



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

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Version 1.3

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## 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 General conceptual model. The methodology presented in this document refers to the part inside the grey square.

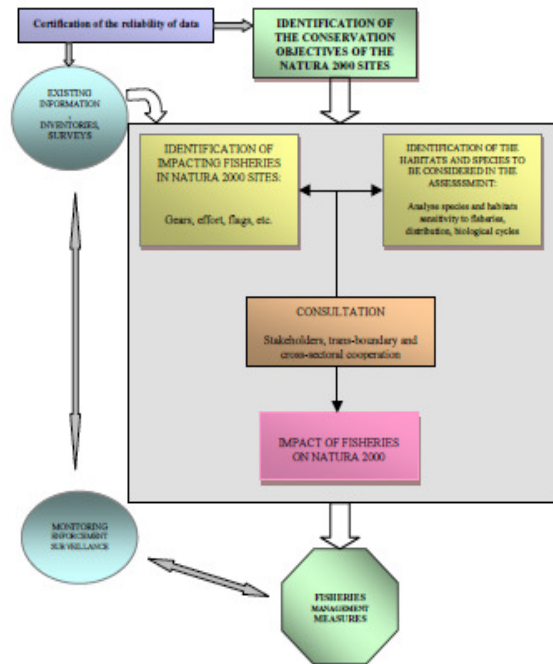


Fig. 1. From the EC guidance on assessing interaction of fisheries and Natura 2000 sites. The assessment of risk is limited to the area within the grey box. Management measures are outside the scope of the risk assessment process.

Fig.2 Methodology protocol (it covers the grey part of Figure 1).

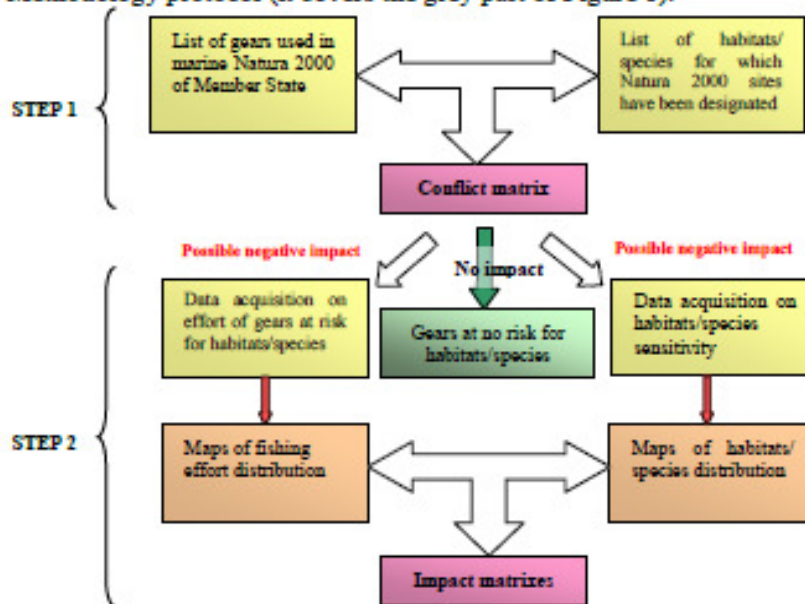


Fig. 2. From the EC guidance on assessing interaction of fisheries and Natura 2000 sites. Maps of fishing activities and designated features are used to construct impact matrices

## 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	High					High	Low
Bottom trawling	High	Medium	Low		Abrasion	Medium	Low	
Mid-water trawling	Low		High	Medium			Entanglement	
Tangle nets	Low		High	Medium			Low	
Bottom set Gill nets	Low		High	Medium			Low	
Pots	Medium			Low			Low	
Lines							Low	

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 <sup>2</sup> )					
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					
		1	2	3	4	5	....
	Units	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 dredging	Dredges						
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 <sup>2</sup> (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<sup>2</sup>)
- ✓ Duration or frequency of activity (months per year, number of days per year)
- ✓ Intensity (effort.km<sup>-2</sup> 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**

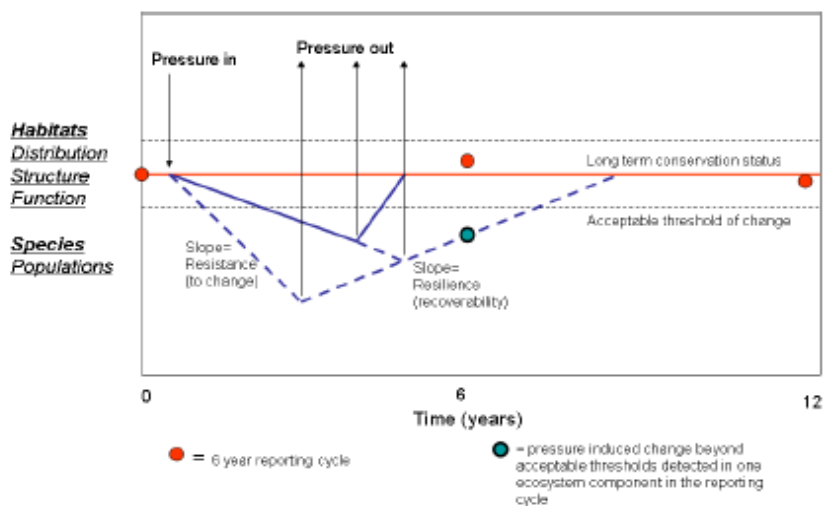
The potential impact of a fishery on a designated feature arises from the type, intensity, footprint and frequency of the activity, the pressures this activity generates and the sensitivity of the feature affected.

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 present or has no contact with habitat	Activity occurs and is in contact with habitat	Up to 15% overlap of fishery and habitat seasonally.	Over 15% overlap of fishery and habitat seasonally.	Over 15% of habitat disturbed persistently leading to cumulative impacts	Impact is effectively permanent due to severe habitat alteration.
No change due to fishing activity can occur			Individual effects on characterising species but this is undetectable relative to background natural variability	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	%	Level	0	1	2	3	4	5
Highly likely	>95	5	0	5	10	15	20	25
Probable	50-95	4	0	4	8	12	16	20
Possible	20-50	3	0	3	6	9	12	15
Unlikely	1-20	2	0	2	4	6	8	10
Remote	1	1	0	1	2	3	4	5

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
  - 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 are 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 6 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.**

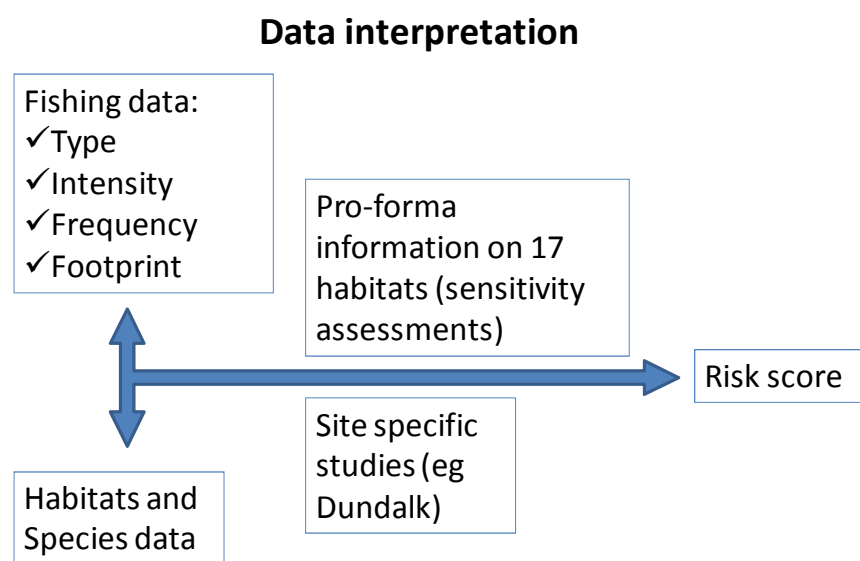
**Table 4. Matrix of conditional probability (consequence \* likelihood), and associated risk scores, for impacts to Annex species.**

Species			Consequence criteria					
			Activity is not present and individuals or population cannot be affected	Activity present. Individuals in the population affected but effect not detectable against background natural variability	Direct or indirect mortality or sub-lethal effects caused to individuals by the activity but population remains self-sustaining	In site population depleted by the activity but regularly sub-vented by immigration. No significant pressure on the population from activities outside the site	Population depleted by the activity both in the site and outside of the site. No immigration or reduced immigration	Population depleted and supporting habitat significantly depleted and unable to continue to support the population
Likelihood	%	Level	0	1	2	3	4	5
Highly likely	>95	5	0	5	10	15	20	25
Probable	50-95	4	0	4	8	12	16	20
Possible	20-50	3	0	3	6	9	12	15
Unlikely	1-20	2	0	2	4	6	8	10
Remote	1	1	0	1	2	3	4	5

## 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 (through contact with industry, BIM, SFPA and other sources of local knowledge)
  - a. (Boats, gears, quantities, seasonality, locations)
  - b. VMS, landings by port, buyers and sellers data,
3. Map fisheries data
4. Calculate overlaps with habitats
5. Produce evidence based risk scores (Fig. 4)
  - a. Produce a risk score (consequence \* likelihood) for each fishery \* habitat or fishery \* species interaction
  - b. Documented information on habitat or species sensitivity to the activities (pressures) will be used to inform the scoring of risk
  - c. Site specific studies will be given highest weight in risk scoring where available
6. 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 where available

3. GeoDatabase of fishing activities and marine communities
4. Maps of designated habitat and species information and conservation objectives
5. Maps showing overlap of fishing activities and designated features
6. Tabulated estimates of the overlap of activities and designated features
7. Qualitative conflict matrices for activities and designated features
8. Consequence and likelihood profiles (scores for each designated feature \* activity combination) using the risk matrices described above
9. Tabular output of risk profile for the site (Table 5).
10. 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 conditional risk 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 level	Habitats	Species
0	5	5
1	20	3
2		
3		
4		
5		
6		2
8		
9		1
10		
12		1
15	3	1
16		1
20	1	
25	1	

**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 3 and 4) and high risk categories (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. Monitoring is not mitigation but could be an acceptable response where the risk profile for the protected feature is low or medium and where there is no imminent threat to the feature. The purpose here would be to increase confidence in the risk score. 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. Draft mitigation plans will be published for statutory and public consultation, in response to the risk assessment, by DAFM.

**Table 6. Risk outcome categories and responses. Advice on management or mitigation is more precautionary for species than habitats.**

	Habitat	Species	
Risk level	Risk scores	Risk scores	Management response
1	0-5	0-5	None required
2	6_10	6_8	Mitigation case by case review
3	12_15	9_10	Mitigation probably needed
4	>15	>10	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