



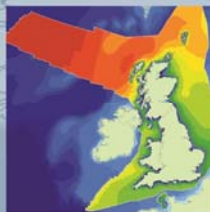
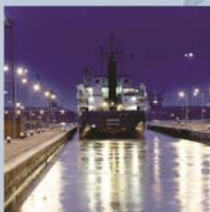
Natural England

## Scientific Peer Review of Outputs of the Solent Disturbance and Mitigation Project

Report R.2051

December 2012

Creating sustainable solutions for the marine environment





Natural England

# Scientific Peer Review of Outputs of the Solent Disturbance and Mitigation Project

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## Summary

The Solent Disturbance and Mitigation Project (SDMP) was established by the Solent Forum to assess the current and future levels of recreational activity on the Solent coastline and the predicted impacts of future development on bird usage in this area. The Solent coastline is recognised through a number of international environmental designations.

The SDMP was undertaken in two phases. Phase I of the SDMP was a desk study and involved the collation and review of information on housing, human activities and birds around the Solent, and reviewed the potential impact of disturbance on birds. Phase II involved a programme of new data collection including information to:

- Estimate visitor rates to the coast from current and future housing; and
- Determine bird disturbance responses.

Phase II of the SDMP also involved the development of a shorebird model which used the primary data collected to predict whether disturbance may be reducing the survival of birds using the Solent coastline both now and under future housing development scenarios.

Natural England commissioned ABP Marine Environmental Research Ltd (ABPmer) to undertake an independent scientific peer review of the SDMP. The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

In order to guarantee an independent peer review of these documents ABPmer identified five peer reviewers to critique the documents through a structured and auditable process. The questions to be considered by each of the panel when reviewing the SDMP outputs were structured into a proforma. These questions were agreed with Natural England in advance of the review and facilitated a standardised approach to the process. A number of guiding principles were also outlined to ensure an objective scientific review of the available evidence in the context of relevant legal and policy context of the decision making process. A series of teleconferences and a face to face meeting were used to ensure that the views of each panel member were fully understood. Specific points of clarification were also requested from the SDMP authors at an early stage in the review process.

This report details the outputs of the review process and the associated meetings, providing a balanced and auditable account of the review findings. During the finalisation of this report, a draft copy was circulated to the peer review team and Natural England for their endorsement to ensure that it delivers an accurate representation of the project deliverables.

Overall, a broad consensus view across all of the five peer reviewers was achieved. It was agreed that a considerable body of evidence has been collated by the SDMP which provides greater understanding of visitor numbers and bird disturbance around the Solent. The objectives of all of the individual reports were clear and the methodologies were generally considered to be appropriate given the available resources to the SDMP. There were, however, a number of assumptions/limitations associated with all of the field data collected which have implications for the shorebird model and the degree of uncertainty that surrounds the outputs.

When considering all of the available evidence it was possible to conclude that the predictions of the shorebird model are likely to be over-estimating the current level of bird disturbance, and the associated impacts for bird fitness, when considering the scale of the Solent as a whole. The review panel had reservations with regard to drawing such conclusions from the shorebird model for individual sections of the study area where site-specific issues would require greater consideration. Similarly the panel were generally of the opinion that the predicted impacts of bird disturbance under future scenarios within the shorebird model were likely to be precautionary at the scale of the Solent as a whole, however, this was not totally conclusive. The peer review panel suggested that the significance of the limitations and the uncertainties introduced through the assumptions of the shorebird model would be further exacerbated by the uncertainty surrounding how each of the potentially relevant parameters around the Solent will change in the coming decades. The peer review panel would, however, feel more confident in all of these conclusions if more sensitivity analysis had been conducted with the Southampton Water shorebird model around the input parameters, the assumptions made and the scenarios tested.

Given that the peer review panel considered that it was not possible to draw firm quantitative conclusions from the shorebird model with regard to increased disturbance from future housing developments, the outputs of the shorebird model alone may not be sufficient to meet the requirements of formal scrutiny as part of an Environmental Impact Assessment or a Habitat Regulations Appraisal. The panel suggested that all future housing developments may be required to provide an evidence based approach to defining the potential impacts associated with the respective schemes. The review panel considered it may therefore be possible to generate some guiding principles to be applied in the monitoring and assessment of individual housing developments. These could build upon the methods employed to collate the empirical evidence for the SDMP work but with refinements made that are based on the recommendations arising from this peer review. The peer review panel suggested that the SDMP outputs may also help to inform the requirements for mitigation and management measures for bird disturbance both currently and in the future should these be required.

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- The project team at Natural England including: Simon Thompson, Chris McMullon, and Richard Saunders.
- The peer review panel including: Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), and John Goss-Custard.
- The SDMP authors that were directly involved with this peer review: Richard Stillman (Bournemouth University), Ralph Clarke (Bournemouth University) and Durwyn Liley (Footprint Ecology).

# Scientific Peer Review of Outputs of the Solent Disturbance and Mitigation Project

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## 1. Introduction

The Solent Disturbance and Mitigation Project (SDMP) was established by the Solent Forum to assess the current and future levels of recreational activity on the Solent coastline and the predicted impacts of future development on bird usage in this area. The conservation importance of the Solent coastline for birds is recognised through a number of international environmental designations including:

- Chichester and Langstone Harbours Special Protection Area (SPA);
- Portsmouth Harbour SPA; and
- Solent and Southampton Water SPA.

These sites are designated for a range of features including wintering birds, birds on passage, nesting terns and Mediterranean Gull. The region is also densely populated and hosts a range of recreational activities. In addition it is understood that there are an additional 82,000 houses planned for authorities around this coast from 2006 to 2026 (based on data from the South East Plan).

Natural England commissioned ABP Marine Environmental Research Ltd (ABPmer) to undertake an independent scientific peer review of the SDMP. The Government highlights the importance of evidence as a key part of environmental decision making. It is therefore essential that Natural England is able to demonstrate its commitment to science through ensuring that any advice provided is based on a robust and auditable evidence base. The peer review outputs will influence how Natural England applies the SDMP evidence in advising on land use planning casework in the Solent and inform its views on the acceptability of existing activities. The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

It should be noted that this report is focused on the consideration of overwintering birds which was the main concern within the SDMP. This does not, however, detract from the importance of breeding birds which are also recognised through the international environmental designations that are applied to the Solent.

The peer review was undertaken in a number of stages to achieve these objectives and as such this report is structured as follows:

- Section 1**      **Introduction** - Background information to the project;
- Section 2**      **Methodology** - A description of the work undertaken including the reports that have been reviewed, the peer review panel, and the peer review process;
- Section 3**      **Results** - A summary of the review outputs; and

**Section 4**      **Conclusions and Recommendations** - A summary of the key findings and recommendations of the peer review process.

## **2. Methodology**

### **2.1 Solent Disturbance and Mitigation Project**

The SDMP was undertaken in two phases. Phase I of the SDMP was a desk study and involved the collation and review of information on housing, human activities and birds around the Solent, and reviewed the potential impact of disturbance on birds. Phase II involved a programme of new data collection including information to:

- Estimate visitor rates to the coast from current and future housing; and
- Determine bird disturbance responses.

Phase II of the SDMP also involved the development of a shorebird model which used the primary data collected to predict whether disturbance may be reducing the survival of birds using the Solent coastline both now and under future housing development scenarios. The SDMP resulted in the delivery of the following Phase I and II reports:

- Report 1 - Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Report 2- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase II: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Report 3 - Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II – On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Report 4 - Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Report 5 - Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

Figure 1 shows how these reports are interlinked and the information sources that have been passed between each of the project phases.

### **2.2 Peer Review Panel**

In order to guarantee an independent peer review of these documents ABPmer identified five peer reviewers to critique the documents through a structured and auditable process. The members of the peer review panel are listed below with a more detailed description of each of their backgrounds provided in Appendix A.



- Colin Scott (ABPmer);
- Aonghais Cook, British Trust for Ornithology (BTO);
- Nick Cutts, Institute of Estuarine Coastal Studies (IECS);
- Gareth Bradbury, Wildfowl and Wetlands Trust Consulting (WWTC); and
- John Goss-Custard (Independent Consultant).

During an inception meeting teleconference ABPmer and Natural England considered the addition of a sixth member to the panel from the Royal Society for the Protection of Birds (RSPB). Having contacted a number of members of RSPB none were available to input into the project given the short timescales and quick turn around of the project.

## 2.3 Peer Review Process

The questions to be considered by each of the panel when reviewing the SDMP outputs were structured into a proforma. These questions were agreed with Natural England in advance of the review and facilitated a standardised approach to the process. The questions were first defined for the review of each respective report before considering the wider questions posed by this review. A copy of the blank proforma is provided in Appendix B. An initial teleconference was held between ABPmer, Natural England and the review panel to discuss the reports to be reviewed, the structure and content of the proforma and the timescales of the project. All meeting (including teleconferences and face to face meetings) agendas and minutes recorded throughout this project are provided in Appendix C.

The first project team teleconference was followed by a two week review period when an initial review of the reports was undertaken. This allowed time for the reviewers to consider the documents in the context of the proforma and identify whether they had any points for clarification for the SDMP authors or wider stakeholders. As a result of this initial review a series of questions were collated for the SDMP authors (see Appendix C5) but no questions were identified for wider stakeholders.

A second project team teleconference provided the opportunity for reviewers to ask questions of the project team as a whole to ensure the objectives of the study were fully understood. The questions for the SDMP authors were circulated to them in advance of the teleconference so that they could also participate in the relevant aspects of these discussions. In this respect three of the authors of the SDMP reports (Richard Stillman, Durwyn Liley and Ralph Clarke) were involved in part of the teleconference to answer the specific questions posed. A subsequent clarification note was also produced by the SDMP authors where it was not possible to resolve specific points during the teleconference (see Appendix C7). The review meeting also identified the need for minor modifications to the proforma which were again endorsed by the whole project team (Appendix B).

This teleconference further ensured overall clarity and that all of the team fully understood what was required in undertaking the review process. In this context the need for an objective scientific review of the available evidence in the context of relevant legal and policy context of the decision making process was re-iterated. The overall guiding principles in undertaking the review were also highlighted, including:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available including the robustness of both the accuracy and appropriateness of the data gathered for the purpose to which it has been applied and the validity of the assumptions underpinning the modelling;
- Work within and have reference to the legal and policy context of the decision making framework;
- Present clear decisions and conclusions;
- Identification of implications of any decisions or conclusions for review group constituency including business, planning sector and wider public; and
- Respect differences of opinion and aim to reach unanimous decisions and where this is not possible provide an auditable trail of the differences.

In addition to the guiding principles outlined above Natural England also produced a document outlining their role within this peer review project (see Appendix C8).

The peer reviewers were then allocated two weeks to review the reports and complete the proforma before returning it to ABPmer. A copy of the completed proformas is provided in Appendix D. The proformas were circulated to the entire project team in advance of a meeting attended in person at ABPmer's office in Southampton. During this meeting the project team discussed the findings of the review and ensured that all opinions of the respective reviewers were fully understood. This report details the outputs of the review process and the associated meetings, providing a balanced and auditable account of the review findings. During the finalisation of this report, a draft copy was circulated to the peer review team and Natural England for their endorsement to ensure that it delivers an accurate representation of the project deliverables.

### **3. Results**

The following section provides the peer review outputs for each of the SDMP reports in turn before considering the wider objectives of the study. A brief overview of each of the reports is first provided to ensure that the outputs of the peer review process remain in context. Report 1 was the main deliverable of Phase I of the SDMP which included the outputs of a literature review undertaken to define the remainder of the project. Phase II included Reports 2 to 4 which detail the collation and review of information on housing, human activities and birds around the Solent, and reviewed the potential impact of disturbance on birds. Report 5 was also produced in Phase II of the SDMP and describes the development of a model of shorebird populations which used the primary data collected to predict whether disturbance may be reducing the survival and body condition of birds using the Solent coastline both now and under future housing development scenarios. Figure 1 provides additional detail on how the SDMP reports are interlinked and the information sources that have been passed between each of the project phases. For more detail on the content of the respective reports readers are directed to the original documents as referenced below.

### 3.1 Review of SDMP Reports

#### **Report 1 - Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum**

The initial output of the SDMP project was the Phase I desk based research study. The report includes summaries of the planning context of the project, the ways in which human disturbance can influence birds with specific reference to the Solent, existing visitor data for the Solent, existing evidence for impacts of disturbance on birds (derived from a series of workshops and interviews) and data on bird distribution and abundance around the Solent (derived from WeBS counts). Potential mitigation measures that could offset increased disturbance to birds around the Solent resulting from future housing developments, should this arise, were also identified.

The review panel agreed that the objectives of this particular report were clearly identified at the outset. The data inputs, methodology and results were all considered to be fit for purpose given the context of the study. In this respect it is understood that the SDMP was purely focused on overwintering birds and their usage of the Solent SPAs during the winter months. The report authors are considered to have identified the majority of literature, particularly considering the Solent focus of the work. The expert panel used within the SDMP is also understood to be representative of the Solent region as a whole. It is acknowledged that, as with any study, it is always possible to do more research, but given the budget and time constraints of the study, the report met its objectives in defining the scope of work for the rest of the SDMP.

#### **Report 2 - Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase II: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum**

The second SDMP report details the results of the bird disturbance field work conducted at 20 different locations along the Solent coastline during the period December 2009 to February 2010. Data recorded included all recreational activity, counts of birds and detailed behavioural observations. The following parameters were defined from the collected data which were later used to parameterise the predictive shorebird model:

- Response distance – the distance over which birds respond to disturbance;
- Response time – the time taken to resume feeding after disturbance; and
- Displacement distance – the distance birds moved following disturbance.

A total of 44 different bird species were recorded during the fieldwork. A total of 2507 potential disturbance events were recorded, with 4064 species specific observations. 17% of these resulted in disturbance. Further analysis was carried out on these results to establish the values of the parameters that were used in the shorebird model. In order to simplify the analyses, activities were aggregated into land-based and water-based types, and only a selection of bird species was included.

The objectives of this report were clearly stated and justifiable in the context of obtaining information to parameterise the predictive shorebird model. A number of limitations in the approach, which have implications for the SDMP findings as a whole, were however identified by the review panel. Firstly, the bird disturbance data were only collected in the winter months. This was considered acceptable given that the focus of the SDMP was on overwintering birds and that this would be the time of year when most birds are likely to be under most food stress. However, it should be recognised that some human activities that cause disturbance at other times of the year might thereby have been missed. Similarly, the bird disturbance data were only collected in one winter season and the representativeness of the dataset for extrapolation to other years is of concern. The particularly cold weather during the 2009/ 2010 season, for example, could have affected the birds in a number of different ways. Firstly, in cold weather birds may be more tolerant of disturbance as their priority would be to achieve their required energy intake. In addition birds may change their feeding patterns in response to differing prey availability in harsher winters. It is also recognised that the distribution of birds frequenting UK estuaries differs annually according to relative temperatures which can in turn impact upon competition and ultimately disturbance responses. All of these factors could have differing impacts on different bird species and have implications for assumptions used in the shorebird model.

The vantage points for the bird observations were chosen based on their accessibility rather than to incorporate a range of environmental variables such as tidal elevation, habitat or sediment type. While this was considered likely to be a limitation in distinguishing disturbance affects between different location types it is acknowledged that this is a pragmatic approach that is generally employed by surveyors. The absence of any monitoring of background noise or natural disturbance observations (eg raptors) was also noted as being of concern by the reviewers as well as the lack of cumulative disturbance observations. It was not possible to determine, for example, whether multiple disturbance events had resulted in an observed behavioural response or whether disturbance causing events did not result in a behavioural response because the birds had already been displaced by a previous stimulus. Similarly the panel noted that there are limitations when employing a single surveyor methodology as it is difficult to capture all of the required observation events and this surveyor restriction was acknowledged as being likely to be a function of the resources available to the SDMP as opposed to deficiencies in the survey design.

Despite these limitations, the peer review panel agreed that the results from the field data were useful in their own right and could have wider benefits rather than just providing data with which to parameterise the shorebird model (Report 5). The results were considered to be generally fit for purpose as long as the limitations are fully acknowledged when interpreting the outputs of the SDMP as a whole.

**Report 3 - Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance and Mitigation Project. Phase II – On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology**

Report 3 outlines the results of the on-site visitor survey conducted at 20 locations during the winter 2009/2010 that was designed to assess the level and type of visitors using selected locations along the Solent coastline. The 20 locations were selected from the 103 discrete

patches of the Solent shoreline that had been identified within the SDMP, based loosely on WeBS boundaries. A total of 16 hours of survey were carried out at each location, split equally between weekend (8 hours) and a weekday (8 hours). A total of 784 interviews were conducted, accounting for 1322 people and 550 dogs. The outputs of this survey were designed to include:

- The relationship between housing density and visitor numbers;
- Visitor numbers in relation to car parking and housing;
- Visitor rates in relation to distance;
- Car visitor rates in relation to distance from home and car parking spaces; and
- Intertidal visitor routes.

In summary, there was a positive relationship between the number of houses within 1km, 3km and 5km of the coast and the number of visitors entering each survey location. Of the people interviewed, 7% did not go within 25m of Mean High Water Neaps (MHWN), a further 78% remained at the top of the beach or on the sea wall and 14% of the interviewees went below 50m from MHWN.

The objectives of Report 3 were clear and the rationale for the proposed data collection methods was understood. The report itself does not, however, make it entirely clear how the interviews were conducted. It is not possible, for example, to determine how people were selected for questioning and what the rejection rate was. It is also not possible to determine whether the surveys were conducted on dates that might be considered atypical, such as bank holidays.

The rationale for the spatial coverage of the surveys was considered appropriate for the intended use of the data. However, a key deficiency recognised by the peer review panel was in the subdivision of the study area, particularly where no attempt was made to take account of the relative number of visitors/ activities associated with different sediment types. This was despite the importance of this parameter being identified in Phase I of the SDMP and is considered to represent a significant limitation to the shorebird model. Similarly the panel agreed that the survey work could have been refined by dividing sections of the coast through characteristics of shoreline rather than solely WeBS data. The use of GPS devices to map visitor routes, detailing more demographic information and the mapping of activities associated with different sediment types as well as elevations throughout the intertidal zone was therefore recommended.

The limitations identified in Report 2 above with regard to the data only being collected through what was considered to be one relatively harsh winter season also apply to this report. The harsh winter may, for example, have impacted on both the numbers of visitors to the coast and the activities that were undertaken. This generates a lot of assumptions when extrapolating beyond one cold winter and to locations outside of the 20 surveyed locations.

The peer review panel considered that, generally, the evidence was complete for its intended use but it was not clear whether possible biases introduced through survey design were fully considered. The main limitations were thought likely to be the absence of information on the relative usage of different sediment types by people in the intertidal zone and the

representativeness of the single year that was studied; both of these could be critical for interpreting the outputs of the SDMP as a whole. Despite these limitations the peer review panel agreed that the results from the field data were useful in their own right and could have wider benefits rather than just informing the shorebird model (Report 5). The further conclusion from this report, that there was a requirement for a household survey to supplement the visitor statistics, seemed reasonable and justified.

#### **Report 4 - Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance and Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology**

The study reported within Report 4 of the SDMP details a survey of households within 25km of the Solent coastline with a view to understanding the link between housing and recreational use of the coast. The postal household survey was distributed to 5000 households within 25km of the Solent coastline between October and December 2010.

A total of 1382 completed questionnaires were returned representing a response rate of approximately 25%. The 1155 households providing full responses to the survey made an estimated annual total of 154,433 visits to the Solent coastline. The project and survey divided the coastline into 103 numbered sections. On average each section received a total of 1490 annual visits but the number of visits made to each coastal section was significantly different. The most frequent activity undertaken by visitors was walking (20% of responses). During the coastal visits respondents stated that 47% of their activities were undertaken on the seawall or river bank. A further 39% of responses by households indicated that they venture on to the beach/ mudflat and 15% of responses actually took to the water. There was a significant difference in coastal visit frequency between households which owned at least one dog and non dog owning households, with dog owning households making more visits.

Predictions of visitor numbers to the coast were derived by fitting formal statistical models to the data obtained from the household visitor surveys: these models are referred to here as the 'household survey models'. Separate models were generated for car and foot visitors with each model showing a declining visitor rate with distance from the coast. The on-site survey numbers (Report 3) were compared to the visitation rates predicted by the household survey results. While the two surveys correlate the numbers of annual visits given by household respondents was consistently higher than would be estimated by scaling up the on-site survey numbers. The predictions of visitor numbers to the coast, based on the household survey data, were later used to inform potential bird disturbance in the later phase of the SDMP.

It should be noted that additional clarification was provided by the SDMP authors in relation to this report following the initial review of the documents (Appendix C7). The review panel confirmed that they had taken account of this supplementary information when formulating their opinions on this report.

The review panel were satisfied that the objectives of this report were clearly stated and consistent with the wider aims of the SDMP. It was also agreed that the methods seemed appropriate, whilst recognising that there are always limitations associated with such studies in terms of the potential bias of responses. It was acknowledged by the peer review panel that



the alternative of on-site surveys on this scale would not have been practical. The spatial and temporal resolution of the study was therefore agreed to generally be appropriate.

The greatest concern with regard to this report was the number of responses that were received from the survey and how these data were later interpreted. The lack of testing of the representativeness of the responses was considered to be a serious deficiency in the dataset. It is considered that with only a 25% response rate that visitation rates to the coast could have been exaggerated. This is based on the assumption that the people most likely to respond to such a questionnaire are those that are more likely to have a vested interest in the coast. Some members of the review panel suggested that visitation rates may have been overestimated by a factor of four. In addition there was no testing of the representativeness of the demographics of the respondents in relation to the relatively high number of pensioners that replied. Similarly it was not possible to take account of the socio-economic status of the respondents.

The comparison of the on-site survey numbers (Report 3) with the visitation rates predicted by the household survey models added to the concerns that the numbers of visitors to the coast were being over-estimated. Predicted visitation rates were higher for both car and foot visitors than were actually recorded by the on-site surveys and the hypothesis that this was caused by the poor weather, as suggested by the authors, was not tested. In this respect it is not clear whether the household survey model accurately predicts the numbers of visitors to each section of the coast and whether any account was taken for site-specific differences and what might be causing them. This results in uncertainty with regard to the level of disturbance that may actually be occurring at the coast as a result of human activity.

The review panel were in agreement that sensitivity analysis around the predicted number of visitors to the coast should have been undertaken. It might then have been possible to better determine the degree to which visitor numbers and ultimately bird disturbance and the implications of this were over estimated as input parameters to the SDMP shorebird model (see Report 5 below).

In addition the survey results did not allow for a distinction to be made between activities being carried out in different seasons and as such the degree of overlap with the bird disturbance surveys could not be established. Again this was seen as an important deficiency in the greater understanding of the SDMP outputs.

In summary while the SDMP authors acknowledge the limitations of the approach and the resulting datasets no attempt was made to validate the results or test the resulting sensitivity around predicted visitor numbers. This was considered by the review panel to be a serious flaw in the dataset which has significant implications for the use of the data in the later modelling phases of the SDMP.

## Report 5 - Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum

The fifth SDMP report describes the modelling approach that uses the primary data collected in each of the previous reports to predict whether disturbance is having an impact on the survival of overwintering birds using the Solent. Predictions were derived for wader species by developing detailed computer models of birds and disturbance within Southampton Water and Chichester Harbour. These shorebird models incorporate the intertidal invertebrate food supply of the birds (derived from previous intertidal surveys), the exposure and covering of this food through the tidal cycle (predicted from a hydrodynamic model of the Solent), disturbance from human activities, and the energy requirements and behaviour of the birds as they avoid humans and search for food.

The shorebird model incorporates the costs that birds incur when avoiding human activities (e.g. increased density in non-disturbed areas, reduced time for feeding and increased energy demands when flying away), but also their abilities to compensate for these costs (e.g. by feeding for longer or avoiding more disturbed areas). The following waders were included in the shorebird model: Dunlin *Calidris alpina*, Ringed Plover *Charadrius hiaticula*, Redshank *Tringa totanus*, Grey Plover *Pluvialis squatarola*, Black-tailed Godwit *Limosa limosa*, Bar-tailed Godwit *Limosa lapponica* (Chichester Harbour model only), Oystercatcher *Haematopus ostralegus* and Curlew *Numenius arquata*. A simpler approach was used to assess how disturbance may be affecting Brent Geese *Branta bernicla bernicla* in the Solent. Report 5 identifies a number of assumptions that are inherent within this type of modelling approach as summarised below:

- Some of the data inputted into the shorebird model was itself predicted, as detailed in Reports 2, 3 and 4;
- All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters;
- It was assumed that visitors and birds were independently distributed over the intertidal habitat;
- Some species and activity types were restricted to some coastal sections;
- It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide;
- Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent;
- Southampton Water shorebird model did not include the effect of depletion of food supply by non-modelled species; and
- Individual based models considered average conditions, rather than extremes of weather or visitor numbers.

The estimated invertebrate biomass from the Chichester Harbour was not adequate to support the modelled number of birds that currently use this location and as such it was not possible to develop a model for predicting the effect of disturbance on birds at this location. Within



Southampton Water, in the absence of disturbance, all wader species modelled were predicted to have 100% survival and maintain their body masses at the target value throughout the course of winter. Based on the scenarios tested within the shorebird model, which restricted bird movement around the estuary, disturbance from current housing was predicted to reduce the survival of Dunlin, Ringed Plover, Oystercatcher and Curlew. Increased visitor numbers as a result of future housing was predicted to further reduce the survival of Dunlin and Ringed Plover. Disturbance was predicted to have a relatively minor effect on the mean body mass of waders surviving to the end of winter, largely because the individuals with very low mass starved before the end of winter anyway. The SDMP concluded that the Southampton Water shorebird model provided evidence that current and future disturbance rates may reduce wader survival in this site. It should be noted that the shorebird model does not predict whether the distribution of birds across the Solent is being affected by visitor disturbance which could be considered an impact in its own right. The results from the Southampton Water shorebird model and certain aspects from Chichester Harbour were scaled up to give Solent scale predictions of the impacts of disturbance under current and future scenarios.

The peer review panel were in agreement that the objectives of the modelling approach were clearly identified at the outset of the report. As described above, many of the disturbance-related input parameters for the Southampton Water shorebird model were largely derived from the primary data collected in earlier phases of the SDMP. The assumptions and limitations described above for each of the respective reports are therefore all compounded within the shorebird model. The key assumptions which the review panel felt led to the greatest sources of uncertainty within the shorebird model are summarised below.

A key input to the shorebird model is the invertebrate food supply that is available to the birds. It was clear within the report that the data from the survey of invertebrates in Chichester Harbour was not adequate to support the birds that currently use this location. The review panel agreed with the SDMP authors that this probably signified that the invertebrate survey had not accurately characterised the available prey resource as opposed to a deficiency with the shorebird model itself. While this does not necessarily invalidate the modelling approach, which has been applied successfully to a number of different estuaries, it does highlight a key limitation of the shorebird model. Similarly it was recognised that there was a degree of uncertainty over how the food supply changes over the winter where the field data appeared to suggest that the prey resource was not depleted but it was reduced in the parameterisation of the shorebird model. For the purposes of the shorebird model bird predation was also assumed to be the main source of invertebrate mortality.

A further limitation to the shorebird model with regard to food supply is that it was assumed that there was no prey available to the birds above the level of MHWN. In reality this zone typically provides an important feeding resource for the birds in terms of both prey availability and available foraging time. Redshank, for example, are known to feed in terrestrial areas. These factors all lead to a degree of uncertainty over the initial food supply and the distribution of this resource around the Solent. In addition by assuming that no food supply was available above the level of MHWN it is possible that conditions were made more difficult for the birds than would have been expected in reality and thus more likely to be affected by disturbance.

The shorebird model itself was based on a relatively small number of bird species. The bird data was based on peak WeBS counts but this did not take account of when the peak counts were observed. They could, for example, have occurred during the migration period resulting in an over estimate to birds using the site. In reality, according to published WeBS data, the numbers of several species using either Southampton Water, Chichester Harbour or both do peak during the migration periods.

The Southampton Water shorebird model was sub-divided into a number of sub-sites to restrict bird movement. These divisions were based on observations of bird movements within the site. But this introduces the improbable consequence that even a starving shorebird would still remain in that same third of the estuary rather than move elsewhere in the estuary to find food. This assumption had important implications for the shorebird model results because when birds were allowed to move up and down the river, and thus to feed outside their restricted patch, none died because of disturbance. The application of this assumption will therefore have led to an exaggeration of the impacts of disturbance on birds in Southampton Water.

The review panel also commented that there was no distinction between parts of the intertidal used/ not used by birds and visitors i.e. birds and people are distributed independently of each other in the shorebird model. In fact, it is likely that there is some degree of spatial separation between birds and people because many birds prefer the muddy areas that people tend to avoid. This omission was considered surprising given the importance of different sediment types being more commonly used by people and birds being highlighted in Report 1. Similarly the food supplies of shorebirds are often better at the lower elevations in the intertidal zone, where people are again least likely to cause disturbance. It can therefore be extrapolated that by not separating birds and people, as would be expected in reality, this has resulted in an over estimate of the impact of disturbance.

The shorebird model uses national average mortality rates to provide an "observed" comparator for the predicted model outputs. The "observed" mortality rates for Southampton Water were obtained by assuming 50% of the annual mortality rates published by the BTO for the UK as a whole. The panel were unclear as to whether the migration period was included in the definition of the overwintering period used within the shorebird model. It is also unclear why a statistic of 50% has been applied or its applicability for use in the context of Southampton Water. Overall it was considered by the panel that 50% was likely to be an over estimate of actual overwinter mortality rates in Southampton Water, however, this value could be an underestimate for a cold winter. It was therefore agreed that there is considerable uncertainty around the applicability of this statistic. If it is assumed that 50% was an overestimate of mortality rates then conditions within the shorebird model would be more difficult for the birds than in reality. This would again increase the predicted impact of disturbance on the bird populations within the shorebird model.

The applicability of the aggregation factor (the density at which birds are assumed to be foraging) which was essentially a best estimate for the estuary due to the lack of available field data was also raised by the peer review panel. If the aggregation factor is set too high it will cause the shorebird model to exaggerate the impact of disturbance to birds.

The outputs of the household visitor survey were considered by the panel to be an over estimate of visitor numbers to the coast (see Report 4 above). If this assumption by the review panel is correct then the rates of disturbance within the shorebird model will also have been over predicted. Other limitations noted within the shorebird model were the representativeness of the field data (both bird and visitor activity) with regard to its collection over a single winter period (see Reports 2, 3 and 4 above).

While the majority of the assumptions and sources of uncertainty are considered to have made things more difficult for the birds three assumptions were identified that could have had the opposite affect. Where birds were unable to feed above MHWN this may have caused birds to feed further from the main sources of disturbance at the top of the intertidal zone. This would make it easier for the birds in the shorebird model to obtain their energy requirements and thus make them less likely to be affected by disturbance. In addition the extra energy requirements of birds at lower temperatures were not factored into the shorebird model. The birds would also be expected to be subject to disturbance at their roost sites as well as natural sources of disturbance such as raptors. In this context starvation was assumed to be the only source of bird mortality. The omission of these parameters would have made it easier for birds to survive the winter and as such the impacts of disturbance would have been underestimated within the shorebird model.

Overall the review panel were relatively satisfied that, at least for the current situation, the shorebird model is likely to be overestimating the sources of disturbance. Measures of uncertainty were not, however, always provided for the input parameters and considerable uncertainty as to the sensitivity of the shorebird model predictions to differing levels of disturbance remains. The applicability of scaling the results from the Southampton Water shorebird model to give Solent-scale predictions will also have introduced assumptions in its own right. The panel acknowledged that the shorebird model is only one piece of the evidence base for evaluating the potential impacts of bird disturbance and that the field data itself also informs an important component when making such assessments.

### **3.2 Peer Review Objectives**

Following the review of individual reports the review panel considered each of the main questions posed by the objectives of the study. The opinions of the review panel with respect to each of these questions is summarised below with additional detail from each reviewer provided in Appendix D.

It should be noted that all of the questions below are set in the context of overwintering birds which were the main consideration within the SDMP. This does not, however, detract from the importance of breeding birds which are also recognised through the international environmental designations that are applied to the Solent.

**Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent?**

The review panel recognised that the shorebird model itself as documented in Report 5 was underpinned by a number of valuable field studies (Reports 1 to 4). These research exercises have generated useful data in their own right and have helped to provide a greater understanding of visitor numbers and of potential bird disturbance around the Solent. There are, however, a number of assumptions associated with each of these studies and their outputs therefore need to be reviewed in this context. The shorebird model itself is built on a large number of uncertainties which are inherent from all of the earlier phases of the project. The uncertainties which are thought to have had the biggest impact on the shorebird model predictions are described in detail above (Report 5) and summarised below:

- The distribution and availability of the food supply accessible by the birds;
- The use of subdivisions in the shorebird model that restrict bird movement;
- People and birds were distributed independently of each other;
- The appropriateness of the mortality rates that were used to validate the shorebird model;
- Predictions of the number of visitors; and
- The representativeness of the data and therefore its applicability to other spatial/ temporal scenarios.

What the shorebird model does provide, however, is an additional measure/ estimate of bird fitness or survival through the winter based on the assumptions that have been developed through the previous studies (Reports 1 to 4).

The conclusions from the shorebird model alone are not sufficient to determine the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent. Through an understanding of the underlying data and assumptions, however, it is possible to conclude that the predictions of the shorebird model are likely to be over-estimating the current level of impacts of disturbance from visitors to the coast when considering the scale of the Solent as a whole. On this basis the results are considered to be highly precautionary in nature and as such the current levels of disturbance may not be impacting on the overall fitness of the birds that over winter on the Solent. The peer review panel would, however, feel more confident in this conclusion if more sensitivity analysis had been conducted around the input parameters and the scenarios tested. In addition this does not reflect on whether the distribution of birds across the Solent is being affected by visitor disturbance which could be considered an impact in its own right.

The review panel had reservations with regard to drawing such conclusions for individual sections of the study area. Some areas of the Solent would, for example, be more attractive to birds and in such locations the potential for disturbance to have an impact on the birds would be greater than for the region as a whole. Birds in these locations are already likely to be at greater densities and as such the impacts of disturbance could be greater than in locations where birds are less aggregated. In addition some locations on the coast may attract a disproportionate number of visitors or a disproportionate number of high impacting activities

which could again result in disturbance rates higher than those simulated within the shorebird model. The outputs of the field studies and the shorebird model itself could, however, be used to develop some guiding principles to evaluate the potential disturbance effects on a site-specific basis.

**Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent?**

The limitations of the individual studies and the shorebird model described above are equally as applicable to this question. The conclusions from the shorebird model alone are not sufficient to determine the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent under future scenarios. In this instance the significance of the limitations and the uncertainties introduced through the assumptions of the shorebird model would be further exacerbated by the uncertainty surrounding how each of the potentially relevant parameters around the Solent will change in the coming decades.

Overall the panel were generally of the opinion that the predicted impacts of bird disturbance under future scenarios within the shorebird model were again likely to be precautionary at the scale of the Solent as a whole, however, this was not totally conclusive. The peer review panel emphasised the importance of reviewing the results in the context of the entire evidence base.

The distinction regarding separate analyses being required for site-specific assessments was again equally applicable to the consideration of future scenarios.

**Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?**

To determine the potential contribution that residential development makes to the predicted impacts of disturbance it is important that the relationship between the location/ density of housing and the number of visitors to the coast is understood. In this context the peer review panel highlighted the importance of the limitations associated with the outputs of the household visitor questionnaire (Report 4). In particular the lack of testing of the representativeness of the responses was considered to be a serious deficiency in the dataset. It was considered that with only a 25% response rate that visitation rates to the coast could have been exaggerated. This is based on the assumption that the people most likely to respond to such a questionnaire are those that are more likely to have a vested interest in the coast. This was supported by the predicted visitation rates (based on the household surveys) being consistently higher for both car and foot visitors than the on-site observations (Report 3). In this respect it is not certain how well the numbers of visitors to each section of the coast were estimated for inclusion in the final modelling.

To increase confidence that the shorebird model was parameterised with a realistic estimate of visitor disturbance the peer review panel would have preferred to have seen greater validation of the results of the survey and testing of the resulting sensitivity around predicted visitor numbers. This was considered by the review panel to be a serious flaw in the dataset which has significant implications for the use of the data in the later modelling phases of the SDMP.

Despite these considerations it was largely agreed that the visitor numbers to the coast were very likely an over prediction of real visitor numbers and as such the potential impacts of disturbance would have been exaggerated within the shorebird model. The current housing development scenario tested within the shorebird model was therefore considered to be highly precautionary in terms of the level of bird disturbance at the coast. In other words the impacts on bird fitness across the Solent as a whole would be expected to be less than those predicted under this modelling scenario.

In the context of assessing the potential impacts of bird disturbance associated with future housing developments it was considered that there would be greater uncertainty across all of the shorebird model input parameters. For example, the overall numbers and the patterns of usage of visitors to the coast could change in the future in an unquantifiable manner. The future residential developments could also be populated by a different demographic to that predicted based on the current household survey results. On this basis the review panel were generally of the view that the evidence base was insufficiently robust for identifying the contribution which residential development will make to bird disturbance impacts. This is true even if the shorebird model results were considered to be precautionary as it is important not to either over or under predict the impacts of disturbance around the Solent coastline when assessing potential impacts.

The question was also posed as to whether the scale of the impacts that the shorebird model is seeking to resolve (i.e. the predicted increase in disturbance from the planned future housing developments) falls within the range of uncertainties within the shorebird model. Given the large number of uncertainties within the shorebird model it was considered that it would not necessarily be sensitive to this level of change. It is therefore not possible to draw firm quantitative conclusions from the shorebird model with regard to increased disturbance from future housing developments and as such the outputs of the shorebird model alone would be unlikely to meet the requirements of formal scrutiny as part of an Environmental Impact Assessment or a Habitat Regulations Appraisal. The shorebird model is therefore considered to be a useful simulation tool, based on sound theoretical science, for estimating bird fitness under a range of scenarios but it cannot be adequately calibrated to make firm quantitative predictions.

The SDMP has, however, generated some very useful quantitative information on the causes and levels of disturbance from field observations. This information can all be used to inform the potential impacts associated with individual housing developments. When considering the implications of future developments it is useful to understand which areas are already subject to a relatively high degree of visitor disturbance and/ or those that are most used by birds. In this context it should be remembered that all housing developments will be required to provide an evidence based approach to defining the potential impacts associated with the respective schemes. In addition the review panel considered it would be possible to generate some guiding principles to be applied in the assessment of individual housing developments. The SDMP outputs will also help to inform the requirements for mitigation and management measures for bird disturbance both currently and in the future.



### **Are there any caveats required or limitations to be aware of before using this evidence?**

There are understood to be a number of limitations that need to be understood when this evidence base is being used to inform the decision making process. These limitations have been highlighted throughout this write up of the peer review outputs. For completeness the key assumptions which were of greatest concern to the reviewers are summarised below:

- There has been no consideration of breeding birds throughout the study;
- The distribution and availability of the food supply accessible by the birds;
- The use of subdivisions in the Southampton Water shorebird model to restrict bird movement;
- People and birds were distributed independently of each other;
- The applicability of the mortality rates applied;
- The shorebird model was only based on a relatively small number of birds;
- The applicability of the aggregation factor in the shorebird model;
- No account was made for natural sources of disturbance;
- The additional energy requirements of birds at lower temperatures were not taken into account;
- Predictions of the number of visitors derived from the household questionnaires; and
- The representativeness of the data and therefore its applicability to other spatial/temporal scenarios.

It is fully acknowledged by the peer review panel that the majority of these assumptions and limitations were acknowledged by the SDMP authors. However, on the basis that a number of these assumptions remained untested and little sensitivity analysis was conducted around the shorebird model input parameters there is still a high degree of uncertainty associated with the shorebird model outputs. This does not discredit the work that has gone in to developing the shorebird model but those responsible for interpreting the SDMP outputs need to have due regard to all of these interlinking factors.

## **4. Conclusions and Recommendations**

Overall, a broad consensus view across all of the five peer reviewers was achieved. It was agreed that a considerable body of evidence has been collated by the SDMP which provides greater understanding of visitor numbers and bird disturbance around the Solent. The objectives of all of the individual reports were clear and the methodologies were generally considered to be appropriate given the available resources to the SDMP.

In summary Report 1 adequately set the understanding and context for the remainder of the SDMP. The field studies that were undertaken to inform the model included observations of bird disturbance through a single winter period which generated a lot of useful data in 2009/2010 that needs to be considered in the context of the fact that it was a relatively harsh winter. In addition not all sources of potential disturbance were fully recorded and it was not possible to distinguish cumulative disturbance events from the data provided within the report. Overall, however, the results were generally considered fit for the purposes of the SDMP as a

whole. Estimates of visitor numbers were obtained from both on-site surveys and household questionnaires. In this respect one of the largest sources of uncertainty within the SDMP was considered to be the outputs of the household survey models in terms of the predicted number of visitors to the coast, particularly as the representativeness of the respondents was not tested. Consequently it was considered that the number of visitors to the coast and, as a consequence the level of bird disturbance, was greatly overestimated. The final element of the SDMP was the development of a predictive shorebird model that was used to estimate the impact of disturbance on bird survival and body condition through a winter period. The shorebird model is therefore built on a large number of uncertainties which are inherent from all of the earlier phases of the SDMP.

The conclusions from the shorebird model alone are not considered sufficient to determine the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent. Through an understanding of the underlying data and assumptions, however, it is possible to conclude that the predictions of the shorebird model are likely to be over-estimating the level of bird disturbance when considering the scale of the Solent as a whole. On this basis the results are considered to be highly precautionary in nature. The peer review panel would, however, feel more confident in this conclusion if more sensitivity analysis had been conducted with the Southampton Water shorebird model around the input parameters, the assumptions made and the scenarios tested. The review panel had reservations with regard to drawing such conclusions from the shorebird model for individual sections of the study area where site-specific issues would require greater consideration.

The limitations of the individual studies and the shorebird model described above are equally as applicable when considering the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent. In this instance the significance of the limitations and the uncertainties introduced through the assumptions of the shorebird model would be further exacerbated by the uncertainty surrounding how each of the potentially relevant parameters around the Solent will change in the coming decades. Overall the panel were generally of the opinion that the predicted impacts of bird disturbance under future scenarios within the shorebird model were again likely to be precautionary at the scale of the Solent as a whole, however, this was not totally conclusive. The distinction regarding separate analyses being required for site-specific assessments was again equally applicable to the consideration of future scenarios.

In the context of assessing the potential impacts of bird disturbance associated with future housing developments the review panel considered that there would be greater uncertainty across all of the shorebird model input parameters. For example, the overall numbers and the patterns of usage of visitors to the coast could change in the future in an unquantifiable manner. The future residential developments could also be populated by a different demographic to that predicted based on the current household survey results. On this basis the review panel were generally of the view that the evidence base was insufficiently robust for identifying the contribution which residential development will make to bird disturbance impacts. This is true even if the shorebird model results were considered to be precautionary as it is important not to either over or under predict the impacts of disturbance around the Solent coastline when assessing potential impacts.



Given that the review panel considered that it was not possible to draw firm quantitative conclusions from the shorebird model with regard to increased disturbance from future housing developments, the outputs of the shorebird model alone would be unlikely to meet the requirements of formal scrutiny as part of an Environmental Impact Assessment or a Habitat Regulations Appraisal. The shorebird model is therefore considered a useful simulation tool, based on sound theoretical science, for estimating bird fitness under a range of scenarios but it cannot be adequately calibrated to make firm quantitative predictions. The SDMP has, however, generated some very useful quantitative information from field observations on the causes and levels of disturbance. This information can all be used to inform the potential impacts associated with individual housing developments.

When considering the opportunities for further work it is recognised that a number of limitations identified above were largely a result of the available time and budget resources of the SDMP. It is acknowledged that as with any research project it is always possible to do more. There were, however, a number of work elements that the peer review panel considered would have been useful to help increase confidence in the shorebird model outputs.

The recommendations for further work centre on a desire to gain a greater understanding of the sensitivity of the shorebird model predictions to each of the numerous input parameters and assumptions. This would allow bands of uncertainty to be attached to the results and provide greater confidence in the outputs of the SDMP as a whole. Similarly it would have been useful for a larger number of scenarios to be tested. This would have allowed the relative importance of each of the input parameters to be understood and as such the implications surrounding the uncertainty of each of these parameters could be placed in to context. A greater understanding of the relative importance of each of the underlying assumptions and uncertainties would allow future survey effort to be focused around the most critical input parameters. This would maximise the value of any future data collection. Studies which are currently thought to offer most benefit in providing greater certainty to the results include:

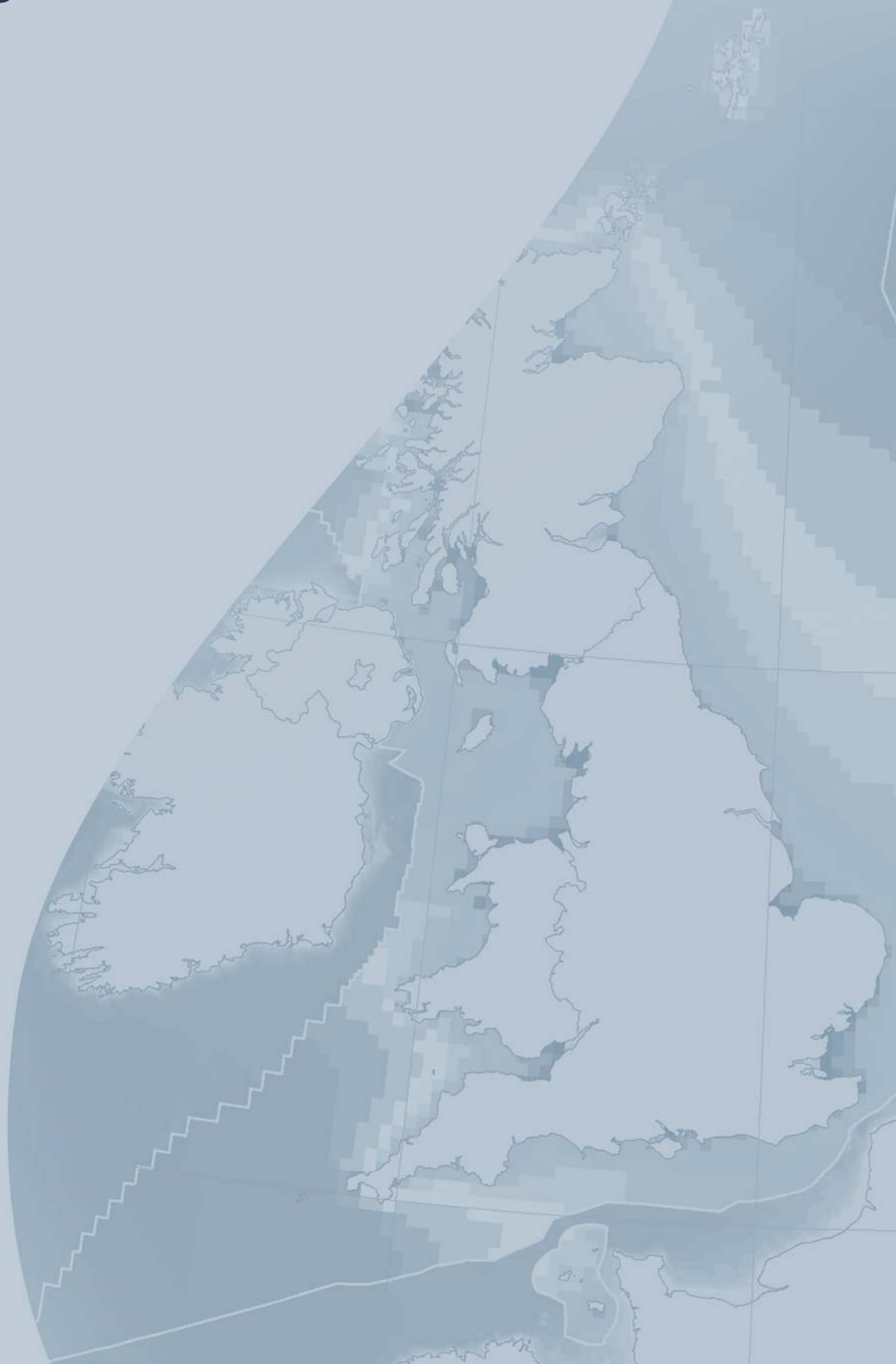
- Greater analysis on the household visitor survey data to assess its representativeness and predictive accuracy of the numbers of visitors to particular parts of the Solent;
- Determining the prey availability to the birds throughout the study area;
- A refined estimate of overwintering bird mortality rates for the Solent; and
- A greater understanding of the relative usage of different sections, habitats and intertidal zones along the coastline by both people and birds which could be done using a sector plot style of analysis.

The panel acknowledged that all future housing developments may be required to provide an evidence based approach to defining the potential impacts associated with the respective schemes. The review panel considered it would be possible to generate some guiding principles to be applied in the assessment, monitoring and, if required, adaptive management of individual housing developments in the future. Such principles could be based on the methodological precedents applied for the SDMP but with refinements made that are based on the recommendations arising from this peer review. The existing SDMP outputs will already help to inform the requirements for mitigation and management measures for bird disturbance should they be required. However, in the future, the ongoing assessment and monitoring work that is likely to be required to accompany developments could be pursued and collated in a



strategic and systematic manner which allows these SDMP products to be continually enhanced and updated and made more robust over time.

# Figures



Report 1: Desk based research study, analysing and summarising existing data sources

**Report 2: Bird disturbance field**  
 Inputs:  
 •Distribution of birds in relation to sites and distance from shore –variation between species, feeding ecology, how birds use the site and potential impacts of disturbance  
 •Levels of human activity  
 •Levels of disturbance  
 •Types of activities and disturbance  
 •Comparison between sites  
 •Variation in response between species  
 •Distance from the source of disturbance  
 Outputs:  
 •Response distance – the distance over which birds respond to disturbance;  
 •Response time – the time taken to resume feeding after disturbance;  
 •Displacement distance – the distance birds move following disturbance.

**Report 3: On site visitor**  
 Inputs:  
 •Visitor numbers at surveyed sites  
 •Group size  
 •Frequency of visits  
 •Timing of visits  
 •Activity  
 •Motivation for site visit  
 •Mode of transport to location  
 •Distance travelled to access points  
 •Transport mode  
 Outputs:  
 •Relationship between housing density and visitor numbers  
 •Visitor numbers in relation to car parking and housing  
 •Visitor rates in relation to distance  
 •Car visitor rates in relation to distance from home and car parking spaces  
 •Intertidal visitor routes

**Report 4: Household postal survey**  
 Inputs:  
 •Access patterns and distance travelled to the coast  
 •Seasonal and diurnal visitation  
 •Frequency of coastal visits compared to household characteristics  
 •Activities per coastal section  
 •Features that attract and deter households  
 •Visit frequency to specific coastal sections including transport and activities undertaken  
 •Estimated number of annual coastal visits made to sections of the coast  
 •Characteristics of coastal sections and car parking capacities  
 Outputs:  
 •Foot visitor rate by straight line distance in relation to section features  
 •Car visitor rate by road distance in relation to section features  
 •Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.

**Report 5: Predicting the impact of human disturbance on overwintering birds in the Solent**  
 Inputs:  
 •Outputs from Reports 2, 3 and 4  
 •Bird populations of the Solent (WeBS low tide and high tide counts)  
 •Wader food supply in Southampton Water (intertidal invertebrate survey conducted by Pippa Wood, PhD studentship)  
 •Wader food supply in Chichester Harbour (intertidal invertebrate survey conducted by EMU Ltd)  
 •Food supply of Brent Geese (Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)  
 •Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)  
 Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):  
 •Environmental parameters (A3.1)  
 •Patch parameters (A3.2)  
 •Food resource parameters (A3.3)  
 •Bird parameters (A3.4)  
 •Disturbance parameters (A3.5)  
 Behavioural response of waders to disturbance in the Solent. Analysis was carried out to (Appendix 4):  
 •Quantify the response to disturbance (A4.1)  
 •Estimate the probability of disturbance response (A4.2)  
 •Estimate effective disturbance distance (A4.3)  
 •Predict feeding time lost per disturbance (A4.4)  
 •Predicting feeding area lost to disturbance per visitor (A4.5)  
 •Predict current and future visitor numbers, activities and zones (A4.6)  
 •Estimate seasonal patterns of visits (A4.7)  
 •Estimate diurnal patterns of visits (A4.8)  
 •Estimate total feeding area lost per hour per section (A4.9)  
 The model was run under different disturbance scenarios which included (Appendix 5, A5.2):  
 •current and future housing  
 •sea level rise  
 •change in habitat area  
 •changes in numbers and distribution of visitors to the coast

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Projection		n/a	
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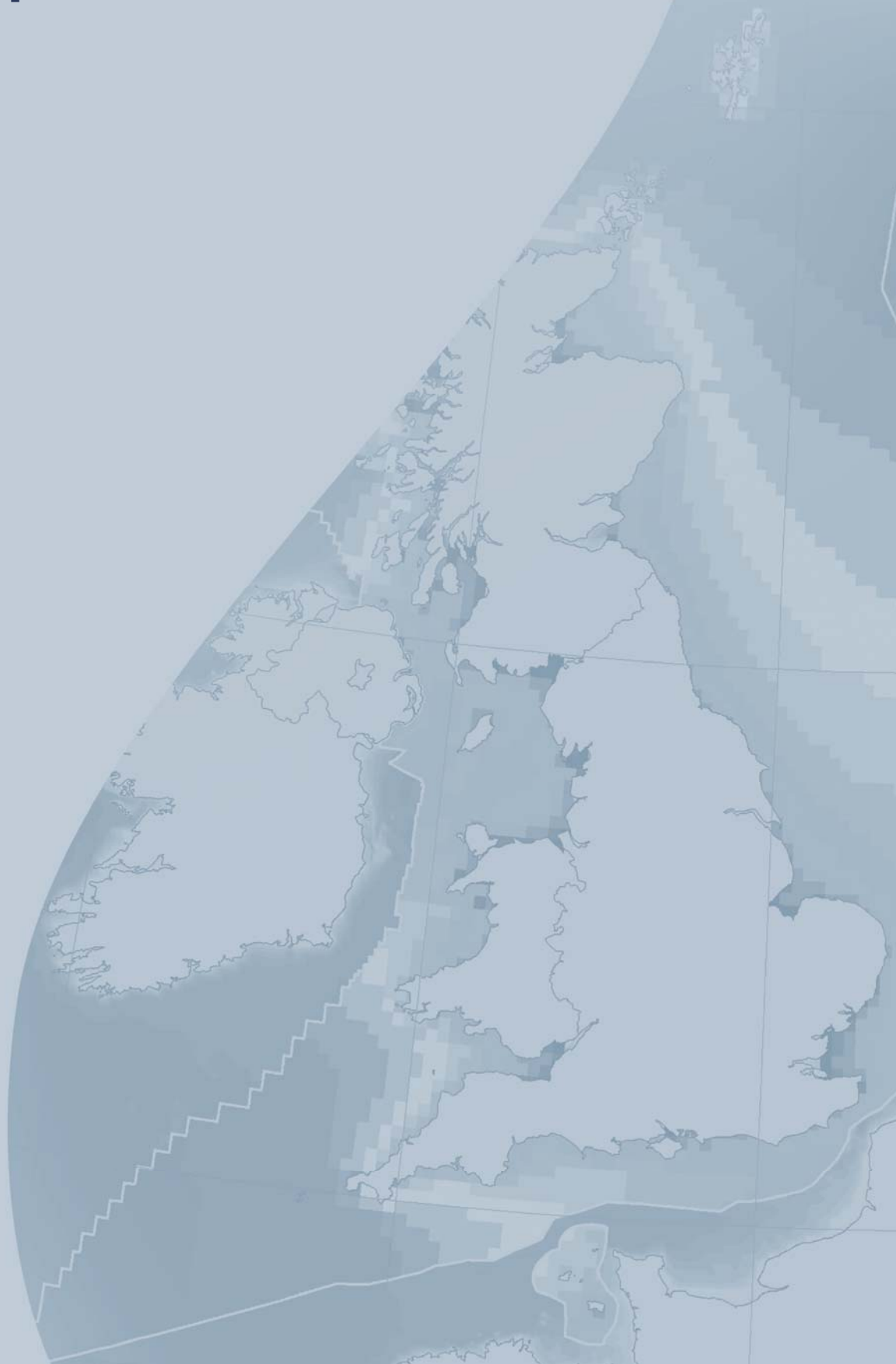
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**Linkages between the SDMP reports**

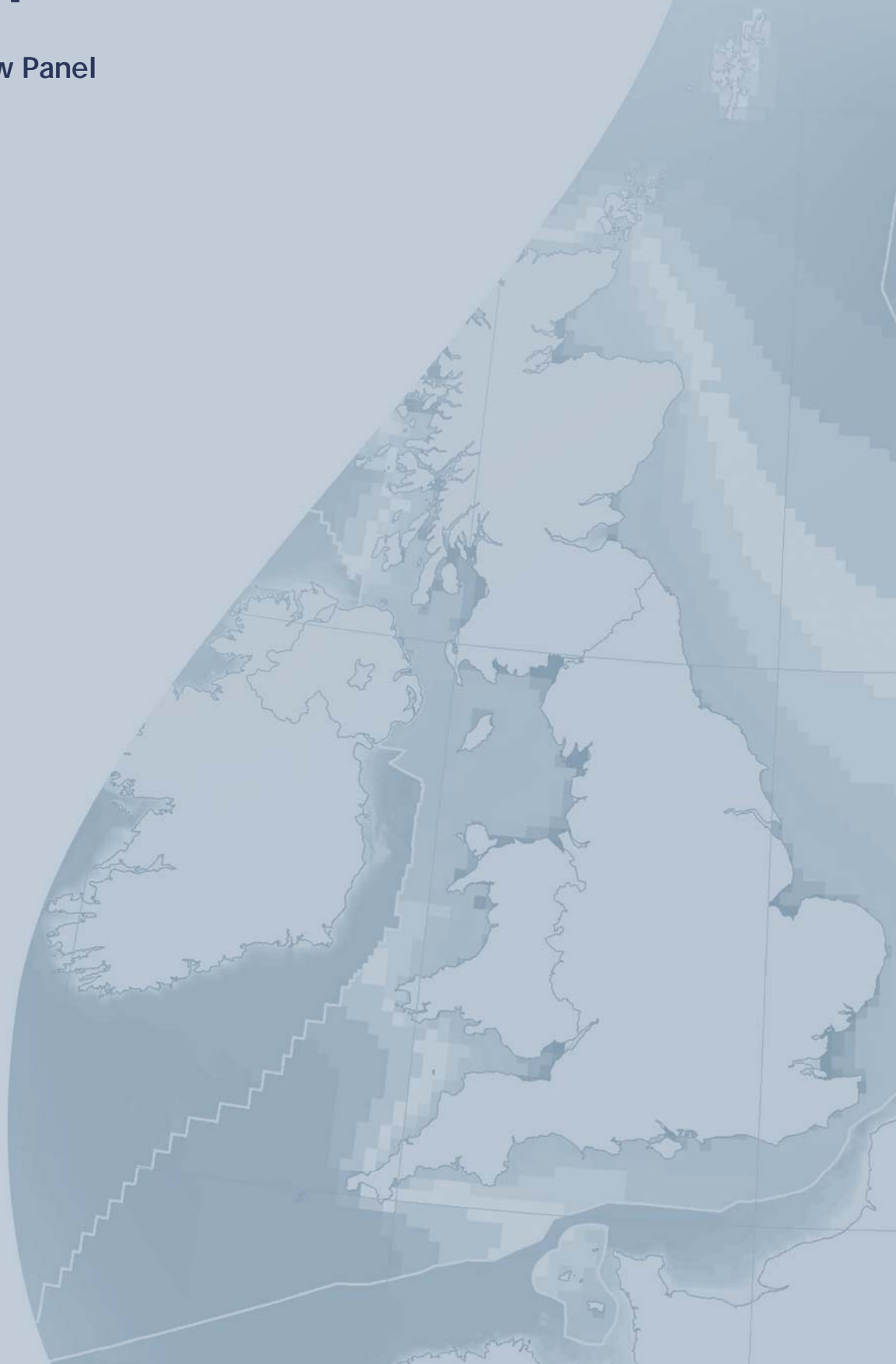
**Figure 1**

# Appendices



# Appendix A

Review Panel



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix A: Review Panel

**Colin Scott** is an Associate Grade Consultant with experience of EIA, HRA and ecological monitoring work in coastal and estuarine environments. He has 20 years experience of commercial environmental consultancy work and has managed EIAs for a wide range of developments/proposals such as: coastal defences; port developments; dredging activities; coastal realignment schemes and power station construction/operation work. He was the project manager for the plan-level HRA that ABPmer produced to accompany for The Crown Estate's PFOW Round 1 Plan and also Project Manager for the recent HRA of the Draft Plans for Offshore Wind in Scottish Territorial Waters and Wave and Tidal Energy generation in Scotland. Recent project examples of direct relevance to this tender include a review of compensatory measures in relation to bird usage at Allfleets Marsh and understanding the impacts of a development proposal on waterbird populations at the Port of Mostyn. Colin also served as an expert witness at the Wightlink Public Inquiry.

**Aonghais Cook** is a research ecologist in the BTO's Wetland and Marine Research Team and has over seven years' experience of investigating human interactions with birds. Aonghais is a strong numeric and statistical analyst, with a research interest in population ecology, and the interactions of populations with the environment. He has experience in a broad range of statistical and analytical techniques, including statistical, mathematical, and spatial software packages such as R, SAS, DISTANCE and ArcMap GIS. He has recently undertaken training in applying distance analysis techniques at the Centre for Research into Ecological and Environmental Modelling. Since joining the BTO he has been involved in a wide range of projects, both on estuarine waterbirds and seabirds. These have included a particular focus on the potential impacts on these groups of renewables, especially tidal power and offshore wind farms. Other projects have included reviews of the impacts of aggregate dredging on birds and a review of mitigation measures to reduce avian collisions with offshore wind turbines.

**Nick Cutts** has over 20 years experience as a professional ornithologist with IECS, specialising in estuarine and marine avifaunal communities and their management, and prior to joining IECS he worked for both the RSPB undertaking a range of surveys and the BTO in their ringing section. His work for IECS includes both the survey and assessment of avifaunal estuarine and coastal communities, but with particular focus on the development of practical procedures and tools to assist in their management within Natura estuarine and coastal systems. This work has been carried out on behalf of statutory agencies such as Natural England and the Environment Agency, as well as for industrial sector clients, and most recently has included the development of a range of management guidelines and tools to plan, assess and mitigate for construction disturbance stimuli in relation to waterbird assemblages. In addition, Nick provides advice on waterbird management matters to statutory bodies.

**Gareth Bradbury** is an experienced ornithologist currently employed by WWTC. He has extensive experience of managing and conducting coastal and marine bird surveys including, visual and digital aerial surveys, boat surveys and shore based studies. He has personally conducted over 170 visual aerial surveys around the UK coast for a range of clients including offshore windfarm developers and statutory agencies. Following training from the Centre for Research into Ecological and Environmental Modelling, Gareth has gained experience in applying distance analysis techniques including Density Surface Modelling on marine survey data. Examples of marine survey and analysis projects managed by Gareth include the digital

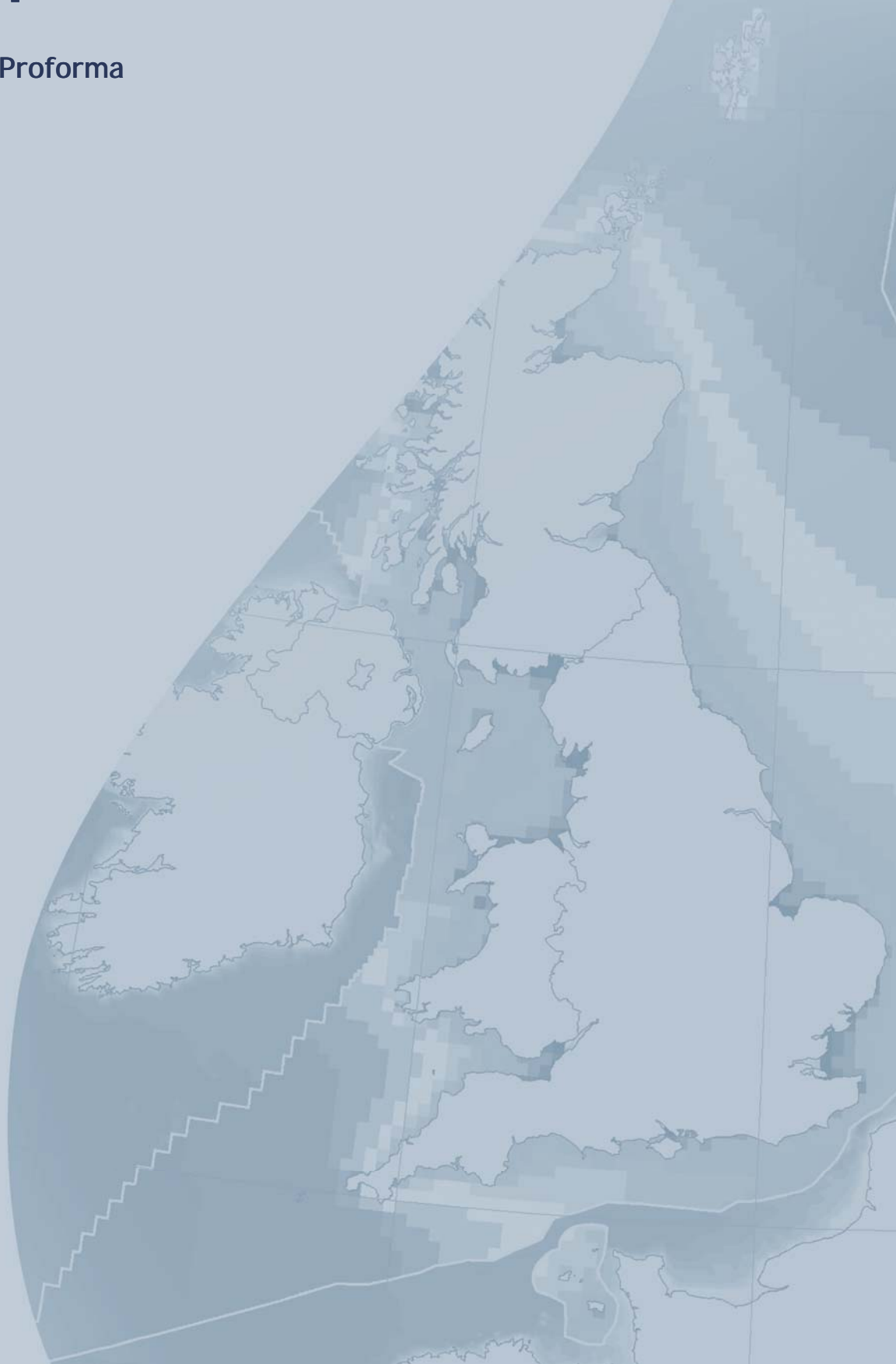
and visual aerial surveys monitoring pilot study for the Irish Sea and Liverpool Bay for JNCC, visual aerial surveys of the Teeside offshore windfarm, visual and digital aerial surveys for cetaceans in the Moray Frith for University of Aberdeen and Density Surface Modelling for the Atlantic Array.

**John Goss-Custard** retired in 2002 but has kept very active in both consultancy and research work since then. During the 30 years that he worked with the Natural Environment Research Council his principle work involved research in to the ecology and behaviour of over-wintering shorebirds and the development of methodologies for predicting the effect on them of the wide range of human activities that are carried out on the coast. John Goss-Custard has developed habitat association models that applied to different parts of a single site (Wash) and also contributed to models that applied across whole estuaries. But in view of the well-understood limitations of habitat association models, his main work focussed on finding ways to predict the effect of human activities on shorebird fitness. Accordingly, he led a team of 2-6 scientists for some 25 years that eventually led to the development and successful testing of an individual-based population model of oystercatchers eating mussels in the Exe estuary. Subsequently, he helped to develop methods that enabled an individual-based population model to be built and tested, within a period of 6-24 months) for any species of shorebird eating any species of prey in any coastal site in the World.



# Appendix B

Blank Proforma



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix B: Blank Peer Review Proforma

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.

## Peer Review

Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009)  
Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	
Were the methods used to collate the data appropriate?	
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	
Are the quality standards associated with such data included within the report?	
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	
Has modelling been used in the analysis? If so are the	

assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<p>Reviews of the most current data including:</p> <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ ground truthing of predictive results?	
Is the evidence complete for its intended use?	
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	
Has an audit trail been maintained throughout the analysis to support the final conclusions?	
Do all sources of evidence/ analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	
Were the methods used to collate the data appropriate?	
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	
Are the quality standards associated with such data included within the report?	
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>• Statistical analysis using box plots and GIS.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed	

on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul> <p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the observation period</li> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species combined analysis was performed in which species were represented by their body mass in order to estimate disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the</p>

	body mass of the species being disturbed and the activity type causing the disturbance
Has there been any validation/ ground truthing of predictive results?	
Is the evidence complete for its intended use?	
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only wading bird species that had at least 20 observations of their response to disturbance</li> <li>• The body mass of these bird species was also linked to response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</li> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance from population centres.</li> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading</li> </ul>

	<p>bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</p> <ul style="list-style-type: none"> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	
Has an audit trail been maintained throughout the analysis to support the final conclusions?	
Do all sources of evidence/ analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	



Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	
Were the methods used to collate the data appropriate?	
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	
Are the quality standards associated with such data included within the report?	
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site visitor surveys including counts of people and interviews.</li> <li>• Car parks and parking spaces were also analysed using Google Earth</li> <li>• Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from	Results from surveys included:

the report	<ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
Has there been any validation/ ground truthing of predictive results?	
Is the evidence complete for its intended use?	
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits made to the coast. Activities coded as "Other" (70 interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</li> <li>• The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site</li> </ul>

	surveys correlate, in terms of visitor rates, will be important in directing further analysis.
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	
Has an audit trail been maintained throughout the analysis to support the final conclusions?	
Do all sources of evidence/ analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	
Were the methods used to collate the data appropriate?	
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	
Are the quality standards associated with such data included within the report?	
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Household questionnaires.</li> <li>• Statistical analysis and presentation using Minitab and MapInfo</li> <li>• Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from	Analysis from results from surveys included:

the report	<ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.</p>
Has there been any validation/ground truthing of predictive results?	
Is the evidence complete for its intended use?	

Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	
Has an audit trail been maintained throughout the analysis to support the final conclusions?	
Do all sources of evidence/ analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	
<b>Data Inputs</b>	
Key data types used within the report.	<p>MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used:</p> <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	
Were the methods used to collate the data appropriate?	
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	
Are the quality standards associated with such data included within the report?	
What are the limitations of the datasets that have been used? Do they compromise the extent	

to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
Are the methods adopted generally appropriate given the objectives?	
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> <li>• Scaling up predictions to the Solent</li> </ul>



	<ul style="list-style-type: none"> <li>• Predictions for Brent Geese</li> </ul>
Has there been any validation/ ground truthing of predictive results?	
Is the evidence complete for its intended use?	
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters</li> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	
Has an audit trail been maintained throughout the analysis to support the final	

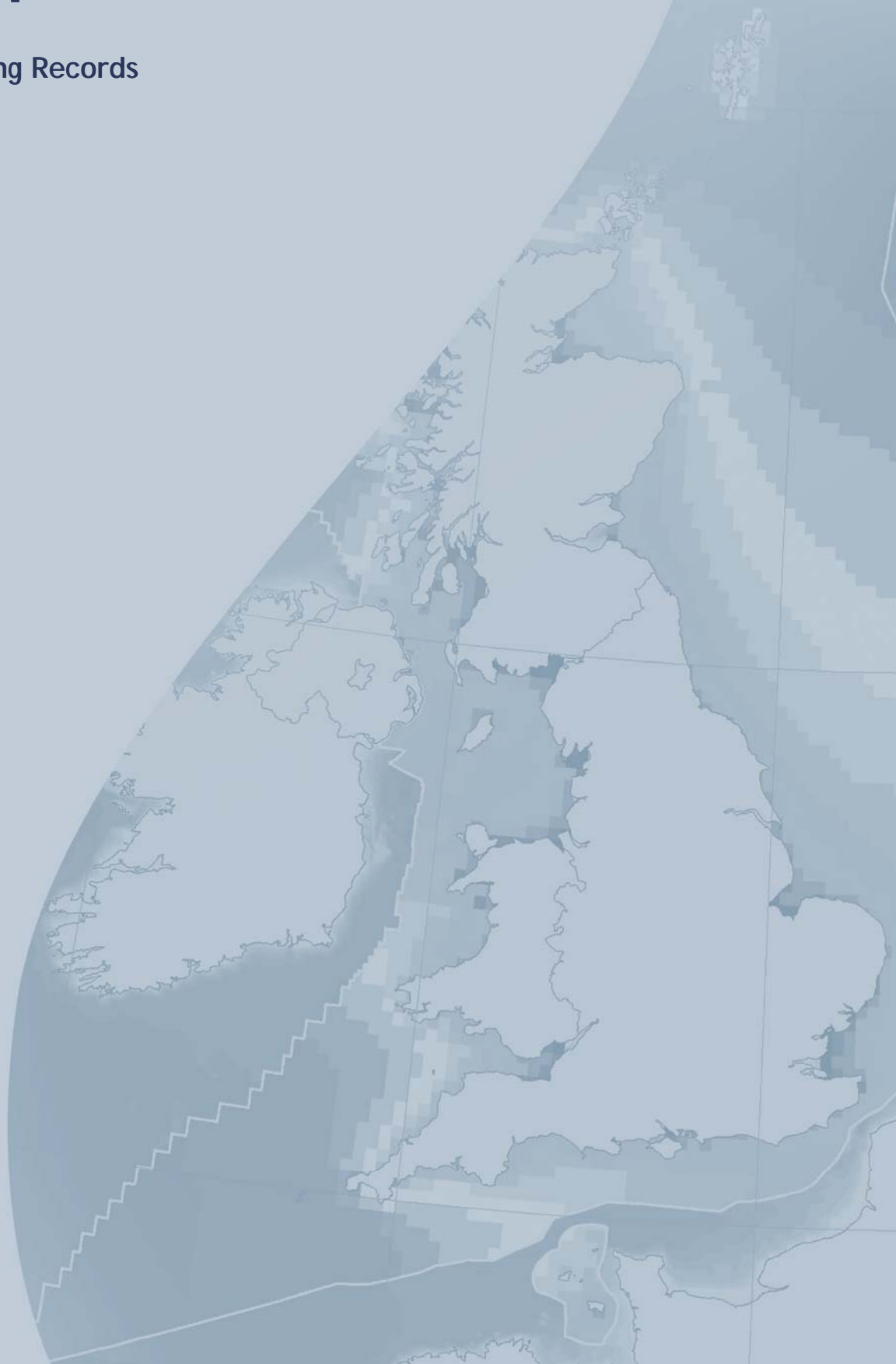
conclusions?	
Do all sources of evidence/ analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

## Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	
Does the evidence base provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?	
Are there any caveats required or limitations to be aware of before using this evidence?	
Is there a requirement for further work? If so what would you recommend?	
Additional Comments	

# Appendix C

## Meeting Records



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C: Meeting Records

- C1 Inception Meeting Minutes
- C2 Teleconference 1 Agenda
- C3 Teleconference 1 Minutes
- C4 Teleconference 2 Agenda
- C5 Questions for Authors
- C6 Teleconference 2 Minutes
- C7 Clarification from Authors
- C8 Natural England Guiding Principles
- C9 Face to Face Meeting Agenda
- C10 Face to Face Meeting Minutes
- C11 Teleconference 3 Agenda
- C12 Teleconference 3 Minutes

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C1: Inception Meeting Teleconference Minutes 22/10/12

Attendees: Alice Bowles (ABPmer), Natalie Frost (ABPmer), Chris McMullon (Natural England), Simon Thompson (Natural England)

Discussion Point	Action
<b>Objectives/ Project Plan</b>	
NE highlighted importance of a clear, transparent and fully auditable process to meet government requirements of a sound and robust review of evidence.	ABPmer to maintain an audit trail throughout including all proformas and minutes of meetings/teleconferences as Appendices to the main report.
Evidence needs to be fully challenged including any assumptions of reports, models used, best available evidence, etc.	ABPmer to structure questions of proforma to address key issues whilst covering all aspects of review. Proforma will be signed off by NE prior to dissemination to reviewers.
NE highlighted that they are hoping to get a consensus view from reviewers.	ABPmer understand that this is a key requirement; if a consensus view cannot be reached a description will be included as to why this cannot be achieved.
<b>Review Panel</b>	
NE confirmed that they are happy with the suggested review panel. The addition of Tony Prater (RSPB) as a sixth reviewer was discussed.	ABPmer to contact Tony Prater and discuss availability and day rates, get back to NE with additional cost. If no additional budget is available Tony Prater could replace review role of Colin Scott.
<b>Proforma</b>	
The importance of the proforma was discussed.	ABPmer to circulate the 1 <sup>st</sup> draft of the proforma to NE by the end of 25/10/12. To be signed off in advance of circulating to the peer reviewers.
<b>Assumptions/ Project Risks</b>	
Time constraints discussed, considering late start up. Reviewers input is currently restricted to 5 days including attendance at meetings.	ABPmer to send revised programme and will actively manage time constraints. ABPmer to organise first teleconference for 31/10/12 to get work underway. NE to confirm availability for 31/10/12.
<b>Communication Plan</b>	
NE project team Simon Thompson (main contact) Chris McMullon Rob Cameron Richard Saunders	N/A
ABPmer project team Natalie Frost (Project manager) Stephen Hull (Project director) Elena SanMartin (Quality manager) Alice Bowles (Researcher)	N/A

All minutes and agendas need signing off by NE.	ABPmer to send agendas to NE in advance of meetings. Minutes will be signed off post meetings.
Hosting of teleconferences.	ABPmer will arrange and host teleconferences and meetings.
Potential location of face to face meeting was discussed	ABPmer to look into best available option. NE venues could all be provided at no cost.
The benefits of talking directly to Durwyn Liley (Footprint Ecology) to clarify any questions or queries about methods, assumptions etc was discussed.	ABPmer to invite Durwyn to second teleconference to answer any questions, whilst still ensuring independent review of work is undertaken.
<b>Reporting</b>	
Progress update procedures.	Fortnightly/weekly updates will be provided to NE as appropriate.
Reporting standards discussed.	NE to provide details of the current reporting guidelines.
Final report will be signed off by both the review panel and NE.	ABPmer to action once proformas collated and report finished.

Signed off by Simon Thompson 05/11/12

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C2: Teleconference Call 1 Agenda

Date: 31/10/12

Time: 14.00-16.00

#### Attendees

Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

#### Agenda

- Introductions (all to provide brief introductions to themselves)
- Overview of what we want to achieve throughout the project (NE)
- Documents to review (ABPmer)
- Proforma and overall approach (ABPmer and group discussion)
- Programme (ABPmer)
- Questions/A.O.B (all)



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C3: Teleconference 1 Meeting Minutes 31/10/12

Attendees: Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

<b>Introductions</b>	
Natalie Frost is a principal consultant and has over 10 years experience in marine ecological research and managing projects. Natalie is project manager within ABPmer for this work.	
Alice Bowles is a marine environmental scientist and has over three years of experience working at ABPmer.	
Colin Scott has 17 years experience of commercial environmental consultancy work including EIA, HRA and ecological monitoring work in coastal and estuarine environments. Colin will be a member of the peer review panel for this project.	
Nick Cutts has over 20 years experience as a professional ornithologist with IECS, specialising in estuarine and marine avifaunal communities and their management, and prior to joining IECS he worked for both RSPB and BTO. Nick will be a member of the peer review panel for this project.	
Gareth Bradbury is an experienced ornithologist currently employed by WWTC. He has extensive experience of managing and conducting coastal and marine bird surveys. Gareth will be a member of the peer review panel for this project.	
Aonghais Cook is a research ecologist in the BTO's Wetland and Marine Research Team and has over seven years' experience of investigating human interactions with birds. Aonghais will be a member of the peer review panel for this project.	
John Goss-Custard worked with the Natural Environment Research Council for 30 years. His principle work involved researching the ecology and behaviour of over-wintering shorebirds and to develop methodologies for predicting the effect on them of human activities carried out on the coast. He retired in 2002 but has kept very active in both consultancy and research work since then. John will be a member of the peer review panel for this project.	
Simon Thompson is a lead advisor at NE and project manager at NE for this work.	
Chris McMullon is a senior coastal advisor at NE and is providing an overview role for this project.	
Richard Saunders is a senior ornithologist at NE.	
RSPB have been contacted to determine their availability to contribute to the review panel.	
<b>Overview of Project/Objectives</b>	
<b>Discussion Point</b>	<b>Action</b>
Natural England is seeking an independent scientific review of outputs of the Solent Mitigation and Disturbance Project to ensure that any advice provided on the basis of this study is founded on a robust and auditable evidence base. The Peer Review outputs will influence how Natural England applies the SDMP evidence in advising on land use planning casework in the Solent and inform its views on the acceptability of existing activities.	NE to provide a brief overview of how the outputs of this peer review will be used in informing the decision making process. These guiding principles will help the panel to focus their review and ensure a shared understanding of NE requirements.
ABPmer reiterated overall aims and guiding principles of the project as stated on page 1 of	Review panel to refer to project objectives and all guiding principles as they progress through

the review proforma.	the review process.
<b>Programme</b>	
Reviewers were made aware that an inception meeting had already occurred between ABPmer and NE from which the programme and proforma were agreed.	ABPmer has circulated programme of work and proforma to review panel.
<p>ABPmer highlighted key dates from programme:</p> <ul style="list-style-type: none"> <li>- Consider points for discussion as a group and for authors/Solent wide stakeholders by 09/11/12</li> <li>- Second teleconference 13/11/12</li> <li>- Complete proformas 23/11/12</li> <li>- ABPmer to collate and circulate to project team 28/11/12</li> <li>- Face to face meeting 03/12/12 or 04/12/12</li> <li>- Circulate draft version of report 10/12/12</li> <li>- Third teleconference to agree actions to finalise the report 14/12/12</li> <li>- Final report signed off by reviewers 19/12/12</li> <li>- Submit final report 21/12/12</li> </ul>	<p>Any problems with dates and overall programme to be raised as early as possible.</p> <p>Project team to confirm availability for the 03/12/12 or 04/12/12 for a face to face meeting in Southampton (11am to 3pm).</p>
<b>Reports</b>	
Reports to be reviewed are all available to download.	Reports are available at: <a href="http://www.solentforum.org/forum/sub_groups/Natural_Environment_Group/Disturbance_and_Mitigation_Project/">http://www.solentforum.org/forum/sub_groups/Natural_Environment_Group/Disturbance_and_Mitigation_Project/</a>
<b>Proforma</b>	
Questions are to be answered in the context of each of the reports with an overall assessment at the end, keeping in mind the objectives/aims and guiding principles of the project from the outset.	
If there are comments which do not fit into a box, reviewers are encouraged to write additional information. If it is a question which the reviewer thinks the whole panel should be considering then questions can be added to the proforma.	Review panel to consider: points for discussion within the review team, questions for third parties (including the report authors) and any updates for the proforma by 09/11/12.
Proformas will be available for public viewing forming appendices to the main report.	Review panel asked to explain abbreviations and any technical terms used.
Citations to add weight to critique or additional evidence were encouraged if they relate to the work being reviewed.	Review panel asked to keep full reference list.
<b>Communication</b>	
All communication/questions to go through NF and AB at ABPmer.	Review panel to raise questions as they arise.
Contracts are in the process of being set up with each of the reviewers.	Reviewers to sign and return to ABPmer so that POs can be issued.

All meeting minutes will be circulated to all attendees for review and sign/ off.	All to provide comments on minutes and confirm that they provide an accurate representation of the meetings.
Second teleconference planned for 13/11/12	ABPmer to circulate details including time, dial in and pin number.

Project member	Signed-off minutes	Confirmed 3 <sup>rd</sup> or 4 <sup>th</sup> Dec for face to face meeting	Additional comments
Alice Bowles	02/11/12	Available for both	
Natalie Frost	02/11/12	Available for both	
Colin Scott	02/11/12		
Aonghais Cook	02/11/12	Available for both – 4 <sup>th</sup> preferable	
Nick Cutts	05/11/12	Available for both – 4 <sup>th</sup> preferable	Cannot make teleconference on 13/11/12 Lucas Mander to sit in
Gareth Bradbury	02/11/12	Available for both	
John Goss-Custard	09/11/12	Available for both	
Chris McMullon	02/11/12	Available for both	
Richard Saunders	02/11/12	Available for both	Cannot make teleconference on 13/11/12
Simon Thompson	02/11/12		

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C4: Teleconference Call 2 Agenda

Date: 13/11/12          Time: 14.00-16.00

#### Attendees

Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Lucas Mander (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE) and Simon Thompson (NE).

Richard Stillman and Durwyn Liley (SDMP report authors) will be dialling in for part of the teleconference.

#### Apologies

Nick Cutts (IECS), Richard Saunders (NE)

#### Agenda

- Minutes of last meeting (ABPmer/ all)
- General progress update (ABPmer)
- Review responses to date (Group discussion with report authors)
- Finalise Proforma for completion (ABPmer and group discussion)
- Programme/ Future Meetings (ABPmer)
- Questions/A.O.B (all)

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C5: Discussion points for second teleconference (13 November 2012)

The following points for discussion/ specific questions have been extracted from the initial comments provided by each of the review panel members.

#### General

Overall use/ suitability of the proforma.

Has the review panel identified the need to pose any questions to wider stakeholders at this stage?

#### **Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2008) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum**

How was the literature review carried out to ensure all literature was captured?  
(Suggested missing reference - WWT review of disturbance to waterbirds in Kirby et al. 2004 and references therein)

How was the sample of experts selected to ensure they were wholly representative?  
Is it safe to assume that they were a representative and unbiased sample of local people with extensive knowledge of the subjects being discussed?

The trends in the numbers of shorebirds, relative to the regional and national population, varied between species and between different parts of the Solent. Might not these differences provide clues – or even tests – of whether some activities by people are having an impact on bird numbers? For example, perhaps the numbers of a species known to be very prone to disturbance (as judged by the experts) might have decreased in areas where people are abundant (as judged by the experts) but increased in less accessible places. Alternatively, species that mostly occur on muddy sediments which are typically avoided by people - might have remained stable or even increased, whereas numbers in the sandy areas, where people tend to congregated, might have gone down. If the current amount of activity by people has been having an effect on the birds, some re-distribution within the Solent between people-abundant and people-scarce areas might be expected.

As oystercatchers are discussed in later reports, why are their trends in numbers not discussed relative to regional and national trends?

#### **Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10**

Report 2 mentions that winter bird disturbance surveys were carried out in 2008/09, however, this does not seem to be reported anywhere. Is this correct?

Should the results on the relative frequencies with which the different kinds of activities occur only be viewed as 'winter only' findings. In this context certain activities might have not been well represented due to the timings of the data collection.

Given the timings of the surveys what consideration has been given to breeding birds and how has this been incorporated into the analysis?

Were observations made with respect to bird usage throughout the intertidal zone and if so how was this information incorporated into the model?

In terms of bird disturbance how is 'major flight' defined?

**Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). On-site visitor survey results of the Solent area, 2010**

Were the interview locations representative in terms of how people access the coast?

The surveys were limited to mid-winter and not representative for the year as a whole. What impact will this have had on the analysis?

Was consideration given to the type of intertidal substrate used by people for each activity type (e.g. failure to distinguish between muddy and sandy routes) and as such the relative disturbance of different locations?

What methodology was used to select visitors at random? Were people asked in groups and as individuals?

**Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey**

What testing was applied to the visitor model and could more vigorous testing have been applied? What reason is there to think that the weather would have caused a sufficiently large reduction in visitation rates to completely explain away the large discrepancy between predicted and observed rates?

What attempts were made to assess the representativeness of the householder survey respondents? Could more vigorous testing have been applied?

**Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum**

Do the assumptions inherent within the model result in precautionary results?

Which of the assumptions are least/ most likely to be true?

How do the difficulties associated with accurately defining biomass availability limit the applicability of the models e.g. within Chichester Harbour and what implications does this have for other sites? What assumptions were made in relation to biomass availability through the winter and how does this reflect the results from field surveys?

Should patterns of turnover across the region be included within the analysis?

How valid is the comparison of mortality rates with national statistics?

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C6: Teleconference 2 Meeting Minutes 13/11/12

**Attendees:** Project team: Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Lucas Mander (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Simon Thompson (NE) and, by request, the SDMP report authors: Ralph Clarke (Bournemouth University), Durwyn Liley (Footprint Ecology) and Richard Stillman (Bournemouth University).

**Apologies:** Nick Cutts (IECS), Richard Saunders (NE)

Subject/ Attendee	Discussion Point	Action
<b>Overview</b>		
NE	NE to provide a brief overview of how the outputs of this peer review will be used in informing the decision making process. These guiding principles will help the panel to focus their review and ensure a shared understanding of NE requirements.	NE to send guiding principles
NE	NE reiterated that their involvement in these teleconferences for project clarification purposes but that they will not actively be involved in discussions relating to the reports themselves to ensure a completely independent review.	
All	Review panel confirmed that they did not feel it necessary to talk to any wider stakeholders to aid in the review of the reports.	
<b>Project Team</b>		
NF	Confirmed that no one at RSPB was available to take part in the review due to insufficient resources within the timescales of the project.	
<b>Proforma</b>		
All	From an initial review the panel were happy with proforma as it stands with only minor amendments suggested and agreed should be incorporated.	<p>ABPmer will update the proforma and re-circulate a final version to the review panel.</p> <p>As the review panel complete the final 'overall assessment' section of the proforma they are to inform ABPmer of any updates/suggested changes to the proforma and questions within it that they think are appropriate.</p>

CM	There is no limit to the text that can be inserted into the boxes of the proforma and thus the reviewers should not feel constrained in their write up. All answers should be explained and evidence provided if relevant.	Any supplements or additional information can be inputted into the proforma in the 'additional comments' box.
<b>Programme</b>		
NF	<p>Completed proformas to be returned to ABPmer by 23/11/12</p> <p>Face to face meeting 4 December in Southampton 11-3pm approx.</p> <p>ABPmer to complete draft Peer Review Report by 10/12/12 and circulate to project team for final review</p> <p>Teleconference 3 - 14/12/12 to discuss draft Peer Review Report and agree actions to finalise the report.</p> <p>Final report signed off by reviewers 19/12/12</p> <p>Final report issued to NE 21/12/12</p>	ABPmer to circulate completed proformas to review panel prior to face to face meeting.
<b>Report 1 – Key points raised by peer reviewers authors and during discussions</b>		
DL	The literature review undertaken in Report 1 was not intended to be a repeat of previous reviews and the specification for the work had been Solent specific. The expert review panel involved with this project were considered to be representative of the Solent. Jon Cox, who was involved with this work, has been living and working in the Solent for a number of years and helped to select the panel along with the Solent Forum.	
JGC	Might it not be possible to examine the trends in the numbers of shorebirds, relative to the regional and national population, in relation to the different kinds of human usage around the Solent? For example, perhaps the numbers of a species known to be very prone to disturbance might have decreased in areas where people are abundant but increased in less accessible places. In addition, numbers of species that mostly occur on muddy sediments - which are typically avoided by people might have remained stable or even increased, whereas numbers in the sandy areas, where people tend to occur, might have gone down. If the current amount of activity by people has been having an effect on the birds, some re-distribution within the Solent between people-abundant and people-scarce areas might be expected. JGC wondered whether such an analysis was possible and whether it had been considered.	



AC	Similar analysis was undertaken on the Wash where WeBS counts were compared to the national population trends, looking at the effect of anthropogenic activities, specifically wildfowling.	
RS/DL	Confirmed that trends in oystercatcher numbers within the Solent were not discussed relative to regional and national trends but could not remember the reason for the omission.	Authors to check and report back to the group.
<b>Report 2 – Key points raised by peer reviewers authors and during discussions</b>		
RS	Winter bird surveys were conducted in 2009/10. Another report describes the results of a 2008/09 survey but this was not included in the model so it was not described further.	
DL/RS	The authors acknowledged that human activities may be different in Autumn/ Spring. Originally the project had intended to look at visitors/activities throughout the overwintering period but budgetary and time constraints meant that the project focussed on mid-winter.	
RS and JGC	It was agreed that the mid winter period was the most harsh/ critical time for overwintering birds so, given the overall project constraints, this was the most useful data that could have been collected.	
RS	The study was focussed on wintering birds and no consideration was given to breeding birds within this work. Assessing the effects of disturbance on breeding birds was proposed as another potential study that could be undertaken in the future and the results of the household survey could feed into this.	
CM	Noted that the SDMP was contracted by the Solent Forum, with NE on a steering group, thus NE had limited capacity to expand the review. A consensus view was reached by that steering group as a whole on the budget and what the project should cover.	
RS	Confirmed that a 'major flight' within this project was defined as birds moving greater than 50m.	
<b>Report 3 – Key points raised by peer reviewers authors and during discussions</b>		
DL	In determining interview/survey locations the shoreline was divided up into sections. The 09/10 survey locations were chosen to be different to those surveyed in 08/09 and were evenly spread across the Solent so that locations were distributed with an approximate gap of every three sections. Within these sections people were surveyed where it was most practical (and safe) to do so, with the choice of location made based on the path network and access infrastructure present within the section. Some interview locations were centred at car parks whilst others were around intersections in footpaths where people could be easily intercepted.	

RC	Interview locations were also chosen where it was known a decent number of visitors would be.	
DL	The methodology for conducting the interviews involved surveying one person per group, everyone in that group was then assumed to have the same behaviour. The surveyors then tried to interview the next person they saw once an interview was completed. It was acknowledged that it was difficult to select one person at random within small groups, however, this should not have had a profound effect on the outcome.	
<b>Report 4 – Key points raised by peer reviewers authors and during discussions</b>		
JGC/RC/ RS/DL	A detailed discussion was held on the calculation and prediction of visitation rates, based on data from the household survey and whether the cold weather was sufficient to account for any apparent discrepancies between on-site visitation rates and the predictions of the household survey model.	RC will produce a flow diagram/short description to clearly explain how these statistics were calculated.
AC/JGC	It was questioned whether the responses from the household surveys could be considered both accurate and representative of the population as a whole - with those most likely to visit the coast having the closest connection to it and thus being the ones most likely to respond. No analysis was done to compare the composition of the sample that responded to the population as a whole.	
RC/DL	It was acknowledged that this was a reasonable comment, that people are more likely to respond if interested in the site. Testing the overall representation of the sample of those who responded and those who did not along with a check on the accuracy of the replies is a large undertaking and was beyond the budget of this project. The profile of respondents was checked with local authority data and was deemed to be fairly reasonable with regard to dog walkers and number of retired people. Particularly encouraging was the overall (reasonably high) 27% response rate.	
<b>Report 5 – Key points raised by peer reviewers authors and during discussions</b>		
JGC	The assumptions need to be clearly identified. Over cautious assumptions may exaggerate disturbance e.g. extremely high visitation estimates, constraining birds to 1/3 <sup>rd</sup> of the estuary, no prey above MHWN. If, for example, birds were allowed to move up and down the length of the estuary the effect of disturbance would be predicted to be much less. Particular concern was expressed that there was no sub-division in the intertidal areas within the model between muddy sediments, which many people avoid but where many birds feed, and sandy	

<p>RS</p>	<p>sediments where most people may go and many birds may avoid.</p> <p>A lot of thought went into how people and birds interact in the intertidal. The decision was taken that both the birds and the people should be assumed to be distributed without regard to each other throughout the intertidal as there was not enough data to say otherwise; that is, the people in the model were distributed without regard to the presence of birds and thus neither congregated where birds were present or where they were absent. Sediment distribution was not incorporated into the model, thus the model only differentiates between the intertidal zone and sea wall. People on the sea wall could only disturb birds within a certain distance whereas people on the intertidal could disturb birds on the entire area that was uncovered at that time.</p>	
<p>RS</p>	<p>Splitting the estuary into thirds gave the closest predictions to mortality rates when compared to national rates under a baseline scenario. RS agreed that if pushed birds could move more widely.</p>	
<p>JGC</p>	<p>It was suggested that, as is usually included in multi-site models of this kind, an additional decision rule could have been incorporated in the Southampton Water so that when model birds lost most of their body reserves they could then move to any other sub-site in the estuary.</p>	
<p>NF</p>	<p>Reminded panel that they should focus on reviewing the work that has been undertaken as part of the project, although it is possible to suggest what could be done in the future, as this additional work would not be available to inform NE advice.</p>	
<p>CRS</p>	<p>Noted that the model can be viewed as being precautionary and its outputs and conclusions can be viewed in this context. However, it should be noted that the huge data input and the links made between data e.g. activity and bird use / housing and activity each provide their own individual regression relationship which will be extremely valuable products that could be used in their own right by NE alongside the model.</p>	
<p>JGC</p>	<p>Agreed the outputs of the project provide a good description of the way birds respond to people but from his perspective the essence of the review is to demonstrate the effect on bird fitness of certain disturbance activities.</p>	

NF	Asked whether the failure of the model to work in Chichester Harbour undermined the project in any way was discussed.	
JGC	It was highlighted that the model had been applied successfully to approximately 15 separate estuaries around the UK and, as such, Chichester Harbour presents an interesting case rather than one that reflected badly on the modelling approach as a whole. The invertebrate survey at Chichester Harbour needs to be looked at in more detail to explain the failure here.	
AC	Suggested the difference may also be down to the way the birds use the estuary. At Chichester Harbour the birds may use the site as a migration site whereas at Southampton the birds may use it as a wintering site thus bird numbers may have been over estimated for the Chichester Harbour model.	
RS	Chichester Harbour failed due to the fact that the intertidal survey suggested that food supply was insufficient to support birds irrespective of disturbance. This suggests that, for unknown reasons, much of the food supply of the birds had been missed in the invertebrate survey. Accordingly, Chichester was not modelled as the problem with the intertidal survey was never resolved.	
CM	Confirmed that NE are funding a re-survey of intertidal invertebrates at Chichester Harbour to more fully understand this issue.	

Project member	Signed-off minutes	Additional comments
Alice Bowles	16/11/12	
Natalie Frost	16/11/12	
Colin Scott	16/11/12	
Aonghais Cook	20/11/12	
Lucas Mander	19/11/12	
Gareth Bradbury	16/11/12	
John Goss-Custard	19/11/12	
Chris McMullon	04/12/12	Provided note about NE's role and short summary of the Habs Regs tests as they apply to their advice (19/11/12)
Simon Thompson	04/12/12	
Richard Stillman	04/12/12	
Ralph Clarke	16/11/12	Provided clarification on the approach and assumptions used to model and predict visitor numbers (16/11/12)
Durwyn Liley	16/11/12	

## Appendix C7: Authors requested Contribution to Solent Disturbance and Mitigation Project (SDMP) Peer Review

Ralph Clarke, Durwyn Liley and Helen Fearnley 16/11/12

At a teleconference on 13/11/12 between the Review panel and the SDMP reports authors, the authors were requested to following provide further clarification and support information on aspects on the Household survey approach used to derive estimates and predictions of visitor numbers to each of the 103 Solent coast sections – this is provided here

Our household survey report (Fearnley et al 2011) includes discussion on our study design, approach and limitations (paragraphs 5-2-5.13).

### 1. Representativeness of responding households of the intended study population

In any remote (postal or on-line) survey of people or households, there will usually be concerns that those responding may not be a random and thus representative subset of the population of interest.

In our Household survey of coastal visits (Fearnley et al 2011), we allocated the planned and costed survey sample of 5000 questionnaires to the existing District and City Councils along the Solent coast in proportion to their population size. We chose to concentrate effort on households within 5km of the coast (from where much higher coastal visit rates were expected ). We asked each Council to supply us with the required size random sample of their households, 91% (10/11) randomly from those within 5km of the coast and the remaining 9% (1/11) randomly from those households within 5-25km. These Councils by distance bands form our statistical sampling strata and our posted sample of households within strata was random. Our overall response rate (i.e. returned completed questionnaires) was 27.6% (1382 households). It is possible, as with any remote non-compulsory questionnaire survey of people, that the responders may not represent a random sample of the intended whole survey population. In particular, there may be a concern that those people with more time (such as retired people) and/or more interest in visiting the coast will be more likely to reply.

The results of the household survey were circulated to the Solent Forum and representatives from the local authorities. We received comments that were incorporated into the report, but this also served as a check that the survey was representative. Comments were positive and there were no concerns raised by local authorities that there were any particular biases apparent

#### **Percentage response by 'retired' people**

The 2011 ONS population age structure (child (<20), (20-64), retired age group (65+)) are available for the Hampshire Council and Chichester sub-regions abutting the Solent coast to give:

Population sub-region	Total Population	Population Aged 65+ (read from graphs)	% Aged 65+
New Forest (covers sections 1-18)	174400	43000	25
Southampton	235000	35000	15
Eastleigh	123400	20000	16
Fareham	111300	23000	21
Gosport	80100	14000	17
Portsmouth	199600	33000	17
Havant	116700	25000	21
Chichester (West Sussex)	113700	27800	24

Total	1154200	220800	19
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(Websites: <http://www3.hants.gov.uk/factsandfigures/population-statistics/demographicfactsheets.htm> and [http://www.westsussex.gov.uk/your\\_council/performance\\_facts\\_and\\_figures/population\\_and\\_census\\_data/census\\_2011\\_statistics\\_for\\_we.aspx](http://www.westsussex.gov.uk/your_council/performance_facts_and_figures/population_and_census_data/census_2011_statistics_for_we.aspx) )

We did not record the age category of all people in all responding households in our Household survey. However we did record the number of people 'Permanently retired from paid work', as summarised in Table 31 of Fearnley et al (2011). Although this group will include numerous people less than 65 (especially 60-64 year old women) and exclude a few >65, it should be quite closely related to the 65+ age group of responders. Fearnley et al (2011) para 3.69 reports that 49% of all responding households had at least one retired' person. However this statistic can be mis-interpreted as very high. The statistic we need for comparison is the percentage of all of the people in the responding households who are 'permanently retired'; this can be calculated from Table 31 and is 29%. (Note in Table 31, the total number 'Employed full-time' should have read 897 not 987).

The percentage of population in the Solent coastal region aged 65 or more varied from 15-17% in the Southampton and Portsmouth to 24% in Chichester and 25% in the New Forest District which covers all SDMP sections 1-18. Across all of these coastal sub-regions, 19% of people are 65 or more.

Therefore the responding households in our Household survey may have some bias towards 'retired' (or 65+) people (29% of total) compared to the 19% in the whole Solent coastal population. However, this is much less than implied by the quoted percentage in our Report of 49% households with at least one retiree.

### ***Dog ownership***

In in Household survey 19% of responding households owned one or more dogs; this is close to the national average of 20%.

## **2. Uses and comparisons of Household survey visits to all of 103 sections and the on-site visitor surveys at single points on 20 sections**

Our SDMP research remit required us to derive estimates of visitor numbers to the whole of the Solent coast, which we divided into 103 sections. These sections then formed the geographic basis for the individual-based models. Modelling effects of bird disturbance over the whole of a section (treated by necessity in the bird model as one varyingly-exposed food patch) requires estimates of visitor numbers to the whole of the section. Such estimates are provided for all 103 sections by the Household questionnaire survey responses because households were asked to record the frequency of annual visits (with main season(s)) to their most commonly visited Solent coast sections. Maps were provided with the questionnaire and sections were clearly labelled and named.

In contrast, the on-site interview survey of visitors was, of practical necessity, at just one access point or commonly passed point in each of 20 of the 103 sections (Fearnley et al 2010). A principle aim of the on-site visitor survey was to interview people on leaving to record their activities and the routes and distances they had walked/moved within the section (whether along the sea wall or on the inter-tidal area). This was used to help determine the typical (potential bird feeding) area disturbance by each type of visitor, as required by the bird modelling. These 20 sections were chosen to be spread systematically over the Solent coast section 1-103 and to be the same 20 sections as surveyed and assessed for birds and visitor-bird interactions (i.e. disturbance) (Liley et al. 2010).

The on-site visitor data therefore provide specific details for visitors passing a single point and the counts of visitors at these locations are specific to a single point, they cannot be used to derive an estimate of daily or annual visit or rates to the section as a whole. As a simple example, if a section has two other equally well visited main access points or car parks to the one monitored in the on-site survey, then the on-site survey estimate of visit rate could be expected to about one-third of the whole section visit rate and should be multiplied up by a factor of 3 for this whole section. By contrast the household survey provides data for a section of coast – that encompasses multiple access points and maybe car parks and stretches for multiple kilometres. The Household survey and on-site visit rates are therefore not necessarily comparable.

In the Household survey report (Fearnley et al 2011), we did try to use the on-site survey data to derive estimates of average annual visits per section per household by distance band (weighted average across sections) on foot (Table 39) and by car (Table 44) to compare with the equivalent rates derived from the household survey data. The aim was partly to show the pattern of decrease in visitor rates with distance from home to the coastal section – a crucial relationship for assessing the potential effect of new housing developments at different distances from the coast and inter-tidal bird habitats. For the reasons stated above (namely Household survey provides whole section visitor numbers while on-site survey provides point winter visit numbers), we would expect annual visit rates based s on the on-site survey section visit rates to generally be much lower than the Household survey estimates, as they are for all distances for both foot- and car-based visitors (Table 39 and 44; the only exception being the high rate of visiting on foot from homes within 500m during the very cold on-site survey period). Tables 39 and 44 and their initial interpretation in Fearnley et al (2011) are therefore perhaps misleading. However in the discussion in the household report (e.g. para 5.6) there is comment on the scale of the section and the difficulties relating on-site point survey data to the household whole-section data.

Equally importantly, the number of main access points in a section varies between sections, so the single point on-site survey numbers cannot easily be scaled up by a constant factor to provide an estimate for the whole section, and thus the on-site survey visitor numbers cannot be expected to have a very high correlation with the estimates of whole section annual visitor numbers provided by the Household survey.

This is seen in Figure 10 of the Household survey report, where the quoted rank correlation is only 0.645. It may help to see examples of section boundaries and on-site survey points on a map (see Figure 1 below). The numbered blue dots indicate the points where the surveyor stood and counted people and conducted the interviews. The black lines show the section boundaries, and it is clear that the point data represents just one specific point along a length of the coast. As illustration, on-site survey sections 34 and 37 have two and three other official (i.e. OS mapped) car parks, while nearby survey section 32 has none. This may partly explain why sections 34 and 37 have relatively high Household survey whole section visitor estimates compared to the general relationship with on-site point survey estimates in Figure 10 of Fearnley et al 2011). Also the on-site survey point within section 69 was on the border with section 68 (as this was the most practical location to intercept and interview people) and thus visitors to this main access point for both sections may (being unaware of our research sections) spread out over both sections and thus on-site numbers for section 69 should perhaps be expected to be correlated to the combined Household survey visitors across both sections (which is roughly double section 69) (see Figure 10 of the Household Survey report ). However, these are inevitable idiosyncrasies of individual survey observations.

The important point is that the on-site single-point survey visitor numbers cannot be expected to provide reliable estimates of whole section visitors, nor have an extremely high correlation with



Household survey whole section estimates. The on-site survey mostly provides the information on routes, behaviour of visitors etc.

This is why we used only the household survey response data to derive estimates of visitor rates per household and overall to each section (including using the Household survey responses on season(s) of visiting to estimate the percentage (average 42%) of all annual visits which are made during the autumn-winter over-wintering period (Stillman et al 2012, p111).

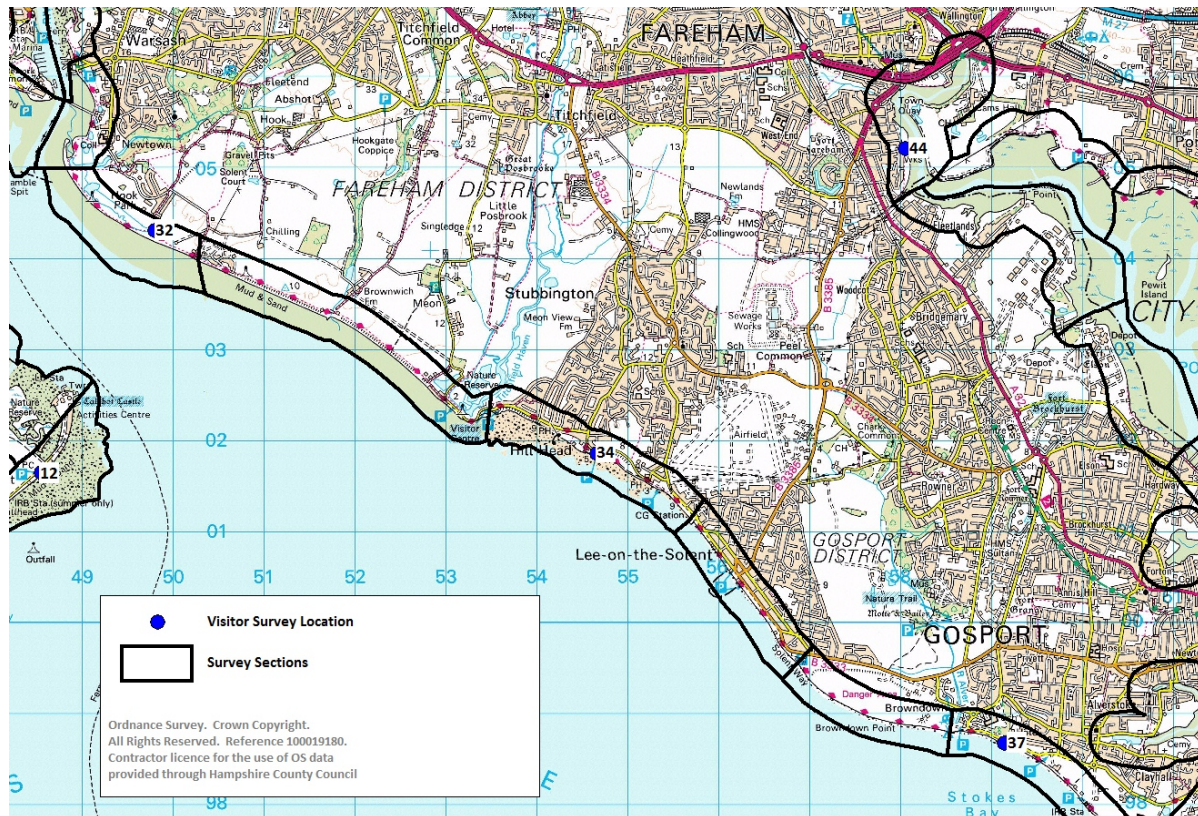


Figure 1 Map of Solent coast sections 32-37 showing on-site survey points (numbered blue circles) and OS marked car parks (P) providing alternative access points (zoom for more clarity)

### 3. Statistical modelling of visitor numbers to each section

The approach and statistical methods used to model and predict the numbers of visitors to each of the 103 Solent coast sections are described in paragraphs 2.37-2.46 of our SDMP Household survey report (Fearnley et al 2011). Crucially any method we developed had to be able to predict visitor rates per household in different distance bands from the coast, as we needed to combine these rates with known total numbers of households in each distance band from each section to derive estimates of total visitor numbers to each section. For reasons explained above in (A), all our modelling and prediction of visitor rates and numbers was based on the Household survey whole section visitor data.

A wide range of trial generalised linear models were assessed which related the observed number of visits ( $V_{SD}$ ) to section  $S$  from distance band  $D$  to the number of responding households ( $H_{SD}$ ) in distance band  $D$  from section  $S$  while allowing for differences in observed overall visiting rates between sections. It was not possible to predict visit rates from each distance band independently for each section, as there were too few (or none) responding households in some distance bands to some sections, especially where current housing density was relatively low. Yet we needed to be able to make predictions for current and possibly additional housing densities at all distances to all



sections of the coast. To achieve this we analysed the complete dataset together to derive a model which could be used for predictions for all sections and distances.

We assessed whether inter-section differences in rates could be represented by one or more of features measured for each section (see Table 3 of Fearnley et al 2011). Although we found that the presence of open-coast, a slip-way and monitored bathing were positively correlated with annual visit rates per household, there was no statistically relationship between visit rates and either the area of a section or the percentage cover of the section with mudflat (mudflat extent from the Natural England website) (see Tables 40 and 45 and Figures 13-20).

In the absence of being able to predict section-specific visitor rates at each distance using the available section characteristics, we acknowledged that we must allow for the obvious section differences in visitor attraction/usage. We therefore fitted GLM models which involved a rate of decline in visit rate with distance band modified by a separate multiplicative factor for each section. This was done separately for foot and car visits which operate over different distance ranges. These models thus implicitly incorporate both the influence of measured section characteristics and other factors influencing the relative 'attractiveness' of individual sections. The fitted model was (from paragraphs 4.18 and 4.41) :

$$\text{Log } V_{SD} = \text{Log } (H_{SD} + A_D + B_S)$$

where  $V_{SD}$  = observed visits to section S from distance band D

$H_{SD}$  = number of responding households in distance band D from section S

$A_D$  = coefficient representing the general rate of visiting from distance band D

$B_S$  = coefficient representing the relative (within-band) rate of visiting section S.

The predicted visit rate ( $R_{SD}$ ) (per household per year) from distance band D to section S is then :

$$R_{SD} = \exp(A_D + B_S) \quad , \text{ where 'exp' is the exponential mathematical function.}$$

The fitted values ( $A_D$ ) representing the rate of decline with distance are given in Tables 42 and 49 and the declines are shown graphically in Figures 14-15 and 19-20.

The fitted coefficients ( $B_S$ ) representing differences between sections in visit rate per household from any given distance are given in Table 2 of the Final data tables and map annex accompanying Fearnley et al (2011). The ratio ( $A_{J/K}$ ) of visits per household from any distance band to section J relative to section K is assumed to a constant for all distances and the ratio is estimated by :

$$A_{J/K} = \exp(B_J - B_K)$$

e.g. visit rate per household to Section 85 relative to section 84 from same distance:

foot:  $\exp(-0.1655 - (-2.2394)) = 8$  times as many

car :  $\exp(-0.1745 - (-3.6359)) = 32$  times as many

These relationship and coefficients are fitted separately for visitor arriving on foot and by car and then estimates combined and adjusted (x1.093) for visitors arriving by other transport means.

#### 4. Visitor Prediction accuracy

It is not obvious how we can make independent assessments of the accuracy of our modelling predictions of visitor numbers to each section, either annually or even more importantly for the bird over-wintering period. Ideally there would be completely independent data on visitor numbers. Our report para 5.13 discusses a few available examples. In addition, the 'Visit England' and 'Tourism South East' groups estimate that West Wittering beach has about one million visitors per year (

[http://www.visitengland.org/Images/Visits%20to%20Visitor%20Attractions%20Survey%2006%20-%20Top%20Attractions%20-%20South%20East\\_tcm30-23339.pdf](http://www.visitengland.org/Images/Visits%20to%20Visitor%20Attractions%20Survey%2006%20-%20Top%20Attractions%20-%20South%20East_tcm30-23339.pdf)) which is in close agreement with our visit rate modelling estimate (Table 50) of 1070626 annual visits to section 85 (East Stoke point to East Wiitering) within which this beach is the major attraction.

The correlation between the predicted total annual number of visits to a section and the observed number from the household survey respondents is very high at 0.98. This very high correlation is at least partly due to the GLM models including section-specific factors estimated to maximise statistical likelihood agreement with the observed visit rates from the household survey respondents. However, the fitted model only allows for an assumed constant proportional rate of decline with distance for all sections. The model predicted overall visitor numbers to a section will depend on the total number of households (not just the few sampled) within each distance band, while the observed visitor numbers will depend on the number of survey households responding with visits to that section. Thus the strong correlation across the 103 sections between Household survey observed and model predicted visitor numbers to individual sections is encouraging, but not totally convincing because of the logical but optimised fitting of section-specific terms in the visitor rate per household models.

#### **Possible bootstrap re-sampling of responding households to assess sampling precision**

Beyond the scope and resources of our SDMP contract, we could have tried to assess uncertainty in visitor estimates arising from the available data and our predictive modelling approach using some form of random bootstrap re-sampling of the responding households within each sampling strata of the Household survey (namely each District/City council area by coast distance category (close 0-5km and further 5-25km). But this would be an enormous amount of effort to follow through all the predictive modelling stages and then on to their input and effects within the bird modelling of disturbance effects. This would provide an estimate of the effect of responding household sampling variation and sampling precision, but not of any potential responding sample bias.

### **5. Comparison of our Household survey estimates with NEME national estimates of natural environment visitor rates**

Natural England's recent MENE 2011-12 survey report based on in-home interviewing of householders throughout England estimates that on average, adults make around 65 visits to the open natural environment per annum (see para 2.13 in <http://publications.naturalengland.org.uk/publication/1712385?category=47018>).

Around the Solent there are over 600,000 residential properties within 5km of the coast (from past SDMP Phase I report of Stillman et al 2008). There are on average 2.37 people per household in Hampshire (2011) including 24% children (i.e. <20year olds; see link in (A)). If we assume  $2.37 \times 0.76 = 1.8$  adults per household then the population living within 5km of the Solent coast is about 1,080,000 adults. Using the MENE estimate of 65 visits per adult, this equates to 70 million visits to open spaces from the Solent adult population living within 5km of the coast.

The MENE survey records visits from households throughout England to all open greenspace sites ("including parks, canals and nature areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers). However, for households near the coast, especially in built-up areas, we might expect the nearby coast to have a strong draw and most green space to be around the coast; therefore our estimate in Table 50 of Fearnley et al (2011) of 52 million annual household visits to the Solent coast doesn't seem to be far out or a gross overestimate. This is particularly so as our estimate includes estimated visits from additional people who live more than 5km (5-30km) from the coast.

## Appendix C8: Natural England's role – some context for the Peer Review Panel

Chris McMullon and Simon Thompson 14<sup>th</sup> November 2012

### Natural England's role

Natural England is the government's advisor on the natural environment. We provide practical advice, grounded in science, on how best to safeguard this. In fulfilling this function, we are a statutory consultee on environmental assessment processes and the implementation of the Habitats Regulations such as where this relates to development proposals and strategic Development Plans. Our role is to provide advice, but it is the responsibility of the relevant decision-maker to consider our advice when reaching a decision.

The evidence within the Solent Disturbance and Mitigation Project and this subsequent Peer Review is relevant to the statutory advice that Natural England needs to provide to Local Planning authorities on proposals such as housing developments and strategic plans such as Local Plans and their housing allocations.

### The Habitats Regulations and their application in the context of this project

One of the key pieces of nature conservation legislation (although not the only one) under which Natural England needs to provide statutory advice is the Conservation of Habitats and Species (Amendment) Regulations 2012 (which replaced the original 1994 Regulations and amendments and is commonly referred to as the "Habitats Regulations").

These regulations place specific requirements on decision makers (called Competent Authorities) to appraise the potential implications of proposed developments and their plans on European sites designated under the Habitats Regulations. This includes Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites, that together across Europe make up the Natura 2000 (N2K) site network.

The Habitats Regulations set out a specific step-wise process to appraise proposals (termed Plans and Projects). Where there is likely to be a significant effect either alone or in combination on a European site, as a result of a new plan(s) or project(s) that are not considered to be directly connected with or necessary to the management of the site, competent authorities are required to make an Appropriate Assessment in view of that site's conservation objectives. In undertaking that assessment, the competent authority will consult Natural England.

The Appropriate Assessment needs to determine that there **will not be** an adverse effect on the integrity of the European site(s). The test is therefore precautionary. The assessment is undertaken with respect to conservation objectives of the site and their designated interest features, such as specific habitats or bird populations. The integrity of a site has been defined as "the coherence of the site's ecological structure and function, across its whole area, that enables it to sustain the habitats, complex of habitats and/or populations of species for which the site is designated".

As the above test is based on a precautionary principle, there is a clear requirement to demonstrate that the proposed plan(s) or project(s) will not have an adverse effect on the integrity of the designated site. Therefore when it comes to Natural England's advice, we will need to be sufficiently assured that adverse effects on the European sites will not occur so that we can advise the competent authorities accordingly.

To summarise:

- Natural England's role is to provide statutory advice. It is the role of the competent authority to make the decisions on planning issues, taking account of our advice
- The Habitats Regulations sets out a clear process and series of steps to assess the implications of plans and projects that may affect European sites.
- The first stage of the assessment process is the test of Likely Significant Effect. This is a screening stage where a broad-brush approach is adopted. Unless effects can be deemed not likely to be significant, or effects can be excluded, then an Appropriate Assessment is required.
- The Appropriate Assessment stage needs to determine that there will not be an adverse effect on the integrity of the European site(s). Rather than proving adverse effects, the test is precautionary in that it needs to provide assurance that adverse effects will not occur.
- It is important however, that reliance upon the precautionary principle is not unreasonable. The integrity of Natura sites must be ensured, yet without imposing an unreasonable burden of proof on a developer.

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C9: Face to face meeting agenda, ABPmer Office Southampton

Date: 04/12/12

Time: 11.00-15.00

#### Attendees

Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

#### Agenda

- Coffee and welcome (All)
- Objectives of meeting (ABPmer)
- Minutes of last meeting (ABPmer/ all)
- Structured Discussions (All)
- Report Structure (ABPmer/ all)
- Review Process and Programme (ABPmer/ all)
- Questions/A.O.B (All)

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C10: Face to face meeting minutes, ABPmer Office Southampton

04/12/12  
11.00-15.00

**Attendees:** Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

Subject/ Attendee	Discussion Point	Action
<b>Overview</b>		
NF	Aim of the meeting is to ensure that the views of all reviewers are fully understood and to gain a consensus view on questions posed where possible, or where opinions differ to document the rationale behind the differences.	
All	The review panel all confirmed that they had received a copy of each others proformas, the authors' comments and NE's guiding principles.	
CM	Highlighted that NE were involved in the meeting for the opportunity to clarify any points that arise but would not get too involved in discussions in order for the review to remain independent.	
<b>Minutes of last meeting</b>		
JGC	Asked to remove the comment that 'the same logic that people are more likely to respond if interested in the site could be applied to any remote survey' as we are considering the appropriateness for this survey alone.	AB to update
All	Agreed to sign off minutes and that all previous minutes were considered to be signed off.	
<b>Structured Discussions</b>		
All	Numerous structured discussions were had and the outcomes of these discussions will be reflected in the report which will be sent to the project team for their review and final comment.	ABPmer to circulate draft report on 10/12/12
<b>Report Structure</b>		
NF	The proposed structure of the report was outlined, reminding the panel that all proformas, minutes and agendas would form appendices to the final report.  All summaries and conclusions reached in the report will be assumed to be endorsed by the whole panel, unless specifically stated otherwise. If the authors disagree they were asked to make their opinions known as soon as possible during their review of the report.	Comments on draft report to be sent to ABPmer by 13/12/12

Review Process and Programme		
NF	Draft report to be circulated 10/12/12 Comments from project team 13/12/12 Final teleconference 14/12/12 Re-issue report 19/12/12 Final sign off report 21/12/12	ABPmer Review panel & NE All ABPmer All

Project team signed off minutes 14/12/12

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C11: Teleconference Call 3 Agenda

Date: 14/12/12

Time: 13.00-15.00

#### Attendees

Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

#### Agenda

- Minutes of last meeting
- Report Comments
- Report Finalisation
- Questions/A.O.B



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix C12: Teleconference 3 Meeting Minutes 14/12/12

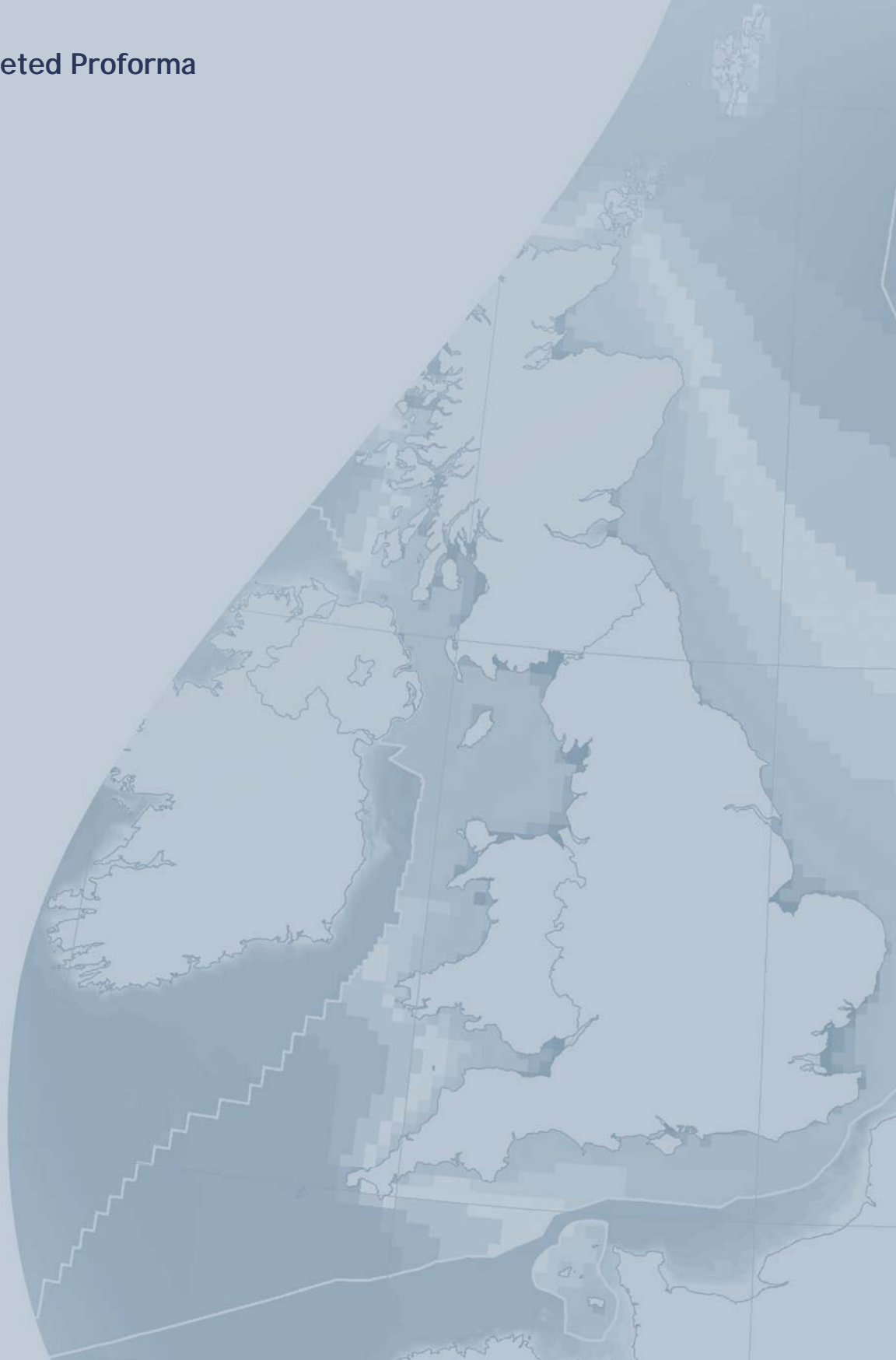
**Attendees:** Alice Bowles (ABPmer), Natalie Frost (ABPmer), Colin Scott (ABPmer), Aonghais Cook (BTO), Nick Cutts (IECS), Gareth Bradbury (WWTC), John Goss-Custard, Chris McMullon (NE), Richard Saunders (NE) and Simon Thompson (NE).

Subject/ Attendee	Discussion Point	Action
<b>Overview</b>		
NF	Confirmed comments on the draft report had been received from the entire review panel.	
<b>Minutes of last meeting</b>		
All	Agreed to sign off minutes from previous face to face meeting.	
<b>Structured Discussions</b>		
All	Comments and changes made to the draft report were discussed in detail. The panel agreed with all changes in principle. A track-changes version of the report will be re-circulated to the review panel to sign-off any changes.	ABPmer to re-circulate draft report on 17/12/12
<b>Report Finalisation</b>		
NF	If the review panel have any further comments/edits to make to the report they are to send to ABPmer by 19/12/12 at the latest.  Final report to be sent to NE by 21/12/12	Comments on draft report to be sent to ABPmer by 19/12/12

Project team signed off minutes 19/12/12

# Appendix D

Completed Proforma



## Solent Disturbance and Mitigation Project Evidence Review

### Appendix D1: Colin Scott (ABPmer) Peer Review Proforma – (13/11/12)

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Report 1 - Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Report 2 - Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Report 3 - Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Report 4 - Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Report 5 - Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.

## Introduction

When reviewing these reports, my emphasis has been on considering how (and whether) this model (and the individual reports and studies that have underpinned it) can be used to inform future impact assessments for residential development (and, especially driving Natural England's advice in the context of such assessments). This focus is, of course, in keeping with the core objectives of the project but it also arises because my background and areas of specialism are in Environmental Impact Assessment and Habitats Regulations Appraisal. Therefore, I do not focus so much on the detail of the modelling work which I will leave instead to other reviewers who have greater expertise in this area.

## Robustness of the Evidence Base

In general my view is that there is a lot of really useful work here that has been pursued with the emphasis on model development. I think that the survey work and data review are especially valuable and could become the building blocks of the tools for future NE advice. I think the model that has been produced can be the basis of one such tool (as long as the 'worst-case' nature of it is always fully recognised). However I am not sure it will ever be the most useful tool. This is because it is just a model and therefore is subject to all the limitations associated with models, especially ecological ones, where multiple assumptions about cause and effect relationships need to be built in. The authors clarify these model limitations very clearly in Section 7.2 of Report 5.

There are also problems with the model that the authors have identified about the Chichester Harbour invertebrate data. I am less concerned about this data issue, which I assume can be resolved, than with the principles of using this kind of black-box 'virtual environment' modelling as a decision-making device with all the opacity that that entails. Natural England are going to need clarity as part of their decision making and especially for any inquiries or reviews.

These reports also focus very much on developing the thinking that underpins the model and then producing the model and regularly identifying the mitigation options throughout the process. There is a missing step which is to work out what the issues are and what, and where, the impacts are that (may) require mitigation. This assessment conclusion work still needs to be done. Therefore, in terms of directing futures resources, I think the valuable data that these studies have collated can form the basis for developing clearer tools that will more transparently demonstrate whether there is a problem and what and where anything needs to be done about it when future developments are put forward. Therefore, in answer to one of the key questions, I do not view this as a '*robust basis for predicting the impacts*' in its own right but it could be one subsidiary component alongside a series of more intuitive products. Before beginning to think about what those other products might look like. I would only note the following in respect of the existing work:

- 1) **Can areas be refined.** This model work divided the shoreline into 103 sections based principally on WeBS count sectors. I would like to see the character of the habitat play a greater role in the selection of areas for examination. This is because habitat plays a crucial role not just in determining the ecological and ornithological value of the habitats but also the type of human activity that may occur. The model also assumes an even spread of birds and humans whereas the reality is that there are often separate.

- 2) **What/when is the baseline?** This model and any future tools will need to be very clear on what/when the baseline is. Is it the time of SPA designation (and the housing then present) or the current year (and present housing levels);
- 3) **Can it be further validated against Solent mortality?** In general, I understand that one of the big tests of the model's validity comes from comparing observed and predicted mortality levels. This makes entire sense to me and the authors appear to have used the best available source of such information (derived from other sites and in the UK). I would like to understand whether it is possible to derive something that is specific to the Solent and also to better understand the accuracy of mortality records as this is one key test of model validity.
- 4) **There are more possible impacts than to selected feeding waders.** The model is inherently accompanied by big gaps because the focus is on 8 feeding waders (Dunlin, Ringed Plover, Redshank, Grey Plover, Black-Tailed Godwit, Bar-Tailed Godwit, Oystercatcher and Curlew) and Brent Geese. Therefore, feeding wildfowl species and roosting waders and wildfowl on habitats such as upper marshes are missing (a total of 44 species were recorded in the underlying surveys). The authors make this point clearly in Section 7.1 of Report 5. Natural England is going to also need to understand effects on roosting and breeding birds as well as on other feeding wildfowl and waders and therefore there is an inherent gap. They may also need to know the effects of spring/autumn passage periods.

#### **Assess the robustness of the conclusions of the SDMP**

The data that has been collected on visitor numbers from household surveys and on-site observations looks really useful to me and is an excellent building block for future assessments and Natural England decisions. This work was then parameterised for the modelling which was the core objective of the project. For Natural England's purposes, it would be good to have a further literature review element following the household surveys and on-site observations (in addition to at the opening of Report 1). This because understanding these results data in the context of the available science will be important foundation for future work.

In general though this work provides Natural England with initial encouraging assurances that the risks of disturbance to feeding waders are not immediately onerous and are likely to be manageable. Following the data project also concludes (Pg 4, Report 2):

*'There was no significant correlation between people numbers and the number of disturbance events, indication that high numbers of visitors per se does not necessarily results in high levels of disturbance'*

This is because the correlation is weak due to the other variables that are playing their part. One of these factors will be the type of activity but, as explained in Paragraphs 4.4 to 4.8 of Report 2) there are other reasons. It is also encouraging that this work indicates that 17% of disturbance events (I think these are 'potential disturbance events' and should always be called such or at least just be called "activities <200m" to avoid confusion) had a consequence for birds and 13% resulted in any sign of bird emigration. Even before these 'potential disturbance events' are considered, over 50% of activities are >200m and are deemed to have no potential consequence at all. The low level of responses to shore-based activities (87% causing no

response) is also encouraging as these clearly dominate the activities on the shoreline (Paragraph 2.21, Report 3).

What this empirical work indicates particularly is that increases in activities in the context of a high activity baseline will be of relatively low concern. The model however indicates effects from current housing (see my comment about 'what is baseline?' as above) and future development. It concludes that there will be an effect on time spent feeding and survival. The authors appropriately caveat their findings in recognition of the data/model limitations and, as part of that, they highlight areas where there are worst-case and best-case assumption inherent in the work. The major worst-case elements are restricted bird movements; the fact that people and birds being independently distributed (Section 7.2.2 Report 5) and the absence of bird habitation in the model. The best-case elements are: a perfect knowledge of prey and visitor numbers by birds (Section 2.3 Report 5) and colder conditions during the baseline surveys affecting bird response (Section 7.2.1 Report 5) and visitor numbers (Summary Report 3).

Overall the fact that people and birds are independently distributed in this model (when the surveys show a spatial separation) and there is no habituation indicates that model findings are likely to will be 'worse than worst-case'. Once again the points to the actual 'real world' effects being relatively lower and manageable.

Finally, due to the inherent limitations of the modelling approach, I don't believe this work on its own is going to be enough to meet the challenges of 'impact certainty' that is required (in the context of available science) under the Habitats Regulations.

### **What additional evidence would be required**

I would recommend that for Natural England there is a need to focus much more closely on the empirical evidence starting with the data and findings in Report 2, 3 and 4. This work provides a very valuable source of information. It should now be possible to do a review of this data to more closely understand the character of individual locations and what they tell us overall about the relationship between humans and bird. In particular, the habitats could be characterised across the full range of conditions types and with the emphasis being on the actual (or at least the relative) levels of human activity (i.e. which shorelines are being used). So, rather than the 103 WeBS-based areas that are used in the model, across the Solent for instance you might get a range that, very roughly, begins to look like this:

1. **Secluded saltmarsh bird roosts and nesting grounds:** Remote locations with no access and almost no human activity (e.g. Outer Eastern Lymington Marshes);
2. **Partially exposed saltmarsh bird roosts and nesting grounds:** Areas where there is access and low levels of human activity that is constrained along one edge (e.g. Inner Eastern Lymington Marshes);
3. **Moderately exposed saltmarsh bird roosts and nesting grounds:** Areas where there are moderate levels of human activity that are constrained along one edge (e.g. Inner Western Lymington Marshes and West Wittering Lagoons);
4. **Highly exposed saltmarsh bird roosts and nesting grounds:** Areas with high levels of unconstrained human activity (e.g. not sure whether there are any);
5. **Partially exposed mudflat low water feeding areas:** Mudflats that have low levels of very constrained human activity along one edge (e.g. Porchester/A27);

6. **Moderately exposed mudflat low water feeding areas:** Mudflats that have moderate/high levels of very constrained human activity along one edge (e.g. Emsworth); (NB unlikely to be any 'highly exposed mudflat');
7. **Highly exposed gravel and sand beaches:** Accessible locations with lots of human activity that have low value for birds (e.g. Calshot); and
8. **Moderately exposed land that are foraging locations for Brent Geese** (e.g. West Wittering Fields).

This is just 8 categories but I would envisage perhaps as many as a 15-20 category types. In addition to the habitats and activity levels some categorisation of activity type (dog walking or recreational yachting) and bird usage is also likely to be appropriate. This would give a basis for comparing similar areas and then making empirically-informed judgements about whether areas that have comparable conditions, but perhaps slightly different levels of disturbance, have different bird use levels. This kind of work could be used to, for instance, identify areas that are "under-used" for reasons linked to disturbances and from that to identify which species are being affected and how.

One useful way to visually and technically inform this comparative analysis about the visitor-effect relationship could be through the creation of a series of 2-way or 3-way plots which express the relationships between the following:

- Bird usage (possibly by species) and Habitat type;
- Habitat type and Human Activity Levels (linked to infrastructure levels);
- Human Activity Levels and Detectable Bird Disturbance Events; and
- Detectable Bird Disturbance Events and Bird usage (possibly by species).

From this work, graphic visual and technical outputs could be produced and the work embedded into a revisiting of the literature on bird disturbance studies. The results would be a robust evidence-base which would provide Natural England with a better understanding of the baseline conditions and the future projections (once sea level rise, habitat erosion and increased human activity are taken into account).

I would prefer to see money spent on developing this first before then doing a 'gap analysis' on the data and then collecting more field data on disturbance behaviour to enhance the value and accuracy of the products where required (using the kind of field survey work that is described in Report 2). Therefore, I would therefore not view an intertidal invertebrate at Chichester Harbour as a 'priority' (Section 7.3.2 of Report 5). Instead I think something is required which is closer to 'systematic monitoring of recreational access' (the absence of which was highlighted in Report 1) and which builds on the practical field methods pursued in Report 2.

## Peer Review

Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009)  
Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Not as clearly as in other reports, would have been good to have the questions to be addressed set out.
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	<p>Just one literature source I note could be added, the Smit and Visser paper 1993 was very useful at describing distances of bird disturbance.</p> <p>Smit, C. J. &amp; Visser, G. J. M. 1993. Effects of disturbance on shorebirds a: summary of existing knowledge from the Dutch Wadden Sea and Delta area. Wader Study Group Bull. 68: 6-19.</p>
Were the methods used to collate the data appropriate?	The literature is good for setting the tone of the work that follows but it would have been useful to also do such a review after the site survey work (Reports 2-4) so that the findings of that work could be viewed in the context of the science to date. I suspect there are a lot of similarities between the Solent results and those in the published literature that it is worth highlighting as part of the evidence-base.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	N/A
Are the quality standards associated with such data included within the report?	N/A
What are the limitations of the datasets that have been used?	N/A



Do they compromise the extent to which the data is fit for purpose?	
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, but I would like the outcome of all this good work and mapping to have been a more detailed breakdown of habitats into disturbance sensitive categories (see covering text)
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	N/A
<b>Results</b>	
Key data outputs identified from the report	<p>Reviews of the most current data including:</p> <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ ground truthing of predictive results?	N/A
Is the evidence complete for its intended use?	Yes but I note that low water WeBS data were not used due to time availability. These would be very useful.
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional comments
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	No additional comments
<b>Conclusions</b>	

Are the conclusions justified by the evidence base?	The report leaps from data review to a review of mitigation without the intermediate assessment needed to determine whether and why there is a need to mitigate.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	This report is more of an introduction to the next phase of work which appears to have already been planned so this is not so good at setting objectives and then identifying the conclusions to underpin the next phase.
Do all sources of evidence/analysis point to the same conclusions?	The literature review shows that there is a range of findings and conclusions. I think this points to the need for greater emphasis on empirical evidence collation rather than on modelling and certainly mitigation should only be considered after an assessment has been done.
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Well set out in Paragraphs 1.16 and 1.17
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No additional data identified.
Were the methods used to collate the data appropriate?	<p>This is a well written report and the methods look appropriate with efforts made to standardise across surveys. This was important because this work is often subjective.</p> <p>It does sound like it might be necessary to have had two surveyors on site (in areas of high activity), one dealing with activities and human movements while the other focussed on the birds.</p>
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	<p>It may be that the data is sufficient to parameterise a model with all the understood limitations of the model. In that case it is fit for propose.</p> <p>It is clear though that more data from more sites will be needed in the future to provide the robust tools and that are needed to underpin Natural England decisions.</p>
Are the quality standards associated with such data included within the report?	I believe so
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	As with all aspects of the modelling the process of taking complex variable datasets and parameterising them for a model brings assumptions and limitations (see authors' comments in Report 5). I think the data looks fit for purpose for model creation but for Natural England the model should not be viewed as the key outcome. Instead, in my view, the field data is probably the most valuable element.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>• Statistical analysis using box plots and GIS.</li> </ul>

<p>Are the methods adopted generally appropriate given the objectives?</p>	<p>As the data collected are very extensive I think they are more valuable than the model that they are designed to inform. I would like to have seen a greater 'picking apart' of the field data before the process of parameterising the information and applying tools such as multivariate statistics to inform the model parameters. For instance could the dominant effect of water-based activities be defined before multivariate statistics were applied.</p> <p>Just regarding the term 'disturbance events', I find this term confusing because it implies a consequence or at least something that is separate from an activity. I think this is shorthand for 'potential disturbance events' and should at least always be called such.</p>
<p>Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	<p>N/A</p>
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul>

	<p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the observation period</li> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species combined analysis was performed in which species were represented by their body mass in order to estimate disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the body mass of the species being disturbed and the activity type causing the disturbance</p>
Has there been any validation/ ground truthing of predictive results?	N/A
Is the evidence complete for its intended use?	I believe so
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only wading bird species that had at least 20 observations of their response to disturbance</li> <li>• The body mass of these bird species was also linked to</li> </ul>

	<p>response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</p> <ul style="list-style-type: none"> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance from population centres.</li> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</li> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional comments
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	No additional comments
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	No clear conclusion text available
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Once again the report is one element in a fuller phase of work so it doesn't ultimately identify discrete conclusions to underpin the next phase.
Do all sources of evidence/	N/A

analysis point to the same conclusions?	
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Generically in Paragraphs 1.13 and 1.14
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No
Were the methods used to collate the data appropriate?	I believe so
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	An argument can always be made for more data from more sites. But, as far as I am aware, for the purposes of developing a model this is appropriate, my concerns relate to the efficacy of the modelling approach.
Are the quality standards associated with such data included within the report?	I believe so
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	As far as I am aware, for the purposes of developing a model this is appropriate my concerns relate to the efficacy of the modelling approach.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site visitor surveys including counts of people and interviews.</li> <li>• Car parks and parking spaces were also analysed using Google Earth</li> <li>• Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	<p>In this report the Solent is broken down into 103 areas based on WeBS counts sectors. This is probably expedient because it allows the bird data to be readily incorporated but I think it needs greater reference to habitats and activity types. It will probably be better for the coast to be divided into 'disturbance sensitive categories' based on habitat, bird use, activities, activity type etc</p> <p>I am also unsure about the appropriateness of the buffer zones around MHWN that were used. I suspect that more intuitive categories were relevant which could incorporate both the types of activity that are likely to occur and the likely</p>



	bird usage such as: 1) promenade next to inaccessible mud; 2) open access sandy foreshore etc.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	N/A
<b>Results</b>	
Key data outputs identified from the report	<p>Results from surveys included:</p> <ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
Has there been any validation/ ground truthing of predictive results?	N/A
Is the evidence complete for its intended use?	It looks like a really good dataset. Would be good to see the GIS route maps
Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits</li> </ul>

	<p>made to the coast. Activities coded as "Other" (70 interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</p> <ul style="list-style-type: none"> <li>The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site surveys correlate, in terms of visitor rates, will be important in directing further analysis.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional comments
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	No additional comments
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	No additional comments
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The aim is to inform the development a model and identify mitigation. The dialogue of the findings are well summarised in Section 3 pg 50. The work still leaps from the analysis to the mitigation review without a consideration of the impact (as per previous report)
Do all sources of evidence/ analysis point to the same conclusions?	The conclusion is that a household survey is needed. That seems like a sensible conclusion but the rational for it is not stated. Again this is because the report feels more like part of a continuum to a pre-determined concluding model rather than perhaps discrete stand-alone products in their own right
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Clearly set out in Paragraphs 1.4 and 1.5
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	None identified
Were the methods used to collate the data appropriate?	I believe so
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	I believe so, an argument can always be made for more data but this looks appropriate and I am reassured by later analysis which shows a strong correlation between the household surveys and the on-site survey work.
Are the quality standards associated with such data included within the report?	I believe so
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	None identified
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>Household questionnaires.</li> <li>Statistical analysis and presentation using Minitab and MapInfo</li> <li>Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	I believe so
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	No additional comments
<b>Results</b>	
Key data outputs identified from	Analysis from results from surveys included:

<p>the report</p>	<ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, IoW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.</p>
<p>Has there been any validation/ground truthing of predictive results?</p>	<p>No additional comments</p>
<p>Is the evidence complete for its intended use?</p>	<p>No additional comments</p>

Are the figures and tables easy to understand?	
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional comments
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	No additional comments
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	No additional comments
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The aim is to inform the development a model and identify mitigation. The dialogue of the findings are well summarised in Section 5 pg 83 and 84. The work still goes from the analysis to the mitigation review without an intermediate consideration of the impact (as per previous reports)
Do all sources of evidence/ analysis point to the same conclusions?	The conclusion is that prediction modelling is needed but again the report is more part of a continuum to a pre-determined concluding model rather than perhaps discrete stand-alone product in their own right.
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	The objectives and thinking are clearly expressed throughout. <b>Overarching aim</b> is in Section 1.2: - Are visitors reducing bird numbers? <b>Individual aims</b> are in Section 1.3: - (inc. evaluate Effect of humans on feeding waders and Develop and test model)
<b>Data Inputs</b>	
Key data types used within the report.	MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used: <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	<ul style="list-style-type: none"> <li>• Species mortality data from various sources within the BTO web site (<a href="http://www.bto.org/birdfacts">www.bto.org/birdfacts</a>) were used to test and 'validate' model predictions for mortality</li> </ul>
Were the methods used to collate the data appropriate?	In terms of the detail of the analysis I have no comment and will largely leave to others who know more about the model construction. My main view relates to the issue of the 103 areas as developed in report. I am sure that a closer of human activities and disturbance risk that can be used to drive this model but, of course, there will be many habitats, in different conditions and providing different functionalities which means inherently mean that the model can only be broad-brush and reinforces the fact that it can only ever be one tool for NE when making judgements about effects in the Solent EMS.

Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	No additional comments
Are the quality standards associated with such data included within the report?	No additional comments
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	No additional comments
<b>Methodology</b>	
Key methods used within the report.	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
Are the methods adopted generally appropriate given the objectives?	No additional comments

Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	One of the key tests of the model's accuracy or at least 'representativeness' is the mortality of birds. I note that the Chichester Model does not fit well and that is explained in detail. The Southampton model fits well for most though not all species. I would like to better understand how representative the 'observed' mortalities from the BTO site are in the Solent.
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> <li>• Scaling up predictions to the Solent</li> <li>• Predictions for Brent Geese</li> </ul>
Has there been any validation/ ground truthing of predictive results?	No additional comments
Is the evidence complete for its intended use?	No. While I think the work is good, there are simply too many assumptions inherent in the model for it to be possible to draw out real world conclusions.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters</li> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional comments
What are the limitations of the methodology/ approach that	The report notes early on that making an evaluation of impact (i.e. bird survival) from human activity is complex and



<p>have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?</p>	<p>involves many factors such that it requires modelling. Modelling can only be one tool in the armoury for understanding these issues and all types of models have their limitations and cannot be expected to precisely replicate the real world in their own right. Expert oversight in the context of the empirical evidence base is required in the first instance which can then be complimented by this kind of model. The MORPH model has clearly been used in other estuaries successfully and other reviewers will be able to advise whether it has been a better tool in those systems</p>
<p><b>Conclusions</b></p>	
<p>Are the conclusions justified by the evidence base?</p>	<p>I like how the review of predicted bird effects (e.g. in Sections 4.2.1, 4.2.2, 4.2.3 and 5.2.1.) nicely links the findings to ecology (terrestrial feeding and night time feeding etc.) and bird behaviour. How much of this is simply because these behaviours are put into the model and hence they then come out of it I am unsure.</p> <p>In many other areas later in the report I get confused as to what is being predicted by the model and what is a prediction underpinning the model. I would like to see more frequent references to the underlying thinking and data in order to understand 'how real' the predictions are (i.e. rather than just references to the predictions from the model but references back to the underlying presumptions which drive these predictions). E.g. a good example is the references to the visitor predictions in Section 7.3.1 which could usefully have been in earlier sections too. Also, Section 7.3.1 states that predicting visitor numbers to the Solent is not an objective whereas I thought his was core component as indicated in the summary text.</p> <p>A good example of where references to the underlying thinking are made is where correlations exist and are clearly stated such as between household survey and visitor numbers Section 7.2.1) [NB that the household survey wasn't a "perfect" descriptor of activity (as noted in same section) is to be expected but these findings provide a grounding to the model while also emphasising is that situ surveys look useful and would be preferred in future].</p> <p>It is worth checking whether the visitor numbers and on site observations indicate a defined zone of movement. I always understood that visitors never really go more than 1km from a car park and whether that is a useful way of helping to characterise the foreshore activity levels.</p> <p>I don't quite follow Section 4.2.4 so well, it strikes me that this is explaining the sensitivity of the relationship between predicted human activity changes and predicted effects but it</p>

	<p>is also showing the sensitivity of the underlying assumptions and issue of habitat scale etc. The final concluding sentence seems like quite a definitive one given the model limitations. It is a presumption that is then used in the scaling up but other non-technical readers might conclude this as a finding.</p> <p>Section 4.2.5 states that there are no data of relative locations of visitors and birds. I would have thought that such data must exist or could be assembled with the evidence base already available. Also, re second sentence, visitors often use different parts of the shoreline which would imply that the predictions are higher than reality. The authors then illustrate this numerically but of course this is just a mathematical function. A reality gap needs to be plugged here and I believe that there is need for "<i>data measuring [the] overlap</i>" between birds and visitors if this model is to be used in anger. Though I suspect that once such data are effectively collected and analysed they will in their own right be more valuable than the model (see my comments in the introduction).</p>
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The work seems very thorough and I don't believe anything is missing but I would like the audit of the process to be more clearly explained. The early reports talks about a 'series of models' (Summary, Report 2) I would like to see this idea brought forward with this fifth report being the culmination of all that has gone before and including some sort of flow diagram representing the model components (and the positive correlation and assumptions that underpin it) would have been useful.
Do all sources of evidence/analysis point to the same conclusions?	For me the key thing is that this model, any model, can only do so much and it is limited by gaps in data (e.g. the absence of data informing roost site disturbance for instance).
What additional analyses might/should have been done?	
<b>Additional Comments</b>	

## Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	I think the authors have come to sensible informed conclusions following a detailed study. However there is still a need to do the 'assessing' bit of the analysis. This needs to take account of the data and conclude what effects there are and will be from existing and future residential developments. Relevance on the model to guide conclusion, although useful, is not enough for Natural England to base its judgements upon (NB I fully recognise that Natural England were not the client and that we are looking at reports which were not developed with their needs specifically in mind).
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	Same as previous comment
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	It is not robust on its own right but it is a very useful contribution and begins to indicate that the impacts may not be too onerous.
Does the evidence base provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?	Due to the inherent limitations of the modelling approach, it is not going to be enough to meet the challenges of 'impact certainty' that is required in the context of available science under the Habitats Regulations
Are there any caveats required or limitations to be aware of before using this evidence?	Yes, the model itself has inherent assumptions, limitations and gaps as described above and as highlighted by the authors.
Is there a requirement for further work? If so what would you recommend?	Yes as described in my introduction.
Additional Comments	

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix D2: Aonghais Cook (BTO) Peer Review Proforma – (13/11/12)

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.

## Peer Review

## Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. &amp; Wells, M. (2009) Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes – collate household/visitor data, assess stakeholder opinion, collate bird data and outline potential mitigation measures
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No additional data sources identified.
Were the methods used to collate the data appropriate?	<p>The number of visitors approached was only a small fraction of the total visitor numbers at each site. There is no indication of how representative a sample this is.</p> <p>No methodology is described for the collection of the breeding bird data so it is not possible to assess how appropriate data collection was.</p> <p>Seabird Monitoring Programme Data are available for the Solent and Hampshire in general. These data could have been used to supplement breeding bird data.</p>
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	<p>No. Visitor data collected from only 4 sites in recent years (+ 3 others in 2002). Temporal coverage was uneven and differed between sites, meaning it was not possible to identify how visitor numbers varied within and between sites throughout the year.</p> <p>There does not appear to be any data relating to visitor numbers and activities for the breeding period of SPA features. This is of concern given that many of the activities thought to cause the greatest disturbance will be most prevalent during the summer. Their potential to cause disturbance to breeding birds needs to be considered.</p>
Are the quality standards	The surveys of Browdown, the New Forest and the Solent

associated with such data included within the report?	<p>Visitor Monitoring Survey do not mention the months over which they were carried out.</p> <p>How were experts recruited to the workshops?</p> <p>No details of survey methodology for breeding birds.</p>
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Limited temporal coverage
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	<p>A list of search terms used for the literature review of disturbance would have been useful.</p> <p>Why were SMP data not considered for breeding birds?</p>
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	No modelling has been used in the analysis
<b>Results</b>	
Key data outputs identified from the report	<p>Reviews of the most current data including:</p> <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ ground truthing of predictive results?	No predictive results
Is the evidence complete for its intended use?	No reference to SMP data.
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these	No additional assumptions identified

assumptions fully documented and valid?	
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	<p>The key limitations surround the timing and format of the initial surveys. However, the review of these provides a useful basis for the later reports.</p> <p>Limited data are collected in relation to disturbance over the summer, making it difficult to draw conclusions about the impacts of disturbance on breeding birds.</p>
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	The report forms a review of available data and no conclusions are made.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	NA see above
Do all sources of evidence/ analysis point to the same conclusions?	NA see above
What additional analyses might/should have been done?	A sector plot analysis of WeBS data would show how population trends of wintering waterbirds have varied in WeBS count sections across the Solent. These could be compared to data on visitor numbers and activities at each site to identify links between disturbance and changes in populations.
<b>Additional Comments</b>	

Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes, the report aims to address a series of questions.  How does bird distribution vary between sites?, What are the current levels of disturbance? What activities result in disturbance? How do birds respond to disturbance? And How can data be combined for use in Individual Based Models (IBMs)?
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Additional visitor/disturbance data collected during the surveys of the WeBS sectors.
Were the methods used to collate the data appropriate?	They appear to be.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Data collection was limited to the winter, making it impossible assess potential disturbance to breeding birds.
Are the quality standards associated with such data included within the report?	The data collection and analysis methodology is set out extremely clearly.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Data only cover winter months, meaning that impacts on breeding species cannot be considered.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>• Statistical analysis using box plots and GIS.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Survey methods seem appropriate, however it would have been useful to extend surveys into the summer to consider the impact of disturbance on breeding birds.
Has modelling been used in the analysis? If so are the	No modelling has been used in the analysis.



<p>assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul> <p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the observation period</li> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species</p>

	combined analysis was performed in which species were represented by their body mass in order to estimate disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the body mass of the species being disturbed and the activity type causing the disturbance
Has there been any validation/ ground truthing of predictive results?	There didn't appear to be. Perhaps some sort of jackknife approach would be useful to identify the contribution made by each site to the parameter estimates.
Is the evidence complete for its intended use?	It would be useful to have estimates of the uncertainty surrounding each parameter estimate in order to demonstrate their robustness and the robustness of the subsequent modelling exercise.
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only wading bird species that had at least 20 observations of their response to disturbance</li> <li>• The body mass of these bird species was also linked to response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</li> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance from population centres.</li> </ul>

	<ul style="list-style-type: none"> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</li> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	I did not find any additional assumptions.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Methods seem appropriate in relation to calculating parameter estimates for wintering birds. No data are available to generate parameter estimates for breeding birds. This means it will not be possible to assess the impact of disturbance on breeding birds.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	The conclusions seem reasonable given the data presented.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The origin of data presented within the report seems clear.
Do all sources of evidence/ analysis point to the same conclusions?	All evidence appears to support the conclusions.
What additional analyses might/should have been done?	No obvious additional analyses.
<b>Additional Comments</b>	

Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes. To identify visitor patterns and use of the coastline with a view to predicting the impact of increased pressure from local populations.
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Responses to visitor survey. Postcode data were obtained from the Royal Mail in order to calculate the distance travelled to each site by visitors. Data from Google Earth were used to estimate the size and location of nearby car parks.
Were the methods used to collate the data appropriate?	Methods appeared to be appropriate.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Again, no data were collected during the breeding season meaning that no assessments could be made on the effects of disturbance on breeding birds.
Are the quality standards associated with such data included within the report?	Methodology seems to be clearly explained.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Biases associated with survey design have not been accounted for.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>On site visitor surveys including counts of people and interviews.</li> <li>Car parks and parking spaces were also analysed using Google Earth</li> <li>Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Methods seem to be generally appropriate.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	Modelling has not been used in the analysis.

<b>Results</b>	
Key data outputs identified from the report	<p>Results from surveys included:</p> <ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
Has there been any validation/ ground truthing of predictive results?	No predictive results.
Is the evidence complete for its intended use?	Yes. Detailed data are presented describing visitor numbers, how visits vary throughout the year and what attracts them to particular sites.
Are the figures and tables easy to understand?	Yes.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits made to the coast. Activities coded as "Other" (70 interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</li> <li>• The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular</li> </ul>

	clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site surveys correlate, in terms of visitor rates, will be important in directing further analysis.
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional assumptions.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Survey carried out during cold winter, meaning visitor numbers are potentially underestimated in comparison to other years. How representative of all visitors were those surveyed?
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	The conclusions seem to be supported by the evidence presented.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The explanation and reasoning behind the report's conclusions is clear.
Do all sources of evidence/ analysis point to the same conclusions?	Evidence and analyses all seem to point to broadly the same conclusions.
What additional analyses might/should have been done?	An assessment of how representative survey respondents were of visitors to each site.
<b>Additional Comments</b>	

Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes. To survey households within 25 km of the solent coastline with a view to understanding the link between housing and recreational use of the coast.
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Responses to survey questions.
Were the methods used to collate the data appropriate?	The methods seemed to be appropriate
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	The spatial and temporal resolutions of the data seem to be appropriate.
Are the quality standards associated with such data included within the report?	The methodology and analyses are clearly described and a copy of the questionnaire is included.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Survey data may not be representative of the local population. No attempt has been made to measure this. However, if data are unrepresentative, they are likely to be skewed towards people who are more likely to visit the sites. This means that the impact of additional housing may be over-estimated.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Household questionnaires.</li> <li>• Statistical analysis and presentation using Minitab and MapInfo</li> <li>• Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	The methods appear to be generally appropriate.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	<p>Modelling has been used in the analysis. However, no information has been given about what model selection procedures were used.</p> <p>Accuracy of modelled results has been assessed by comparing differences between observed and predicted values. This is reasonable, however, it would have been useful to examine the patterns in these differences to</p>

	understand whether any particular site was skewing the parameter estimates.
<b>Results</b>	
Key data outputs identified from the report	<p>Analysis from results from surveys included:</p> <ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.</p>
Has there been any validation/	Comparison has been made between observed and



ground truthing of predictive results?	predicted visitor rates. The models appeared to fit the data reasonably well but, the authors highlight the importance of features associated with specific sites. It would have been useful to assess the contribution made by individual sites to the parameter estimates.
Is the evidence complete for its intended use?	No data given describing the socio-economic status of respondents. My understanding is that different socio-economic groups vary markedly in their use of parks etc. Consequently, to predict how pressure on these areas is likely to change, there needs to be an assessment made of how the socio-economic status. This may be reflected in the differing return rates between local authority areas.
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No additional assumptions identified.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	No correction has been made for the fact that survey respondents may not be representative of the population as a whole. However, as stated above, this may mean that the predicted impact of additional development is over-estimated and therefore precautionary.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	The conclusions appear to be justified by the evidence base.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Additional information about model selection would be useful. Otherwise, the reasoning behind the conclusions appears to be clearly explained.
Do all sources of evidence/ analysis point to the same conclusions?	The conclusions seem consistent given the evidence presented.
What additional analyses might/should have been done?	An assessment of how representative of the local population respondents were, and whether response could be corrected to take this into account.
<b>Additional Comments</b>	

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	The objectives are clearly stated at the outset of the report.
<b>Data Inputs</b>	
Key data types used within the report.	MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used: <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Species body masses from literature review presented in A3.4, estimates of energy content of food/fat etc.
Were the methods used to collate the data appropriate?	The methods used to collate the data appeared to be appropriate.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Bird data are derived from WeBS peak counts. However, no consideration is given to the timing of these peak counts. Whilst for some species, the peak occurs in December/January, for others the peak occurs earlier and may reflect migratory birds. In some cases models may therefore be based on an over-estimate of the number of birds supported by a site.
Are the quality standards associated with such data included within the report?	The origins of all data in the models are clearly described.
What are the limitations of the	Prey availability datasets are only available for Southampton

datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Water and Chichester Harbour. These are scaled up to reflect abundance elsewhere in the Solent. Providing a representative range of habitats were sampled, this should not compromise the extent to which data are fit for purpose.
<b>Methodology</b>	
Key methods used within the report.	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Given the objectives stated, the methods adopted are generally appropriate and have been widely applied elsewhere.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	<p>Modelling has been used in the analysis and the assumptions, limitations and uncertainty have all been documented.</p> <p>The accuracy of the modelled results have been assessed by ensuring the models show the estuaries are capable of supporting the observed number of birds.</p>
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> </ul>

	<ul style="list-style-type: none"> <li>• Scaling up predictions to the Solent</li> <li>• Predictions for Brent Geese</li> </ul>
Has there been any validation/ ground truthing of predictive results?	Yes modelled estimates of survival and distribution were compared to observed estimates of distribution and estimates of survival published in the peer-reviewed literature.
Is the evidence complete for its intended use?	Yes.
Are the figures and tables easy to understand?	Yes, detailed legends make the more complicated tables/figures easier to interpret.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters</li> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	That 50 % of mortality occurs over the winter period. Would be nice to see some documentation in support of this. I can see the argument for this being right, but I can also see an argument for > 50 % of mortality occurring in the winter.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Individual based models are a powerful tool for predicting changes to populations. Parameterising the models requires a detailed understanding of the system concerned and given the number of parameters required, it can be difficult to assess the model sensitivity to variation in the input data. However, this model has been used effectively elsewhere and as such should be fit for purpose.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	The evidence presented supports the report's conclusions

<p>Has an audit trail been maintained throughout the analysis to support the final conclusions?</p>	<p>The reasoning behind the final conclusions has been clearly explained and appears sensible.</p>
<p>Do all sources of evidence/analysis point to the same conclusions?</p>	<p>The evidence presented appears consistent with the conclusions made.</p>
<p>What additional analyses might/should have been done?</p>	<p>The models considered movement between sites. However, it would have been interesting to see if including estimates of the length of time birds remained at each site affected the results.</p>
<p><b>Additional Comments</b></p>	

Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	The evidence and conclusions are robust in assessing the current impacts of disturbance on wintering birds populations, but not on breeding bird populations.
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	The evidence is robust in the context of assessing the future impacts on wintering bird populations, but no attempt is made to assess the impact of developments on breeding populations.
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	The evidence is reasonably robust, however, they could be improved with an assessment of how representative survey respondents were of the local population. As it is, the data presented may be biased towards those who use the site most often and therefore reflect an over estimate of visitor numbers. However, this would give a reasonable, precautionary estimate of the contribution of residential developments to disturbance.
Does the evidence base provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?	The evidence base provides a robust basis for predicting the impacts of residential development on wintering bird populations of Solent SPAs. However, no consideration is given to the impact on breeding populations of SPAs – Common Tern, Little Tern, Sandwich Tern, Roseate Tern, Mediterranean Gull – all of which are listed as being of conservation concern in the UK. There is an acknowledgment that activities differ between winter and summer, but none of how “summer” activities may affect bird populations, particularly of breeding birds.
Are there any caveats required or limitations to be aware of before using this evidence?	No assessment has been made of how representative the data are of the local population as a whole.
Is there a requirement for further work? If so what would you recommend?	<p>Two additional pieces of work would be beneficial to provide additional evidence about the impact of disturbance on waterbirds.</p> <p>The first is a sector plot analysis of WeBS data from the Solent. Such an analysis would compare the population trends of key species on each WeBS count section. Differences between each sector could be compared to differences in visitor numbers/activity levels.</p>

	<p>An investigation of turnover on sites across the Solent would be valuable as it would allow estimates of both the total number of birds that pass through a site and also estimates of how long birds remain on a site for. By estimating turnover we could determine how disturbance impacts on the length of stay at a given site.</p>
<p>Additional Comments</p>	<p>I am uneasy about interpreting the data presented by Fearnley <i>et al.</i> 2010 &amp; 2011 and by Liley <i>et al.</i> 2010. These reports cover visitor and household surveys, of which I have no experience. Their results and conclusions are central to the validity of predictions made about the impacts of increased disturbance for additional housing on birds. With this in mind, it is important that the surveys were appropriately designed and outputs were appropriately interpreted.</p>

## Solent Mitigation and Disturbance Project Evidence Review

### Appendix D3: Nick Cutts (IECS) Peer Review Proforma – (13/11/12)

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.



## Peer Review

Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009)  
Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes – generically in introduction, but with no specific research questions outlined
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Yes – expert opinion used during workshop, general literature review summary.
Were the methods used to collate the data appropriate?	<p>Birds: To some extent, although the literature review did not identify the search metrics used (e.g. search terms, dates, extent etc). The review seems to include some generic information and as such Smit &amp; Visser appears to have been missed as a useful source, and indeed Davidson &amp; Rothwell, although these are now quite old and may not always be relevant to the Solent, there is some useful information in them on disturbance which would be transferable.</p> <p>Users: Small sample size may restrict value of data.</p>
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	<p>To some extent, given the context of the later reports. As the first in the tranche, this does provide an overview, but great spatial/sectoral focus would be useful in some instances.</p> <p>Birds: Yes at a general level, using basic data sources. However, the approach in general was relatively broad scale with no detailed sub-site analysis. Given BB imp at the site, then data seem very light.</p> <p>User information based on a small study, but the use of expert opinion is very valuable in terms of identifying specific problem areas and updating/broadening the reported data.</p>
Are the quality standards associated with such data included within the report?	Not as far as I can see. The expert opinion is perhaps some of the most useful data – no indication of the selection criteria etc. Limited use of WeBS data – with usual limitation of spatial coverage etc, but QS are known. No information

	on BBs.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Within the context of the subsequent reports, then this one is useful in that it provides an overview against which subsequent studies were designed. There are obviously issues regarding the level of data used (temporal/spatial & birds/users).
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes at a general level, but report seems to fall between two scales (overview and detail) – Literature review was useful but could have been expanded on if report at a high background level, but bird and user data very broad scale and needed more focus.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	No, report presents an overview of existing data.
<b>Results</b>	
Key data outputs identified from the report	Reviews of the most current data including: <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ ground truthing of predictive results?	N/A – no predictive modelling
Is the evidence complete for its intended use?	As an overview, yes, but more is required (hence subsequent reports presumably).
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	None
What are the limitations of the methodology/ approach that have been used? Do they	As above – level of detail, scale, and use of limited datasets e.g. WeBS information, compression issues etc. Results are reasonable for the report context, but with more needed.

compromise the extent to which the outputs of the study are fit for purpose?	
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Conclusions are limited at this stage - subsequent phases to address this.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	N/A – as above, although expert opinion sources inc. organisation are provided.
Do all sources of evidence/analysis point to the same conclusions?	N/A – as above.
What additional analyses might/should have been done?	More detailed WeBS analysis showing spatial variation and any potential correlation to activity and disturbance
<b>Additional Comments</b>	

Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes – clearly stated in Aims and Objectives section.
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Waterfowl disturbance responses from a range of activities
Were the methods used to collate the data appropriate?	Methods appear to be well thought out and appropriate to the survey/report aims.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Assuming a resource limitation, then the methods are reasonable. There might be a potential issue relating to a restricted visitor volume during the winter, but key usage is addressed (except for BBs). It is also understood that the field work was carried out during an unusual spell of hard weather which possibly had an effect on bird disturbance responses and recreational activities in the Solent, which in turn might have impacted on the overall results. With the same caveat, then spatial coverage is reasonable.
Are the quality standards associated with such data included within the report?	Yes. Always potential issues in addressing range across intertidal and water habitats, and obviously differing surveyor potential although issues are largely noted and addressed where possible.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Skew to winter data as discussed above, but generally FFP.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>• Statistical analysis using box plots and GIS.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes – generally the methods appear to be fit for purpose, although coverage over summer/passage would have been useful as described above. The ability of the observers to record behavioural responses of small waders to disturbance will decrease with increased

	<p>distance from the surveyor – and the detection will be affected by the weather conditions and the observer’s ability (this may differ between observers). As such, a 500m edge of range may be too great, or at least may require some factor application if responses at this range were considered important..</p> <p>However, the derived data in general are very useful and perhaps more could have been done with the observational information on responses. Disappointingly however, there are a number of co-variables that might also be of relevance to disturbance response etc, that do not appear to have been recorded e.g. available area, sightlines etc, nor any responses that were non-anthropogenic – spooks, raptors etc..</p>
<p>Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	<p>Basic statistical analysis undertaken.</p>
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul>

	<p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the observation period</li> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species combined analysis was performed in which species were represented by their body mass in order to estimate disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the body mass of the species being disturbed and the activity type causing the disturbance</p>
<p>Has there been any validation/ ground truthing of predictive results?</p>	<p>No</p>
<p>Is the evidence complete for its intended use?</p>	<p>There are additional metrics that could have been recorded, and the analysis could have been taken further using a range of uni/multivariate approaches.</p>
<p>Are the figures and tables easy to understand?</p>	<p>Generally yes, but the maps appear unnecessarily small for some reason.</p>
<p><b>Assumptions</b></p>	
<p>Main assumptions/ limitations identified within the report.</p>	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only wading bird species that had at least 20 observations of their response to disturbance</li> </ul>

	<ul style="list-style-type: none"> <li>• The body mass of these bird species was also linked to response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</li> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance from population centres.</li> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</li> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
<p>Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?</p>	<p>The extreme cold weather period appears to be assumed to have not altered any responses against those for a 'normal' winter.</p> <p>Tide state hasn't been assessed as a potential variant in response.</p>
<p>What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?</p>	<p>The reliance of conclusions on one short season is an obvious problem.</p> <p>Seasonal effect excluded from the analysis, but the occurrence of land-based and water-based recreational activities as well as bird responses are likely to vary according to the weather conditions e.g. high winds.</p> <p>Seasonal variability is a flaw – responses will vary between habituated winter birds and unhabituated early winter arrivals, passage birds etc, as will energy requirements and associated tolerances from early winter to late winter.</p> <p>Post response return time information would be useful metric.</p> <p>However, presumably given finite resources, the methods</p>

	are reasonable, and with caveats, outputs can be seen as fit for purpose.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Yes, given the caveats above, and in particular, the short-term nature of the data collection phase.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	The methods used to establish the data are provided, and measures were put in place to reduce counting errors.
Do all sources of evidence/analysis point to the same conclusions?	In terms of the 'conclusions' within the discussion and earlier text, it would appear so.
What additional analyses might/should have been done?	A single surveyor methodology seems to have been used and this can be problematic where a series of events occur, as time is spent recording information with eyes are off the receptors, and some responses can therefore be missed. Disturbance is addressed on an activity basis, but without any metrics for variations in noise. In most instances a visual cue will lead to a response before an aural one, however in some instances this is not the case (loud, sudden noises), and as such, can be an important metric in its own right (e.g. noise from a crop scarer, vehicles, yacht race starting canon etc can have a substantial disturbance effect without any visual stimuli).
<b>Additional Comments</b>	



Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Coverage seemed reasonable.
Are the quality standards associated with such data included within the report?	The methodology describes the data sourcing. Some of this is not really my field, so I am not sure whether this is the 'best' approach.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	Bank holidays? Visitor testimony vs. observation of actual activity. However at this scale of analysis, then probably reasonable for purpose.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site visitor surveys including counts of people and interviews.</li> <li>• Car parks and parking spaces were also analysed using Google Earth</li> <li>• Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, but again with a seasonal constraint and reliant on testimony.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	No, other than statistical analysis
<b>Results</b>	
Key data outputs identified from	Results from surveys included:

<p>the report</p>	<ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
<p>Has there been any validation/ ground truthing of predictive results?</p>	<p>N/A</p>
<p>Is the evidence complete for its intended use?</p>	<p>Yes, although it would have been helpful to present in the report the distribution of visitors across the intertidal areas (mapped tracks), and determine the relationship between habitats type, the presence of visitors and other environmental variables.</p>
<p>Are the figures and tables easy to understand?</p>	<p>Yes</p>
<p><b>Assumptions</b></p>	
<p>Main assumptions/ limitations identified within the report.</p>	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits made to the coast. Activities coded as "Other" (70 interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</li> <li>• The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular</li> </ul>

	clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site surveys correlate, in terms of visitor rates, will be important in directing further analysis.
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	Nothing glaring apart from survey results are assumed to be applicable for all years etc.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Seasonal nature of survey and general transferability of data to other seasons, years etc.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Again no clearly defined conclusions, rather discussion on a series of findings. The findings however are often of interest and value, and based on the evidence presented.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	The findings discussed in Section 3 are based on good evidence provided earlier in the report.
What additional analyses might/should have been done?	As ever, additional survey data from other seasons, years etc would be useful, and further actual observed usage rather than part reliance on visitor testimony.
<b>Additional Comments</b>	

Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Respondent information
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	Again, in that methods are described and appear appropriate.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	It is recognised in the report that retired people are strongly represented in the sampling, due to a high return of questionnaires from this section of the population. This may result in a bias indicating potentially a greater than actual level of usage, but also a difference in the areas used and in what way.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Household questionnaires.</li> <li>• Statistical analysis and presentation using Minitab and MapInfo</li> <li>• Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, and there are issues/weaknesses identified in the text.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	Yes. Techniques appear suitable, but potential sample bias (retired and unemployed respondents does not appear to have been addressed. Differences were noted between the outcomes and the on-site results, but perhaps additional targeted survey work could have been undertaken to establish causal factors for the disparity and thus any future model runs.
<b>Results</b>	

<p>Key data outputs identified from the report</p>	<p>Analysis from results from surveys included:</p> <ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.</p>
<p>Has there been any validation/ground truthing of predictive results?</p>	<p>Some comparison between predicted and observed usage, with discrepancies noted.</p>
<p>Is the evidence complete for its</p>	<p>Determine the causal factors for the discrepancy – is this</p>

intended use?	related to high number of retired/unemployed respondents. Given the differences, then model is only partially fit for purpose, and additional ground truthing would be useful.
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	An obvious issue would be in the number of respondents and their representiveness. Respondents tend to be 'interested parties' and an assumption might be that they are less like to be a causal factor in disturbance....or at least this bias requires addressing. Again direct observation vs. witness testimony may be an issue compounding bias.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Is the response demographic representative of the wider population and how they use the coast. As these data feed into the model, then this has potential implications for the model outcome.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	To some extent yes, but the discrepancies between observed and modelled outcomes and the potential respondent bias would make conclusions somewhat weaker than they might be.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	As above – the outputs reflect inputs etc, but with issues relating to bias.
What additional analyses might/should have been done?	As noted above, it is questionable whether the response demographic is representative of the wider population and how they use the coast. This requires ground-truthing through on site observation/questionnaire to quantify any potential bias.
<b>Additional Comments</b>	

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used: <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	A lot of other data from published and grey literature appeared to be used as parameters in the model (including bird mortality rates etc)
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	The model uses a number of datasets from the previous reports, which have one or more spatial/temporal issues. However it is important to acknowledge that such datasets are a pragmatic trade-off, and generally therefore fit for purpose, although areas of weakness need to be known to address any issues from subsequent analysis outcomes.
Are the quality standards associated with such data included within the report?	Data sources are identified.
What are the limitations of the datasets that have been used? Do they compromise the extent	The disturbance data used is as already noted, of limited spatial and temporal extent. Household data were potentially biased.

<p>to which the data is fit for purpose?</p>	<p>As noted for the Chichester Harbour model – It is understood that the invertebrates population used to parameterise the individual based models failed to support the bird population currently using the site. Therefore, the Chichester Harbour model was not used to predict the effect of disturbance of birds in the Solent. The reasons given in the report point to limitations in the invertebrate survey of Chichester Harbour, possibly because of the numbers of sampling location relative to the total intertidal area.</p>
<p><b>Methodology</b></p>	
<p>Key methods used within the report.</p>	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
<p>Are the methods adopted generally appropriate given the objectives?</p>	<p>Yes – the MORPH individuals-based model is potentially a reasonable tool to model survival rates of waders in response to disturbance. Appropriate techniques were applied to assist in the robustness of the outcomes through sensitivity analysis. However, it is not clear in the report whether other tools were available or have been considered to predict the impact of disturbance.</p>



Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	Yes. Such an approach has been applied elsewhere with good results. I am not aware of the reasons for the problems at Chichester, but most probably relate to data used rather than the model itself. Sensitivity assessments were made which are useful, and uncertainties etc are addressed.
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> <li>• Scaling up predictions to the Solent</li> <li>• Predictions for Brent Geese</li> </ul>
Has there been any validation/ground truthing of predictive results?	Yes, model outputs of survival were assessed against published research and distribution estimates.
Is the evidence complete for its intended use?	Yes
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters</li> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	The approach assumes that 50% of the annual mortality occurs during winter but there is an apparent lack of evidence to support this assumption throughout the report. It is understood that BTO mortality rates were halved in Southampton Water to derive the observed mortality rates. With limited knowledge of the individual behaviour model details, it is difficult to gauge the importance of the

	<p>assumption in the final prediction, but it is felt that there is insufficient evidence/discussion provided in the report and it is suspected that this value cannot be applied uniformly across all waders species considered in this study as the spilt in mortality between breeding and wintering grounds is likely to vary between wader species.</p> <p>It is understood that simulations of the model ran from 1<sup>st</sup> September to 31<sup>th</sup> March, using the WeBS core count data, and assuming therefore that the birds remain in the estuary during this period. This assumption is perhaps 'over-precautionary', as the period encompasses a period of high bird turnover in estuary (September and October). It is unclear whether turnover rates were parameterised in the report, and the effect of the turnover rates on the predicted mortality rates. An assumption of over precaution is perhaps good in any case.</p>
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	The limitations are inherent to the numbers of assumptions taken in the model as well as the input data. It would however appear to be the case that throughout the process a precautionary approach has been followed where possible.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Although some of the data that are used in the model have had issues noted earlier, it would appear that the model itself uses precautionary assumptions and has had some validation through sensitivity analysis.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes, documentation is good.
Do all sources of evidence/ analysis point to the same conclusions?	Yes, this would appear to be the case with the exception of the Chichester Harbour outcomes which are presumed an error..
What additional analyses might/should have been done?	An obvious one would be to clarify the Chichester Harbour source of problem – either sample or data processing, interpretation or even survey issues, although the latter would be surprising given standardised methods etc. Depending on outcomes, this might then allow the model to be re-run.
<b>Additional Comments</b>	

Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	Across the development of the reports then in general, yes. However there are some flaws in each of the reports that weaken the conclusions. Many of these might be readily actioned, although not within a short-timescale or with a small budget. As such, it is assumed that any additional data gathering and analysis relating to the reports in terms of additional data collection is unlikely in the short-term, but with the potential for the results of the outcomes of the studies to have greater validation efforts applied. Perhaps it might be useful for a short over-arching report, which takes the various key findings and collates them, whilst clearly identifying the information deficiencies and assumptions.
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	As above.
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	A series of uncertainties have been identified relating to the household/visitor surveys which mean that any conclusions are weakened in respect to associated outcomes.
Does the evidence base provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?	Not fully, given the issues above. Maybe OK at a Solent-wide level, but with potential issues at an individual site level.
Are there any caveats required or limitations to be aware of before using this evidence?	As above
Is there a requirement for further work? If so what would you recommend?	As described above, there are weaknesses identified from each report, although given the importance of the component, the household/visitor information is possibly the weakest, although reliance on bird data from only a short single period is also of concern. There may be opportunities to expand/address these issues, although timescale and budget may be an issue.
Additional Comments	

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix D4: Gareth Bradbury (WWTC) Peer Review Proforma – (13/11/12)

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.

## Peer Review

Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Could be clearer - Chapter 1 <i>Introduction</i> , summarised what was done, Chapter 2 <i>Planning context for the project</i> , described why it was done.
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	<p>Literature on impacts to SAC habitats; Interviews/workshops for expert opinion on recreational impacts (section 5) and mitigation techniques (section 7); Aerial photographs to ground-truth 1995 marinas and moorings data. Recreational access restrictions around the Solent information.</p>
Were the methods used to collate the data appropriate?	<p>Bird impacts: The disturbance to birds literature review did not give search methods used, eg if an internet search was used, then which search engine and which keywords were used. At least one key text was missing, <i>Waterbirds &amp; Wetland Recreation Handbook a review of issues and management practice</i>, published by WWT (2004). When the authors were questioned on this they said it was not supposed to be an extensive review of impacts but more focused on the Solent. However many of the referenced studies in the <i>Handbook</i> relate to similar English waterbodies as the Solent, a similar range of recreational impacts and many of the target SPA species. Little attempt was made to link impacts on habitats (SAC features) with potential impacts on bird populations – eg the loss of sandhopper and mollusc prey in sandflats, mudflats and lower beaches following trampling. Additionally the authors could have made more use of habitat management plans to identify impacts for these habitats as they did for Coastal Lagoons. Recreational use:</p>

	<p>Quite a diverse range of data sources were used: physical shoreline access, car parks and visitor surveys. Again methods for shortlisting these were not given, eg were tourist office figures and studies requested, civic refuse collection data from coastal paths, etc.?</p> <p>Expert opinion: Very useful addition, however the method of selection of experts was not provided. This question was put to the authors who said Jonathon Cox and the Solent Forum assembled the experts and they should be seen as representative.</p> <p>Bird population trends: Appropriate data sources used, however tern and gull population trends not put in national context.</p> <p>Mitigation techniques: No literature review was done for this, just the local expert consultation so there was little evidence base from techniques used elsewhere.</p>
<p>Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)</p>	<p>Bird disturbance: One disturbance study specific to the Solent (Thompson 1994), others elsewhere in England or overseas. Several recent studies (at time of writing) and most are of relevant species. However the review found very few directly relevant studies of impacts of disturbance to waterbirds on the Solent.</p> <p>Recreational use: The authors sought the most recent visitor surveys around the whole Solent coast, however the number of studies available were limited.</p> <p>Expert opinion: Very useful for providing up to date opinions and site-based observations from managers.</p> <p>Bird population trends: Core counts data were unavailable for plotting distributions of species, so the report used quite temporally spaced low tide counts data. This makes interpretation of spatial trends difficult.</p> <p>Population trends for breeding terns and gulls were not put into a national context in this report, eg with reference to BoCC or JNCC reports.</p>
<p>Are the quality standards associated with such data included within the report?</p>	<p>Bird disturbance: The review notes Gill, 2007 who reports there is still contention about the applicability of the methods of (disturbance) study and the impacts on bird populations and reiterates elsewhere that most studies demonstrate behavioural and not population effects. The authors critically evaluated the use of set-back distances concluding they were inappropriate given variation between individuals, species, environmental conditions, etc.</p> <p>Recreational use:</p>

	<p>The limitations in coverage and data gathering completeness of the different surveys was reported.</p> <p>Expert opinion: No quality standards were provided, however on questioning, the authors were confident they were a representative sample of experienced land managers.</p>
<p>What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?</p>	<p>Bird disturbance: Few studies on disturbance to breeding birds. No consistent standards in waterbird disturbance studies, so applicability to Solent cannot be tested.</p> <p>Recreational use: The lack of systematic monitoring of visitor rates restricts the ability to compare between sites and over time and to compare with bird population trends.</p> <p>Expert opinion: Non peer-reviewed, potentially subjective technique dependant on individual's experiences.</p>
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, though the bird disturbance literature review was apparently not that complete and a review wasn't done for mitigation techniques.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	The extent of analysis was presenting review findings, so no modelling used.
<b>Results</b>	
Key data outputs identified from the report	<p>Reviews of the most current data including:</p> <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ground truthing of predictive results?	No, this phase of the study does not make predictions.
Is the evidence complete for its intended use?	As a standalone document the bird disturbance and mitigation literature reviews were incomplete and elements of the review were not brought together, eg comparisons between apparent spatial population trends of species and levels of activity, however as an initial review as part of a multi-phased project it was adequate.
Are the figures and tables easy	Yes, though one table was curtailed, probably due to

to understand?	formatting.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	No assumptions are stated, though some are inherent, such as using Low Tide WeBS data as a proxy for Core Count data.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	The bird disturbance and mitigation literature reviews were incomplete and some data sources they had identified were unfortunately unavailable to them for this study. I think including expert workshops was very valuable though for potentially plugging gaps in available published studies. As the first part of a multi-phase project the study is fit for purpose.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	No conclusions were reached. Impacts and potential mitigation would be assessed in Phase III.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	No conclusions, but literature references and names of experts used for consultation were provided.
Do all sources of evidence/ analysis point to the same conclusions?	Some implied conclusions suggest convergence, such as the bird disturbance literature review suggested responses of birds to disturbance were variable depending on particular conditions, and this is echoed by the experts, such as the consensus that there was minimal or habituated disturbance where people walk along defined structures eg. sea walls, but disturbance to shingle nesting birds, eg terns, ringed plover and oystercatcher was high.
What additional analyses might/should have been done?	It would have been useful to include a literature review matrix – impacts vs species and also site vs access/activity data. Studies of invertebrate prey biomass were omitted and might have been included if available especially since it was noted by the experts that intensive levels of bait digging at several locations were considered a 'problem'.
<b>Additional Comments</b>	



Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Tide times.
Were the methods used to collate the data appropriate?	Yes.
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	N/A
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	N/A
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>• Statistical analysis using box plots and GIS.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	<p>The methods do not address the objectives to establish how bird distribution varies between sites and with distance up shore too well. Individual locations of birds or flocks were not mapped and covariates such as sediment type or prey abundance not sampled. The results deal with birds in bands but do not relate this to proportion of intertidal area available given tidal state so it is made very hard to interpret why birds are at different distances.</p> <p>Although a previous season of fieldwork was conducted, it is</p>

	<p>not reported, so the results are based on one year only and only late winter (Dec-Feb) from that year. As it was January and February were 'intensely cold' so behaviors may have been abnormal and certain species (e.g. smaller birds) may have been effected to a greater extent.</p> <p>If the results of the study were to be scaled up to the whole Solent then the patches to be sampled ideally would have been randomly selected (maybe within strata). However they were chosen as they provided better vantage points, so undoubtedly introduced some bias, but from a practical point of view maybe this is acceptable. Looking at the WeBS data they appear to include a reasonable selection of important sites for the target species. Also the report does not say that the survey days and times were selected randomly. This could introduce bias if the choice of day and time is linked to similar processes as visitation, bird distribution, disturbance, etc. With regard to the plot size, 500m seems quite large and size and distance biases may creep in. For example seeing if a dunlin looks alert or walks slightly from 500m is inevitably much harder than seeing a curlew or oystercatcher move, especially when trying to watch the whole plot and 200m outside it. Also measuring distances becomes harder at greater distance, particularly for objects on the water, which generally would have been at the greatest distance in the 500m arc, so if errors were unidirectional, e.g overestimates it may lead to biases.</p> <p>Then there is the issue of flocks, the methodology does not detail if flock size of the responding birds was taken into account; it does not detail if it was the response of the whole flock of a species or a single bird or a threshold proportion of individuals within it that was counted; and analyses did not determine if the presence of some species in flocks (such as Oystercatchers which gave major flight, and no doubt called to 16% of potential disturbance events) lead to biases.</p> <p>With regard to disturbance events, the methodology does not include trials to see any effects of the surveyor appearing on site (in which case they were already dealing with a 'disturbed' assemblage); of those sites selected, were there features where people/disturbance events would be visible to study birds but not to the observers?; there seems to be no consideration in the method for natural non-anthropogenically disturbed bird behaviour - how did they distinguish birds moving to find prey; dodging swash of waves on the shore, reacting to overflight of con-specifics or other species which can cause waders especially to walk, run or fly? There is no mention of how cumulative effects were considered, e.g how could response times, distances and displacement distances be assessed if several disturbance events were occurring simultaneously or consecutively? The final point is how were observers</p>
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	<p>scanning in the methodology- it may be that the observer used cues from bird behaviour to detect a disturbance event more for some species (e.g. oystercatcher) and for other species see the disturbance factor first and then look for a response (e.g. in smaller species (unless they took flight)).</p>
<p>Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	<p>Generalised linear modelling was used to test for relationships between the factors and to derive simplified model parameters. Assumptions are fully documented however the grouping of input parameters was largely done on the basis of poor sample sizes and sensitivity testing was not done to see the effects of using different groupings and using, for example, general site disturbance rates as opposed to alternative indices to relate different sites.</p>
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul> <p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the</li> </ul>

	<p>observation period</p> <ul style="list-style-type: none"> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species combined analysis was performed in which species were represented by their body mass in order to estimate disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the body mass of the species being disturbed and the activity type causing the disturbance</p>
Has there been any validation/ ground truthing of predictive results?	No, this is lacking
Is the evidence complete for its intended use?	Not complete, though has thoroughly recorded disturbance events as far as is practical and a good range of responses. Too few data were collected to develop models for many of the other wintering SPA waders let alone other wintering SPA waterbirds and SPA breeding birds. Other waders will be modeled based on body mass, however Table 6 suggests the relationship is not simple, as is to be expected given the range of species life histories represented. Not enough evidence was provided on how responses were isolated to individual events. In just 11 cases out of 2,507 potential events the observers recorded not being able to assign a response to an event, which seems very low given the study plot size, and numbers of birds (including gulls probably) and events at some sites.
Are the figures and tables easy to understand?	Figure 4 does not allow for proportion of intertidal area available, i.e. were birds constrained by tidal state?
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only</li> </ul>

	<p>wading bird species that had at least 20 observations of their response to disturbance</p> <ul style="list-style-type: none"> <li>• The body mass of these bird species was also linked to response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</li> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance from population centres.</li> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</li> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
<p>Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?</p>	<p>Minor responses (i.e. not major flights) assumed to have no energetic costs. However there is still a gradient from alert birds (not feeding) to birds walking (using energy and not feeding) and flushing short distances.</p> <p>Birds become habituated to more disturbance events. Not sure the data showed this explicitly. Earlier in the text the conclusion was birds tend to leave or avoid areas of higher disturbance. Para 4.8 states habituation not proven by this study.</p> <p>Response type (M or F) not used in analysis of displacement distance as distances not recorded for minor responses.</p> <p>Para 4.6 densities of birds showed significant negative correlations with amount of visitor activity indicating birds are already avoiding locations with higher levels of disturbance BUT this was only using counts at the end of disturbance surveys, so they might have been there but left due to disturbance.</p>

	<p>Para 4.10 Intense cold weather in January and February – assumes responses to all species same, however could be species/size related effect? Thus further seasons need to be studies, or analysis done on existing data to relate temp/weather to species response times and distances.</p> <p>Para 4.12 acknowledges tidal state not taken into account in this study but would be used in subsequent modelling.</p>
<p>What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?</p>	<p>Only winter of one year and only enough data for some wader species. This means no measures of confidence can be assigned to whether it was a 'typical' year for activities, bird distribution and behaviour, and the extent of application for other SPA species is limited (at best assumed through body mass). The approach assumes other areas can be predicted by a general potential disturbance rate, although different areas will be characterized by different proportions of sources of disturbance and environmental variables. The methodology is not clear in how it separates out responses to several concurrent (e.g. bait digging plus another?) or consecutive activities (e.g. the response time if one event has passed and another has occurred) and has no tests for how accurately or precisely events and responses are recorded.</p>
<b>Conclusions</b>	
<p>Are the conclusions justified by the evidence base?</p>	<p>Generally yes, although hugely reliant on the accuracy of the surveys which were untested either experimentally or analytically. Also there was no sensitivity testing of the initial groupings to be used to develop parameters, being instead more confined by sample size.</p>
<p>Has an audit trail been maintained throughout the analysis to support the final conclusions?</p>	<p>Not really. The report heads in a particular direction from start to finish, but assumptions seem largely untested, and it's not until the Discussion that the additional data collected, such as tidal state, weather conditions, etc are mentioned, which could be very important in interpreting the results before conclusions were drawn.</p>
<p>Do all sources of evidence/ analysis point to the same conclusions?</p>	<p>See above. Also, 'surfer' is recorded on the shore in Table 3, but included as a water-based activity in Table 8 and as 6/8 'surfer' events led to major flights this could be important!</p>
<p>What additional analyses might/should have been done?</p>	<p>More testing of methodology and assumptions. The present methodology seems very reliant on each observer recording everything very accurately. Having one observer record anthropogenic activities and another independent observer continuously recording bird behaviour could remove some potential biases. The use of cameras can also be useful for increasing independence. With the data that have been collected though it would be good to see the results of more tests, such as any differences with observer, species size/observability, weather, tidal state, etc as covariates.</p>
<b>Additional Comments</b>	

Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Aerial photographs, postcode locations
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	The effects of generality of postal codes may be greater at shorter distances than larger ones, but generally not applicable.
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	N/A
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>On site visitor surveys including counts of people and interviews.</li> <li>Car parks and parking spaces were also analysed using Google Earth</li> <li>Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, though only looked at winter and in just one year, so results may not be applicable to summer and may not reflect a 'typical' winter. Also, 42% of respondents said they visited a site most days, which could lead to double counting if they are counted on both days, or bias results if they are excluded. Also, as with the bird disturbance study, intertidal use was divided into bands, not proportions down available beach depending on where tide was, thus kite surfers for example were not recorded >150m down beach.
Has modelling been used in the analysis? If so are the assumptions, limitations and	No modelling

degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<p>Results from surveys included:</p> <ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
Has there been any validation/ground truthing of predictive results?	No predictions made
Is the evidence complete for its intended use?	It samples one winter only, so applying to other seasons or years relies heavily on assumptions. Also as there was significant variation between sites, results may not apply to other patches along the Solent. As a snapshot of what was happening during the bird disturbance study period it is fairly complete.
Are the figures and tables easy to understand?	Yes, though as with the bird study I would like to see proportional distances down available beach that activities took place as well.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits</li> </ul>



	<p>made to the coast. Activities coded as "Other" (70 interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</p> <ul style="list-style-type: none"> <li>The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site surveys correlate, in terms of visitor rates, will be important in directing further analysis.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	<p>Surveys avoided inclement weather, these may have been when some water sports take place.</p> <p>Assumed people within 25m of MHWS did not cause disturbance.</p> <p>Maybe fewer people using the exposed intertidal areas as it was particularly cold.</p>
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	<p>The study is directly applicable to the corresponding bird disturbance studies. However given only 20 sites were selected, and only part of one winter was studied making inferences about other places and times becomes loaded with assumptions.</p>
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	<p>Conclusions were not really drawn, just a summary of results which were well backed up by the data available and discussion of some of the limitations.</p>
Has an audit trail been maintained throughout the analysis to support the final conclusions?	<p>Yes.</p>
Do all sources of evidence/ analysis point to the same conclusions?	<p>Yes.</p>
What additional analyses might/should have been done?	<p>Additional seasons and a further year of study would have helped place confidence in making inferences to other times.</p>
<b>Additional Comments</b>	

Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Ordnance Survey Meridian 2 GIS layer (for road distances, mudflat habitat layer from Natural England website & Monitored bathing sites from MAGIC, results from on-site surveys.
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	N/A
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	N/A
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Household questionnaires.</li> <li>• Statistical analysis and presentation using Minitab and MapInfo</li> <li>• Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Generally yes. The authors recognized the threats to a postal questionnaire, mainly the lack of control over who completes them, but successfully took steps to maximize the number of respondents. Address locations were stratified and then random addresses generated, which was a sensible approach. Respondents were not asked how far away they worked/whether they visited the coast at lunch-times which could have been useful for midweek data patterns as winter days were short and few people visited the coast in darkness. Also, as noted in the report no distinction was made as to which activities were carried out

	in winter, so they may not be applicable to those observed in the on-site and bird disturbance surveys.
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	Yes, GLM for foot and car visit rates in relation to section features and distances. Some model testing was done of input parameters, however no measures of confidence were assigned to predicted visitation values. Visitation rates were higher for both car and foot visitors than was recorded in the on-site surveys and although a hypothesis was given for the discrepancy– poor weather, this was not tested.
<b>Results</b>	
Key data outputs identified from the report	<p>Analysis from results from surveys included:</p> <ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits</p>

	made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.
Has there been any validation/ ground truthing of predictive results?	The model predictions were comparable to visitation rates for individual sections from the household survey data, however as these formed the basis for the modelling, as noted, this is not surprising, but is reassuring. However results were compared with the on-site survey as a form of ground-truthing but the household survey seemed to consistently overestimate annual foot and vehicle visitation numbers. A cold weather hypothesis was put forward, but was untested.
Is the evidence complete for its intended use?	It would be good to see more testing to see why the on-site data and household data are so different and to see how the demographics of the respondent population compare with overall demographics from censuses to see if any biases can be identified before the models are believed to be as robust as possible.
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	<p>The authors assumed more households near the coast would visit it and so weighted the mail drop accordingly. This pattern was observed from the on-site surveys.</p> <p>The authors made proxy numbers for responses to frequency of visitation, e.g. "a few times a year" was assigned 4 visits, etc.</p> <p>Visits to sections were assumed to be conservative minimum numbers of visits, especially for cyclists who could visit many sections in a week.</p> <p>The authors suggested the proximity of Section 50 to a populous area as accounting for why it was so popular despite it not having a slipway, a bathing beach and no open coast, however this was untested.</p> <p>Lower estimated on-site survey rates &gt;500m from the coast than the household survey likely due to unusually cold winter weather. However, this is untested. It may be for example that more people not using the coast did not respond to the questionnaire. Also in calculating rates from the on-site survey they used average household size of 2.36, whereas</p>

	the household study showed average household size of 2.25 for people visiting the coast. Testing the effects of weather during the on-site survey should be possible to an extent.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	Respondents could only choose up to four coastal locations (though five were allowed in some instances), so reported number of visits to other sites could be underestimates. How was the tide shown on the map that respondents completed? This will probably relate to proportion of beach available rather than absolute distance from shore. As the questionnaire had to be accessible to a general audience, more useful section descriptive parameters than, for example, 'open coast' were not used. The methodology did not test how representative the respondents were against other demographic studies, though they did get a good return rate. Generally a sound approach though and the relative results seem sensible.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	In as far as there are assumed to be no biases in the type of people responding, the report follows a clear logical path for the household survey in its own right. Comparison with the on-site survey however needs further analysis to identify and test possible causes for discrepancies between the two studies.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	The conclusions are based on constructing models from the results for which a good quantity of data were collected, so as its own study conclusions are consistent. However, there is a fundamental reliance on non-bias in the demographic of people responding which is largely untested (aside from their distance from shore) and the discrepancies with the on-site field data are not adequately explored.
What additional analyses might/should have been done?	More analysis/comparisons with the on-site data, such as testing for any weather effects, and testing response rates against other demographic censuses to check for and guard against biases.
<b>Additional Comments</b>	

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<p>MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used:</p> <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Solent Waders and Brent Goose Strategy policies and proposals, distribution of eelgrass beds.
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Disturbance data is only from late winter of a single year. Invertebrate surveys were only undertaken in Southampton Water and Chichester Harbour.
Are the quality standards associated with such data included within the report?	Limitations of the different data sources are discussed
What are the limitations of the datasets that have been used? Do they compromise the extent	The Chichester Harbour invertebrate survey showed few larger invertebrate prey items than were predicted by modelling to be required to sustain populations counted in

<p>to which the data is fit for purpose?</p>	<p>WeBSs. This was possibly due to too few samples not adequately sampling clumped distributions of larger species. The lack of invertebrate surveys from other parts of the Solent mean that inferences have to be made from Southampton Water results.</p> <p>The disturbance field data is only from one winter and by all reports a particularly cold winter, so may not represent 'typical' behaviours in other winters. Sufficient data were only collected for a few species, so other species had to be modeled based on body mass, with no tests as to how appropriate this was. The disturbance study did not consider disturbance to roosting birds, only feeding birds, so disturbance to roosting birds had to be modeled based on further assumptions.</p> <p>The on-site visitor survey data did not match the household survey data too well, however for this study the authors used the household data which generally predicted higher levels of disturbance, which is the more precautionary approach to take.</p>
<p><b>Methodology</b></p>	
<p>Key methods used within the report.</p>	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> </ul>

	<ul style="list-style-type: none"> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
Are the methods adopted generally appropriate given the objectives?	<p>Yes, the individual based modelling was a useful approach to assess future impacts of disturbance. The authors did sensitivity analysis on several aspects of the modelling which was good to see and lacking in the earlier reports. Examples include the overlap of people and waders on intertidal, which predicted survival to decrease when separated and increase when together (independent) but for the rest of the modelling they were precautionary in using the independent condition. The hypothetical simulations provided further sensitivity analysis for doubling visitor numbers, reducing area available (sea level change), disturbance to roost sites and changes to frequency of intertidal (and water borne) activities.</p> <p>The methods used to scale up to Solent wide effects seemed sensible.</p>
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	<p>Yes. MORPH was used. The models developed were fully documented and sensitivity analyses for different functions were undertaken. Assumptions, caveats and limitations were also well documented. Measures of uncertainty are not always provided with point estimates provided.</p>
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> <li>• Scaling up predictions to the Solent</li> <li>• Predictions for Brent Geese</li> </ul>
Has there been any validation/ ground truthing of predictive results?	<p>Yes, simulations were run to predict current conditions and then for future conditions. Generally current condition simulations matched observed patterns quite closely (not for species distributions within WeBS sub-sections at the end of the winter though).</p>
Is the evidence complete for its intended use?	<p>The models seem overall quite precautionary (e.g. assuming all intertidal visitors occupy the same space as waders) and sensitivity analyses have been conducted on several key inputs. This together with a good appraisal of the assumptions and limitations of the study mean the report can be used to put future disturbance predictions into context, with the caveats provided.</p>
Are the figures and tables easy to understand?	Yes.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to</li> </ul>



	<p>estimate disturbance parameters</p> <ul style="list-style-type: none"> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
<p>Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?</p>	<p>Bird predation was assumed to be the only invertebrate mortality source, which referenced the Southampton Water invertebrate survey which showed no decrease in prey abundance through the winter.</p> <p>In modelling, starvation was assumed to be the only source of bird mortality, which would seem a reasonable assumption of the primary cause of mortality (starving birds more prone to predation, hypothermia, etc...).</p>
<p>What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?</p>	<p>The main modelling outputs are only applicable to wintering waders, with some consideration given to Dark-bellied Brent Geese, but not to other SPA species. The modelling is reliant on input parameters from the disturbance and household survey studies, some of which were not subjected to sensitivity analysis before being compiled which may lead to untested under or over estimates. The models are fitted around a selection of sites and a small selection of wader species. Beyond these sites and species inference is made using further assumptions. Generally decisions have been taken following sensitivity analyses to use models that over-estimate mortality and thus lead to perhaps precautionary results so when inferences are made, hopefully this precaution is transferred. Alongside this, note is made of the assumptions and limitations to the modelling used and occurrences where mortality may lead to underestimates, such as sites where bait-digging or other potentially more disturbing activities that were not commonly recorded in the disturbance study are more widespread. The report suggests further studies are undertaken to explore impacts from these if they occur more frequently at some sites.</p>
<p><b>Conclusions</b></p>	
<p>Are the conclusions justified by the evidence base?</p>	<p>The model construction for this report is well documented and sensitivity analyses conducted to test performance and provide a range of mortality outcomes under different</p>

	scenarios. The conclusions presented seem justified by the models constructed, though some input disturbance parameters were initially untested through sensitivity analysis. However generally the model uses precautionary assumptions and other assumptions and caveats are clearly described.
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes, with good detailed analysis methods and intermediate modelling parameter results provided in the Appendices.
Do all sources of evidence/analysis point to the same conclusions?	Excluding the Chichester Harbour invertebrate predictions, generally yes.
What additional analyses might/should have been done?	Natural England have confirmed that a further invertebrate survey of Chichester Harbour is planned. It would be useful to re-run the models with revised data from this to see if the picture is changed. It would be useful to consider future predicted mortality rates in the context of the WeBS sector trends. Further sensitivity analyses particularly of disturbance experimental errors and parameters used from the disturbance study would be useful to see included.
<b>Additional Comments</b>	

## Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	There were discrepancies between the on-site survey and the household visitor surveys that suggested one or other or both approaches did not truly reflect the existing visitation patterns at the subject sites which is somewhat concerning. The bird disturbance report did not fully describe the methodology so it is hard to say how robust it is to measurement errors. It seems that a single observer continuously scanning a 500m arc and consistently recording potentially small behavioural differences to a range of species differing greatly in size and response behaviour and assigning these to individual non-cumulative is too ideal for just 11 responses to be unassigned. Sensitivity testing of measurement errors and identification of any biases (including any weather effects) should have been provided as such measurements were going to be used for subsequent modelling. However in the individual-based modelling, data were generally pooled which would probably have added certain robustness (though losing some activity, species and site specific resolution) and assumptions generally well caveated. In terms of assessing current impacts to SPA species, only wintering waders were really considered (with some species being modeled from body size) and reference was not made back to local trends, only starting population sizes from WeBS sector data. For those species modeled, the studies will provide useful information on types of disturbance and responses and probably an overall level of disturbance within the right order of magnitude.
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	Again of the SPA species, the studies only really consider impacts to wintering wader species (some of which are modeled from body size), based on one season's worth of disturbance studies. The MORPH model was well applied and sensitivity analysis conducted to test effects of different levels of input parameters. Input data were generally further pooled which added robustness (though took away some specificity) and generally more precautionary models were run. The caveats are well documented, so if acknowledged, then the predictions seem to provide sensible scenarios of the expected order of magnitude.
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	The 5 reports have been well planned so that disturbance events most closely associated with residents have been isolated and the authors have divided parameters to scales relevant for housing planning (e.g. distance bands from coasts). Given the above notes, and caveats in the reports the outputs are directly useful in assessing the contribution which residential development does and will make.
Does the evidence base	The evidence base for breeding SPA species and the non-

<p>provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?</p>	<p>modeled wintering birds is minimal, based on modelling body mass or a brief literature review. For those modeled wintering species the studies are robust enough to put disturbance into context with responses probably in the right order of magnitude which will help statutory advisers identify the most important considerations for wintering waders at least.</p>
<p>Are there any caveats required or limitations to be aware of before using this evidence?</p>	<p>The caveats provided in the reports seem comprehensive, with untested weather effects (both to people and birds) perhaps being that of greatest importance. Users should also be aware that the disturbance field measurements appear untested for accuracy and sensitivity of errors here and in simplifying terms for modelling parameters.</p>
<p>Is there a requirement for further work? If so what would you recommend?</p>	<p>Yes: further sensitivity studies as above; comparing results with observed site bird trends; incorporating new invertebrate survey data; and further species and activity specific disturbance studies.</p>
<p>Additional Comments</p>	

## Solent Disturbance and Mitigation Project Evidence Review

### Appendix D5: John Goss-Custard Peer Review Proforma – (13/11/12)

#### Project Aims

The overall aims of the project can be summarised as:

- To assess the robustness of the conclusions of the SDMP in relation to:
  - Existing and likely impacts of disturbance on the important bird populations of the SPAs in the Solent; and
  - The contribution which residential development makes to the impacts.
- Assess whether the evidence base provides a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs; and
- If it does not, assess what additional evidence would be required to do this.

#### Documents to be reviewed

The Phase I and II reports to be reviewed include:

- Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009) Solent disturbance and mitigation project: Phase I report. Report to the Solent Forum;
- Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10. Footprint Ecology / Solent Forum;
- Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region. Solent Forum / Footprint Ecology;
- Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey. Solent Forum / Footprint Ecology; and
- Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent. Report to the Solent Forum.

#### Guiding Principles

The overall guiding principles in undertaking the review include:

- The need for a transparent decision making process with a clear auditable rationale for the conclusions reached;
- An objective scientific assessment of evidence available;
- Work within and have reference to the legal and policy context of the decision making framework; and
- Present clear decisions and conclusions.

## Peer Review

Report 1. Stillman, R. A., Cox, J., Liley, D., Ravenscroft, N., Sharp, J. & Wells, M. (2009)  
Solent disturbance and mitigation project: Phase I report.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• Solent region planning policies</li> <li>• South East Plan</li> <li>• Solent and Southampton Water, Portsmouth Harbour and Chichester and Langstone Harbour SPA interest features</li> <li>• Solent and Isle of Wight Lagoons and Solent Maritime SAC interest features</li> <li>• Bird disturbance literature</li> <li>• Existing housing and human activities data sourced from local authorities and the Solent Forum.</li> <li>• Existing bird data e.g. WeBS counts</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Expert opinion
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	No
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	This project collated existing information and opinion and provided the start-up information on which the subsequent new research was based. Accordingly, the data were used to identify their limitations and therefore can only be fit for purpose.
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Desk based research study, analysing and summarising existing data sources.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes
Has modelling been used in the analysis? If so are the	No modelling

assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	Reviews of the most current data including: <ul style="list-style-type: none"> <li>• Impacts of recreation on birds (Section 3)</li> <li>• Summary of current existing visitor data (Section 4)</li> <li>• Expert opinion regarding existing impacts of recreation on birds (Section 5)</li> <li>• Existing data on bird populations (Section 6)</li> <li>• Mitigation to offset potential impact of disturbance (Section 7)</li> </ul>
Has there been any validation/ ground truthing of predictive results?	There are no predictive results
Is the evidence complete for its intended use?	Yes
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Key assumptions are not stated within a clearly identifiable section of the report.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	None
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	None
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Yes
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	Yes
What additional analyses might/should have been done?	None
<b>Additional Comments</b>	As oystercatchers are discussed in later reports, I was

	puzzled that trends in their numbers in relation to regional and national trends were not also discussed.
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Report 2. Liley, D., Stillman, R. & Fearnley, H. (2010). The Solent Disturbance and Mitigation Project Phase 2: Results of Bird Disturbance Fieldwork 2009/10.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes. It was appropriate to concentrate the necessarily limited resources available for the work to the mid-winter period as this is the time of year when the shorebirds are most likely to be hard-pressed and thus most likely to be affected by disturbance. The downside of doing this might be that any human activities that are mainly carried out at other times of year which cause particularly severe disturbances would be under-represented in the data.
Are the quality standards associated with such data included within the report?	Yes
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	There are no obvious limitations to the datasets that would compromise their fitness for purpose
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>On site bird and visitor monitoring surveys covering twenty patches. Each location was visited 12 times over the period 01/12/09 to 28/02/10. Visits were spread evenly over the three months, such that four visits were made to each location each month. No attempt was made to limit visits to particular states of tide or tide heights. One visit per month per location was made at a weekend.</li> <li>Statistical analysis using box plots and GIS.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes
Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully	No

documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<ul style="list-style-type: none"> <li>• Distribution of birds in relation to sites and distance from shore – plots show the variation between species, reflecting the feeding ecology, how birds use the site and potentially the impacts of disturbance</li> <li>• Levels of human activity – recording numbers of people, activities observed at each site and distance from shore</li> <li>• Levels of disturbance – disturbance events, potential disturbance events and no response</li> <li>• Types of activities and disturbance – responses of birds to each activity including no response, alert, short walk/swim, short flight, major flight, uncategorised with activities split into occurring in three zones: shore, intertidal and water based</li> <li>• Comparison between sites</li> <li>• Variation in response between species</li> <li>• Distance from the source of disturbance</li> </ul> <p>Estimating disturbance parameters – separate analyses were conducted for three disturbance responses:</p> <ul style="list-style-type: none"> <li>• Response distance – the distance over which birds respond to disturbance;</li> <li>• Response time – the time taken to resume feeding after disturbance;</li> <li>• Displacement distance – the distance bird move following disturbance.</li> </ul> <p>The following explanatory variables were initial incorporated into the analysis:</p> <ul style="list-style-type: none"> <li>• Aggregated activity – Dog walker, Other land-based activity or Water-based activity;</li> <li>• Aggregated response - Minor response or Flight response;</li> <li>• Site disturbance rate – the number of potential disturbance events recorded at each site divided by the observation period</li> <li>• Intertidal activity – 0 if land-based activity; 1 if intertidal activity;</li> <li>• Some birds feeding – 1 if some birds feeding prior to disturbance, else 0.</li> </ul> <p>Disturbance parameters for the individual based model could only be calculated for species listed. For other species combined analysis was performed in which species were represented by their body mass in order to estimate</p>

	disturbance parameters. Response to disturbance was explained in terms of the disturbance rate on the site, the body mass of the species being disturbed and the activity type causing the disturbance
Has there been any validation/ ground truthing of predictive results?	Not needed
Is the evidence complete for its intended use?	Yes
Are the figures and tables easy to understand?	The tables are but not always the figures. In Map 3, for example: in many of the pie charts that are superimposed on the map, it is not possible to decide which scale ( <i>i.e.</i> 200, 1000 or 2000 birds) is being used. This is because the size of the pie charts on the map itself (but in the key) grade one into the other, so you have to guess. The same point can be made about Map 4 too, for example.
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Sample sizes were in many cases too small to allow comparison, for individual species, of the distances at which birds responded in relation to particular activities. Data were extracted for the three species for which there were the largest number of observations (brent goose, oystercatcher and redshank).</li> <li>• Populations represent minimum numbers of people as the surveyors were positioned at locations where they had a good view of the birds present, rather than the best locations to count people</li> </ul> <p>To simplify analysis for the model runs, data were simplified in the following way:</p> <ul style="list-style-type: none"> <li>• Behavioural response was aggregated into minor response and flight response</li> <li>• Number of bird species were reduced to include only wading bird species that had at least 20 observations of their response to disturbance</li> <li>• The body mass of these bird species was also linked to response to disturbance to predict the response to disturbance of wading bird species for which insufficient data were obtained during the field study.</li> <li>• Sites surveyed comprise only short length of Solent shore. Thus characteristics of sites were used to make predictions for entire length of coast. The response to disturbance is linked to the frequency of potential disturbance events at a site. The rate of potential disturbance events will be used to interpret between-site variation in the response to disturbance. In subsequent modelling the potential disturbance rate in different sections of coast throughout the Solent will be predicted from characteristics of the coast including distance to an access point / car park, and distance</li> </ul>

	<p>from population centres.</p> <ul style="list-style-type: none"> <li>• Seasonal responses to disturbance will vary as the birds' energy requirements and the quality of their food resources change.</li> <li>• Given that the disturbance study was conducted in late winter (when the response to disturbance in a wading bird species has been shown to vary less than between autumn and winter, and the relatively low number of disturbance responses observed in some species, seasonal effects were excluded from any subsequent analyses.</li> <li>• Activity types were aggregated into land-based and water-based</li> </ul> <p>The data are not necessarily relevant at a local level, for example in assessing the impacts of a single development.</p>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	None
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	By having to restrict the data collection to winter, some forms of disturbance mentioned by the expert panel – such as, canoes disturbing roosting birds in narrow creeks – would not have been covered in this study.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Yes
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	Yes
What additional analyses might/should have been done?	The combined results showing bird densities down the shore (Figure 4) include data collected at all states of the tide. Accordingly, sometimes only the top 'zone' would have been exposed; sometimes all zones would have been exposed; sometimes no zones would have been exposed at all. This was done to show the numbers of birds overall that are likely to be subject to disturbance from people onshore ( <i>eg.</i> on the seawall) or on the water. But it might also have been instructive to see the birds' distribution downshore separately at high tide (all zones covered by water) and at low tide (all zones exposed). If there was a downshore gradient in bird density over most of the tidal exposure period (as would be

	expected), for example, the individual-based model for the birds of Southampton Water should be set up to reflect this potentially very important fact: if most shorebirds feed at least 200m downshore for much of the tidal exposure period, they would only infrequently be disturbed by onshore people.
<b>Additional Comments</b>	None

Report 3. Fearnley, H., Clarke, R. T. & Liley, D. (2010). The Solent Disturbance & Mitigation Project. Phase II - On-site visitor survey results from the Solent region.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	The extent of the spatial coverage was good. However, Phase 1 of the study highlighted the importance in the intertidal zone of the nature of the sediment in determining where people walk: not surprisingly, most people avoid muddy sediments and prefer to walk on sandy ones. The interviewees were asked for the length of their route but they were not asked to say how much of it was on sandy ground and how much was in muddy areas. Given the emphasis that the experts in Phase 1 placed on the importance of the sediment, it is very surprising that this point was not pursued in this part of Phase II. The absence of information on the kinds of sediments on which visitors chose to walk in the intertidal zone introduced a serious limitation to the individual-based model of the birds of Southampton Water.
Are the quality standards associated with such data included within the report?	No
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	With the very important exception of the failure to distinguish between muddy and sandy routes that were taken by visitors in the intertidal zone, I think it unlikely that the fitness of the data to purpose will be much compromised by any bias in the data set
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>On site visitor surveys including counts of people and interviews.</li> <li>Car parks and parking spaces were also analysed using Google Earth</li> <li>Data was analysed and presented using GIS, Minitab and box plots.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	Yes, apart from not asking interviewees whether their route in the intertidal zone took them across mud or sand or a mixture of the two
Has modelling been used in the	No

analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?	
<b>Results</b>	
Key data outputs identified from the report	<p>Results from surveys included:</p> <ul style="list-style-type: none"> <li>• Visitor numbers at surveyed sites</li> <li>• Group size</li> <li>• Frequency of visits</li> <li>• Timing of visits</li> <li>• Activity</li> <li>• Motivation for site visit</li> <li>• Mode of transport to location</li> <li>• Distance travelled to access points</li> <li>• Transport mode</li> </ul> <p>Data were then analysed to produce the following results:</p> <ul style="list-style-type: none"> <li>• Relationship between housing density and visitor numbers</li> <li>• Visitor numbers in relation to car parking and housing</li> <li>• Visitor rates in relation to distance</li> <li>• Car visitor rates in relation to distance from home and car parking spaces</li> <li>• Intertidal visitor routes</li> </ul>
Has there been any validation/ ground truthing of predictive results?	No
Is the evidence complete for its intended use?	An important omission was the incomprehensible failure to identify the sediment in the intertidal zone where people went. Apart from this, the results are probably good enough for purpose
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• The survey period was exceptionally cold and thus visitor numbers could be underestimated, especially visitors undertaking water based activities.</li> <li>• Route paths determined through interviews were mapped with 25m buffer to capture the detail of where people deviated from a particular route.</li> <li>• Visitors were recorded entering and leaving the site and so these numbers could include double counts of visitors who entered and left the site during the survey period.</li> <li>• Many of the activities undertaken were not easily categorised, highlighting the diverse range of visits made to the coast. Activities coded as "Other" (70</li> </ul>

	<p>interviews) included commuting to work; metal detecting; beach combing; litter picking, wildfowl shooting; photography; geocaching and the collection of drift wood and glass.</p> <ul style="list-style-type: none"> <li>The analysis of the on-site visitor data has highlighted the need for the household survey which will need to check the effect of the winter weather, and in particular clarify whether few people were undertaking water-based activities as a result of the cold weather. The extent to which the household survey and on-site surveys correlate, in terms of visitor rates, will be important in directing further analysis.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	The main unexpressed assumption was that the intertidal walk routes were unaffected by the nature of the sediment. This assumption is highly unlikely to be true.
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	The previous assumption could greatly affect how fit the results were for modelling the impact of disturbance on the birds. It is a serious omission and it should not have happened because the importance of the sediment had been clearly highlighted in the Phase I report. The reason for this should become clear in the report on the bird modelling project
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	Yes
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same conclusions?	Yes
What additional analyses might/should have been done?	Intertidal routes should have been divided into muddy parts and sandy parts
<b>Additional Comments</b>	none



Report 4. Fearnley, H., Clarke, R. T. & Liley, D. (2011). The Solent Disturbance & Mitigation Project. Phase II – results of the Solent household survey.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data/ Inputs</b>	
Key data types used within the report.	<ul style="list-style-type: none"> <li>• WeBS boundaries were used loosely to break the shoreline into discrete patches.</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	No
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	No
What are the limitations of the datasets that have been used? Do they compromise the extent to which the data is fit for purpose?	There was, of course, no control over who responded to the questionnaire and, with only one in four responding, there is plenty of space for biased sampling. There is a real possibility that the 75% who did not respond to the questionnaire went to the coast very much less frequently, on average, than did those who completed the questionnaire. Fallible human memory may also have had an influence on the answers of those who did complete the questionnaire, resulting in an inflated estimate of how often they visited the coast. Therefore, to an unknown extent, the data may greatly exaggerate the number of visitors to the coast and, again to an unknown extent, thereby reduce their fitness for purpose
<b>Methodology</b>	
Key methods used within the report.	<ul style="list-style-type: none"> <li>• Household questionnaires.</li> <li>• Statistical analysis and presentation using Minitab and MapInfo</li> <li>• Models were developed which characterised sections of the coast and then analysed the number of foot and car visitors, and the distance travelled to each section.</li> </ul>
Are the methods adopted generally appropriate given the objectives?	No, but the alternatives (such as on-site counts of each section) would have been impractical
Has modelling been used in the	Yes, modelling was used. While the problem of biased

<p>analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	<p>sampling is recognised, no attempt was made to measure the magnitude of any resulting bias and how any bias would affect the predictions for the numbers of visitors there are to each section of the Solent. Nor have the predictions of the model been tested in a comparison with the numbers of people who actually visit some of the sections: see below</p>
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<p>Analysis from results from surveys included:</p> <ul style="list-style-type: none"> <li>• Access patterns to the coast</li> <li>• Seasonal visitation</li> <li>• Frequency of coastal visits</li> <li>• Visit frequency of households with and without dogs</li> <li>• Visit frequency and household characteristics</li> <li>• Diurnal visitation</li> <li>• Activities undertaken at the coast</li> <li>• Features that attract and deter households with and without dogs, and undertaking water and land based activities.</li> <li>• Visit frequency to specific coastal sections including transport and activities undertaken.</li> <li>• Estimated number of annual coastal visits made to sections of the coast</li> <li>• Characteristics of coastal sections and car parking capacities</li> <li>• Activities per coastal section</li> <li>• Distance travelled to visit the coast</li> <li>• Householder information including: number of occupants, children, dogs, employment status, dwelling type and garden access.</li> <li>• Comparison of on-site visitor surveys (from Report 3) and household survey results</li> </ul> <p>Separate models were developed for the rate of visiting sections on foot from home and the rate of visiting by car to analyse:</p> <ul style="list-style-type: none"> <li>• Foot visitor rate by straight line distance in relation to section features</li> <li>• Car visitor rate by road distance in relation to section features</li> </ul> <p>Section features include: SPA, wooded, marina, urban, open coast, monitored bathing, slip-way, loW.</p> <p>These data based GLM models can be applied to current total number of households living within each of the straight line and road travel distance bands of each section to obtain predictions of current numbers of foot visits and car visits made to each section from the households currently living in each distance band. Estimates of total visits to each section were obtained by increasing the visits made on foot or by car</p>

	by a multiple of 1.093 to account for those household survey respondents who made visits to the coast by other means namely bike, public transport and boat.
Has there been any validation/ ground truthing of predictive results?	No
Is the evidence complete for its intended use?	No as it is not clear whether the model accurately predicts the numbers of visitors to each section of the coast
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Bias may be inherent in questionnaire responses as it is a certain type of household that will respond.</li> <li>• Sections used were on average over 2km long and may encompass multiple access points</li> <li>• The final predicted visitor numbers were based on foot visit rates in distance bands up to 10km from each section and on car visit rates in distance bands up to 30km from each section</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	The assumption is made that the 25% of the sample in the household survey to whom questionnaires were sent are representative of the entire Solent population, including the 75% of 'non-responders' who did not reply. This assumption is not adequately tested. Furthermore, it is also necessary to take on trust that the respondents accurately reported the numbers of visits they make each year to the coast. Much more attention should have been given to assessing any bias and inaccuracy that might be present in the sample of responses. The predictions for the numbers of visitors to each section of the coast are so central to the objectives of the project that much more attention should have been devoted to testing the accuracy of the predictions that resulted from this survey: see below
What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?	The representativeness and accuracy of the responses is an important concern. So long as these important issues are unresolved, there must be doubt about the fitness for purpose of the resulting predictions.
<b>Conclusions</b>	
Are the conclusions justified by the evidence base?	For many of the components of the study – such as where people go and what they do when they are at the coast – yes. But on the predictions of the model for the numbers of people visiting the coast, no: there are major concerns
Has an audit trail been maintained throughout the analysis to support the final conclusions?	Yes
Do all sources of evidence/ analysis point to the same	Yes

conclusions?	
What additional analyses might/should have been done?	Testing the representativeness and accuracy of the responses to the questionnaire
<b>Additional Comments</b>	<p>No doubt it was shortage of resources that prevented these additional analyses and testing of the model's predictions from being carried out. However, this Review Panel is not required to assess the level of the resources made available to the research team nor to evaluate their efforts, but just to assess whether the outputs – for whatever reason - <b>are</b> or <b>are not</b> convincing enough for decisions to be based upon them. Had a thorough test of model predictions been possible, everyone would surely agree that it would have been <b>highly</b> desirable.</p> <p>It is implied in the Report that the strong correlation between the numbers of visitors to various sections of the coast that were counted on-site and the predictions of the household model should inspire confidence in the model. All the high correlation coefficient implies that the model identifies popular and less popular sites very well. It does <b>not</b> mean that the model accurately predicts <b>the numbers</b> of visitors to a section. This point is illustrated in Appendix 1.</p>

Report 5. Stillman, R. A., West, A. D., Clarke, R. T. & Liley, D. (2012) Solent Disturbance and Mitigation Project Phase II: Predicting the impact of human disturbance on overwintering birds in the Solent.

Checklist	Comments
<b>Objectives</b>	
Are the objectives clearly stated at the outset of the report?	Yes
<b>Data Inputs</b>	
Key data types used within the report.	<p>MORPH individuals based model for Chichester Harbour and Southampton Water. Datasets and sources used:</p> <ul style="list-style-type: none"> <li>• Bird populations of the Solent (WeBS low tide and high tide counts)</li> <li>• Wader food supply in Southampton Water (derived from intertidal invertebrate survey conducted by Pippa Wood as part of a PhD studentship)</li> <li>• Wader food supply in Chichester Harbour (derived from an intertidal invertebrate survey conducted by EMU Ltd)</li> <li>• Food supply of Brent Geese (derived from the Hampshire and Isle of Wight Wildlife Trust Eelgrass Inventory)</li> <li>• Response of birds to human activities (derived from observations as detailed in Report 2, Liley et al., 2010)</li> <li>• Number of people visiting the Solent coast (derived from postal household survey as detailed in Report 4, Fearnley et al., 2011)</li> <li>• Activities of people on the Solent coast (derived from observations as detailed in Report 3, Fearnley et al., 2010).</li> <li>• Tidal exposure of intertidal habitats (predicted by ABPmer using a hydrodynamic model)</li> </ul>
Did you identify any additional types of data used within the report? If so what were they?	Yes: various parameters for the model were obtained from the literature
Were the methods used to collate the data appropriate?	Yes
Is the spatial/ temporal resolution of the data suitable? (Is it up to date/ collected at the most suitable times in the year? Is there sufficient spatial coverage?)	Yes
Are the quality standards associated with such data included within the report?	No
What are the limitations of the datasets that have been used? Do they compromise the extent	<b>Chichester Harbour model:</b> As the Report itself states, the data from the survey of the invertebrates in Chichester Harbour were not adequate to parameterise the shorebird

<p>to which the data is fit for purpose?</p>	<p>model for this site. The evidence for this is that the invertebrate biomass that was recorded by the survey was not sufficient to support half of the shorebirds that actually lived there. This makes it very clear that the survey – for reasons which are not understood – did not capture all the food supplies that were actually available to the birds in Chichester Harbour.</p> <p><b>Southampton Water model:</b> the main limitations in the data that were available for the modellers to use were these:</p> <p>(i) No data were available to the modellers on the abundance of invertebrates living upshore of Mean High Water Neaps (MHWN).</p> <p>(ii) No data were available to the modellers on the extent to which visitors in the intertidal zone occurred in those parts of it that were actually used by the birds for feeding.</p> <p>(iii) For insurmountable technical reasons, there were no estimates available to the modellers of the mortality rates of the different shorebird species in Southampton Water itself. There is a widely-used alternative measure of the difficulties the birds have in obtaining their food in winter (the time spent feeding in daylight (TSF)) but no data on this were available to the modellers.</p> <p>(iv) That redshank almost certainly feed in terrestrial habitats around Southampton Water (as they do in so many other parts of south and west England) was not known to the modellers.</p> <p>(v) No data were available to the modellers on the actual frequency with which shorebirds are disturbed by visitors at their high-tide roosts and in terrestrial feeding areas</p> <p>(vi) No data were available to the modellers on the extent to which birds of prey attack shorebirds in Southampton Water. It is well-known that such attacks not only disturb the birds but some shorebirds might be forced by hunger to feed in places where they are at especially at risk of being killed by birds of prey.</p>
<p>Methodology</p>	

<p>Key methods used within the report.</p>	<p>Parameters of MORPH IBM for both Chichester Harbour and Southampton Water (Appendix 3):</p> <ul style="list-style-type: none"> <li>• Environmental parameters (A3.1)</li> <li>• Patch parameters (A3.2)</li> <li>• Food resource parameters (A3.3)</li> <li>• Bird parameters (A3.4)</li> <li>• Disturbance parameters (A3.5)</li> </ul> <p>Analysis was carried out on data inputs to (Appendix 4):</p> <ul style="list-style-type: none"> <li>• Quantify the response to disturbance (A4.1)</li> <li>• Estimate the probability of disturbance response (A4.2)</li> <li>• Estimate effective disturbance distance (A4.3)</li> <li>• Predict feeding time lost per disturbance (A4.4)</li> <li>• Predicting feeding area lost to disturbance per visitor (A4.5)</li> <li>• Predict current and future visitor numbers, activities and zones (A4.6)</li> <li>• Estimate seasonal patterns of visits (A4.7)</li> <li>• Estimate diurnal patterns of visits (A4.8)</li> <li>• Estimate total feeding area lost per hour per section (A4.9)</li> </ul> <p>The model was run under different disturbance scenarios which included (Appendix 5, A5.2):</p> <ul style="list-style-type: none"> <li>• current and future housing</li> <li>• sea level rise</li> <li>• change in habitat area</li> <li>• changes in numbers and distribution of visitors to the coast</li> <li>• influence of dog walking</li> <li>• influence of bait digging</li> </ul>
<p>Are the methods adopted generally appropriate given the objectives?</p>	<p>Yes: individual-based modelling of the shorebird populations was entirely appropriate. This is true despite the unsuccessful attempt to model the birds in Chichester Harbour. Because of this, some critics might reject this modelling approach altogether. However, this would be to cherry-pick the evidence in a most blatant and unscientific fashion!</p> <p>For reasons that are not understood, the invertebrate survey must have considerably under-estimated the amount of food that was available to the birds in the Harbour. This conclusion is underlined by the fact that most of the many other cases to which the same model has been applied showed that shorebirds in many coastal areas in the UK are not normally hard-pressed for food during their non-breeding season: see Appendix 1. This accords well with recent evidence from the Delta region of the Netherlands where a 10% reduction in the intertidal area has actually been</p>

	<p>followed by an <b>increase</b> in the numbers of birds that spend the non-breeding season there.</p> <p>Up to now, 21 other models using the same MORPH platform have been built and, in many cases, their most important predictions have been tested successfully, as is illustrated in Appendix 2. Figure A2(a) shows the tests that have so far been made for the model's most important prediction, the mortality rate in winter. Figure A2(b) shows the tests that have so far been made for the time spent feeding (TSF) which co-varies with the mortality rate but is much easier to measure. Many tests have been made of how well the model predicts the diet and distribution of real birds on the estuary in question and have achieved generally good agreement (Table A2.1). Because of the confidence in the model's predictions that these successful tests have predictions has created, the model have been used by several authorities to guide policy, as Table A2.2 in Appendix 2.</p>
<p>Has modelling been used in the analysis? If so are the assumptions, limitations and degree of uncertainty fully documented? Has an accuracy assessment been completed on modelled results?</p>	<p>Yes, modelling is used. However the limitations and degree of uncertainty in some of the assumptions are not fully discussed – see below</p>
<p><b>Results</b></p>	
<p>Key data outputs identified from the report</p>	<ul style="list-style-type: none"> <li>• Predictions of the Chichester Harbour model</li> <li>• Predictions of the Southampton Water model</li> <li>• Scaling up predictions to the Solent</li> <li>• Predictions for Brent Geese</li> </ul>
<p>Has there been any validation/ground truthing of predictive results?</p>	<p>Yes. Tests were made for the model's main output – survival. However, it was not possible to measure the actual survival rate of the birds in Southampton Water over the winter that was modelled. Instead, it was done indirectly in a way that may well have under-estimated the actual survival rates and thus over-estimated the degree to which the birds are hard-pressed for food in winter and therefore over-estimated their vulnerability to disturbance. On the assumption that 50% of the annual mortality occurs on the wintering grounds and the remained on migration or on the breeding grounds, the annual mortality rates given by the BTO in their BTOFacts website were halved. One assumption in this approach is that these annual mortality rates will apply to Southampton Water and they may not do so; for example, the rate may be lower than the national figure in birds wintering on the relatively mild south coast. The other assumption is that 50% of the annual mortality does occur in winter but the very limited amount of data available from UK estuary shorebirds suggests that, actually,</p>



	a very much lower proportion of the annual mortality occurs on the wintering grounds (Appendix 3).
Is the evidence complete for its intended use?	Yes
Are the figures and tables easy to understand?	Yes
<b>Assumptions</b>	
Main assumptions/ limitations identified within the report.	<ul style="list-style-type: none"> <li>• Some of the data inputted into model was itself predicted, as detailed in Reports 2, 3 and 4.</li> <li>• All analyses and modelling was restricted to the eight species of wading birds which rely on intertidal feeding habitat and were observed in sufficient numbers to estimate disturbance parameters</li> <li>• It was assumed that visitors and birds were independently distributed over the intertidal habitat.</li> <li>• Some species and activity types were restricted to some coastal sections.</li> <li>• It was assumed that visitor rates did not vary with tidal cycle, thus for some activities e.g. bait digging visitor numbers would have been over estimated at high tide and underestimated at low tide.</li> <li>• Predictions for bait diggers were based on an assumed low frequency and so are not accurate for areas where bait digging is more frequent.</li> <li>• Southampton Water model did not include the effect of depletion of food supply by non-modelled species.</li> <li>• Individual based models considered average conditions, rather than extremes of weather or visitor numbers.</li> </ul>
Outline any additional assumptions that you have identified within the review process. Are these assumptions fully documented and valid?	<p>When, for lack of information, there was any doubt about the assumptions that should be made and the parameter values that should be used, the modellers were required to err on the side of caution. Using the precautionary principle in environmental assessments of this kind is standard practice and is required by the conservation authorities. In this study, there were seven such 'pre-cautionary' assumptions and parameter values that could or would augment the predicted impact of disturbance on the birds' ability to survive the non-breeding season in good condition. They are:</p> <p>1 Page 15 2.3: Leaving out the shore above Mean High Water Neaps (MHWN) not only removes some food that the birds might consume but – very importantly indeed – removes some foraging time. Even if the prey there are sparse and small, shorebirds can usually feed at the wetted perimeter over the topmost part of the flats when the feeding areas downshore are covered by the tide. This part of the intertidal zone can be very important to shorebird survival, as was shown by modelling redshank feeding on the Rhydney</p>

	<p>flats in the Severn estuary (Goss-Custard <i>et al.</i> 2006a). Accordingly, forcing the birds only to feed below MHWN is a very stringent assumption which makes it more likely that the birds in the model will be hard-pressed and so more likely to be affected by disturbance.</p> <p>2 Page 16 2.3: It was necessary to restrict the movement of individual birds to one third of Southampton Water to ensure that birds occurred in the parts of the estuary where visitors also occurred: this was a very appropriate decision that ensured that realistic numbers of the birds fed where they would be disturbed by people. But this introduces the improbable consequence that even a starving shorebird would still remain in that same third of the estuary even when it was starving. Species that are able to move from the east coast of UK to the west coast in severe weather would certainly be able <i>in extremis</i> to navigate up and down the 5-10 mile length of their 'home' estuary.</p> <p>This proved to be a vital assumption. If the birds in the model were allowed to move up and down river, none died because of disturbance. This assumption is therefore likely to exaggerate the impact of disturbance on the birds.</p> <p>3 Page 34 4.2.5 The assumption that birds and people are distributed independently of each other is another assumption that is likely to cause the model to over-estimate the real impact of disturbance on the birds. As stated above, it was surprising that, for lack of data, this assumption had to be made by the modellers in view of the fact that (i) the expert panel in Phase 1 had previously stressed the importance of the nature of the sediment in influencing the numbers of visitors to an intertidal area, and (ii) on page 58 6.3 of the current Report, it is stated that "<i>Geese feed on mud which people tend not to use</i>". If this point is made for geese, it should also have been recognised in the model of Southampton Water wading birds.</p> <p>People and birds often use different parts of the intertidal zone. In many estuaries, most birds occur on mud while most people occur on sand. Also, the food supplies of shorebirds are often better at the lower levels of the intertidal zone so the birds tend to congregate there. In contrast, many people do not penetrate as far as the lower shore levels, especially where the ground is muddy.</p> <p>The importance of the nature of the sediment – so clearly highlighted in the Phase 1 report - is not even mentioned in the Phase II reports, except in the case of brent geese: it seems to have become forgotten as the project progressed!</p>
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	<p>It is difficult to imagine why this happened because it is so fundamental and should be well known by anybody with any field experience of shorebirds.</p> <p>That there is often a natural spatial separation between birds and people should be taken into account in the model if the frequency with which birds are disturbed is not to be exaggerated. As this natural separation was not employed in the model, the model would again over-estimate the impact of disturbance on the birds.</p> <p>4 page 21 3 While the predictions for survival in the report are impressive, the 'observed' mortality rates may be inflated compared with the real rates in Southampton Water. As discussed above, the observed rates were obtained by halving the <b>annual</b> mortality rates published by the BTO for the UK as a whole, a procedure that is thought very likely to considerably overestimate the actual winter mortality rate in the Solent. It is quite possible that rather few die in the rather mild Southampton Water in winter, especially now that the winter re-distribution of shorebirds in Europe has reduced their numbers in south and west UK and thus reduced competition for food. There is therefore a real risk that winter mortality rates based on the 50:50 split would over-estimate the actual mortality rates of shorebirds in Southampton Water. If so, it would mean that, by apparently predicting winter mortality quite well, the model was actually making life more difficult for the birds than was in fact the case. If the birds were in reality less hard-pressed for food, the model would again exaggerate the effect of disturbance upon them.</p> <p>To illustrate this point, imagine that all the annual mortality occurs on migration or on the breeding grounds – both of which are likely to be highly risky periods of the year. The real mortality rate in Southampton Water would therefore be 0%. Accordingly, if the model predicts the '50-50' value of, say, 5%, it would mean that the model is set up so that model birds are very much more hard-pressed than are real birds, and this could cause the impact of disturbance in the simulations to be exaggerated.</p> <p>5 page 93 A3.4.9 The aggregation factor set at 10. This means that if there are 11 birds foraging over one hectare of mud, the density of competitors around each bird would be assumed to be <math>(11-10) \times 10 = 100</math> competitors/ha. Fieldwork on the Exe in the 1980s and recent Dutch work suggest that, unless they cannot avoid it, shorebirds spread out enough over much of the exposure period to eliminate the risk of interference, unless there is too little available space in which to do so: this is most likely to happen as the tide is</p>
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	<p>receding and advancing on both Neaps and Springs.</p> <p>As resources did not allow fieldwork to be carried out on such critical aspects of the birds' natural history in Southampton Water, it is more-or-less a guess that this aggregation factor accurately captures the average increase in density over the entire exposure period in Southampton Water.</p> <p>If the aggregation factor is set too high – which seems quite likely - it will cause the model to exaggerate the impact of disturbance on the birds. This is because the rate of feeding of model birds that had been displaced by disturbance to already crowded feeding areas would be reduced through interference more than would real birds.</p> <p>6 page 96 A3.4.11 It is assumed that redshank do not feed in terrestrial habitats whereas many redshank do feed in such habitats in many parts of the UK. Accordingly, one of the options that real redshank have for compensating for disturbance at its current levels was not available to the model birds. As redshank were not predicted to be affected by the present-day visitation rates, this does not matter but it could cause the model to exaggerate the impact of disturbance on this species at higher visitation rates in the future.</p> <p>The tendency of the model to over-estimate the impact of disturbance on the birds is partly countered by three assumptions that might cause the model to under-estimate its impact:</p> <p>1 Page 15 2.3 The assumption that no feeding was done above MHWN may have caused model birds to feed further from onshore footpaths and so not to be disturbed by people there.</p> <p>2 Page 89 A3.4.4 The Nagy equation does not include the effect of ambient temperature so that the extra energy demands of the birds at temperatures below thermo-neutrality were not included in the model. Accordingly, this will make it easier for birds in the model to obtain their energy requirements and thus make them less likely to be affected by disturbance.</p> <p>3 It is very likely that, in reality, the birds are disturbed by people and birds of prey when they are at their roosts and when feeding in terrestrial habitats. Omitting this would have made it easier for model birds to survive the winter in good condition</p>
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	<p>It is not possible to 'trade-off' the net effect of these six 'worst case' (precautionary) assumptions against the three 'best case' (anti-precautionary) assumptions. However, the quantitative consequences for the model's predictions for the survival of the birds almost certainly exceed the net effect of the remaining assumptions. Accordingly, there is little doubt that the model's predictions err firmly on the side of precaution.</p>
<p>What are the limitations of the methodology/ approach that have been used? Do they compromise the extent to which the outputs of the study are fit for purpose?</p>	<p>The model for Southampton Water is likely considerably to over-estimate the impact of disturbance on the shorebirds for the reasons given above. But by erring so much on the side of precaution (as the modellers were required to do), the approach does lead to a clear conclusion, as discussed below.</p>
<p><b>Conclusions</b></p>	
<p>Are the conclusions justified by the evidence base?</p>	<p>The conclusions should be regarded as 'worst case' scenarios</p>
<p>Has an audit trail been maintained throughout the analysis to support the final conclusions?</p>	<p>Yes</p>
<p>Do all sources of evidence/ analysis point to the same conclusions?</p>	<p>Yes, they do. The conclusion is that, unless the model birds are (improbably) constrained to restrict their foraging to just one third of Southampton Water, the model – though precautionary - predicts that disturbance does not reduce their survival. The threshold value of 30 people/ha/day at which disturbance starts to cause birds to starve is therefore a very precautionary value to apply to the whole of the Solent.</p>
<p>What additional analyses might/should have been done?</p>	<p>More simulations should be done with the three sub-site model in which model birds would not always be constrained to use just one-third of the estuary. Instead, the same condition could be applied to this model as is used in other multi-site models of this kind; that is, if a bird is starving, it would be able to move to the other (sub-)sites. This would add an important degree of realism to the model. These simulations would be done to redefine the 'critical threshold' for visitation rates; that is, the point at increasing numbers of visitors begins to cause birds to starve. It is very likely that the value of 30people/ha/day used in the report is setting the threshold too low.</p> <p>Only one set of climate conditions and one population size of shorebirds were used in these simulations. It would be advisable to run the three sub-site model – modified as suggested above - across the range of probable populations sizes and winter weather conditions, as has been done, for example, for the baie de Somme, France (Goss-Custard <i>et al.</i> 2006b). This would show how sensitive the value of the</p>

	critical threshold is to the main factors that vary annually and give more robust predictions for the critical thresholds
<b>Additional Comments</b>	The research team are to be congratulated on predicting the effect of human activities on what really matters to the birds – their chances of surviving the winter in good condition. It is these quantities that determine the size of their populations, the criterion used to evaluate the conservation significance of an estuary. Despite this, such an attempt is rarely made in environmental impact studies of this kind, a tendency which is very much to the detriment of objective scientific appraisal of impacts, and therefore to the support of the public for measures taken for shorebird conservation.

## Overall assessment

Checklist	Comments
Do you consider the evidence/ conclusions to be robust in the context of assessing the current impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	Not quite but the additional simulations that are suggested above – which should not take very long to carry out - would increase confidence in the predictions enormously
Do you consider the evidence/ conclusions to be robust in the context of assessing the future impacts of bird disturbance on the important bird populations of the SPAs in the Solent? If it is not please explain where it is lacking?	<i>ditto</i>
Do you consider the evidence/ conclusions to be robust in the context of identifying the contribution which residential development makes to these impacts?	No, because there is so much uncertainty about the accuracy of the predictions of the household survey model for the present and future visitor rates to different sections of the coast
Does the evidence base provide a robust basis for predicting the impacts of residential development on the important bird populations of the Solent SPAs? If it is not please explain where it is lacking?	<i>ditto</i>
Are there any caveats required or limitations to be aware of before using this evidence?	None to add to those already mentioned above
Is there a requirement for further work? If so what would you recommend?	If possible, to test the predictions of the visitor rate model and to extend the simulations of the model for Southampton Water to include a range of weather scenarios and population sizes, as suggested previously
Additional Comments	<p>If the further work suggested above cannot be carried out, the conclusions of the work up to this point can be summarised as follows:</p> <ol style="list-style-type: none"> <li>1 The present results of the Southampton Water model do allow a strong conclusion to be drawn about the impact of disturbance on the shorebirds there.</li> <li>2 Despite the numbers of disturbers in the model probably being set higher than the numbers that actually occur there,</li> </ol>

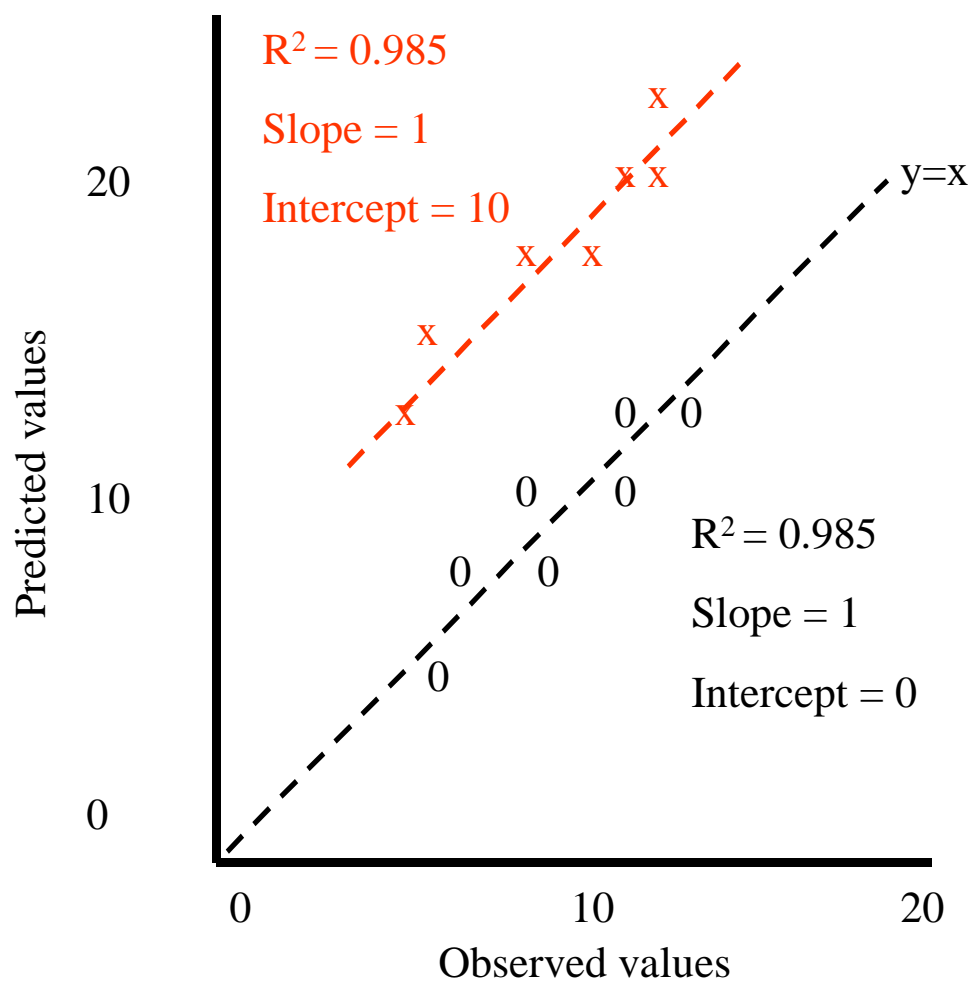
	<p>despite the precautionary nature of the model, the survival and body condition of the birds is <b>only</b> reduced if the unrealistic assumption is made that starving individuals would not move about the estuary in search of food. As this assumption is unlikely to be true, it can be concluded that disturbance in Southampton Water almost certainly did not affect the survival and body condition of the birds in the year that was modelled.</p> <p>3 However, the modelling of the sub-sites in Southampton Water does suggest the circumstances in which disturbance could have a detrimental impact on the birds. This would happen where the food supply is rather poor and when there are more than 30 visitors per hectare per day. For the reasons given above, the value of 30people/ha/day should be regarded as an interim and precautionary estimate that would probably have to be revised (upwards) if further work were to be carried out.</p> <p>4 Although the food supply elsewhere in the Solent has not been measured, it might be safe to assume that the food supply in the lower reaches of Southampton Water is similar to the poorest places elsewhere in the Solent. Accordingly, the value of 30people/ha/day could be applied as an interim and precautionary value elsewhere.</p> <p>5 As the Report shows, however, Southampton Water is amongst the most visited sites within the Solent and only a few rather small sites elsewhere have higher visitation rates.</p> <p>6 In view of this, and in view of the precautionary nature of the 30people/ha/day criterion, it can be concluded that the present science is far from providing convincing evidence that disturbance is affecting the birds in a way that is likely to reduce their numbers.</p> <p>A FINAL COMMENT</p> <p>1 Future modelling studies of this kind must be provided with the funds that are required to test the main predictions of the models: if this is not done, why should policy-makers believe the conclusions arising from the model? In the case of the household survey model, this would mean testing the predictions for the numbers of visitors per day at particular sites. In the case of the bird model, this would mean testing the model's predictions for the Time Spend Feeding (TSF), which is a reliable surrogate for its main predictions, the mortality rate</p> <p>2 In addition, sensitivity tests should be carried out so that</p>
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	<p>an estimate is obtained of the confidence that can be placed on a model's predictions. In the case of the household survey, for example, it could be argued that many or most of the non-responders never use the coast (and therefore did not have an interest in replying to the questionnaire) while many of the responders may have over-estimated their visitation rates (in order to make sure that their use of the coast is well represented in the results!) It would not be unreasonable, therefore, to argue that the model-predicted average household visitation rate should be divided at least four-fold, from 111 p.a. to &lt;28 p.a. In the case of the bird model, and as already described above, simulations using a range of annual variation in population size, food supply and winter weather would provide a range of predictions for the threshold number of visitors/ha/day at which disturbance begins to affect the birds' survival.</p>
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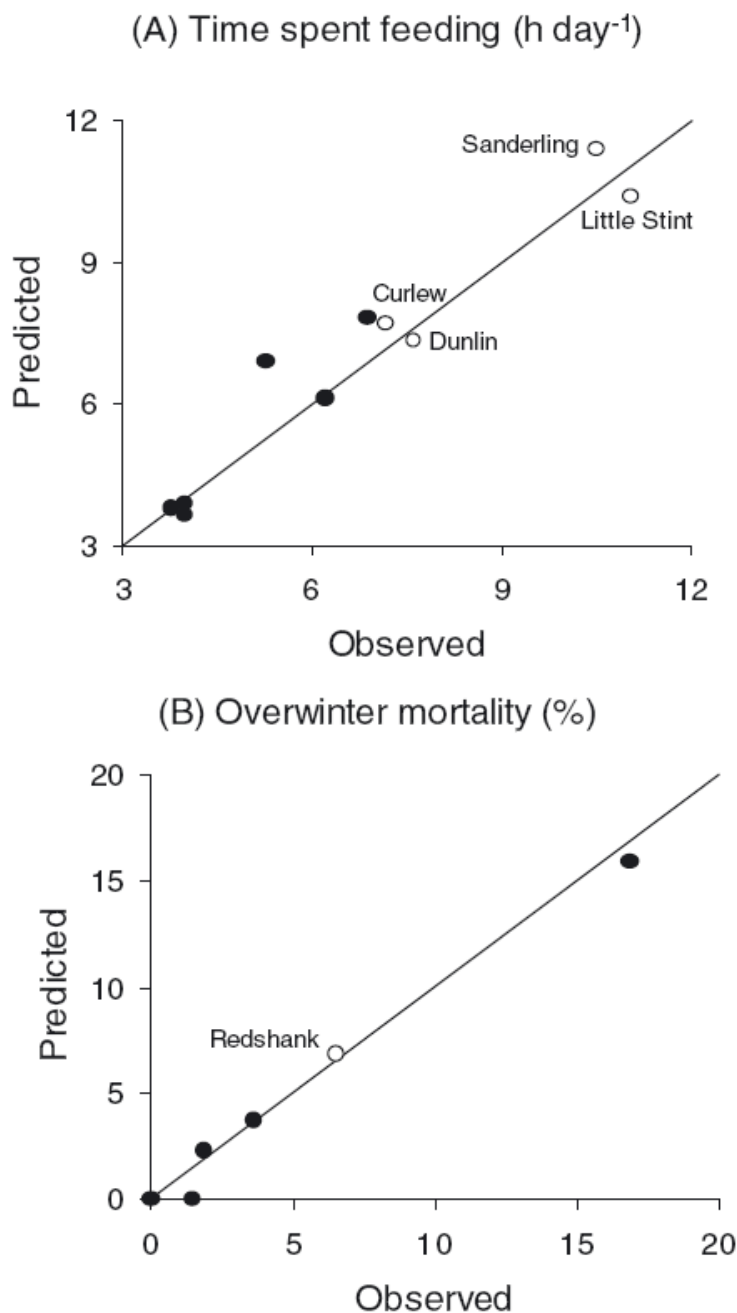
**APPENDIX 1** Why a high correlation between observed values and those predicted a model does not necessarily mean that the model makes accurate predictions.

The test that would inspire confidence in a model's predictions is shown by the black symbols. Here the predicted values are very close to the observed values and so fall along the  $y=x$  line of perfect fit in which, for example, if the observed value was 5, the predicted value would also be 5. The fit isn't perfect so the correlation between the predicted and observed data is not 1, but is very close to it and a line fitted to the data points would have a slope close to 1 and an intercept close to 0. In the red example, the correlation is also very good and the fitted line also has a slope of about 1 but, nonetheless, the predictions are poor because they are much greater than the observed values by an average of about 10. Thus, if the observed value is 5, the model predicts 15, which is three times too high. For the model to inspire confidence, not only must the correlation coefficient and the slope of the line fitted through the points be close to 1 but the intercept must be about 0; *i.e.* the line must pass through the origin.



**Appendix 2** Some information on individual based models of shorebirds, including MORPH that was employed in this project

**Figure A2.1** Comparisons between model predictions and (A) the observed amount of time spent feeding by an average bird over a single daylight tidal cycle (filled symbols: oystercatchers *Haematopus ostralegus*, open symbols: little stint *Calidris minuta*, sanderling *C. alba*, dunlin *C. alpina* and curlew *Numenius arquata*, data from the Exe estuary, Burry Inlet and Bangor flats in the UK, Seine estuary, France and Bahia de Cadiz, Spain), (B) the observed winter mortality rates of oystercatchers (filled symbols; data from the Burry Inlet, Exe estuary and the Wash in the UK) and redshank *Tringa totanus* (open symbol; data from the Rhydney flats of the Severn estuary, UK).



**Table A2.1.** A summary of the tests made on the predictions of the individual-based models of coastal birds. The test columns indicate whether the predicted time spent feeding (Feed), diet selection (Diet), distribution (Dist), body condition (Cond) or mortality (Mort) were compared with observations: - = no comparison made; ✓ = predictions supported by observations; × = predictions not supported by observations; ✓× = some predictions supported by observations, others not supported. From Stillman, R.A. & Goss-Custard, J.D. (2010). Individual-based ecology of coastal birds. *Biological Reviews*, **85**, 413-434 where the references cited in the final column of this Table can also be found.

Site	Species	Issues	Tests					References
			Feed	Diet	Dist	Cond	Mort	
Burry Inlet, UK	Oystercatcher <i>Haematopus ostralegus</i> , knot <i>Calidris canutus</i>	Shellfishing, site quality	✓	✓	✓	-	✓	(West <i>et al.</i> , 2003)
Bahia de Cadiz, Spain	Little stint <i>Calidris minuta</i> , kentish plover <i>Charadrius alexandrinus</i> , sanderling <i>Calidris alba</i> , ringed plover <i>Charadrius hiaticula</i> , redshank <i>Tringa totanus</i> , grey plover <i>Pluvialis squatarola</i> , black-tailed godwit <i>Limosa limosa</i> , bar-tailed godwit <i>Limosa lapponica</i> , oystercatcher	Salina abandonment, fish farms, shellfishing, disturbance, habitat creation	✓	✓×	✓	-	-	(Stillman <i>et al.</i> , 2005a)
Caerlaverock, UK	Barnacle goose <i>Branta leucopsis</i>	Habitat change	-	-	✓	✓	-	(Pettifor <i>et al.</i> , 2000)
Cardiff Bay, UK	Redshank	Habitat loss	-	-	-	-	✓	(Goss-Custard <i>et al.</i> , 2005)
Dee estuary, UK	Knot, oystercatcher	Shellfishing	-	-	-	-	-	(West <i>et al.</i> , 2005b)
Exe estuary, UK	Oystercatcher	Shellfishing	✓	✓	✓	✓	✓	(Stillman <i>et al.</i> , 2000c; Stillman <i>et al.</i> , 2001)
Exe estuary, UK	Dunlin <i>Calidris alpina</i> , grey plover, black-tailed godwit, bar-tailed godwit, oystercatcher, curlew <i>Numenius arquata</i>	Disturbance, site quality, sea level rise	-	-	✓	-	-	(Durell <i>et al.</i> , 2007)
Humber estuary, UK	Dunlin, ringed plover, knot, redshank, grey plover, black-tailed godwit, bar-tailed godwit, oystercatcher, curlew	Sea-level rise, port development, habitat loss, site quality	-	✓	✓	-	-	(Stillman <i>et al.</i> , 2005c)
Liverpool bay, UK	Common scoter <i>Melanitta nigra</i>	Wind farms, habitat loss, disturbance	-	-	✓	-	-	(Kaiser <i>et al.</i> , 2005)
Menai Straits, UK	Oystercatcher	Shellfishery management	✓	-	✓×	-	-	(Caldow <i>et al.</i> , 2004)

**Table A2.1 (continued)**

Site	Species	Issues	Tests					References
			Feed	Diet	Dist	Cond	Mort	
Poole Harbour, UK	Dunlin, redshank, black-tailed godwit, oystercatcher, curlew	Sea-level rise, site quality	-	-	✓×	-	-	(Durell <i>et al.</i> , 2006)
Poole Harbour, UK	Oystercatcher	Shellfishing, invasive species	-	✓	✓	-	-	(Caldow <i>et al.</i> , 2007a)
Baie de Seine, France	Dunlin, oystercatcher, curlew	Port development, habitat creation	-	✓	✓	-	-	(Durell <i>et al.</i> , 2005)
Solway Firth, UK	Knot, oystercatcher	Shellfishing	-	-	-	-	-	(Stillman, 2008b)
Baie de Somme, France	Dunlin, oystercatcher, curlew	Hunting, shellfishing, sedimentation, site quality, <i>Spartina</i> encroachment	✓	-	✓×	-	-	(Durell <i>et al.</i> , 2008; Goss-Custard <i>et al.</i> , 2006a)
Southampton Water, UK	Dunlin, ringed plover, turnstone <i>Arenaria interpres</i> , redshank, grey plover, black-tailed godwit, oystercatcher, curlew	Port development, habitat loss, site quality	-	✓	✓	-	-	(Wood, 2007)
Strangford Lough, UK	Oystercatcher	Shellfishing	-	-	-	-	-	(West, Stillman & Portig, 2002b)
Wash, UK	Oystercatcher	Shellfishing	-	-	-	-	✓	(Stillman <i>et al.</i> , 2003)
Wash, UK	Dunlin, knot, redshank, grey plover, black-tailed godwit, bar-tailed godwit, oystercatcher, curlew	Site quality	-	✓	-	-	-	(West <i>et al.</i> , 2007)
Wash, UK	Eider <i>Somateria mollissima</i>	Shellfishing	✓	✓	✓	-	-	(Caldow, Stillman & West, 2007b)
Western Europe	Brent goose <i>Branta bernicla</i>	Agriculture change, habitat loss, hunting, disturbance	✓	✓×	✓×	✓	✓	(Stillman <i>et al.</i> , 2005a)

**Table A2.2 Applications of the MORPH software at Bournemouth University**

This summarises the projects in which the MORPH software has been used at Bournemouth University up to the date given above. The elements of a typical project are as follows. MORPH is applied to a range of species within a single site to answer a specific conservation question. MORPH is parameterised using data on the food supply and population sizes of the species of interest, which is collected or has been collected by another organisation. Predictions are used to advise on the conservation management of the site. MORPH is used because no other alternative approaches are available, and only staff at Bournemouth University have sufficient experience of the software to use it and interpret its outputs. (prepared by Richard Stillman, May 2012)

**Completed projects**

<b>Date</b>	<b>Site</b>	<b>Species</b>	<b>Funder</b>	<b>Summary of project</b>
2007	Solway Firth, UK	Oystercatcher and Knot	Solway Shellfish Management Association	MORPH used to predict amount of shellfish required by Oystercatcher and Knot in the Solway Firth. Predictions used to advise on setting of shellfishing quotas in the site.
2008-2009	Ralph's Bay, Tasmania	Pied Oystercatcher	British Trust for Ornithology	MORPH used to predict the effect of habitat loss on Pied Oystercatcher in Tasmania. Predictions used to advise on the consequences of a marina development.
2008-2009	Burry Inlet and Three Rivers, UK	Oystercatcher and Knot	Countryside Council for Wales	MORPH used to predict amount of shellfish required by Oystercatcher and Knot in the Burry Inlet and Three Rivers. Predictions used to advise on setting of shellfishing quotas in the sites.
2008-2010	Burry Inlet, Exe Estuary, UK	Several shorebird species	Natural Environment Research Council (NERC)	User-friendly interface to MORPH developed as part of a NERC knowledge transfer grant.
2008-2010	River Frome, UK	Salmon, Brown Trout and Dace	European Union Marie Curie Fellowship	Post-doc project using MORPH to predict the effect of changes in flow on Salmon, Brown Trout and Dace in the River Frome.
2010	Morecambe Bay, UK	Oystercatcher and Knot	Natural England	MORPH used to predict amount of shellfish required by Oystercatcher and Knot in Morecambe Bay. Predictions used to advise on setting of shellfishing quotas in the site.
2010	Severn Estuary, UK	Several shorebird species	British Trust for Ornithology	MORPH used to predict the effect on shorebirds of changes in tidal regime and habitat quality due to tidal barrage development. Predictions used to rank the impact on birds of alternative tidal power schemes.
2011	Fehmarn Belt, Denmark	Eider, Long-tailed duck, Common Scoter	DHI (Danish Consultancy)	MORPH used by DHI to predict the effect on sea ducks of a proposed bridge between Denmark and Germany through the Fehmarn Belt.

2011	Bridgwater Bay, UK	Several shorebird species	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)	MORPH used by CEFAS to predict the effect on shorebirds and shelduck of reduced prey abundance due to a warm water outflow from a proposed nuclear power station.
2011-2012	Southampton Water and Chichester Harbour, UK	Several shorebird species	Solent Forum (conservation, industrial and public sector organisations)	MORPH used to predict the effect of human disturbance on shorebirds in Southampton Water and Chichester Harbour. Predictions used to assess the impact on birds of current and proposed future housing around the Solent.

### Current projects

Date	Site	Species	Funder	Summary of project
2008-2012	River Frome	Mute Swan	Natural Environment Research Council (NERC)	PhD project using MORPH to predict the effect of management on Mute Swan within the River Frome.
2009-2012	Poole Harbour	Avocet	HR Wallingford	PhD project using MORPH to predict the effect of climate change on Avocet within Poole Harbour. Match-funded by HR Wallingford.
2009-2012	River Frome	Salmon and Brown Trout	Game and Wildlife Conservation Trust	PhD project using MORPH to predict the effect of predator and vegetation management on Salmon and Brown Trout within the River Frome.

### New projects

Date	Site	Species	Funder	Summary of project
2012	Bridgwater Bay, UK	Several shorebird species	CEFAS	MORPH to be used by CEFAS to predict the effect on shorebirds and shelduck of reduced prey abundance due to a warm water outflow from a proposed nuclear power station.
2012	Humboldt Bay, USA	Black Brant	Ducks Unlimited	MORPH to be used to predict the effect on Black Brant of sea level rise, human disturbance and habitat change in Humboldt Bay.
2012-2015	Several UK sites	Several shorebird species	HR Wallingford	PhD project in which MORPH will be used to predict the effect on shorebirds of environmental change in several sites
2012-2015	Poole Harbour	Several shorebird species	Natural England	PhD project in which MORPH will be used to predict the effect on shorebirds of algal mats in Poole Harbour.
2012-2015	Several UK sites	Several shorebird species	Natural England	PhD project in which MORPH will be used to predict the effect on shorebirds of Pacific Oyster.
Pending	Severn Estuary	Several shorebird species	Halcrow Ltd.	MORPH to be used to predict the effect on shorebirds of changes in tidal regime and habitat quality due to tidal barrage development. Predictions to be used to rank the impact on birds of alternative tidal power and mitigation schemes.
Pending	Exe Estuary	Several shorebird species	Darts Farm	MORPH to be used to predict the effect of human disturbance on shorebirds. Predictions to be used to assess the impact on birds of future housing.

**APPENDIX 3** Estimates from UK estuaries of the over-winter mortality of redshank and oystercatchers compared with the estimates of the annual mortality measured on site and as given on the BTOFacts website.

Species	Location	Annual mortality from BTO BirdFacts %	Annual mortality measured on estuary %	Mortality in winter only %	Source
redshank	Severn estuary	26	15	5	Burton <i>et al.</i> 2006
oystercatcher	Exe estuary	12	4 - 14	0 - 2	Goss-Custard <i>et al.</i> 1982
oystercatcher	Wash	12	11	3	Atkinson <i>et al.</i> 2003

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