Otter Survey of Ireland 2004/2005

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Otter Survey of Ireland 2004/2005

Mike Bailey and **John Rochford**

Wildlife Ecology Group
Department of Zoology
Trinity College Dublin
http://www.tcd.ie/Zoology/

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Summary

The third Otter Survey of Ireland was carried out between August 2004 and August 2005. One principal surveyor and a team of trained NPWS personnel visited a total of 525 sites in 435 10km squares, distributed across the entire country, although concentrated in the 44 otter-designated Special Areas of Conservation.

Of the 525 sites surveyed, 370 (70.48%) had signs of otters. This compares with 88.20% in 1980/1981 and 75.20% in 1990/1991. The overall percentage decrease in positive records between 1981 and 2005 was 17.72% (0.74% *per annum*), and between 1991 and 2005 was 4.72% (0.34% *per annum*). Positive records were returned for 323 (74.25%) of the 435 10km squares surveyed.

Data were analysed and presented on the basis of River Basin Districts. The highest percentage occurrence of otters was recorded in the South Western (74.47%) and South Eastern (72.97%) RBDs, with the lowest in the Eastern (59.50%).

The highest percentage occurrence of otters was recorded at running freshwater sites. There was a negative relationship between otter occurrence and altitude, and a positive relationship with channel width and presence of in-stream vegetation. No significant relationships were detected with other habitat variables, nor, surprisingly, with pollution or human disturbance. There was no difference in terms of percentage occurrence of otters between sites within and outside of SACs.

Mink were recorded at 80 of the 525 sites surveyed, and their distribution was seen to have spread throughout the midlands and west of the country since 1981. There was no relationship detected between otter and mink occurrence.

Diet was found to be broadly similar to that reported from Northern Ireland, with a dominance of fish, and a high proportion of salmonids, eels and sticklebacks. Frogs, and to a lesser extent birds and mammals, occurred at quite high levels, but crayfish, while present in just under 10% of spraints examined from 2004/2005, were less frequent than reported from several other Irish studies.

A number of recommendations are made in connection with future otter surveys and monitoring.

Contents

1. Introduction

L.Ó Neill

The Eurasian otter *Lutra lutra* has the widest distribution of all otter species, with its range covering parts of three continents: Europe, Asia and Africa. Originally the species was widespread throughout Europe, but populations declined sharply during the 1960s and 1970s due to pollution, exacerbated by hunting and habitat loss. Currently it has a rather discontinuous distribution with strong populations in Greece, Spain, Portugal and much of Eastern Europe. Over most of continental Western Europe the species is scarce to extinct, but reintroduction or restocking projects are in progress in several countries.

Historically, otters occurred over most of Britain and Ireland. However, persecution, habitat loss and, more recently, the impact of toxic organochlorine insecticides caused a marked reduction in the range of the species. In recent years, the majority of the otter population in Britain has been found in Scotland, with a significant proportion of this number being found in the north and west of the country, and Wales. The otter is still scarce over much of England, where the highest concentrations are in the southwest. However, the most recent survey (Crawford, 2003) suggests that the otter population is now recovering well and recolonising parts of its former range.

Ireland has long been considered to hold one of the most important otter populations remaining in Western Europe (Whilde, 1993), and surveys carried out in the early 1980s (Chapman and Chapman, 1982) and again in the early 1990s (Lunnon and Reynolds, 1991) confirmed the species to be widespread throughout the country in freshwater and coastal habitats.

As a result of the widespread decline in populations mentioned above, and the possible continued threats to the species from habitat loss, disturbance and pollution, the otter has been listed on Annex II and Annex IV of the EU Habitats Directive (CEC, 1992) and Appendix II of the Berne Convention (Council of Europe, 1979). It is Red-data book listed as Vulnerable (Whilde, 1993) and fully protected in Ireland under the Wildlife Acts of 1976 and 2000.

Special Areas of Conservation (SACs) are strictly protected sites designated under the EU Habitats Directive. Article 3 of the Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive. Ireland has designated approximately 400 SACs, of which 44 have been designated for the Otter (Appendix 1). In addition to designating SACs, however, Article 11 of the Habitats Directive requires that *'Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2...'* a category that includes the otter.

Between 1977 and 1979, systematic surveys of otter distribution in England, Scotland and Wales were undertaken in order to provide a baseline against which future changes in the otter's distribution could be monitored. Since then, repeat surveys have been carried out at intervals of five to ten years. The methods used (described by Jeffries, in Lenton *et al.*, 1980) were based on earlier work by Erlinge (1967), in Sweden.

At the time of the initial UK surveys, information on the status and distribution of the otter in Ireland was scarce and confusing. As many Irish wetlands were coming under threat from development, and given the dramatic and rapid decline of the otter experienced in Britain and elsewhere in Western Europe, it was decided to extend the baseline survey to Ireland. With funding from the Vincent Wildlife Trust, the first systematic survey of otter distribution in Ireland was carried out between January 1980 and February 1981 (Chapman and Chapman, 1982).

The main findings of the 1980/1981 Otter Survey of Ireland were that otters were widely distributed and recorded in a diverse range of wetland and coastal habitats. Of the 2,373 sites surveyed, signs of otters were recorded at 2,177 (91.7%). There was a significant relationship between pollution and the distribution of otters, with lower percentage occurrence recorded from the more heavily populated eastern half of the country. Viewed within the European context, Irish otter populations were considered to be of international importance. The report concluded by drawing attention to the increasing pressures on Irish wetland and coastal areas, and recommended that further studies and surveys should be carried out to monitor any changes in status that may occur (Chapman and Chapman, 1982).

Ten years later (1990/1991), Lunnon and Reynolds (1991) undertook a partial resurvey. Using essentially the same techniques, they revisited sites in approximately 12% of the area previously covered by Chapman and Chapman and reported only a slight decrease in the percentage occurrence of otters (down 3% from 92.2% to 89.5% in the 268 sites). Analysis of the data once again indicated a significant relationship between pollution and otter distribution, with bank side cover also showing up as important in a more intensive survey in the Dublin area. Overall it was concluded that no significant change in otter distribution had occurred over the past decade in the areas surveyed.

In Northern Ireland, Preston *et al.* (2004) carried out a resurvey in 2000/2001 of 181 of the sites originally surveyed by Chapman and Chapman in 1980/1981, and reported a significant decrease of almost 10% in the percentage occurrence of otters (down from 72.4% to 62.5% in the 181 sites). In addition to the resurvey, Preston *et al.* expanded the coverage of the survey by adding a further 441 sites to the baseline, bringing the total to 622. Percentage otter occurrence at these new sites was 65.08% - broadly in line with the findings of the resurvey, but lower than that found in a more intensive survey of the Upper Lough Erne SAC in 2000 (71%) (Preston *et al.,* 2004).

Two further small-scale regional surveys in 2000 also reported an apparent decline in percentage occurrence of otters. In three Hydrometric Areas in the East of Ireland, Hamilton and Rochford (2000) found evidence of otters at 176 of 273 sites (64.47%), while Chapman and Chapman (1982) had reported 84.02% in the same general area 20 years earlier. Meanwhile, in the Galway Bay area of the West, Springer (2000) recorded a significant decrease of 15.7% (down from 93.1% to 77.5% in the 102 sites) over the same period. Clearly change was taking place.

In light of the commitment to monitor the conservation status of the otter, and given the apparent regional declines noted above, the National Parks and Wildlife Service commissioned this current survey in 2004. The purpose was three-fold:

(a) to resurvey the same sample of 10km squares last surveyed in 1990/1991, seeking to establish any trends in the status of the otter over the past 15 to 25 years,
(b) to extend the survey to take in the 44 SACs recently selected and designated for otters, seeking to establish/confirm the status of the species in these areas, and
(c) to further broaden the baseline for future monitoring activities.

Fieldwork commenced in August 2004 and the survey was essentially completed by the end of August 2005.

2. Methods

2.1. Survey Method

Positive site on River Slaney at Aghade Bridge (S858682) – 25 Nov 2004 – M.Bailey

This survey, like its predecessors (Chapman and Chapman, 1982; Lunnon and Reynolds, 1991) and those conducted since 1977 in England, Scotland, Wales and Northern Ireland, is based on the detection of signs of otter presence or absence at selected sites. The 'Standard Otter Survey' method, developed by Jefferies and adopted by Lenton *et al.* (1980) (see Box below) was used with slight modification.

Summary of Standard Otter Survey Method developed by Jefferies
(from Lenton et al., 1980)

(a) sites are selected at intervals of about 5-8km along river systems, coasts or lake shores, at bridges or other convenient access points.
(b) a survey is carried out for spraints (but other signs, such as footprints, fish remains, slides, etc. are also recorded) over a distance of 600m along the bank.
(c) as soon as one spraint is found a site can be recorded as positive – otherwise the complete 600m stretch should be searched.
(d) at each site a map is drawn, and photographs taken to aid relocation, while habitat variables (both aquatic and terrestrial), pollution and disturbance levels are recorded.

A standard survey form, together with sketch map and digital photographs, was completed for each site (Appendix 2) and a representative sample of all spraints found was collected, labeled, frozen and stored for later dietary analysis.

Some workers have advocated surveying the entire 600m stretch in all cases, recording the number of spraints found, and using this number to estimate relative otter densities. While Strachan and Jefferies (1996) provide some evidence to support such a relationship, it is not generally considered to be strong, and the approach has been discontinued in the most recent surveys (*e.g.* Crawford, 2003). In this survey a minimum distance of 100m was covered at all sites, and the number of spraints and other otter signs found was counted.

2.2. Site Selection and Identification

In the absence of original data from the 1990/1991 survey, initial site selection was based on the original Chapman and Chapman (1982) database, as extracted by *Quercus*, and GIS-based information on the extent of otter-designated SACs (Figure 2.1).

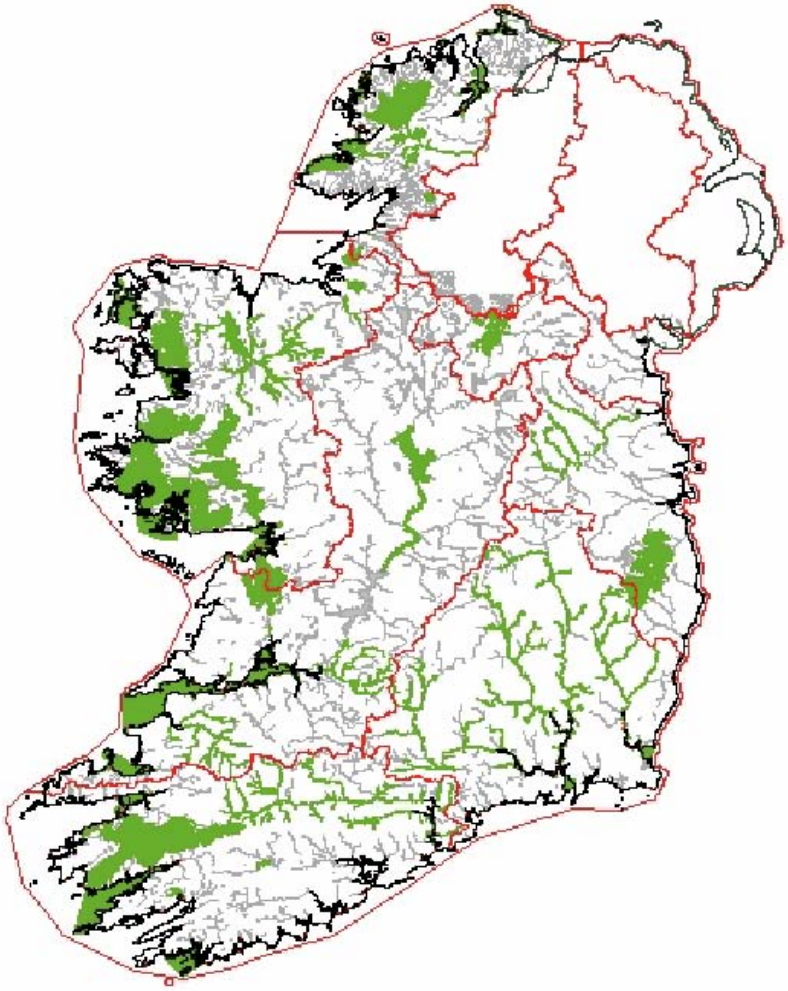

Figure 2.1. *Map of Ireland showing the location of the 44 SACs designated for Otters (green) in relation to the outline of the River Basin Districts (red).*

On the basis of this information, over 400 10km squares of the National Grid, containing almost 500 sites to be surveyed were identified. When it came to selecting sites within 10km squares containing SACs, and where no original Chapman and Chapman sites were available, sites used by the Environmental Protection Agency (EPA) for routine water quality monitoring were identified, and one of these was selected at random as the Otter survey site for that 10km square, using the EPA Water Quality Webmapper Interactive Map site and ArcGIS9.

Linking otter survey/monitoring sites with EPA water quality monitoring sites allows for a more objective investigation into possible links between water quality and otter distribution than that based solely on a visual assessment of water quality at the time of the survey.

Completed survey forms were returned from a total of 525 sites in 433 10km squares (Figure 2.2)

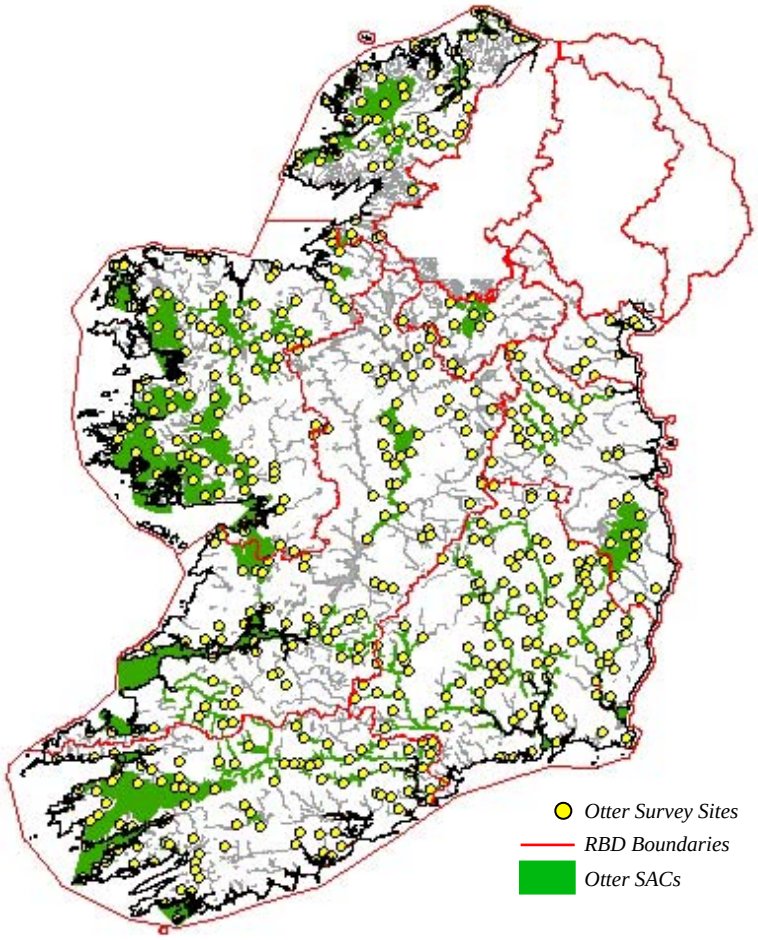

Figure 2.2. *Map of Ireland showing the coverage obtained during the Otter Survey of Ireland 2004/2005 in relation to the River Basin District boundaries and the 44 SACs designated for Otters.*

2.3. Manpower and Coverage

Lenton *et al.* (1980) recommended that surveys should be carried out using the smallest possible number of surveyors to give greater consistency because of the technical skills required. For that reason most of the early surveys in England, Scotland and Wales were undertaken by one or two individuals. With the recent availability of well-trained and experienced surveyors, however, it is now possible to employ larger teams to carry out the work – the 2000/2002 Otter Survey of England (Crawford, 2003) was carried out by 25 surveyors covering from 12 to 595 sites each.

The 1980/1981 survey of Ireland was carried out by only two individuals (Chapman and Chapman, 1982). In 1990/1991, however, Lunnon and Reynolds (1991) used a wide range of volunteers and NPWS staff with varying degrees of training and experience, in addition to the senior author, to carry out the work. As a result of this, there may be some variability in the data.

Initially it was intended to carry out all of this survey using a small team made up of the senior author and one or two part-time field assistants, with some field support being provided by NPW Conservation Rangers. Phase 1 of the project (August to October 2004) concentrated on the East and Southeast of the country, with survey work being carried out on the River Boyne and River Blackwater (SAC No. 2299), the River Barrow and River Nore (SAC No. 2162), the Slaney River Valley (SAC No. 0781) and in the Wicklow Mountains (SAC No. 2122).

Early on, however, it was agreed to involve the Conservation Rangers in the survey on a more formal basis, and in March 2005, two training workshops were held in Nenagh and Carrick-on-Shannon, attended by 15 District Conservation Officers and many of their Rangers from the South, West and Northwest of the country. Following the workshops, almost 350 sites were identified, and their details, together with survey forms, were distributed to NPWS staff. Subsequently a further 200 non-SAC sites were identified and assigned in the same way. The new target, set to ensure extensive coverage of the country, was in the order of 700 to 750 sites.

A total of 47 NPW staff completed some 230 surveys (varying from 1 to 19 sites). The remaining sites were surveyed by the senior author, with the assistance of field assistants. A full list of all the surveyors who participated is included in Appendix 3.

2.4. Data Management and Analysis

All survey data were collated into a centralised database (MS Access 2003) and explored using MS Excel 2003 prior to analysis. Maps were produced using DMAP(Version 7.2e) and ArcGIS (Version 9.1).

All tests were carried out in SPSS Version 12.0 (SPSS Inc., Chicago, IL). Spatial and temporal differences between and within surveys were tested using χ^2 and non-parametric Mann-Whitney *U* tests, while Spearman's rank-order correlation was used to explore relationships between variables. The χ^2 test was further used for testing differences in otter occurrence across habitat and human impact variables. Finally, forced entry logistic regression analysis was used to explore the habitat characteristics associated with otter occurrence. Statistical significance was set at 0.05 in all cases.

3. Results

3.1. Distribution and Status of Otter in 2004/2005

Positive site on the King's River (O036024) – 15 Sept 2004 – M.Bailey

A total of 525 sites were included in the 2004/2005 survey, distributed widely across the country, although concentrated in areas where Special Areas of Conservation (SACs) have been designated for the species. Of these sites, 147 had been initially selected by Chapman and Chapman and included in the survey of 1980/1981, while the remaining 378 were first visited in 2004/2005. Positive signs of otter activity were recorded at 370 (70.48%) of the 525 sites (Figure 3.1).

The 525 sites surveyed were spread across 435 of the approximately 840 10km national grid squares that cover the Republic of Ireland (including all offshore islands), representing 51.79% coverage. Signs of otters were found in 323 (74.25%) of these squares. The map (Figure 3.2), produced from these data, shows the minimum distribution of the otter in Ireland during 2004/2005. In most cases the symbols represent the results of a single survey visit to no more than one or two sites within the 10km square. Some of these visits undoubtedly produced 'false negative' results. In addition, casual and anecdotal records of otter occurrence obtained during the study period, are not shown.

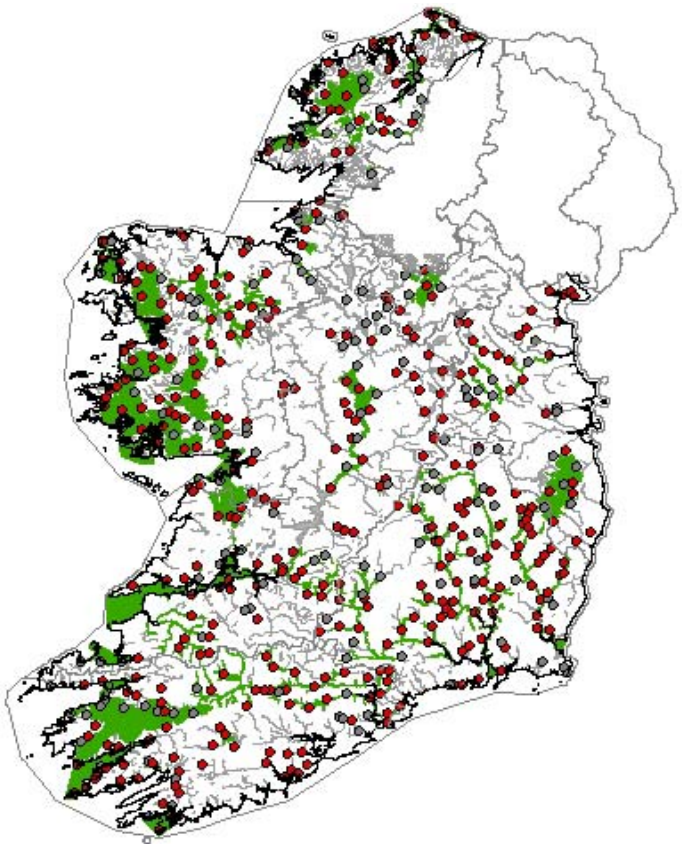

Figure 3.1. *Distribution of all sites surveyed in 2004/2005 for signs of Otter activity throughout the country. Positive sites are shown by solid red circles; negative sites by grey circles. The location of the 44 SACs designated for otters is shown in green.*

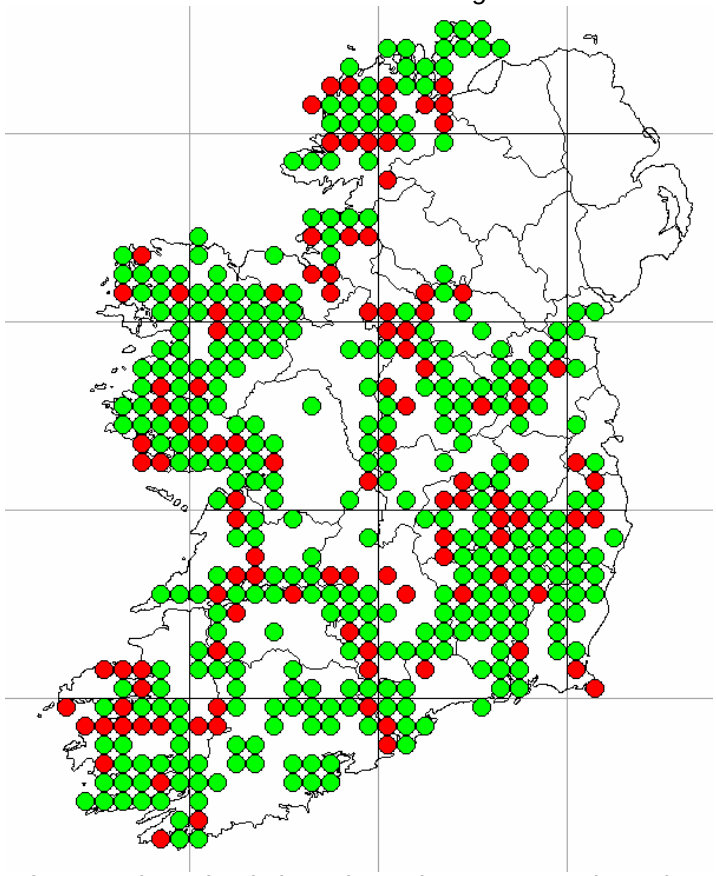

Figure 3.2. *Distribution of Otters in Ireland, based on the presence (green) or absence (red) of Otter signs at sites in 10km squares during the 2004/2005 survey. 10km squares not surveyed are left blank.*

3.2 Overall Comparison with Previous Surveys

In their initial survey of Otter distribution in Ireland in 1980/1981, Chapman and Chapman (1982) surveyed a total of 2,373 sites spread across 447 10km squares covering approximately half of the island, as shown in Figure 3.3. In 1990/1991, Lunnon and Reynolds (1991) subsampled these original sites, covering a total of 268 sites in 33 10km squares – 11.29% of the original sample.

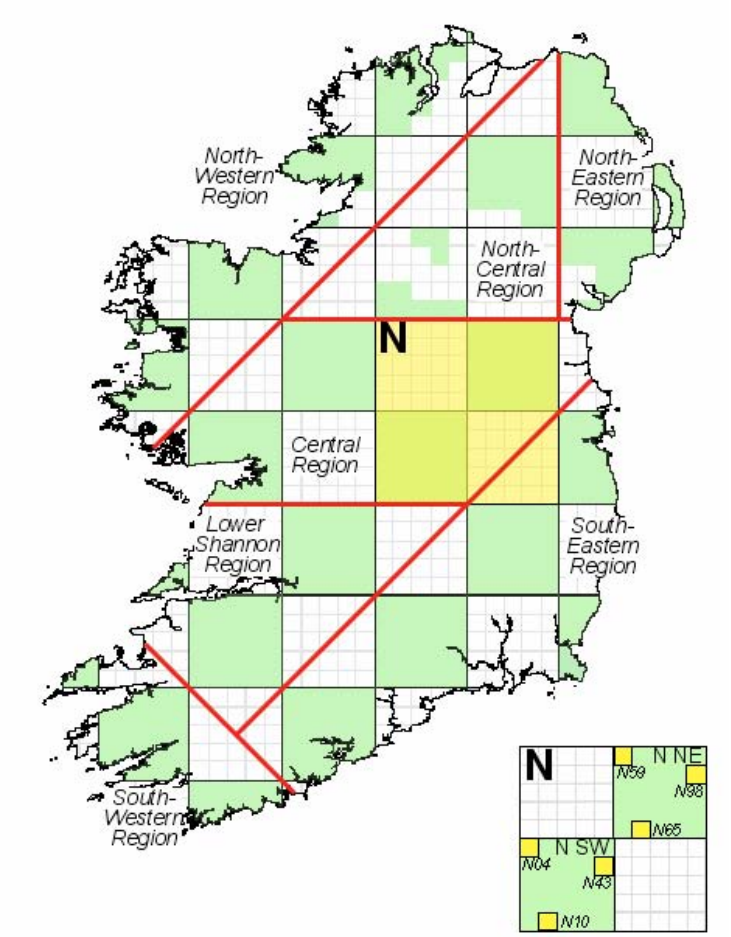

Figure 3.3. *Map of Ireland showing the alternate 50km squares (green) initially surveyed by Chapman and Chapman (1982), and the distribution of the six 10km squares (yellow) subsampled from each 100km square by Lunnon and Reynolds (1991). Regional boundaries used in these surveys are shown in red.*

In the 2004/2005, 147 of the sites originally visited by Chapman and Chapman were resurveyed, of which 124 were also included in the Lunnon and Reynolds subsample

A Note on Oversurveying

Ideally, when surveying animal populations, both accuracy (a measure of bias error) and precision (a measure of sampling error) should be maximised. In practice, however, there is inevitably some trade-off between the two parameters. When it comes to routine monitoring, to

detect spatial variation and temporal change, consistent high precision is essential, with accuracy of lesser importance. High precision is obtained by rigid standardisation of survey methods, sampling in the most efficient manner, and taking a large sample (Sinclair, et al., 2006). The Standard Otter Survey method, adopted by Lenton et al. (1980), and used as the basis for all subsequent otter surveys in Britain and Ireland, is an example of just such a high precision approach.

Use of the Standard Otter Survey method results in the misclassification of some sites in relation to otter activity. These are generally in the form of 'false-negatives' – sites were otter activity occurs, but is not detected by the strict application of the survey method. Given the nature of the evidence used for site classification, the occurrence of 'false-positives' is deemed highly unlikely. Overall results, therefore, represent minimum levels of otter activity, but allow for the detection of spatial and temporal trends.

In order to increase the accuracy of their surveys, both Chapman and Chapman (1982) and Lunnon and Reynolds (1991) reported some departure from the Standard Otter Survey method where the initial findings were negative. This involved 'overdistance' surveying' (extending the length of bank/shore surveyed beyond 600m) and/or 'resurveying' (making a repeat visit to a site at a later date). Chapman and Chapman (1982) resurveyed 155 of their 2,373 sites (6.53%), adding a further 104 positive records – contributing 4.4% to the overall result. Lunnon and Reynolds (1991) reported that resurveys contributed 13.1% to their overall result.

Before making any comparisons between the present survey and these earlier surveys, it was necessary to return to the original 1980/81 and 1990/91 survey data and to correct these for the effects of oversurveying. Sites, which were returned as positive only as a result of such oversurveying were recoded as negative. Corrected results for Chapman and Chapman (1982) and Lunnon and Reynolds (1991) are shown in Table 3.1.

Table 3.1. *Results for Ireland and the Republic of Ireland only, from the 1980/81 (Chapman and Chapman, 1982) and 1990/91 (Lunnon and Reynolds, 1991) otter surveys, corrected for the effects of oversurveying.*

	n	Original results			Corrected results		
		+ive	-ive	% occurrence	+ive	-ive	% occurrence
Ireland							
1980/81	2,373	2,177	196	*91.74*	2,073	300	***87.36***
1990/91	268	240	28	*89.55*	205	63	***76.49***
Republic of Ireland only							
1980/81	2,042	1,888	154	*92.46*	1,801	241	***88.20***
1990/91	246	221	25	*89.84*	185	61	***75.20***

Change in Status

A comparison of the 2004/2005 results with the corrected figures from 1980/1981 and 1990/1991 (Table 3.2) shows a significant overall decline in percentage occurrence of otters nationwide of 17.72% or 0.74% per annum over 24 years (χ^2 = 156.76, d.f. = 1, p <0.001). The bulk of this decline, however, appears to have taken place during the first 10 years (13% overall; 1.30% per annum), with the decline since 1990/1991 only moderately significant at 4.72%, or 0.34% per annum (χ^2 = 6.04, d.f. = 1, p = 0.014)

Table 3.2. *Comparison of results from the three otter surveys of Ireland (corrected data for the Republic of Ireland only, as extracted from the original databases, has been used for the 1980/1981 Chapman and Chapman, and 1990/1991 Lunnon and Reynolds surveys).*

	n	+ive	-ive	% occ.	Change since 1980/81 *(%)*	Rate *(% pa)*	Change since 1990/91 *(%)*	Rate *(% pa)*
1980/81	2,042	1,801	241	***88.20***				
1990/91	246	185	61	***75.20***	13.00 ***	1.30		
2004/05	525	370	155	***70.48***	17.72 ***	0.74	4.72 *	0.34

*(n.s. – not significant, * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001)*

3.3. Regional Variation in Distribution and Status

For analytical purposes, Chapman and Chapman (1982) divided Ireland up into seven broad geographical regions (see Figure 3.3), each containing from approximately 200 to 500 sites. Lunnon and Reynolds (1991), who subsampled from within these sites, reported their data from the same regions. However, while satisfactory as a means for dividing up grid-based samples, these regions have absolutely no biogeographical or hydrological justification, and many of the catchments and Special Areas of Conservation (SACs), which form the basis of this current survey, fall across these divides. Hence, the use of an alternative and more appropriate set of regional subdivisions was deemed justifiable.

Since the adoption of the European Water Framework Directive (EP and CEU, 2000), which came into force in 2000 and is now incorporated into Irish legislation (Minister for the Environment, Heritage and Local Government, 2003), the island of Ireland has been divided for water management purposes into a series of eight River Basin Districts (RBDs), based for the most part on the existing Hydrometric Areas. Figure 3.4 shows the distribution of these RBDs (one of the eight lies wholly in Northern Ireland while three others are International River Basin Districts – IRBDs).

As Otters are essentially aquatic animals, whose conservation status is, to a considerable extent, dependent on the quality of the freshwater

environment, and as the majority of the 44 Special Areas of Conservation (SACs) designated for Otters fall within river catchments or Hydrometric Areas, it seems appropriate to use RBDs as the basis for monitoring and reporting on Otter distribution in the future. For this reason, we also report on the 2004/2005 data on the basis of RBDs, using the earlier Chapman and Chapman regions only when making direct comparisons with data from the earlier studies.

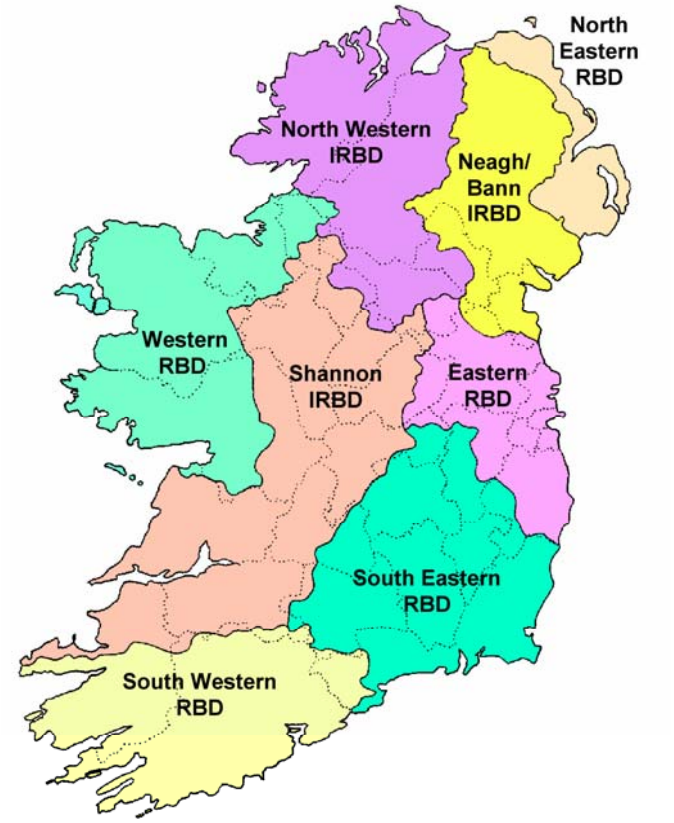

Figure 3.4. *Map of Ireland showing the eight River Basin Districts established as a result of the Water Framework Directive, and used as the basis for dividing up the country in this study (see Section 3.4). Large parts of the North Western and Neagh/Bann districts and a tiny portion of the headwaters of the Shannon lie within Northern Ireland (hence International River Basin Districts – IRBD), as does all of the North Eastern RBD.*

When the 2004/2005 survey data are analysed with respect to River Basin District (and ignoring the very small number of sites located in the Neagh/Bann IRBD), the highest percentage occurrence of Otters was found in the South Western (74.47%) and South Eastern (72.97%) RBDs. Perhaps not surprisingly, the Eastern RBD, which comprises the catchments of the Boyne, Liffey, Avoca and Nanny, and is the most highly urbanised and populated RBD in the country, had the lowest percentage occurrence of Otters at 59.50%. The differences between the various RBDs is, however, not significant ($\chi^2 = 4.24$, $p = 0.516$, d.f. = 5). A full breakdown of the data by RBD is given in Table 3.3 and Figure 3.5.

Table 3.3. *Number of sites within each River Basin District, surveyed in 2004/2005, showing the percentage occurrence of Otters.*

RBD	n	+ive	-ive	% occurrence
Eastern	37	22	15	**59.50**
South Eastern	111	81	30	**72.97**
South Western	94	70	24	**74.47**
Shannon	95	67	28	**70.53**
Western	114	80	36	**70.18**
North Western	65	42	23	**64.61**
Neagh/Bann	*9*	*8*	*1*	***88.89***
All	525	370	155	**70.48**

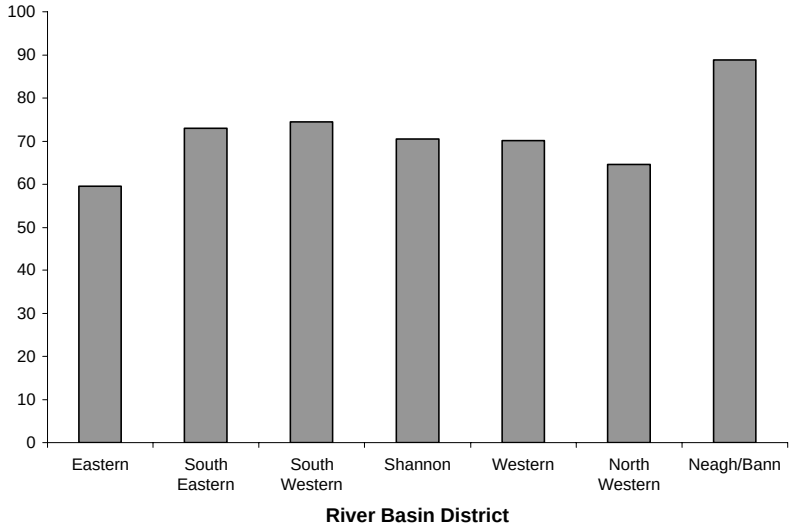

Figure 3.9. *Percentage occurrence of Otters within each River Basin District, surveyed in 2004/2005.*

3.4. Factors Influencing Otter Occurrence

Habitat Type

While a wide variety of habitats were sampled in both fresh and salt waters, the majority of sites (462 – 88.00%) were located on running waters or canals, with 29 (5.52%) on lakes, tarns or reservoirs, and the remaining 34 (6.48%) on the sea-coast or estuaries. When the data were analysed with respect to these broad habitat types, the highest percentage occurrence of otters was on running waters, with the lowest percentage occurrence at sites along the coast (Table 3.4, Figure 3.6). These differences, however, were not significant ($\chi^2 = 1.007$, $p = 0.604$, d.f. = 2)

Table 3.4. *Number of sites within broad habitat types surveyed in 2004/2005, showing the percentage occurrence of otters.*

Habitat Type	n	+ive	-ive	% occurrence
Running Water/Canal	462	329	133	**71.21**
Lake/Tarn/Reservoir	29	19	10	**65.52**
Sea Coast/Estuary	34	22	12	**64.71**

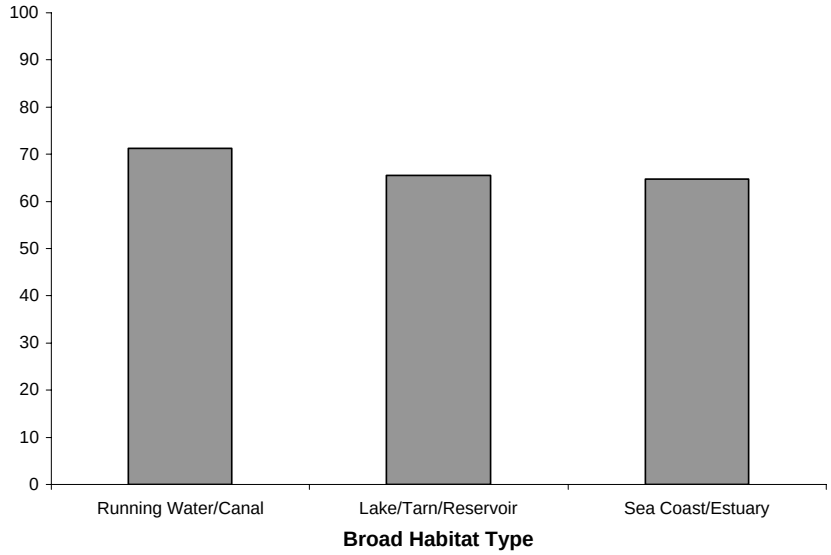

Figure 3.6. *Percentage occurrence of otters within broad habitat types surveyed in 2004/2005.*

Habitat Variables - Physical

Among the 'Running Water' sites, otter occurrence varied significantly with both altitude ($Z = 2.257$, $p = 0.024$) and channel width ($\chi^2 = 11.210$, $p = 0.004$, d.f. = 2), but not, however, with mean water depth ($\chi^2 = 0.062$, $p = 0.969$, d.f. = 2) or current ($\chi^2 = 2.999$, $p = 0.224$, d.f. = 2) (Tables 3.5 to 3.8, Figures 3.7 to 3.8). The highest percentage occurrence of otters was found at sites on larger rivers, with a significantly lower incidence of otters on streams less than 2m wide, while, similarly, otters were more frequent at sites below 100m OD (75.22%) than at higher altitudes (65.48%). These two variables are not necessarily independent, as, while narrow streams may be found at low altitude, there is nevertheless a general negative correlation, albeit weak, between altitude and channel width ($r_s = 0.208$, $p \leq 0.01$).

Table 3.5. *The percentage occurrence of otters at 'Running Freshwater' sites above and below 100m OD surveyed in 2004/2005.*

Altitude	n	+ive	-ive	% occurrence
<100m	339	255	84	**75.22**
≥100m	84	55	29	**65.48**

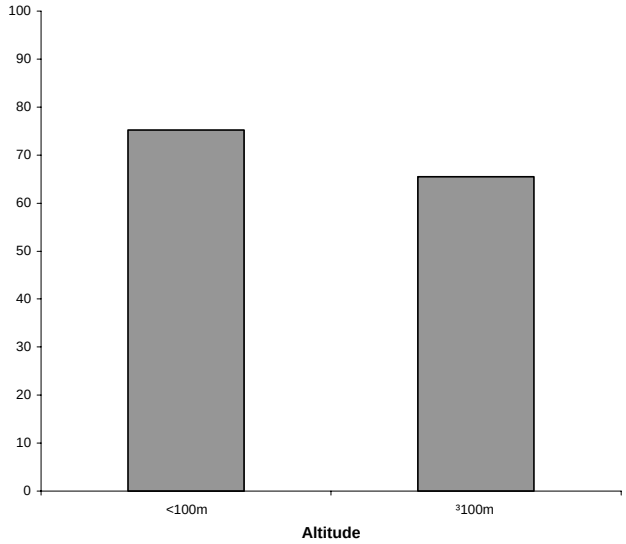

Figure 3.7. *The percentage occurrence of otters at 'Running Freshwater' sites above and below 100m OD surveyed in 2004/2005.*

Table 3.6. *The percentage occurrence of otters at 'Running Freshwater' sites surveyed in 2004/2005 in each of three channel-width categories.*

Channel Width	n	+ive	-ive	% occurrence
<2m	76	42	34	**55.26**
2-10m	292	216	76	**73.97**
≥10m	89	67	22	**75.28**

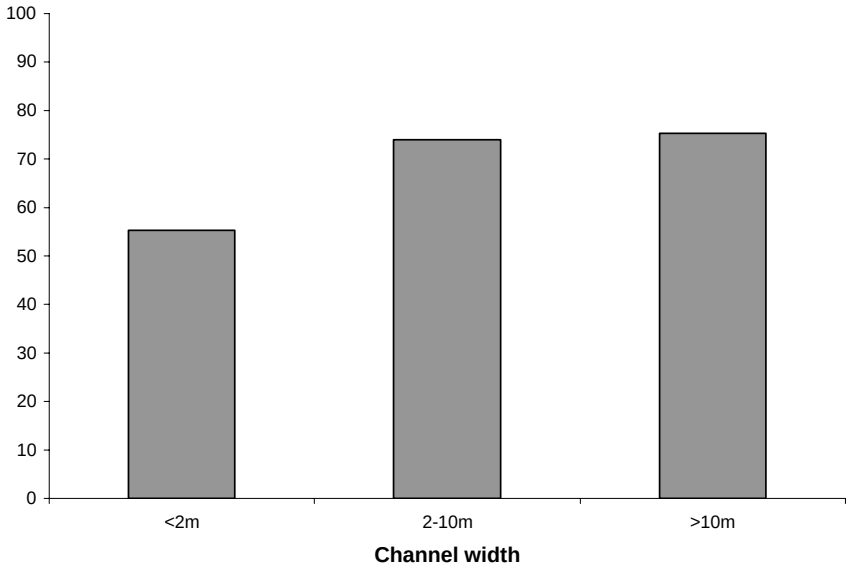

Figure 3.8. *The percentage occurrence of otters at 'Running Freshwater' sites surveyed in 2004/2005 in each of three channel-width categories.*

Table 3.7. *The percentage occurrence of otters at 'Running Freshwater' sites surveyed in 2004/2005 in each of three mean water depth categories*

Mean Water Depth	n	+ive	-ive	% occurrence
<0.5m	187	134	53	**71.66**
0.5-1m	180	127	53	**70.56**
>1m	81	58	23	**71.60**

Table 3.8. *The percentage occurrence of otters at 'Running Freshwater' sites surveyed in 2004/2005 in each of three current categories*

Current	n	+ive	-ive	% occurrence
Rapid/Fast	257	190	67	**73.93**
Slow	159	105	54	**66.04**
Sluggish/Static	43	31	12	**72.09**

A number of bank structure variables – bank type (predominantly earth or rock), bank height and bank slope (< or >45°) – were also recorded for each site. There was no significant difference for any of these variables between sites that were positive or negative for signs of otter activity. Likewise, predominant bed type was not significantly related to otter occurrence.

Habitat Variables - Biological

In-stream vegetation may reflect productivity of the aquatic environment, and hence ultimate prey availability, although in extreme cases it may indicate eutrophication and possible organic pollution. Four separate categories of in-stream vegetation were recorded at all sites, with considerable overlap between them. For analytical purposes all categories were combined, and there was a significant difference in the percentage occurrence of otter signs at sites with and without in-stream vegetation ($\chi^2 = 8.07$, $p = 0.0045$, d.f. = 1) (Table 3.9).

Table 3.9. *The percentage occurrence of otters at sites with and without in-stream vegetation (all types) surveyed in 2004/2005.*

In-stream Vegetation	n	+ive	-ive	% occurrence
Present	234	177	57	**75.64**
Absent	228	152	76	**66.67**

A number of early studies of habitat requirements of the otter sought to establish links between specific aspects of the riparian environment with the presence or absence of otter activity in an area (Macdonald and Mason 1983; O'Sullivan 1993). These included the presence of riparian trees, and the nature and use of the adjoining terrestrial habitats. In this survey, land adjoining the survey sites was divided into three zones – 0-5m from the water (riparian); 5-15m; >15m (bordering land) – and

vegetation and land use was recorded in each. However, when viewed individually, none of the variables (presence/absence of trees or shrubs; vegetation density; habitat classification; land use) were in any way related to the presence or absence of otter activity.

Distribution and Spread of American Mink

During the 2004/2005 survey, recorders were asked to note any signs of American mink *Mustela vison* present in the survey areas, although they were not specifically asked to search for them. As a result, the species is likely to have been under-recorded, especially at sites where signs of otter were detected relatively early on in the survey process. Mink were reported as being present at only 80 out of the 525 sites surveyed (15.24%) (Figure 3.9a). While there was a slightly greater percentage occurrence of otters at sites also containing mink (72.50% to 69.89%), this was not significant (χ^2 = 0.200, p = 0.655, d.f. = 1) (Table 3.10).

Signs of mink were similarly recorded during the 1980/1981 survey (Chapman and Chapman, 1982), and, while neither survey is definitive, an examination of the distribution of records from the two periods (Figure 3.9b) gives some indication of the spread of the species into the west and southwest of the country over the past 25 years.

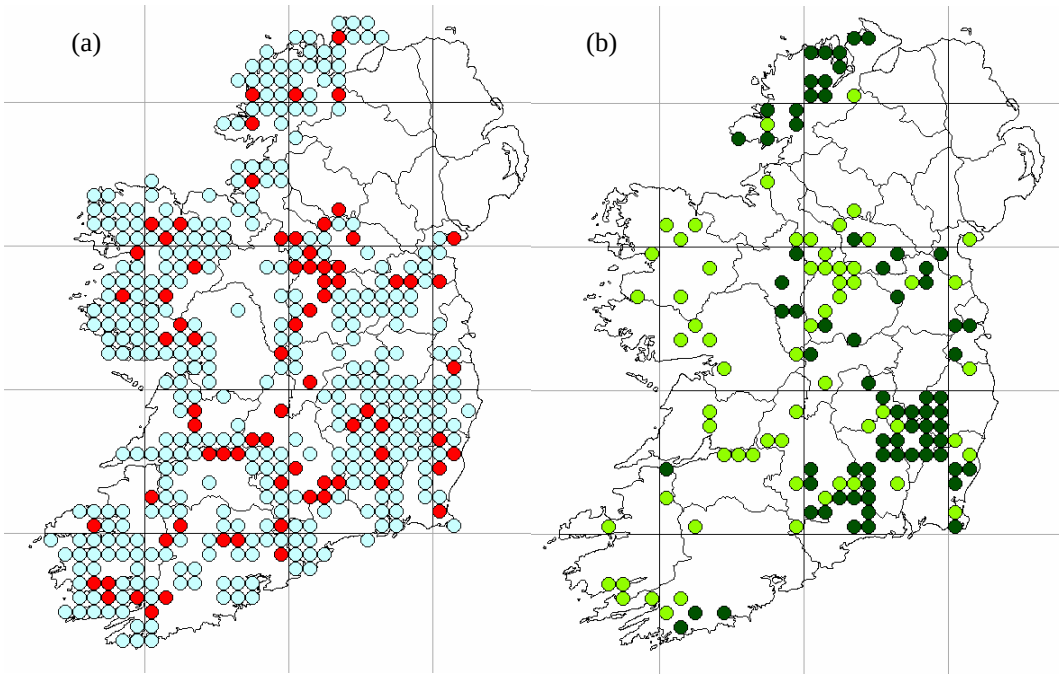

Figure 3.9. *(a) Distribution of mink in Ireland, recorded during the 2004/2005 otter survey. 10km squares surveyed are shown in blue, and those where mink were recorded are shown in red. (b) Spread of mink in Ireland over the last 25 years. 10km squares in which mink were present in 1980/1981 are shown in dark green, while those in light green show the additional distribution in 2004/2005.*

Table 3.10. *The percentage occurrence of otters at sites with and without Mink, surveyed in 2004/2005.*

Mink	n	+ive	-ive	% occurrence
Present	76	56	20	**73.68**
Absent	386	273	113	**70.73**

Pollution

Both Chapman and Chapman (1982) and Lunnon and Reynolds (1991) carried out a visual assessment of the degree of pollution at each site surveyed, and found a significant relationship between levels of pollution observed and signs of otter occurrence. In the present survey, all new running freshwater sites were chosen to coincide with EPA monitoring sites at which water quality is regularly assessed. Latest Biotic Index or Q values were obtained for 304 of these sites from Toner *et al.* (2005) and the online interim reports of the EPA (see - www.epa.ie/OurEnvironment/Water/Rivers/RiverWaterQualityReports/2004Report/). These Q values were classified according to pollution status (see Toner *et al.,* 2005, for a description of Q values and quality classes) and sites were analysed for presence or absence of otter signs (Table 3.11 and Figure 3.10). No significant difference was found between polluted and unpolluted sites (χ^2 = 3.123, p = 0.2098, d.f. = 2), although the data appeared to show a slight preference for slightly polluted sites over both extremes.

Table 3.11. *The percentage occurrence of otters at sites surveyed in 2004/2005, grouped according to EPA quality class. (Water quality data from 2001-2003 survey, updated where possible to 2004).*

Quality Class	A	B	C/D
Q Values	5 - 4	3.5	3 - 1
Pollution Status	Unpolluted	Slight Pollution	Moderate - Gross Pollution
No. Sites	194	65	45
Otters present	133	52	32
Otters absent	61	13	13
% occurrence	**68.56**	**80.00**	**71.11**

.

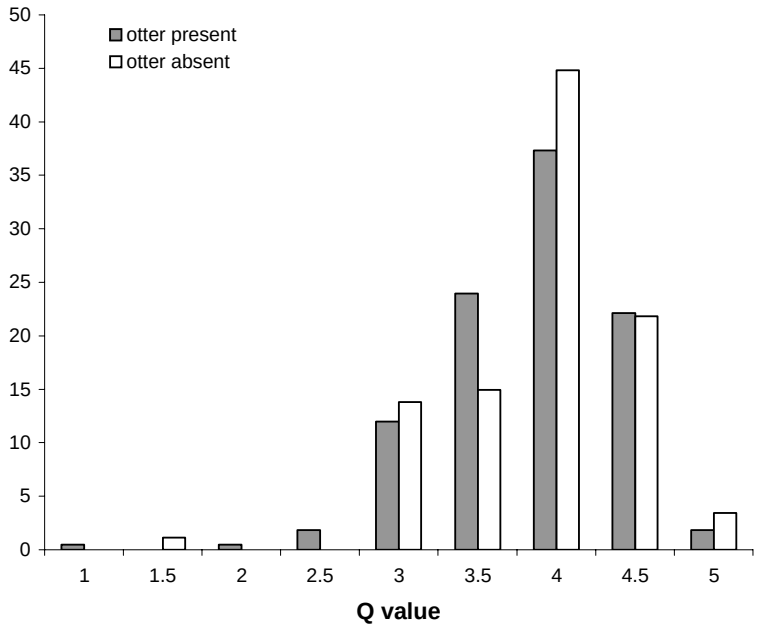

Figure 3.10. *Histogram of percentage frequency distribution for Q values at sites classed as positive (n = 217) and negative (n = 87) for otters in the 2004/2005 survey.*

Other Human Impacts

Disturbance at the survey sites was assessed in a number of different ways, which, despite attempts to standardise scoring, proved to be rather subjective. Potential human disturbance at sites was scored on a scale from 0 (remote, with no obvious signs of human activity) to 3 (built-up areas), with most sites being classified as intermediate. While there was no significant relationship observed between disturbance and otter occurrence, when looking at all sites or running freshwater sites only (χ^2 = 2.838, p = 0.4171, d.f. = 3 and χ^2 = 2.501, p = 0.4751, d.f. = 3 respectively – Table 3.12), it is interesting to note that the lowest percentage occurrence was found at the sites with the lowest recorded disturbance! In the case of running freshwater sites this is likely to have been connected to lower disturbance at high altitude/narrow channel width sites, but this relationship has not been tested.

Table 3.12. *The percentage occurrence of otters at sites surveyed in 2004/2005, grouped according to EPA quality class. (Water quality data from 2001-2003 survey, updated where possible to 2004).*

	All sites				Running Freshwater sites only			
Human Activity Score	n	+ive	-ive	% occ.	n	+ive	-ive	% occ.
0	39	23	16	**58.97**	33	20	13	**60.61**
1	248	179	69	**72.18**	221	158	63	**71.49**
2	197	139	58	**70.56**	174	126	48	**72.41**
3	28	20	8	**71.43**	23	18	5	**78.26**

A number of recreational activities, with the potential for causing disturbance to otters, were also recorded at various sites, but all were infrequent with the exception of bank angling and/or shooting which occurred at 134 (29%) of 463 running freshwater sites surveyed. No significant difference in otter presence was found between sites with and without recreational activity (χ^2 = 1.370, p = 0.2418, d.f. = 1 for bank angling/shooting and χ^2 = 1.350, p = 0.2453, d.f. = 31 for all recreational activity respectively – Table 3.13).

Table 3.13. *The percentage occurrence of otters at sites with and without recreational activities, surveyed in 2004/2005.*

Recreational Activity	n	+ive	-ive	% occurrence
Bank Angling/Shooting only				
Present	134	100	34	**74.63**
Absent	329	229	100	**69.60**
All Recreational Activity				
Present	141	105	36	**74.47**
Absent	322	224	98	**69.57**

During the 1980/1981 survey Chapman and Chapman recorded human disturbance at sites using a somewhat similar scale – from 0 (no disturbance) to 5 (high disturbance) in intervals of 0.5 – and they too found no significant relationship. Although both measures of human disturbance were subjective and not directly comparable (and neither proved significant), it is, nevertheless, apparent that there has been an increase in the overall level of disturbance at sites over time. Grouping sites into two categories – undisturbed (1980/1981 classes 0 – 2.5; 2004/2005 classes 0 – 1) and disturbed (1980/1981 classes 3 – 5; 2004/2005 classes 2 – 3) – the percentage in the latter category has increased significantly from 21.66% to 43.68% over the 24 years (χ^2 = 466.8, p ≤ 0.001, d.f. = 1).

In both the 1980/81 and 2004/2005 surveys, banks at the survey sites were recorded as being either 'wild' in appearance, or obviously maintained in some manner – a further indicator of potential disturbance. Once again, the level of bank maintenance had no significant impact on otter occurrence (χ^2 = 1.430, p = 0.2318, d.f. = 1 – Table 3.14), the slightly lower percentage occurrence at the 'wild' sites possibly explained by a higher proportion of high altitude/narrow channel width sites falling into that category. As with human disturbance, however, the level of bank management had increased significantly, from 3.77% to 47.93% over the 24 years (χ^2 = 1593.8, p ≤ 0.001, d.f. = 1).

Table 3.14. *The percentage occurrence of otters at sites classified as being 'wild' or maintained, surveyed in 2004/2005.*

Bank Management	n	+ive	-ive	% occurrence
Wild	239	165	74	**69.04**
Maintainted	220	160	60	**72.73**

Although no direct evidence was available, the possible deliberate disturbance or hunting of otters was reported at 13 (2.48%) of the 525 sites surveyed – 10 of which were, nevertheless, returned as positive for otters.

Special Areas for Conservation

From the start, one of the objectives of the 2004/2005 national survey was to expand the coverage of the earlier surveys so as to incorporate sites from within the 44 SACs designated for otters into a new baseline. 413 of the 525 sites surveyed (including a small number of the original Chapman/Lunnon sites) fall within the selected SACs, and these were compared to non-SAC sites in terms of percentage otter occurrence (Table 3.15). Although there was a very slightly higher occurrence of otters at site not within the SAC, there was no significant difference between the two samples (χ^2 = 1.190, p = 0.2753, d.f. = 1), thereby removing any doubt about the unbiased nature of the sites used in the overall survey.

Table 3.15. *The percentage occurrence of otters at sites within and outside the 44 selected SACs, surveyed in 2004/2005.*

Site Status	n	+ive	-ive	% occurrence
Within otter SACs	413	290	123	**70.22**
Outside otter SACs	112	80	30	**71.43**

3.5. Habitat Requirements for Otters

As with many earlier attempts at determining otter habitat requirements, through seeking relationships between the occurrence of otter spraints and individual physical, biological and anthrophogenic variables at sites, this present survey has been unsuccessful. Otters were found in a wide range of habitats, under different influences, with only altitude and channel width (which proved to be interrelated) seeming to have any significant influence on their occurrence. With so many habitat variables, however, a multivariate approach, similar to that used by Macdonald and Mason (1983), was considered worthwhile. Habitat features, recorded on the survey sheets, were coded into a series of 9 continuous or discrete variables, and a further 37 recorded or derived categorical variables (Table 3.16).

Table 3.16. *Variables used in a multivariate investigation of habitat associates and otter occurrence. (Grouped variables are shown in bold italics).*

Variable No	Type	Variable Name	Range of Values
Dependent Variable			
VAR00001	Categorical	Otter Signs Present (No/Yes)	0/1
Predictor Variables			
VAR00002	Continuous	Altitude (m)	0 – 271
VAR00003	Continuous	Bank Height (m)	0 – 10
VAR00004	Continuous	Mean Depth (m)	1 – 4
VAR00005	Discrete	Latest Q Value (Low → High)	1 – 5
VAR00006	Discrete	Current (Fast → Static)	1 – 6
VAR00007	Discrete	Channel Width (Low → High)	1 – 6
VAR00008	Discrete	(0-5m) Veg.Density (None → High)	0 – 5
VAR00009	Discrete	(5-15m) Veg.Density (None → High)	0 – 5
VAR00010	Discrete	Human Activity (Low → High)	1 – 4
VAR00011	Categorical	Otter designated SAC (No/Yes)	0/1
VAR00012	Categorical	Hab:Running FW (Abs/Pres)	0/1
VAR00013	Categorical	Hab:Still FW (Abs/Pres)	0/1
VAR00014	Categorical	Hab:Marine (Abs/Pres)	0/1
VAR00015	Categorical	Bed:Boulder (Abs/Pres)	0/1
VAR00016	Categorical	Bed:Stone (Abs/Pres)	0/1
VAR00017	Categorical	Bed:Gravel (Abs/Pres)	0/1
VAR00018	Categorical	Bed:Sand (Abs/Pres)	0/1
VAR00019	Categorical	Bed:Silt (Abs/Pres)	0/1
VAR00020	Categorical	Bank Type (Rock/Earth)	0/1
VAR00021	Categorical	Bank Slope (<45º/>45º)	0/1
VAR00022	Categorical	Stream Veg:Emergent (Abs/Pres)	0/1
VAR00023	Categorical	Stream Veg:Float.-Attach. (Abs/Pres)	0/1
VAR00024	Categorical	Stream Veg:Float.-Free (Abs/Pres)	0/1
VAR00025	Categorical	Stream Veg:Submerged (Abs/Pres)	0/1
VAR00026	Categorical	Stream Veg (ALL) (Abs/Pres)	0/1
VAR00027	Categorical	Rip:Trees (Abs/Pres)	0/1
VAR00028	Categorical	Rip:Shrubs (Abs/Pres)	0/1
VAR00029	Categorical	Rip (ALL) (Abs/Pres)	0/1
VAR00030	Categorical	(5-15m) Veg:Trees (Abs/Pres)	0/1
VAR00031	Categorical	(5-15m) Veg:Shrubs (Abs/Pres)	0/1
VAR00032	Categorical	(5-15m) Veg (ALL) (Abs/Pres)	0/1
VAR00033	Categorical	Land:Grassland/Marsh (Abs/Pres)	0/1
VAR00034	Categorical	Land:Heath (Abs/Pres)	0/1
VAR00035	Categorical	Land:Peatland (Abs/Pres)	0/1
VAR00036	Categorical	Land:Woodland/Scrub (Abs/Pres)	0/1
VAR00037	Categorical	Land:Cultivated (Abs/Pres)	0/1
VAR00038	Categorical	Land:Built Land (Abs/Pres)	0/1
VAR00039	Categorical	Land:Coastland (Abs/Pres)	0/1
VAR00040	Categorical	Bank Manage (Wild/Maintained)	0/1
VAR00041	Categorical	Water Abstraction (No/Yes)	0/1
VAR00042	Categorical	Boating (No/Yes)	0/1
VAR00043	Categorical	Bank Fish./Shoot. (No/Yes)	0/1
VAR00044	Categorical	Recreational Activity (ALL) (No/Yes)	0/1
VAR00045	Categorical	Keeper/Reserve (No/Yes)	0/1
VAR00046	Categorical	Mink Present (No/Yes)	0/1
VAR00047	Categorical	Otter Hunting (No/Yes)	0/1

Logistic Regression

Because of the dichotomous categorical nature of the dependent variable (otter occurrence/lack of occurrence) and the large number of categorical predictor variables to be used, (binary) logistic regression, initially using the forced entry method, was chosen as the preferred approach.

A first attempt at developing a model was made using all but the four grouping variables (VAR00026, VAR00029, VAR00032 and VAR00044). Because of missing values for some of the variables, only 222 of the 525 cases could be included in this model. Goodness of fit, while significant, was poor ($p = 0.032$) and the model explained between 22.6% and 32.7% of the variation in the dependent variable. While the model correctly classified 77.0% of all sites, the prediction level was better for positive sites (89.4%) than for negative sites (44.3%). Only 3 variables (Altitude, Bank Height and Emergent Stream Vegetation) contributed significantly to the model, all negatively. There were 9 clear outliers – cases where the model predicted a positive record, but no otter signs were observed (possible false negatives).

A second run was attempted using the same predictor variables with the exception of VAR0005 (Latest Q Value), which was missing for many of the sites, in order to increase the number of cases included. Despite the larger sample size (387), the model generated was even poorer, correctly classifying only 73.4% of sites, and explaining only 13.4% to 19.2% of the variation in the dependent variable. Two further runs, with and without VAR0005, but replacing the individual vegetation and recreational variables (VAR00022-25, VAR00027-28, VAR00030-31 and VAR00042-43) with the four grouping variables, resulted in little change, with slight improvements in some features of the model offset by deterioration elsewhere.

Because of the very different nature of the few still freshwater and marine sites, it was then decided, while retaining the grouping variables and VAR0005 (Latest Q Value), to restrict the model by discarding or grouping those dichotomous categorical variables that were extremely skewed in their distribution (<5% in one category). This reduced the number of cases to 225 and the number of predictor variables to 29, but the model thus developed, (Run 5) while simpler, was still poor.

Finally, accepting that the extreme outliers probably did reflect false negatives (a product of the Standard Otter Survey method, which could be overcome by 'oversurveying' if so required), it was decided to remove a total of 10 cases. Using the same combination of variables as for Run 5 (above) the model was now substantially improved. Goodness of Fit was relatively high (Omnibus Test of Model Coefficients – $\chi^2 = 76.219$, $p = 0.000$, d.f. = 29; Hosmer and Lemeshow Test – $\chi^2 = 9.965$, $p = 0.267$, d.f. = 8), with the model explaining between 29.8% and 44.8% of the variation in the dependent variable. The model correctly classified 80.9% of all sites, and while the

prediction level was better for positive sites (91.5%), it was still moderately good for negative sites (47.1%). Five variables (Altitude, Bank Height, Mean Depth and Riparian (0-5m) Vegetation Density – all negative – and channel width – positive) all contributed significantly to the model, while one further (Bed Type: Silt) was approaching significance. The Odds Ratios, however, are more difficult to interpret, suggesting as they do an increasing likelihood of otter occurrence with SAC designation (despite the apparent lack of any relationship from the overall data), Bed Type: Silt and Bank Angling/Shooting, and a decrease with presence of Built Land and Woodland/Scrub in the environs.

The contribution and importance of the predictor variables to the final model (Run 6) are given in Table 3.17, while summaries for all 6 models are given in Table 3.18.

Table 3.17. *Variables in the Equation for Logistic Regression Model (Run 6) developed to assess the impact of 29 selected habitat (predictor) variables on the occurrence of otter signs at sites*.

	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for Exp(B)	
							Lower	Upper
VAR00002	-0.016	0.005	12.884	1	0.000	0.984	0.975	0.993
VAR00003	-0.625	0.235	7.113	1	0.008	0.535	0.338	0.847
VAR00004	-0.860	0.381	5.105	1	0.024	0.423	0.201	0.892
VAR00005	-0.270	0.368	0.536	1	0.464	0.764	0.371	1.572
VAR00006	0.085	0.310	0.075	1	0.785	1.088	0.593	1.999
VAR00007	0.686	0.317	4.690	1	0.030	1.987	1.067	3.697
VAR00008	-0.584	0.245	5.682	1	0.017	0.557	0.345	0.901
VAR00009	0.427	0.301	2.014	1	0.156	1.532	0.850	2.761
VAR00010	0.449	0.359	1.565	1	0.211	1.566	0.775	3.164
VAR00011(1)	2.052	1.242	2.732	1	0.098	7.784	0.683	88.728
VAR00012(1)	-0.168	0.981	0.029	1	0.864	0.845	0.123	5.787
VAR00015(1)	-0.887	0.702	1.594	1	0.207	0.412	0.104	1.632
VAR00016(1)	0.425	0.573	0.549	1	0.459	1.529	0.498	4.699
VAR00017(1)	-0.620	0.554	1.252	1	0.263	0.538	0.181	1.594
VAR00018(1)	-0.307	0.715	0.184	1	0.668	0.736	0.181	2.989
VAR00019(1)	1.170	0.559	3.811	1	0.051	3.223	0.995	10.434
VAR00020(1)	-0.424	0.538	0.621	1	0.431	0.655	0.228	1.878
VAR00021(1)	-.069	0.510	0.018	1	0.892	0.933	0.344	2.535
VAR00026(1)	-0.090	0.482	0.035	1	0.852	1.094	0.425	2.816
VAR00029(1)	-1.237	0.858	2.075	1	0.150	0.290	0.054	1.562
VAR00032(1)	0.570	0.681	0.701	1	0.403	1.768	0.466	6.714
VAR00033(1)	-0.192	1.196	0.026	1	0.872	0.825	0.079	8.592
VAR00035(1)	-0.725	1.446	0.251	1	0.616	0.485	0.028	8.249
VAR00036(1)	-1.969	1.138	2.991	1	0.084	0.140	0.015	1.300
VAR00038(1)	-20.111	7555.097	0.000	1	0.998	0.000	0.000	.
VAR00040(1)	0.123	0.482	0.065	1	0.799	1.131	0.440	2.909
VAR00041(1)	-0.375	0.739	0.257	1	0.612	0.687	0.162	2.925
VAR00043(1)	1.043	0.607	2.955	1	0.086	2.839	0.864	9.326
VAR00046(1)	-0.134	0.554	0.059	1	0.808	0.874	0.295	2.591
Constant	26.545	7555.098	0.000	1	0.997	3.37E+11		

Table 3.18. *Summary statistics for 6 Logistic Regression Models developed to assess the impact of a set of 46 habitat (predictor) variables on the occurrence of otter signs at sites.*

Run		1	2	3	4	5	6
Cases		222	387	225	391	225	215
Omnibus Tests of Model Coefficients	χ^2	56.950	55.660	42.100	56.983	41.914	76.219
	df	39	39	33	33	29	29
	Sig	0.032	0.041	0.133	0.006	0.057	0.000
Hosmer and Lemeshow Test	χ^2	9.350	10.730	3.483	8.866	7.321	9.965
	df	8	8	8	8	8	8
	Sig	0.314	0.217	0.901	0.354	0.502	0.267
Model Summary	-2 Log likelihood	204.10	406.35	220.86	409.59	221.05	159.35
	Cox & Snell R^2	0.226	0.134	0.171	0.136	0.170	0.298
	Nagelkerke R^2	0.327	0.192	0.248	0.194	0.247	0.448
PAC overall*		77.0	73.4	76.9	74.4	76.4	80.9
Specificity*		44.3	22.7	34.4	23.4	32.8	47.1
Sensitivity*		89.4	93.5	92.7	94.6	92.7	91.5
Positive Predictive Value*		80.9	75.3	79.2	75.7	78.8	84.7
Negative Predictive Value*		61.4	58.11	63.6	63.5	62.5	63.2
Significant Variables	+		VAR 00007		VAR 00007		VAR 00007 (00019)
	-	VAR 00002 00003 00022	VAR 00002 00003	VAR 00002 00003	VAR 00002 00036	VAR 00002 00003	VAR 00002 00003 00004 00008

** PAC overall – Percentage Accuracy of Classification of all sites; Specificity – True negatives (percentage of sites observed to be negative in the survey which the model accurately identified as negative); Sensitivity – True positives (percentage of sites observed to be positive in the survey which the model accurately identified as positive); Positive Predictive Value – percentage of sites predicted by the model as being positive which were actually observed as being positive in the survey); Negative Predictive Value – percentage of sites predicted by the model as being negative which were actually observed as being negative in the survey;*

3.6. Direct Comparison of Sites

In 2004/2005 survey, 147 of the 2,042 sites originally visited by Chapman and Chapman in 1980/1981 were resurveyed, including 124 which were also included in the Lunnon and Reynolds 1990/1991 subsample (see Figure 3.3 and Table 3.1). While the percentage occurrences were somewhat different in these relatively small subsamples from those obtained from the overall survey results (by as much as 7.06% in the case of the subsample of the 1990/1991 data) none of these differences were significant. However, this variation, which saw both the 2004/2005 subsamples producing lower percentage occurrence figures than the overall survey, resulted in greater apparent rates of decline (23.81 - 25.81% since 1980/81; 14.52% since 1990/91) (Table 3.19).

Table 3.19. *Comparison of percentage occurrences and rates of decline calculated from the overall survey results and from the various subsamples of sites included within the three surveys.*

	Overall results				Subsample results			
	n	+ive	-ive	% occ.	n	+ive	-ive	% occ.
Sites included on all three surveys								
1980/81	2,042	1,801	241	88.20	*124*	116	8	93.55
1990/91	246	185	61	75.20	124	102	22	82.26
2004/05	525	370	155	70.48	124	84	40	67.74
Observed change since 1990/91				**-4.72**				**-14.52**
Observed change since 1980/81				**-17.72**				**-25.81**
Sites included in the 1980/81 and current surveys								
1980/81	2,042	1,801	241	88.20	147	136	11	92.52
2004/05	525	370	155	70.48	147	101	46	68.71
Observed change since 1980/81				**-17.72**				**-23.81**

These data are presented below, divided up on the basis of the regions used by Chapman and Chapman (1982) and the River Basin Districts used elsewhere in this report, for comparative purposes only (Tables 3.20 – 3.23, Figures 3.11 – 3.12). Because of the relatively small size of these subsamples, no further analysis of trends was attempted.

Table 3.20. *Change in percentage occurrence over time for the subsample of 124 sites included in all three surveys, shown by regions defined by Chapman and Chapman (1982).*

Region	n	% occ. 1980/81	% occ. 1990/91	% occ. 2004/05	Change % occ. 1980/81 to 1990/91	Change % occ. 1990/91 to 2004/05	Change % occ. 1980/81 to 2004/05
S. Eastern	41	87.80	82.93	68.29	-4.87	-14.64	-19.51
S. Western	10	100.00	80.00	70.00	-20.00	-10.00	-30.00
Lr. Shannon	12	100.00	83.33	75.00	-16.67	-8.33	-25.00
Central	34	97.06	85.29	64.71	-11.77	-20.58	-32.35
N. Western	22	88.89	77.27	63.34	-11.62	-13.63	-25.55
Others*	5	100.00	80.00	80.00	-20.00	0.00	-20.00
All	124	93.55	82.26	67.74	**-11.29**	**-14.52**	**-25.81**

**** Data for the North Central and North East Regions, most of which fall into Northern Ireland, are grouped together.***

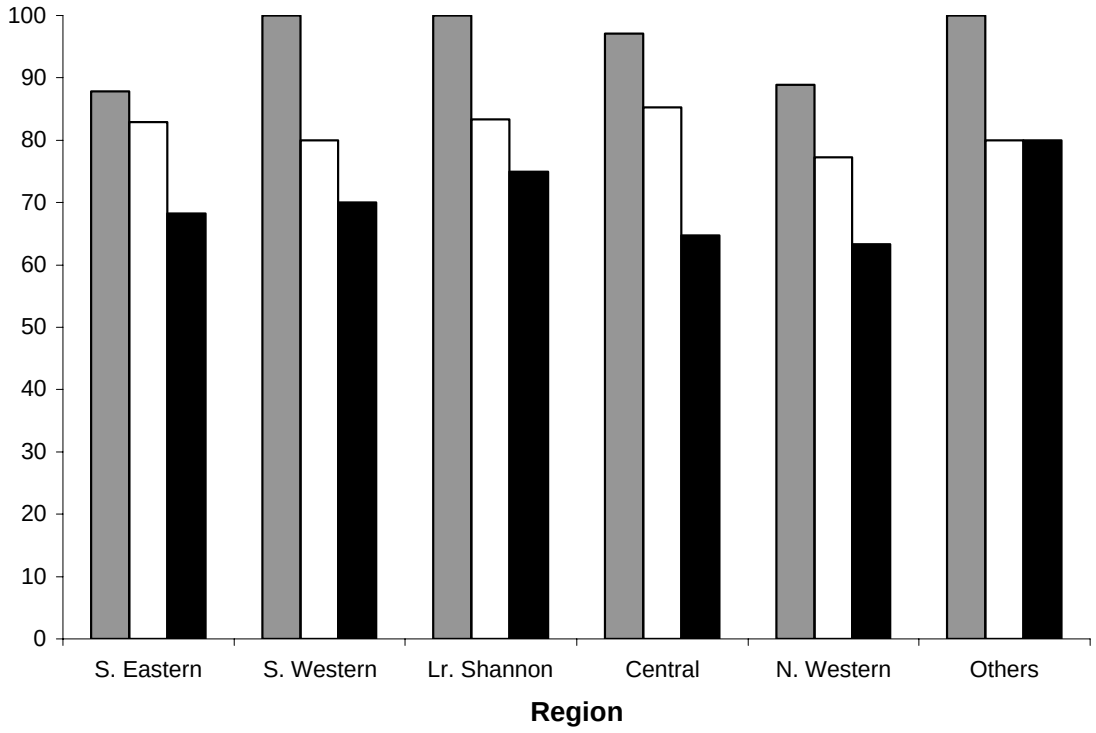

Figure 3.11. *The percentage occurrence of otters within each of the Chapman and Chapman (1982) regions (North Central and North East are grouped) at the 124 sites surveyed in 1980/1981 (grey), 1990/1991 (white) and 2004/2005 (black).*

Table 3.20. *Change in percentage occurrence over time for the subsample of 147 sites included in the 1980/1981 and 2004/2005 surveys, shown by regions defined by Chapman and Chapman (1982).*

Region	n	% occ. 1980/81	% occ. 2004/05	Change % occ. 1980/81 to 2004/05
S. Eastern	52	86.54	71.15	-15.39
S. Western	13	100.00	69.23	-30.77
Lr. Shannon	13	100.00	69.23	-30.77
Central	37	97.30	62.16	-35.14
N. Western	27	88.89	70.37	-18.52
Others*	5	100.00	80.00	-20.00
All	147	92.52	68.71	**-23.81**

as for Table 3.20

Table 3.22. *Change in percentage occurrence over time for the subsample of 124 sites included in all three surveys, shown by River Basin District.*

RBD	n	% occ. 1980/81	% occ. 1990/91	% occ. 2004/05	Change % occ. 1980/81 to 1990/91	Change % occ. 1990/91 to 2004/05	Change % occ. 1980/81 to 2004/05
Eastern	12	91.67	83.33	50.00	-8.34	-33.33	-41.67
S. Eastern	26	88.46	88.46	65.38	-0.00	-23.08	-23.08
S. Western	22	95.45	81.82	72.73	-13.63	-9.09	-22.72
Shannon	28	96.43	75.00	75.00	-21.43	0.00	-21.43
Western	26	96.15	88.46	61.54	-7.69	-26.92	-34.61
Others*	10	90.00	70.00	80.00	-20.00	+10.00	-10.00
All	124	93.55	82.26	67.74	**-11.29**	**-14.52**	**-25.81**

**** Data for the North Western and Neagh/Bann International River Basin Districts, most of which fall into Northern Ireland, are grouped together.***

Table 3.23. *Change in percentage occurrence over time for the subsample of 147 sites included in the 1980/1981 and 2004/2005 surveys, shown by River Basin District.*

RBD	n	% occ. 1980/81	% occ. 2004/05	Change % occ. 1980/81 to 2004/05
Eastern	13	92.31	46.15	-46.16
S. Eastern	34	88.24	70.59	-17.65
S. Western	28	92.86	71.43	-21.43
Shannon	30	96.67	73.33	-23.24
Western	32	93.75	65.63	-28.12
Others*	10	90.00	80.00	-10.00
All	147	92.52	68.71	**-23.81**

as for Table 3.22

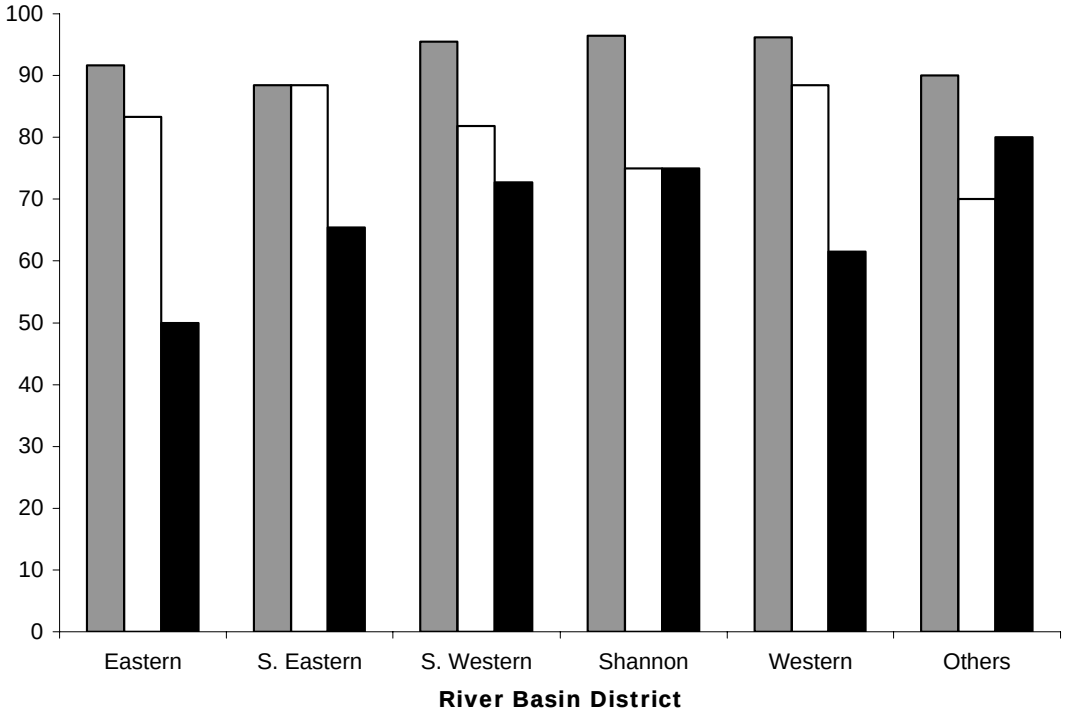

Figure 3.12. *The percentage occurrence of otters within each River Basin District (North Western and Neagh/Bann are grouped) at the 124 sites surveyed in 1980/1981 (grey), 1990/1991 (white) and 2004/2005 (black).*

3.7. Regional Comparisons

Since the Lunnon and Reynolds survey of 1990/1991, a number of smaller scale studies have been carried out into the distribution of otters at a regional or local level. Two of these studies, both carried out in the summer of 2000 using the 'Standard Otter Survey' techniques of Lenton *et al.* (1980), are of particular interest as they covered substantial areas in the East and West of the country.

East of Ireland

In the first of these, Hamilton and Rochford (2000), with funding from the Heritage Council, carried out a full survey of three Hydrometric Areas in the east of Ireland – HA07 (Boyne), HA09 (Liffey) and HA10 (Avoca/Vartry) – a total land area of approximately 5,560 km^2. This study area overlapped for the most part with the 50km squares N.NE and O.SW used in the original Chapman and Chapman 1980/1981 survey, and falls entirely within the Eastern RBD, which also contains HA08 (Nanny) – a further 710 km^2 (Figure 3.13).

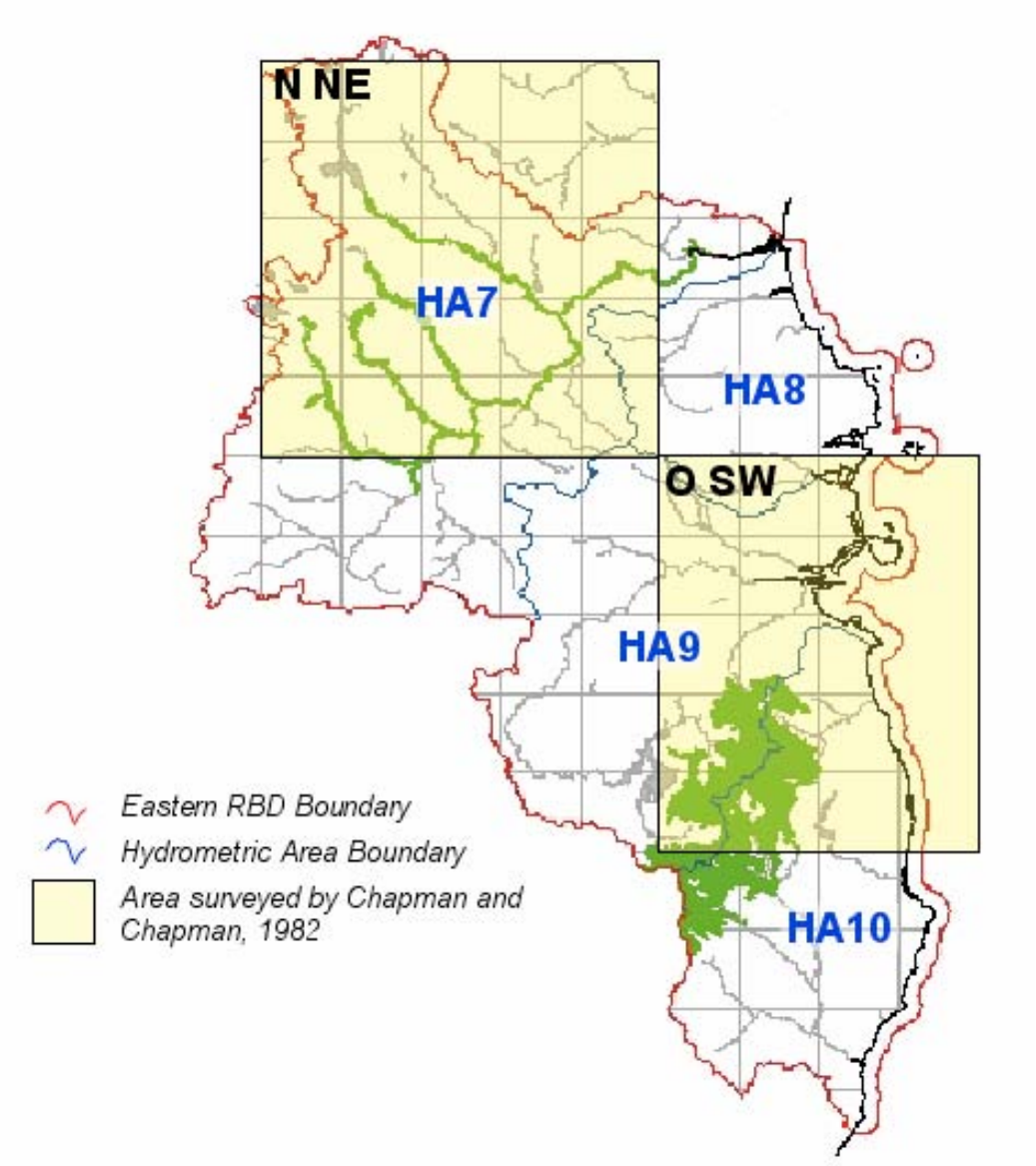

Figure 3.13. *Hydrometric Areas surveyed by Hamilton and Rochford, 2000 in relation to 50 km squares used by Chapman and Chapman, 1982 and Lunnon and Reynolds, 1991. SACs are shown in green.*

273 sites, used by the EPA for water quality assessment, were surveyed, and presence or absence of otter signs was reviewed in relation to pollution status, disturbance and a variety of habitat parameters at the sites.

Signs of otters were found at 176 of these 273 sites (64.47%). A comparison of data for this area from the four surveys carried out since 1980/81 is given in Table 3.24.

Table 3.24. *Regional comparison of surveys carried out in the East of Ireland (Hydrometric Areas 07,09 and 10) from 1980/1981 to 2004/2005, showing the change in percentage occurrence over the time interval.*

	n	+ive	-ive	% occ.	Years since prev. survey	Change % occ.
1980/81 *(squares N NE and O SW) **	219	176	41	80.36		
1990/91 *(squares N NE and O SW) §*	28	19	9	67.86	10	-12.5
1990/91 *(squares N NE and O SW) ¶*	*89*	*57*	*32*	*64.04*		
2000 *(HAs 07,09 and 10)*	273	176	97	64.47	9	-3.39
2004/05 *(HAs 07,09 and 10)*	37	22	15	59.46	5	-5.01

Notes:

* *Chapman and Chapman (1982) reported 184 sites positive in 1980/1981 (84.02%). Inspection of the original survey forms for square O SW revealed that resurveying or 'oversurveying' had contributed to the number of positive sites. While the original record sheets for most of square N NE were not available, a proportional correction factor was applied to entire area to give the above figures.*

§ *Lunnon and Reynolds (1991) – 28 selected Chapman and Chapman sites resurveyed (corrected for oversurveying).*

¶ *Data for 18 selected sites from square N NE and all 71 Chapman and Chapman sites from square O SW resurvey by Lunnon in 1990/1991 (extracted and corrected from original record sheets).*

West of Ireland

The second of the studies was carried out by Springer (2000) in square M SW (Galway/North Clare) as part of her research for a MSc at NUIG. This area falls within five Hydometric Areas, mostly in the Western RBD and contains a number of important otter-designated SACs (Figure 3.14).

Springer resurveyed all 102 Chapman and Chapman sites within the study area, 37 of which had been covered by Lunnon and others during the 1990/1991 survey. In 2000, signs of otters were found at 79 of the 102 sites (77.45%). A comparison of data for this area from the four surveys carried out since 1980/81 is given in Table 3.25.

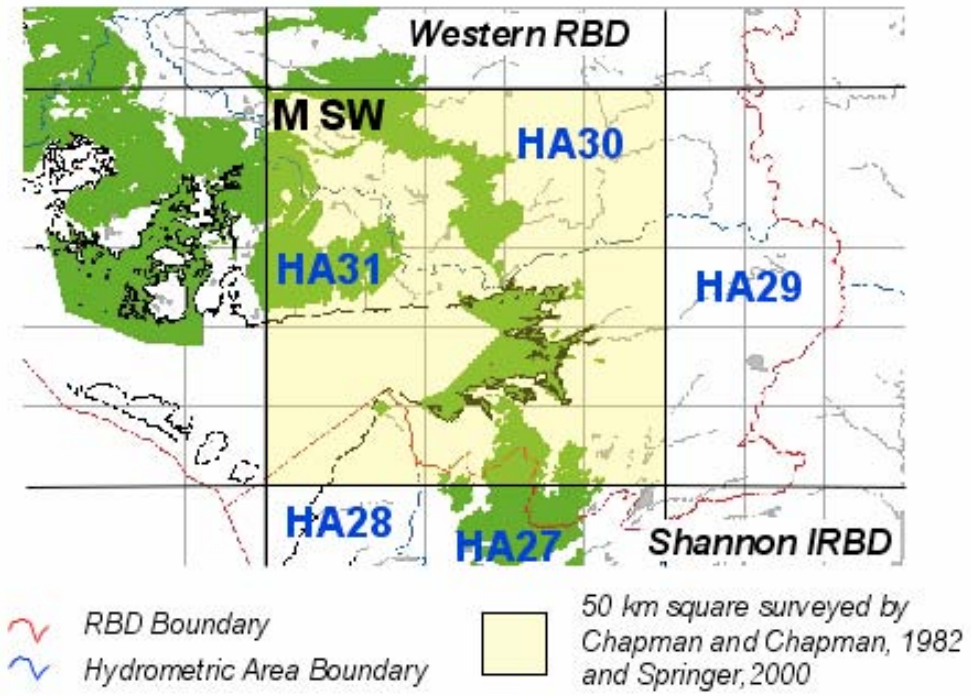

Figure 3.14. *50 km square M SW, surveyed by Chapman and Chapman, 1982 and Lunnon and Reynolds, 1991 and Springer, 2000 in relation to Hydrometric Area and River Basin District boundaries. SACs are shown in green.*

Table 3.26. *Comparison of surveys carried out in the West of Ireland (square M SW) from 1980/1981 to 2004/2005, showing the change in percentage occurrence over the time interval.*

	n	+ive	-ive	% occ.	Years since prev. survey	Change % occ.
1980/81 *	102	95	7	93.14		
1990/91 §	*12*	*8*	*4*	*66.67*		
1990/91 §	39	31	8	79.49	10	-13.65
2000	102	79	23	77.45	9	-2.04
2004/05	26	19	7	73.07	5	-4.38

Notes:

* *Chapman and Chapman (1982) reported 95 sites positive in 1980/1981 (93.14%). Inspection of the original survey forms for square M SW revealed that while some resurveying and 'oversurveying' had taken place, it had not contributed to the number of positive sites.*

§ *Twelve sites, from the original 102 sites surveyed by Chapman and Chapman, were included in the subsample resurveyed and reported on by Lunnon and Reynolds (1991). However, a total of 39 sites in square M SW were resurveyed by Lunnon and others during 1990/1991, and the original survey forms have been made available. All data are corrected for oversurveying.*

3.8. Regional Reports

Eastern River Basin District

Scarriff Bridge on the Stonyford River (N732533) – 22 Nov 2004 – M.Bailey

The Eastern River Basin District comprises four Hydrometric Areas, HA07 (Boyne), HA08 (Nanny), HA09 (Liffey) and HA10 (Avoca/Vartry) which drain into the Irish Sea. Except for the loss of HA06 (Newry, Fane, Glyde and Dee) to the Neagh/Bann RBD, its boundaries are the same as those of the old Eastern Water Management Region.

With a land area of 6,270 km2, this is the second smallest of the river basin districts in Ireland, although it is the most heavily populated, with an average of approximately 240 people per km2. The Greater Dublin Area alone covers almost 250 km2, while there are other large tracts of discontinuous urban and industrial land elsewhere in the district.

Almost two-thirds of the land surface of the ERBD is used for agriculture, particularly in the North, where the Nanny catchment contains almost 50% arable land (some intensively cultivated). Forest, wetlands (primarily upland blanket bog) and other semi-natural areas occur mainly in the uplands to the South (the Avoca/Vartry and upper Liffey catchments) (Dublin City Council, 2005).

Overall water quality in the ERBD is the lowest in the country. In the most recent (2001-2003) survey, the EPA reported that there had been a further reduction in Class A channel which now stands at 41% - the lowest in the country. While the extent of serious pollution had been reduced, a considerable proportion (30%) of channel was classed as

moderately polluted, and a similar proportion as slightly polluted (Toner et al., 2005).

Two otter SACs occur within the ERBD – the Wicklow Mountains (SAC No. 2122), and the River Boyne and River Blackwater (SAC No. 2299) – together covering approximately 395 km2, or almost 6.3% of the district.

37 sites were surveyed within the ERBD, of which 22 (59.46%) were recorded as positive, the lowest rate in the country. (Figure 3.15, Appendix 4)

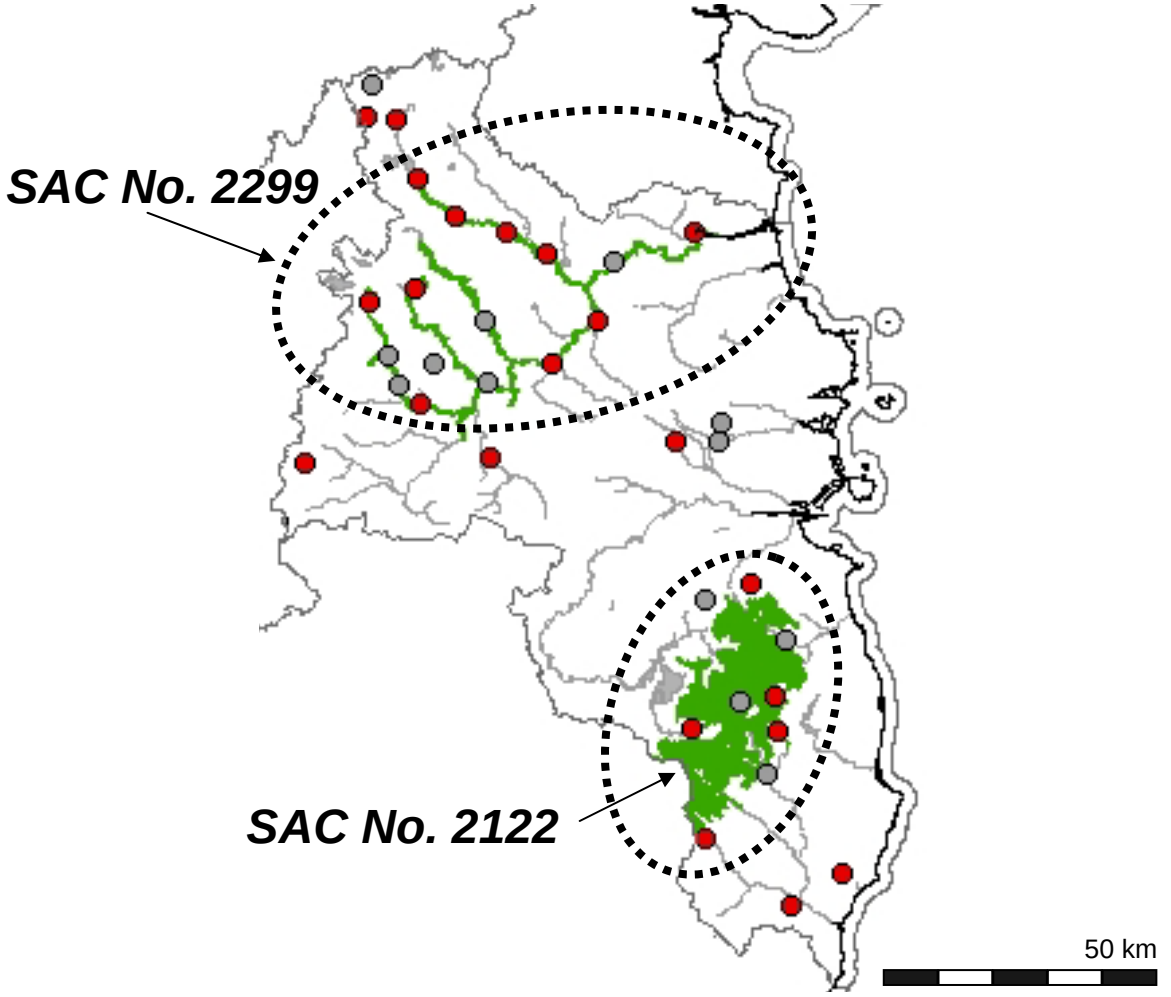

Figure 3.15. *The Eastern River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the two otter SACs in the district (green).*

South Eastern River Basin District

Threecastles Bridge on the River Nore (S458627) – 11 Jan 2005 – M.Bailey

The South Eastern River Basin District comprises seven Hydrometric Areas, HA11 (Owenavorragh), HA12 (Slaney and Wexford Harbour), HA13 (Ballyteige - Bannow), HA14 (Barrow), HA15 (Nore), HA16 (Suir) and HA17 (Colligan - Mahon) which drain into the Celtic Sea and St. George's Channel. The boundaries of the SERBD are exactly the same as those of the old South Eastern Water Management Region.

The total land area of the district is just under 12,750 km^2, most of which comprises the Slaney (1,944 km^2) and the Barrow/Nore/Suir system, which drains a combined area of over 9,000 km^2, making it the second largest river system in the country (after the Shannon). Hydrometric Areas 11, 13 and 17 are small coastal areas, draining directly to the sea by a network of small streams.

The physical conditions in the SERBD are such that the area is highly suitable for agriculture, with rainfall relatively low, temperatures moderate and the soils in the low-lying districts being well drained. Traditionally the Southeast has a higher level of tillage and grassland farming than occurs nationally, with almost 50% of the tillage land in Ireland occurring in the district. Population density is relatively high at 59.6 per km^2 (second only to the ERBD) and is continuing to grow (Carlow County Council. 2003).

Water quality in the SERBD is improving in recent years. There has been a significant reduction in the extent of serious pollution, particularly in the Suir catchment, but the extent of moderate pollution (13% of channel) has remained unchanged. Overall, 58% of the channel surveyed is now classified as unpolluted (Class A).

There are three otter SACs within the SERBD – the Slaney River Valley (SAC No. 0781), the Lower River Suir (SAC No. 2137) and the River Barrow and River Nore (SAC No. 2162) – together covering approximately 425 km^2, or about 3.3% of the district (although representing a far greater proportion of the potential otter habitat). 111 sites were surveyed within the SERBD, of which 81 (72.97%) were recorded as positive. (Figure 3.16, Appendix 4)

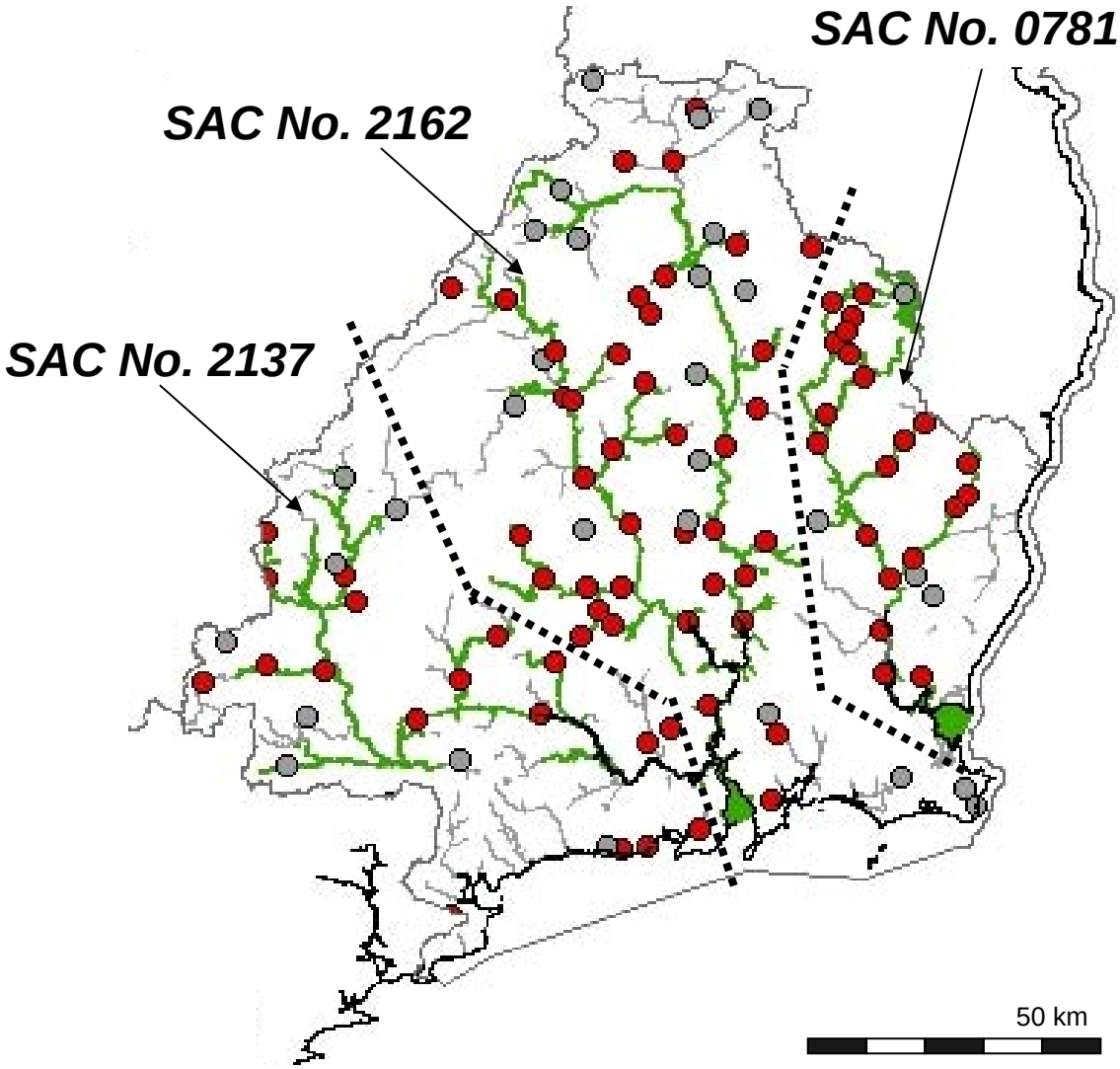

Figure 3.16. *The South Eastern River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the three otter SACs in the district (green).*

South Western River Basin District

Belgooly Bridge on the Stick River (W663537) – 07 July 2005 – M.Bailey

The South Western River Basin District comprises five Hydrometric Areas, HA18 (Munster Blackwater), HA19 (Lee, Cork Harbour and Youghal Bay), HA20 (Bandon - Ilen), HA21 (Dunmanus – Bantry - Kenmare) and HA22 (Laune – Maine – Dingle Bay, which drain into the Celtic Sea and Atlantic Ocean. The boundaries of the SWRBD are exactly the same as those of the old Southern Water Management Region.

The total land area of the SWRBD is approximately 11,150 km^2. The Western half of the district is dominated by mountains, natural grasslands and peatlands, with high rainfall (generally in excess of 1,400 mm and 175 raindays *per annum*) and rapid runoff leading to spate conditions. Land use capability is extremely limited, with tourism and livestock grazing as the most important activities. In contrast, the Eastern half of the region has a much greater proportion of cultivated land. Population and industrial activity is concentrated in Cork city and its environs (Cork County Council, 2005).

With 89% of river channel surveyed in the 2001-2003 period being classified as unpolluted (an improvement of 6% on the previous three year period) and only two short stretches of stream recorded as seriously polluted, water quality in the SWRBD is the best in the country.

There are eight otter SACs occur within the SWRBD – Glengarriff Harbour and Islands (SAC No. 0090), Roaringwater Bay and Islands (SAC No. 0101), The Geragh (SAC No. 0108), Castlemaine Harbour

(SAC No. 0343), Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment (SAC No. 0365), Kenmare River (SAC No. 2158), Blackwater River (Cork/Waterford; SAC No. 2170) and Blackwater River (Kerry; SAC No. 2173). Four of these SACs are predominantly coastal, SAC No. 0365 is the most mountainous region of Ireland and one of the largest SACs in the country at over 750 km2, over 100 times larger than SAC No. 0108 (the alluvial woodland of the Gearagh). 94 sites were surveyed within the SWRBD, of which 70 (74.47%) were recorded as positive – the highest percentage for any RBD. (Figure 3.17, Appendix 4)

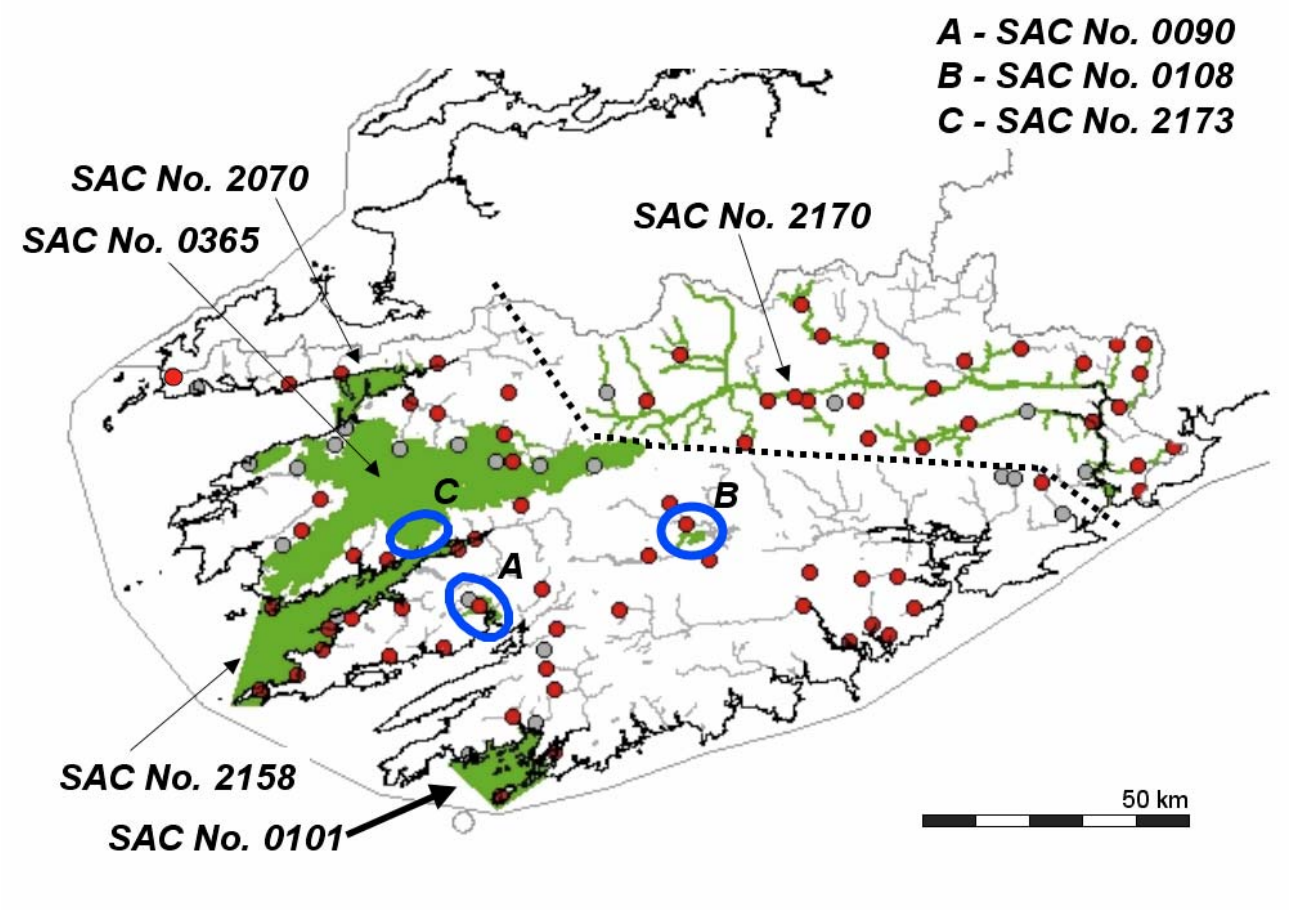

Figure 3.17. *The South Western River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the eight otter SACs in the district (green).*

Shannon International River Basin District

River Shannon Callows near Portumna (M872048) – 11 May 2005 – M.Bailey

The Shannon International River Basin District (ShIRBD) comprises six Hydrometric Areas, HA23 (Tralee Bay - Feale), HA24 (Shannon Estuary South), HA25 (Lower Shannon), HA26 (Upper Shannon), HA27 (Shannon Estuary North) and HA28 (Mal Bay) which drain into the Atlantic Ocean, primarily through the Shannon Estuary. The ShIRBD is a combination of the old Shannon and Mid Western Water Management Regions.

Draining an area in excess of 18,000 km^2 (approximately 2.5 km^2 of which lie in Northern Ireland, thereby making it an 'International' River Basin District), the ShIRBD is the largest River Basin District in Ireland. The area contains a number of large lakes, and extensive wetlands (the Shannon callows and large areas of mostly developed raised bog), as well as many large tributaries of the Shannon, draining the central plain.

Agriculture is the predominant land use throughout the region (70.7%), with only a small amount of woodland (3.2%), and peatlands (11.1%) contributing to the land cover. Population density is low (34.4 per km^2), and concentrated around Limerick city in the Southwest. Athlone, Mullingar and Tullamore are the only urban centers of any size within the centre of the region (Limerick/Clare/Roscommon County Councils, 2005)

Water quality in the ShIRBD has deteriorated slightly in recent years, with a 4% reduction in the length of channel classified as unpolluted (63%) and an overall increase in both slightly and moderately polluted stretches, resulting from both agricultural and municipal sources.

There are seven SACs within the ShIRBD – the East Burren Complex (SAC No. 1926), together with two very small sites, both less than 10 km^2 (Dromore Woods and Loughs - SAC No. 0032; Moyree River System - SAC No. 0057), in North Clare; Tralee Bay and the Magharees Peninsula, west of Cloghane (SAC No. 2070); and three sites along the Shannon itself (Lough Ree - SAC No. 0440; River Shannon Callows – SAC No. 0216; Lower River Shannon – SAC No. 2165). A very small part of the Northeastern edge of the East Burren Complex, which has a complex underground drainage system, lies within the Western River Basin District. 95 sites were surveyed within the ShIRBD, of which 67 (70.53%) were recorded as positive (Figure 3.18, Appendix 4).

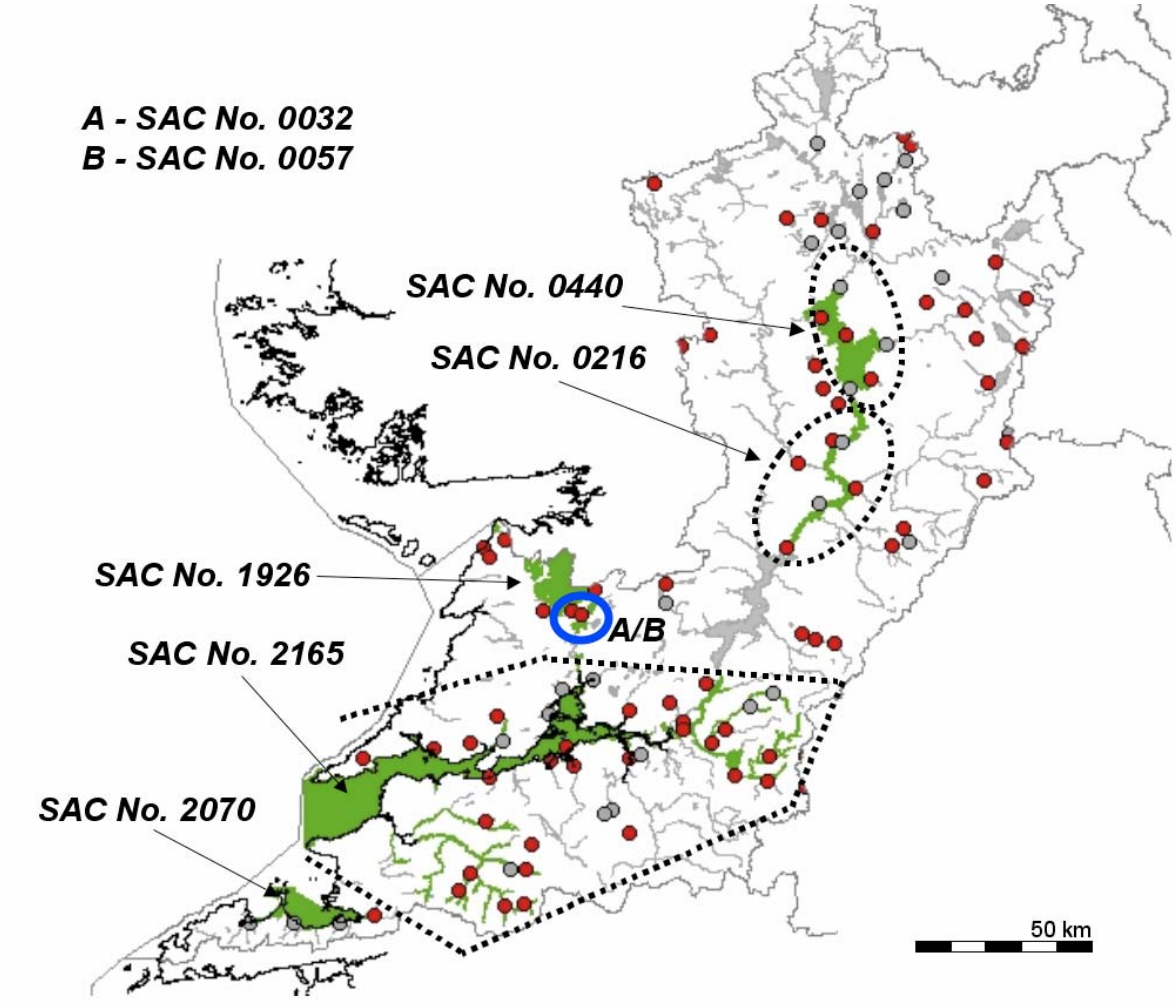

Figure 3.18. *The Shannon International River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the three otter SACs in the district (green).*

Western River Basin District

Stream in blanket peatland near Blacksod Bay (F757162) – 26 June 2005 – M.Bailey

The Western River Basin District comprises seven Hydrometric Areas, HA29 (Galway Bay South), HA30 (Corrib), HA31 (Galway Bay North), HA32 (Erriff – Clew Bay), HA33 (Blacksod - Broadhaven), HA34 (Moy and Killala Bay) and HA35 (Sligo Bay) which drain into the Atlantic Ocean. A small part of HA35 (the Drowes and Duff Rivers) has been transferred to HA36 in the North Western River Basin District. With the exception of the remainder of HA35, the boundaries of the WRBD are the same as those of the old Western Water Management Region.

The land area of the WRBD extends over some 12,190 km^2, an area comprising 14,200 km of river channel and the highest number of lakes in the country (5,638, 69 of which are greater than 40 ha). Together with some 2,700 km of heavily indented coastline, this offers an immense wealth of potential otter habitat.

The Eastern part of the region is dominated by karst limestone overlain by grassland, generally used for agriculture. In the West, the region is dominated by blanket bog, with some forestry. Overall, agriculture comprises 47% of the land use, with natural areas (peatlands, forestry and lakes) comprising the remainder. The area is only sparsely populated (mean density 30.7 per km^2), with Galway city the only major centre of population (Galway County Council, 2005).

Overall water quality in the WRBD is good – second only to the SWRBD with 84% of the channel length surveyed being classified as unpolluted in 2000-2003. The main pressures acting on water bodies in the WRBD are diffuse pollution from agriculture and forestry, and morphological

change from drainage and abstraction/impoundment, but these are slight.

A significant portion of the region has been designated as SACs, and 15 of these, a number of them quite small are among those designated for otter. These include four coastal areas – Galway Bay Complex (SAC No. 0268), Kilkieran Bay and Islands (SAC No. 2111), Clew Bay Complex (SAC No. 1482) and Mullet/Blacksod Complex (SAC No. 0470) – and a number of upland/blanket bog areas Connemara Bog Complex (SAC No. 2034), The Twelve Bens/Garraun Complex (SAC No. 2031), Mweelrea/Sheeffry/Erriff Complex (SAC No. 1932), Owenduff/Nephin Complex (SAC No. 0534) and Ben Bulben/Gelniff and Gleade Complex (SAC No. 0623). The remainder consists of two river systems – the Moy River (SAC No. 2299) and the Unshin River (SAC No. 1898; at 9.22 km^2, one of the smallest otter SACs) – and three lakes – Lough Corrib (SAC No. 0297), the Lough Carra/Mask Complex (SAC No. 1774) and Lough Gill (SAC No. 1976). Finally, the WRBD also contains a very small portion of the East Burren Complex (SAC No. 1926). 114 sites were surveyed within the WRBD, of which 80 (70.18%) (Figure 3.19, Appendix 4).

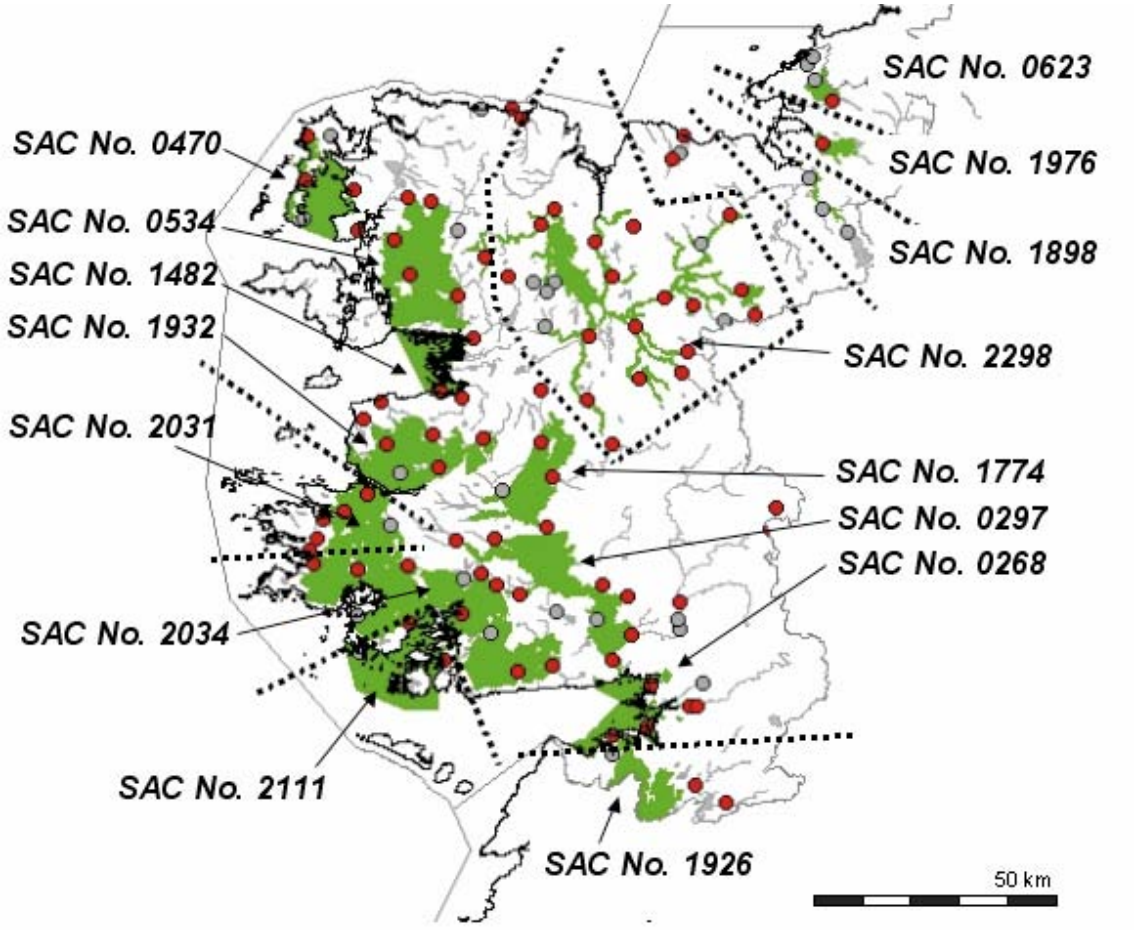

Figure 3.19. *The Western River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the 15 otter SACs in the district (green).*

North Western International River Basin District

Leannan River near Lough Swilly (C220208) – 15 June 2005 – M.Bailey

The North Western International River Basin District comprises seven Hydrometric Areas, HA36 (Erne), HA37 (Donegal Bay North), HA38 (Gweebarra - Sheephaven), HA39 (Lough Swilly), HA40 (Donagh - Moville), HA01 (Foyle) and HA02 (Faughan - Roe) that drain into the Atlantic Ocean. All of HA02, and large parts of HA 01 and HA36 lie within Northern Ireland. Those parts of the NWIRBD that lie within the Republic of Ireland are essentially those that made up the old North Western Water management Region.

The land area of the NWIRBD extends over some 12,265 km^2, 4,785 km^2 of which lie in Northern Ireland, leaving the remaining 7,480 km^2 in two separate areas – Co Donegal in the Northwest, and a Southeastern area centered on Co Cavan. Co Donegal is similar to the Western parts of the SWRBD and WRBD, being dominated by mountains and blanket bogland, with a long, rugged and indented coastline. In contrast, the Southeastern area lies in the drumlin belt of the North midlands, where the topography, coupled with poor drainage and high rainfall results in a network of interconnecting lakes and streams, making surveying very difficult.

Agriculture and forestry are the main land uses in the area, and there are no large centers of population or industry. Water quality is generally good, with 76% of the channel length surveyed being classified as unpolluted. Agricultural pollution, however, remains a serious threat, particularly in the Southeastern area.

There are ten SACs within the NWIRBD – nine in the Co Donegal area,

and one – Lough Oughter and associated Loughs (SAC No. 0007) – in the Southeast. The Co Donegal sites include six coastal sites (North Inishowen Coast - SAC No. 2012; Lough Swilly – SAC No. 2287; Mulroy Bay – SAC No. 2159; Gweedore Bay and Islands – SAC No. 1141; the coastal area West of the Ardara/Maas Road – SAC No. 0197; Slieve Tooey/Tormore Island/Loughros Beg Bay – SAC No. 0190), a large upland/bogland complex (Cloghernagore Bog and Glenveagh National Park – SAC No. 2047) and part of the Finn River (SAC No. 23012). Finally, in the Southwest corner of the area there is Lough Melvin (SAC No. 0428). 65 sites were surveyed within the NWIRBD, of which 42 (64.61%) were recorded as positive (Figure 3.20, Appendix 4).

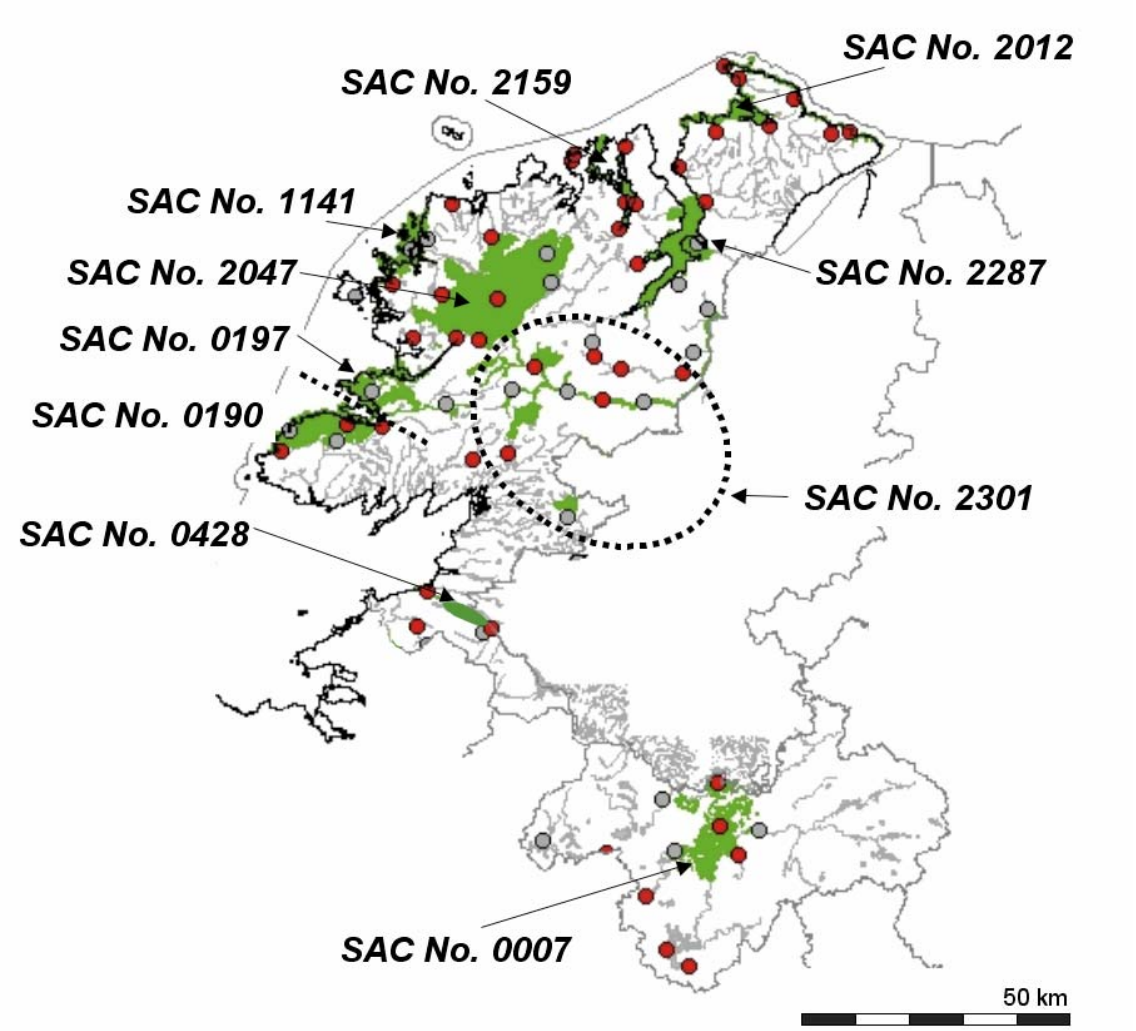

Figure 3.20. *The North Western International River Basin District, showing the location of all sites surveyed (red circles – otter signs present; grey circles – no otter signs), in relation to the main rivers and the 10 otter SACs in the district (green).*

Neagh/Bann International River Basin District

The Neagh/Bann International River Basin District comprises two Hydrometric Areas, HA03 (Neagh/Bann) and HA06 (Newry, Fane, Glyde and Dee) that drain North into the Atlantic Ocean/North Channel at Coleraine, and East into the Irish Sea.

The land area of the N/BIRBD extends over some 7,900 km^2, all but 2,160 km^2 of which lies in Northern Ireland. The Southern part of the district, which lies in the Republic of Ireland, consists of most of Co Louth, a small section of North Co Meath and the Eastern and Northern parts of Co Monaghan.

Water quality in the Southern part of the N/BIRBD is generally quite poor (second only to the ERBD), with only 55% of the channel length surveyed being classified as unpolluted, 30% as moderately polluted (Class C).

There are no otter SACs within the N/BIRBD. Only nine sites were surveyed, of which eight (88.89%) were recorded as positive (Figure 3.21, Appendix 4).

Figure 3.21. *The Neagh/Bann International River Basin District, showing the location of all sites* surveyed *(red circles – otter signs present; grey circles – no otter signs.*

3.9. Otter Diet Analysis

Otter spraints, including remains of crayfish, Owenbeg River (S518836) – 08 Feb 2005 – M Bailey

Spraints were located and used to confirm otter occurrence at a total of 319 of the 370 sites recorded as positive during the survey (footprints, slides, holts and sightings accounted for the remainder). A sample of these spraints was collected from the field and returned to the laboratory for dietary analysis. This sample was collected, as available, from throughout the survey period, covering all seasons. Individual fresh spraints were placed in labelled plastic bags and kept refrigerated until ready for processing.

In the laboratory, spraints were oven dried at 60ºC for 48 hours and weighed to the nearest 0.1mg. Dried spraints were broken apart, and hard parts extracted, by overnight immersion in a mild detergent solution, followed by gentle washing through a 0.5mm mesh sieve. The extracted hard parts were dried on filter paper at 20ºC and examined under a binocular microscope (x8 – x40). Identification of dietary remains (for the most part bones and fragments of arthropod exoskeleton) was carried out with the aid of reference collections and a key (Conroy, et al., 2005).

During the 1980/1981 survey, Chapman and Chapman similarly collected spraints from a sub-sample of the 2,073 positive sites recorded. These dried spraints had been preserved, and were made available to the authors for comparative analysis.

In total, 265 spraints collected during the 2004/2005 survey and a further 319 collected by Chapman and Chapman in 1980/1981 were examined. These came from a broad range of primarily running freshwater sites from across the country, which were grouped for analytical purposes into River Basin Districts.

Expression of Results from Dietary Analysis

Results from dietary analysis from spraints may be expressed in one of three ways: as **percentage occurrence** (sometimes referred to in the literature as percentage frequency of occurrence), which is the number of spraints containing a category of prey (the number of occurrences - n_c) divided by the total number of spraints in the sample x 100 ($100n_c/n$); as **percentage frequency** (also called percentage relative frequency of occurrence), which is the number of occurrences divided by the total occurrences of all prey categories in the sample of spraints x 100 ($100n_c/\sum n_c$); and **percentage bulk** (also percentage weight), in which a score of relative importance is assigned to each prey category in each spraint, such that the sum of the scores for all of the prey categories in a spraint equals 10, the scores are then multiplied by the dry weight of the spraint, summed for the entire sample and expressed as a percentage of the dry weight of the entire sample.

Percentage occurrence and percentage frequency are the most widely used measures. The former, where the score for any one prey category is independent of all others, is particularly useful for comparing sub-groups within and between samples, while the latter, where values sum to 100%, is best for illustrating the dietary intake of otters in a given area. Unfortunately, there is still a lot of confusion in the literature with regard to the use of these terms. Where more detailed dietary studies are undertaken, it may be possible to attempt to calculate the biomass or energy value of the prey items taken, however, such detail was not possible in this study.

Because of their ease with which spraints may be collected and analysed, more studies have been carried out on the food and feeding habitats of the otter, even here in Ireland, than on all other aspects of its biology and ecology combined. Many of these studies are extremely local or seasonal, but what they do show is the varied nature of the otter's diet, which appears to be more a response to local or seasonal availability of prey rather than preferences. Chanin (2003b) examined fifteen dietary studies, carried out in Europe between the 1960's and 1990's (two of them from Ireland), to produce the summary statistics (percentage occurrence) shown in Table 3.27.

Table 3.27. *Summary of fifteen dietary studies carried out in Europe between the 1960s and 1990s – taken from Chanin (2003b).*

Prey Category	Minimum	Maximum	Median
Fish	49.8	94.0	67.7
Amphibia	0.5	36.7	13.4
Crayfish	0.0	34.8	3.0
Mammals	0.0	11.4	0.6
Birds	0.0	9.3	1.5
Reptiles	0.0	9.2	0.0

It is no surprise that fish tend to dominate the diet of otters in most parts of their range, but both crayfish and amphibia (mostly frogs) can, and do, reach high values at certain times.

Results from this Study

In this study, seven separate categories of fish were recorded, along with frog, bird, mammal, crayfish and all other invertebrates. The birds remains identified were feathers and bone from Ralliformes and Columbiformes; mammals remains identified, in the form of hair and bones, came from *Rattus norvegicus*, *Apodemus sylvaticus, Sorex minutus* and unidentified Lagomorpha; while the category 'Invertebrates: others' included molluscs and a wide range of arthropod. Some of these later, as well a plant material, discarded as debris, occurred in very low quantities and may have been ingested accidentally, or in the form of food of prey items. Most of the unidentified bone was of fish origin, although a few fragments of other vertebrate bone were also present.

The percentage occurrence and percentage frequency of all prey categories in the total sample is presented in Table 3.28 and shown in Figure 3.22. Noticeable are the decline in stickleback and frog in the 2004/2005 sample, while crayfish and mammal have both increased significantly.

Table 3.28. *Comparisons of overall percentage occurrence and percentage frequency of prey categories found in otter spraints collected during the 1980/1981 and 2004/2005 surveys, showing changes over time (a negative value indicates a decrease in consumption).*

Prey Category	% occurrence			% frequency		
	1980/ 1981	2004/ 2005	Change	1980/ 1981	2004/ 2005	Change
Salmonid	32.6	40.4	7.8	20.6	21.1	-0.5
Cyprinid	11.6	7.9	-3.7	7.3	4.2	-3.1
Eel	24.8	35.1	10.3	15.6	18.4	2.8
Stickleback	36.4	24.2	-12.2	23.0	12.6	-10.6
Perch	6.0	10.6	4.6	3.8	5.5	1.6
Pike	3.1	2.3	-0.8	2.0	1.2	-0.8
Stoneloach	0	1.9	1.9	0	1.0	1.0
Unidentified bone	7.5	16.2	8.8	4.8	8.5	3.7
Frog	30.4	24.5	-5.9	19.2	12.8	-6.4
Bird	3.4	6.8	3.4	2.2	3.6	1.4
Mammal	0.3	11.3	11.0	0.2	5.9	5.7
Crayfish	2.2	9.8	7.6	1.4	5.1	3.7

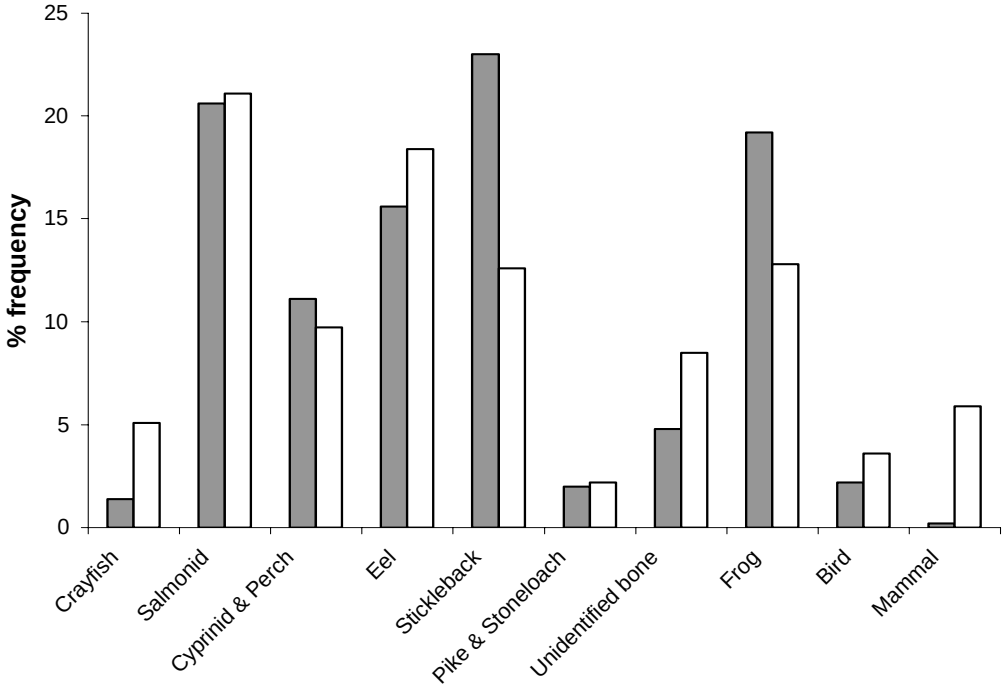

Figure 3.22. *Comparison of percent frequency of main prey groups in spraint samples from 1980/1981 (grey) and 2004/2005 (white). Some of the minor fish categories have been combined. Unidentified bone is primarily fish.*

The percentage occurrence of all prey categories in each River Basin District for each of the periods are presented in Tables 3.29 and 3.30, while regional variations in the occurrence of the main fish categories shown in Figures 3.23 and 3.24.

Table 3.29. *Percentage occurrence of prey categories found in otter spraints collected during the 1980/1981 survey from the seven River Basin Districts. (E – Eastern; SE – Southeastern; SW – Southwestern; Sh – Shannon; W – Western; NW – Northwestern;N/B – Neagh/Bann. n – sample size) .*

Prey Category	River Basin District							All
	E	SE	SW	Sh	W	NW	N/B	
n	*49*	*40*	*36*	*130*	*26*	*26*	*12*	*319*
Salmonid	26.5	52.5	50.0	28.5	23.1	26.9	16.7	32.6
Cyprinid	16.3	10.0	25.0	5.4	3.8	23.1	16.7	11.6
Eel	10.2	30.0	33.3	16.9	53.8	34.6	41.7	24.8
Stickleback	42.9	30.0	11.1	46.9	38.5	11.5	41.7	36.4
Perch	2.0	5.0	11.1	7.7	0	3.8	8.3	6.0
Pike	4.1	2.5	0	3.1	3.8	7.7	0	3.1
Stoneloach	0	0	0	0	0	0	0	0
Frog	42.9	20.0	19.4	36.9	26.9	7.7	33.3	30.4
Bird	0	0	0	4.6	15.4	0	8.3	3.4
Mammal	0	0	2.8	0	0	0	0	0.3
Unidentified bone	0	2.5	8.3	4.6	23.1	30.8	0	7.5
Crayfish	2.0	2.5	0	2.3	3.8	3.8	0	0.3

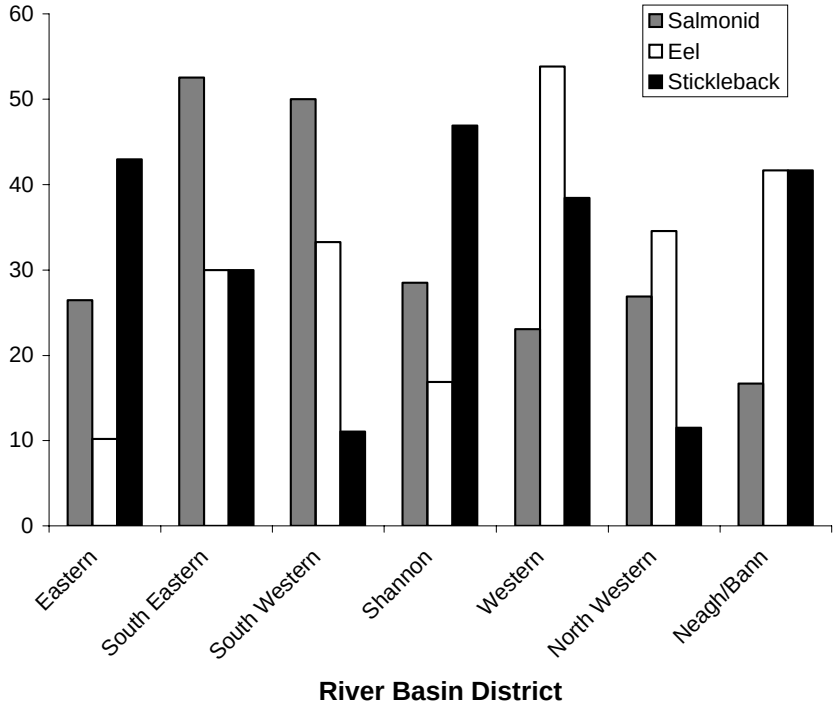

Figure 3.23. *Variation in the percentage occurrance in the three main fish categories in the diet of otters from the various River Basin Districts in 1980/1981.*

Table 3.30. *Percentage occurrence of prey categories found in otter spraints collected during the 2004/2005 survey from the seven River Basin Districts. (abbreviations as for Table 3.29) .*

Prey Category	River Basin District							All
	E	SE	SW	Sh	W	NW	N/B	
n	*39*	*70*	*40*	*28*	*59*	*16*	*13*	*265*
Salmonid	43.6	55.7	35.0	21.4	35.0	25.0	46.2	40.4
Cyprinid	12.8	10.0	2.5	10.7	6.7	0	7.7	7.9
Eel	20.5	15.7	47.5	17.9	53.3	50.0	76.9	35.1
Stickleback	10.3	17.1	35.0	35.7	16.7	50.0	46.2	24.2
Perch	15.4	10.0	22.5	0	5.0	6.3	15.4	10.6
Pike	0	0	5.0	0	5.0	0	7.7	2.3
Stoneloach	2.6	1.4	2.5	3.6	1.7	0	0	1.9
Frog	35.9	35.7	7.5	42.9	16.7	6.3	0	24.5
Bird	7.7	4.3	5.0	7.1	10.0	6.3	7.7	6.8
Mammal	12.8	21.4	5.0	17.9	5.0	0	0	11.3
Unidentified bone	12.8	4.3	12.5	3.6	35.0	31.3	23.1	16.2
Crayfish	0	18.6	0	10.7	13.3	6.3	7.7	9.8

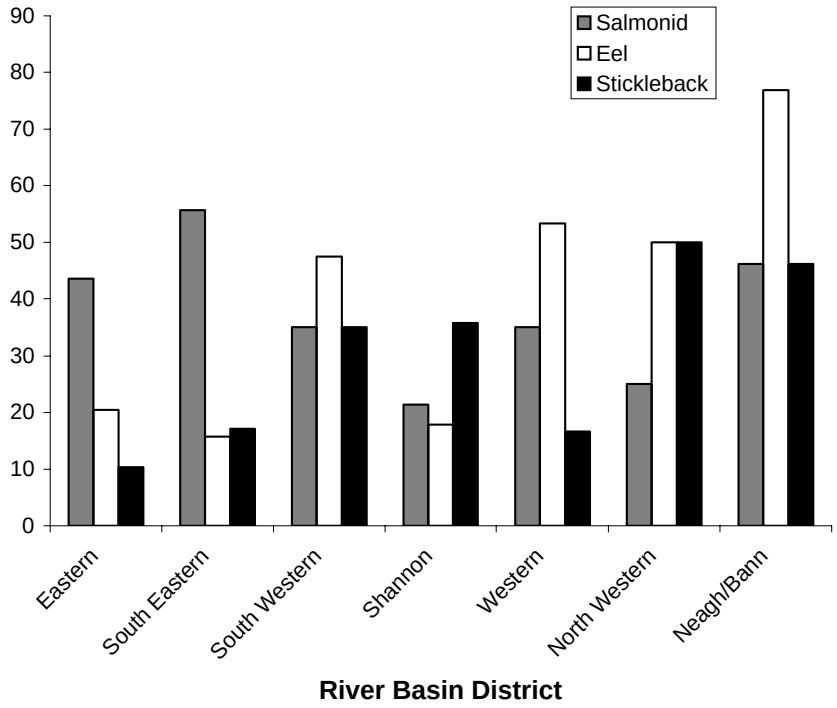

Figure 3.24. *Variation in the percentage occurrance in the three main fish categories in the diet of otters from the various River Basin Districts in 2004/2005.*

Overall, fish dominate in the diet of the otter, occurring in 85.3% of all spraints in 1980/1981 and 78.5% in 2004/2005. While in the 2004/2005 sample salmonids were the most important group, followed by eel and stickleback, both in terms of occurrence and frequency, in the 1980/1981 sample the positions of salmonids and sticklebacks was reversed. Other species (including unidentified fish) contribute only small amounts. Frog remains occurred in almost 25% of spraints examined, although it seldom dominated, and both bird and mammal remains also occurred towards the upper limit of the range cited by Chanin (2003b) (Table 3.31).

Table 3.31. *Overall percentage occurrence of major prey categories in the 1980/1981 and 2004/2005 samples, compared with median and maximum values from 15 studies reported by Chanin (2003b).*

Prey Category	1980/81	2004/05	*from Chanin (2003)*	
			Median	Maximum
Fish	85.3	78.5	67.7	94.0
Amphibia	30.4	24.5	13.4	36.7
Crayfish	2.2	9.8	3.0	34.8
Mammals	0.3	11.3	0.6	11.4
Birds	3.4	6.8	1.5	9.3

Crayfish were surprisingly scarce in both samples, and absent from the Eastern RBD in 2004/2005. This is despite the fact that anecdotal evidence and unpublished student studies have suggested that they feature strongly in the diet of otters in this area. However, when feeding on large crayfish, otters tend to dismember the prey, leaving large parts

of the exoskeleton lying on the bank, but passing only small fragments into their spraints. While some of these fragments, as well as parts of appendages of crayfish were found in the spraints, many small fragments may have been overlooked and classified with 'unidentified invertebrate' parts or debris. Crayfish remains were detected in spraints from 21 10km squares, all from within the known distributional range of the species in Ireland as follows: G75, L83, L98, M07, M16, M94, N26, N88, O09, R93, R94, R95, S02, S12, S22, S23, S32, S34, S43, S44 and S57.

4. Discussion

Crooked River near Clopook House (S576907) – 08 Feb 2005 – M.Bailey

While the otter is still widespread in all wetland habitat types throughout Ireland, results from this and other surveys show that there has been a clear and significant decline in the percentage occurrence at sites over the past 25 years. The same trend emerges, whether one considers the overall figures or just those for individual sites that have been resurveyed over the years. The decline, which has been in the order of 0.75 percent per annum, is further confirmed by inclusion of data from two regional surveys undertaken in 2000 (Hamilton and Rochford 2000, Springer 2000). When the issue of 'oversurveying' in the 1980/1981 and 1990/1991 surveys is addressed, the evidence points to a more rapid decline during the first decade, with the situation considerably better for the period 1990/1991 to 2004/2005 *(see Table 3.2, page 13)*. It is unwise, however, to try to read too much significance into these figures, given the differences in sample size and personnel between the three surveys.

Results from this survey suggest that there has been little spatial variation to this decline. While the percentage decrease detected has been greatest in the Eastern RBD and least in the South Eastern RBD, the differences across the country were not statistically significant.

While the overall percentage occurrence still compares favourably with figures obtained in 2001/2002 from Northern Ireland (overall 70.48% in the Republic of Ireland and 65.01% in Northern Ireland), the decline in Ireland as a whole comes at a time when otter numbers are recovering, albeit from much lower initial levels, through Britain and many parts of Western Europe (Table 4.1).

Table 4.1. *Comparison of rates of increase/decrease in percentage occurrence of otters at sites in Britain and Ireland over the past 25 years.*

	n	% +ive 1977/79	% +ive 1984/86	% +ive 1991/94	% +ive 2000/02	% increase per annum
England	2,940	5.78	9.59	23.37	36.26	1.33
Scotland	2,650	57.02	64.79	83.43	-	1.76
Wales	1,008	20.04	37.99	52.98	74.00	2.35
*Northern Ireland**	**	*82.18 (1980/81)*			*65.01 (2001/02)*	*-0.82*
Republic of Ireland	**	88.20 (1980/81)		75.20 (1990/91)	70.48 (2004/05)	-0.74

Data from Crawford, 2003 (England); Green and Green, 1997 (Scotland); Jones and Jones, 2004 (Wales); Preston et al., 2004 (Northern Ireland)

* *Northern Ireland data are not strictly comparable, due to the inclusion of a disproportionate number of negative sites from 1980/1981 included in the 2001/2002 resurvey.*

** *Variable: Northern Ireland 1980/81 – 331; 2001/02 – 441. Republic of Ireland 1980/81 – 2042; 1990/91 – 246; 2004/05 – 525*

In the past, factors such as the removal of bankside vegetation, increased disturbance, lower water quality and pollution, particularly with organochlorine residues, have all been linked, at least anecdotally, with declines in otter populations. Throughout Britain, a general reduction in riparian habitat quality both for otters and their prey, as a result of agricultural intensification and urban and industrial development within catchments, occurred in the 1950s, 60s and 70s. However, there has been a more enlightened attitude in recent years, and an emphasis on habitat improvement has been the rationale behind all recent otter conservation and recovery work, and is credited with the positive response in status (Jones and Jones, 2004).

In an attempt to determine factors affecting the trend observed, a wide variety of habitat variables were measured and examined at sites surveyed. Channel width (>2m) and presence of in-stream vegetation were positively linked with otter occurrence, while there was there was also an inverse relationship with altitude (<100m). Altitude and channel width also emerged as significant variables in a best-fit logistic regression model, although its predictive value was less than ideal. Other variables contributing significantly to the model were bank height, mean depth of channel and vegetation density in the riparian (0-5m) zone. There is clearly need for a more detailed investigation of otter habitat requirements, and this is currently being undertaken as part of a research programme at Trinity College.

Human disturbance is another factor that has been implicated as impacting on otter occurrence in the past, although there is growing evidence that otters appear oblivious to even quite high levels of non-confrontational disturbance (Crawford, 2002; Jones and Jones, 2002). In the present survey, we observed the lowest percentage occurrence of otters at sites with no human disturbance – not as surprising as it

might at first seem, as otters were scarcest on small (<2m) streams at high altitude (>100m), and such areas experience lower levels of human disturbance that the more attractive broader lowland rivers. Indeed, there is even a slight link between otter occurrence and angling at sites, suggesting that otters and anglers are using the same cues in selecting 'good' habitat.

One factor that we had expected to find linked with otter occurrence was water quality, as this had been reported as significant by Chapman and Chapman (1982), Lunnon and Reynolds (1991) and Hamilton and Rochford (2000). Somewhat surprisingly, therefore, no significant link was found, with either a contemporary subjective assessment of pollution status, or the most recent site-specific EPA data. This does not mean, however, that water quality is not affecting otter status in the long term.

The EPA (and its predecessors) has been monitoring river and lake water quality on a rolling three-yearly cycle throughout the country since the 1970s. While the incidence of serious (Class D) pollution has declined over this period, a major trend in recent years has been the decline in the proportion of sites classified as unpolluted (Class A), with an increase in the number of sites that are now slightly or moderately polluted (Classes B and C) (Table 4.2). In many cases this downward trend in water quality reflects a shift from acute point source pollution to chronic diffuse pollution from agriculture (Toner *et al.,* 2005).

Table 4.2. *Changes in water quality in Irish rivers, from 1987 to 2003, as indicated by the proportion of channel length surveyed in each class.*

Year	Class			
	A	B	C	D
1987-1990	77.5%	12.0%	9.5%	0.6%
1991-1994	71.2%	16.8%	11.4%	1.0%
1995-1997	66.9%	18.2%	14.0%	0.9%
1998-2000	69.8%	17.0%	12.4%	0.8%
2001-2003	69.2%	17.9%	12.3%	0.6%

Given the potentially large home range of otters (5-15 km of shoreline or channel), and the often localised nature of severe pollution, any response is likely to be based on more subtle and widespread change, for example at the level of the catchment, Hydrometric Area or RBD. Unfortunately, the data to assess this are inadequate.

It is also interesting to note that there is no difference in the percentage occurrence of otters at sites within and outside of SACs. This is hardly surprising when one considers that the 40 SACs involved were not

selected specifically with otters in mind. Several of the more extensive are in upland areas, where otter occurrence is generally lower, while several others are relatively small, and likely to be of little significance for otters within the general landscape.

Among the more important SACs for otters are some of the larger catchments, including the Boyne, Slaney, Barrow, Nore, Suir, Blackwater (Cork/Waterford) and Moy. These would benefit from a more detailed investigation of otter occurrence in relation to habitat and water quality, perhaps employing the more frequent and intensive monitoring protocol proposed by Chanin (2003a). Others sites of importance include Lough Ree and the Callows, south to Banagher, Lough Corrib, the Connemara Bog Complex (as surveyed by Springer, 2000), and a number of sheltered coastal and transitional areas, including the Kenmare River, Shannon Estuary, Galway Bay, Clew Bay, Mulroy Bay and the North Inishowen coast.

In the end it may be that we are, perhaps, trying to read an awful lot into 'site-specific' habitat variables, as though the sprainting site was being selected for its suitability as otter habitat, rather than a 5-50km stretch of river/shoreline? While accepting the anecdotal nature of the observations, we have found adjacent sprainting sites on the same river to have totally different habitat parameters; otters to spraint in heavily disturbed and/or acutely polluted locations within a large and heterogenous home range; and proximity to bridges/access (and possible human disturbance) being more a feature of 'surveyed' sprainting sites than sprainting sites in general. Chanin (2003b) reports on a number of similar attempts to associate habitat and other variables with the presence/absence of sprainting activity, and despite the use of abundant, high quality data and sophisticated analytical approaches, results have generally been poor and inconsistent.

In a survey of this nature, the question of potential observer bias inevitably arises. Many authors, including Lenton *et al.* (1980) recommend the use of the minimum possible number of observers to minimise bias, and indeed previous survey, with the possible exception of Lunnon and Reynolds (1991), relied heavily on a small number of highly trained surveyors. In this survey, slightly over half (56%) of all sites were surveyed by the senior author. The remainder was surveyed by 47 individual NPWS staff members, each of whom followed a standard protocol and received some training in advance of participation. Table 4.3 shows a comparison of the 'success' rates (percentage positive sites) of the principal author with those of the other surveyors in each of the river basin districts. While there was a significant difference in the 'success' rates observed, this need not suggest bias, as there are several other plausible explanations.

Table 4.3. *Comparison of the percentage positive sites detected by the principal author and other surveyors in the 2004/2005 survey in each of the river basin districts .*

RBD	n	Author n	Author %	Author % +ive	Others % +ive	
Eastern	37	37	100.00	59.46	-	-
S.Eastern	111	86	77.48	73.26	72.00	n.s.
S.Western	94	38	40.43	78.95	71.42	n.s.
Shannon	94	62	65.96	77.42	56.25	*
Western	114	50	43.86	84.00	59.38	**
N.Western	66	16	24.24	68.75	62.00	n.s.
Neagh/Bann	9	6	66.67	100.00	66.67	n.s.
Overall	525	295	56.19	75.25	63.91	**

*(n.s. – not significant, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$)*

As coverage by the principal author was not evenly spread across the country (ranging from 100% of sites in the East and over 3 out of every 4 sites in the Southeast, to as low as 40% of sites in the Southwest and West and only 25% of those in the Northwest), regional variation in otter occurrence/abundance could be involved. Also, in areas where the author and regional NPWS staff shared the workload, the latter often covered the less accessible (including coastal and high altitude) sites where otter occurrence may have been lower or simply more difficult to detect.

Results from the analysis of spraints collected during the 2004/2005 survey, and their comparison with data from 1980/1981, suggest that the otters diet in the Republic of Ireland, as elsewhere in Britain and Europe (Copp and Roche, 2003), is composed predominantly of fish, with salmonids, eels and sticklebacks comprising the bulk of this prey group. Cyprinids, however, were noticeably scarce in both of the samples when compared to Northern Ireland. The dominant position of sticklebacks, particularly in the 1980/1981 sample, is interesting, as few authors, with the exception of Preston *et al.* (2006) have reported them at such high frequencies. Preston, however, suggests that sticklebacks may be a secondary prey item, since they are known to be eaten in large numbers by salmonids.

Some regional variation in the diet is suggested from the analysis of diet by river basin district, especially in the 1980/1981 sample. Salmonids occurred more frequently in the South and East, while eels were more common in the West and North – these differences, however, were not significant. These variations are most likely to be related to changes in the availability of the different prey species in the different regions, as there is little evidence that otters show any preference for any species (Thom, 1997, in Chanin, 2003b).

Non-fish prey items play an important part in the diet, with frogs, and to a lesser extent birds and mammals making up a sizeable proportion of the diet. Although Copp and Roche (2003) report little seasonal variation in the main fish component of the diet, otters feed

opportunistically and the non-fish component's importance is likely to be seasonal – we have been provided with anecdotal evidence of otters making foraging trips away from rivers in search of frogs at certain times of the year (Ó Neill *pers.comm.*). Alas, no attempt was made in this study to analyse the diet on a seasonal basis, nor, because of the nature of the sample, to relate diet to local availability of prey, both of which would require a more detailed and intensive study.

5. Recommendations

Otter tracks near Waterloo Bridge on the River Nore (S411840) – 08 Feb 2005 – M.Bailey

Arising from the findings of the 2004/2005 survey, the following recommendations are made with regard to future monitoring of otters in Ireland.

1 The Standard Otter Survey.

Despite a number of drawbacks, and the availability of several other more sophisticated, detailed or labour intensive methods, appropriate for local or small scale determination of otter populations (Chanin, 2003a), the Standard Otter Survey method, which has now become the *de facto* 'standard method' throughout continental Europe (Reuther *et al.,* 2000), should continue to be used as the basis for routine periodical surveys at the All Ireland level.

While the methodology employed has been deemed adequate for detecting trends in otter distribution at the national or regional level, it is less useful when attempting to make spatial or temporal comparisons at a local level (*e.g.* between small SACs, or within a small SAC between years). The 44 otter SACs vary enormously in size (ranging from SAC No. 0365 – Killarney National Park, Macgillycuddy's Reeks and the Caragh River Catchment at 767.11km^2 to SAC No. 0057 – Moyree River System at 4.81km^2). The number of sites surveyed within the SACs varied (from 1 to 55) in proportion to their size and the length of river channel and/or shoreline contained in them.

Chanin (2003a) has proposed an alternative protocol for monitoring the otter within catchment-based SACs. This protocol requires the

identification of a minimum of 60 sites within each SAC (more in the case of large SACs), which should be surveyed between May and September, annually at first and subsequently at intervals of three years, by experienced surveyors. Although a higher density of sites is recommended, than that used in the 'Standard Otter Survey' method, less effort is employed at each site. A strong case is made that this new protocol represents a better approach to assessing otter status within and between local areas such as individual SACs, with the 'Standard Otter Survey' being retained to monitor longer-term trends at the national or regional level.

2 All Ireland Basis for Future Surveys

Future Irish surveys should be organised on an island-wide basis, using the river basin districts and catchments (hydrometric areas) as the most appropriate regional sub-divisions. While it is excepted that an important part of such future surveys will involve the monitoring of otters within designated SACs, most of the otter-designated SACs in Ireland fall naturally within river basins, and some are even designated on a catchment basis. As wildlife is unlikely to recognise arbitrary administrative boundaries, the only ecologically sound approach to monitoring otters within SACs is to monitor within the natural boundaries of a catchment or sub-catchment (Chanin 2003a).

3 Frequency and Timing of Future Surveys

A time interval of 10 years between surveys seems appropriate, and is in line with the practice elsewhere. More frequent surveys, while good would undoubtedly place considerable strain on resources and manpower. Individual SACs, or other areas considered to be under particular stress, could be subjected to more intensive monitoring during the interval. Given the fact that the most recent Northern Ireland survey was conducted in 2000/2001, and that previous All Ireland surveys took place 10 and 20 years earlier, it is recommended that the next All Ireland otter survey should be planned for 2010/2011, with plans being drawn up, and sites selected at least a year in advance.

4 Site Selection for Future Surveys

A minimum of 1,000 sites for inclusion in the 2010/2011 survey should be selected following a number of basic criteria:

- Sites should include as many of those used in the 2000/2001 (Northern Ireland) and 2004/2005 (Republic of Ireland) surveys as possible.
- Sites should be spread across all river basin districts and hydrometric areas, ensuring that, where possible, there are at least 60 within each of the larger catchment-based SACs.
- Within individual RBDs and HAs, sites should be spread across the different order of streams. Evidence from England is that as otters become more abundant within a catchment, they begin to spread from higher to lower order streams (Chanin 2003a). It might be expected, therefore, that any decline in the otter population within a

catchment would first be signaled by a disappearance of otter activity in the uppermost tributaries.
- Sites should, where possible, be selected to coincide with those used for other routine monitoring of the environment. In the case of running freshwater sites, those where water quality assessment (Environment Agency/Environmental Protection Agency) and river habitat surveys are carried out should be give priority in selection.

5 Recording of Habitat Parameters

Much of the site specific habitat detail recorded in past surveys has been highly subjective and of little value in interpreting habitat requirements or factors affecting the distribution and status of otters. We, therefore, recommend that its routine collection should be thoroughly reviewed before, if not altogether omitted from future surveys, concentrating instead on two factors likely to influence the quality of the habitat for otters – food supply and pollution (Chanin 2003b). The former can be measured directly (possibly from other sources) or, as is often the case, indirectly through the use of Biotic Indices (*e.g.* the EPA Q scores) or Habitat Modification Scores from the River Habitat Survey, while the latter can be determined from the routine monitoring of the appropriate agency. Other site features, such as altitude, channel width, etc. should be predetermined by the site selection process, while yet others (current, disturbance levels, etc.) may be ephemeral or difficult to determine on the basis of a single visit.

6 Spraint Counts

The practice of counting all spraints in the first 100m surveyed is of dubious merit, given their ephemeral nature, and adds nothing to the overall picture obtained. We recommend its discontinuation in future surveys.

7 Maximising Precision

In order to maximise precision and minimise potential surveyor bias, we recommend that a small, highly-experienced team of surveyors be employed in furture All Ireland surveys using the Standard Otter Survey method. Enthusuastic and appropriately trained field staff and volunteers can then be employed in carrying out more frequent spot-checks or localised surveys within catchments or SACs, where accuracy rater than precision is paramount

8 National Scheme for the Collection of Otter Carcasses

During the course of the 2004/2005 survey, and associated work, we have become increasingly aware of the high level of otter mortality on roads, which is often a feature of dispersal within fragmented habitat. There is currently a need to develop a coordinated scheme for the recording of such casualties, and for the collection of otter carcasses (roadkill and others) on a regional and national basis, for post-morten and other study. A scheme, similar to that employed by the Department of Agriculture for the collection and transport of culled badger carcasses, is envisaged. The loss of even a small number of animals

from a relatively isolated population could have dramatic effects on its long-term prospects. Data from a comprehensive scheme could provide an insight into the structure of otter populations, potentially explaining local changes in status, allow mitigation measures to be proposed, and generally provide information on the health and diet of the species.

6. Acknowledgements

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Peter Chapman and Ruth Lunnon, who carried out the earlier surveys in Ireland, made original data available to us, which was extremely helpful, as was the computerised database of the 1980/1981 survey data, prepared by Jane Preston and Alex Portig of *Quercus* in Belfast. We are also grateful to Sabrina Springer for allowing us to make use of original data in her 2002 Masters thesis. Paul Mills of Compass Informatics and Larry Stapleton of the EPA provided access to GIS information.

The help and support we have had from Trinity College staff and researchers has been overwhelming, and we would particularly like to thank Lughaidh Ó Neill, Ailbhe Kavanagh, Siobhán Murphy, Úna Fitzpatrick, Ian Donohue, Myra O'Regan and Peter Stafford for all their help.

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Appendix 1

List of SACs designated for Otters.

SAC No.	SAC Name
000007	Lough Oughter and associated Loughs
000032	Dromore Woods and Loughs
000057	Moyree River System
000090	Glengarriff Harbour and Islands
000101	Roaringwater Bay and Islands
000108	The Geragh
000190	Slieve Tooey/Tormore Island/Loughros Beg Bay
000197	West of Ardara/Maas Road
000216	River Shannon Callows
000268	Galway Bay Complex
000297	Lough Corrib
000343	Castlemaine Harbour
000365	Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment
000428	Lough Melvin
000440	Lough Ree
000470	Mullet/Blacksod Complex
000534	Owenduff/Nephin Complex
000623	Ben Bulben, Gleniff and Gleade Complex
000781	Slaney River Valley
001141	Gweedore Bay and Islands
001482	Clew Bay Complex
001774	Lough Carra/Mask Complex
001898	Unshin River
001926	East Burren Complex
001932	Mweelrea/Sheeffry/Erriff Complex
001976	Lough Gill
002012	North Inishowen Coast
002031	The Twelve Bens/Garraun Complex
002034	Connemara Bog Complex
002047	Cloghernagore Bog and Glenveagh National Park
002070	Tralee Bay and Magharees Peninsula, west of Cloghane
002111	Kilkieran Bay and Islands

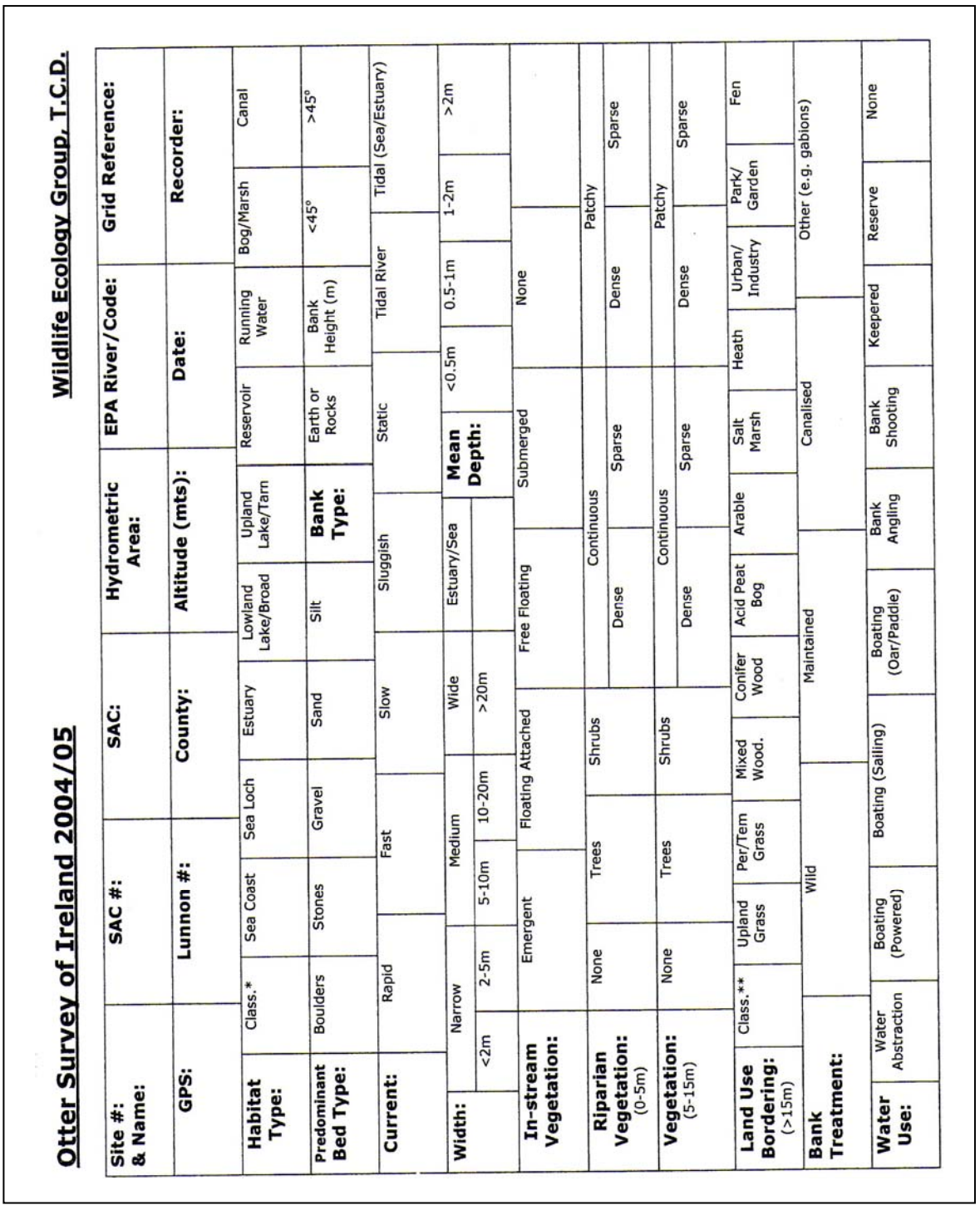
continued over

Appendix 1 *(continued)*

SAC No.	SAC Name
002122	Wicklow Mountains
002137	Lower River Suir
002158	Kenmare River
002159	Mulroy Bay
002162	River Barrow and River Nore
002165	Lower River Shannon
002170	Blackwater River (Cork/Waterford)
002173	Blackwater River (Kerry)
002287	Lough Swilly
002298	Moy River
002299	Boyne and Blackwater Rivers
002301	Finn River

Appendix 2

Survey Form



Otter Survey of Ireland 2004/05 — **Wildlife Ecology Group, T.C.D.**

Site #: & Name:	**SAC #:**			**SAC:**		**Hydrometric Area:**			**EPA River/Code:**			**Grid Reference:**			
GPS:	**Lunnon #:**			**County:**		**Altitude (mts):**			**Date:**			**Recorder:**			
Habitat Type:	Class.*	Sea Coast	Sea Loch	Estuary	Lowland Lake/Broad	Upland Lake/Tarn	Reservoir	Running Water	Bog/Marsh	Canal					
Predominant Bed Type:	Boulders	Stones	Gravel	Sand	Silt	**Bank Type:**	Earth or Rocks	Bank Height (m)	<45°	>45°					
Current:	Rapid		Fast		Slow		Sluggish		Static		Tidal River	Tidal (Sea/Estuary)			
Width:	Narrow		Medium		Wide		Estuary/Sea		**Mean Depth:**	<0.5m	0.5-1m	1-2m	>2m		
	<2m	2-5m	5-10m	10-20m	>20m										
In-stream Vegetation:	Emergent		Floating Attached		Free Floating		Submerged		None						
Riparian Vegetation: (0-5m)	None		Trees		Shrubs		Continuous					Patchy			
							Dense		Sparse			Dense		Sparse	
Vegetation: (5-15m)	None		Trees		Shrubs		Continuous					Patchy			
							Dense		Sparse			Dense		Sparse	
Land Use Bordering: (>15m)	Class.**	Upland Grass	Per/Tem Grass	Mixed Wood.	Conifer Wood	Acid Peat Bog	Arable	Salt Marsh	Heath	Urban/ Industry	Park/ Garden	Fen			
Bank Treatment:	Wild			Maintained				Canalised			Other (e.g. gabions)				
Water Use:	Water Abstraction	Boating (Powered)	Boating (Sailing)		Boating (Oar/Paddle)		Bank Angling	Bank Shooting	Keepered		Reserve	None			

Mink Signs:	Present	Absent	**Otter Hunting:**	Yes	No

Fish species present:	

Distance Surveyed and Comments:	**Human Activity*** **	0	1	2	3

Sketch of Site:	**Description of Site:** **Photograph Info.& #:**

Otter signs and Description:

Number of Otter spraints in 1st 100m surveyed:

**** -

Pollution:	Q-value	Domestic		Agricultural			Industrial			
		organic	other	organic	pesticide	fertilizer	organic	toxin	solid	temp.
Weed Control:		Mechanical		Chemical			None		Other	
Other Notes:										

Survey Form notes:

- *- Habitat Type: 'Class' box. The vegetation classes indicated here are those described in 'A Guide To Habitats In Ireland' (The Heritage Council 2000).
- ** - Land-Use Bordering: 'Class' box. The land-use classes indicated here are those described in 'A Guide To Habitats In Ireland' (The Heritage Council 2000).
- *** - Human Activity:
  - **0** – indicates a very remote area with no obvious signs of human activity.
  - **1** – some activity e.g. remote farm or public footpath.
  - **2** – areas with public amenities, picnic areas & car parks, occasional farms and farm houses, or scattered housing.
  - **3** – built-up areas e.g. housing estates, towns, cities etc.
- **** - the information collected on page 3 is not always apparent from the field survey and can be added at a later date.

Appendix 3

List of Surveyors.

	Sites
Mike Bailey	295
S.Breen	7
Tim Burkitt	4
Carl Byrne	9
Sue Callaghan	1
Patrick Clancy	6
Cameron Clotworthy	6
Jimi Conroy	8
Miriam Crowley	7
Pascal Dower	10
Triona Finnen	3
Emma Glanville	2
Patrick Graham	5
Brian Haran	3
Clare Heardman	19
Ger Higgins	6
John Higgins	5
R.Holloway	6
Emmet Johnston	13
Rosemarie Kiely	3
James Kilroy	3
Liam Lenihan	5
Annette Lynch	3
Deirdre Lynn	3
D.Lyons	7
Emer Magee	9
Sarah Malone	3
Ferdia Marnell	3
John Matthews	6
Larry McDaid	2
David McDonagh	8
Maurice McDonnell	2
Seamus McGinty	1
Eoin McGreal	12
B.Mc Inerney	2
Robert Miller	8
Susan Moles	8
A.O'Donaill	10
Ger O'Donnell	3

continued over

Appendix 3 *(continued)*

	Sites
Barry O'Donoghue	2
Tim O'Donoghue	4
Michael O'Sullivan	6
Denis Ryan	4
Cyril Saich	1
Donal Scannell	4
Lorcan Scott	1
Pat Smiddy	7
Andrew Speer	10

Appendix 4

Survey results by SAC, within each of the seven River Basin Districts.

RBD	SAC	Area (km^2)	Sites	+ive	-ive	% +ive
Eastern	002122	326.02	10	5	5	50.00
	002299	23.97	18	11	7	61.11
	All SACs		*28*	*16*	*12*	*57.14*
	Non-SACs		*9*	*6*	*3*	*66.67*
	All Sites		***37***	***22***	***15***	***59.46***
South Eastern	000781	60.22	25	21	4	84.00
	002137	72.09	21	14	7	66.67
	002162	124.10	55	41	14	74.55
	All SACs		*101*	*76*	*25*	*75.25*
	Non-SACs		*10*	*5*	*5*	*50.00*
	All Sites		***111***	***81***	***30***	***72.97***
South Western	000090	13.06	2	1	1	50.00
	000101	142.59	5	3	2	60.00
	000108	5.59	4	4	0	100.00
	000343	87.13	5	3	2	60.00
	000365	767.11	16	7	9	43.75
	002158	338.23	12	11	1	91.67
	002170	103.15	32	25	7	78.13
	002173	59.03	0	0	0	0
	All SACs		*76*	*54*	*22*	*71.05*
	Non-SACs		*18*	*16*	*2*	*88.89*
	All Sites		***94***	***70***	***24***	***74.47***
Shannon	000032	8.78	1	1	0	100.00
	000057	4.81	1	1	0	100.00
	000216	58.58	7	5	2	71.43
	000440	143.71	9	6	3	66.67
	001926*	188.14	2	2	0	100.00
	002070	116.34	4	1	3	25.00
	002165	684.76	34	25	9	73.53
	All SACs		*59*	*42*	*17*	*71.19*
	Non-SACs		*36*	*25*	*11*	*69.44*
	All Sites		***95***	***67***	***28***	***70.53***

continued over

Appendix 4 *(continued)*

RBD	SAC	Area (km^2)	Sites	+ive	-ive	% +ive
Western	000268	144.09	7	5	2	71.43
	000297	253.88	6	5	1	83.33
	000470	140.65	6	4	2	66.67
	000534	270.29	6	5	1	83.33
	000623	59.19	4	2	2	50.00
	001482	119.90	5	4	1	80.00
	001774	135.27	4	3	1	75.00
	001898	9.22	3	0	3	0
	001926*	188.14	1	1	0	100.00
	001932	210.94	6	5	1	83.33
	001976	32.98	1	1	0	100.00
	002031	161.33	3	2	1	66.67
	002034	493.25	11	8	3	72.73
	002111	213.14	6	3	3	50.00
	002298	156.46	24	19	5	79.17
	All SACs		*94*	*68*	*26*	*72.34*
	Non-SACs		*21*	*13*	*8*	*61.90*
	All Sites		***114***	***80***	***34***	***70.18***
North Western	000007	47.58	6	3	3	50.00
	000190	94.35	5	3	2	60.00
	000197	67.47	4	2	2	50.00
	000428	22.70	3	2	1	66.67
	001141	60.16	5	2	3	40.00
	002012	70.69	9	9	0	100.00
	002047	335.01	6	4	2	66.67
	002159	32.09	5	5	0	100.00
	002287	92.62	4	2	2	50.00
	002301	55.39	9	3	6	33.33
	All SACs		*57*	*35*	*22*	*61.40*
	Non-SACs		*9*	*7*	*2*	*77.78*
	All Sites		***65***	***42***	***23***	***64.62***
Neagh/ Bann	*Non-SACs*		*9*	*8*	*1*	*88.89*
	All Sites		***9***	***8***	***1***	***88.89***

* The East Burren Complex (SAC No. 001926) lies on the border between the Shannon and Western RBDs.