Spatial Sampling Strategies for Assessing Public Opinion Under the Water Framework Directive: A Case Study of the Ythan Project

N. Sang
Macaulay Institute, Craigiebuckler, Aberdeen, AB15 8QH Scotland

1 Introduction

> ".. public participation is perhaps the most pressing and problematic issue in ensuring the prompt and adequate implementation of the Water Framework Directive (WFD), and the achievement of integrated river basin management."
>
> **Harrison et al. 2001**

The above quote refers to opinion expressed at the joint European Commission (EC) / World Wildlife Fund (WWF) seminar on "Good practice in River Basin Planning" (Brussels, May 2001), along with calls for advice on best practice in public participation to be included in the Common Implementation Strategy (CIS). White and Howe (2003) argue that the CIS favours the influence of Non Governmental Organisations over that of civil society in the implementation of the WFD. This, it is posited, has lead to a principle of minimising human impact on water resources, rather than the traditional Land Use planning perspective of sustainability (White and Howe 2003). If there does indeed develop a difference in perspective between existing planning authorities ethos and the River Basin Management Plans (RBM/RBMP) ethos, they believe, it will be the public popularity of the organisations which will determine the outcome (White and Howe 2003). While the example may be " in extremis", clearly public awareness has now the potential for

fundamental influence on the balance between water as a resource for people and water as a resource for nature.

Surveying opinion is already one of the most common methods of public participation (Pratchett 2000) and general methodologies are well defined (Rubenstein 1995). However, although policymaking has always had a spatial dimension, the WFD is (literally) redrawing the boundaries for the policy role of spatial statistics. That the potential for impact on and experience of water varies with location, means spatial design is critical for the success of surveys of both physical and social phenomena. In establishing a catchment rather than discipline based approach to management, the WFD recognises the spatially integrated nature of the issues. It also poses a challenge to research, in that the pattern presented by the interaction between human and biophysical processes is a compound of the complexities of the two systems. Capturing the detail of such a pattern from a sample requires a strategy which is sensitive to the relevant dynamics of each system.

The methodology presented represents the attempt to attain a sample of opinion which is representative of just a few small elements from the two halves of this larger system, as defined by the goals of the survey. Even so defined the compound pattern remains a complex one.

2 The Ythan Project's Objectives for the Survey.

The River Ythan is situated on the North-East coast of Scotland about 10 miles North of Aberdeen, its estuary is of international importance as a habit resource (Hill et al.

2002). The Ythan is also the first catchment in Scotland to be designated a Nitrate Vulnerable Zone (NVZ) due to concern for protecting that habitat resource from eutrophication and algael bloom. In response to this the Ythan Project was funded by the EC *Life* Environment Fund with the aim of involving local people and farmers in the protection, restoration and enhancement of the River Ythan (http://www.ythan.org.uk). Aberdeenshire Council leads the project, with a wide range of partners including Scottish National Heritage, Scottish Environment Protection Agency, Ythan District Fishery Board, Forest Enterprise, River Restoration Centre, Formartine Partnership and the Macaulay Institute. The project is to provide a model for best practice in the involvement of communities in protecting their local water resources. To assess effectiveness in reaching the public the Macaulay Institute has so far undertaken two postal surveys out of an eventual three over the lifetime of the project. To assess initial awareness of the project its self and the issues it is addressing, a base-line postal survey was made of 1000 addresses in the catchment of the River Ythan. A year later a further survey was made to consider its wider dissemination. Addresses in the adjacent catchment of the River Ugie and the more distant Loch Leven catchment, Stirlingshire were sent a shorter survey considering some of the original questions but replacing those specific to the Ythan with a more general attitudinal question. A final survey will be carried out in the Ythan catchment at the end of the project to assess any change in awareness and attitudes towards the river (For location of catchments see Fig 1).

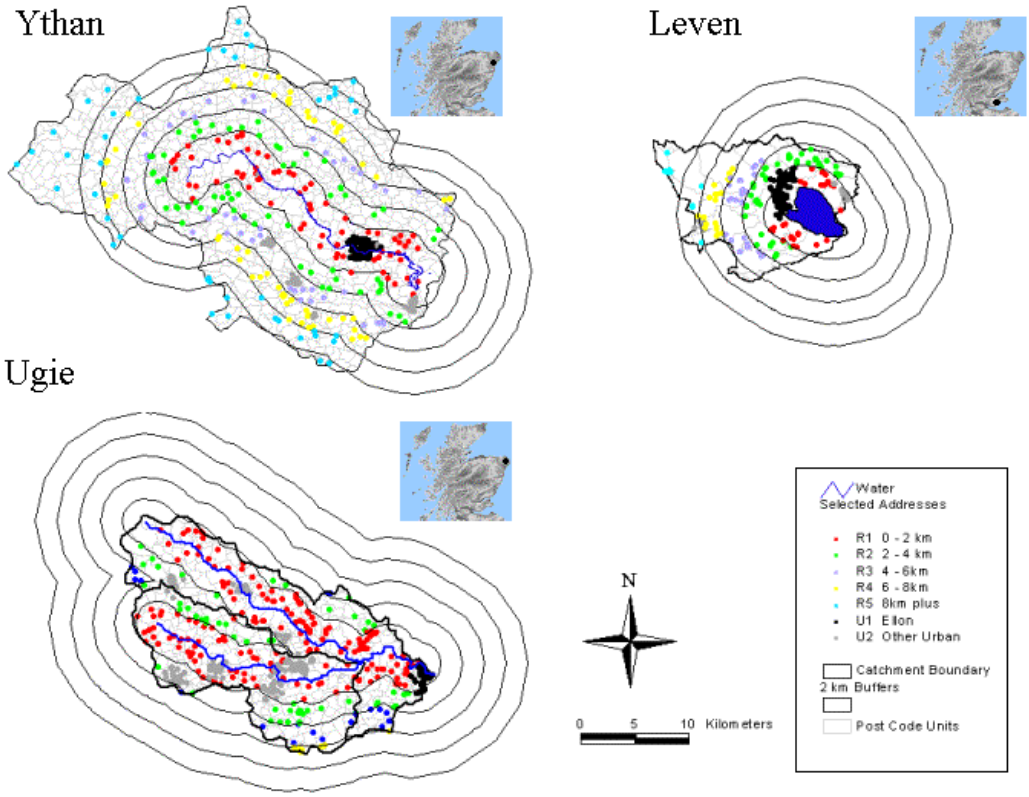
The initial survey then had two main aims:

1) To assess who was aware of the project and where.
2) To assess the views of the local population (and farmers) as to how their river or loch should be managed.

To provide a context to this a third kind of question requesting information on factual indicators of personal use of (recreation, private water supplies) and impact on (private septic tanks) local water resources was included.

These aims provide the terms of reference when defining what aspects (variables) to introduce to the survey design. Specifically an emphasis on where and with whom awareness is high or low, on the primary water body in the area (as opposed to ground water or other lesser water features), and on the use of that primary water body for recreation and domestic water provision.

Figure 1 – Sampling Distribution in Three Different Catchments.



3 Objects and Spatial Pattern

The key issue from a spatial sampling point of view is recording the over all pattern of each variable and the spatial pattern of their interaction. Variables are themselves the combination of two fundamental geographical categories – phenomena and entities (Couclelis in Longley et al. eds. 1999) or in more generally used language, phenomena that are the *subjects* of interest and the *objects* they operate through.

The spatial expression of an object is closely inter-related with the phenomena associated with it and the discussion can seem somewhat philosophical in the context of practical participatory planning. For example how much water constitutes a water body useful for recreation rather depends on whether one is interested in fly fishing or swimming. The conceptualisation of space is dealt with thoroughly elsewhere (Burrough and McDonnell 1998, Longley et al. 1999) but the salient point for this discussion is that :

> "people .. perceive phenomena that are fixed or change in space and time. Their perceptions will influence all subsequent analysis; Success or failure with GIS does not depend in the first instance on technology but on the appropriateness or otherwise of the conceptual model of space and spatial interactions."
>
> **Burrough and McDonnell 1998**

In particular, for surveys, the conceptual model will determine what stratification methods are appropriate. The methodology presented below therefore focuses first on the decisions made as to the spatial conceptualisation of the subjects of the survey. What are the phenomena of interest and how do they theoretically change over space. Then on the objects in the survey. What is their location as defined by their associated phenomena of interest (facility for fishing, facility for swimming). It is indicative of the nature of the problem that the subsequent section considers the interplay between selection of a conceptualisation and the pragmatic sampling issues which will thereby result, only then is the sampling process its self addressed.

4 Methodology

4. 1 Conceptual Design - Water

Although water in a catchment is effectively a continuous object, water bodies, such as ground cover, lakes and rivers represent spatial phase-shifts[1] for many of the phenomenon it carries. For example, in a river depth may increase rapidly allowing swimming where this was not possible a few meters upstream. Water is also a highly spatially auto-correlated feature, both in its self and in terms of each of its functions, thus to continue the previous example, depth may fall again producing separate areas of facility for swimming while facility for fishing may be a continuous variable. If one is interested in how distance to a facility affects its utility for "recreation" in general, a decision has to be made as to how to define that facility (i.e. the

[1] Burrough and McDonnell 1999, p.20, argue that "remarkable clusters of like attribute values" , regions within continuous fields, may be recognised as "things". As will be shown in the case study, clusters are necessarily fuzzy with boundaries being part of a continuum, hence my use of the term "phase shift".

river/loch)? Should it be mapped once for each kind of recreation of interest and distance strata measured separately for each, or one time but using a compromise definition between these different areas of facility?

The survey was also interested in whether people had private water supplies and private septic tanks. The existence of these facilities affects extraction rates from the catchment as a whole and (treated) waste entering the system. For the most part these facilities first affect ground water, in some cases septic tanks drain directly to a stream. If the prime interest were to make an assessment of the environmental impact these facilities were having, it would be necessary to include a geological map as well as information about tributaries and streams. In terms of assessing household attitudes, rather than impact, the spatial expression of this aspect of water is considered less important since it is unlikely householders would have this knowledge themselves. In terms of water quality however, geology and ground water flows might be important in distinguishing regions.

There are then a number of aspects to the definition of water resources in relation to the subjects of interest in the survey. Most important is whether to use a single definition of water or multiple definitions for each different use. In this specific case this relates to three aspects, the definition of the main water body, whether to include tributaries and streams (and if so the definition of these) and whether to include ground water flows.

The answer must first come from the priorities of the problem before using pragmatic compromises (for example available data) in the final definition. Firstly it is

important to match the spatial definition with respondents expectations – the object that they have in mind when answering the questions. It was considered that tributaries and ground water are not (generally) considered to be part of the nominal river/loch. Certainly feeder rivers are not considered part of a Loch, so responses as to use of the river/loch for recreation are likely to be different to responses as to the use of the river/loch *and/or its tributaries*. The Ythan Project is premised on the idea of the local water body as a focus for action from a community for which it is a vernacular feature, a broader more technical definition runs counter to that principle. It was decided the main water body should be defined only[2].

As already discussed however, what constitutes the river or loch is purpose dependent. To return to the recreation example, although the survey does specify certain recreational activities, it also includes an "other" (recognising the possibility of a locally popular past-time which the research team is unaware of) and is also more interested in absolute levels of use than the specific activity. Since an unspecified object cannot be mapped, a general definition using the whole of the river must be adopted. It needs to be recognised that in parts, such as near source, this may not actually provide the real distance traveled by a specific respondent for their chosen activity so any distance relationships found will be most relevant for recreation as a whole, not for comparison between activities.

[2] The significance of ground water quality determinants is excluded for pragmatic considerations discussed later.

4.2 – Conceptual Design - People

In a sense, the "human" side of the equation is also a continuous phenomenon and again it is highly auto-correlated, with concentrations of flows of people along roads and through towns. Indeed it is arguable that the definition of a person's location is even more subject dependent than that for water features. People are capable of going, or at least seeing, hearing or even just thinking about anywhere that water might reach, and of placing that experience in a given "spatial context" (Rindfuss et al. 2003). If one is aware that a factory sits on a river's bank up stream, that may affect perceptions as to its utility for recreation down stream, whatever the *apparent* water quality. For human perception, topographic/topological distance and cause and effect are a-morphous and may even change with the immediate context of the surroundings at the time of survey (for examples of *some* of the dimensions by which perception may vary see; Brabyn 1998; Kemmerer 1999; Ode 2003; Uzzell 2000) . Each response at a particular location is providing a combination of location and respondent. Together this can be seen as representing a surface of opinion, either as might have been provided by one individual at different locations or within the range of opinion that may be provided by different individuals at one location.

Perception is however less mobile for some subjects than others. For example experience of the quality of water from a private supply is fixed to the respondents home. Recreational utility however may be experienced from many locations- a convenient "escape" for a walk at lunch time, including by people resident outside the catchment. So whether it is only recreational use which is of interest or recreational use by those for whom the river is also a domestic water resource, may

determine whether a household based survey is conceptually the best approach. A survey taken at selected sites could capture more detail in the picture for a surface such as recreational use. On balance, it was considered a better picture of recreational use could be gained from a household sample, than could be gained for the domestic water issues without the ability to pre-stratify residency.

More importantly the prime aim of the project is not to assess visitor pressure on the River Ythan, but to involve *local communities* in the *protection and enhancement*, of the river. The ability to link long-term personal interest in and responsibility for the water body outweighs considerations of the spatial distribution of recreation use over a river's course or by people living beyond catchment boundaries. Whether "the population" is conceived as a group of individuals or a group of households, affects not just the wording of the questions or even the type of survey conducted. It determines whether or not people can be considered to have fixed locations for the spatial interpretation of their answers.

Survey by household having been selected, this also needs defining - whether or not to include the extents of property owned or simply the address. As will be discussed, some indications from the results suggest using cadastral information may have been relevant. However, in the UK the lack of a formal cadastral system makes this difficult (Morad 2002) and with returns being anonymous the degree to which the two factors could in anycase be linked would be limited. So the "household" is now defined as those living in a given address[3], the location of which is defined by a point rather than an area.

[3] Obtaining information as to the demographic composition of residents within a property is extremely difficult in the UK (Rindfuss et al. 2003).

Before considering the sampling technique its self, there is one final aspect to define from the summary presented. Where, in terms of location relative to the river, the population to be sampled is, has been considered. Where, in terms of place or environ, remains and is closely related to “who” (that is what kind of person) is to be sampled. Clearly it is desirable that a group of people representative of the population as a whole be obtained, including minority views. However, although the cadastral information has already been excluded, it has to be recognised that the opinions of those controlling more land, have more potential influence on the water than those with less. So sampling purely by democratic count may miss some of the dynamics in terms of influence. Similarly, spatial change in factors such as water quality may mean that the views of people with a common experience from a low population area, are lost under the weight of higher density urban areas with different experiences. More succinctly, a spatial minority may be either an area under populated by human representatives, or a population concentration under represented by the area it controls. This relates to the importance of place rather than location (Johnstone 2003). The issue of place and person has been left until now since ideally both the range of people and of places could be included. In reality these two dimensions are spatially too close to be pragmatically distinguished.

5 Who or Where – Conceptual idea or Sampling Rate?

Stratification is employed for two purposes. Firstly stratification for inclusion – that is to ensure a comprehensive pattern is provided by the results for a given sampling

effort. Secondly extraction, that is to allow key elements of the pattern to be extracted from results and analysed. Stratification for inclusion has the pragmatic limit that a sufficient number of samples must be taken from across area and social class to get the full picture. Stratification for extraction allows particular groups of people (e.g. spatial clusters or socio-economic types) to be identified so their responses can be compared, the pragmatic limit in this case is that sufficient samples must be taken within each strata to maintain the confidentiality of respondents from each group. The difficulty is that spatially, similar socio-economic groups tend to cluster together (Dietz 2002), so it becomes an additional spatial strata.

Overlaying the spatial pattern of socio-economic groups with that which is of interest in terms of living environ, location relative to the water course *and* natural ground water quality determinants. The numbers of people within each segment available to sample may not be sufficient to maintain confidentiality and a statistically significant sample rate. A decision needs to be made which of these four aspects so far considered are the most relevant variables to extract from the stratification in order to compare responses between groups within them?

Location relative to the water may be key to better understanding the catchment as a community – does the whole catchment feel the river is a vernacular feature as suggested.

“Place” (specifically the urban or rural nature of the living environ) is related to specific factors such as access to public water services and access to recreation, as

well as, perhaps, socio-economic and other more general attitudinal factors (Bonaito, Fornara & Bonnes 2003, Giles-Corti & Donovan 2002).

The inclusion of strata related to the bio-physical determinants of ground water could inform regional experiences, however it was considered only relevant to the secondary question of concern over private water supply quality. It will be acknowledged later that this may have been a limitation, albeit a necessary one.

Socio-economic status is likely to have connections to both water usage and attitudes (through selection of living environ or choice of recreation). However socio-economic variables bring extra complications in that the census information with which to stratify samples is only available for set "Output Areas" (OA), it is not per address information. This makes combining its information with either of the other two factors prone to error, particularly since for many OA's the population is too low to maintain confidentiality. Catchment wide classes would need to be created which would be difficult to develop for both intra- and inter-catchment comparisons. For these reasons it was decided to ensure *spatially* the inclusion of socio-economic groups but not to attempt to extract the socio-economic characteristics of respondent groups.

Having selected "place" as the final subject of interest, it needs to be spatially defined. Although the significant components of an Urban or Rural environment have been described, how to measure these proved difficult. Officially defined urban boundaries or administrative boundaries would have no explicitly causal relationship to the criterion of interest, being based on many different factors (Rindfuss et al.

2003). This could be argued as being a positive advantage but it is not a random definition with no preconceptions, there will be common factors to water in administrative areas, rather it is a structured definition the significance of which is unknown.

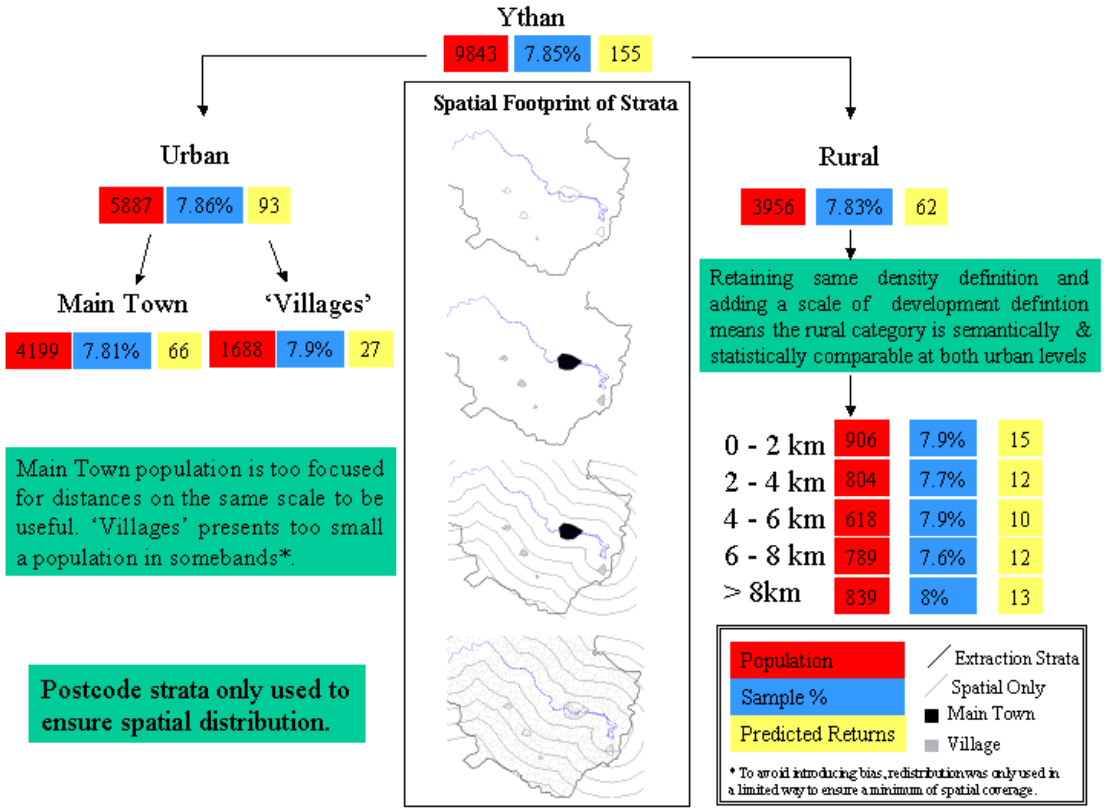
Since the purpose of the definition of an address as urban or rural was to establish its *individual* characteristics it was decided to use a cluster algorithm to consider each individual property's environment. This made the basis for defining each property explicit and portable to different areas within Scotland. Using a housing density based criterion would also pick up individual circumstances relevant to *both* the provision of facilities such as private water and the experience of surroundings as "urban". Importantly the cluster definition does not necessarily view one half of the subjects of interest through the perspective of the other (as would be the case if access to public water supplies were part of the definition of urban for example).

Selection of a good definition for an urban cluster also proved tricky. The concept is, from a Scottish perspective, conditioned by the size of other towns in Scotland. Official systems, designed for the UK as a whole, often missed local variations (Rindfuss et al. 2003, Asthana et. al 2002). Absolute numbers for more sparsely populated countries such as the official Canadian definition of 400 persons per km^2 (du Plessis et al. 2002) also proved too stringent and aimed at major towns and cities. The Swedish definition (Malbert 2003) of another house within 200 m proved to classify too much area as "urban" on property density alone, it had the additional criterion of 200 people in the town but it was addresses not population being surveyed in this case.

The method selected was a radial density to avoid small “ribbon” developments being included, the intention being to pick out only those addresses (rather than villages/towns) with a substantively urban character. As such the terms Main Town and Villages are post-selection terms for two scales of urban development, not two different densities of urbanisation *per address* , i.e. Main Town and Village describe if the *address* is within a small urban area or a large one.

The actual radius was adjusted to achieve a clustering which matched a qualitative assessment of OS building layers and picked out the key small towns/villages plus a strong boundary for the main towns (see Rindfuss et al. 2003 p.11). The resulting required density was 100 addresses in a 1km radius. Urbanisation per address defined, the clusters for large towns were separated from villages by property address[4].

Figure 2 – The Stratification Hierarchy



Together the spatial objects so defined produced a hierarchical stratification of nine different groups as illustrated in figure 2.The central column of maps shows (approximately) the spatial division produced by each stratification and how this accumulates to smaller areas. This clearly shows why the number of extractable strata is necessarily limited, text in green provides details, however the hierarchical design allows results to be considered at different scales and careful selection of criterion on which to base such divisions maximizes utility for interpretation without necessarily introducing extra levels of spatial division. For example, basing the division between urban and village on the scale of settlement rather than two density definitions means that the issue at question as to the position of a property as "urban" is clear once they

[4] Average standard deviation in predicted variance between Maintown, Village and Rural categories was 5% (based on binomial confidences for the Ythan at 20% returns (pra inc 2001) and a 75% to 25% split in opinion.)

are combined while a looser definition, better suited to defining villages, would leave outliers not suited to a broader classification as urban.

It should be noted here that the term villages is technically a misnomer, since the intent was to identify degree of per address urbanisation, it has been used in the public dissemination of survey results however since in the context of the catchments surveyed, beyond the Main Town, lack of other smaller towns meant urban addresses were de-facto also in villages.

The key distinction to be drawn between “urban” village addresses and non urban village addresses is that the urban addresses meet the same density criterion as the addresses surveyed in the main-town but differ in terms of scale and thus “main town” facets, eg. recreational or water facilities that require a critical mass as well as density of population to be viable. The distinction then addresses two different dimensions – density and scale, adding in a second density criterion to better catch village addresses would divide the urban space up by four potential sub combinations and leave a question as to how to include non-urban village addresses in the higher urban-rural comparison since they would inevitably have far too small a relative population to be comparable with all urban and all rural categories. From a pragmatic perspective, avoiding the density subdivision this provides a fall back position in the event that returns are too low be reliable for the finer classification.

Sampling

Compared to the time taken in defining the spatial objects which are used to stratify the sample, the sampling system its self was comparatively straightforward:

> For each stratification, the address-points were over-lain with the post-code boundaries and one random address at a time selected from random post-codes without using the same area twice until all spatial units had been used. Repeat this procedure until the required sample size is achieved.

In addition to providing extractable groupings, the spatial strata discussed play a role in improving the chances of an inclusive overall sample. The Urban/Rural split helps ensure the correct sample is achieved between these two groups, as does that between Main Town and Villages, while the distance buffers applied to rural addresses ensure the correct proportions are sampled with regards to distances from the water body. Using a geometric layer such as Post-code areas (or their corresponding OA) then ensures the distribution within each of these spatial strata covers the whole area of population. The population of each OA was not included as a factor since density of addresses within each of the Rural and Urban groups would not be too dissimilar (it is in anycase reflected in the post-code geometry also). As it was, any small bias towards higher sampling rates for relatively less dense postcodes and OAs is considered beneficial to representing spatial-minority opinion, however if variation was high population density could be used to further even out the sampling rate. To ensure an even geographic spread a geometric shape may also be sufficient, however

post-code geography is defined by population variation and is the base unit for the census OA so effectively ensures an inclusive picture of opinion from the range of socio-economic groups as thereby reported.

With small sample rates in each catchment, 8-10% of up to 10000 people and low population densities, the most likely spatial result is never-the-less unlikely to be achieved by a given random selection (Burrough and McDonnell 1998). By sampling the same proportion of addresses from each strata an over all distribution is achieved which is similar to that most likely from a simple random sample. Figure 1 shows the final distribution of samples for each catchment.

Farmers

Lower numbers, plus the complication of establishing extents and locations of farm land meant that a mixed survey was adopted consisting of 100% of farmers identified within the catchment and 50% of those outside (but close enough to potentially have land within the catchment). For the later survey 100% samples were attempted in each catchment.

The nature of the farm and whether or not it included land within the catchment, rather than the location of the farm house, was seen as the most important factor as much of the first survey of farmers considered commercial impact on, rather than personal use of, water. Since there was no reliable way of pre-stratifying these, it was asked within the survey. Highlighting the importance of location in sampling design under the WFD, some evidence will be considered that not including the location of

the farms within the catchment, may have been an oversight for the later survey where personal use of water was included in the questions.

Results

It is the success or otherwise of the methodology in establishing interesting and reliable information for the sampling effort which is of prime interest to this paper (rather than the results of the survey per. se.). On average, in the population survey, a response rate of around 19**%** was received, giving an average absolute sample of 2.5% from around 8% of the population. For most questions responses were sufficiently numerous and gave sufficiently distinct decisions to make reasonably confident predictions for the over all population and for comparison between catchments. Though some un-evenness cannot be ruled out, it was felt reasonable to assume that stratification for spatial inclusion has been successful given response rates in the different strata (see table 1). One factor that cannot be accounted for here is the possibility of clustered respondents due to, for example, easy access to a postbox.

Stratification by Location

In terms of distance relationships, absolute response numbers (**table 1**) were sometimes too low for individual distance bands to make reliable cross-tabulations with regards to the significance of distance. While limited redistribution of sampling effort between urban and rural was used to ensure minimum sampling rates, if distance relationships were the primary concern, there may be some argument for more significant redistribution. Any such redistribution would inevitably impact on

the survey's representativeness of the population as a whole. In addition to the problem of low numbers, when comparing distance band results across catchments, the variable nature of water as a spatial entity is highlighted. The River Ugie does not have an 8 – 10 km distance band within its catchment and the true effect of a split river course as regards distance effects is difficult to establish.

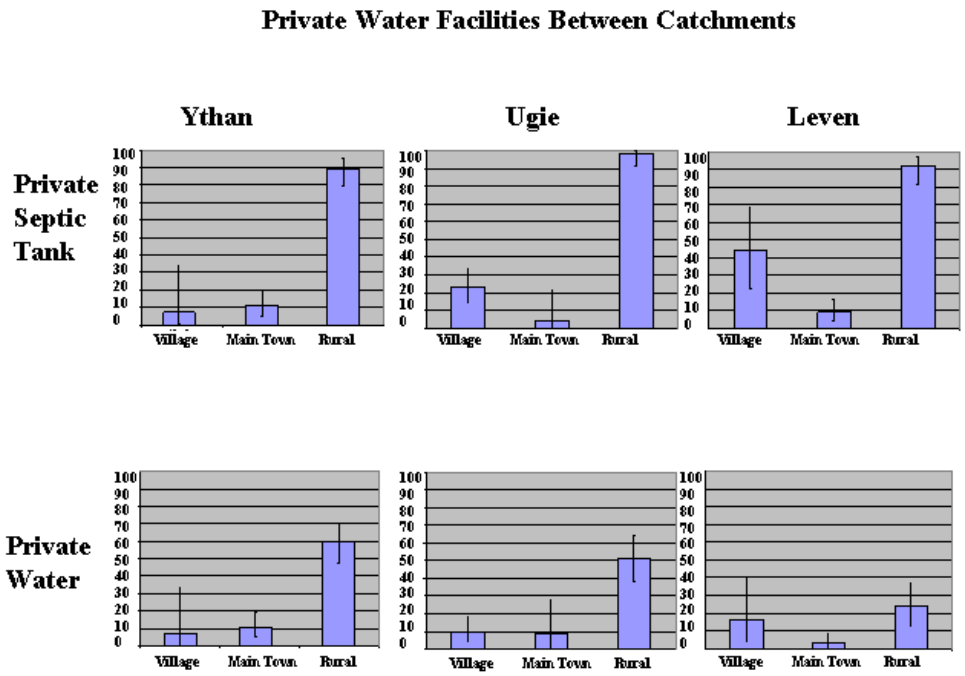
Results from the Ythan *indicated* that there may be some inverse relationship between distance and the frequency of use of the river, but no clear result for rates of usage per. population by distance. Alternatively, results from the Ugie and Leven catchments *indicated* that rates of usage increased with distance from the river. Both are plausible and not mutually exclusive results and it is hoped the additional numbers from the final survey will indicate their validity or otherwise. It is, none-the-less, accepted that the distance strata required an ambitious return rate, they functioned well as a stratification for inclusion but the ability to aggregate up the hierachy proved prudent.

Stratification by place

Due to the small numbers problem on some questions, most analysis was done according to place rather than distance. Division by Main Town, Village and Rural reduced numbers but for most questions a reasonable understanding was gained in that the ranking between the three categories could be ascertained with some confidence[5].

[5] Confidence in a result being if the error bars were balanced and small enough such that the majority opinion is not likely to be in question.

Figure 3 – Domestic Sanitation



As with the stratification for location, the spatial arrangements of addresses with regards to the definition of place proved important. That there are any addresses at all in Main Town urban areas that have private water or a septic tank is perhaps surprising (**Fig 3**) but the "boundary" between dense and sparse is a continuous one and urban boundaries are thus necessarily fuzzy. That septic tank use is so much more distinguishable by the clustering than private water illustrates the problem well. Public water supplies can viably reach further into the countryside than the more expensive sewerage systems. A lower cluster density requirement may have picked up the public water supply boundary better but given the impression of more urban addresses having septic tanks, yet both facilities are features which might have been used in the defining of an urbanised environment (such as an administrative boundary).

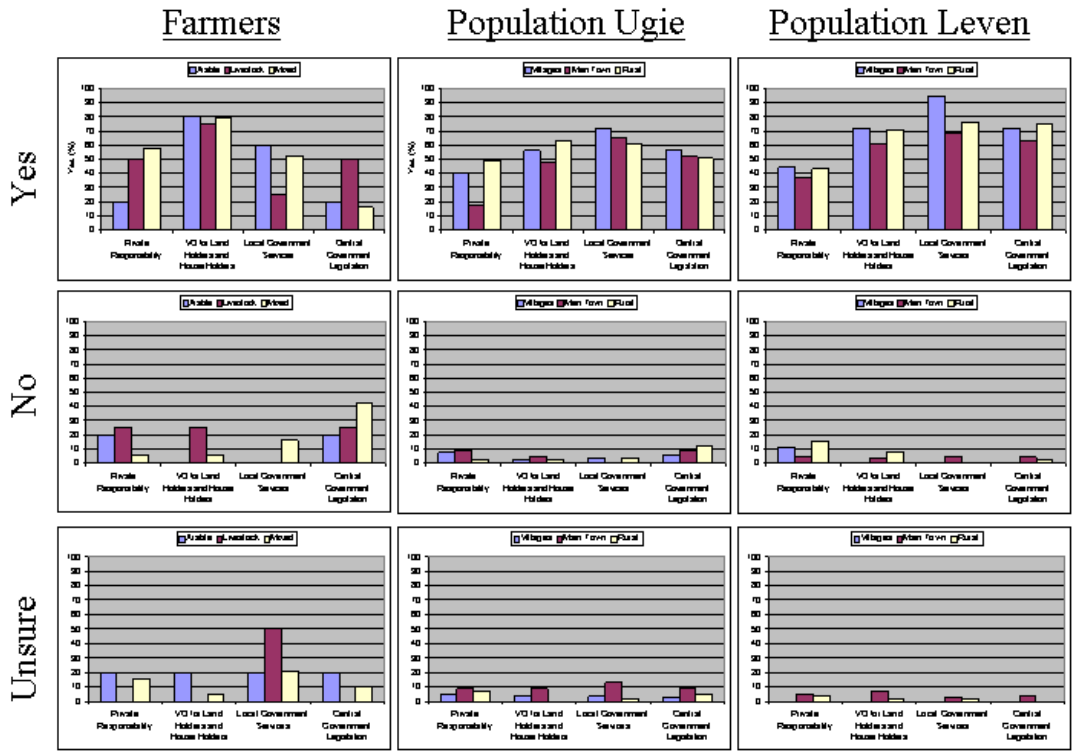
Leven is a significantly smaller catchment than the Ythan or Ugie, which may go part way to explaining its high rates of public water supply to Rural areas. That unexpected factors may come into play in this way demonstrates the importance of having consistently sized units, a possible issue given the tendency under WFD and other cross-compliance projects to take the catchment as a "natural" statistical unit (**EU 2003)**.

A example result from the spatial 'extraction' strata - Place and "Proximity"

The idea of psychological proximity[6] was first raised by answers to the question of whether the Ythan Project was a good idea. That is do people who individually, or as a community, have more direct experience of, and/or responsibility for the river environment view the project differently? If so is the mechanism one of self-interest or greater awareness?

In the Ythan catchment, Ellon and Villages returned high rates of support for the project. Rural areas returned lower rates stating that it was a good idea but most of the remainder was unsure rather than negative. This result combined with the fact that Rural areas returned significantly higher rates of those willing to get involved with the project than did Main Town responses, suggests a cautious rather than negative attitude from the Rural community as a whole. There may be demographic factors in play so too much should not be made of that result alone. The higher rate for Villages is subject to considerable error, though is most likely at least similar to returns for rural areas.

Figure 4 – Preference by approach to management



For Ugie and Leven it was felt that the Ythan Project would be more theoretical to the reader. So the question as to whether or not respondents thought the Ythan Project was a good idea, was replaced by a more generalised question designed to ascertain what approaches the respondent would support (f**ig 4).** The first thing to be noted about responses to this question, which is pertinent to the idea of proximity to the issues, is the high response rate. Indeed many people responded to this question alone. One interpretation would be that this question has clear policy implications, and therefore responses to the questionnaire could affect the "big picture" giving everyone a stake in providing an answer, whether or not they view themselves as being able to have a significant effect personally. The graphs presented in fig 4 are in

[6] The term "psychological proximity" has been developed to distinguish between that perception of importance that non-the less leaves the subject as abstract and a perception that the issue is personally important and thus merits an active response.

percentages of the absolute votes *for each option*, so represent over all interest in the option from each Place as well as balance of opinion within respondents.

In Ugie responses for individual/voluntary responsibility are consistently lower from the Urban areas than from Rural and higher for Local and central government involvement. In Leven the distinction is less clear, mainly since rural areas are more in favour of some form of state intervention. However the balance of votes from urban areas does lean more towards state intervention and away from private/voluntary than is the case for rural areas.

Clearly there is a context whereby there may be greater opportunity for individual action in villages or rural areas both from a social cohesion to scale of problem point of view and in terms of private ownership of land and sanitation facilities. It could also be seen as a preference by those with the responsibility of individual action to not be required by taxation or legislation. This “self interest” effect is not born out by the over all view however as local government action consistently comes out highly and, even for rural areas where a majority of respondents have private sanitation, central legislation is selected more often than private responsibility. The consensus between the places seems to be on organised action, arguably with the varying degree of state aid or compulsion resulting from different perceptions of proximity. The final piece of evidence relating to this issue of proximity is provided when the replies to the farmers’ surveys are considered.

Farms

Response rates from farmers in the Ythan and Ugie were good, perhaps a direct result of a high awareness of the project since for the Leven catchment the return was so low that it was not separately analysed for farmers. Reliability in the remaining two catchments was very good, as was that for the largest subcategory of farm type, Mixed farms. Smaller numbers did produce more variance for Arable and Livestock categories though not critically so.

In the Ythan catchment survey distribution of farm type was similar for farms within and outwith the Ythan catchment. That proximity to the issue has an effect on responses is suggested therefore by the fact that those outside the catchment were more likely to consider the Ythan project to be a good idea and more likely to be (in theory) willing to accept volunteers [7].

In the second survey, responses to the attitudinal question also showed this proximity effect. There is a definite bias towards voluntary measures and away from legislative measures compared to the answers from the general population. Farmers also had stronger views on the question with higher "No" responses as against unsure. Unsure responses were also higher, particularly for local government.

While the initial impression might be one that farmer's are primarily concerned with the costs of central or local government involvement, the picture is not that simple.

[7] Despite the assurances of anonymity and confidentiality, some comments from farmers suggested concern as to what stating willingness in principle would effectively commit themselves to in future. This highlights the need for great care in making the status of a survey clear, particularly when it carries official logos from institutions such as the EC.

Farmers rated voluntary organisations more highly than did the general population and evidence from the Ythan survey suggests that farmers are slightly more willing to participate in such voluntary organisations. 34% of farmers were willing to accept volunteers on their land with the majority unsure rather than negative, this compared to 24% of the population being interested in volunteering[8].

So it would be too simplistic to suggest that farmers are less committed to environmental protection (since they are more reluctant to accept legislative measures) or that the general population is less committed since they are less willing to take personal measures. Rather, there appears to be a difference in "proximity" to the issues, in perceived responsibility / ability with regards to them, particularly as between Urban populations and Farmers, with Rural populations being in-between.

A spatial definition of a social phenomenon has allowed an important potential dimension of how people approach the issues of environmental protection to be distinguished. However before concluding that this necessarily runs from large urban populations at one end of the scale to those working on the land at the other, two pieces of evidence raised the question that perhaps the necessary exclusion of certain spatial factors discussed above may have left an incomplete picture.

When the second survey's Farmer responses were divided by ownership of private water supplies, the result was very strongly towards private and voluntary for those with private supplies but for those with public supplies the pattern was more evenly distributed, with higher rates for local and central government involvement. This

[8] Volunteers are not cost free, there are public liability concerns and insurance costs.

suggests that the link may be in part due to the unusual position of farmers as large landholders with, in most cases, private water supplies and leads to caution as regards interpreting the farmers' responses as being made necessarily on a commercial basis. Having cadastral information as to the size and position of farms might therefore have been of use in determining to what extent it was this, rather than occupation which influenced farmers responses.

Livestock farmers returned a significantly different pattern from the Mixed and Arable farmers, one much more in favour of central legislation than other farm groups. Livestock farmers also expressed most concern with regards to their private water supplies' quality. This may be related to their use of the farm for livestock, but this applies to Mixed farms too, so it may be a result of the likely spatial auto-correlation of different farming types. It may be that live stock farms coincide with areas of poor ground water. To determine which, an extractable stratification of farmer surveys by location may have been desirable, although probably impossible under privacy regulations for cadastral information and sampling rates.

Awareness of the Project and Information Dissemination.

Ultimately the ability to extract spatial relationships within the catchments was a secondary aim. The primary aim of the survey was to assess awareness in the catchments overall and direct future information dissemination. Stratification by place has provided some additional interesting detail to consider for this.

It would seem in the case of Ugie that the more urbanised the area, the greater the fall in awareness of the project from the levels recorded in the Ythan catchment survey. While the fall in awareness is much greater for Leven, as would be expected, the difference in awareness between the Places is no longer statistically significant. It would seem that awareness of the project at this distance is either by chance regardless of Place or because the mechanisms which sustained higher awareness in more Rural areas for Ugie and Ythan do not extend as far as Leven**.** Logically this is likely to be due to the fact that national press has a longer reach but also a broader one than word of mouth or local initiatives. It is hoped to assess more comprehensively the reliability of these initial indications and the nature of dissemination in the final survey.

Conclusion

It was stated at the beginning that spatial sampling was undertaken for two purposes, *Inclusion* of the range of views from people and the places and locations they occupy or represent. *Extraction* of the significance of spatial factors (place and location) for the questions of interest.

In terms of spatial inclusion, to the extent it can be determined the technique seems to have worked reasonably well:

- Returns were structured to reflect the correct proportions of population relative to distance from the water.

- Population clusters were largely separated out such that they did not affect the spatial sampling of low-density areas.
- While it cannot be guaranteed, given the ratio of postcode sampling areas to samples taken, it is unlikely that the distribution of returns within each stratum was significantly spatially biased.

In terms of extraction, Place was useful, however, given the sample numbers, the variance for location was disappointing and the facility to aggregate these to higher level stratifications proved worthwhile:

- The Location stratification may indicate two different relationships between recreation use and distance, one for frequency and one for rate of uptake. To confirm this higher sampling effort and/or greater redistribution of effort to rural areas will be necessary.

- The problems of sampling rate experienced for the distance strata confirm the utility of a hierarchical stratification when the lower level is considered ambitious given resources.

- The “Place” strata proved useful in its self, identifying the potential significance of place in the dissemination of information particularly as between urban and rural, to confirm this will require a inter-catchment transect approach.
- The reason for using an individual property based definition of urban, rather than administrative boundaries, is highlighted by its picking up

the distinction in distance between private septic tank ownership and private water supply.

- Being able to distinguish the different variation for septic tanks and water supply across catchments highlighted the fact that while catchments may be natural geographic units, they are not neutral statistical ones.

- The different results in opinion on private-public responsibility between farmers in general and livestock farmers in particular, is a reminder to look behind clear results for other, possibly spatial explanations.

In addition to these specific examples from the survey, this paper draws two general conclusions. The first is that considering the precise conceptual definition of each element in a survey is critical. The spatial expression of these different definitions can magnify and compound their effect. This is particularly so in this case as water is a particularly complex spatial phenomenon for which the WFD requires such a broad range of information. In particular, if other EU and UK Government objectives on the collection and re-use of data (Masser 1997) are to be observed then the objectives of one survey may have to compromise with the objectives of others within the system, thus for example pollution surveys may need to consider recreation hotspots in their design.

White and How predict that under the WFD some of the influence of "knowledgeable interest groups and industry" (2003) will transfer to public opinion. However that opinion will be garnered by NGOs, industry and government experts and, whether party to a specific interest group or not, it is essential that the conceptual design, so critical to the proper analysis of results, is both consistent and publicly available. It is hoped that this paper, in presenting both the benefits and limitations of the methodology chosen for one survey, will encourage openness and the development of the best practice guidelines called for at the World Wildlife Fund seminar.

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TABLE 1

Strata	Ythan	Ugie	Leven
All	22.1%	36.1%	17.4%
Urban	20.9%	16.8%	15%
Rural	23.8%	20.7%	28%
Main Town	25.3%	18.1%	14.2%
Villages	10.3%	16.6%	21.2%
Rural < 2km	19.4%	16.6%	30%
Rural 2km – 4 km	24.1%	35.1%	32.4%
Rural 4 km – 6 km	34.6%	15%	17.6%
Rural 6 km – 8km	18.3%	26.7%	25%
Rural > 8km	25.3%	NA	30%
		Ugie and Leven * Farmer returns were combined due to low response rate from Leven catchment.	
Farmers	31.3%	21.3%	