Marine Management Organisation

Modelling marine recreation potential in England

June 2014

Modelling Marine Recreation Potential in England

MMO Project No: MMO1064

Project funded by: Marine Management Organisation

Report prepared by: Marine Planning Consultants

Disclaimer

This report contributes to the Marine Management Organisation (MMO) evidence base which is a resource developed through a large range of research activity and methods carried out by both the MMO and external experts.

The opinions expressed in this report do not necessarily reflect the views of the MMO nor are they intended to indicate how the MMO will act on a given set of facts or signify any preference for one research activity or method over another. The MMO is not liable for the accuracy or completeness of the information contained nor is it responsible for any use of the content.

This report should be cited as

MMO (2014). Modelling Marine Recreation Potential in England. A report produced for the Marine Management Organisation, pp 35. MMO Project No: 1043. ISBN: 978-1-909452-27-5.

First published June 2014.

Contents

Figures

Tables

Executive Summary

The Marine Management Organisation (MMO) commissioned the project “Modelling Marine Recreation Potential” to Marine Planning Consultants (MPC) in December 2013. The aim of the project was to develop a spatial model to predict areas of marine recreation potential in England.

Previous MMO recreation projects have focused on gathering spatial evidence of marine recreation at the national and East Plan and South Plan Areas (MMO 1013, MMO1043). This work highlighted gaps in data availability as well as low confidence in some existing spatial data that detail where marine recreation occurs. As part of MMO1043 tools and guidance were developed to aid future data collection. Until high quality data is available it was considered that predictive models would allow the recreation sector to be more fully represented in current Marine Plan development and marine management generally. In the long term observational data of suitable quality will be favoured to predicted data.

The models were developed through a process of stakeholder consultation, spatial analysis in a geographic information system (GIS) and stakeholder validation. Representatives from recreational user groups were asked to rate the influence of various environmental conditions that might be preferred by users undertaking their activity (this resulting in an ‘activity matrix)’. The GIS model then used these scores to calculate the potential of recreation to occur in different areas based on the presence of these ‘preferred’ conditions. This process was undertaken for 12 recreational activities.

Model predictions demonstrated that vessel based activities were broadly successful with key controls governed by access to infrastructure, such as marinas, slipways and moorings. The more near shore, beach focused, activities such as surfing and windsurfing were more sensitive to the input data, with critical dependency on a ‘land access’ parameter formed in the model which categorised ease of access to roads and footpaths. These activities also require accurate environmental data at high resolutions to provide suitable model outputs, e.g. wind speed and wave height.

Once the model outputs were produced a validation workshop was held which allowed stakeholders the opportunity to assess their model scores and the suitability of the source data. Feedback from this process aided further model development and a second iteration of model output which are presented in this report.

The approach and principles of the model are broadly supported by the recreation community. However, the success of the model relies predominately on the quality, relevance and availability of input data to derive suitable data layers. This ensures the model outputs reflect stakeholder input as accurately as possible. Improvements in source data must be considered in future iterations of the model and ongoing stakeholder validation and engagement is necessary to ensure the model is suitable for marine planning.

The resulting model predictions for England’s marine areas now provide the foundation for identifying where activities can occur; this may be built upon in future years, should actual collected data on marine recreation be made available to

marine planners. It should be noted that the project time scale, data and stakeholder availability influenced the number of model iterations during the project; however, it has been designed to be delivered as set of tools to allow future iterations as new data/information becomes available.

1. Introduction

1.1 Project statement

The Marine Management Organisation (MMO) commissioned the project "Modelling Marine Recreation Potential in England" to Marine Planning Consultants (MPC) on 13th December 2013, project ref. MMO1064. This project was a short-term study with delivery in March 2014, to develop a computer model to map areas of marine recreation potential and build on previous evidence gathering marine recreation projects, MMO1013 and MMO1043. Map Annex B provides national scale output maps of all activities modelled in this study.

The key dates of this project are detailed in Table 1.

Table 1: Project key dates.

Deliverable	Date
Contract award	13th Dec 2013
Inception meeting	17th Dec 2013
Project announcement to stakeholders	19th Dec 2013
Inception Report	6th Jan 2014
Remote stakeholder consultation, webinar series (4 days)	20th – 23rd Jan 2014
Interim Report	14th Feb 2014
Draft report on model and communication materials for workshop.	3rd March 2014
Validation workshop	5th March 2014
Delivery of draft deliverables	14th March 2014
Delivery of final deliverables	28th March 2014

1.2 Requirement for this project

The MMO has been developing regional Marine Plans for England, since 2011, as part of a new marine planning system to ensure the sustainable development of our marine area, as described in the Marine and Coastal Access Act 2009 (HMSO, 2009). The MMO is currently developing plans for the South marine plan areas, informed through a robust and high quality evidence base for each of the 11 marine sectors stated in the Marine Policy Statement (HMG, 2011), of which tourism and recreation is one.

Sectors such as energy production, marine aggregates and subsea cabling have developed comprehensive datasets over years of operation, to support marine licence applications, as well as to fulfil other statutory and commercial requirements, which have been used to inform the development of marine plans. In contrast the tourism and recreation sector does not have the same extensive and comprehensive data and evidence. It is important that efforts are made to build robust and comprehensive information on tourism and recreation, to ensure these activities are represented alongside other marine activities/users in the decision-making process informing the content of marine plans.

Establishment of a robust evidence base for marine recreation in England constitutes part of the MMO's wider research remit under its Socio-economic Evidence Programme, which is one of eight priority areas of research stipulated in the MMO's Strategic Evidence Plan (SEP). To date, the evidence base is based on four specific recreation evidence gathering projects as shown in Table 2: StakMap, MMO1013, MMO1043 and Sea Angling 2012. These illustrate that the quality and availability of spatial data on marine recreation for England could be further developed to better meet the needs of marine planning. Whilst some (recreational) activities are represented by full coverage spatial data on where the activity takes place, others vary considerably in terms of both coverage as well as confidence, e.g. the accuracy, age and methods applied in obtaining the data. To support this lack of data, Phase 2 of the compilation of spatial data on marine recreation (MMO1043) produced guidance on how to supply data to inform marine planning, as well as other relevant documentation to ensure recreation data suppliers can share data confidently and easily with the MMO.

Table 2: MMO and associated agency publications to date relevant to marine recreation data.

Month/Year	Publication	Scale/Scope	Reference
2011	UK Marine Policy Statement (HMG, 2011)	National	-
2011/2013	Strategic scoping exercise and Report (MMO, 2013a)	National	-
2011	Maximising the socio-economic benefits of marine planning for English coastal communities (Tym and Partners, 2011)	-	-
2012	Summary of evidence and issues to date (MMO, 2012b)	National	-
2012	Marine Conservation Zone regional projects - Natural England / South West Food and Drink (Natural England, 2013)	National	
2012	Compilation of spatial data on marine recreation activities: Phase 1 (MMO, 2012a)	National/East Plan Areas	MMO1013
2012	Marine social and economic data: A critical review of tools and methods to apply marine social and economic data to decision making.(MMO, 2012c) A review of marine social and economic data (MMO, 2012d)	National	MMO1012
2013	Compilation of spatial data on marine recreation activities: Phase 2 (MMO, 2013b)	South Plan Areas	MMO1043
2013	Sea Angling 2012 (Armstrong *et al.*, 2013)	National	-

By developing a simple rule-based spatial model, with justified assumptions to predict areas suitable for recreation, the MMO is aiming to reduce these data gaps. It is important to note, however, that actual data with high confidence, e.g. from a survey of users, will always remain a preference to model data, so long as this data fulfils the required confidence assessment. The model will provide full coverage predictive maps that can be combined with spatial data where this is a suitable quality. The combined datasets will ensure recreation can be considered immediately in the same context as other sectors, enabling the MMO to proceed with its statutory functions under the SEP. It must be noted that the modelled outputs will inform marine planning alongside the existing data i.e found on the portal and information i.e. reports, stakeholder knowledge and expertise already held by the marine planning team. This will inform marine planning and an indicative plan policy, providing some level of protection to certain recreation activities, or specific geographical locations, which are of particular importance for recreation.

1.3 Other work to date

The underlying theory of ecosystems services, which influences the concept of marine planning, has started to focus the attention of researchers on the economic assessment of marine recreation and the value of the marine area to this group. For example Chambers *et al.* (2014) produced the first multiple marine recreation activity valuation mapping of a region (south west Wales), finding the tourist area of St David's was valued at £24.5m; and Dale at £3.5m (Gross Value Added). Furthermore the valuation by Ruiz-Frau *et al.* (2013) found that the economic importance of marine recreation was comparable to that of commercial fisheries in Wales; and Sea Angling 2012 (Armstrong *et al.*, 2013) demonstrated that recreational sea angling was worth over £1.2 billion to the UK economy (both studies being based on survey/stakeholder consultation).

However, a spatial model of this nature has not been developed before to map multiple marine recreation potential in the UK and has limited application elsewhere. For example Balaguer *et al.* (2011) provided a spatial analysis on recreation boating on the island of Mallorca, in the Balearic Islands. This study combined data representing natural (habitats, geology), physical (wave patterns) with stakeholder interviews to determine patterns of use and evaluate available anchorage space around the island to help inform management measures. This study provides an example of the role modelling can play in the first stages of formulating marine spatial planning, albeit focused on one activity.

In the terrestrial environment a few more studies have taken place, for example GIS modelling has been applied to identifying key ecosystems services for tourism in Switzerland (Buchecker *et al.*, 2013). Here selected criteria combined with standardised surveys and interviews demonstrated the significance of accessibility and distance to parklands, footpaths and ecological features for influencing outdoor recreation use.

Although not focused on marine recreation, there are many other simple rule based spatial models that may be drawn on to modell recreation potential. For example the Humber Regional Environmental Characterisation (REC) (Tappin *et al.* 2011) demonstrated the suitability of GIS mapping analysis using multi-layer environmental

data to identify seabed biotopes in a region of the North Sea, applying a measure of confidence through the final model scores.

Overall, it should be noted that all models have limitations. The model developed and described in the following section has been developed based on data available to the team and stakeholder validation over a short period of time. The project team have made recommendations as to how additional data, validation and stakeholder engagement can be built into future iterations and developments of the model.

1.4 Summary of model approach

As demonstrated marine recreation is a valuable sector and modelling can be used to provide a basis on which to inform the decision making process in the marine planning context. Therefore, the aim of this study is to develop a predictive spatial model of where individual activities take place in England's marine area. This was designed on a 1km^2 model grid to show the potential for recreation, using a 'heatmap' approach. This was intended to provide scores from low to high in terms of the total potential for each activity to be carried out.

To achieve this goal, the work has been designed around four objectives:

- Establish recreational user's preferences for use in model parameters, e.g. required wind speed, wave height, car park presence
- Source and derive data layers to use in the model
- Create and review predictive spatial models
- Develop tools/processes for ongoing validation and testing.

Recreational user's preferences

The model was designed to follow a Multi-Criteria Evaluation (MCE) approach. This technique requires a range of criteria (recreation user preferences) to be assessed (confidence score) based on the criteria's influence on a particular subject (recreation activity). In this project, stakeholders scored the different user preferences, e.g. car park or marina access in terms of their importance to their respective activity, e.g. sailing, windsurfing.

It is therefore important to the model outputs and its overall success that these criteria or user preferences are correctly identified and defined for the model. These user preferences are the model controls, providing a focus for stakeholder input, which is transparent and enables ongoing validation of the model outputs. In addition, these set of 'user preferences' will also be of wider benefit to a general understanding in marine management, e.g. enhancing the possibility of mitigating impacts from other activities or helping to facilitate co-location studies.

Input data layers

Each user preference is supported by a data layer to describe the characteristics of the marine area, e.g. water depth, access to marinas or presence of an ecological feature such as seals. To inform these data layers, source data with national coverage was acquired to meet the project timescales. Each input data layer was created from either single or multiple source datasets.

Predictive spatial models

All input data sourced was processed to fit a uniform format; this was comprised of a 1km^2 grid. The grid allowed the model to parcel up the marine area into 1km^2 cells to assess against the user preferences. This resulted in a cumulative score to identify the cells, or areas of the sea and coast, which demonstrated most, or least, potential for any activity being modelled. Sections 4 and 5 provide further explanation on the input data and the model development. Technical information on the specific stages of the data processing and model development can be found in the Technical Annexes F, G and H.

The temporal extent of the model is dictated by the input data parameters. Where possible, environmental parameters have been averaged from sequential years up to 5 years, i.e. 2009-2013. This allows for some smoothing out of annual anomalies, e.g. wet and stormy years impacting on water quality. Details of the temporal assessment of each input parameter is provided in Annex G. Due to the timescales of the project, seasonality has not been addressed by the model, with only one annual summary produced per activity.

Tools to inform validation and testing

The model developed in this project is the first iteration and has been designed with stakeholder input in mind, with detailed processing logs to allow the model to be updated and developed in the future. The following sections summarise the approaches taken to address the project objectives.

2. Activity Preferences

The activity preferences were informed through a) the activities selected to be modelled; b) the input parameters; and c) the formation of a spreadsheet tool to score and assess the relevance of these through user preferences.

2.1 Activities modelled

Activities which occur within the marine plan areas, i.e. from the Mean High Water Spring, out to England's offshore limit, were considered for this modelling study. Due to the short timescales of the project, activities to be modelled were limited in number and were sub-selected from those listed in previous projects (MMO1013 and 1043) as shown in Table 3.

Table 3: Activities selected for model.

	Activity modelled in MMO1064	Definition
1	Land based wildlife watching	Watching wildlife on land from the land
2	Beach activities	Beach activities[1] swimming and paddling
3	Paddle sports	Kayaking, canoeing, stand-up-paddle boarding, rowing
4	Surfing	Surfing, body-boarding
5	Windsurfing	Windsurfing, kitesurfing
6	Sailing	Yacht sailing, dinghy sailing, catamaran sailing, racing
7	Motor-boating	Motor-boating, power-boating, wake boarding, water-skiing
8	Personal water craft (PWC)	Jet ski
9	SCUBA-diving	SCUBA-diving, snorkelling
10	Vessel based wildlife watching	Watching wildlife at sea from the sea
11	Offshore angling	Charter vessel, angling from a boat, game angling, fishing trips
12	Shore angling	Shore angling, crab lining

This selection was carried out to meet the following criteria:

- Grouping of activities that share the same influences
- Preference was given to 'wet' based activities
- Stakeholder input essential in project timescales.

Activities with broadly similar characteristics and requirements or with a variety of nuanced sub-categories were assembled into suitable groups adopted from MMO1013 and MMO1043, e.g. sailing to include dinghy sailing, cruiser sailing, racing, etc.; windsurfing to represent kitesurfing; and grouping of all paddle sports. In contrast, where one activity had clear division in participants, e.g. angling, this was subdivided out, e.g. angling into boat based and shore based angling.

[1] Where beach activities include beach combing, beach games, rock pooling, kite flying, fossil hunting, naturism and sunbathing/picnicking as defined in MMO1013 and MMO1043.

Whilst preference was given to water based activities, e.g. sailing, as opposed to activities which predominately occurred along the coast, e.g. walking, land yachting, climbing, other key activities were included. These were those with a wide user group, an obvious interaction between land and sea and where a lack of actual (un-modelled) data exists e.g. wildlife tours/watching and general beach activities. Lastly, activities were excluded where there was incomplete stakeholder consultation (coasteering, wildfowling); therefore a final list of 12 was taken forward in the modelling as shown in Table 3. Those activities not taken forward in the model is provided in Annex C and details on stakeholder consultation are reported in Annex D.

2.2 Input parameters

The individual characteristics of the marine area that influence where an activity takes place form the 'input parameters' to the model. These range from access, e.g. car-parks, footpaths, marinas and slipways; to ecological characteristics, e.g. intertidal and subtidal habitats and species; as well as environmental conditions, e.g. wind speed, water depth and wave height; and anthropogenic characteristics, e.g. wrecks, restricted areas.

Approach to prioritisation of parameters

A list of parameters to inform the selected activities was originally compiled based on stakeholder consultation in the previous projects, research and personal knowledge of the project team. This long list of ~80 was filtered down to ~30 (to fit into project timescales) based on:

- Ensuring the most essential influencing factors were accommodated, e.g. wrecks and reefs for SCUBA diving
- The number of activities a given parameter was likely to influence, e.g. an initial access point is of high priority for all
- The availability of model-ready datasets or potential for rapid processing to fit within the project timescales, e.g. a single source of consistently gridded depth.

This first draft parameter selection list was then discussed with stakeholders at a series of webinars and reviewed post-consultation and during model development. Some parameters included in or recommended through the consultation have since been excluded. This has been necessary due to:

- Data availability, e.g. jetties, upstream estuary entry points, toilets
- Consideration of bias due to model resolution, e.g. groynes
- Consideration of bias in future potential, e.g. beach services
- Non-conformity of parameters in their influence, e.g. ports.

Final selected parameters

A final list of 24 parameters was used in the model as shown in Table 4 and a full definition and justification of these is provided in Annex C. To simplify the model development it was necessary for the list of parameters to be standard for all activities being consulted. Therefore in some cases a parameter is only required by a few activities, e.g. reefs; however they are included because they carry significant impact on those activities, e.g. diving. In addition, from the outset of the project it was deemed that access and entry point parameters, e.g. footpaths, roads, carparks, marinas, beaches, would be the key controlling parameters influencing where a user can conduct their respective activity. In contrast, this system of prioritisation has resulted in some parameters which are keenly associated with recreation activities to be excluded, e.g. prevailing wind direction, air/sea temperature and rainfall/sunny days. Whilst these seasonal conditions were recognised as important influences on whether marine recreation took place, they fell lower down the priority list than others. For example, beach activities may be carried out in the slightly cooler northeast of England in similar scales to warmer Cornwall, due to local residents' willingness to travel, time and financial resources.

Table 4: Parameters selected for modelling.

	Parameter Group	Parameter Modelled
1	Area	Baseline activity area (extent inshore/offshore)
2	Area	Estuary presence
3	Access	Land access (footpaths and roads)
4	Access	Car parks
5	Access	Marinas
6	Access	Slipways
7	Access	Moorings
8	Land Ecology	Land habitats
9	Land Ecology	Intertidal habitats
10	Land Ecology	Birds on land
11	Land Ecology	Terrestrial reserves
12	Environment	Water depth
13	Environment	Wind magnitude
14	Environment	Wave height
15	Environment	Water quality
16	Marine Ecology	Reefs and hard substrate
17	Marine Ecology	Seahorses
18	Marine Ecology	Cetaceans
19	Marine Ecology	Basking sharks
20	Marine Ecology	Birds at sea
21	Marine Ecology	Seals at sea
22	Anthropogenic	Wrecks
23	Anthropogenic	Leisure Navigation
24	Anthropogenic	Restricted areas

Overall, it is important to note the limitations in number of parameters that can be included in this model and the resulting requirement for prioritisation of layers. In addition it is important to state that stakeholders have confirmed through survey that

they consider this final list to be a suitable representation of the essential controls on each activity included, though the success of their control is dependent on the quality and level of detail of the input data used. For information on data identification, sourcing and processing, which impacted on those parameters that could be selected, see Section 4.

2.3 Activity Matrix

An 'Activity Matrix' was created to combine the activities and parameters in a matrix format. This provides a spreadsheet within which to define the nature of each activity-parameter combination according to the user preferences. The matrix then provides what is essentially two sets of information per activity/parameter combination:

- Confidence of influence[2]: the scale of influence the parameter has on the activity
- Parameter conditions: the conditions of the parameter that the activity requires.

An example of the blank Activity Matrix used in consultation is provided below in Table 5.

Table 5: Example activity martix, for one activity's set of values.

Parameter Group	Parameter	Numerical/ Category	Confidence of Influence	Positive / Negative impact	Primary Condition	Secondary Conditions	Rational and Comments
Entry point	Marinas	Numerical					
Land ecology	Habitats general	Category					
Meteorology	Wind magnitude	Numerical					
Seabed geology	Outcropping rock	Category					
Etc							

Confidence of Influence

The level to which a parameter influences the activity prediction is termed the 'confidence of influence'. For every parameter-activity combination this is scored from 0 (no influence) to 3 (always influences); however this may be either positive (e.g. +3) or negative (-3), as fully defined below and illustrated in Table 6.

- 0 = Does not influence (high confidence)
- 1 = sometimes influences (low confidence)
- 2 = sometimes influences (high confidence)

[2] Consultees will have seen this as the 'model score' in the Activity Matrix. However, this has been renamed as the term 'confidence of influence' and has been applied to the final outputs. Confidence of influence is a more accurate term to use here.

- 3 = Always influences (high confidence).

This scoring system is intended to be very simple and with a limited number of options. This is considered a sufficient level of detail for the model. It also allows less disagreement between stakeholders to inform the model. The results of the model predictions were used to validate the success of this approach, with potential to increase the number of categories/model scores either within this project or post-project.

The influence of any one parameter may be positive (i.e. +1, +2, +3) to act as an attraction, or negative (i.e. -1, -2, -3) to act as a deterrent, i.e. something to avoid.

A summary of the confidence of influence for each activity-parameter interaction is shown in Table 6 below.

Parameter conditions

Once the confidence of influence was assigned, the next stage was to identify the conditions of the parameters that satisfy the activity requirements. For example, the intertidal substrate is an important parameter for beach activities. The conditions of this parameter refer to the different sediment/geology types (as defined by the source dataset). In this instance the intertidal substrate conditions which are required, or preferred, for beach activities (as reported by stakeholders), are sand or shingle. To add further differentiation between areas in the model, the conditions were further subdivided into ‘Primary’ and ‘Secondary’ conditions, e.g. sand was identified as a Primary and shingle as a Secondary condition.

Primary conditions have been defined as those that accommodate the majority of users, e.g. beginner to intermediate skilled participants, or the preferred requirement. Secondary conditions are those that accommodate the more experienced users, e.g. multi-day sailing, or the second preferred requirement, e.g. further walking distances to reach a beach. However, secondary conditions are not intended to account for extreme users, e.g. around the world sailors. As a way of demonstrating this, Primary conditions may account for 75% of users, whilst Secondary conditions may account for 20% of users (the top 5% of extreme users are not included).

Table 6: Activity Matrix scores for input to model (Tool 3).

	1. Wildlife land	2. Beach activities	3. Paddle sports	4. Surfing	5. Windsurfing	6. Sailing	7. Motor boating	8. Personal water craft	9. SCUBA Diving	10. Wildlife boat	11. Boat angling	12. Shore angling
Baseline Activity Area	3	3	3	3	3	3	3	3	3	3	3	3
Estuary	2	-3	2	-3	1	1	1	1	-2	2	1	1
Land Access	3	3	3	3	3	3	3	3	3	3	3	3
Car parks	2	3	2	2	3	3	3	3	3	2	2	2
Marinas	0	0	2	-1	-3	3	3	1	2	2	3	1
Slipways	0	1	2	1	2	3	3	3	2	2	3	0
Moorings	0	1	0	0	0	3	3	0	1	1	3	1
Land habitats	3	1	2	1	0	0	0	0	0	0	0	0
Intertidal habitat	3	3	2	3	2	1	1	1	3	0	0	3
Birds on land	3	0	2	0	0	1	1	0	0	0	0	0
Land reserves	3	1	0	0	0	1	1	0	0	0	0	0
Water depth	0	2	3	3	3	3	3	3	3	3	3	3
Wind magnitude	2	2	3	3	3	3	2	2	3	0	3	3
Wave height	0	2	2	3	2	2	2	2	3	3	3	3
Water quality	0	3	2	1	1	2	0	2	2	0	2	0
Reef and Hard Substrate	0	0	0	0	0	0	0	0	3	0	2	2
Seahorses	0	0	0	0	0	0	0	0	3	0	3	0
Cetaceans	1	0	2	0	0	1	2	0	0	3	0	-2
Basking sharks	1	0	0	0	0	1	2	0	0	3	0	0
Birds at sea	1	0	2	0	0	1	2	0	0	3	2	2
Seals at sea	1	0	2	0	0	1	2	0	3	3	0	-2
Wrecks	0	0	0	0	0	0	0	0	2	0	3	1
Leisure navigation	0	0	0	-2	-2	2	2	1	-3	2	-3	-2
Restricted Area	-2	-2	-1	-2	-3	-3	-3	-3	-2	-2	-2	-2

Score	Definition
+3	Positive/high confidence that the parameter always influences the activity
+2	Positive/high confidence that the parameter sometimes influences the activity
+1	Positive/low confidence that the parameter sometimes influences the activity
0	High confidence that the parameter does not influence the activity
-1	Negative/low confidence that the parameter sometimes influences the activity
-2	Negative/high confidence that the parameter sometimes influences the activity
-3	Negative/high confidence that the parameter always influences the activity

Model-ready data

Lastly, the categories required by each activity-parameter combination were made consistent throughout the Activity Matrix to fit to the input data terminology or values. For example, ‘shingle’ was converted to ‘coarse and mixed sediment’. This also required assessment of numerical input data (see following sections) to assess the thresholds adopted in the model. For example, depth input data was by necessity averaged to fit to the model grid and so a range of 0-5m required in reality was expanded to 0-10m for the model environment.

Whilst the Final Activity Matrix cannot be shown within this report due to its size, the summary of scores is shown in Table 6, above.

The Activity Matrix is further discussed in Section 4.

3. Stakeholder Input

The role of stakeholders in the project was to advise on the activity preferences through input on the Activity Matrix; and to validate results from the model at a workshop. (Consultation on data sources is addressed separately in Section 4). As the model is focused at the national level, only national recreation organisations were consulted on the project unless this was not possible for any one activity (Table 7).

Table 7: Stakeholders who contributed to the project.

MMO1064 Activity Modelled	Stakeholder(s)
Wildlife tours: on land	Royal Society for the Protection of Birds (RSPB)
	Wildlife Trust
Beach activities	National Trust
	Royal National Lifeboat Institute (RNLI)
Paddle sports	Canoe-England
	British Stand Up Paddle-Boarding Association (BSUP)
Surfing	Surfers Against Sewage (SAS)
	Magic Seaweed
Wind surfing	UK Windsurfing Association (UKWA)
	British Kite Sports Association (BKSA)
Sailing	Royal Yachting Association (RYA)
	British Marine Federation (BMF)
	UK Harbour Masters Association (UKHA)
	MDL Marinas
	Marine Coastguard Agency (MCA)
	Cruising Association
Motor-boating	Royal Yachting Association (RYA)
	British Marine Federation (BMF)
	UK Harbour Masters Association (UKHA)
	MDL Marinas
	Marine Coastguard Agency (MCA)
	British water ski and Wakeboarding Association (BWSW)
Jet skiing	Royal Yachting Association (RYA)
SCUBA diving	British Sub-Aqua Club (BSAC)
Wildlife tours: by vessel	Royal Society for the Protection of Birds (RSPB)
	Wildlife Trust
Offshore angling	Angling Trust
	Northumberland/Kent and Essex IFCA
Shore angling	Angling Trust
	Northumberland/Kent and Essex IFCA
Multi-activity	VisitEngland
	Solent Forum

Consultation was informed through two main consultation exercises. The first was a webinar series concerning the Activity Matrix. This provided instruction and guidance on completing the Activity Matrix, to gather initial feedback on the user preferences and identify potential sources of data. A ‘user friendly’ version of the Activity Matrix activity preferences was distributed to all consultees with guidance and descriptions of all the fields to complete, including drop down menus and a comments box to justify the values chosen.

17 of the 23 invited stakeholders took part in the webinar, which resulted in 13 completed Activity Matrices which are provided as an electronic Annex to the report (see Annex A). These were Quality Assured by the project team against the justification comments as well as making information consistent with the input data.

The second consultation phase was a validation workshop on 5th March 2014. This allowed for discussion on the responses and subsequent Quality Assurance of the Activity Matrices; and validation of initial model outputs illustrated over 5 case study areas. The workshop was attended by 15 of the webinar stakeholders, with the addition of VisitEngland and the Solent Forum, who represented Coastal Partnerships in England.

Following the workshop the amended values were again Quality Assured and assessed against model outputs, altering where necessary due to the input data categories or ranges in numerical data. This was necessary in a second stage due to the development of model input layers in tandem with the consultation process. Whilst the final Activity Matrix cannot be shown within this report due to its size, the summary of scores is shown in Table 4 and the full matrix is provided in spreadsheet format (Annex J).

4. Input Data to Model

Further details on this chapter can be found in Annex B, Annex F and Annex G which accompanies this report.

4.1 Origin of data

The purpose of the 'input data' was to represent the geographic distribution of the 24 parameters defined in Section 2. It was agreed with the MMO that priority be given to sourcing national, UK wide, datasets, as opposed to regional or even England specific datasets, so as to meet the project timeframe. Where possible these had to be data products (pre-processed and collated dataset) to reduce processing times and model complexity, e.g. the marina location dataset. However, it was acknowledged that to inform some parameters, raw data may have to be processed. Or in the absence of specific data, different datasets would have to be combined and processed to suit the requirements of the model, e.g. land access was a combination of footpath, road and elevation datasets; and birds on land was a combination of different bird reserves / designations and bird counts.

Over 45 datasets were used to inform the 24 model parameters, of which 31 were sourced from the MMO's own data archive. Data providers ranged from Government agencies, including the JNCC, Natural England, the UK Hydrographic Office (UKHO) and independent providers, such as rowmap.com and OpenStreetMap. Ordnance Survey datasets such as Tidal Boundary Line were used to define the baseline of the model, i.e. the dry, intertidal and wet zones; as well as others including Boundary Line district / borough / unitary / region and Vector District Roads to define land access. The UKHO was also an important source of data helping to identify for example navigation channels, restricted areas, mooring areas, anchorage and wreck sites. A full reference to the data sources used to inform the model parameters is detailed in Annex G.

4.2 Getting data 'model-ready'

Many of the data layers required significant processing prior to making them 'model-ready' and full details are contained within Annex F and G. After this initial processing, each parameter dataset was next classified as to how it informs the model. Essentially, this may be in one of three ways:

- In-situ: something that is visual / present or measurable at each model grid cell, e.g. seabed wreck, depth or habitat type
- Proximity: the distance from each model grid cell to a feature e.g. marina
- Access category: the category for land access and car parks defined at MHW that is then assigned to areas of the model grid by proximity.

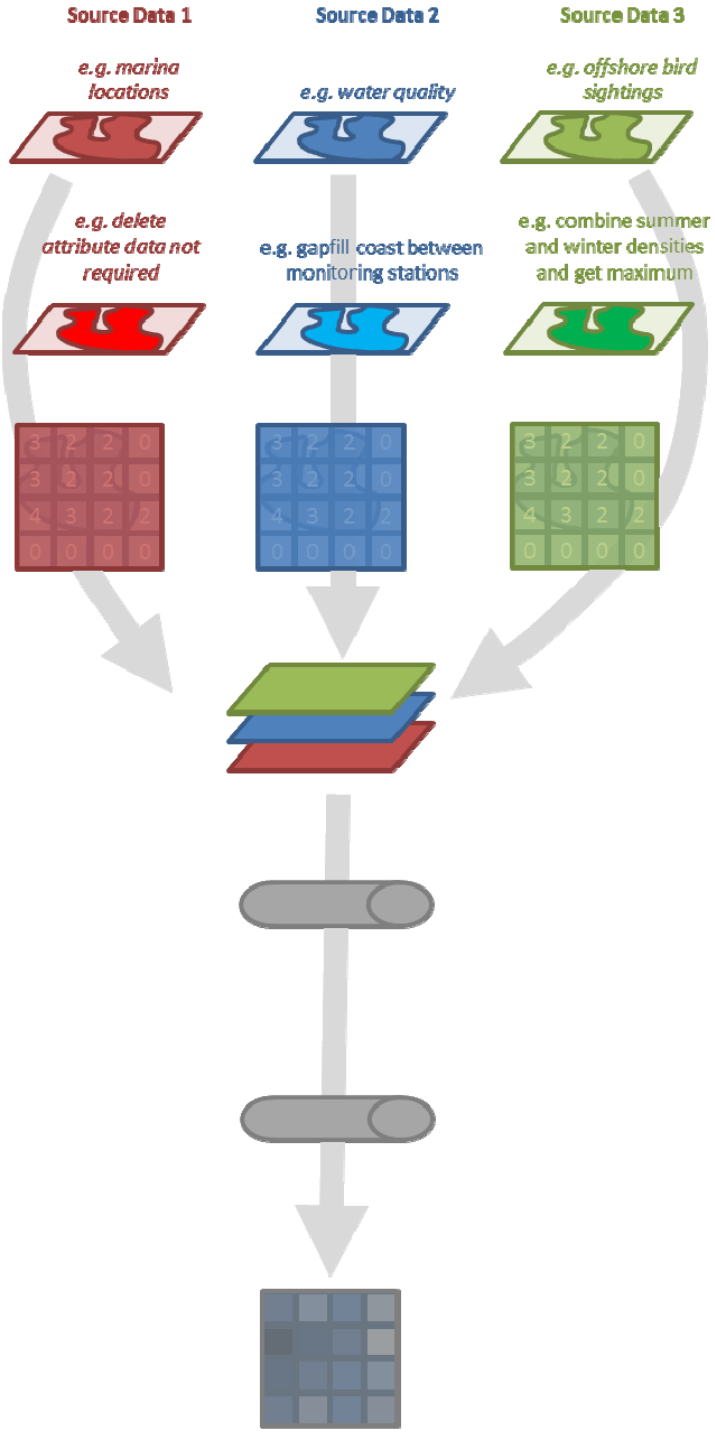
Each parameter dataset was processed to a $1km^2$ grid through one of the above approaches, i.e. in-situ, proximity or access category. This is addressed further in Annex F. As a result, the parameter datasets then each formed a single gridded output, all with the same grid definition of $1km^2$, ready to be combined together and interrogated in the model.

5. Model Development

5.1 Overview

The development of the model followed a series of steps as shown in Figure 1 below. Steps 1 – 3, concerning the source data and its processing to make it model-ready, have already been discussed in Section 3.

Figure 1: Model Development Summary.



1. Source Data

2. Process source data
Cleaning, processing and combining source data

3. Grid input data
Summary attributes by grid cell to make it model ready

4. Combine input data grids
To make one analysis grid containing all summary attributes, one grid cell per activity

5. Interrogate model with control matrix
Search for activity preferences

6. Select matching grid cell
Select and score each cell according to suitability with allocated weights

6. Activity prediction maps
Combine parameter suitability scores per cell, higher scores indicate more suitable grid cells for activity

5.2 Combining input data

Gridding all the input data at step 3 provides a series of layers all uniform in model extent with a consistent resolution of 1km^2. By combining all the data layers in Step 4 a single model layer can be produced, e.g. a given cell may record the presence of reserves, intertidal substrate type, and access to roads, paths and moorings. At this stage it becomes a single gridded map with multiple attributes.

5.3 Assess suitability against Activity Matrix

Step 5 begins to apply the scores and conditions reported by the stakeholders. Here the model refers to the Activity Matrix described previously, i.e. a table containing the activity preferences per parameter, with a score on the confidence of influence (score) and Primary and Secondary conditions. Through this matrix the model then assesses each cell for its suitability to an activity, i.e. whether the cell contains the relevant scored parameters(s), meeting the conditions identified by the stakeholders.

The model assigns the allocated Activity Matrix score if a parameter is present in the cell. It then applies a weight of either 3, if the parameter meets the Primary condition or 1 if it meets the Secondary condition (Step 6). This simple multiplication of 3 or 1 to the parameter score, allows the model to differentiate clearly between the two conditions reported by the stakeholders, giving a higher score to areas that satisfy the Primary conditions as these attract the greatest number of participants.

For example, water depth is an influential parameter on SCUBA diving and is allocated a score (confidence of influence) of +3. The activity requires a water depth of 2 to 30m (Primary condition) or a depth of 30 to 50m (Secondary condition) to occur. If the model identifies a cell with a depth of 25m, then it has satisfied the water depth requirement and is scored with a 3. It is also within the Primary condition range (2-30m), meaning it meets the higher weighting requirement and so is multiplied by 3; 3 x 3 = 9. This final parameter score is then applied to the cell. In contrast, if the depth had been 40m, then this falls into the Secondary condition for SCUBA diving (30-50m) and this value would then remain unchanged (weighted by a multiplier of 1).

The cell is assessed for all parameters in the table using this process. If other parameters are identified in the cell as suitable for diving, e.g. reef presence, then this is recorded and weighted according to whether it meets the Primary or Secondary conditions. The final scores for all parameters in the cell are then summed together. The higher the cell value based on these scores, the greater the potential it has for SCUBA diving. If the cell contains very few suitable parameters, this results in a lower total score for the cell, i.e. a lower potential for diving.

As some parameters are negatively scored, i.e. because they have a negative effect on an activity, some areas of the maps may have negative total scores. This occurs where the negatively scored parameters override any positive parameter scores present. However the scale bar is simply a reflection of high (high positive scores) to low (low or negative scores) potential for an activity. In addition all activity prediction areas are masked to a limited distance inshore or offshore, according to that

activity's core baseline activity area, e.g. swimming (part of beach activities) from MHW up to 500m offshore.

A detailed account of the modelling approach is provided in Annex H.

6. Model Predictions

6.1 National prediction maps

The final modelled predictions for each activity are shown in Appendix B, displayed at a national scale. These are an overview and the reader is referred to the MMO evidence and reports webpage for this project:
http://www.marinemanagement.org.uk/evidence/1064.htm

6.2 Case study validation

To illustrate some of the findings at a higher resolution, a series of case studies have been assessed in terms of their accuracy. As shown in Figure 2, these include:

- **Newquay/North Cornish Coast**
  - Slipway (plus quayside) access and natural entry points
  - Known surfing and summer tourist destination (multiple activities)

- **Portland Harbour/Chesil Beach**
  - Marina, slipways and natural entry points
  - Large protected harbour area famous for wind surfing/sailing/kitesurfing
  - Expansive beach access from Portland

- **The Solent**
  - Marinas, slipways and natural entry points
  - Car park facilities, roads and footpaths
  - Known sailing/marine recreation area - heavy recreation use

- **Seahouses and the Farne Islands/Northumberland coast**
  - Slipway (plus quayside) and natural entry points
  - Car park facilities, roads and footpaths
  - Known diving and wildlife location

- **Walney Island/Morecombe Bay**
  - Slipway and natural entry points
  - Active kayak, windsurfing and sailing clubs
  - Known area amongst these activity groups

Figure 2: Case Study locations.

Figure 3: Example model prediction maps for Newquay / North Cornish Coast.

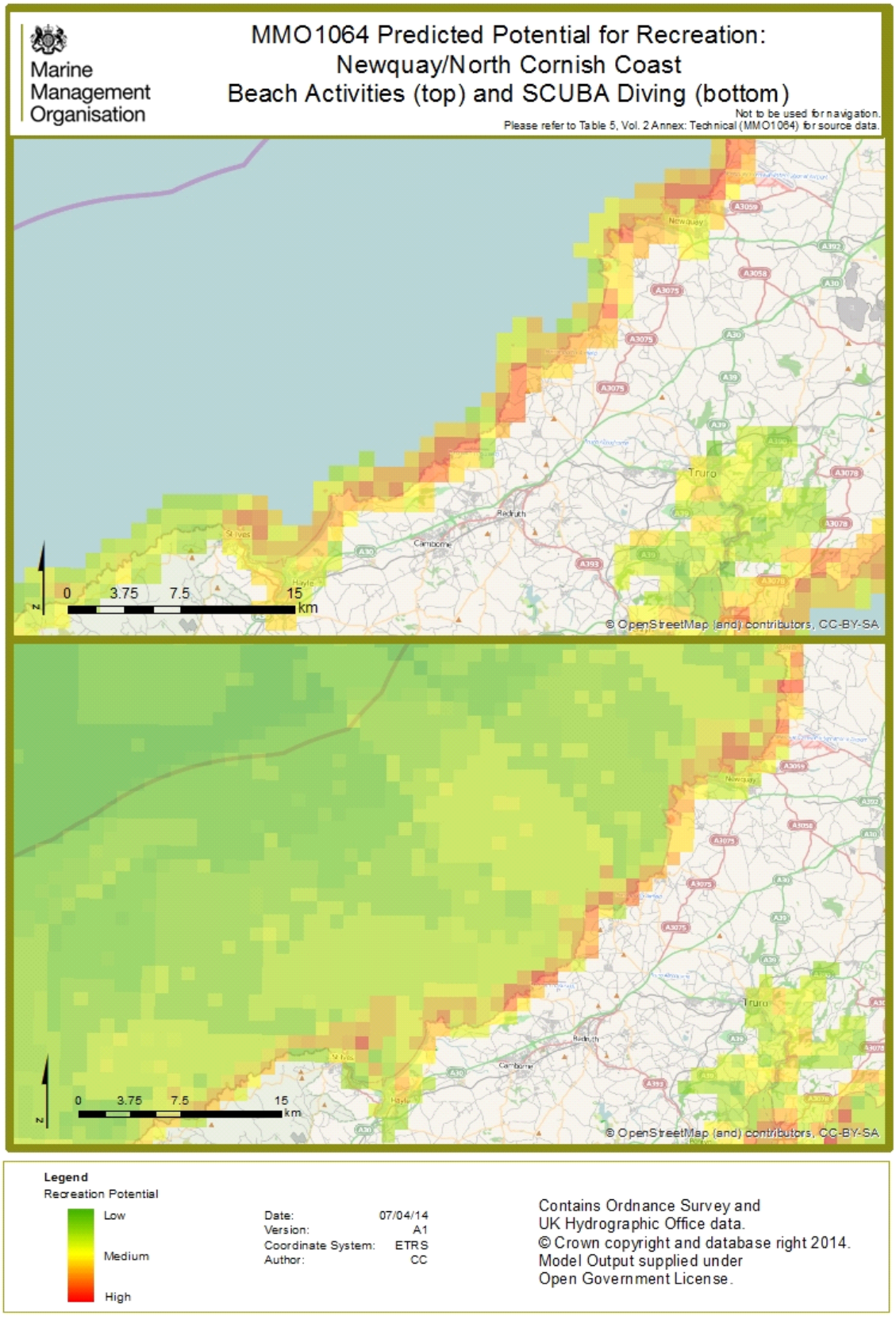


Figure 4: Example model prediction maps for Portland / Chesil Beach.

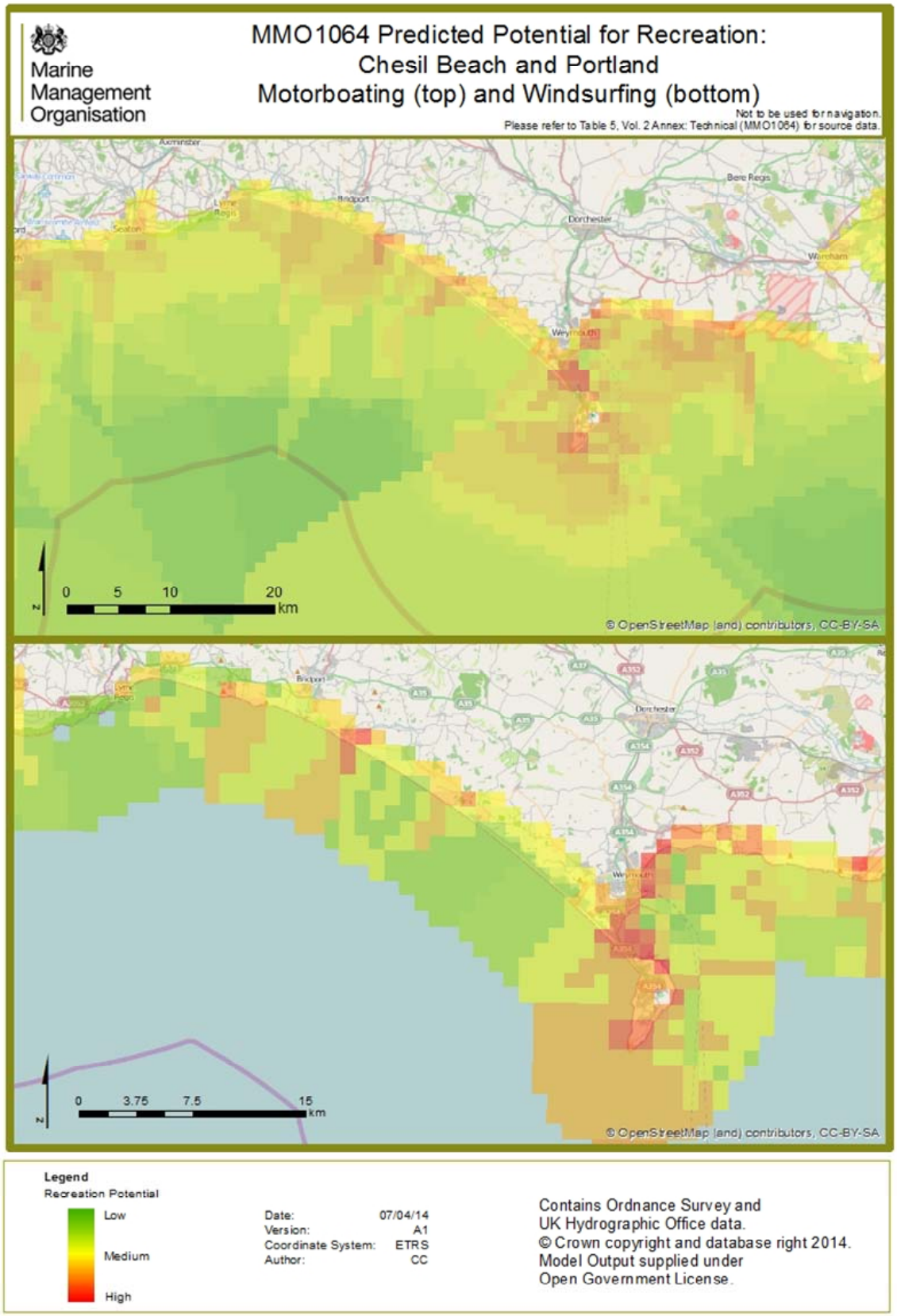


Figure 5: Example model prediction maps for the Solent.

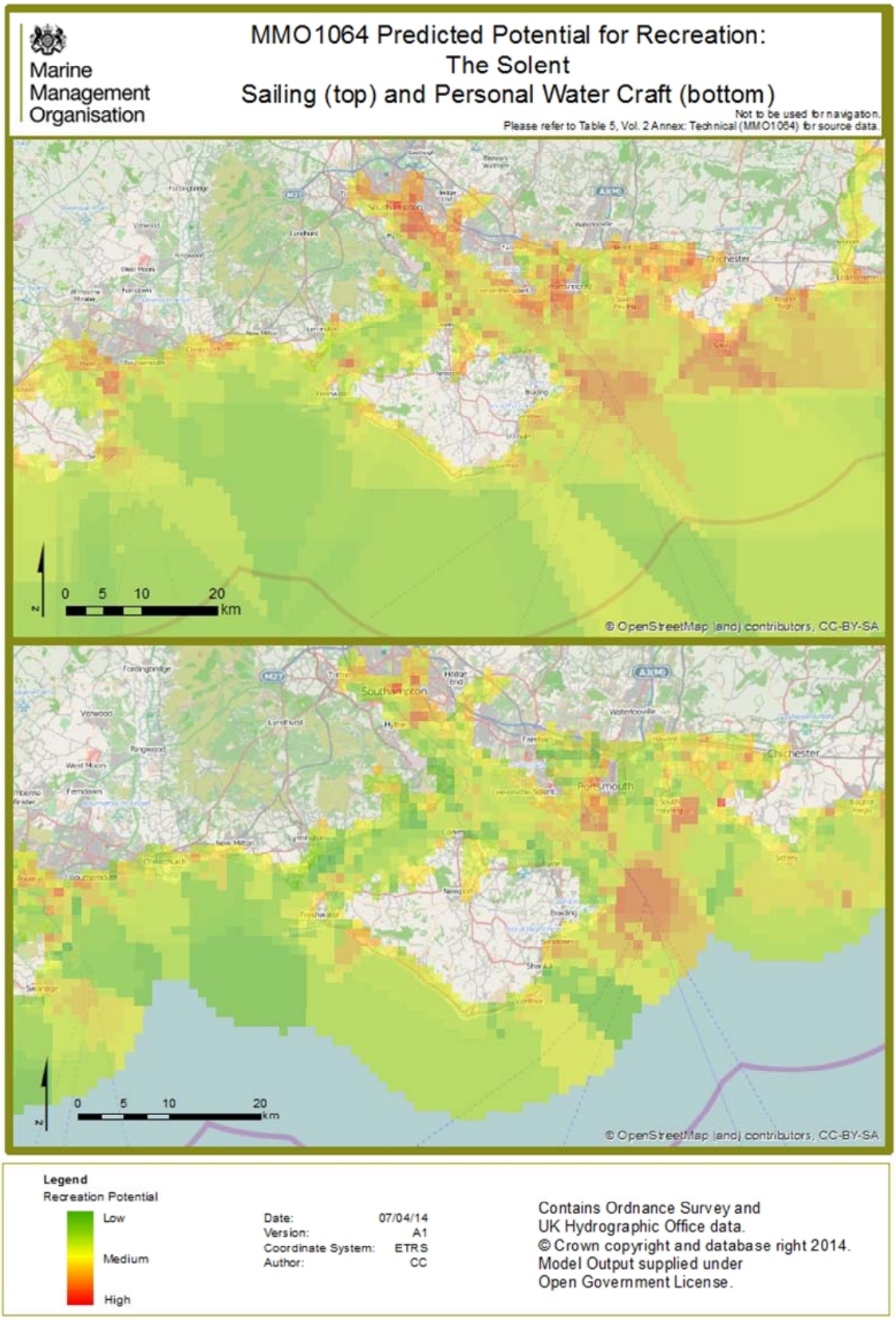


Figure 6: Example model prediction maps for Seahouses / Farne Islands.

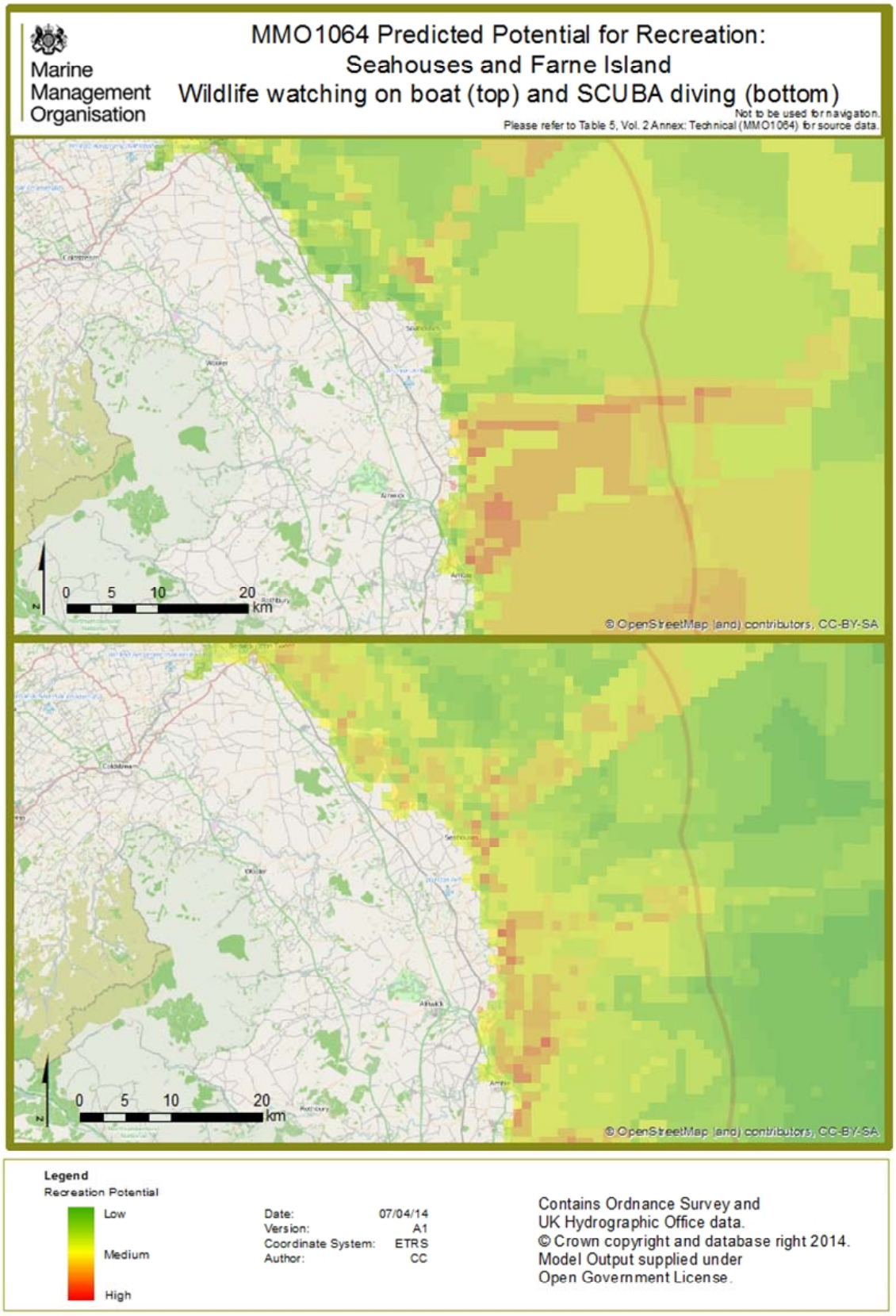
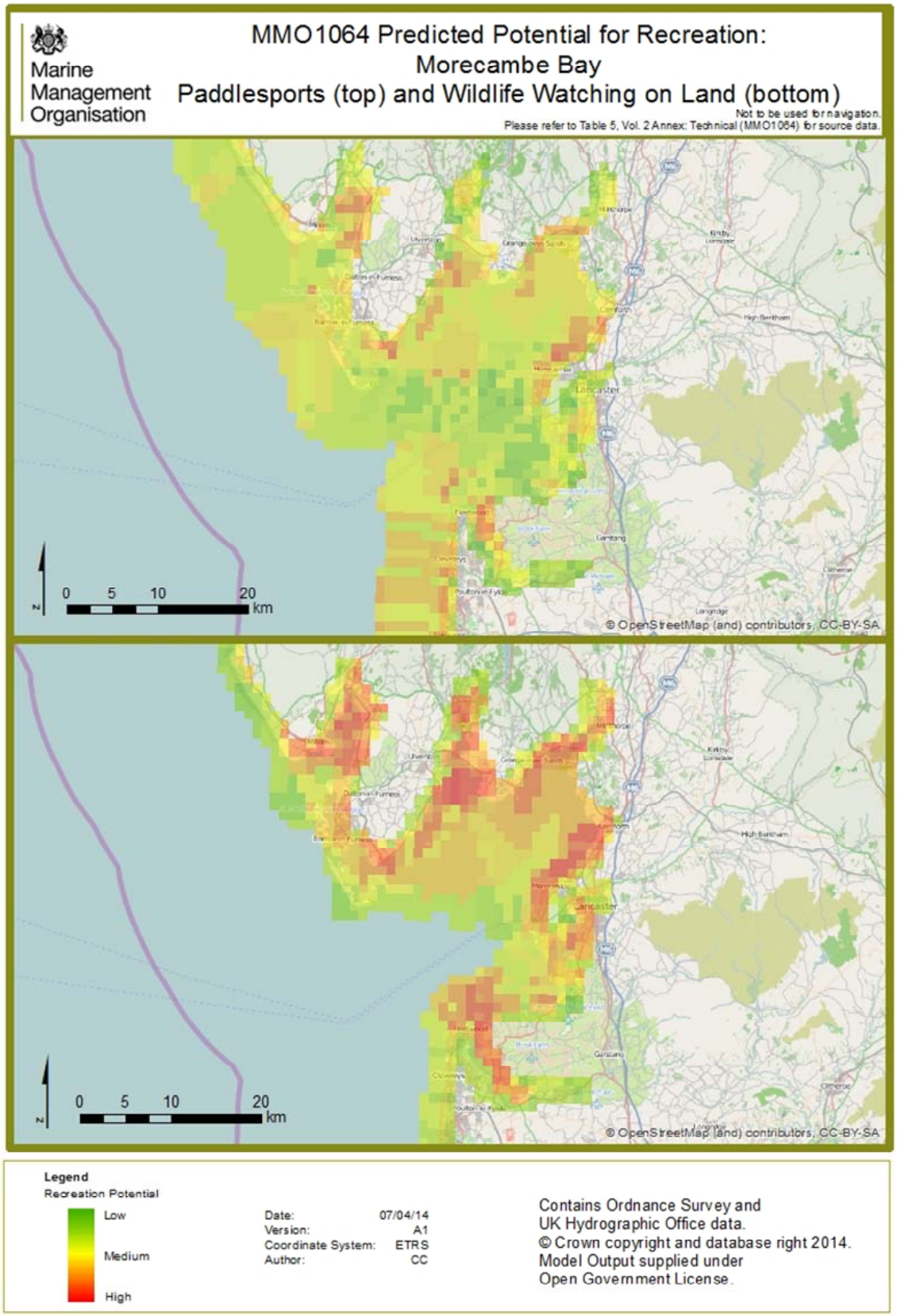


Figure 7: Example model prediction maps for Walney Island / Morecambe Bay.



Validation of the prediction maps was carried out through comparison with previously gathered data, some of which are available via the MMO's marine planning portal: http://planningportal.marinemanagement.org.uk/ and web sources previously identified, but not currently available via the planning portal. A summary of each activity is provided below.

Wildlife watching from land

Validation datasets: Natural England's National Nature Reserves data layer (Defra magic webGIS); RSPB Reserves, Bird Reserves and Sanctuaries, Important Birds data layers (Marine Planning Portal).

Validation Summary:

- Validation of wildlife watching on land cannot be carried out as there is no data on where this takes place and instead data relies on where reserves, etc. are located. As these inform the model input layers, they cannot be used to validate. However some comments are provided below.
- Model outputs broadly compare to the Natural England's NNR data layer and bird reserves and sanctuaries sub-layer in The Solent, Walney Island/Morecombe Bay and Farne Islands.
- Model output at Walney Island/Morecombe Bay compared well with the Important Birds data layer
- The RSPB reserves by area compare to the high wildlife watching potential in the Solent area and Morecombe Bay.
- The north Cornish coast and Chesil beach and Portland Harbour scored high for wildlife watching potential but did not correspond with the above layers.

Beach activities

Validation datasets: EA bathing water monitoring sites, Blue Flag status (Marine Planning Portal).

Validation Summary:

- Model outputs broadly compare with designated bathing and water quality monitoring sites and Flag status beaches at all case study locations.
- The eastern Solent (Portsmouth to West Wittering) and the north Cornish coast (St. Ives Bay to Padstow, including Newquay), scored relatively highly.
- Chesil beach, opposite Portland harbour, the SE end of the Isle of Portland, Walney Island and the coast around Seahouses all illustrated a relatively high potential, despite lack of Blue Flag status beaches.
- Car park presence, land access, land habitats and water quality are dominant parameters, which are likely to influence areas with potential, currently not represented by bathing water sites and Blue Flag status.

Paddle sports

Validation datasets: Paddle sports StakMap data layer (Marine Planning Portal).

Validation Summary:

- Model outputs show a higher potential for paddle sports compared to the paddle sports Stakmap dataset, however there are comparable, relatively low scores at Seahouses.

- The eastern Solent, and Chesil Beach, opposite Portland harbour, demonstrated medium to high scores, as did Walney Island and the north Cornish coast.

Surfing

Validation datasets: Surfing locations (Magic Seaweed, WannaSurf websites).

Validation Summary:

- The model outputs illustrate high potential along the North Cornish coast, including Newquay and North East of England , including Seahouses, which compare to the surfing locations on MagicSeaweed and WannaSurf.

Windsurfing

Validation datasets: Windsurfing was validated against the Windsurf magazine website beach guide map, the Forces of Nature website beach guide and the Northumbrian Windsurfing website location guide.

Validation Summary:

- Model outputs for the south and south west are comparable to the Windsurf magazine website beach guide map with relatively high potential for windsurfing in the Solent.
- Model outputs broadly compare with the Forces of Nature guide and Northumbrian Windsurfing guide; Seahouses, Morecambe Bay and Chesil Beach scored highly for windsurfing activity.

Sailing

Validation datasets: RYA cruising routes, sailing, slipways and marina locations (Marine Planning Portal).

Validation Summary:

- Model outputs are comparable to RYA sailing areas, cruising routes and slipways and mostly comparable with the marinas, with the exceptions of Walney Island and north Cornish coast.
- The Solent has scored relatively highly for sailing potential which is comparable to cruising routes and sailing area datasets. The results also correspond to the locations of slipways and marinas.
- Walney Island has scored relatively highly despite no marinas and medium cruising routes.
- Isle of Portland has scored relatively highly which is comparable to the sailing areas, heavy cruising routes and marinas at Weymouth.

Motor boating

Validation datasets: marina and slipway location (Marine Planning Portal); motor cruising data layer (iCoast).

Validation Summary:

- Model outputs broadly compare with the presence of marinas and slipway locations. In particular, the eastern Solent from Portsmouth to West Wittering scored relatively highly for motorboat activity.
- Portland Harbour and Chesil beach, illustrated a medium to high potential, as did Walney Island and Northumberland coastline encompassing Seahouses.
- The north Cornish coastline (St Ives to Padstow, including Newquay) illustrated a medium to high potential for motor boating despite the low presence of marinas and widely dispersed slipways.

Personal watercraft

Validation datasets: slipway data layer (Marine Planning Portal), personal watercraft data layer (iCoast).

Validation Summary:

- Model outputs broadly compare with the slipway locations data layer.
- Particularly high scores in Eastern end of Solent and Walney Island/Morecombe Bay.
- The medium to high scores around Isle of Portland compare with the location of tuition opportunities as shown on the iCoast map.

Scuba diving

Validation datasets: JNCC/Natural England StakMap, Wight Dolphin Dive Club data layers (Marine Planning Portal), scuba diving data layer (iCoast).

Validation Summary:

- The Farne Islands and eastern Solent show relatively high scoring for diving potential, despite no reference on Stakmap (it is a recommended site on the BSAC guide list)
- The model outputs are comparable to StakMap diving dataset for Newquay, Chesil Beach and Isle of Portland and to the south of the Isle of Wight.
- The medium to high diving potential along Chesil beach and around Isle of Portland corresponds to the iCoast data showing locations of shore, reef and wreck dives and club presence.

Boat based wildlife watching

Validation datasets: Sightseeing and Visitor Centre data layer, Grey and Harbour seal density data layers (Marine Planning Portal)

Validation Summary:

- Model outputs compare well with presence of sightseeing and visitor centre locations
- There is relatively high wildlife watching (boat) potential from Seahouses especially around Farne Islands which corresponds with the high grey seal density data layer.
- The other case study areas have high scoring potential as well despite the low density or absence of grey and harbour seal densities.

Boat angling

Validation datasets: Bembridge angling club, anglers (charter boat), recreational angling data layers (Stakmap dataset/Marine Planning Portal).

Validation Summary:

- The Solent scored medium to high for potential which is comparable to the anglers (charter boat), recreational angling data layers and the Bembridge angling club intensity dataset.
- Walney Island and Seahouses, demonstrated medium scores; more so around the Farne Islands, despite low level densities recorded on Marine Planning Portal data layers.
- The north Cornish coast (St Ives Bay to Padstow) scored relatively low for potential boat angling which is comparable with the Stakmap datasets.
- The areas of Plymouth and Clacton-on-Sea represent areas of high boat angling activity on the Stakmap datasets however are not of high potential on the model outputs.

Shore angling

Validation datasets: Recreational sport data layer, Stakmap Recreational angling (Marine Planning Portal), Shore angling data layer (iCoast).

Validation Summary:

- Model outputs illustrate a high potential for shore angling along the north Cornish coast (including Newquay), despite a low to moderate indication of shore angling from the sport angling and Stakmap datasets available on the Marine Planning Portal.
- Model outputs for Portland harbour and Chesil beach immediately adjacent to the Isle of Portland broadly compare with the validation. However the model shows only a low to moderate angling potential along Chesil beach, when validation datasets illustrate moderate to high activity.
- Model outputs show some comparison with the validation datasets on the marine planning portal for the Solent. Portsmouth to West Wittering show moderate to high shore angling, as confirmed by the validation datasets. However, the model illustrates moderate to high potential for angling around the Isle of Wight, whilst the validation data suggests low angling use.
- The shoreline around Seahouses and Walney Island are shown to have high moderate potential for shore angling, whilst the validation datasets show a low angling use.
- Note: the validation datasets present on the marine planning portal illustrate approximate densities of use over a year and the presence of points of interest. The fact these datasets acknowledge activity presence supports the models output.

7. Conclusion and Recommendations

7.1 Overview

A model to map areas of marine recreation potential, rather than actual activity presence, has not been attempted before in the marine planning context. This project has provided a pioneering methodology on a selected number of activities and control parameters. The resulting model predictions for England's marine areas now provide the foundation for identifying where activities can occur; this may be built upon in future years, should actual collected data on marine recreation be made available to marine planners. It should be noted that the project time scale, data and stakeholder availability influenced the number of model iterations during the project; however, it has been designed to be delivered as set of tools to allow future iterations as new data/information becomes available.

7.2 Model success

For activities which rely on man-made infrastructure, e.g. marinas, slipways and moorings, to enter the marine area, the model outputs present a broadly accurate illustration of where these activities can occur e.g. sailing, motorised boats and personal water craft. Equally, as these activities occur further offshore, i.e. not close to the shoreline or in the nearshore area, the 1km^2 resolution is less of a limitation. Within any given 1km^2 grid cell and within the prescribed distance of an entry point these activities are likely to occur approximately as predicted.

However, those activities which are not vessel based and which use the marine area only out to 1km, carry greater sensitivity to model parameters which are not supported by accurate or suitable input data.

7.3 Data availability

The land access parameter has been developed based on national datasets available and these do not include all paths to the marine area (taken as Mean High Water). Therefore assumptions have had to be made as to whether the nearest roads/paths are accessible and this has had to use relatively coarse elevation data to calculate slope, to assume access. As a priority the model may be improved by an accurate spatial layer on land access points through analysis of the Ordnance Survey maps and digitising/classifying each entry point, which was out of scope of this current project. It is considered that this approach is far more accurate than any rule based logic that could be applied to national datasets and is recommended for future iterations of this model.

The physical environmental parameters data collected, i.e. depth, wave and wind data, have a strong influence on where activities can take place, especially small craft sport based activities, e.g. surfing and windsurfing. However the data available nationally is of a very coarse spatial/temporal resolution that cannot pick out the local detail attributed to small bays and coves, etc. Lack of data for wave height may be improved with further negotiation with data providers (who were not able to provide data in the timescales of the project). Unfortunately modelling complex hydrographic processes was outside of the scope of this project.

Of the ecology based parameters the principal absence of spatial data was highlighted for fisheries. Current work is underway at the MMO that may address this gap[3], which is of particular relevance to angling. .

Socio-economic factors were purposely excluded from the model apart from physical structures and essential services, i.e. car parks, access, navigation, restricted areas, wrecks. The reason for this was that other parameters selected were considered to have a greater influence on the prediction and that socio-economic factors are by nature more variable over time and don't necessarily capitalise on the total recreation potential available (e.g. hire shops are not provided at all areas that are good for windsurfing; and toilets are not at all good beaches that people may enjoy in the future).

There is a wide range of other socio-economic factors which could influence marine recreation, such as the presence of local amenities, tourism offer, population densities, local and regional affluence and seasonal fluxes, e.g. staycation effect. These factors were mentioned during the project consultation and in further iterations or developments of the model will provide further insight on the potential for areas to attract marine recreation activity. However if current services and infrastructure are used in any future model iterations it should always be remembered that they are the influence of the present conditions and not the future/potential. Furthermore, marine planners may also require indications of the socio-economic value or potential generated by marine recreational activity, which could contribute to a number of marine plan socio economic policies.

7.4 Stakeholder's feedback

Stakeholder feedback was broadly supportive of the model and the principles behind it. The marine recreation community is a motivated group and as the recently published Sea Angling 2012 report illustrated there is great potential for different recreation activities to contribute significantly to the UK economy. Stakeholders consulted in this project are increasingly aware of the potential influence marine planning can have on their respective sports and activities. There was also a constructive recognition that models of this nature are limited by the available data and therefore, assumptions need to be built into the model and reflected by those that use the results.

It took time and careful consultation to explain the Activity Matrix, however, this was well received by consultees, as it provided a valuable, transparent tool, allowing them to directly influence the model outputs based on their scores and feedback. However, the success of applying the activity preferences will always be dictated by the accuracy of the input data layers, as emphasised by stakeholders at the workshop.

At the validation workshop, the wave data was considered unsuitable to use to predict any surf based activity and the stakeholder wished to see this improved

[3] MMO1044 Spatial Models of Essential Fish Habitats

before any results were considered in marine management decisions. Further validation of the model outputs and consultation is, therefore, required with the national recreation stakeholders consulted with in this project, before outputs illustrating surfing, kitesurfing, windsurfing and other wave riding activities are published via the marine planning portal, or used to inform marine licence applications.

In general with particularly in reference to the vessel based activities, consultees were happy with interim prediction results presented. Due to the necessary adjustments since the workshop, the consultees will view the final products upon publication of this report.

7.5 Model data vs. real data

The success of the model relies predominately on the quality, relevance and availability of input data to derive suitable data layers to support the parameters, as these are the foundations on which the model is built. Without this the input provided by stakeholders cannot influence the model as required. Spatial data on certain parameters, particularly in the marine area, will always be predicted, e.g. wind, wave; or interpolated from point data measurements, e.g. depth, habitat type. Therefore, the recreation prediction model will always be less accurate than collected data where this is of a suitable standard and confidence level.

Marine plan policy that focuses on potential will likely have a broader spatial consideration. For example, where modelled data exists demonstrating recreation potential, policy could be developed signposting the need for consultation. But if real data of suitable accuracy and coverage were available it could make the policy more prescriptive.

Whilst this project has addressed the requirements of marine planning at a national scale and enables the MMO and recreational stakeholder/bodies to take this work forward, the greatest recommendation that can now be made is that future efforts are focused on obtaining actual data for where activities take place, in the long term.

8. Project Resources External to the Main Report

8.1 Annexes

The project annexes consist of two volumes. The first volume comprises the non-technical annexes, including a map annex, activity preferences and stakeholder consultation. The second volume comprises the technical annexes, including detail on input data and data layer processing, model development, confidence assessment and Marine Recreation Model User Guide.

These annex volumes are separate documents and are referenced in the main report. Only the Vol. 2 Technical Annex is stand alone and can be used separately from the main project report to inform the model development. The annexes are structured as follows:

8.2 Annex volume 1

Annex A: **Guide and References** - provides a reference list of acronyms and terminology descriptions, as well as references cited throughout the project report and appendices.

Annex B: Modelled Activity Maps - provides maps of the activities modelled in this study, presented at the national scale.

Annex C: Activity Preferences - provides further detail on the activities selected to model and the influencing user preferences, or parameters. This includes the approach taken to prioritising the parameters and a more detailed breakdown of the varying elements of the Activity Matrix (activity preferences).

Annex D: Activity Consultation - gives further description to the stakeholder consultation steps taken and stakeholder feedback.

8.3 Annex volume 2

Annex E: Model Baseline and Definition - technical annex detailing the baseline model and its definitions.

Annex F: Input Data Processing - technical annex detailing the input data processing, including the input data catalogue.

Annex G: Common/Multi-Layer Processing – technical annex providing a description of the Tool 1 Gridding Tools and their use

Annex H: Model Methodology - is a technical annex describing the model methodology, detailing Tool 2, the ‘Union Tool’, Tool 3, the model ready Activity Matrix and Tool 4, the model.

Annex I: Confidence Assessment - provides an assessment of the model outputs, including the confidence assessment of the input data (not sourced from the MMO) and the confidence assessment of the input data layers.

Annex J: Future application of the model – provides recommendations for future use and evolution of the model

Annex K: MMO1064 Marine Recreation Model User Guide – step by step instructions on processing data suitable for the model and rerunning the model.

8.4 Electronic deliverables

Below is a complete list of electronic deliverables with this project.

- Final report
- Vol. 1 Report Annex
- Vol. 2 Technical Annex, including model guidance
- Project research flier
- Data processing logs, including flow diagrams
- GIS data layers
- XML metadata
- Model Tools 1, 2, 3 and 4
- Combined Consultation Activity Matrix spreadsheet
- Data confidence assessments
- Input data catalogue.

All associated documents for the MMO1064 project can be found in the MMO website evidence pages at:
http://www.marinemanagement.org.uk/evidence/1064.htm