A Risk Assessment Framework for Fisheries in Natura 2000 sites in Ireland

with

Case study assessments

July 3rd 2013 Version 1.2

Contents

Introduction

Habitats Directive sub-Article 6.2

Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.

To know what appropriate steps to take or management measures to introduce the likelihood of significant deterioration or disturbance occurring due to given activities needs to be assessed. Given that fisheries and environmental data are not available for a fully quantitative risk assessment process the likelihood of significant effects is assessed using a qualitative framework using semi-quantitative data on fisheries relative to the conservation objectives described for each feature in each site.

This document describes a framework for the assessment of risk posed by fishing activities in Natura 2000 sites in Ireland. The framework is based on EC guidance, Fletcher (2005) and from guidance provided by NPWS as applied in the appropriate assessment (Article 6.3) of fisheries and aquaculture projects and plans in Natura sites.

DPSIR Framework (Drivers, Pressures, States, Impacts, Responses)

The EC has provided guidance(s) on an RA framework to assess the potential for impacts to be caused by fisheries and aquaculture. A DPSIR approach is recommended which describes the Drivers, Pressures, States, Impacts and Responses of the Fisheries-Natura site system.

Drivers: What promotes and stimulates fishing activity

Pressures: What particular environmental pressures are caused by different types of fishing activity

State: What is the state (conservation status) and conservation objective for designated features

Impacts: What impacts to the designated features in Natura 2000 sites are caused by pressures resulting from fishing activities

Response: What management measures or other mitigations can be put in place to effectively respond to the impacts found. Such response should be proportionate to the risk of impact which itself is a composite of the likelihood of the risk occurring and the consequence if it does occur

As described in the EC Guidance the scope of the risk assessment is defined through a potential conflict matrix which would cross-tabulate the fisheries activities and the designated features and assess the potential for impact in each cell in such a matrix. This assessment will identify the type and severity of impacts that might arise from each activity, relative to the sensitivity of the receiving environment and indicate to managers of these activities the degree to which the impact needs to be mitigated, if necessary. The

identification and design of mitigation or management measures is outside the scope of the risk assessment process.

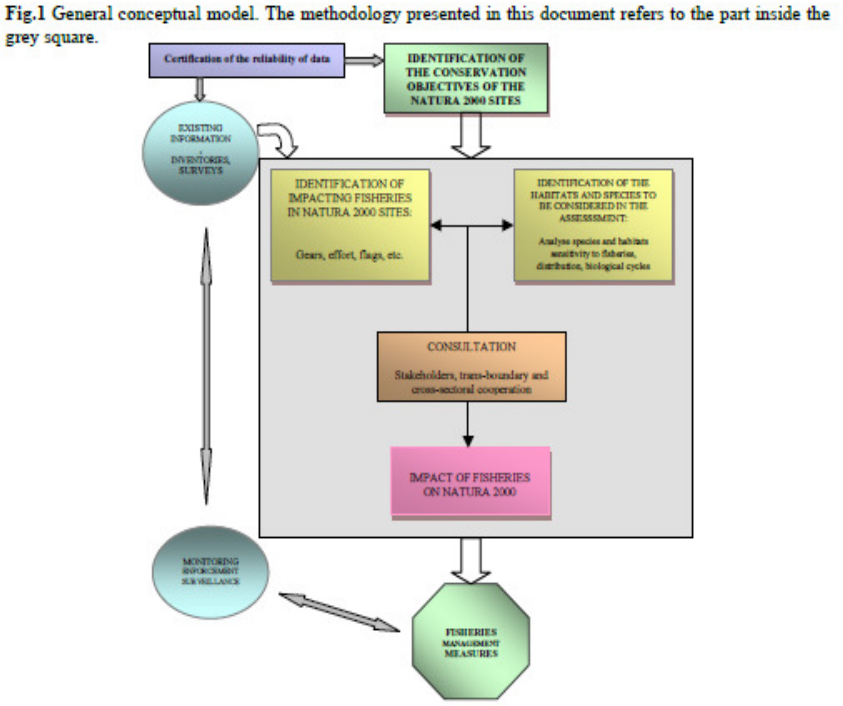

Fig. 1. From the EC guidance on assessing interaction of fisheries and Natura 2000 sites. The assessment of risk is limited to the area within the grey box. Management measures are outside the scope of the risk assessment process.

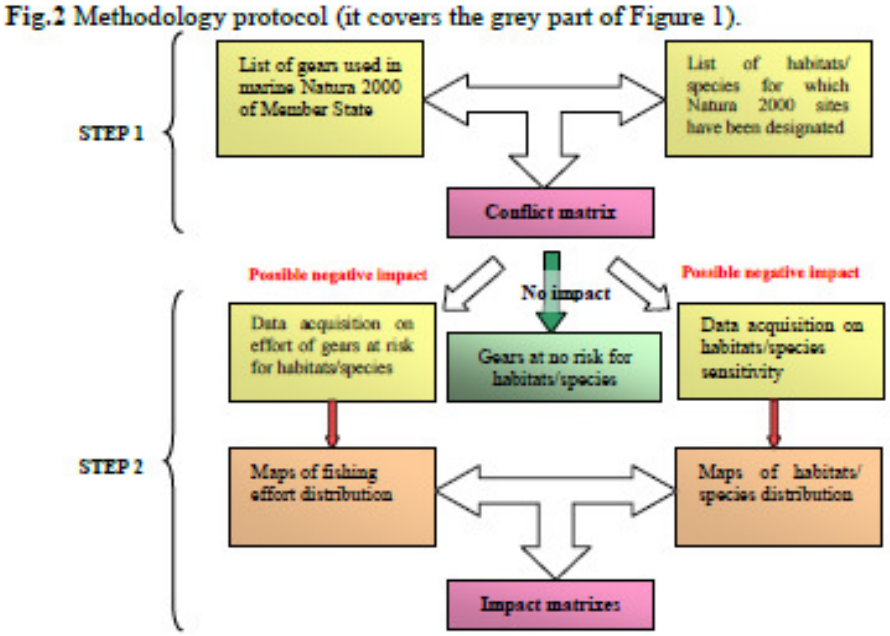

Fig. 2. From the EC guidance on assessing interaction of fisheries and Natura 2000 sites. Maps of fishing activities and designated features are used to construct impact matrices

Components of the RA Framework in the Irish context

a. What is Risk Analysis?

"*Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur." (*AS/NZS 4360 – 1999). The consequences also depends on what it is that is being protected and to what level and should consider the current profile of activity and management regime for fisheries in the sites being assessed. In the present context the risk assessment asks 'what is the risk, to the conservation objectives, of having a particular fishery in a Natura site?'.

b. Drivers

Understanding and profiling drivers and constraints on fishing activity can help to identify the risk of **future escalation** in activity and the increased pressures on designated features that this may bring. Some drivers include

- ✓ Increases in fleet size
- ✓ Market demand for product (driver and constraint)
- ✓ Licencing system (driver and constraint)
- ✓ Tradition of the activity (may be partially independent of the market)
- ✓ Biomass of the target species and its stability (driver and constraint)
- ✓ Coastal distribution of target species biomass (constraint)

c. Pressures

Pressure on habitats can be identified from the distribution, intensity and frequency of fishing activity for each type of activity (Table 1). The pressure caused by each fishing gear type may be different. For example the expected pressures arising from fishing with bottom gear is abrasion (disturbance) of the seabed habitat. Some dredging gear may also affect the sub-surface (shallow or deep disturbance) seabed habitat.

Table 1. Example activity-pressures-features conflict matrix (step 1 in Fig 1 above) identifying pressures that might arise from different fishing activities which interact with various habitats and species. The pressure type is indicated in each cell. The level of pressure is indicated by the cell colour (red = high, orange = medium, green = low, blank = none). Equivalent to Table 2.3 in EC guidance

	Habitats					Species		
	1	2	3	4	5	1	2	3
Bottom dredging	Abrasion							
Bottom trawling					Abrasion			
Mid-water trawling							Entanglement	
Tangle nets								
Bottom set Gill nets								
Pots								
Lines								

To determine the level of pressure of each pressure arising from each activity (as described in Step 2 EC Guidance on fishing activity)

- ✓ the geographic footprint, frequency (with defined unit of time) and intensity (number of defined gear units per unit of time per habitat area) of each activity should be profiled (equivalent to section 2.2.2c in EC Guidance)
- ✓ the overlap of each activity with designated features should be mapped
- ✓ the cumulative or combined overlap of all activities on particular features can be estimated; different activities can occupy the same space at different times.

In Irish fisheries spatially referenced fishing data is available in different forms

- ✓ GPS position data from the vessel monitoring system (VMS) from which vessel speed and inferred fishing activity can be derived
  - Data are available for vessels over 15m
  - From Sept 2013 data will be available for vessels 12-15m in length
- ✓ Fishing distributions are known only generally (local knowledge) relative to the distribution of the target species
  - For bivalves the fishing footprint is fixed year on year as bivalve 'beds' generally have stable and well defined distributions. These distributions are known in many cases from fisheries survey data
  - In the case of bottom trawling the annual footprint may be relatively fixed along well known 'trawl tracks'
  - Fisheries pursuing mobile species have a less definable footprint which may vary year on year.

In each case data is not spatially resolved below the level of the footprint identified, which is a polygon describing where the activity generally takes place. The intensity of fishing activity therefore, cannot be resolved across habitats except where VMS data are available. Furthermore the effort units or data to assess intensity may vary across fisheries. For example the unit of fishing effort could be described as number of vessels, total amount of gear, gear and its frequency of use (intensity), frequency could be variously resolved to seasonally, monthly, number of days, number of operations per unit of time. The expression of fishing effort and intensity of effort and therefore the units of pressure against which to assess risk will vary on a case by case basis.

Data on the geographic footprint, frequency of activity and intensity of activity of each fishery in each site can be collected using the sources of information from VMS, fisheries survey data and expert knowledge. The data formats shown below can be used to derive semi-quantitative estimates of footprint, frequency/duration and intensity (gear units per area of footprint) of activity.

Table 2. Format for the presentation of fishing pressure information in the risk assessment process. Equivalent to Step 2 (semi-quantitative assessment) in EC guidance

FOOTPRINT area	Habitat					
Activity	1	2	3	4	5	6
Bottom dredging	Overlap of activity and habitat (km^2)					
Bottom trawling						
Mid-water trawling						
Tangle nets						
Bottom set Gill nets						
Pots						
Lines						

FOOTPRINT %	Habitat					
Activity	1	2	3	4	5	6
Bottom dredging	Overlap of activity and habitat (% of habitat)					
Bottom trawling						
Mid-water trawling						
Tangle nets						
Bottom set Gill nets						
Pots						
Lines						

DURATION and LEVEL of activity		Month					
	Units	1	2	3	4	5	....
Bottom dredging	Dredges	Duration (months) and level of activity indicating the fishing effort units per month. Definition of effort unit may vary by metier (depending on what data are available)					
Bottom trawling	VMS hrs						
Mid-water trawling	VMS hrs						
Tangle nets	Boats						
Bottom set Gill nets	Boats						
Pots	Number						
Lines	Boats						

INTENSITY per habitat area	Number of active months	Units	Month					
			1	2	3	4	5	....
Bottom dredging		Dredges	Intensity of activity per month. Intensity expressed in effort units km^2 (units per month or season or annual)					
Bottom trawling		VMS hrs						
Mid-water trawling		VMS hrs						
Tangle nets		Boats						
Bottom set Gill nets		Boats						
Pots		Number						
Lines		Boats						

For each habitat therefore there are 3 indices of activity for each fishing metier;

- ✓ Footprint (km^2)
- ✓ Duration or frequency of activity (months per year, number of days per year)
- ✓ Intensity ($effort.km^{-2}$ habitat but where the effort unit will vary)

The risk (consequence * likelihood) that this profile of activity poses to each habitat is then assessed

d. Impacts

The potential impact of a fishery on a designated feature arises from the type, intensity, footprint and frequency of the activity, the pressures this activity generates and the sensitivity of the feature affected.

In the RA framework described here the risk of impact is assessed as a conditional probability and is the product of consequence and likelihood as described below.

Consequence, Likelihood and Risk

The consequence of a pressure when applied to a given habitat or species depends on the sensitivity of the habitat or species to the pressure and the frequency and intensity at which the pressure is applied. However, it is very difficult to be quantitative about the level of consequence arising because habitat and species sensitivity may vary depending on the level of pressure received. Population recovery for instance will depend on the degree of depletion of the population due to the pressure. The rate of depletion will depend on the intensity of the pressure applied. Generally the impact and recovery profiles resulting from pressures are unknown but can at least be categorised with a given likelihood. These concepts and uncertainties in assessing impacts are explained in the EC Guidance (as shown in Fig 3). The varying resilience and recoverability (sensitivity = resilience*recoverability) characteristics of habitats is reasonably well known in which case the short and longer term consequences of an activity which impacts such habitats can be derived.

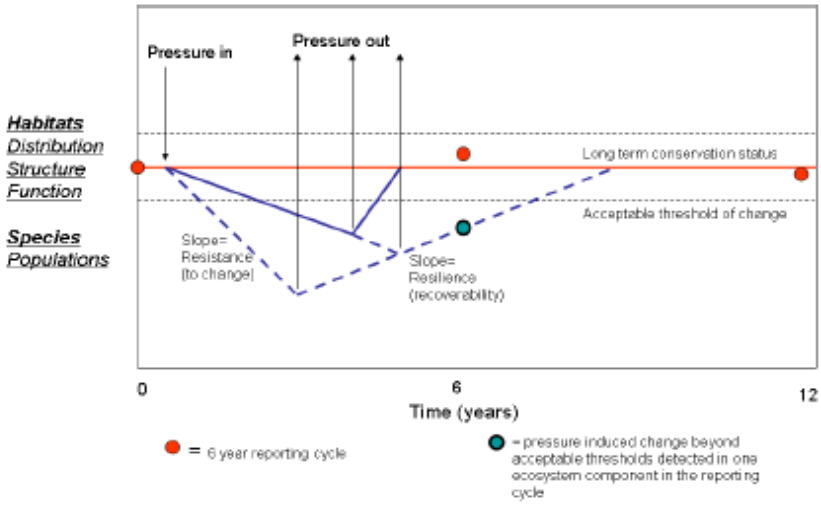

Fig. 3. Diagrammatic representation of Favourable Conservation Status (FCS) in relation to changes to habitats and species brought about by fisheries. The red line represents FCS for attributes of species and habitats.The level of impact to designated features and profile of recovery may depend on the type and degree of pressure applied to the feature. This occurs against a background of natural variability in the feature.

Categorising and defining consequence and likelihood (of the consequence) is the key issue in RA. In qualitative RA frameworks it is very important that assessment of consequence has a clear rationale, is transparent and is linked to the objectives. Different sets of objectives (what is being conserved and how) may, legitimately, lead to different consequence scoring. Consequence cannot be calculated as such but can be categorised based on a list of criteria.

Likelihood is the probability of the consequence occurring given the current level of activity and asks what is the likelihood, based on data on current fishing activity at a site, that a given consequence will arise in a given habitat considering the sensitivity of that habitat to the activity. Likelihood scores might change if the level of activity was reduced or increased.

Likelihood	0	1	2	3	4
	None	Unlikely	Possible	Probable	Certain
	0%	<10%	10-50%	>50%	>95%

The Risk (of impact) is the product of likelihood and consequence. By maintaining a link to the criteria by which consequence and likelihood are scored the risk score provides a decision support for management response to the risk as envisaged in EC guidance (Fig. 3. Decision support tree) and as shown below. The risk scores are equivalent to the Effects categories in Table 2.5 of the EC Guidance.

In this RA framework there are two risk matrices; one for habitats and its constituent species and one for species (Habitats Directive Annex species and Bird Directives species). This is rational as the consequence categories or scoring should be linked to the conservation objectives and to do so requires different criteria for scoring consequence for habitats and species. This separation is already envisaged in the EC Guidance (Table 2.6) but a risk, consequence or impact matrix for species is not presented in the Guidance.

Consequence criteria (Habitats) (Table 3)

The criteria for scoring consequence of habitats include whether disturbance of habitat occurs, whether this is persistent and the amount of habitat affected. These criteria are consistent with those used in the assessment of significant effects of fisheries and aquaculture projects and plans in Article 6.3 appropriate assessments in Ireland. Disturbance, persistent disturbance and significance thresholds for habitat disturbance are defined in those assessments and summarised below.

Disturbance : The distribution and abundance of characterising species, as listed in the Conservation Objectives, and which are important in the structure and functioning of the habitat, are negatively affected. Characterising species may be dominant species, key structural species or key functional species. Whether disturbance occurs or not depends on the type and the intensity of the activity in relation to the resilience of the habitat and species to the pressures resulting from the activity

Persistent disturbance: The disturbance effect, as defined above, may be temporary or persistent. The persistence of the disturbance is determined by the frequency of impact relative to the recoverability of characterising species. However, even if habitats have intrinsically high recoverability persistent impacts will not allow the recovery to occur and the habitat will be in unfavourable condition (most of the time).

Habitat impact thresholds: The footprint of the pressure depends on the distribution of the fishing activity in the site. In appropriate assessments of fisheries and aquaculture in Ireland a threshold of 15% of habitat is used as a criterion for significance. NPWS have provided this guidance. Footprints may be fixed or roving depending on the behaviour and distribution of the target fish species. So a once off assessment of a given activity may indicate that less than 15% of the habitat is affected but the location of fishing in the following year may be in a different location leading to accumulation of impacts across the habitat over time if recovery duration is longer than the duration between seasonal fishing events.

Table 3. Matrix of conditional probability (consequence * likelihood), and associated risk scores, for impacts to habitats. Colours indicate risk category. Disturbance is defined as that which leads to a change in characterising species. Such disturbance may be temporary or persistent depending on the frequency of impact and the sensitivity of the receiving environment

Habitats		**Consequence criteria**				
		Activity is not disturbing to habitat	Up to 15% of habitat disturbed seasonally	Over 15% of habitat disturbed through fixed or roving fishing activity seasonally	Over 15% of habitat disturbed persistently leading to cumulative impacts	Impact is effectively permanent due to severe habitat alteration
		No change in characterising species	Seasonal change in characterising species and community structure and function	Seasonal change in characterising species and structure and function	Persistent change in characterising species, structure and function	Biodiversity reduction associated with impact on key structural species
				Frequency of disturbance < recovery time. Non-cumulative	Frequency of disturbance> recovery time. Cumulative	No recovery or effectively no recovery
Likelihood		**0**	**1**	**2**	**3**	**4**
Highly likely	**4**	0	4	8	12	16
Probable	**3**	0	3	6	9	12
Possible	**2**	0	2	4	6	8
Unlikely	**1**	0	1	2	3	4
None	**0**	0	0	0	0	0

Adapted from Fletcher 2005.

Consequence criteria (Species) (Table 4)

EC Guidance on Article 6 of the Habitats Directive identifies the generic objectives for designated or Annex species

- ✓ Population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable element of its natural habitats.
- ✓ The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future
- ✓ There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

In addition, Article 12 of the Directive provides for a strict protection of Annex IV species whether populations of these species are inside or outside of Natura 2000 sites

"Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned."

These generic objectives are clearly transposed in the specific conservation objectives for species in Natura 2000 sites in Ireland as defined by NPWS. The objectives are to maintain a strict protection, or a level of protection that does not lead to any negative effect on populations of such species. However, the EC Guidance is not clear on what constitutes a significant effect on a species inside a Natura site especially if such species, as is generally the case, may move freely to and from the site, migrate seasonally to and from the site, show varying site fidelity and are relatively small components of much larger single populations or metapopulations.

The EC Guidance indicates that

"Although the methodology for assessing the impacts of fisheries to habitats and species in a particular site can also be applied to mobile species, for which the site is designated, the relevance of doing so will depend on the proportion of the population of the designated species that occurs in the site".

Also, the methodology does not cover Annex IV species although it could be applied to these species. It further indicates that

"The possible need to extend the scope of assessments outside the Natura 2000 sites is to be established on a case-by-case basis, according to the conservation objectives (e.g. may be required for highly mobile species, protection of bird species from by-catch, harbour porpoise, etc.)".

The EC guidance, therefore, indicates that the scope of the assessments may need to be extended well beyond the borders of the Natura sites depending on the population distribution and mobility and the importance of the site to the population.

In the RA framework described here the criteria for scoring consequence to species relate to

- ✓ the significance of impact of the activity (pressure) on the population inside the designated site,
- ✓ the significance of impact of the activity (pressure) on the population outside the designated site
    - o the geographic scope of the assessment in this case will be informed by information on the geographic range of the population being assessed
- ✓ the degree to which the population is isolated from other populations of the same species outside the site and
- ✓ whether the pressure also impacts the habitat which supports and maintains the population and which may be critical to the continued presence of the species in the site (Table 3).

Accidental removal or indirect lethal or sub-lethal effects of individuals of Annex species may not have significant consequences for local populations even if they cannot be supplemented by immigration. The implication of removing a number of individuals will depend on the rate at which the local population can re-build i.e. its net reproductive rate. If the local population is supplemented by immigration 'it' will of course recover faster. Even if it can be supplemented, however, this amounts to drawing individuals from the wider population which may also be subject to various pressures. An assessment of risk which relies on supplementing the population in the site (*in situ*) from outside the site would not, therefore, be precautionary. To assess more completely, therefore, the

consequence of depleting *in situ* individuals of a population, which has a wider distribution, would mean assessing the prevailing risks on the wider population. In many cases, for example, for seabird breeding colonies, all of the pressures resulting from fishing will occur outside the site (*ex situ*) and to properly assess risk to such species will mean inclusion of a broader geographic area in the assessments.

Long term effects within a site to a local population is more ecologically important when the population cannot be supplemented by immigration. Recovery in this case will depend on the net reproductive rate of the species. If the habitat is also disturbed or destroyed, eg prey removed, the population cannot recover even if its net reproductive rate is high and it has significant potential to recover.

The criteria for assessing and scoring consequence, likelihood and risk to Annex species are outlined in Table 4. The approach is precautionary in indicating a high risk, and therefore advising on the need for mitigating measures, in 4 of the 5 consequence categories even when the likelihood of effects at population level is possible (rather than probable) and also indicating a need to investigate more closely if mitigation is needed where individual rather than population effects may occur.

Table 4. Matrix of conditional probability (consequence * likelihood), and associated risk scores, for impacts to Annex species.

Species		**Consequence criteria**				
		Non disturbing to individuals in the population	Direct or indirect mortality or sub-lethal effects caused to individuals but population remains self-sustaining	In site population depleted but regularly subvented by immigration. No significant ex situ pressure	Population depleted by ex situ and/or in situ fishing pressures	Population depleted and supporting habitat significantly depleted and unable to support population
Likelihood		**0**	**1**	**2**	**3**	**4**
Highly likely	**4**	0	4	8	12	16
Probable	**3**	0	3	6	9	12
Possible	**2**	0	2	4	6	8
Unlikely	**1**	0	1	2	3	4
None	**0**	0	0	0	0	0

Process of conducting the RA

The process of obtaining information for the RA, interpretation of data and deriving risk scores for each habitat by fishery combination in each site is as follows;

1. Organise the GIS layers
    a. Admiralty
    b. Habitats and species
2. Obtain data on fisheries
    a. (Boats, gears, quantities, seasonality, locations)
    b. VMS, landings by port, buyers and sellers data,

3. Hold regional workshops with experts who have local knowledge
    a. BIM, SFPA, MI
4. Map fisheries data
5. Calculate overlaps with habitats
6. Hold an 'expert judgement RA workshop' (Fig. 4)
    a. Score all incidences of activity * habitat in all sites for consequence and likelihood using the risk matrices for habitats and species
    b. Documented information on habitat sensitivity to the activities (pressures) will be used to inform the scoring of consequence
    c. Site specific studies will be given highest weight in risk scoring where available
7. Produce risk profiles for each site

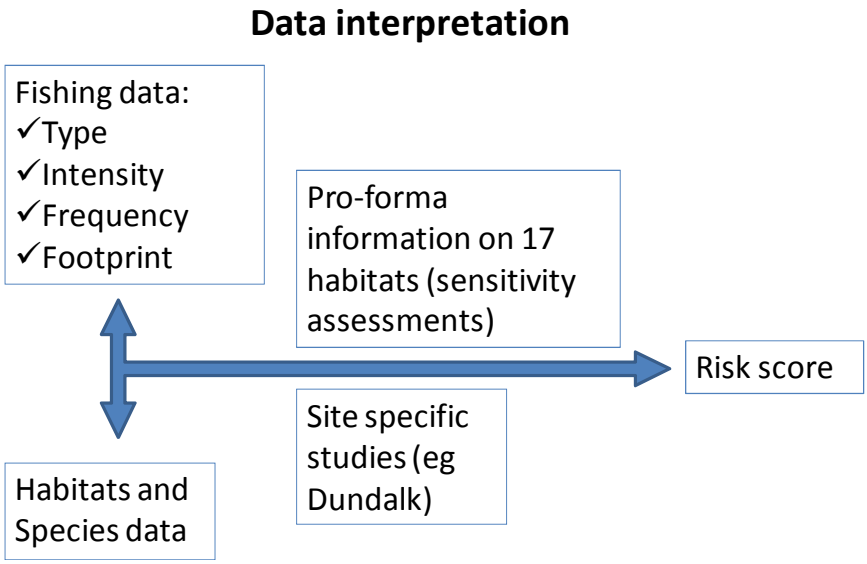

Fig. 4. Data interpretation and derivation of risk score. Sensitivity of habitats to physical disturbance is documented and combined where available with site specific studies to identify the consequence and likelihood of consequence of an effect occurring on designated features given the current profile of fishing activity

Output of the RA process

For each site the following outputs will be produced

1. Typology of fishing activity in the site
2. Lists of Gears, vessels, seasonality, target species
3. Maps of designated habitat and species information and conservation objectives
4. Maps showing overlap of fishing activities and designated features
5. Tabulated estimates of the overlap of activities and designated features
6. Qualitative conflict matrices for activities and designated features
7. Consequence and likelihood profiles (scores for each designated feature * activity combination) using the risk matrices described above
8. Tabular output of risk profile for the site (Table 5, Table 6).
9. Tabulated description of identified potential risks including supporting information used to derive the risk score.

Table 5. Hypothetical profile of risk to designated features due to fishing activities in a Natura 2000 site. The number of incidences is from a conflict matrix which identifies all possible interactions

(habitat * fisheries and species * fisheries). The risk profile is a point in time estimate and may change due to reduction or escalation of activity.

Risk	Incidences	Mitigation requirement
0	69	No mitigation required
1	6	Review mitigation requirement
2	3	
3	6	Review mitigation requirement
4	3	Review mitigation requirement
5	0	
6	7	
7	0	
8	0	Mitigation probably required
9	2	Mitigation probably required
10	0	
11	0	
12	2	Mitigation required
13	0	
14	0	
15	0	
16	1	Mitigation required

Table 6. Consequence, likelihood and risk scores for activity*habitat combinations

Activity	Habitat	Consequence	Likelihood	Risk
1	**A**	**1**	**3**	**3**
1	**B**	**3**	**3**	**9**
2	**B**	**2**	**3**	**6**
3	**A**	**2**	**4**	**8**
3	**C**	**4**	**4**	**16**
3	**D**	**4**	**1**	**4**

e. States

Habitat and species state is identified in the COs and supporting documents produced by NPWS. Status of some commercial species is known from fisheries survey.

f. Responses

The requirement for management measures increases as the consequence and likelihood of the consequence occurring increases. The profile of risk for the site therefore signals the level of management intervention that may be needed to mitigate the risk down to an acceptable level.

Management intervention would be indicated in cases of high consequence and likelihood scores (red areas in Tables 4 and 5) and high risk categories (Fig. 5 and Table 5) as summarised in Table 6. Medium level scores for consequence, likelihood and risk may require management intervention but such cases are not black and white and could be

discussed on a case by case basis or more information to inform the scoring of risk in these cases could be obtained through monitoring or research. Such monitoring may also be required where mitigations are introduced to reduce risk scores from high to medium or low to verify that the mitigations are effective. The design of mitigation is outside the scope of the RA process.

Table 6. Risk outcome categories and responses. Advice on management or mitigation is more precautionary for species than habitats. For species consequence is higher in orange cells than in yellow even if risk is similar.

	Habitat	Species	
Risk level	Risk scores	Risk scores	Management response
1	0	0	None
2	1_5	1_4	Mitigation case by case review
3	6_8	3_4	Mitigation probably needed
4	>8	>5	Mitigation required

References

EC (2012). Common methodology for assessing the impact of fisheries on marine Natura 2000. Service Contract No. 070307/2010/578174/SER/B. DGEnv Brussels.

Fletcher 2005. The application of qualitative risk assessment methodology to prioritize issues for fisheries management. *ICES J. Mar. Sci. 62, 1576-1587*

Annex I: Case study 1 Roaringwater Bay SAC

For background description of fisheries and maps of fishing distribution consult the Appropriate Assessment document of 2011.

Table 1 Potential conflict matrix for fisheries in RWBay. The type of pressure generated by the activity is listed in the table cells. The significance of such pressure and considering the sensitivity of the habitat to it, is colour coded. Red = most likely to be significant, green = least likely

	Designations 1170 and 1160									1230	4030	1351	1364	1355	8330
Metier	*Reef - exposed to moderately exposed intertidal*	*Reef - exposed to moderately exposed below 20m subtidal*	*Reef - sheltered intertidal and subtidal*	*Reef- Laminaria dominated communities*	*LSIB - Zostera dominated community*	*LSIB - Maerl dominated community*	*LSIB - Muddy sand with bivalves and polychaetes*	*LSIB - Mixed sediment*	*LSIB - Shallow sand/mud*	*Vegetated sea cliffs of the Atlantic and Baltic coasts*	*European dry heaths*	*Harbour porpoise*	*Grey seal*	*Otter*	*Sea caves*
Shrimp Potting	No overlap	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	No overlap	No overlap	None	None	None	No overlap
Crab Lobster potting	No overlap	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	No overlap	No overlap	None	None	Capture	No overlap
Crayfish tangle nets	No overlap	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	*Abrasion*	No overlap	No overlap	Capture, prey removal	Capture, prey removal	Capture	No overlap
Scallop dredging	No overlap	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	No overlap	No overlap	None	None	None	No overlap
Pelagic Jigging	No overlap	None	None	None	None	None	None	None	None	No overlap	No overlap	Prey removal	Prey removal		No overlap
Pelagic mid water trawl	No overlap	None	None	None	None	None	None	None	None	No overlap	No overlap	Capture, prey removal	Capture, prey removal		No overlap
Whitefish gill netting	No overlap	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	No overlap	No overlap	Capture, prey removal	Capture, prey removal	Capture	No overlap
Demersal trawling	No overlap	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	Abrasion	No overlap	No overlap	Capture, prey removal	Capture, prey removal	Prey removal	No overlap

Table 2. Habitat area and footprints (km^2) of individual metiers across each habitat and total metier footprint in the site.

	Designations 1170 and 1160									1230	4030	1351	1364	1355	8330	
Metiers	*Reef - exposed to moderately exposed intertidal*	*Reef - exposed to moderately exposed below 20m subtidal*	*Reef - sheltered intertidal and subtidal*	*Reef- Laminaria dominated communities*	*LSIB - Zostera dominated community*	*LSIB - Maerl dominated community*	*LSIB - Muddy sand with bivalves and polychaetes*	*LSIB - Mixed sediment*	*LSIB - Shallow sand/mud*	*Vegetated sea cliffs of the Atlantic and Baltic coasts*	*European dry heaths*	*Harbour porpoise*	*Grey seal*	*Otter*	*Sea caves*	*Total foot print*
Habitat area	**3.25**	**12.78**	**0.06**	**18.81**	**1.19**	**0.96**	**24.07**	**32.05**	**33.35**							
Shrimp Potting	0.00	10.74	0.01	10.72	1.09	0.88	19.01	23.45	21.10	0.00	0.00	All metiers potentially overlap with all designated species but the spatial overlap is not fixed and therefore cannot be calculated			0	87.00
Crab Lobster potting	0.00	11.76	0.01	10.83	0.41	0.09	21.34	22.14	10.17	0.00	0.00				0	76.75
Crayfish tangle nets	0.00	1.78	0.00	0.66	0.00	0.00	0.32	0.98	0.00	0.00	0.00				0	3.74
Scallop dredging	0.00	2.64	0.05	2.83	0.10	0.04	1.16	7.56	7.92	0.00	0.00				0	22.29
Pelagic Jigging	0.00	3.41	0.00	2.83	0.00	0.00	0.56	3.33	2.54	0.00	0.00				0	12.67
Pelagic mid water trawl	0.00	4.89	0.00	3.00	0.00	0.00	5.05	12.67	2.81	0.00	0.00				0	28.42
Whitefish gill netting	0.00	2.27	0.00	0.56	0.00	0.00	0.75	0.81	0.30	0.00	0.00				0	4.68
Demersal trawling	0.00	5.47	0.00	3.48	0.00	0.00	20.24	16.89	1.65	0.00	0.00				0	47.73

Table 3. Percentage overlap of fishing metier and individual habitats. Overlaps >15% are highlighted.

	Designations1170 and 1160									1230	4030	1351	1364	1355	8330
Metiers	*Reef - exposed to moderately exposed intertidal*	*Reef - exposed to moderately exposed below 20m subtidal*	*Reef - sheltered intertidal and subtidal*	*Reef- Laminaria dominated communities*	*LSIB - Zostera dominated community*	*LSIB - Maerl dominated community*	*LSIB - Muddy sand with bivalves and polychaetes*	*LSIB - Mixed sediment*	*LSIB - Shallow sand/mud*	*Vegetated sea cliffs of the Atlantic and Baltic coasts*	*European dry heaths*	*Harbour porpoise*	*Grey seal*	*Otter*	*Sea caves*
Shrimp Potting	0	84	10	57	92	92	79	73	63	0	0	All metiers potentially overlap with all designated species but the spatial overlap is not fixed and therefore cannot be calculated			0
Crab Lobster potting	0	92	22	58	34	9	89	69	30	0	0				0
Crayfish tangle nets	0	14		3	0	0	1	3	0	0	0				0
Scallop dredging	0	21	73	14	6	4	5	23	17	0	0				0
Pelagic Jigging	0	27		15	0	0	2	10	8	0	0				0
Pelagic mid water trawl	0	38		16	0	0	21	40	8	0	0				0
Whitefish gill netting	0	18		3	0	0	3	3	1	0	0				0
Demersal trawling	0	43		18	0	0	84	53	5	0	0				0

Table 4. Units of fishing effort potential per metier by month. The fishing unit definition varies across metiers because of variable data availability. Units per km^2 is the number of effort units per km^2 of habitat and is an index of the intensity of gear use on the habitat. Other than for VMS data the intensity is presumed to be the same across all habitats on which the activity occurs. There is no finer spatial scale data on effort distribution for vessels under 15m (under 12m from Sept 2013) to disaggregated effort distribution at a finer scale.

			Units per month													**Intensity**
Metiers	**Units**	**Active months**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average units per active month	Units per km^2
Shrimp Potting	*Pots*	8	9250	10400	7000	0	0	0	0	13468	13335	13482	13513	12526	11622	133.58
Crab Lobster potting	*Pots*	12	2700	2700	5376	6225	7097	7779	7774	7259	7259	7258	7258	6824	6292	81.98
Crayfish tangle nets	*Boats*	12	1	1	1	4	6	5	5	5	5	4	3	2	4	0.94
Scallop dredging	*Dredges*	9	18	20	19	9	3	0	0	0	3	7	9	14	11	0.51
Pelagic Jigging	*Boats*	12	2	3	3	7	10	12	12	10	10	3	2	2	6	0.50
Pelagic mid water trawl	*Boats*	7	3	3	2	0	0	0	0	0	2	2	3	3	3	0.09
Whitefish gill netting	*Boats*	12	6	6	6	7	5	3	4	4	5	6	4	4	5	1.07
Demersal trawling	*Boats*	12	4	4	4	4	4	4	4	4	4	4	4	4	4	0.08

Table 5. Consequence, likelihood and risk scores and evaluation of the interaction of fishing metiers and designated habitats and species in RWBay.

Metier	Feature	Habitat species	Consequence	Likelihood	Risk	Risk evaluation
Shrimp Potting	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Zostera dominated community	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Maerl dominated community	*H*	4	2	16	Cumulative disturbance probable
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	1	1	1	Likelihood of individual capture rare
	Sea caves	*H*				
Crab Lobster potting	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Zostera dominated community	*H*	3	1	3	Cumulative disturbance unlikely
	LSIB - Maerl dominated community	*H*	4	1	4	Cumulative disturbance unlikely
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk

	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	1	2	2	Likelihood of individual capture possible
	Sea caves	*H*				
Crayfish tangle nets	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	3	3	Likelihood of individual capture probable
	Grey seal	*S*	1	3	3	Likelihood of individual capture probable
	Otter	*S*	0	4	0	No risk. Nets in deep water
	Sea caves	*H*				
Scallop dredging	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	3	9	Persistent disturbance probable
	Reef - sheltered intertidal and subtidal	*H*	0	3	0	No risk
	Reef- Laminaria dominated communities	*H*	3	3	9	Persistent disturbance probable

	LSIB - Zostera dominated community	*H*	4	3	12	Persistent disturbance probable
	LSIB - Maerl dominated community	*H*	4	3	12	Persistent disturbance probable
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk. Does not occur in this habitat
	LSIB - Mixed sediment	*H*	2	3	6	Non-cumulative disturbance probable
	LSIB - Shallow sand/mud	*H*	0	3	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	0	4	0	No risk
	Sea caves	*H*				
Pelagic Jigging	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	0	4	0	No risk
	Grey seal	*S*	0	4	0	No risk
	Otter	*S*	0	4	0	No risk
	Sea caves	*H*				
Pelagic trawl	*Reef - exposed to moderately exposed intertidal*	*H*				

	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	1	1	Likelihood of individual capture unlikely
	Grey seal	*S*	1	1	1	Likelihood of individual capture unlikely
	Otter	*S*	1	0	0	No risk
	Sea caves	*H*				
Whitefish gill netting	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	0	4	0	No risk
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	3	3	Likelihood of individual capture probable

	Grey seal	*S*	1	3	3	Likelihood of individual capture probable
	Otter	*S*	0	3	0	No risk, nets in deep water
	Sea caves	*H*				
Demersal trawling	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	3	2	6	Persistent disturbance possible
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	3	2	6	Persistent disturbance possible
	LSIB - Zostera dominated community	*H*	0	4	0	No risk
	LSIB - Maerl dominated community	*H*	0	4	0	No risk
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	3	2	6	Persistent disturbance possible
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk
	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	1	1	Likelihood of individual capture rare
	Grey seal	*S*	1	1	1	Likelihood of individual capture rare
	Otter	*S*	1	0	0	No risk
	Sea caves	*H*				
Trammel netting	*Reef - exposed to moderately exposed intertidal*	*H*				
	Reef - exposed to moderately exposed below 20m subtidal	*H*	0	4	0	No risk
	Reef - sheltered intertidal and subtidal	*H*	0	4	0	No risk
	Reef- Laminaria dominated communities	*H*	1	1	1	Disturbance unlikely
	LSIB - Zostera dominated community	*H*	4	1	4	Likelihood of activity very low
	LSIB - Maerl dominated community	*H*	4	1	4	Likelihood of activity very low
	LSIB - Muddy sand with bivalves and polychaetes	*H*	0	4	0	No risk
	LSIB - Mixed sediment	*H*	0	4	0	No risk
	LSIB - Shallow sand/mud	*H*	0	4	0	No risk

	Vegetated sea cliffs of the Atlantic and Baltic coasts	*H*				
	European dry heaths	*H*				
	Harbour porpoise	*S*	1	2	2	Likelihood of individual capture possible
	Grey seal	*S*	1	2	2	Likelihood of individual capture possible
	Otter	*S*	1	3	3	Likelihood of individual capture probable
	Sea caves	*H*				

*Table 6. Summary risk score table indicating the number of incidences (fishing activity * designated feature interaction) at each risk score. Refer to Table 5 above for details. Both Habitats and Species risk assessments are included.*

Risk	Incidences	Mitigation requirement
0	69	No mitigation required
1	6	Review mitigation requirement
2	3	
3	6	Review mitigation requirement
4	3	Review mitigation requirement
5	0	
6	7	
7	0	
8	0	Mitigation probably required
9	2	Mitigation probably required
10	0	
11	0	
12	2	Mitigation required
13	0	
14	0	
15	0	
16	1	Mitigation required

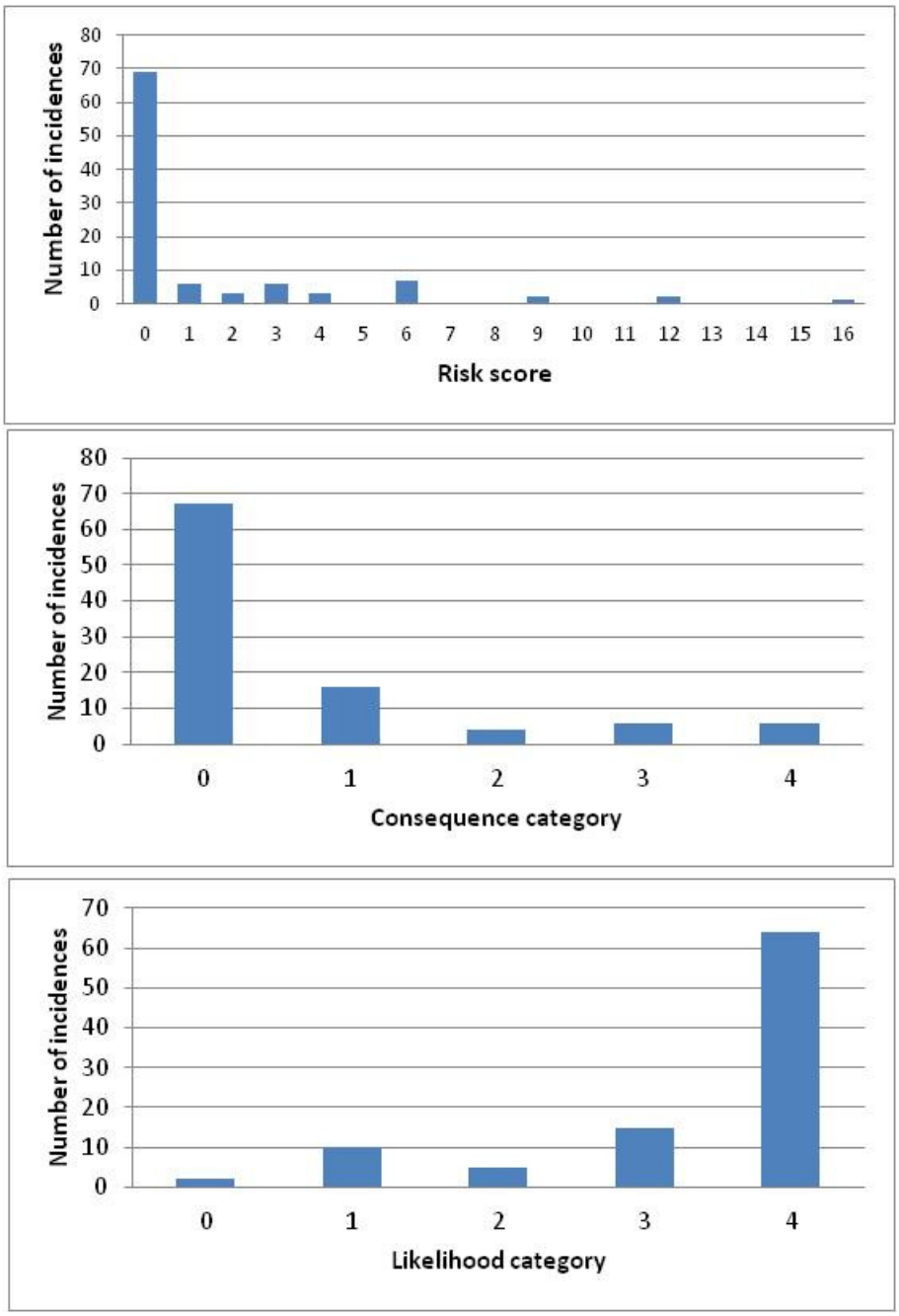

Fig. 1. Profile of risk of interaction between designated features and fishing metiers in RWBay.

Annex II: Case study 2 Dundalk Bay SPA in relation to the cockle fishery

In this case study the risk posed by the cockle fishery to overwintering waterbirds at the site is assessed under two scenarios; in an unregulated fishery as was the case prior to 2007 and under the current fishery natura plan which imposes a number of legally binding conditions on the activity of the fishery and provides for annual review of fishing activity based on regulatory and environmental monitoring. This comparison tests the logic and sensitivity of the RA framework and scoring outputs to fishery management measures.

For a background description of the fishery and the management measures see the Appropriate Assessment of Dundalk Bay SAC/SPA and associated Annexes.

The main management measures (harvest control rules) in the fishery plan are

1. ***The fishery does not open when the biomass of cockles at the site is <800 tonnes***
2. ***The proportion of the biomass of cockles that can be removed is 0.33***
3. ***The fishery closes when the catch rate declines to 250kg per boat per day***
4. ***The minimum landing size is legally 17mm but operationally is 22mm***
5. ***Opening and closing dates are set each year***
6. ***The number of fishing permits is limited to 32***
7. ***Fishing occurs on one tide per day***

The environmental monitoring programme includes the following

1. ***Cockle biomass, distribution and size and age structure is estimated in May-June each year***
2. ***Distribution and abundance of characterising bivalves and the polychaete Arenicola is mapped in May-June***
3. ***The polychaete:bivalve ratio is estimated from core samples in May-June***
4. ***Dedicated low tide bird counts are completed monthly (these are in addition to iWeBs high tide counts)***
5. ***The feeding behaviour of oystercatcher has been studied for 2 years***
6. ***In some years a post fishery cockle survey is completed***
7. ***Short and medium term effects on benthos have been studied***
8. ***Shell damage and mortality of discarded bivalves is periodically assessed by targeted sampling in dredge tracks and control areas***

Table 7. Risk scores for the cockle fishery on each of the SPA conservation interests in the Dundalk Bay SPA. Risk scores are colour coded as in the scoring matrices in Table 4 in the RA framework. Red indicates a requirement for mitigation, orange a probable need for mitigation.

COCKLE DREDGING						
No fishery management plan (prior to 2007)	**Trophic group prey**	**Bivalves >20% of diet**	**Consequence**	**Likelihood**	**Risk**	**Risk evaluation**
Great crested grebe (Podiceps cristatus) – wintering	Piscivore		1	3	3	Individuals may be impacted; reduction in fish prey possible
Greylag goose (Anser anser) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Light-bellied brent goose (Branta bernicla hrota) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Shelduck (Tadorna tadorna) – wintering	Invertebrates	Y	0	3	0	No overlap between feeding areas and fishery
Teal (Anas crecca) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Mallard (Anas platyrhynchos) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Pintail (Anas acuta) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Common scoter (Melanitta nigra) –wintering	Bivalves		1	2	2	Individuals unlikely to be impacted; little overlap with fishery
Red-breasted merganser (Mergus serrator) – wintering	Piscivore		1	3	3	Individuals may be impacted; reduction in fish prey possible
Oystercatcher (Haematopus ostralegus) – wintering	Bivalves	Y	3	4	12	Population decline due to prey removal and habitat change probable
Ringed plover (Charadrius hiaticula) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Golden plover (Pluvialis apricaria) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Grey plover (Pluvialis squatarola) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Lapwing (Vanellus vanellus) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Knot (Calidris canutus) – wintering	Bivalves	Y	3	4	12	Population decline due to prey removal and habitat change probable
Dunlin (Calidris alpina) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change

						possible
Black-tailed godwit (Limosa limosa) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Bar-tailed godwit (Limosa lapponica) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Curlew (Numenius arquata) – wintering	Invertebrates	Y	3	3	9	Population decline due to prey removal and habitat change possible
Redshank (Tringa totanus) – wintering	Invertebrates		3	3	9	Population decline due to prey removal and habitat change possible
Black-headed gull (Chroicocephalus ridibundus) – wintering	Invertebrates and Fish	Y	1	3	3	Negative and positive effects possible
Common gull (Larus canus) – wintering	Invertebrates and Fish	Y	1	3	3	Negative and positive effects possible
Herring gull (Larus argentatus) – wintering	Invertebrates and Fish	Y	1	3	3	Negative and positive effects possible
Wetlands and waterbirds (Habitat score)			3	3	9	Cumulative habitat changes due to protracted fishing season possible
Cockle management plan in place (post 2007)	**Trophic group prey**	**Bivalves >20% of diet**	**Consequence**	**Likelihood**	**Risk**	**Risk evaluation**
Great crested grebe (Podiceps cristatus) – wintering	Piscivore		1	2	2	Individuals unlikely to be impacted; reduction in fish prey unlikely
Greylag goose (Anser anser) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Light-bellied brent goose (Branta bernicla hrota) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Shelduck (Tadorna tadorna) – wintering	Invertebrates	Y	0	3	0	No overlap between feeding areas and fishery
Teal (Anas crecca) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Mallard (Anas platyrhynchos) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Pintail (Anas acuta) – wintering	Plants/invertebrates		0	3	0	No overlap between feeding areas and fishery
Common scoter (Melanitta nigra) –wintering	Bivalves		1	2	2	Individuals unlikely to be impacted; little overlap with fishery
Red-breasted merganser (Mergus serrator) – wintering	Piscivore		1	2	2	Individuals unlikely to be impacted; reduction in fish prey unlikely

Oystercatcher (Haematopus ostralegus) – wintering	Bivalves	Y	1	2	2	Sub-lethal effects on individuals due to reduced prey biomass unlikely
Ringed plover (Charadrius hiaticula) – wintering	Invertebrates		1	2	2	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Golden plover (Pluvialis apricaria) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Grey plover (Pluvialis squatarola) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Lapwing (Vanellus vanellus) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Knot (Calidris canutus) – wintering	Bivalves	Y	1	2	2	Sub-lethal effects on individuals due to reduced prey biomass unlikely
Dunlin (Calidris alpina) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Black-tailed godwit (Limosa limosa) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Bar-tailed godwit (Limosa lapponica) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Curlew (Numenius arquata) – wintering	Invertebrates	Y	1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Redshank (Tringa totanus) – wintering	Invertebrates		1	3	3	Sub-lethal effects on individuals due to seasonal habitat disturbance unlikely
Black-headed gull (Chroicocephalus ridibundus) – wintering	Invertebrates and Fish	Y	1	3	3	Antagonistic negative and positive effects possible
Common gull (Larus canus) – wintering	Invertebrates and Fish	Y	1	3	3	Antagonistic negative and positive effects possible
Herring gull (Larus argentatus) – wintering	Invertebrates and Fish	Y	1	3	3	Antagonistic negative and positive effects possible
Wetlands and waterbirds (Habitat score)			2	4	8	Seasonal changes in characterising species probable

Table 8. Frequency distribution of risk scores for the cockle fishery on SPA conservation interests prior to and post the implementation of the cockle fishery natura plan (scores from Table 7)

Risk	No plan	With plan
0	6	6
1	0	0
2	1	6
3	5	11
4	0	0
5	0	0
6	0	0
7	0	0
8	0	1
9	10	0
10	0	0
11	0	0
12	2	0
13	0	0
14	0	0
15	0	0
16	0	0

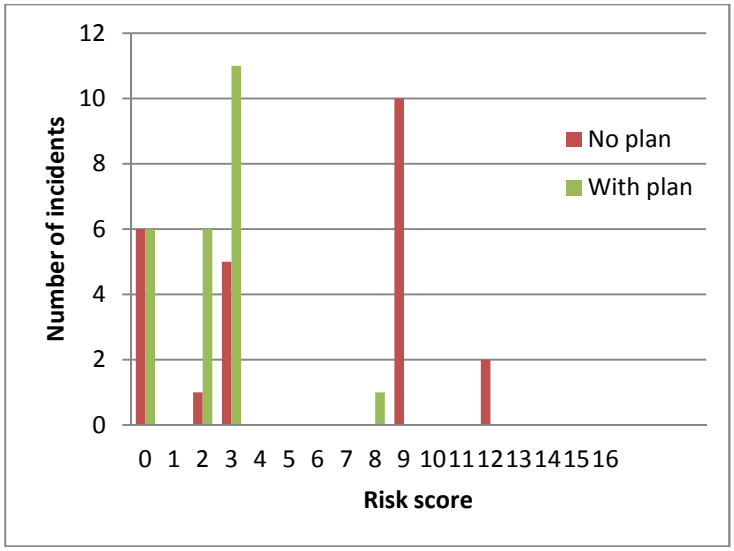

Fig. 2. Frequency distribution of risk scores for the cockle fishery on SPA conservation interests prior to and post the implementation of the cockle fishery natura plan. Data from Table 8.