

# Habitat selection by five otters *Lutra lutra* in rivers of northern Scotland

Leon S. Durbin

Institute of Terrestrial Ecology, Banchory, Aberdeenshire AB31 4BY, Scotland, U.K.

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## Abstract

Understanding the effects of habitat structure on otter (*Lutra lutra*) movements is critical to conservation management, but such information is scarce for riverine habitats where the species is most vulnerable. Between 1987 and 1990 the patterns of habitat use by five otters from river catchments in north-east Scotland were examined by using radio-telemetry. The main habitat variables analysed were channel width, substrate size, riparian vegetation, proximity to roads and buildings, and the coverage of surrounding vegetation and land use. All of the otters spent more of their time in relatively wide sections of river or stream, with high boulder cover and many riparian trees. However, when use was calculated as the time spent per unit area of water, narrow, gravelly streams were selected by most animals. Some of the habitat features traditionally thought to influence otter movements (e.g. riparian vegetation, land use) did not show the predicted effects. The conservation implications of these observations are discussed.

**Key words:** otters, habitat selection, rivers, preference index, *Lutra*

## INTRODUCTION

Habitat deterioration is considered a significant threat to otter (*Lutra lutra*) populations in most countries where the species is endangered (Macdonald & Mason, 1990). To manage riverine habitats for otters it is necessary to understand how various habitat components affect otter movements. Despite this, little information is available on the relationship between habitat structure and its use by otters. Distributions of field signs (mainly faeces, 'spraints') have traditionally been used to estimate habitat use by otters (e.g. Jenkins & Burrows, 1980; Macdonald & Mason, 1983; Bas, Jenkins & Rothery, 1984; Adrian, Wilden & Delibes, 1985), but such patterns are difficult to interpret because spraints are often deposited as scent-marks, and are not necessarily associated with time spent (Kruuk & Conroy, 1987). For example, trees are often used as conspicuous spraint sites along rivers (Chanin, 1985), but the distribution of trees may have little influence on otter movements. Furthermore, along the coasts of Shetland, there does not appear to be any relationship between habitat use and the numbers of spraints found (Kruuk *et al.*, 1986). Clearly, more direct measures of habitat use are required, but this is difficult because riverine otters are mainly nocturnal, unobtrusive and trap-shy, and have extensive ranges (Durbin, 1993).

Few studies have been published where otters were radio-tracked in riparian habitats. Among these, Green,

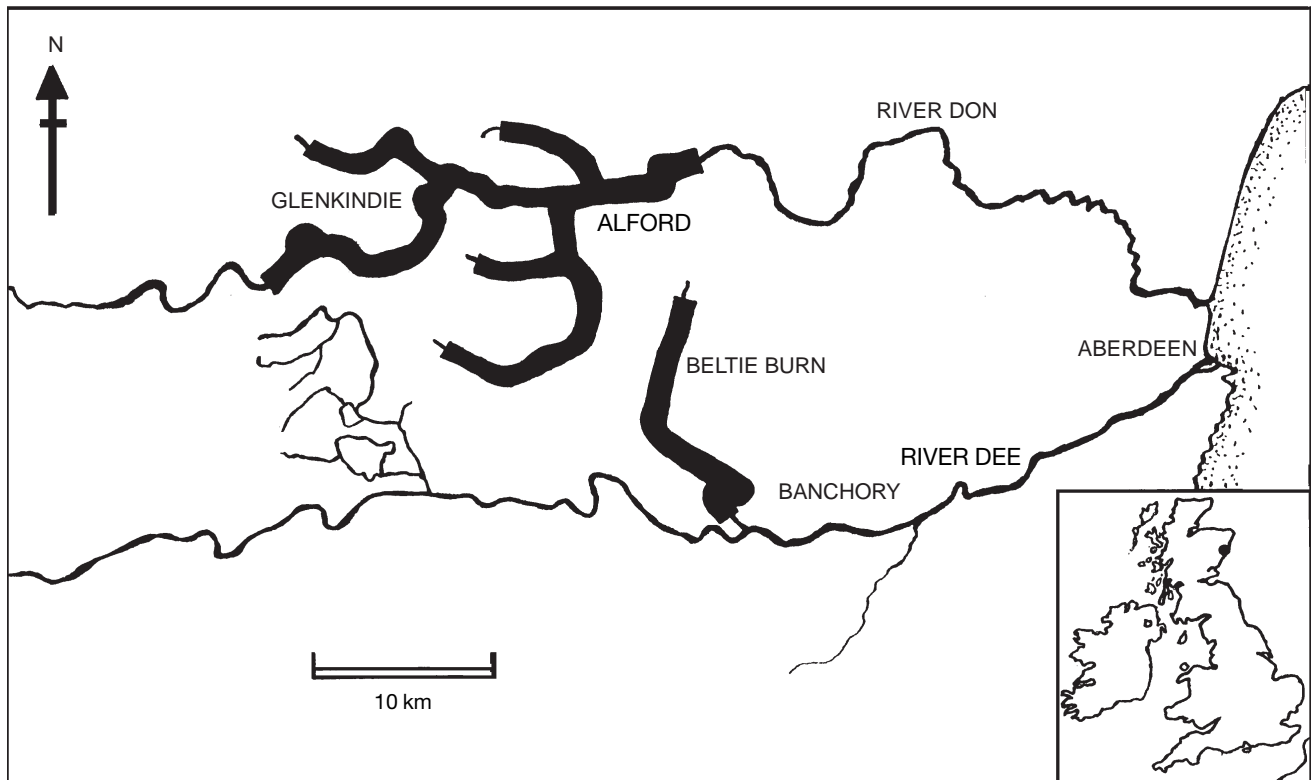
Green & Jefferies (1984) largely ignored the issue of habitat use; Kruuk *et al.* (1993) restricted their habitat analysis to stream width, and Durbin (1996a) dealt mainly with spatial use *per se* (i.e. range sizes, rates of travel etc.). The present study, however, uses radio-tracking observations of five otters inhabiting river-systems, to examine the relationships between a variety of habitat variables and the allocation of active time. Among the variables concerned are some of those often thought to affect otter movements (e.g. riparian vegetation, surrounding land use, and distance from roads and buildings). Such assumptions underlie present management policies (e.g. N.R.A., 1993), but have yet to be tested directly.

The central aim of this study was to identify habitat variables that are associated with patterns of otter use, in terms of both aquatic activity and the distribution of daytime resting sites.

## METHODS

### Study areas

Otters were captured and later radio-tracked in the neighbouring catchments of the River Don and River Dee in north-east Scotland (Fig. 1). Both rivers are approximately 140 km long, are fast-flowing with eroding substrates, and have their outflows at Aberdeen.



**Fig. 1.** Map of study areas in the River Don and Dee catchments, with banded regions covering the ranges of the five otters radio-tracked between 1987 and 1990.

These mainly oligotrophic rivers flow through regions of mixed agriculture, forestry, moorland, and deciduous woodland. Riparian trees are predominantly alder *Alnus glutinosa* or willow *Salix* spp., and herbaceous bank vegetation comprises a mixture of grasses, herbs, rushes, and sedges. In almost all parts of the study areas there is at least a thin band (>2 m wide) of rough vegetation bordering the banks. The fish fauna is dominated by two salmonid species—the brown trout *Salmo trutta* (including migratory sea trout) and Atlantic salmon *S. salar*—but there are also eel *Anguilla anguilla*, three-spined stickleback *Gasterosteus aculeatus*, minnow *Phoxinus phoxinus* and brook lamprey *Lampetra planeri* (Durbin, 1993). Rivers and streams often run close to minor roads and houses.

The Don study area extends from Alford (G.R. NJ554169; Fig. 1) to Glenkindie (G.R. NJ400149), whereas the Dee study area is restricted to one tributary, the Beltie Burn (G.R. NO671964; Fig. 1), where two of the otters remained during radio-tracking.

### Habitat survey

Waterways used by the otters during radio-tracking were arbitrarily divided into 200-m sections ( $n = 695$ ), and during 1989 and 1990 these were surveyed for 12 habitat variables (see Table 1). Summer was chosen for surveying as low water levels improved the substrate

visibility. Most of the chosen habitat variables did not change seasonally. There was obviously less riparian vegetation in winter; however, dried herbaceous vegetation persisted and the number of trees largely remained constant.

For each habitat section, the areas or lengths of the appropriate variables (see Table 1) were estimated by eye, and assigned to the following percentage classes using midpoint scores: 3 = 0–5%; 13 = 6–25%; 35 = 26–50%; 73 = 51–95%; 98 = 96–100%.

Surrounding land classes (i.e. those within 100 m of each bank) were quantified by estimating the length of bank adjacent to particular habitat types (Table 1). The mean width of each section was calculated from two measurements at the upstream and downstream boundaries (see Kruuk *et al.*, 1993). A count was made of the number of trees (>2 m high) overhanging the water, and the minimum distance of each section from roads and buildings was measured from maps.

### Study animals

Five otters (Table 2) were caught in box traps, anaesthetized with ketamine hydrochloride, and radio-tagged (for details see Melquist & Hornocker, 1979). Two males (DM1 and DM2) and a female (DF1, which gave birth during the study) came from the Don catchment, and a male (BM1) and female (BF1) came from the

**Table 1.** The habitat variables surveyed and logarithmic transformations used for linear regression analysis

Variables		Code	Description	Measurement	Log-conversion
Substrate:	gravel	GRAV	< 1 cm diam.	PAC	$\ln(x/(100-x))$
	stones	STON	1–15 cm	PAC	$\ln(x/(100-x))$
	boulders	BOUL	> 15 cm	PAC	$\ln(x/(100-x))$
Surrounds:	arable	ARAB		PLC	$\ln(x/(100-x))$
	pasture	PAST		PLC	$\ln(x/(100-x))$
	bog	BOG		PLC	$\ln(x/(100-x))$
	coniferous	CONIF		PLC	$\ln(x/(100-x))$
	deciduous	DECID		PLC	$\ln(x/(100-x))$
Bank vegetation		BVEG	Herbaceous vegetation overhanging by > 0.2 m from bank or semi-submerged	PLC	$\ln(x/(100-x))$
Bank trees		TREE	No. of trees overhanging the water	Count	$\ln(x+1/(\text{mean}+1))$
Channel width		WIDTH	Mean width	In metres	$\ln(x/\text{mean})$
Roads		ROAD	Minimum distance from public roads	In metres	$\ln(x/\text{mean})$
Buildings		BUILD	Minimum distance from inhabited buildings	In metres	$\ln(x/\text{mean})$

PAC = percentage area class; PLC = percentage length class;  $x$  = habitat variable score

**Table 2.** Radio-tracking periods and estimated range sizes of the otters

Animal	Body mass (kg)	Tracking period			Total range size	
		Dates (month/year)	No. of nights	Otter activity (h)	Length (km)	Area (ha)
BF1	5	10/87–5/88	85	53	19.0	6.6
BM1	7	10/87–5/88	100	75	19.6	6.2
DF1	6	8/88–7/89	125	261	24.0	33.5
DM1	7	4/88–7/88	45	189	50.2	28.6
DM2	8	6/89–6/90	97	243	84.4	78.7

Beltie Burn. In initial examinations and during subsequent tracking there were no obvious signs of physical or behavioural abnormality. For more detailed descriptions of the otters see Kruuk *et al.* (1993) and Durbin (1996a).

### Radio-tracking

The otters were generally nocturnal, therefore nearly all tracking occurred at night. Several tracking sessions lasted the whole night (from emergence at dusk, to retirement at dawn), but often only part of the night was monitored (usually a 4-h session, with an arbitrary start time). Animals were tracked continuously and radio-locations (allocated to 100-m sections), were taken every 15 min, or whenever animals changed their activity or direction, or showed definite changes in their rate of travel. Aquatic activity was easily distinguished from activity on the bank by characteristic signal fluctuations, and only the former activity type was used to

analyse aquatic habitat use. Activity was classified as 'social' if vocalizations were heard, or if animals were seen together (except families). Social activity was excluded from calculations of habitat use in order to avoid obscuring spatial foraging patterns, which were the primary interest.

### Analysis of habitat use

Preliminary analyses demonstrated few differences in DF1's range use before and after parturition, and as this has been described elsewhere (Durbin, 1996b), these data were pooled in the present analysis.

Active time was allocated to individual habitat sections (for algorithm see Durbin, 1993) and, over the study period of each otter, the total amount of active time ( $T$ ) accumulated in each section was calculated. These patterns of utilization were compared with models based on the uniform use of habitat length ( $T^l$ ) and area ( $T^a$ ). Both these models may be appropriate as

**Table 3.** Correlation matrix for habitat variables recorded in the survey

	BOUL	GRAV	BVEG	BOG	ARAB	PAST	CONIF	DECID	WIDTH	TREE	ROAD	BUILD
STON	-0.36	-0.46	-0.15	-0.08	-0.02	0.10	-0.06	-0.04	-0.01	0.05	0.08	0.03
BOUL		-0.35	0.04	-0.10	0.10	-0.20	-0.13	0.18	0.51	0.08	-0.02	0.04
GRAV			0.13	0.17	-0.06	0.14	0.17	-0.10	-0.54	0.02	-0.02	0.00
BVEG				-0.01	-0.04	-0.07	-0.03	-0.04	0.11	-0.30	0.14	0.17
BOG					-0.01	-0.09	0.01	-0.07	-0.12	0.01	0.09	0.07
ARAB						-0.34	-0.16	-0.23	0.15	-0.05	-0.13	-0.13
PAST							-0.08	-0.32	-0.19	-0.09	-0.16	-0.17
CONIF								0.01	-0.17	0.12	0.15	0.10
DECID									0.23	0.33	-0.09	-0.09
WIDTH										0.03	-0.16	-0.13
TREE											-0.16	-0.16
ROAD												0.90

the riverine habitat is clearly linear but also varies in width. The predicted values for each section were calculated as follows:

$$T^l = T^{\text{tot}} \cdot S^l / R^l,$$

$$T^a = T^{\text{tot}} \cdot S^a / R^a,$$

where  $T^{\text{tot}}$  = total amount of active time that the otter was tracked;  $S^l$  = length of the section (i.e. 200 m);  $R^l$  = length of otter's range;  $S^a$  = area of the section, and  $R^a$  = area of the otter's range. Two preference indices were then calculated for each section using natural log ratios of the observed to predicted values:

$$PL \text{ (deviation from uniform use of length)} = \ln(T/T^l),$$

and

$$PA \text{ (deviation from uniform use of area)} = \ln(T/T^a).$$

Sections with indices of zero were used as predicted by the particular model, those with indices greater than zero were used more than expected, and those with values less than zero were used less than expected.

Associations between habitat variable scores and levels of preference were prone to dependence problems because habitat variables were often intercorrelated (Table 3). Initial attempts to control for these effects using multivariate techniques produced results that were difficult to interpret and present (Durbin, 1993), therefore individual habitat variable scores were used. For linear regressions, habitat variable scores were log converted (see Table 1) so that they were compatible with the preference indices (also log functions). Any significant regressions were taken to indicate that the habitat variable concerned, or some correlated variable, was affecting the otter's use of its range. Although habitat-use data from a particular animal tends to be spatially autocorrelated (Aebischer, Robertson & Kenward, 1993), this problem can be resolved by only inferring habitat preference on the basis of consistency between the sample of otters (see 'Discussion'). For this analysis, one-sample  $t$ -tests ( $t = \text{mean coefficient} / \sqrt{(\text{variance}/n)}$ ) were used to test the null hypothesis that the mean coefficient for a particular habitat variable was zero across the sample of five otters. A significant result

indicated a general pattern for the five otters, and the sign of the mean coefficient defined the relationship as a *preference* or an *avoidance*.

#### Daytime resting sites

Resting sites were located during daytime radio-telemetry searches, often guided by information from the previous night's tracking. The influence of habitat composition on the distribution of these sites was then examined. For each otter range,  $t$ -tests were used to test for differences in the habitat variable scores of sections with and without known resting sites.

#### RESULTS

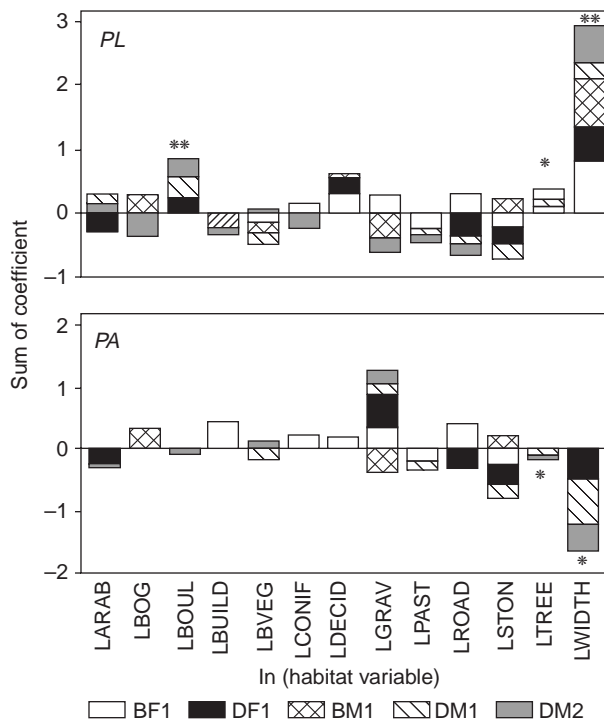
Between October 1987 and June 1990, 821 hours of otter activity were monitored (Table 2). In the Don catchment, otters DM2 and DF1 were each tracked for a year, but DM1 was tracked for only 10 weeks as his radio failed prematurely. Only during June and July 1989 were two of the Don otters (i.e. DF1 and DM2) tracked concurrently. In the Beltie Burn, however, both otters were tracked over the same eight-month period (Table 2).

A total of 146 sections were surveyed along the main stem of the River Don (mean width = 21 m; range 14–40 m); 396 sections from its tributaries (mean width = 2 m; range = 0.2–8.0 m), and 153 sections from the Beltie Burn (mean width = 3 m, range = 0.5–7.2 m).

Among the regressions using the preference index  $PL$  (related to time spent per unit length), the only variables that showed consistent relationships across the sample of the five otters were boulders (mean coefficient =  $0.23 \pm 0.09$  S.D.);  $t$ -test,  $t = 5.63$ ,  $d.f. = 4$ ,  $P < 0.01$ ), trees (mean coefficient =  $0.09 \pm 0.06$  S.D.);  $t$ -test,  $t = 3.21$ ,  $d.f. = 4$ ,  $P < 0.05$ ), and width (mean coefficient =  $0.59 \pm 0.23$  S.D.);  $t$ -test,  $t = 5.69$ ,  $d.f. = 4$ ,  $P < 0.01$ ). These results indicate general preferences for these variables (Fig. 2). Width showed the greatest number of significant regressions (Fig. 2) and highest levels of statistical significance (for regression statistics

**Table 4.** Significant differences in the habitat scores (for units see Table 1) of sections with and without daytime resting sites. *t*-test significance: \*  $P < 0.05$ , \*\*  $P < 0.01$ 

Animal	Habitat variable	Presence of resting site	No. of sections	Mean ( $\pm$ S.D.) variable score	<i>T</i>
BF1	BOUL	—	95	6.0 (9.6)	2.26*
		+	9	2.1 (4.3)	
BM1	TREE	—	103	18.7 (19.7)	−2.04*
		+	12	30.8 (18.2)	
DF1	BOUL	—	79	27.8 (25.4)	−2.18*
		+	27	39.8 (22.7)	
	DECID	—	79	14.1 (25.4)	−2.26*
		+	27	29.9 (33.0)	
	WIDTH	—	79	15.1 (10.8)	−2.06*
		+	27	19.8 (8.2)	
	ROAD	—	79	182.9 (211.7)	2.13*
		+	27	111.1 (123.3)	
DM1	ARAB	—	197	18.1 (32.3)	−2.24*
		+	18	42.6 (45.2)	
	PAST	—	197	40.0 (38.8)	2.02*
		+	18	20.9 (31.4)	
DM2	BVEG	—	333	62.6 (30.3)	−2.53*
		+	30	77.1 (27.1)	
	CONIF	—	333	2.8 (11.5)	3.07**
		+	30	0.4 (2.4)	

**Fig. 2.** Bar charts summarizing the overall habitat preferences of the five otters (BF1, DF1, BM1, DM1, DM2), with separate analyses for preference indices *PL* and *PA*. Bars represent the sum of the regression coefficients for all the significant relationships between each preference index and habitat variable scores. Components of the stack-bars represent the coefficients for the individual otters. Asterisks indicate that the mean coefficient for all five otters (including coefficients for non-significant results) is significantly different from zero (*t*-test: \*  $P < 0.05$ , \*\*  $P < 0.01$ ), suggesting an overall preference or avoidance. For details of regression statistics and statistical tests see Appendix and Methods, respectively.

see Appendix). All three variables were positively correlated, but only width and boulders were *strongly* correlated (Table 3).

In regressions with the index *PA* (related to time per unit area) a different pattern emerged. Trees (mean coefficient =  $-0.07 \pm 0.05$  S.D.);  $t = -3.07$ ,  $d.f. = 4$ ,  $P < 0.05$ ) and wider sections (mean coefficient =  $-0.41 \pm 0.23$  S.D.);  $t = -3.94$ ,  $d.f. = 4$ ,  $P < 0.05$ ) were used less than expected by the five otters. However, it should be noted that regressions with trees were significant for only two animals, and these relationships were relatively weak (Fig. 2; Appendix). Negative relationships with width were not significant for the two Beltie otters, and these animals were never found in the river during the study.

An interesting pattern appeared in the use of substrate. Four individuals showed a significant preference for gravel, and three showed a significant avoidance of stones (Fig. 2). This result was not significant for the sample of five otters, because BM1 showed the opposite pattern. Of these variables, gravel and width were strongly negatively correlated, whereas stones and width were virtually independent of one another (Table 3).

Although there were some significant differences in the habitat characteristics of sections with and without daytime resting sites, each otter showed a different pattern (Table 4). Only boulder cover was related to holt location for more than one otter (i.e. for BF1 and DF1), but these relationships were in opposite directions.

## DISCUSSION

Conclusions drawn from these results will be conservative because they are based on consistent patterns

between a few individuals. For example, if differences between animals in terms of gender, maturity, or idiosyncrasy influence habitat use, some preferences, which could be important at the population level, may not manifest themselves. In addition, because habitat use was examined for 200-m sections, some detailed patterns of microhabitat use will inevitably have been lost. Nevertheless, consistent relationships may be of conservation significance. Clearly causal relationships cannot be defined without experiments, but an attempt to explain these patterns may provide direction for future research.

The five otters spent a greater proportion of their time in relatively wide habitat sections, with high boulder cover, and many bank trees. This cannot be explained simply by the larger areas of stream-bed found within wider sections. When otter use was expressed as time spent per unit area, wider sections and those with many bank trees were used less than expected. However, as boulder cover was positively related to width, the greater use of bouldery sections could be simply related to the greater area. Among the variables surveyed, variation in substrate best explained the disproportionate use of area. Sections with high gravel to stone ratios were generally used more than expected on the basis of their area. Only one otter (BM1) showed the opposite preference, but unlike most of the other animals he used sections in proportion to their area. It is interesting that BF1 preferred gravel to stones, even though she used her range in proportion to the areas available. In this case at least, it appears that the substrate preference was independent of width.

Kruuk *et al.* (1993) suggested that otters concentrated on narrow streams because such areas contained a disproportionately high biomass of fish. Although deeper parts of the River Don could not be electrofished, existing samples indicate that overall salmonid abundance was similar in the river and tributaries (Durbin, 1993). Salmon, however, dominated catches from the river, while trout dominated those from the tributaries (Durbin, 1997). Possibly, interspecific differences in salmonid behaviour or habitat use could increase the susceptibility of trout to predation, but detailed electrofishing studies are required to test this.

Gravelly areas associated with narrow streams may offer advantages to foraging otters because adult salmonids that spawn there are highly susceptible to predation (Carss, Kruuk & Conroy, 1990) and juvenile fish may be easier to catch owing to a lack of boulder refuges. The proportion of the channel overhung by vegetation may also be important, as there is a negative exponential relationship between this and width (Durbin, 1993). Indeed, overhanging vegetation, which is known to be associated with high trout density (Kozel & Hubert, 1989), is often exploited by foraging otters (Durbin, 1996a), so perhaps this could explain the concentrated use of narrower sections. However, on this basis, one would predict a positive relationship between otter use and the length of bank overhung by vegetation. This was clearly not so across the sample of five otters. Likewise, a positive relationship between numbers of

riparian trees and otter use might also be predicted, but after corrections for area, the relationships found were actually negative. These results do not imply that riparian vegetation is unimportant, because otters certainly use semi-submerged tree roots and herbaceous vegetation for both foraging (Durbin, 1996a) and resting (Macdonald, Mason & Coghill, 1987; Green *et al.*, 1984; Durbin, pers. obs.). However, at this sampling resolution (i.e. 200-m sections) riparian vegetation has little effect on otter movements.

The proximity of a section to roads or houses did not limit otter use. On the contrary, some animals used sections close to roads and houses more than expected, and on average resting sites were found no further away than other parts of the range. This further confirms that otters can be tolerant of indirect forms of 'disturbance' (Mason & Macdonald, 1986; Kruuk, 1995), and may have implications for assessing the impacts of construction schemes (e.g. Pearce, Conroy & Holman, 1995).

Agricultural practices are usually thought to be detrimental to otters owing to the effects of drainage, erosion, pesticide run-off, and nitrification (Foster-Turley, Macdonald & Mason, 1990). Any negative effects on fish stocks would probably be concentrated close to the pollutant source because of the effects of current flow and dilution. In this study, a mosaic of natural vegetation and agricultural land provided the opportunity to examine whether the otters avoided sections of water next to particular land-use types. Three otters spent less time than expected next to pasture, and three spent more time than expected next to deciduous woodland. Nevertheless, these relationships were weak and the patterns found were not significant across the sample of five otters. Considering that narrow streams have smaller discharges for diluting run-off, stronger relationships would be predicted after correcting for the areas of water. Contrary to expectations no clear relationships were found after such corrections. In addition, no consistent patterns were found in the distribution of resting sites with respect to land use. Although surrounding land use and vegetation type appear to have little effect on otter movements and resting behaviour *per se*, such factors may have important biological impacts, via changes in water quality (Mason & Macdonald, 1986).

Among the variables considered, width and substrate explain most of the variation in habitat use, with otters concentrating on narrow, gravelly streams. In fast-flowing, oligotrophic rivers at least, it appears that the distribution, quality, and substrate composition of small tributaries could have important effects on otter density. Pending further research, small streams should be targeted for conservation management, and processes affecting substrate composition (e.g. gravel extraction, siltation, canalization) should be minimized.

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## Appendix

Regression statistics for relationships between preference indices (a) *PL*, (b) *PA*, and log-converted habitat scores ( $r = r^2$ ,  $f = f$  ratio,  $b =$  coefficient and  $P =$  significance: \* < 0.05, \*\* < 0.01, \*\*\* < 0.001). The following numbers of sections were used in regressions for otters: BF1 (104); BM1 (170); DF1 (101); DM1 (208) and DM2 (359). Values in bold are members of coefficients (for a particular variable) differing significantly from zero (for explanation see text). For codes for habitat variables, see Table 1

Animal		Habitat variables											
		STON	BOUL	GRAV	BVEG	BOG	ARAB	PAST	CONIF	DECID	WIDTH	TREE	ROAD
(a)													
BF1	<i>r</i>	0.070	0.004	0.100	0.500	0.000	0.002	0.130	0.060	0.110	0.216	0.056	0.075
	<i>f</i>	8.06	0.38	11.84	5.33	0.00	0.17	15.89	6.05	12.34	28.16	0.13	0.31
	<i>b</i>	-0.200	<b>0.084</b>	0.304	-0.142	0.006	0.029	-0.247	0.173	0.327	<b>0.847</b>	<b>0.135</b>	0.313
	<i>P</i>	**		***	*	ns	ns	***	*	***	***	*	**
BM1	<i>r</i>	0.120	0.031	0.180	0.070	0.082	0.004	0.001	0.031	0.014	0.164	0.005	0.004
	<i>f</i>	15.67	3.62	24.21	8.80	9.28	0.42	0.02	3.56	1.59	21.98	0.56	0.46
	<i>b</i>	0.251	<b>0.236</b>	-0.375	-0.155	0.280	0.037	0.008	-0.152	-0.108	<b>0.752</b>	<b>0.034</b>	-0.071
	<i>P</i>	***	ns	***	**	**	ns	ns	ns	ns	***	ns	ns
DF1	<i>r</i>	0.070	0.071	0.000	0.028	0.000	0.200	0.001	0.006	0.11	0.166	0.001	0.067
	<i>f</i>	7.61	7.96	0.01	2.79	0.04	26.19	0.15	0.58	12.73	20.78	0.07	7.52
	<i>b</i>	-0.248	<b>0.238</b>	0.008	0.114	-0.05	-0.281	0.025	0.202	0.226	<b>0.525</b>	<b>0.019</b>	-0.323
	<i>P</i>	**	**	ns	ns	ns	***	ns	ns	***	***	ns	**
DM1	<i>r</i>	0.051	0.140	0.009	0.142	0.004	0.096	0.030	0.008	0.007	0.055	0.041	0.043
	<i>f</i>	9.82	32.48	1.80	34.35	0.85	22.68	7.40	1.74	1.46	12.05	8.76	9.16
	<i>b</i>	-0.20	<b>0.334</b>	-0.092	-0.184	-0.157	0.142	-0.078	-0.086	-0.070	<b>0.245</b>	<b>0.098</b>	-0.143
	<i>P</i>	**	***	ns	***	ns	***	**	ns	ns	***	**	ns
DM2	<i>r</i>	0.002	0.130	0.121	0.020	0.090	0.119	0.120	0.041	0.010	0.505	0.130	0.044
	<i>f</i>	0.74	53.95	49.7	6.58	35.10	46.59	47.06	13.59	4.50	368.08	54.04	16.64
	<i>b</i>	-0.036	<b>0.281</b>	-0.236	0.066	-0.372	0.150	-0.127	-0.231	0.071	<b>0.584</b>	<b>0.163</b>	-0.183
	<i>P</i>	ns	***	***	*	***	***	***	***	*	***	***	***
(b)													
BF1	<i>r</i>	0.140	0.010	0.180	0.000	0.004	0.002	0.090	0.110	0.110	0.009	0.000	0.156
	<i>f</i>	16.9	1.00	21.81	0.00	0.47	0.16	10.56	13.03	4.86	0.920	0.020	18.78
	<i>b</i>	-0.248	-0.121	0.353	-0.003	0.071	-0.024	-0.183	0.218	0.189	<b>-0.153</b>	<b>0.006</b>	0.402
	<i>P</i>	***	ns	***	ns	ns	ns	**	***	*	ns	ns	***
BM1	<i>r</i>	0.100	0.020	0.210	0.008	0.120	0.002	0.003	0.017	0.011	0.021	0.017	0.001
	<i>f</i>	12.90	2.26	29.79	0.87	15.28	0.22	0.33	1.94	1.22	2.39	1.92	0.05
	<i>b</i>	0.213	0.173	-0.376	-0.046	0.324	-0.025	0.033	-0.104	-0.088	<b>-0.248</b>	<b>-0.058</b>	-0.023
	<i>P</i>	***	ns	***	ns	***	ns	ns	ns	ns	ns	ns	ns
DF1	<i>r</i>	0.111	0.000	0.255	0.002	0.000	0.210	0.002	0.007	0.030	0.140	0.032	0.063
	<i>f</i>	13.50	0.00	35.35	0.17	0.04	27.32	0.16	0.73	3.23	17.00	3.49	7.04
	<i>b</i>	-0.320	0.002	0.025	-0.030	0.046	-0.281	0.025	0.223	0.117	<b>-0.475</b>	<b>-0.127</b>	-0.309
	<i>P</i>	***	ns	***	ns	ns	***	ns	ns	ns	***	ns	**
DM1	<i>r</i>	0.031	0.000	0.020	0.072	0.004	0.013	0.100	0.015	0.000	0.356	0.029	0.002
	<i>f</i>	6.42	0.04	4.66	16.00	0.93	2.75	23.51	3.22	0.06	114.44	6.21	0.34
	<i>b</i>	-0.238	0.015	0.176	-0.159	0.200	0.065	-0.162	0.142	0.018	<b>-0.755</b>	<b>-0.100</b>	0.034
	<i>P</i>	*	ns	*	***	ns	ns	***	ns	ns	***	*	ns
DM2	<i>r</i>	0.004	0.020	0.160	0.070	0.005	0.010	0.001	0.008	0.008	0.340	0.028	0.004
	<i>f</i>	1.43	8.40	70.08	24.99	1.76	3.95	0.22	3.03	2.97	186.94	10.37	1.40
	<i>b</i>	-0.043	-0.101	0.235	0.107	-0.075	-0.04	0.008	0.095	-0.05	<b>-0.416</b>	<b>-0.043</b>	-0.047
	<i>P</i>	ns	**	***	***	ns	*	ns	ns	ns	***	***	ns