

Appendix F: GIS processing applied in Haibtat Risk Assessment

This Appendix is provided in support to the following report:

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The report, submitted 18/09/2014, addresses comments made by the wider Lyme Bay Fisheries and Conservation Reserve Working Group at a Workshop 09/09/2014.

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Overview

This Appendix provides a detailed methodology that others may wish to follow in the future to repeat the assessment, allowing for updated input data. The main text details the methodology to a GIS-skilled audience; and this is supported by step by step footnotes that are directly relevant to ArcGIS V10, to help those not as familiar with the technicalities. ArcGIS is one of or probably the most commonly used GIS software in marine environmental management in the UK and is the platform used by MPC in this project. Note that once an operation has been detailed in one footnote, it is not repeated again but the reader should refer back.

Features of conservation interest

Habitat map

Table F1. Habitat category translation of raw data to fit Risk Matrix categories

Original Habitat	Translated Habitat
CR.HCR.Xfa and SS.SMx.CMx	Subtidal bedrock reef
CR.HCR.XFa.ByErSp.Eun	Subtidal bedrock reef
CR.HCR.XFa.ByErSp.Eun and SS.SMx.CMx	Subtidal bedrock reef
SS.SCS.CCS	Coarse sediment (high energy)
SS.SCS.CCS.MedLumVen	Subtidal gravel and sand
SS.SCS.CCS.PomB	Coarse sediment (high energy)
SS.SMx.CMx	Subtidal mixed sediments
SS.SMx.CMx.ClloMx	Subtidal mixed sediments
SS.SMx.CMx.OphMx	Subtidal mixed sediments
SS.SSa	Subtidal muddy sand
SS.SSa and SS.SMu.CSaMu	Subtidal muddy sand
SS.SSa.CMuSa.AalbNuc	Subtidal mixed sediments
A3.1	Subtidal bedrock reef
A3.116/A4.131	Subtidal bedrock reef
A3.2	Subtidal bedrock reef
A4.1	Subtidal bedrock reef
A4.13	Subtidal bedrock reef
A4.131	Subtidal bedrock reef
A4.131/1311/A3.116	Subtidal bedrock reef
A4.131/A4.1311	Subtidal bedrock reef
A4.1311	Subtidal bedrock reef
A4.1312	Subtidal bedrock reef
A5.14	Coarse sediment (high energy)
A5.141	Coarse sediment (high energy)
A5.142	Subtidal gravel and sand
A5.2	Subtidal muddy sand
A5.261	Subtidal mixed sediments
A5.44	Subtidal mixed sediments
A5.441	Subtidal mixed sediments
A5.445	Subtidal mixed sediments

Benthic species

Records of benthic species were mostly provided as GIS layers, if not then Excel coordinate tables. All GIS layers were assigned X and Y coordinates in WGS84 in new fields¹, where not available already. All tables (layer file dbfs and Excel tables) were then combined in Excel to form one table with attributes, including: source (e.g. JNCC), taxonname (Latin name), commonname (commonly used name), riskgroup (e.g. Pink Sea-fan or potential Sabellaria reefs, abundance (normally a letter indicating the SACFOR scale²), date of survey. All other fields were deleted. This single combined table was then imported to GIS³.

Bird foraging

Spatial data of breeding / territories sightings was provided by JNCC from their seabird monitoring programme in ArcGIS point shapefile format. Foraging distances were researched in the literature for each species as shown in **Table F2**. The attribute table was cleaned to leave only the common name and then a new field added with the foraging distance⁴ in km ('FDist'). The points were then buffered to this distance⁵, and a new polygon shapefile produced, dissolved by each species to remove overlaps in a species' foraging grounds⁶.

¹ Open a new map window (select file, select new), right click on data frame ('layers' in table of contents window), select properties, select coordinate system, select spatial reference of input coordinates as WGS 84 (World, WGS84), OK. Open shapefile in this dataframe to add X, Y coordinates to. Open attribute table (right click, open attribute table), choose drop down tab in attribute table (top right), add field, write name as LatWGS84, chose type as float, OK; repeat for new field LonWGS84. Right click on LatWGS84 attribute header, select calculate geometry, select property as Y coordinate of centroid, select use coordinate system of the data frame, select OK. Repeat for LonWGS84 field selecting X coordinate of centroid.

² Superabundant, Abundant, Common, Frequent, Occasional, Rare

³ Open table, right click on table name in table of contents on map window, select display XY data, select Longitude field for X, Latitude for Y, select spatial reference of input coordinates as WGS 84 (select Edit, select Geographic Coordinate Systems, World, WGS84), then select OK. Then right click on table in table of contents, select data export, select shapefile.

⁴ Choose drop down tab in attribute table (top right), add field, write name, chose type as integer.

⁵ First ensure shapefile is in a projection that measures in metres: Open ArcToolbox, select data management tools, select projections and transformations, select project, select input dataset as points file, select output dataset new name, select output coordinate system, select projected coordinate system, select UTM, select the zone relevant to the area, this can be checked in

<http://www.arcgis.com/home/item.html?id=715d4d6a36cc4b019bd84cb34ce37647>

For Lyme Bay select ETRS 1989 UTM Zone 30N, OK.

Then using transformed shapefile in new projection, in ArcToolbox, select analysis tools, select proximity, select buffer, select input features as the point shapefile, select output features as a new file, select distance as Field, OK.

⁶ In Toolbox, select data management, select generalisation, select dissolve, select input features as shapfile to be dissolved, select output features as new name, select dissolve field as species name, OK.

Table F2. Bird species foraging distances

Modelling assessment units	Common name	Species included in assessment unit (to be assessed by proxy)	Foraging Distance (km)	Source of evidence on foraging distance
Pursuit and plunge diving birds	Balearic Shearwater	<i>Puffinus mauretanicus</i>	25	Birdlife Int.
	Common Guillemot	<i>Uria aalge</i>	40	1) Langstone, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Herring Gull	<i>Larus argentatus</i>	40	1) Langstone, 2010 2) Thaxter, 2012
	Common Tern	<i>Sterna hirundo</i>	10	1) JNCC 2) Langstone, 2010 3) Birdlife Int. 4) Thaxter, 2012
	Sandwich Tern	<i>Sterna sandvicensis</i>	15	1) JNCC 2) Langstone, 2010 3) Birdlife Int. 4) Thaxter, 2012
	Little Tern	<i>Sterna albifrons</i>	5	1) JNCC 2) Langstone, 2010 3) Birdlife Int. 4) Thaxter, 2012
	European shag	<i>Phalacrocorax aristotelis</i>	5	1) Langstone, 2010 2) Birdlife Int. 3) Natural England, 2012 4) Thaxter, 2012
	Cormorant	<i>Phalacrocorax carbo</i>	15	1) Langstone, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Common Scoter	<i>Melanitta nigra</i>	5	Birdlife Int.
	Cory's Shearwater	<i>Calonectris diomedea</i>	50	1) Afan, 2014 2) Paiva et al.
	European storm petrel	<i>Hydrobates pelagicus</i>	100	1) Langston, 2010 2) Thaxter, 2012
	Manx shearwater	<i>Puffinus puffinus</i>	200	1) Langston, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Razorbill	<i>Alca torda</i>	25	1) Langston, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Puffin	<i>Fratercula arctica</i>	40	1) Langston, 2010 2) Thaxter, 2012
	Black-legged kittiwake	<i>Rissa tridactyla</i>	25	1) Birdlife Int. 2) Thaxter, 2012
	Arctic tern	<i>Sterna paradisaea</i>	25	1) Langston, 2010 2) Thaxter, 2012
	Gannet	<i>Morus bassanus</i>	100	1) Langstone, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Great northern diver	<i>Gavia immer</i>	1000	Natural England, 2012
Red throated diver	<i>Gavia stellata</i>	15	1) Birdlife Int. 2) Thaxter, 2012	

Surface feeding birds	Fulmar	<i>Fulmarus glacialis</i>	75	1) Langstone, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Lesser Black-backed Gull	<i>Larus fuscus</i>	75	1) Langstone, 2010 2) Thaxter, 2012
	Black-backed Gull	<i>Larus marinus</i>	40	Langstone, 2010
	Common gull	<i>Larus canus</i>	15	1) Langstone, 2010 2) Thaxter, 2012
	Black-headed gull	<i>Larus ridibundus</i>	15	1) Langstone, 2010 2) Thaxter, 2012
	Little gull	<i>Hydrocoloeus minutus</i>	25	Langstone, 2010
	Mediterranean gull	<i>Larus melanocephalus</i>	15	Langstone, 2010
	Arctic skua	<i>Stercorarius parasiticus</i>	25	1) Langstone, 2010 2) Birdlife Int. 3) Thaxter, 2012
	Great skua	<i>Stercorarius skua</i>	40	Birdlife Int.

Fishing activity

Survey patrol effort in Devon and Severn IFCA

Spatial data was provided by DSIFCA in MapInfo format and converted to ArcGIS shapefiles in projection WGS84. New columns (termed 'fields' in ArcGIS) were added⁷ for each gear type assessed in the matrix and in the same order as in the matrix, regardless of whether these gears were included in the DSIFCA data or not. Fields were labelled as shown in **Table F3**. These new fields were then populated with the data in previous columns for the correct gear type⁸, leaving blanks where the gear type was not provided. Then all previous fields were deleted⁹ apart from the Latitude and Longitude references.

Table F3. GIS field names for fishing gear type

Field Name	Description
TRA	Trawling
DRE	Dredging
SCA	Scalloping
POT	Potting
CUT	Cuttle potting
WHE	Whelking
CRA	Crabbing
NET	Netting
DIV	Commercial diving
RAL	Rod and line

Fisher questionnaire in Southern IFCA

Spatial data was provided by SIFCA in MapInfo format and converted to ArcGIS shapefiles in projection WGS84. One layer was provided with all gears except for potting which was provided as a separate layer. The potting data was therefore added to the all gears layer by a Table Join¹⁰, using the column / row unique identifier ('Descriptio'). Next, the fields shown

⁷ Choose drop down tab in attribute table (top right), add field, write name, chose type as text.

⁸ Right click on field name, choose field calculator, in pop up window double click on the field whose value will be copied over, click ok. Repeat for each field that requires data to be populated from previous columns.

⁹ Right click on attribute label, delete.

¹⁰ Right click on shapefile in table of contents on map window, select Joins and Relates, select Join, select join attributes from a table, select field to join by as 'Descriptio', select table (shapefile) to join to this layer, select field in table to base join on as 'Descriptio', select keep all records, OK. Once joined, open attribute table and right click on first potting field in table, right click field name, select field calculator, select second potting field in table (from join) by double clicking, OK. Right click shapefile in table of contents on map window, select Join and Relates, select Remove Join.

in **Table F3** were added on and the attribute table cleaned as detailed for DSIFCA, above. Finally, the shapefile was clipped to the project AOI¹¹.

Presence-absence of sightings across AOI

Sightings data provided by the MMO, including IFCA MMO sightings, were cleaned in Excel. This included adding new columns for gear types as shown in **Table F3**. A value of 1 was entered in each row (i.e., for each location of a sighting) wherever the gear type was fulfilled in the MMO / IFCA gear type given in the raw data, by sorting each in turn to enter the 1 in batches. All other columns were then deleted except for the Latitude / Longitude.

The Excel table was next opened in ArcGIS and converted to X, Y points (see previous footnote) and buffered by 250m¹². This buffering allows for some movement in the area by the vessels, given that there is relatively infrequent patrol effort to the exact same location, by necessity in order to patrol the whole district. A 500 x 500m grid was then created¹³ (using ET GeoWizards V11.0¹⁴) and clipped to the AOI (see earlier footnote). Therefore the gear types provided by points could then be transferred onto the grid through a spatial join¹⁵. Lastly, the final shapefile attribute table was cleaned so the only remaining columns were the fish gears (see previous footnote).

¹¹ In ArcGIS ToolBox, select analysis tools, select extract, select clip, select input features shapefile, select clip features as project AOI (6nm limit), insert new shapefile name in outputs feature class, OK.

¹² Open ArcGIS Toolbox, select analysis tools, select proximity, select buffer, select input features as the shapefile being buffered, select new output shapefile, select distance as 250, select units as metres, OK.

¹³ Open ET Geowizards (see below if not installed), select sampling, select vector grid, select source for initial grid extent as the project AOI shapefile, select output shapefile, ensure grid extents units is metre, if not change, enter cell size as 500 for each of X and Y, finish.

¹⁴ If not already downloaded, then download from http://www.ian-ko.com/ET_GeoWizards/gw_demo.htm, unzip and run the set up file, once run, right click in the ArcGIS window tool bar area, select ET GeoWizards.

¹⁵ In ArcGIS ToolBox, select analysis tools, select overlay, select spatial join, select target features as the grid shapefile, select join features as the point data, insert a output feature class name, select a one to one join operation, in optional field map of join features section of window, scroll down to first fishing gear type attribute heading ('TRA'), right click, select merge rule, select sum, repeat for each gear type, select match options as 'contains', OK.

Risk mapping

Baseline risk

The baseline risk is the risk that a feature (species or habitat) is to a fishing activity regardless of that fishing activity being present. The project risk matrix is presented in two formats, firstly the visual colour coded matrix on the worksheet 'Risk Matrix' and secondly as a simple table ready for import to GIS 'GIS LookupMatrix' worksheet. This second worksheet makes exact copies of the former Risk Matrix worksheet by formula so if values are changed these will carry through.

To provide the baseline risk, the GIS LookupMatrix values were attached to the feature shapefiles using a table join (see previous footnote), having first ensured all features are named in exactly the same spelling / format as in both files¹⁶.

The baseline risk value added onto the attribute table, as in the spreadsheet, was labelled with a suffix "_M", with the M denoting it is the matrix value, e.g. "TRA_M" for trawling.

Risk based on feature-gear interaction

Wherever a fishing activity was present for a feature, the baseline matrix risk value was adopted in the final outcome as provided in the following example:

TRA_R = If TRA_F>0, then TRA_M, otherwise zero.

where TRA_R = the final risk outcome, TRA_F = the fishing activity value and TRA_M is the baseline risk value for that feature-gear combination.

All "XXX_R" values were assigned using spreadsheet formula and using the gear acronyms in the same order as given in Table X.

However before carrying out these calculations in Excel, a unique ID per row was set up in the GIS attribute file¹⁷ to allow re-import of the calculations.

Therefore once calculations were complete in Excel; and made static (all calculated columns copy and pasted as values), all other field were deleted except the ID column, then these values were joined to the baseline risk layer in GIS by a table join (see previous footnote).

¹⁶ Open attribute table, select field header for features column, right click, select sort ascending, scroll through and check consistency, where not, select all rows that are incorrect for one feature (click on first row, press shift, click on end row), right click on field header, select field calculator, write in white box the correct feature name in double speech marks, e.g. "Subtidal sand (high energy)", OK. Repeat for other feature names as required.

¹⁷ Add new field (see previous footnote), use field calculator to make each row equal to the FID field (see previous footnote on using field calculator).