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# Predictive Model of Responsible Environmental Behaviour: Application as a Visitor-Monitoring Tool

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Abstract: This working paper presents a framework for understanding responsible environmental behaviour as a visitor-monitoring tool. Visitor use data forms the basis of any successful visitor management plan to understand user knowledge, awareness and attitudes about pollution issues in order to develop management policies and actions that enhance appropriate visitor behaviour. A case study of the application of a predictive behavioural model on the Chesapeake Bay, Maryland, USA involving boater environmental behaviour as a social indicator is discussed. Results indicate that knowledge of water pollution issues, awareness of the consequences, equipment issues such as boat length and boat type, and situational factors that constrain or hinder appropriate behaviour were indicators of appropriate behaviour. A structural equation path diagram model was tested using AMOS student version 4.01 using up to seven of the eight predictors from boating behaviour case study to demonstrate the strength of a path analysis procedure. Results model those of the stepwise regression procedures used in the original study, yet the path diagrams demonstrate ease of interpreting the structural relationships among variables in a regression equation. Implications for management actions in the case study situation are given followed by a proposed research-monitoring program coupling social science techniques with the natural sciences.

## INTRODUCTION

The environmental impacts of recreational boating in protected waters are recognised, but not well understood. Much of the available information is descriptive or anecdotal, with little hard data and analysis. Most studies are of a short-term nature, and long-term impacts are rarely addressed. The monitoring of environmental impacts of boating is not carried out in the majority of protected area marine parks in developing countries. There is rarely any baseline data with which to compare current situations, and neither is time-series data available for analysing trends. There is a lack of integrated monitoring and management, and no definition of indicators by which to evaluate the environmental performance of protected area tourism. It is recommended that simple social and environmental impact monitoring strategies are implemented, and controls on certain aspects of visitor and boater use are enforced (Goodwin et al., 1997). This paper examines specific issue responsible environmental behaviour as a social indicator in visitor monitoring within a marine resource setting. However, note that the concepts are intended for a broader context of visitor monitoring in protected areas.

Since the 1970's, the concern for the environmental quality of our planet has generated much research on the measurement of responsible environmental behaviour. From a social psychological perspective, environmental quality represents a collective action and a social norm problem (Heberlein, 1975). A litter-free beach zone, for instance, can only be achieved when the vast majority of sun-seekers dispose of their trash appropriately. Similarly, a pollution free marine park will not be realised if visitors do not collectively adhere to the regulations regarding waste disposal. General responsible environmental behaviour is defined as any individual or group action aimed to do what is right to help protect the environment in general daily practise – e.g., recycling (Sivek & Hungerford, 1989-1990). Meanwhile, specific responsible environmental behaviour is any behaviour that is more activity specific in nature (e.g., littering while backpacking in an alpine region) as related to rule compliance or illegal, inappropriate, or non-sustainable behaviour (Heberlein & Black, 1976; Hungerford & Volk, 1990). Although studies of attitudes towards specific issues are limited in overall generalisiability beyond the environmental issues under examination, the literature indicates that attitude measures specific to a given behaviour are better predictors of that behaviour than are more general measures (Cottrell & Graefe, 1997; Heberlein & Black, 1976; Hungerford & Volk, 1990; Marcinkowski, 1988). Yet, research implications imply that by including both, one can better predict behaviour from attitudes and show how actions and beliefs are part of a larger cognitive construct. By including both issue-specific and general attitudes within a predictive model, findings enhance further understanding of the interrelation between variables pertinent to the illegal or nonsustainable behaviour in question.

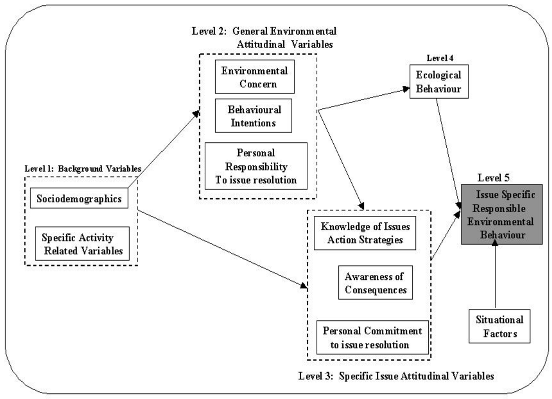
The purpose of this working paper is to present a framework for understanding responsible environmental behaviour as a visitor-monitoring tool (see Figure 1). The basis of a successful visitor management plan is the collection of visitor use data to understand user behaviour, needs, and expectations in order to develop management policies and actions that enhance appropriate visitor behaviour. Next follows a brief summary of a case study of boating impacts on the Chesapeake Bay in Maryland in which a similar predictive model was applied. A structural equation path diagram model was tested using AMOS student version 4.01 with up to seven of the eight predictors from the boating behaviour case study data to demonstrate the strength of a path analysis procedure. Results model those of the stepwise regression procedures used in the original study, yet the path diagrams demonstrate ease of interpretation of the structural relationships among variables in a regression equation. Finally, a proposed research design including visitor surveys of both observed and unobserved rule compliant boaters for comparison of results follow this up.

## PREDICTIVE MODEL OF RESPONSIBLE ENVIRONMENTAL BEHAVIOR

This framework was based on recommendations found in the environmental behaviour literature to test a predictive model of responsible environmental behaviour including both general and specific issue behaviours (Hines et al., 1986/87; Hungerford & Volk, 1990; Sivek & Hungerford, 1989/90). Findings from previous testing (see Cottrell, 1993; Cottrell & Graefe, 1997) of a similar model imply that background variables (i.e., education and specific activity related variables), environmental concern, knowledge of environmental issues and awareness of the consequences of behaviour, were moderate to strong predictors of behaviour in both general and specific issue situations. Secondly, the more specific the indicator of behaviour, the better predictive ability that indicator had of specific behaviour. The author argues that a predictive model of responsible environmental behaviour is a useful tool for monitoring visitor behaviour pertinent to a greater understanding of behaviour leading to better visitor management planning.

Figure 1 shows five levels of variables arranged from left to right to represent an increasing strength of relationship between those variables and the primary dependent variable (specific issue responsible environmental behaviour (SREB)). Activity specific variables (i.e., activity type, equipment, skill level, participation, past experience), income, age, education, and political ideologies are some variables that comprise an individual's background. Background characteristics (level 1) precede other variables in the model and are necessary to understand responsible environmental behaviour (Cottrell & Graefe, 1997; Dunlap & Van Liere, 1984; Hines et al., 1987; Marcinskowski, 1988).

*Figure 1. Predictive Framework of Responsible Environmental Behaviour (adapted from Cottrell, 1993).*




The next two levels in the framework show two groups of variables: general environmental attitudinal and specific issue attitudinal variables. The general environmental group (level 2) includes environmental concern, behavioural intentions, and personal responsibility for issue resolution. As concern (item adopted from Dunlap & Van Liere, 1978) for different aspects of the environment develops, more specific attitudes about specific acts (e.g., water pollution) will evolve and influence feelings of personal responsibility toward an action and verbal commitment to an issue or problem resolution. Ajzen (1991) posed a theory of planned behaviour that has been used to examine indicators of responsible environmental behaviour (see Ajzen in Hrubes et al., 2001). In summary, his theory refers to human action that is guided by three forms of belief: behavioural – beliefs about the likely consequences of the behaviour, normative - beliefs about the normative expectations of others, and control - beliefs about the presence of factors that may further or hinder performance of the behaviour, a form of locus of control. Hrubes et al. (2001) argues that intentions remain a central indicator of actual behaviour and previous studies support their claim (Cottrell, 1993; Cottrell & Graefe, 1997).

An ecological behaviour scale is available and has been tested in a number of studies (Hartig, Kaiser, & Bowler, 2001; Kaiser, Ranney, Hartig, and Bowler, 1999). The scale consists of 51 items, which represent different types of ecological behaviour. This scale offers a more current construct of general environmental behaviour than used in Cottrell's (1993) dissertation and may result in a greater percentage of variance explained by the combined effect of the predictor variables in a regression model. In summary, the level 2 variables are shown to directly influence the specific issue group of variables (level 3) and to directly influence ecological behaviour (level 4), which in turn, influences specific REB (level 5).

The specific issue group of variables (level 3) includes knowledge of issues, which breaks down into three scales (i.e., knowledge about water pollution, knowledge about the laws pertinent to the specific issue and action strategies for rule compliance), awareness of consequences, and personal commitment to issue resolution. In order for an individual to act responsibly towards a given object or situation, a person must have some knowledge or information about it. For instance, to engage in recycling, they must know what they can recycle, where to take the recyclable, and when. Third, some awareness about consequences (e.g., threats to the marine environment) resulting from recycling may influence actual behaviour. Awareness of consequences of behaviour influences personal commitment for a particular action (Heberlein & Black, 1976). The stronger the sense of responsibility, the stronger the personal commitment to performing a particular act should be. Specific issue REB is shaded dark grey to denote its position as the primary dependent variable. Lastly, even though an individual's intentions to comply responsibly may be positive, certain situations and/or constraints might interfere with actual behaviour. Therefore, the variable category, situational factors, is shown in the diagram to influence actual behaviour.

## BOATING CASE STUDY

The predictive model of responsible environmental behaviour was tested in an examination of responsible environmental boating behaviour on the Chesapeake Bay in Maryland (see Cottrell's dissertation, 1993). The following paragraphs summarise the main study results within the context of managing for sewage disposal from boaters as used by the Maryland State Boating Administration, USA.

### *Background*

Recreational boating represents an important activity as it pertains to travel and tourism in the Chesapeake Region where there are an estimated 200,000-registered boats. Chesapeake Bay, the largest coastal embayment on the eastern seaboard, provides excellent opportunities for pleasure boating from sailing to sunbathing. The bay also provides areas for recreational claming, fishing, and crabbing. These recreational boating activities can have a potentially large impact on water quality via the dumping of raw sewage by boaters in high use areas (i.e., marinas, bays and lagoons) and pollution via hydrocarbon loading from boat exhausts. Sewage dumping is an important issue because of eutrophication caused by increased nutrient loads, hypoxia resulting from nutrient loading, high turbidity, and the release of coliform bacteria and other micro organisms of concern to human health. Marine toilets that directly discharge raw sewage are illegal in US territorial waters (i.e., within three miles of the coast). While the effect of a single boat may seem insignificant, the large number of boats on the water, especially during periods of peak use (weekends and holidays) lead to significant impacts on water quality. Marinas, boat anchorage's, and raft-up spots are typically located in quiet, protected waters such as small bays and inlets. Previous research has shown that these sites are frequently ecologically sensitive areas with restricted water flow, which means pollutants are flushed out slowly, thereby decreasing water quality. Recognising the threat of sewage from recreational boats to the quality of water in the Chesapeake Bay region, the General Assembly of Maryland passed legislation in 1988 to allow for use of waterway improvement funds to construct marine sewage pumpout facilities at public or private marinas (Arney, 1990; (Recreational Boat Pollution, 1991).

### *Problem clarification*

Methods of proper disposal of sewage are common knowledge among owners of vessels with portable or marine toilets with holding tanks; yet, most vessel owner/operators generally discharge raw effluent within the three-mile limit. Multiple factors and/or constraints contribute to this behaviour: the inconvenience of travelling offshore, lack of sewage dump stations in the local area, lack of accessible and/or inconvenience of dump station locations, lack of adequate law enforcement, lack of knowledge about coastal marine laws and about the potential threat raw sewage imposes to public health and living resources, and a lack of responsible environmental attitudes (Recreational Boat Pollution, 1991). Another factor contributing to the illegal discharge of raw effluent is that most marine head holding tanks are limited in overall capacity (e.g., 15 gallon capacity on a 35 foot vessel); therefore, when used properly holding tanks fill rapidly, which requires frequent pumping out. The cruising vessel underway daily and travelling offshore while pleasure cruising is able to pump out a holding tank on a frequent basis. However, for those live-aboard vessels that remain indefinitely at a mooring, proper disposal of sewage is inconvenient, although sewage dump stations may be easily accessible (Cottrell, 1993). Thus, the discharge of human waste from recreational boats on the Chesapeake Bay is one aspect of marine pollution to confront as part of the overall problem of marine pollution in protected area waters.

### *Methods*

This case study examined relationships between several of the variables depicted in Figure 1. Independent variables were age, boat length, boat type, years boating experience, knowledge about water pollution issues, awareness of the consequences of raw sewage on water quality, and the convenience of sewage pumpout station usage and the percent of human waste discharged in a sewage pumpout station (dependent variable - SREB). The methods used were:

- Household survey sent to 751 registered owners of boats 22 feet or longer to insure boats had a marine toilet. Sample was reduced to 713 due to insufficient addresses. Response was 41% (n=291), which was surprising due to self-reports of illegal behaviour (raw sewage discharge).
- Descriptive statistics, one-way analysis of variance, and multiple regression techniques were used to examine the predictive strength of the independent variables on the dependent variable (% sewage pumped in a pumpout station).

Note: for a complete overview of the analysis see Cottrell, 1993; Cottrell & Graefe, 1997.

*Selected Results*

Eight predictors of responsible environmental behaviour was determined accounting for 46% of the total variance explained in the % of waste pumped in a pumpout station (Cottrell & Graefe, 1994).

- As length of boat increased, % of waste pumped in a sewage pumpout station decreased[1].
- As years boating experience increased, sewage pumpout station usage decreased[1].
- As education & environmental concern increased, sewage pumpout station use decreased[1].
- As age of boaters increased, sewage pumpout station usage decreased[2]. Boaters 50 or less were more aware of the negative impacts raw sewage discharge has on water quality.

[1] Predictor variable(s) of specific behaviour in Cottrell, 1993.
[2] Correlate of specific behaviour only, Cottrell, 1993

Boat owners in this sample represent an affluent white middle/upper class group who have been boating a long time (average age=50; average years experience=21, boat length=31) and the implementation of a comprehensive SPS program in Maryland was recent at the time this study was conducted (1992). Findings indicate that there is a substantial difference between younger and older age boaters and their environmental attitudes and behaviour in this case study. Much of these results can be explained by situational factors – or in this case, those aspects of pumpout station usage that hinder appropriate behaviour. Although intentions to comply with certain laws or willingness to participate in pro-environmental behaviour may be high, each situation involves barriers or constraints to proactive behaviour (namely - cost, waiting in line, inconvenient location, closed facilities, and ease of use). To develop management implications requires an identification of those constraints to proactive behaviour. Thus, five constraints items combined to create a 5-point agreement scale to measure the convenience of SPS usage (mean=2.7). Reasons for the low mean score included cost, waiting in line, inconvenient location, closed facilities, and ease of use of pumpout stations.

Implications lead to further discussion about the convenience of SPS use and percentage of waste pumped into an SPS. In this case study, the convenience of SPS usage was significantly correlated with boat length. As length of boat increased, the convenience factor decreased, likewise, the percentage of waste pumped in an SPS decreased. Boat owners in this sample have relatively large boats (average length=31 feet). To manoeuvre a large boat within the confines of a marina setting is quite difficult at times. Thus, the degree of boating skill must be greater to bring a larger boat to an SPS location. In essence, to use a sanitation pumpout facility means that boaters must dock their boats twice, once to pump out and again on return to their dockage point. In sum, the larger the boat the less the boater used a sanitation pumpout station, and the more raw sewage was pumped in the Chesapeake Bay. Although an SPS in a marina is important, the convenience of SPS usage must be considered further on the part of marina management. For instance, mobile pumpout units are relatively inexpensive and easy to use, which may encourage further use by both older age cohorts and large boat owners.

- Upon examination of boat type, power boaters used an SPS (77% of waste pumped) significantly more than sailboaters (44%).

This finding relates to the convenience of use issue. Logic implies that powerboats are easier and quicker to manoeuvre than sailboats, which may influence the increased usage among powerboat owners.

Respondents were asked "what would make you use a pumpout station more often". Only 31% indicated that they use a pumpout station every time they go boating. Sixty-one percent said that more convenient hours would help and 42% felt that better designed facilities would encourage more use. Only 20% felt that shorter waiting lines would enhance more use; yet 51% thought that a lower cost to use a pumpout would be of benefit. 42% marked that availability of mobile pumpout units would facilitate more use (see Table 1).

| | N | % Yes |
|---|---|---|
| Always use pumpout stations | 213 | 31.5 |
| Availability of mobile facilities | 147 | 42.2 |
| More convenient location | 147 | 61.2 |
| More convenient hours | 147 | 42.2 |
| Shorter waiting lines | 147 | 19.7 |
| Better designed facilities | 147 | 42.2 |
| Lower cost of using facilities | 147 | 51.0 |

*Table 1. Percentage of response to use pumpout more often*

- As knowledge about water pollution issues, knowledge about the laws concerning discharge of waste at sea, and awareness of the consequences of human waste on water quality increased, sewage pumpout station usage increased; thereby indicating the strength of the knowledge and awareness related variables (note: predictor variables in Cottrell, 1993) .

In summary, these findings imply that public information and boater education may influence pro-environmental behaviour. Management implications suggest that a new approach is necessary to educate or encourage more SPS usage among this particular group of boaters (large boat owner's age 50 or greater).

*Conclusions*

From a monitoring of visitor behaviour perspective by focusing on responsible environmental behaviour as a social indicator of appropriate behaviour, Maryland State boating administration personal can see the need for alternative measures to encourage further use of pumpout stations in marinas. One conclusion was the need for more mobile pumpout units in large marinas occupied by elite boat owners. Secondly, location of fixed pumpout stations is critical to accessibility by larger boats. Thirdly, there was a large discrepancy between pumpout fees between marinas that participated in the federal grant reimbursement program ($5/pumpout) and those that did not ($15/pumpout). To pump raw sewage overboard from any location on the Chesapeake Bay is illegal. Due to the sensitive nature of this issue, measuring this specific behaviour (i.e., whether or not boaters pump raw effluent overboard) by self-reported methods was cause for some concern. Therefore, a replication of the study proposal is recommended (see study proposal later in the paper).

*Structural Equation Modelling – an example*

A structural equation path diagram (AMOS student version 4.01) was used to re-examine seven of the eight predictors of specific behaviour in the boating behaviour case study to demonstrate the strength of a path analysis procedure (See Cottrell & Graefe (1997) for the detailed operationalisation of the variables used in this analysis). ***Note*** that AMOS 4.01 student version limits the number of variables to eight total. Variables included were years boating experience, length of boat, formal education, knowledge of the law about discharge on inland waters, knowledge of water pollution issues, awareness of the consequences sewage has on water quality and environmental concern which explained 42% of the variance in the % of sewage pumped in a pumpout station on shore. Results resemble (see Figure 2) those of the stepwise regression procedures using SPSS software in the Cottrell & Graefe (1997) study ($R^2$ = .42; or 42% of the variance explained by seven variables), yet the path diagram demonstrates ease of interpretation of the structural relationships among variables in a regression equation. ***Note*** that the intent was not to report specific results of the path analysis but to demonstrate its potential as a statistical tool for analysis of complex relationships in visitor behaviour for monitoring purposes.

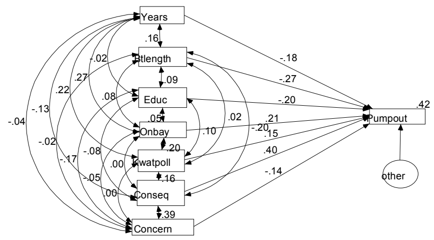



*Figure 2. Path diagram of predictors of specific responsible environmental behavior*

In Figure 2, the value -.18 between YEARS boating experience and PUMPOUT (the specific behaviour variable - % waste pumped in an SPS) is a standardised regression weight. The value .16 is the correlation between Years experience and Boatlength. The number .42 is the squared multiple correlation ($R^2$ value) of PUMPOUT with years experience, boatlength, formal education, knowledge of dumping laws on bay, knowledge of water pollution issues (KWATPOLL), awareness of the consequences of sewage discharge on water quality (CONSEQ), and environmental concern (CONCERN).

To further demonstrate path diagrams use as a statistical tool, three new variables (Awareness of Consequences; Ascription to Responsibility, and Behavioural Commitment) were introduced to the structural equation model replacing EDUC, CONCERN, and CONSEQ. The new variables (see Table 2) were operationalised as multiple item scales in accordance with recommendations of Vaske et al., (1997 unpublished) in their norm activation study of behaviour and introduced here on an exploratory basis.

| **Scaled item measures** |
|---|
| Awareness of Consequences Scale [1] |
| • Sewage discharge from boats is significant enough to cause disease |
| • Sewage discharge from boats contributes to water pollution |
| • Disposing sewage at proper sanitation facility on shore will significantly reduce the amount of water pollution. |
| Ascription of Responsibility Scale[1] |
| • I think I am doing enough to reduce water pollution |
| • I feel my own actions do not cause water pollution |
| Behaviour Commitment Scale [1] |
| • Make a special effort to use a marine sewage pumpout station when I go boating. |
| • Used a sanitation facility every time holding tank was full |

1. Variables coded on a 5-point scale from "strongly disagree" (1) to "strongly agree" (5).

*Table 2. New variables examined in Figure 3 Model*

This analysis was done in an attempt to increase the percentage of variance explained via the net effect of the seven variables. Years boating experience, boat length, onbay, and Kwatpoll remained in the diagram (see Figure 3).

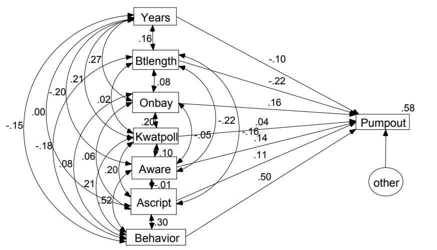



*Figure 3. Path diagram of new predictors of specific responsible environmental behavior*

Note that the squared multiple correlation value ($R^2$) increased from .42 in Figure 2 to .58 in Figure 3 indicating that the predictive strength of the seven variables combined explained 58% of the variance in the percentage of waste pumped in a PUMPOUT station on shore. In conclusion, AMOS path diagram software is useful to examine interrelationships between a set of attitudinal and behavioural variables to monitor visitor behaviour. By entering behavioural commitment, ascription to responsibility, and the reconstructed awareness of consequences variables the squared multiple correlation increased. Strength of other variables can be explored by entering them into the path diagram as well. Secondly, managers can examine those variables that have the greatest predictive strength - such as knowledge (onbay), awareness and behaviour commitment for instance, and the strength of the correlation between each to determine underlying relationships. In this case, as ascription of responsibility, behaviour commitment, and the awareness of consequences increased, the greater % of sewage boaters reported pumping in a pumpout station. Meanwhile, as boatlength increased the % of waste pumped decreased. The same holds true for years boating experience - which at first appears illogical. Therefore, examining the background variables becomes important to note differences in boater types, age, status, etc. In this case, as stated previously, affluent boaters with large boats need additional or alternative attention in terms of information and awareness raising measures to encourage a change in their behaviour.

## STUDY PROPOSAL IN THE WORKS

This study proposes to couple social science techniques with the natural sciences in a comparative study of environmental behaviour among boaters on the Chesapeake Bay, USA and the IJsselmeer, The Netherlands. The project proposes to direct sustainable economic growth and water resource utilisation in a coastal marine embayment while preserving its environmental quality and aid in the design of effective strategies for the management of marine water resources for recreational boating. The study will apply the model discussed previously (Figure 1) in combination with water quality data and GIS to link spatially both data sets to provide marine resource managers information to make decisions on the sustainable management of Inland waters for public recreational use. Objectives are: 1) To examine the Maryland Pumpout Station Grant Incentive Program through assessing usage of the pumpout stations and the percentage of human waste recreational boaters pump legally and/or illegally. 2) To examine water quality and pollution from boat exhausts in selected high-use areas to determine the impact of recreational boaters in those areas (e.g., a number of large marinas and popular anchorage's in both rural and metropolitan areas). 3) To identify recreational boaters' perceptions about specific water quality problems resulting from the illegal disposal of human waste. 4) To develop recommendations for enhancing boater education about sewage pumpout usage and responsible environmental boating behaviour at both a regional and national level. 5) To develop a Geographic Information System (GIS) database for display and analysis of data collected in Objectives 1 and 2. Benefits include: GIS maps illustrating the usage of sewage pumpout stations and water quality in high-use waterways adjacent to pumpout stations, and a descriptive profile of the boaters and their perceptions about water quality. Results may be used by resource managers to make recommendations for further public educational efforts and water resource management. Maps of water quality data will elucidate the degree of boating impact on water resources in high-use areas where pumpout stations are available and will serve as a benchmark for further Bay-wide strategies for managing boating resources to maintain high water quality. A direct economic benefit of this project will be to substantiate the effectiveness of expenditures by the Maryland DNR pumpout grant program. Indirect but equally important economic benefits will be those guidelines determined for the maintenance of water quality levels needed to support fisheries and waterways for pleasure boaters.

*Methods*

Proposed *social science methods* are: 1) A multiple mail survey sent to registered boat owners of vessels 22 feet or greater to assess boater behaviour with regard to sewage pumpout usage. 2) A number of marinas (accepting funds for pumpout stations) will be selected, one representing each of 15 counties bordering the Chesapeake Bay. A mail survey will be sent to boaters observed using pumpout stations at the 15 locations. Similar techniques will be used along the IJsselmeer. 3) A mail survey of marina managers will be conducted of those marinas participating in the pumpout grant program. Data derived from boaters and marina managers will help to establish linkages between pumpout station usage, gallons of sewage removed, and boater/marina manager perceptions of pumpout grant program effectiveness. Qualitative methods include both in-depth interviews of boaters and marina mangers and participant observation of visitors to the area in question.

*Natural science methods*: To assess impacts on water quality, several sites representing the highest percentage of boating use will be selected and sampled. At each site, surface and bottom water samples will be taken at high slack tide and maximum ebb tide, both adjacent to the high-use area and at the mouth of the estuary (entrance to the Bay). At these sites and times, we will analyse for nutrients (nitrate, phosphate), dissolved oxygen, turbidity, and polyaromatic hydrocarbons (an indicator of oil and gas contamination). In addition at each station, a surface sample will be taken in a sterile bottle for counting of fecal coliform bacteria. A pre-season sample will be taken as a control measure followed by sampling on holiday weekends. Additional sampling will occur on non-- holiday weekends and during the week to compare results of peak versus normal use. In this way, we will assess the environmental impact of recreational boating in terms of nutrient loading and fecal contamination from sewage discharge and hydrocarbon emission from boat exhaust. Impacts on the high use waterways and their inputs into the main basin of the Bay can then be integrated into the statistical model and GIS maps.

Analysis procedures involve multiple regression, path analysis or structural equation modelling to determine the predictive strength of the associated variables in the model. Findings and implications can thus be linked directly with those facets of visitor behaviour noted as inappropriate, illegal, or nonsustainable to develop direct and indirect action strategies aimed towards influencing appropriate user behaviour among visitors.

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