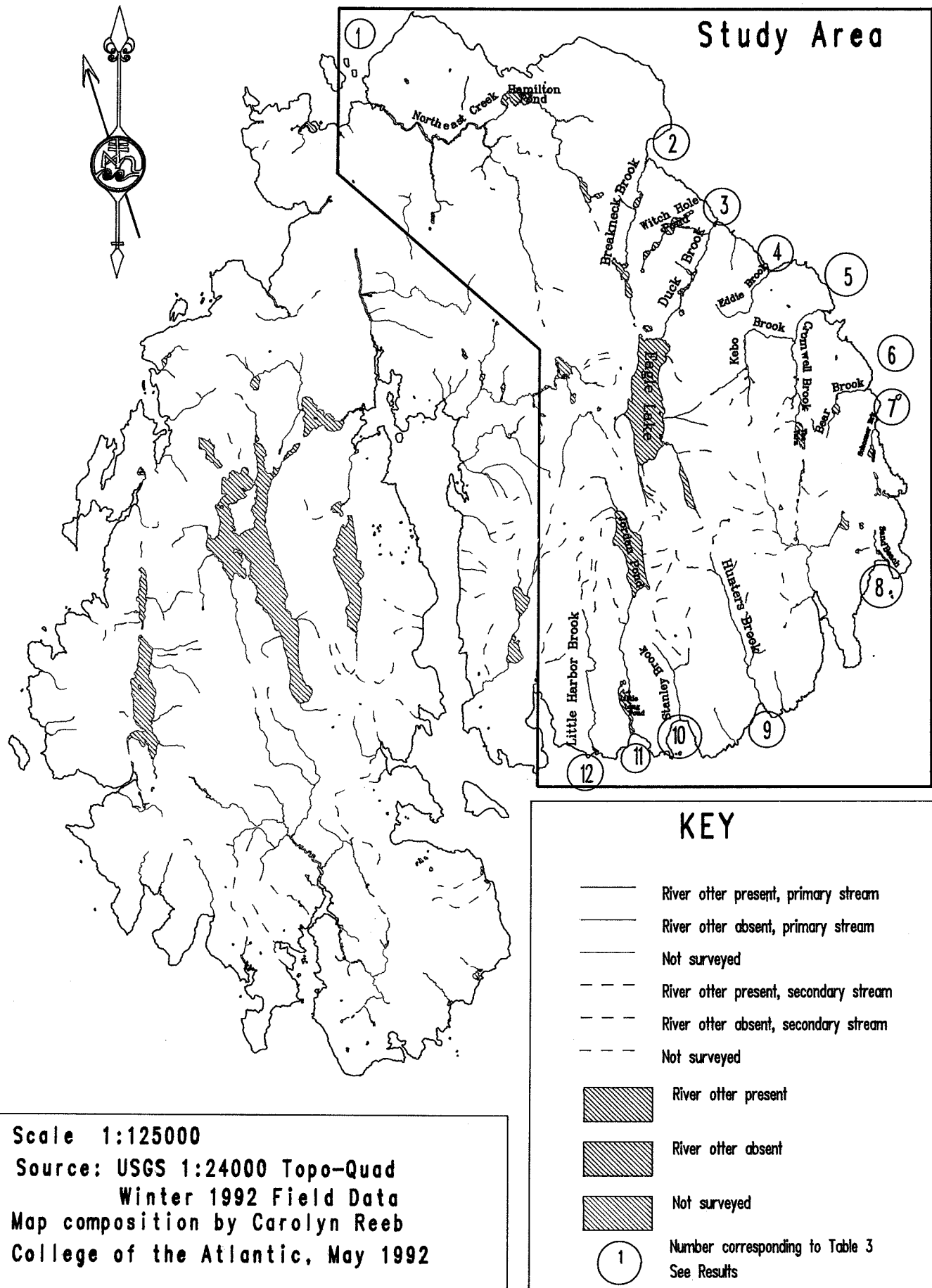


Table 3. Distribution of river otters and beaver on eastern portion of MDI, by watershed.

Number Corresponding to Figure One	Watershed	River Otter Presence/Absence	Beaver Presence/Absence
1	Northeast Creek*	Present	Present
2	Breakneck Creek*	Present	Present
3	Eagle Lake*	Present	Present
4	Bear Brook*	Absent	Absent
5	Tarn/Cromwell Brk.	Present	Present
6	Bear Brook	Present	Present
7	Schooner Head*	Absent	Present
8	Sand Beach	Present	Present
9	Stanley*	Absent	Absent*
10	Hunters Creek*	Present	Absent
11	Jordan Pond	Absent	Present
12	Little Harbor Brk	Absent	Absent

*Watersheds incorrectly classified as being used or unused by river otters by Dubuc, Krohn and Owen's model (1990). Unstarred watersheds were correctly classified by the model.

Table 4. T-test performed on variables used in discriminant analysis

Variable	P value	Watersheds having river otter Present/Absent	Mean	Standard Deviation
NWCBLK	.184	present	.035	.038
		absent	.013	.013
BASP	.244	present	.721	.230
		absent	.450	.423
SEMER	.404	Present	3.723	2.633
		absent	2.465	2.357
SAREAREA	.434	present	443.551	510.307
		absent	226.160	411.920
SPERIM	.200	present	61.486	51.293
		absent	25.668	39.123
MIRREG	.155	present	.727	.015
		absent	.714	.013

DISCUSSION

DISTRIBUTION

Overall, there appears to be only a minor shift in river otter distribution on MDI between the 12 watersheds in this 1992 survey and the surveys which were conducted by Dubuc from 1985-87. The watershed crossing Schooner Head road was found to have no river otters inhabiting it during my study; Dubuc reported otter sign in this watershed for 3 out of her 4 field seasons. This watershed contains active beaver sites and has proven to be suitable for otter habitation in the past; there are several hypotheses as to why otters were not using it during my field study.

The basic family group of Lutrinae consists of an adult female and her juvenile offspring. The role of an adult male within this family group is disputed among researchers, yet most agree that adult male river otters do not function as part of a family group (Melquist 1981, Larsen 1983, Woolington 1984, in Melquist and Dronkert 1987). In comparison to females and juvenile males, adult male otters are thought to have the largest home ranges (Melquist and Dronkert 1987). It is possible that an adult male could inhabit either the Schooner Head watershed and a second watershed located south of my study area (see Figure 1). Independently, both watersheds are relatively short. Together, the two watersheds may provide a large enough home range for an adult male otter. Movement between the two could account for the

absence of otter sign during the week this area was surveyed. Mortality, a change in water quality, or a shift in food resources are also possible reasons for the watershed not being inhabited by otters. Further surveys over several seasons are necessary to determine whether the watershed has been abandoned by river otter.

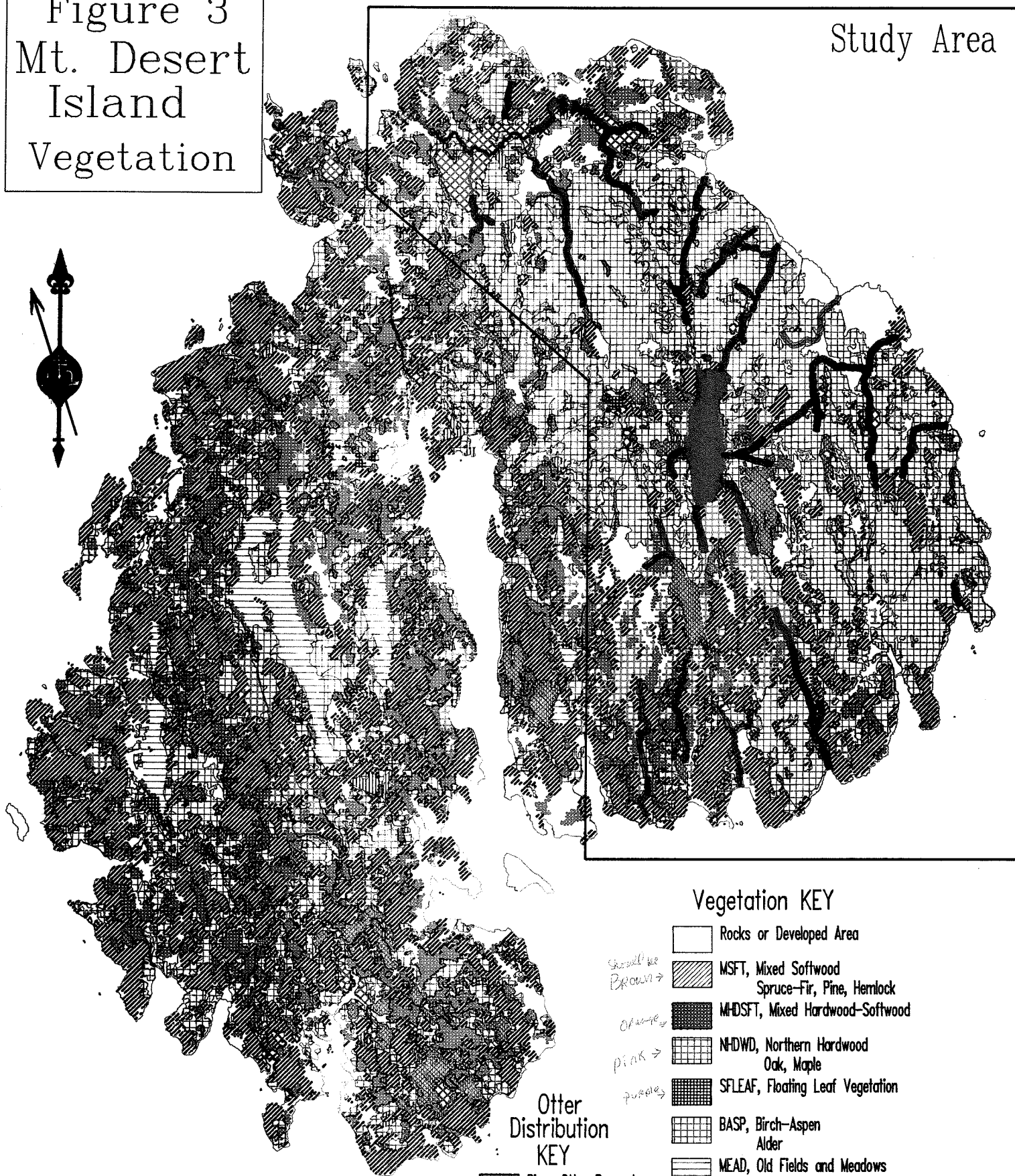
FACTORS AFFECTING RIVER OTTER DISTRIBUTION

The discriminant analysis performed on my data set generated six variables that could collectively distinguish between used and unused watersheds. Those six variables included birch-aspen (BASP), wetland softwood (NWCBLK), emergent herbaceous vegetation (SEMER), area of all water bodies in a watershed (SAREAREA), perimeter of all water bodies in a watershed (SPERIM), and the shoreline diversity [(MIRREG) see Table 2, Methods]

Otters inhabit watersheds characterized by birch-aspen stands (see Figure 3). In 1947 fire burned portions of 13 watersheds on eastern Mount Desert Island. Prior to the burn, the forest was predominantly spruce-fir. Birch-aspen dominated the forest after the burn. This type of vegetation provides key food and building resources that creates a habitat suitable for beaver. Since otters flourish in watersheds altered by beaver, they concurrently inhabit watersheds having a high proportion of birch-aspen. In terms of the model generated by Dubuc *et al.* (1990), this positive correlation of birch-aspen (BASP) in used watersheds is essentially equal to the negative correlation of

Figure 3
Mt. Desert
Island
Vegetation

Study Area



Vegetation KEY

- Rocks or Developed Area
- MSFT, Mixed Softwood Spruce-Fir, Pine, Hemlock
- MHDSFT, Mixed Hardwood-Softwood
- NHDWD, Northern Hardwood Oak, Maple
- SFLEAF, Floating Leaf Vegetation
- BASP, Birch-Aspen Alder
- MEAD, Old Fields and Meadows
- NWCBLK, Wetland Softwoods White Cedar, Black Spruce-Tamarack
- SEMER, Emergent Herbaceous Vegetation Salt and Fresh Marsh, Sphagnum-Sedge Bog
- SERIC, Ericaceous Vegetation Heath
- SALWIL, Alder-Willow

Otter Distribution KEY

- River Otter Present
- River Otter Absent
- Not Surveyed
- River Otter Present
- River Otter Absent
- Not Surveyed

Scale: 1:110000

Source: 1979 Infrared aerial photos delineated on USGS 1:24000 topo-quads. ANP

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mixed hardwood-softwood (MHDSFT) that Dubuc found.

In addition to birch-aspen stands, the variable NWCBLK defining wetland softwood and SEMER, describing emergent herbaceous vegetation such as salt water marshes, fresh water marshes and sedge bogs, proved to be good discriminators. River otters are secretive animals disliking human disturbance and development. Vegetation measured by NWCBLK and SEMER describes wetlands characterized by tall herbaceous vegetation, mucky soils, concealed stumps, and in some areas, an open canopy. In times of heavy visitor use at Acadia National Park, this habitat is a secluded and a "safe" place for otters to inhabit. Wetlands also provide suitable foraging habitat for otters.

Three variables, perimeter of all water bodies in a watershed (SPERIM), area of all water bodies in a watershed (SAREAREA), and the shoreline diversity (MIRREG), depict the general shape of water bodies present within a watershed and were helpful in discriminating between used and unused watersheds. The quick flowing streams characteristic of MDI do not provide suitable foraging habitat for otters; those watersheds lacking water bodies are not able to support otters. Therefore, the amount of total perimeter and area of water bodies within a watershed provide good insight to suitable river otter habitat. A convoluted shoreline (measured by MIRREG) could provide shallow waters in addition to a concentrated food source of fresh water fish, crayfish, and amphibians.

Within each of the following variables: BASP, NWCBLK, SEMER,

SPERIM, SAREAREA, and MIRREG, means were tested for differences between used and unused watersheds. There was no significant difference between the variable means of used and unused watersheds. This indicates that no single variable alone can accurately predict or describe suitable otter habitat. It is the combination of all six variables which provides discrimination between watersheds.

One unexpected result generated by the discriminant analysis was the failure of the variable BEAV to aid in discrimination. Many studies have shown a high correlation between river otter distribution and the activities of beaver (Choromanski and Fritzell 1982, Toweill and Tabor 1982, Anderson and Woolf 1984, Berg and Kuehn 1984 in Melquist and Hornocker 1987; Dubuc 1987). The relatively small sample size is the most likely reason for the failure of the variable BEAV to discriminate in this study. Although the activity of beaver did not prove to be significant in this study, the role they play in terms of otter ecology must be taken into account when considering otter distribution on Mount Desert Island.

TESTING A MODEL PREDICTING SUITABLE OTTER HABITAT

The failure of the model designed by Dubuc *et al.* (1990) to correctly predict otter use on 59 percent of my study site is attributable to factors which vary from watershed to watershed. The model was designed as a predictive tool used by resource managers interested in managing river otters on MDI. In

describing potential river otter habitat, the model incorporates a positive correlation between beaver (BEAV), stream length (TOTL), and shoreline diversity (MIRREG). A negative correlation between percentage of mixed hardwood-softwoods (MHDSFT) is described.

Three out of the 7 watersheds which were incorrectly classified by this model were unused watersheds. Part of the model's predictability requires that unused watersheds have a high proportion of mixed hardwood-softwoods associated with their vegetation composition. None of these 3 watersheds (Schooner, Stanley, Eddie) were characterized by a high proportion of mixed hardwood-softwoods. It is likely that the model failed due to this low variable value. The remaining 4 watersheds which were incorrectly classified were watersheds used by otters. In one watershed (Hunters), beaver had not colonized the watershed and the shoreline diversity was zero--therefore the model misclassified it as unused by otter. Reasons for misclassification of Breakneck, Eagle Lake, and Northeast Creek watersheds are unclear.

RESULTS OF THIS STUDY IN RELATION TO 1985-87 MDI STUDY

A discriminant analysis is one of the steps necessary when developing a statistical model such as that developed by Dubuc *et al.* (1990). Considering that variables evaluated in this study were also evaluated by Dubuc, coupled with the fact that this study area was a portion of the area studied by Dubuc in 1985-87

(excluding Eddie Brook), one might expect that the variables able to discriminate between used and unused watersheds would be the same for both studies. In reality only one variable, shoreline diversity (MIRREG), proved to be a good discriminator in both studies.

One potential reason for different results stems from the different methods used in obtaining data between the two studies. Data for this study was obtained using a GIS system (see Methods). Data from Dubuc's study was obtained using an electronic planimeter (measure of physical features), a random dot grid on orthographic vegetation maps (vegetation), and a Saltzman projector (basin area perimeters).

A second potential reason for different results is related to sample size. The model tested was based on 33 watersheds (39 were surveyed); this study was based on 12 watersheds. As sample size increases, there is a higher probability that the analysis will be able to accurately discriminate. Differences in sample size can also lead to differences in the number and type of variables generated by the analysis. Data for this study is, in essence, a subset of the data used in developing the model that was tested.

MANAGEMENT IMPLICATIONS

The model designed by Dubuc, Krohn, and Owen (1990) should be applied with caution. An exceptionally low or zero value for at least two of the variables (MIRREG, and MHDSFT) proved to yield erroneous predictions. The importance of birch-aspen forest (BASP), wetland softwood (NWCBLK), as well as emergent herbaceous vegetation associated with water bodies (SEMER) should be recognized when describing suitable river otter habitat. Furthermore, the presence of water bodies within a watershed (SPERIM, SAREAREA) should also be taken into account when describing watersheds inhabited by otter.

Results of this study showed that vegetation associated with lakes, streams, and wetland areas are key components to river otter habitat. Within Acadia National Park (ANP) vegetation is protected from development. Acadia encompasses less than half of MDI, and most watersheds traverse through private or town-owned property between their headwaters and the ocean. Because otters inhabit fresh water lakes and ponds as well as coastal environments, riparian vegetation should be maintained throughout the watershed. This will ensure vegetated travel corridors throughout the river otters range.

The Natural Resource Act mandates that 75 foot buffers, or non-developed strips of land, be maintained along streams. Property adjacent to lakes must allow a 250 foot buffer. Homeowners need to be educated as to the importance of maintaining a vegetative buffer (as opposed to clear-cutting the

area) along streams and water bodies to lessen human disturbance. Dubuc (1987) reports that a dense understory of 10 meters in width is a sufficient buffer for otter. The Land Use Regulation Committee, however, suggests a 250 foot vegetative buffer to benefit all wildlife species.

Toweill and Tabor (1982) note that one aspect of river otter ecology which has not been investigated thoroughly is in evaluating the range of water quality that otters will tolerate. Given the highly aquatic nature of this species, understanding the levels of water quality typical of otter habitat would help to clarify the value of certain areas as being suitable for river otter.

In regards to the otter population on MDI, it appears to be most influenced by beaver (Dubuc 1987) followed by vegetation composition and the availability of lakes and ponds for foraging. Because otter distribution is influenced by beaver, it is also indirectly influenced by birch-aspen forest. As the birch-aspen stands mature and give way to spruce-fir stands; key food and building resources for beaver will decline and limit the beaver population. With the decline of beaver, it is expected that suitable habitat for river otter will decrease. It is possible to compensate for the loss of stable beaver ponds through artificial means, yet this process is not natural and could permanently alter watershed flow.

Dubuc (1987) suggested ways to manage for beaver over the long term, whereby indirectly managing river otter. Prescribed

burning can be applied to promote birch-aspen stands, softwood seed trees can be manually removed from birch-aspen stands, or herbicides could be used to suppress softwood regeneration. While these methods would effectively promote resources for beavers, their implementation by ANP is unlikely. Currently, ANP's fire regulations do not incorporate the practice of prescribed burning. The practice of manually removing softwood seed trees or applying herbicides have not been considered due to lack of ANP personnel and funding (J. Hazen-Connery, Acting Chief of Resource Mgmt., ANP, pers. comm.) The most feasible and worthwhile effort in promoting suitable otter habitat on MDI appears to be the protection of vegetation corridors. Efforts should be concentrated on maintaining vegetative buffer zones along privately owned property to minimize human disturbance.

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