Assessment of the Potential Effects on Seabirds of a Proposed Windfarm on the Kish Bank

Adults roseate tern on a nest box at Rockabill Island, Co. Dublin

For: Saorgus Energy Ltd

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1 Preface

1.1 Summary

1.1.1 Background

Saorgus Energy Ltd plan to build a wind farm in the Irish Sea on the Kish/Bray Bank off Cos. Dublin and Wicklow. The Bank is about 10km offshore and it is less than 10m deep. It runs for 20km in an SSE direction from the Kish Light off Dublin Bay almost to the north west corner of the Codling Bank off Greystones in Co. Wicklow. It is intended to construct the wind-farm in a series of building “seasons”, concentrated over three or four consecutive years and avoiding the winter in each case. It is proposed to commence in the south of the area, work northward and assess any impact on the Roseate Tern in each season.

Ecology Consulting were commissioned to do a desk study and carry out bird surveys between September 2001 and September 2002 involving 14 boat surveys over an area up to 4 km around the Bank, 7 fixed point surveys at 10 points along the Bank, and 2 aerial surveys in March and April 2002 of an area about 20 km wide that extended from Lambay Island of north Co. Dublin south to Wicklow Head.

In the autumn of 2004, Coveney Wildlife Consulting was commissioned to provide an assessment of the likely effects on birds from the proposed turbines based on the survey results obtained in 2001 and 2002. The assessment was done as follows:-

- It was based mainly on the results from the moving and fixed point boat surveys because aerial survey data was only available for March and April.

- The assessment was done using a numerical method previously used for the Arklow and Codling Banks. It was done in the context of recent Irish Sea and international seabird population estimates.

- The assessment determined *potential* worst case scenarios, if, contrary to expectations, significant numbers of the birds either collide with turbines or are displaced from the Bank. For the suite of species that occur on the Kish Bank, there is no published *evidence* for or against such effects.

- The assessment was also done in the light of a comprehensive review of the relevant ecology of the birds of the Irish Sea and a review of the actual and predicted effects of many of the actual and proposed offshore wind farms in Europe.

1.1.2 Assessment of potential effects on birds

The assessment procedure for displacement effects involves a four step process to estimate maximum potential risk to the species. Firstly, the numbers of birds at risk in various scenarios were quantified from the survey data. Secondly, these numbers were then adjusted to take account of the conservation status of the species involved. This gives the sensitivity of the local populations. Next, judgements were made on the magnitude of likely effects. Finally, the sensitivities and magnitudes were combined to allow the significance of the risks to the birds to be assessed. This approach was applied to the peak numbers recorded on the whole Bank, and, for the more important species, to average numbers on the Bank, and to peak and average numbers in the central area between the Kish and Bray Banks. This showed that the roseate tern was very highly sensitive at all levels except for average numbers in the latter area where it was highly sensitive. Manx shearwaters, common terns, guillemots and razorbills were highly sensitive at the level of the peak numbers on the whole Bank. Only common tern was still highly sensitive at the average level on the whole Bank.

When magnitudes of effects are concerned, terns are generally considered to be at low risk from wind farms. Combining this low magnitude with common terns' high sensitivity gives a low assessment of the maximum significance of the likely effects on the species. As a precautionary measure, the magnitudes of effects on roseate tens was scored one level higher at medium risk. This gave a high assessment of potential effects at all levels down to average numbers in the centre of the survey area. However, the latter involves, on average, only about 4 birds. A worst case scenario involving a risk to these few birds is considerable acceptable, provided monitoring takes place. The risk to roseate terns on the southern part of the bank is considered acceptable as they made very little use of this part of the bank. The other highly sensitive species were judged to have medium or low magnitudes of risk. Therefore, they were not assessed as being liable to significant effects.

The field survey data did not give breakdowns of the proportions of high flying birds. Therefore a full assessment of the potential effects due to collisions was not carried out. However, results from the Arklow Bank have shown that the vast majority of Irish Sea species fly at less than 7m above the sea and of those above this height, most are below 20 m. This compares with a lowest blade tip height on the Kish/Bray Bank of 40m. Therefore, collision effects were predicted to be insignificant at the conservation level. Effects from loss of habitat are also considered to be insignificant because the turbines would occupy well under 1% of the Bank.

Mitigation measures involve commencing construction work as early as possible in the spring and with a projected completion date prior to the end of August, adherence to the proposed construction schedule, minimisation of the use of fast boats and helicopters to reduce disturbance to birds, best practices during construction and operation to avoid pollution by oil and litter, and best practices during construction to minimise turbine footprints, sediment disturbance and pollution.

1.1.3 Monitoring

Once a decision is taken to submit an application for approval of this project, monitoring should be begun again to increase the amount of pre-construction baseline data. This should comprise monthly boat surveys, except for the critical tern periods in May, August and September, when the frequency should be twice monthly. It should be done in the same way as in 2001/02 to ensure the comparability of results.

There should also be weekly counts at dusk and dawn of the tern roost site on the Merrion and Sandymount Strand in Dublin Bay from late July to the end of September. It is likely that the terns which use the Kish/Bray Bank roost on the Strand in the evenings. The counts should be coordinated with watches from the Dalkey coast to determine the terns' flight directions.

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Photographs were taken by John Coveney. Copyright of all images belongs to Coveney Wildlife Consulting Ltd. Drawings of birds were by Eugene Archer.

2 Introduction

2.1 Background

Saorgus Energy Ltd plan to build a wind farm in the Irish Sea on the Kish/Bray Bank off Cos. Dublin and Wicklow. This bank, which is less than 10m below the surface, is about 10km offshore. It runs for 20km in an SSE direction from the Kish Light off Dublin Bay almost to the north west corner of the Codling Bank off Greystones in Co. Wicklow (See Figure 1 of Percival et al 2002). It is intended to construct the wind-farm in a series of building "seasons", concentrated over three or four consecutive years and avoiding the winter in each case. It is proposed to commence in the south of the area.

Ecology Consulting were commissioned to do a desk study carry out bird surveys between September 2001 and September 2002 (Percival et al 2002). These surveys comprised

1. Fourteen boat surveys over the full year. Bad weather prevented boat surveys from being done in October 2001 and January & February 2002. The boat survey covered an area up to 4 km around the Bank.

2. Seven fixed point surveys between September 2001 and May 2002 at 10 points along the Bank

3. Two aerial surveys in March and April 2002. The aerial survey covered an area about 20 km wide and extended from Lambay Island of north Co. Dublin south to Wicklow Head.

In the autumn of 2004, Coveney Wildlife Consulting was commissioned to provide an assessment of the likely effects on birds from the proposed turbines based on the survey results obtained in 2001 and 2002.

2.2 Rationale for the Assessment

- The assessment was done principally using the data from the moving and fixed point boat surveys. The two months of aerial survey data is of limited value because it does not extend over the whole year.

- The assessment was done using the same numerical method used for the Arklow and Codling Banks (CWC 2002 & 2003). Some of these methods are modified and considerably extended from those developed for the British Wind Energy Association and Scottish Natural Heritage for assessment of terrestrial wind farms in sensitive bird areas in Scotland (Percival et al 1999).

- The assessment was done in the context of recent figures for the Irish Sea and international populations of the relevant bird species (Mitchell et al 2004). The results of the assessment for the Kish are also compared the published in EISs for the Arklow and Codling Banks.

- The assessment of the importance of the site will be used to determine *potential* worst case scenarios if, contrary to expectations, significant numbers of the birds either collide with turbines or are displaced from the Bank. It must be stressed that, for the suite of species that occur on the Kish Bank, BirdLife International have reported there is no *evidence* for or against such effects (Langston & Pullan 2003).

- The assessment has been done in the light of a comprehensive review of the relevant ecology of the birds of the Irish Sea

- A comprehensive review of the actual and predicted effects of many of the actual and proposed offshore wind farms in Europe.

The assessment follows these two reviews.

3 Existing data on protected species

There are currently no conservation designations in the Kish/Bray Bank area.

3.1 Bird conservation areas in the Irish Sea

No offshore Special Protection Areas (SPAs) have been designated or proposed anywhere in Ireland, including the Kish/Bray Bank area, for marine birds listed on Annex I of the EU Birds Directive (79/409). Listing of a bird species on Annex I requires member states to take "*special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution*". Similar measures must also be taken for migratory species. All existing SPAs for marine birds in Ireland relate to their breeding areas and waters immediately adjacent to them. Similarly, there are no proposed Natural Heritage Areas (pNHAs, the developing national conservation designation system) for marine birds in offshore areas on the informal listings proposed to date. Table 1 lists nature conservation areas along the Wicklow and Dublin coasts and their ornithological significance

3.2 Summary of the status of seabirds in the Irish Sea

Knowledge of breeding seabird sites and populations around Britain and Ireland has developed from national surveys in the late 1960's and early 1970's (Cramp *et al.* 1974) and again in the mid 1980's (Lloyd *et al.* 1991). In addition, all-Ireland surveys of terns have been done in 1985 and 1995 (Hannon et al 1995). A further British and Irish breeding seabird survey, Seabird 2000, started in 1999 and was completed in 2001 and the report on this has been published recently (Mitchell et al 2004).

Gathering of information on seabirds at sea developed later. However, the work of the JNCC in the 1990's has provided good baseline information on seabird distributions in the Irish Sea at a broad scale (Pollock *et al.* 1997). A local study of seabirds on the Kish Bank off Co. Dublin showed that auk densities were up to 10 times the peaks recorded by JNCC. Tern densities, especially of the threatened roseate tern, were also much higher than those of JNCC (Newton & Crowe 1999).

Table 1. Nature conservation areas on the Wicklow & Dublin coasts[1]

Name[2]	Conservation status			Ornithological conservation significance	Distance[3] from wind farm (km)
Co.Dublin[4]					
Rockabill	pNHA[5]	SPA[6]		Breeding seabirds (esp. Roseate Terns)	40.7
Lambay	pNHA	SPA	SAC[6]	Breeding seabirds, wildfowl & grey seal	28.2
Irelands eye	pNHA		SAC	Breeding seabirds	21
Irish Sea Front[7]				Seabird concentration	17 +
Howth head	pNHA		SAC	Breeding seabirds	17
North Dublin Bay inc. North Bull Island	pNHA	SPA	SAC	Waterfowl & breeding birds	20
South Dublin Bay inc. Sandymount Strand	pNHA	SPA	SAC	Waterfowl & tern roost site	21
Kish Bank[8]				Auk & tern concentrations	
Co.Wicklow					
Bray Head	pNHA		SAC	Breeding seabirds	12
The Murrough	pNHA	SPA	SAC	Waterfowl & breeding little terns	20
Wicklow Reef			SAC	Non-ornithological	30
Wicklow Head	pNHA	pSPA		Breeding seabirds	30
Magherabeg Dunes	pNHA		SAC	Non-ornithological	34.7
Buckroney-Brittas Dunes & Fen	pNHA		SAC	Non-ornithological	42.5
Arklow Town Marsh	pNHA			Non-ornithological	51.6
Arklow Sand Dunes	pNHA			Non-ornithological	51.6
Arklow Rock	pNHA			Non-ornithological	53.3

[1] Information from http://www.ealga.ie/en/NaturalHeritage/SACsSPAs/SACSPASiteInformation unless otherwise stated.

[2] Sites listed from north to south. Location of seabird sites in Cos. Dublin and Wicklow are shown in Figure 1

[3] Approximate distances from the nearest point of the conservation area to the junction of the Kish and Bray Banks.

[4] Only offshore sites north of Howth Head are listed.

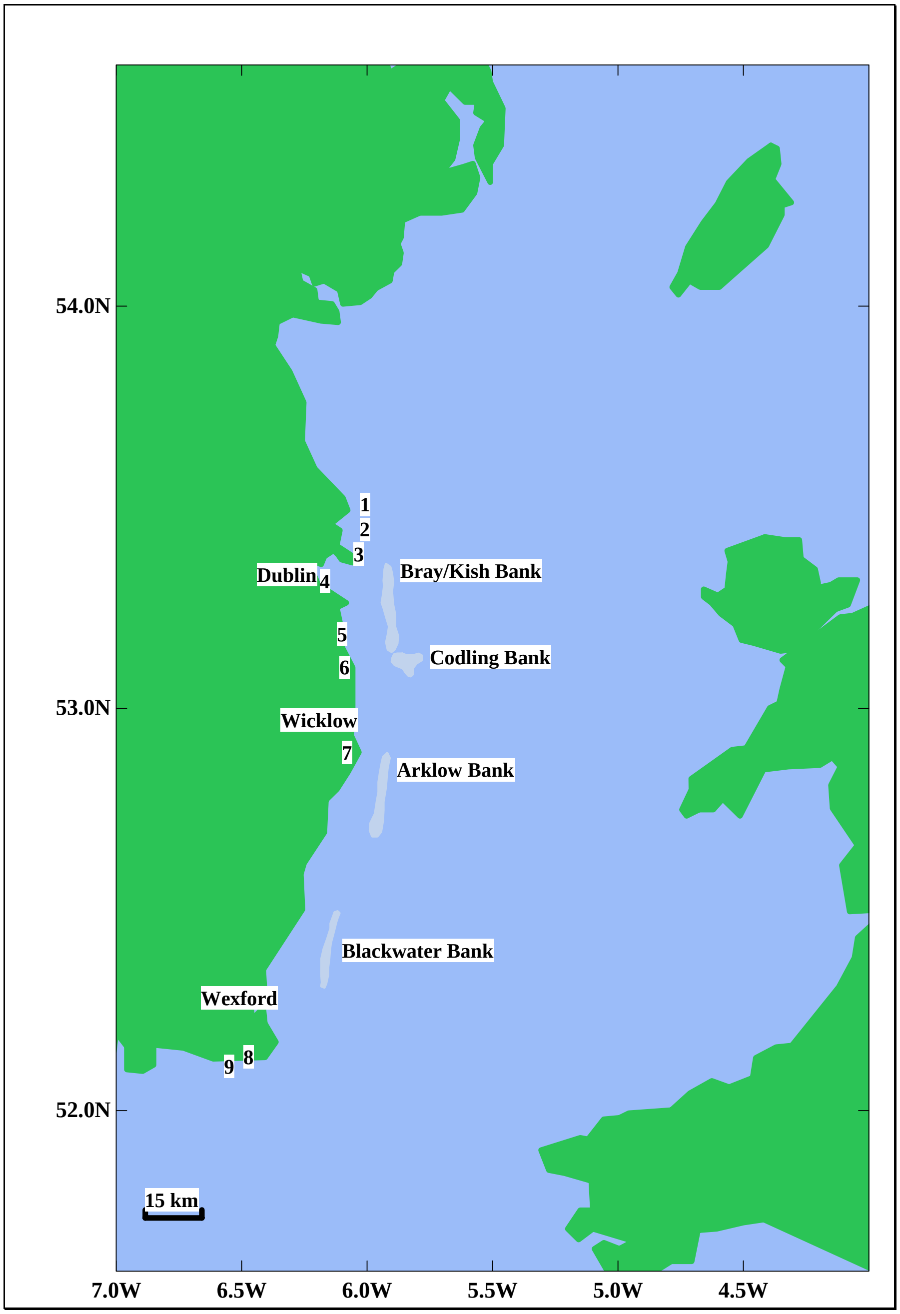
[5] All the proposed Natural Heritage Areas (pNHAs) in this table relate to terrestrial sites, not offshore ones

[6] SPAs are Special Protection Areas designated under the EU Birds Directive (79/409/EEC) (pSPA = proposed SPA). SACs are Special Areas of Conservation designated under the EU Habitats Directive (92/43/EEC).

[7] Begg & Reid 1977, Pollock et al 1997

[8] Newton & Crowe 1999.

Figure 1. Offshore banks and seabird colonies in the western Irish Sea



Seabird colonies in the western Irish Sea

Colony[1]	**Important species** and selected other species
1. Rockabill	**Roseate tern,** common tern, Arctic tern, kittiwake.
2. Lambay Island	**Cormorant**, **shag**, **guillemot**, **razorbill**, herring gull.
3. Ireland's Eye	Gannet, cormorant, guillemot, razorbill.
4. Sandymount Strand	**Evening roost of several thousand terns in early autumn**
5. Bray Head	Kittiwakes
6. Kilcoole	**Little tern.**
7. Wicklow Head	Kittiwake, guillemot, razorbill.
8. Lady's Island Lake	**Roseate tern, sandwich tern**, common & arctic tern, black-headed gull.
9. Saltee Islands	**Gannet, cormorant, guillemot**, **razorbill**.

[1]. Breeding sites, except for Sandymount Strand

3.3 Migration routes of seabirds in the Irish Sea

Seabird migration routes through the Irish Sea are not well defined and it is not known if these involve more than local birds. Migratory concentrations do not occur in the same manner as on the west and southwest coast of Ireland. This probably reflects both smaller numbers and the lack of geographical features and prevailing onshore winds that concentrate migratory flows in the west and southwest. Perhaps the main migratory feature is the concentration of large numbers of Manx shearwaters and auks on the Irish Sea front, between Dublin and the Isle of Man, in late summer. However, this could be a relatively short range movement of British and Irish birds (Begg & Reid 1997, Hutchinson 1989, Pollock et al 1997).

3.4 Overview of seabirds in the Irish Sea

The species accounts below give general information on distributions and populations of seabirds in the Irish Sea. This information is summarised in Table 2. The species accounts and the summary table have been updated to take account of the recently published report on the Seabird 2000 survey (Mitchell at al, 2004). Numbers recorded on the Kish and Bray Bank are not discussed here but are covered in the assessment section of this report.

3.4.1 Red-throated diver

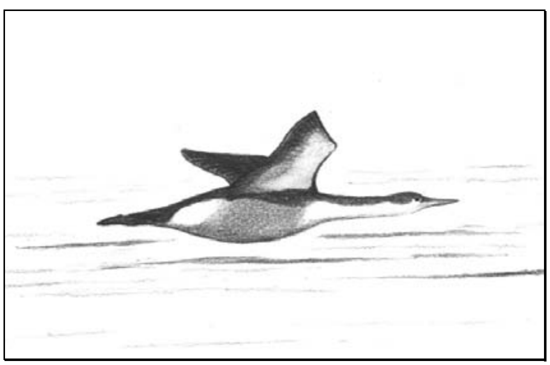


Figure 2. Winter-plumaged red-throated diver

The red-throated diver has a circumpolar breeding distribution that reaches its southern European limits in Donegal. It nests on the edges of pools, lakes and sheltered marine inlets in treeless terrain. It winters on most European coasts from Norway to the northern Mediterranean. Its biogeographic population is is now listed at 1,000,000 (Delany & Scott 2002), which is a considerable increase on the previous figure of 75,000 (Colhoun 2001). This has the effect of reducing the significance of the birds recorded in the Study Area

In Cos. Dublin, Wicklow and Wexford, the main wintering concentrations are in Wexford Bay, Brittas Bay in Co. Wicklow and off the North Wicklow Coastal Marshes with mean peaks in the five winters to 1998/99 of 92, 47 and 28 birds, respectively. However, the national population is poorly known because the species is widely dispersed around the coast in smaller numbers and because accurate counts are dependent on very calm weather conditions (Colhoun 2001). The species does not normally come to land other than to nest. At sea it feeds by diving from the surface and catching fish. It flies at a range of heights. JNCC only recorded it close to Dublin Bay and off south Wexford at densities of up 0.1 birds/km^2. It was not generally recorded in the Irish Sea because it is normally an inshore species (Colhoun 2001, del Hoyo *et al.* 1992, Hagemeijer & Blair 1997, Hutchinson 1989, Pollock *et al.* 1997).

Table 2. Summary details of seabirds in the Irish Sea

Species [1]	**Irish Sea Status**	**Irish Sea Habitat [2]**	**Irish Sea Ecology**	**Flight Heights [3]**	**1 mBU [1]**	**1 RBU [4]**	**Dub, Ww & Wx [5]**	**EU [6]**	**Bird-Life [7]**	**Bird-Watch [8]**
Great Northern Diver	Winter visitor	Coastal waters	Surface dives for fish	Low to high	0.05	N/a	0	Mig.	Secure	**Green**
Roseate Tern	Summer visitor	Coastal & offshore waters & islands (B)	Medium plunge dives for fish	Low to high	0.05	n/a	734 (0 Ww)	Anx. I	SPEC 3	**Red**
Brent Goose	Winter visitor	Intertidal & nearby grasslands	Commutes over sea to wetlands	Mainly low?	0.20	n/a	0	Mig.	SPEC 3	**Amber**
Little Tern	Summer visitor	Coastal waters & beaches (B)	Medium plunge dives for fish	Low to medium	0.34	n/a	80 (40 Ww xx)	Anx. I	SPEC 3	**Amber**
Great Skua* (Bonxie)	Passage migrant	Pelagic	Food piracy, eats birds & fish	Low to high	0.48	n/a	0	Mig.	Secure	**Green**
Arctic Skua*	Passage migrant	Pelagic	Steals from seabirds	Low to high	0.75	n/a	0	Mig.	Secure	**Green**
Little Gull	Winter visitor	Banks and coastal waters	Dips- to- surface feeder	Mainly low	**0.84**	n/a	0	Mig.	SPEC 3	**Amber**
Cormorant	Resident	Coastal waters & islands (B)	Surface dives for fish	Low to high	1.2	n/a	2,012 (0 Ww)	-	Secure	**Amber**
Common Tern	Summer visitor	Coastal & offshore waters & islands (B)	Medium plunge dives for fish	Low to high	**1.9**	120	1,327 (0 Ww)	Anx. I	Secure	**Amber**
Shag	Resident	Coastal waters & cliffs (B)	Surface dives for fish	Low to medium	**2.4**	150	1,646 (19 Ww)	-	Secure	**Green**
Pomarine Skua*	Passage migrant	Pelagic	Food piracy & fish	Low to high	3.0	n/a	0	Mig.	Secure	**Green**
Great Black-backed Gull	Resident	Intertidal to offshore & islands (B)	Dives for fish, offal etc.	Low to high	4.7	57	564 (2 Ww)	-	Secure	**Green**
Lesser Black-backed Gull	Summer visitor	Intertidal to offshore & islands (B)	Dives for fish, offal etc.	Low to high	5.3	n/a	499 (0 Ww)	Mig.	Secure	**Green**

Species [1]	Irish Sea Status	Irish Sea Habitat [2]	Irish Sea Ecology	Flight Heights [3]	1 mBU [1]	1 RBU [4]	Dub, Ww & Wx [5]	EU [6]	Bird-Life [7]	Bird-Watch [8]
Red-throated Diver	Winter visitor	Coastal waters & banks	Surface dives for fish	Low to high	**10.0**	n/a	0	Anx I	SPEC 3	Amber
Herring Gull	Resident	Intertidal to offshore & mainly islands (B)	Follows boats, offal etc.	Low to high	**11.0**	1,600	3,009 (29 Ww)	-	Secure	Green
Manx Shearwater*	Summer visitor	Pelagic & islands (B)	Low plunge dives for fish, squid etc.	Low - medium	**11.3**	5,240	275 (0? Ww)	Mig.	SPEC 2	Amber
Gannet*	Resident – less winter	Pelagic & islands (b	High plunge dives for fish	Low to high	**11.7**	2,110	2,077 (0 Ww)	Mig. ?	SPEC 2	Amber
Razorbill*	Resident	Coastal & offshore waters & cliffs (B)	Surface dives for fish	Low	**15.9**	1,040	6,097 (125 Ww)	Mig. ?	Secure	Amber
Common Scoter	Winter visitor	Coastal waters	Surface dives for molluscs	Low to medium	16.0	n/a	0	Mig.	Secure	Amber
Common Gull	Winter visitor	Intertidal & coastal waters	Dips- to- surface feeder	Low to high	**17.0**	30	0	Mig. ?	SPEC 2	Amber
Arctic Tern	Summer visitor	Coastal & offshore waters & islands (B)	Medium plunge dives for fish	Low to high	**18.0**	90	334 (0 Ww)	Anx. I	Secure	Amber
Black-headed Gull	Resident	Intertidal & coastal waters	Dips- to- surface feeder	Low to medium	64.5	n/a	949 (0 Ww)	-	Secure	Amber
Kittiwake	Resident	Coastal & offshore waters & cliffs (B)	Dips- to- surface feeder	Low – med, some high	**84.0**	1,050	11,000 (1,832 Ww)	-	Secure	Green
Guillemot*	Resident	Coastal & offshore waters & cliffs (B)	Surface dives for fish	Low	**85.5**	5,430	57,606 (473 Ww)	-	Secure	Amber
Fulmar*	Resident most of yr.	Pelagic & cliffs (B)	Low plunge dives for fish, offal etc.	Low – medium	**102.0**	440	1,446 (160 Ww)	-	Secure	Green

Footnotes to Table

[1] **Bolded species** are those which occur regularly in the Study area. Species are ordered from the top by conservation importance in terms of Bird Units (BU). A BU equals 1% of the number of individuals in the species' populations according to the populations estimates published by Wetlands International (Delany

& Scott 2002). For seabird species not covered by Wetlands International, BU's are based on population estimates (individuals) in the report on the Seabird 2000 survey (Mitchell et al. 2004). For convenience, BU are normally divided by 1,000 to get milli Bird Units (mBU). For more on BU's see the Methods. For references on individual species, see the species accounts.

[2] "B" following a habitat indicates that it is used for breeding in the Irish Sea area.

[3] Most seabirds fly relatively low at sea, usually less than 50m. Those categorised as "low" usually stay within 5 metres of the surface in calm weather although they may get up to 10-15 m in rougher weather. Near breeding colonies, which is not relevant to this study, low flying species fly higher to access nest sites.

[4] RBU = Regional Bird Unit. They are available for seabird species that breed in the Irish Sea (Mitchell et al 2004) and they are only given for seabirds species that occurred regularly in the Study Area. For more on RBU's see Methodology in the Assessment section.

[5] The "Dub, Ww and Wx" column gives breeding populations in pairs the seabird species that breed in Cos. Dublin, Wicklow and Wexford, with the Co. Wicklow populations given on their own in brackets. See the Methods for locations of the main seabird colonies in the western Irish Sea (Lloyd *et al.* 1991, Merne & Madden 1999).

[6] Listing of a species on Annex I of the EU Birds Directive (79/409/EEC) requires member states to take "*special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution*". Similar measures must also be taken for migratory species. This normally means the designation of "*Special Protection Areas"* (SPAs) in key areas for the species.

[7] BirdLife International have assessed the conservation status of all European bird species (Tucker & Heath 1994). SPEC 2 indicates a species with an unfavourable conservation status whose global distribution is concentrated in Europe. SPEC 3 indicates a species with an unfavourable conservation status whose global distribution is not concentrated in Europe. SPEC 1 (not relevant to this report) indicates a globally threatened species.

[8] BirdWatch Ireland have prepared a "red amber green" categorisation of Irish birds. "**Red**" is defined as of high conservation concern, "**amber**" as of medium conservation concern and "**green**" as of no conservation concern (Newton et al. 1999).

The red-throated diver is listed on Annex I of the EU Birds Directive. It was listed by BirdLife International as SPEC 3, i.e. a species with an unfavourable conservation status whose global distribution is not concentrated in Europe. It received this listing because of a large decline in its breeding population due to loss and deterioration of breeding habitat and disturbance of breeding sites. It is not known to be threatened on its marine wintering areas. As with all marine species, however, oil spills are always a potential danger (Tucker & Heath 1994).

As with all bird species, the red-throated diver is protected in Ireland under the 1976 Wildlife Act. It was listed as a rare breeding species in the Irish Vertebrate Red Data book (Whilde 1993). In BirdWatch Ireland's "red amber green" categorization of Irish birds, it received an amber listing as a rare breeder and because of its SPEC 3 status (Newton *et al.* 1999). "Red" is defined as high conservation concern for example because of decline of greater than 50% in the population over the last 25 years. "Amber" species are of medium conservation concern, for example because of smaller declines or because they are concentrated in a few areas. "Green" species have a secure conservation status in Ireland (Newton *et al.* 1999).

3.4.2 Great northern diver

Figure 3. Winter-plumaged great northern diver

The great northern diver is very similar to the smaller red-throated diver. Its breeding distribution is mainly from west Greenland through Canada to Alaska. In Europe, only some 300 pairs breed in Iceland. Several thousand, presumably including Greenland or North American birds, winter off western European coasts mainly from Norway to Brittany. In Ireland, the main concentrations are in Donegal and Galway Bays with five year mean peaks of 146 and 78, respectively. The main east coast concentration is in Wexford Bay and Harbour with close to 50 birds.

Numbers using Irish waters that cannot be counted from land are poorly known. Its biogeographic population is 5,000 giving a very low threshold for international importance of only 50 birds. It breeds in large lakes in the taiga and subarctic zones and winters at sea, where it feeds by diving from the surface and catching fish. JNCC recorded only a handful in the Irish Sea, in contrast to the west of Scotland, where they were more numerous (Colhoun 2001, del Hoyo *et al.* 1992, Hagemeijer & Blair 1997, Hutchinson 1989, Pollock *et al.* 1997). The conservation status of great northern divers is secure (Tucker & Heath 1994).

3.4.3 Fulmar

The fulmar is essentially a circumpolar species of petrel with Iceland as its European headquarters. Up to 250 years ago, it was largely confined to Iceland and St. Kilda west of the Hebrides. However, it has since spread through the Faeroes and Britain and began to colonise Ireland from 1911. It now breeds around most of the country wherever there are cliffs. However, there are large gaps in its distribution along the mainly low coasts of the eastern counties.

Figure 4. Fulmar

Some 1,450 pairs breed in Cos. Dublin, Wicklow and Wexford out of an Irish Sea population of 14,600 pairs, which in turn is some 0.43% of the biogeographical population of some 3.4 million pairs. Most of the birds in the three counties breed on Lambay Island in Co. Dublin and on Great Saltee Island in Co. Wexford with smaller colonies at Ireland's Eye, Howth (both Co. Dublin), Bray Head, Wicklow Head (both Co. Wicklow) and perhaps a scattering of pairs elsewhere. Other than at breeding sites, it does not normally come to land. It winters in the North Atlantic mainly north of a line from Brittany to New England.

At sea, it is normally a low flier which practices "dynamic soaring" to take advantage of differing wind speeds between waves and troughs. Densities in most of the Irish Sea are typically less than 1 bird/km^2 but a late summer concentration of greater than 5 birds/km^2 occurs at the Irish Sea front. It feeds at or near the surface on a wide variety of marine items including shrimp, squid, fisheries discards and carrion (Merne 1987, del Hoyo *et al.* 1992, Hagemeijer & Blair 1997, Hutchinson 1989, Lloyd *et al.* 1991, Merne & Madden 1999, Mitchell et al 2004, Nairn *et al.* 1995, Pollock *et al.* 1997, Pollock *et al.* 2000, Snow & Perrins 1998). The fulmar's conservation status is secure in Europe and green in Ireland (Newton et al. 1999, Tucker & Heath 1994).

3.4.4 Manx shearwater

The Manx shearwater's global distribution is centred on Britain and Ireland, with the main breeding concentrations on Rhum off western Scotland, in Pembrokeshire in west Wales, and on the west Kerry Islands. Other than at Great Saltee it probably breeds irregularly in Cos. Dublin, Wicklow and Wexford. Some 175,000 pairs breed in the Irish Sea, mainly on the Pembrokeshire Islands. This is some 47% of the biogeographical population of 375,000 pairs. Other than at breeding sites, it does not normally come to land and then only at night to avoid gull predation because of its clumsiness on the ground when accessing its burrows. With development of reliable diurnal techniques to census birds in burrows, its population estimates in Britain and Ireland are now much better. It winters mainly off the east coast of South America.

Figure 5. Manx shearwater near burrow

At sea it is normally a low flier which practices "dynamic soaring" like the fulmar. It often "rafts" (i.e. roosts on the surface in flocks) in calm weather. Birds arrive back in the Irish Sea during March and April. Densities increase to 5 birds/km^2 by June and reach 10 birds/km^2 in the adjoining Celtic Sea near the Pembrokeshire colonies. By July and August they are spread throughout the Irish Sea in numbers and often exceed 10 birds/km^2 off Pembrokeshire and on the Irish Sea front. In September, they concentrate even more on the Irish Sea front before departure by October. It feeds at or a little below the surface mainly on small fish, often in flocks (Begg & Reid 1997, Stone *et al.* 1994, Additional references as fulmar).

The Manx shearwater is a migratory species requiring conservation measures similar to Annex I species. BirdLife International listed it as a SPEC 2, i.e. a species with an unfavourable conservation status whose global distribution is concentrated in Europe. It received this listing because of its localised distribution. It is not imminently threatened but colonies have been lost on islands that were invaded by rats. It was amber listed by BirdWatch Ireland as a localised breeder and because of its SPEC 2 status (Newton et al. 1999, Tucker & Heath 1994).

3.4.5 Other shearwater and petrel species

Several other species of seabirds occur in small to very small numbers in the Irish Sea. These include Mediterranean, Cory's, sooty, and great shearwaters and storm and Leach's petrels. Mediterranean shearwater is closely related to Manx shearwater and breeds mainly on the Balearic Islands and occurs in the Irish Sea in very low numbers in autumn. Cory's shearwater breeds in the Mediterranean and off west Africa and it was not recorded in the Irish Sea by JNCC. The other two shearwaters breed on islands in the southern oceans and the south Atlantic, respectively. JNCC recorded them in very low numbers in the Irish Sea in the autumn prior to their return to their breeding areas in the southern summer. In contrast, off southern and western coasts of Ireland in some years, hundreds of Mediterranean shearwaters and many thousands of the other three species occur

Storm petrels breed in large numbers off western Ireland and they have their stronghold on the Faeroes. It was recorded in large numbers off south-western Ireland in late summer by JNCC but in much lower numbers in the Irish Sea. Leach's petrels breed mainly in Iceland with smaller numbers southwards to Scotland and Mayo. JNCC recorded low numbers in the Irish Sea but they are sometimes recorded in large numbers in Liverpool Bay after autumnal westerly gales. All are low fliers and have broadly similar lifestyles to Manx shearwater. While Cory's Shearwater, storm petrel and Leach's petrel do not have secure conservation status, all six species occur in insignificant numbers in the Irish Sea in an EIA context (del Hoyo *et al.* 1992, Hagemeijer & Blair 1997, Hutchinson 1989, Pollock *et al.* 1997, Tucker & Heath 1994).

3.4.6 Gannet

The gannet's global distribution is centred on Britain, Ireland and Iceland. In Cos. Dublin, Wicklow and Wexford, the main breeding site is at Great Saltee with some 1,930 pairs. A new colony at Ireland's Eye in Co. Dublin is growing rapidly and had 147 apparently occupied sites during the Seabird 2000 survey. Some 70,000 pairs breed in the Irish Sea, mainly in two large colonies at Grassholm in Pembrokeshire and at Ailsa Craig in Strathclyde. This is some 18% of the biogeographical population of 390,000 pairs.

Figure 6. Adult gannet

Other than at the breeding cliffs gannets do not normally come to land. In winter, they tend to migrate south, especially the young birds, which may reach the equator. However, considerable numbers also remain in our waters. At sea, it is often one of the highest flyers reflecting its habit of making spectacular dives to catch fish. Densities in the Irish Sea are typically 1–2 birds/km^2 but drop off markedly during November to February (references as fulmar).

The gannet was listed by BirdLife International as SPEC 2 because of its localised distribution. It is not currently threatened and its population has increased considerably since the cessation of human exploitation of the species for food early in the last century. It was amber listed by BirdWatch Ireland as a localised breeder and because of its SPEC 2 status (Newton et al. 1999, Tucker & Heath 1994).

3.4.7 Cormorant

Figure 7. Adult cormorant

The cormorant is a larger somewhat less exclusively marine version of the shag (see below). It breeds over a large part of the world from eastern North America through Europe, Asia and Africa to Australia and New Zealand. In the western Irish Sea, its breeding stronghold is on the Skerries, Lambay Island and Ireland's Eye, all off north Co. Dublin with about 1,540 pairs. Its conservation status is secure in Europe but amber in Ireland. JNCC recorded them on the coasts of Cos. Meath. Dublin and Wexford but not off Wicklow (references as fulmar).

3.4.8 Shag

Figure 8. Adult shag

The shag is an essentially European species ranging from the Barents Sea to the Mediterranean Sea and Morocco. Its population is centred on Britain but Norway, Iceland and Ireland are also important. In Cos. Dublin, Wicklow and Wexford, the main breeding sites are Lambay Island and the Saltee Islands. About 1,360 pairs breed in Dublin and about 270 in Wexford, but only about 20 in Wicklow. A total of some 5,000 pairs breed around the Irish Sea, which is some 5% of the biogeographical population of 80,000 pairs.

Shags breed on cliffs and rocky coasts. They feed on nearby marine areas and roost on land at night. They dive to catch fish. In our area they are mainly sedentary except for some juvenile dispersal. They are normally low flyers. JNCC recorded it year round close to Irish Sea coasts with densities of up 0.5 birds/km^2 off Co. Dublin (references as fulmar). The shag's conservation status is secure in Europe and green in Ireland (Newton et al. 1999, Tucker & Heath 1994).

3.4.9 Brent goose

Figure 9. Adult brent goose

Brent geese breed in the high Arctic and winter on temperate coasts in North America, western Europe and in the Far East. The 20,000 Irish wintering birds are from the pale-bellied race that breeds in North America. As the only North American brent geese wintering in Europe, they are accorded separate population status resulting in their low threshold for a bird unit. In winter, they normally feed on estuaries but use agricultural and amenity grassland for supplementary feeding. Up to c. 1,500 commute on a near daily basis, mainly in late winter, between Dublin Bay and agricultural grassland in The Murrough SPA south east of Kilcoole in Co. Wicklow (Colhoun 2001, del Hoyo *et al.* 1992, McMillan 1988).

3.4.10 Common scoter

Figure 10. Female and male common scoter

Common scoter breed on low Arctic and taiga lakes from eastern Canada through northern Europe – with low numbers as far south as northern Scotland – and onto Siberia to Alaska. An atypical population of some 100 pairs uses large limestone lakes in western Ireland. While the species has a generally secure status, the Irish breeding population is red-listed by BirdWatch Ireland. It is not known where the Irish breeding birds winter.

Common scoters winter on shallow coastal waters, usually less than 6m deep, where they dive for shellfish. In the western Irish Sea, the biggest wintering concentrations are in Wexford Bay and off the Nanny Estuary in Co. Meath with recent five-year means of 2,200 and 670 birds, respectively. Between 20 and 70 have been recorded on the Wicklow coast, although larger numbers used Arklow Bay up to the 1960s or 1970s (O. Merne, personal communication). Just 18 birds were recorded during the Year 1 study of the Arklow Bank. JNCC recorded very low numbers in the western Irish Sea (Colhoun 2001, del Hoyo *et al.* 1992, Gittings & Delany 1996, Newton et al 1999, Pollock et al 1997). As part of surveys carried out at the Codling bank, low numbers were recorded between August 2001 and February 2002 – 44 birds in total.

Common scoters are very susceptible to boat disturbance and there is concern in Britain and Denmark about significant impacts form proposed wind farms in areas where they occur in large numbers (Petersen 2001, Robinson 2001).

3.4.11 Skuas

Figure 11. Great skua (bonxie)

Great skuas, often known by their Shetland name of “bonxie”, are predatory seabirds related to gulls. As a breeding species, it is a European endemic with about 16,000 breeding pairs. Some 7,900 of these breed on Shetland and another 5,000 in Iceland. Smaller numbers occur on the Faeroes, Svalbard, Norway and Russia. Their population is still expanding after human exploitation reduced it to very low levels in Scotland in the late nineteenth century. In 2001, breeding by 1-2 pairs was confirmed in western Ireland (Newton 2001).

Bonxies winter on Atlantic coasts in western Europe, New England and northern South America. They catch fish or steal them from other seabirds, scavenge, and prey on smaller seabirds. They are commonly recorded as passage migrants from Irish headlands with many hundreds or a few thousand occurring in most years. The largest numbers occur on western and south western coasts in autumn and the smallest numbers are recorded on the east coast. JNCC recorded up 0.1 birds/km^2 mainly on the southern edge of Irish Sea in autumn but higher numbers west of Cornwall and Brittany in winter.

Two smaller species are the Arctic skua and the omarine skua. They are much more widely distributed as breeders in the Arctic and they winter in South American, African, Asian and Australian waters. Their ecology and occurrence in Ireland are broadly similar to the great skua. Arctic skuas are somewhat commoner than omarine skuas in Ireland and they were the commonest skua recorded by JNCC in Irish waters. Densities of up 0.1 birds/km^2 were recorded in the Irish Sea and off the west coast in autumn (References as fulmar).

3.4.12 Little gull

Figure 12. Adult winter plumaged little gull

The little gull's breeding distribution extends in three disjunct areas from Scandinavia to eastern Siberia. There is also a small population in North America. It breeds on inland marshes and winters offshore. Its main European wintering areas are around the Mediterranean, Black and Caspian Seas. The biogeographical population is only 28,000 pairs (Delany & Scott 2002).

There were only 15 records of little gull in Ireland prior to 1950 but numbers have steadily increased since then. Nowadays, a wintering concentration off Co. Wicklow is considered to be among the largest in northwest Europe. This may involve the same birds that pass through Liverpool Bay in spring and autumn. This concentration was initially identified through observations of flocks off Co. Wicklow during wet weather with strong winds from the south or east. Since then, most records of the species have been concentrated along a 35km strip of coast between Wicklow Harbour and Dun Laoghaire. Peak flock sizes were typically less than 300 during the 1970's and 1980's but reached 600 by the early 1990's (Madden & Ruttledge 1993). High numbers continued through the 1990's and peaks of 604 and 830 birds were recorded at Wicklow Harbour in January 1995 and January 1998, respectively. However, the occurrence of large numbers close to land has remained sporadic. During these periods, they may feed and roost in or near Wicklow Harbour (McAdams *et al.* 2000, Whelehan 1995). In January and February 2002, an influx of up to 500 was recorded along the Wicklow coast during a long period of windy weather (Milne 2002). Recently, similar concentrations have been reported off western Denmark (Noer *et al.* 2000), which is consistent with reports of a northward extension of the wintering range. At sea, it flies slowly into the wind and low over the water, feeding on small items taken from the surface. The diet of wintering birds is unknown, but probably comprises marine invertebrates and small fish (Cramp & Simmons 1982). In the Irish Sea, JNCC recorded winter densities of up to 0.5 birds/km^2 off Co. Wicklow and in Liverpool Bay (Additional references as fulmar).

The little gull is a migratory species requiring conservation measures similar to Annex I species. BirdLife International listed it as a SPEC 3, on the basis of a moderate decline in its European breeding population. The main threats are natural and man induced flooding of breeding sites and recreational disturbance. It was amber listed by BirdWatch Ireland because of its internationally important wintering population localised on the Wicklow coast and because of its SPEC 3 status (Newton et al. 1999, Tucker & Heath 1994).

3.4.13 Black-headed gull

Figure 13. Adult winter plumaged black-headed gull

The black-headed gull is a very common species that breeds from western Europe to the Far East, with an outpost in eastern North America. It winters on coasts from western Europe to equatorial Africa and eastwards to south east Asia. It has a biogeographical population of over two million pairs and a secure conservation status. Although a seabird, only small numbers range far from the coast. They are generally recorded in low densities in the Irish Sea away from the coast (references as fulmar).

3.4.14 Common gull

Figure 14. Adult winter plumaged common gull

Although the common gull breeds across a large swathe of the northern temperate zone from Iceland through northern Europe to Siberia and western North America, 80 – 90% of its population is concentrated in northern Europe. Most populations migrate to warmer areas such as the Mediterranean and the Persian Gulf but they are less migratory in northwest Europe. It usually breeds near coasts or inland wetlands. Its biogeographic population is about 57,000 pairs.

In Ireland, some 970 pairs breed on the north and west coasts from Down to Kerry and a further 650 pairs breed inland in western counties. The Irish Sea population is almost 1,100 pairs, which is about 6% of the biogeographical population. Some 67,500 birds winter around all coasts of Ireland (Lack 1986). There are estuarine concentrations exceeding 1,000 birds in Cork, Donegal and Wexford. The most important of these is on the North Wexford Coastal Marshes with a five-year mean peak to 1998/99 of 2,900 (Colhoun 2001). JNCC recorded coastal concentrations in winter of up to 1 bird/km^2 mainly off Dublin and Wexford. Wintering birds mainly feed on earthworms but they exploit a variety of other habitats such as landfills and marine areas. At sea, it flies at a variety of heights (Additional references as fulmar).

The common gull is a migratory species requiring conservation measures similar to Annex I species. BirdLife International listed it as a SPEC 2, on the basis of a moderate decline in its European breeding population for reasons that are unclear. It was amber listed by BirdWatch Ireland because of its SPEC 2 status (Newton et al. 1999, Tucker & Heath 1994).

3.4.15 Herring gull

Figure 15. First winter herring gull

The herring gull is a very widespread species that breeds in western and northern Europe, northern Siberia and northern North America. European populations winter mainly on the coasts of western Europe and other areas south of the breeding grounds. It uses a broad range of habitats from rubbish dumps to estuaries to marine areas. It has a biogeographical population of almost 367,000 pairs and a secure conservation status in Europe.

However, the Seabird 2000 survey showed that the Irish population of herring gulls declined by 90% from almost 60,000 pairs 1970, and that 80% of this decline occurred since 1985. In the UK large declines since 1985 were recorded mainly in eastern Scotland but increases were recorded elsewhere. Avian botulism associated with feeding at rubbish dumps is believed to be the main reason for the decline in Ireland. Reduction is food sources probably also played a role. These include improvements in the management of rubbish dumps, the virtual cessation of the discharge of raw sewage and the reduction of fishery discards. The current population of the Irish Sea is about 53,000 pairs, which is about 15% of the biogeographical population. Dublin. Wicklow & Wexford holds 3,000 pairs, of which about 29 pairs breed in Co. Wicklow.

JNCC recorded densities of up to 1 bird/km^2 in much of the Irish Sea but there were few or no records in the waters off Co. Wicklow. They recorded higher densities in the northern Irish Sea (references as fulmar)

3.4.16 Lesser black-backed gull

Figure 16. Adult lesser black-backed gull

The lesser black-backed gull breeds through western and northern Europe to western Siberia It is mainly migratory and winters on western European, African and Arabian coasts. It is less than half as numerous than the herring gull with a biogeographical population of 176,000 pairs but still has a secure conservation status. It uses a broad range of habitats from rubbish dumps to estuaries to marine areas. JNCC recorded densities of up 1 bird/km^2 in most parts of the Irish Sea but only in southern parts between November and January (references as fulmar).

3.4.17 Great black-backed gull

Figure 17. Subadult great black-backed gull

The great black-backed gull breeds around low Arctic and temperate north Atlantic coasts with partial migration from more northern areas to winter on temperate and tropical Atlantic north Atlantic coasts. It has a biogeographical population of some 420,000 and a secure conservation status. It uses a broad range of habitats from rubbish dumps to estuaries to marine areas. JNCC recorded very low numbers in most of the Irish Sea including waters off Co. Wicklow (references as fulmar).

3.4.18 Kittiwake

Figure 18. Adult kittiwake

The kittiwake is by far the most abundant gull in the world with a circumpolar distribution. In Cos. Dublin, Wicklow and Wexford some 11,000 pairs breed on cliffs with the main sites at Lambay Island (4,100 pairs) and at Great Saltee (2,100 pairs). There are smaller colonies at Bray and Wicklow Heads, with a total of just over 1,800 pairs in Co. Wicklow. The Irish Sea population is some 35,000 pairs, which is some 1.25% of the biogeographical population of some 2.8 million pairs.

The species is mainly pelagic and moves west into the Atlantic during the winter. Some regularly come to roost on land, however. When feeding at the surface, it often flies low over the water. However it may flies higher on other occasions. Kittiwake densities in the Irish Sea are lowest in February and March, typically less than 1 bird/km^2. They rise to 5 birds/km^2 in June and July off Dublin and north Wicklow and go higher than this in late summer around the Irish Sea Front. Kittiwakes feed mainly on small fish such as sandeels and clupeids, and also take crustaceans and fisheries discards. (Begg & Reid 1997, Cramp & Simmons 1982, Additional references as fulmar). Their conservation status is secure in Europe and green in Ireland (Newton et al. 1999, Tucker & Heath 1994).

3.4.19 Common tern & Arctic tern

Common terns breed in mid-latitudes across most of Eurasia and North America and winter on most tropical and southern hemisphere coasts. Some 1,300 pairs breed in Cos. Dublin and Wexford mostly at Rockabill and at Ladys Island Lake, with the balance at smaller colonies in Dublin Bay. The Irish Sea population is 3,200 pairs, which is some 6.2% of the biogeographical population of 63,000 pairs. Terns normally dive for small fish but from lower heights than gannets. They often fly relatively high.

Figure 19. Common tern & Arctic tern

The Arctic tern is very similar to the common tern but as its name suggests, has a more northerly circumpolar breeding distribution. The Irish breeding population is the most southerly in Europe. It is a famous long distance migrant to Antarctic waters. Some 335 pairs breed in Cos. Dublin and Wexford. Of these 235 are at Ladys Island Lake in Wexford, 100. The Irish Sea population just under 2,900 pairs, which is some 0.5% of the biogeographical population of 600,000 pairs.

Data for common and Arctic terns were presented together by JNCC because they are often difficult to separate at sea. Densities of up to 0.5 “commic” terns/km^2 occur in the Irish Sea in late summer, and somewhat higher densities north of Dublin Bay. Several thousand of both species also use an evening roost on Sandymount Strand in Dublin Bay from late July into September. The feeding areas of the birds using this roost are not known although it is presumed to be the shallow offshore banks in the Irish Sea. Some evidence of such use of the Kish Bank was obtained in 1999 (Newton & Crowe 1999 & 2000; Additional references as fulmar).

Both the common and Arctic terns are Annex I species on the EU Birds Directive. The conservation status of both is secure in Europe. Both were amber listed by BirdWatch Ireland as localised breeders (Newton et al. 1999, Tucker & Heath 1994).

3.4.20 Roseate tern

Figure 20. Adult roseate tern

The roseate tern has a global population of of about 125,000 pairs breeding mainly on tropical coasts with smaller temperate populations in western Europe (2,150 pairs or 1.7% of the global population), north America and South Africa. These temperate breeders winter in the tropics. It is one of Europe’s most threatened seabirds having suffered a large decline in recent decades. The current European population of some 2,150 pairs is concentrated in Ireland (740 pairs) and on the Azores.

The Irish population breeds at two sites at Rockabill off north Co. Dublin and at Ladys Island on the south Wexford coast. They are wardened by BirdWatch Ireland and Dúchas. Roseate terns’ habits are similar to common and Arctic terns. They were only rarely recorded at sea by JNCC indicating they do not regularly use Irish Sea waters far from the colonies. In late summer, some hundreds may use the evening roost at Sandymount Strand in Dublin Bay, and also at Dalkey Island. In 1996 and 1999, BirdWatch Ireland surveys found hundreds using the Kish Bank in August and September. The species is listed on Annex I of the EU Birds Directive, as SPEC 3 by BirdLife International and is red-listed by BirdWatch Ireland (References as fulmar, also Casey *et al.* 1995, Hannon *et al.* 1997, & Crowe 1999, Newton & Crowe 2000).

3.4.21 Little tern

Figure 21. Adult little tern

The little tern breeds in temperate areas from Ireland to Japan and winters on tropical Old World coasts. In Ireland, it breeds mainly on beaches and has declined in numbers and range as these areas become more disturbed by human use. Its Irish population is some 210 pairs and its stronghold on the east coast is now on the shingle beach near the Kilcoole Breaches in The Murrough SPA. This colony has been wardened for over a decade by BirdWatch Ireland and has been increasingly successful in recent years. For several years this typically held about 40 pairs but in 2003 and 2004 numbers increased dramatically to over 80 pairs (Maljkovic 2003)

The little tern's habits are similar to other terns. The species is listed on Annex I of the EU Birds Directive, as SPEC 3 by BirdLife International and on BirdWatch Ireland's amber list (References as fulmar and Hannon et al. 1997, Newton & Crowe 1999).

3.4.22 Guillemot

Figure 22. Adult guillemots in summer plumage

Guillemots have a circumpolar breeding distribution at temperate to Arctic latitudes and disperse across continental shelf waters at similar latitudes in winter. Some 57,600 pairs breed in Cos. Dublin and Wexford, with perhaps 473 in Co. Wicklow, mainly at Wicklow Head. The main site is Lambay Island with about 41,000 pairs, second only to Rathlin Island in Ireland. Great Saltee has about a third as many as Lambay. The Irish Sea population is 181,000 pairs, which is some 6.4% of the biogeographic population of 2.85 million.

Other than at the breeding cliffs it does not normally come to land. At sea it is normally a low flier and is flightless for some weeks after the breeding season, while moulting its wing feathers. The chicks jump from the cliffs when about one-third grown and complete their development at sea, usually accompanied by their father. They feed on small fish that they catch by diving from the surface. They are present in the Irish Sea year round but densities of 50 to 100 birds/km^2 build up from July along the entire east coast. By September these have concentrated around the Irish Sea front. From October they disperse around the coast and into the Celtic Sea (Begg & Reid 1997; Additional references as fulmar).

The conservation status of the guillemot is secure in Europe. It was amber listed by BirdWatch Ireland as a localised breeder (Newton et al. 1999, Tucker & Heath 1994).

3.4.23 Razorbill

Figure 23. Adult razorbill in summer plumage

Razorbills are restricted to the North Atlantic where Iceland is their stronghold. They show a partial southern migration as far as Mediterranean latitudes. Some 6,100 individuals breed in Cos. Dublin and Wexford, with perhaps 125 in Co. Wicklow, mainly at Wicklow Head. The main sites in the three counties are Lambay Island with 2,900 pairs and Great Saltee. The Irish Sea population is about 35,000 pairs, which is some 6.7% of the biogeographic population of 530,000 pairs.

Its habits are very similar to the guillemot. They are present in the Irish Sea year round but densities well in excess of 5 birds/km^2 build up in July east of Co. Wicklow. However, they do not share guillemots' marked preference for the Irish Sea Front later in the summer (Begg & Reid 1997; Additional references as fulmar).

The conservation status of the razorbill is secure in Europe. It was amber listed by BirdWatch Ireland as a localised breeder (Newton et al. 1999, Tucker & Heath 1994).

3.4.24 Other auks

Three other auk species occur in the Irish Sea, black guillemot, puffin and little auk. About 200 pairs of black guillemots breeds on rocky coasts and harbours in Dublin and Wicklow but they much more closely tied to the immediate vicinity of coasts than other auks. Some 295 pairs of puffins breed in Co. Dublin on Lambay and Ireland's Eye and about 1,800 pairs breed on the Saltees in Co. Wexford. The little auk is an arctic breeder that occurs in small numbers in Irish waters in winter. JNCC recorded puffins at densities of up to 0.5 birds/km^2 in much of the Irish Sea during the late summer and early autumn but the other two species were rarely recorded (References as fulmar).

4 Review of assessments of effects on birds of wind farm projects

4.1 Terrestrial wind farms

The large increase in terrestrial wind farms in recent decades has been accompanied by concerns about their impacts on birds. However, studies to date in several European countries and in the USA have typically shown no significant adverse impacts (Gill & Townsley 1996, Morrison *et al.* 1998, Neau & Pages 1999). In some cases, relatively small numbers of birds were killed but this was considered not to have reduced the populations concerned. It was also low compared to other human-related causes of deaths e.g. towers of various kinds in the USA (Evans & Manville 1998). In Holland, strike rates by all species were 0.04 to 0.09 birds per day per turbine or 1 in 5,000 to 1in 10,000 birds. This was at peak migration times in an an area where very high numbers of passerine migrants passed through (Winkelman 1994). Detailed studies of a nine turbine project on the breakwater at Blyth Harbour in Northumberland showed that the initial low collision rate of eider duck decreased to zero over four years even as the local eider population increased. There was a possible correlation between severe weather or reduced visibility and the strikes that did happen (Still *et al.* 1994, Still *et al.* 1997). In Britain and Sweden, falcons and waders have been observed breeding in close proximity to wind turbines (Percival 1988, Percival & Percival 1998). At one site, Bryn Titli in Wales, it has been reported that red kites, other raptors and ravens were deterred from using the wind farm site (Phillips 1994) but this has been disputed elsewhere (Percival 1998).

Overall in Britain, wind turbines do not appear to have had any significant impact on bird populations (Percival 2000). Furthermore, established environmental organisations such as Friends of the Earth and Greenpeace have strongly supported onshore and offshore wind farms and have disputed claims of impacts on birds (Border Wind for Greenpeace 1998, Friends of the Earth 1999, Söker et al 2000).

A recent comprehensive review written by BirdLife International on behalf of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats) had the objective of analysing ‘the impact of wind farms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for wind farms’ (Langston & Pullan 2003). For terrestrial wind farms the report highlights the lack of comprehensive data at present on which to base conclusive results. However, it also clearly showed there is no evidence of disturbance of breeding birds and limited evidence of disturbance of feeding birds. The most notable of these involved geese at a German wind farm where densities of feeding birds were significantly reduced within 600m of the turbines. In Holland, disturbance effects of up to 500m were observed for curlew. Significant collision effects were only noted at poorly located wind farms (see next page). The report also identified potential hazards and recommended stringent environmental assessment to ensure that wind farms are optimally located to avoid or at least minimise any adverse impacts.

The main collision effects during the 1990’s have been observed at two large wind farm areas at Tarifa near the Straits of Gibraltar in southern Spain, and at Altamont Pass in central California. At Tarifa, wind farms are located within an area of international importance for birds, where large numbers of migrating birds of prey pass through in spring and autumn. A survey of breeding and migratory medium to large size birds on two of the wind farm sites in the area between December 1993 and December 1994 estimated avian mortality due to collision with turbine structures to be 106 individuals. The most affected species were common kestrels (49 birds) and griffon vultures (30 birds), both resident species. The report states that if smaller sized species had been included in the study, mortality figures would have been higher. The report also states that registered mortality and potential incidence (probability of risk) were significantly higher on one wind farm site as compared to the other one studied. The report concludes by saying that if additional planned wind farms in the area were carried through, it could result in a critical impact on birds in the absence of an effective management plan and appropriate mitigating measures. Such a management plan would include restrictive zoning, site studies prior to development, monitoring during wind farm operation, and consideration of the effectiveness of mitigating measures (Jaque & Marti-Montes 1995). A more recent study showed a similar pattern of localised mortality of resident birds. This was caused by the presence of updrafts and hunting grounds near turbines, which brought birds into the rotor zone Migratory birds of prey generally flew well above the turbine zone (Barios & Rodriguez 2004, de Lucas et al 2004).

High densities of resident and “floater” golden eagles occur in the Altamont Pass area, where they exploit a large population of ground squirrels. The Predatory Bird Research Group at the University of California, Santa Cruz recorded 100 deaths over a seven year period from a total of 257 radio-tagged golden eagles. The report states that. being naturally slow to reproduce, golden eagles are particularly sensitive to changes in adult and sub-adult survival rates, and are afforded special protection by both federal and state governments. 42 of the 100 deaths recorded were attributed to wind turbines, the actual number being higher because the blades occasionally destroyed the radio transmitter. Data showed that conditions within areas containing a particular type of turbine (Type-13 – the Kenetech 56-100 on an 18.3 meter lattice tower) were more dangerous to eagles than those in areas containing other types of turbines. However, it was unclear if the danger was due to the availability of perches on the lattice towers or simply because the eagles preferred this area for other reasons.

In addressing the question of whether eagle deaths resulting from wind turbine blade strikes at Altamont Pass were seriously affecting the population, a demographic analysis produced an estimate of no annual change in population size, but no production of non-breeding adults (‘floaters’) which buffer the breeding sector in healthy populations. If the model is correct, any further decrease in survival or reproduction, e.g. as might accompany increasing human development, would be mitigated only by immigrant floaters from outside the study area. During the study period virtually all nesting territories occupied by pairs in one year were reoccupied the next, suggesting either a demographic balance in the local population or buffering by immigrant floaters. The report recommends a continuation of nesting surveys every two or three years ‘as a system of early warning should a decline actually be occurring’ (Hunt 2002). It has been recommended that important migratory routes and important areas for birds should be avoided as sites for wind farm developments (Percival 1998 & 2000).

In 2003 concerns were raised about the ecological impacts of terrestrial wind farms in the Appalachian mountain region of Maryland, West Virginia and Pennsylvania in the USA. It has emerged that these wind energy facilities may cause rates of mortality among bats higher than those among birds. Claims have also been both made and denied that inadequate pre-construction studies were commissioned by the developer for a wind plant near Meyersdale in Pennsylvania, and that the developer or their avian consultants did not co-operate or co-ordinate with wildlife agencies or considered local experts. Construction on this wind farm is planned to go ahead, with hopes for the turbines to be fully operational by the end of the year (Williams 2004, http://www.wpm.co.nz/oct03/cont.htm).

4.2 Operational marine wind farms

4.2.1 Introduction

An extensive literature and web search was done to get information on the assessment of the effects of operational, confirmed and proposed offshore wind farms on seabirds. Many assessments are based on unconfirmed predictions in EISs, as is the assessment of this project, because in general there is insufficient knowledge to date on the effect of offshore wind farms on seabirds. However, the broad thrust of thinking in the EISs is similar across projects, e.g. that direct loss of habitat is small, some species such as divers and scoter are considered more prone to disturbance, the flight height of species is important in establishing likely collision risks.

Currently, about 26 offshore wind farms have received permission. 153 are operational, 1 is under construction and the remaining 10 are due to be built in the next year or two (Table 3). These are all in the EU and thus subject to assessment within the frameworks of the Birds, Habitats and EIA Directives.

Prior to 2000, there were only six operational offshore wind farms comprising 30 turbines (Lemming 1999, British Wind Energy Association 2000). Of these, information on birds was available for only three (Table 3). Furthermore, at an average of about 0.5 MW, these turbines are much smaller than the turbines planned for the Kish and Bray Bank.

Recently, there has been opposition to avian EIS assessments two offshore wind farms in the UK. The first is Shell Flats in Liverpool Bay where there are large numbers of common scoters (RSK Environment 2003). The second is at Teeside on the north east English coast only 1.6 km from a designation SPA that holds over 20,000 waterfowl Regular review of the results of monitoring programmes for other offshore wind farms will allow the monitoring of the Kish and Bray Bank project to be put in a broader context.

4.2.2 Nogersund & Bockstigen in Sweeden

The world's first offshore wind turbine was built 250m offshore from Nogersund in Sweden. It had an installed capacity of 200 kW. It was a test project to examine *inter alia* impacts on bird and fish and it was built in the centre of a migration path used twice a year by millions of migrating birds. A five year study showed an avoidance of the turbine by migrating birds. Almost 50% reduction was observed in the number of migrating birds passing within 500 m of the turbine (Anon 1999a). No ecological information was found on another offshore Swedish project at Bockstigen, which has five turbines with a total installed capacity of 2.75 MW.

4.2.3 Lely & Dronten in the Ijsselmeer The Netherlands

Two projects in the Ijsselmeer in Holland are not really offshore as they are located in a very large lagoon that was cut off several decades ago from the Waddensee, itself a relatively enclosed offshoot of the North Sea. The first of these was the Lely project built in 1994, 800m off a dyke near the town of Medemblik. It has two 0.5MW turbines. The main birds of concern were roosts of pochard and tufted duck. These flew around turbines even in darkness (Percival 2001). The second project at Dronten has 19 turbines of 0.6MW each and is similarly close inshore (http://www.offshorewindfarms.co.uk/faqs.html). No information on ornithological studies was found for Dronten.

4.2.4 Tuno Knob & Vindeby in Denmark

The first Danish wind farm was a technical feasibility project, comprising 11 turbines at Vindeby west of the island of Lolland. Environmental assessment showed that it led to a local increase in marine life (Lemming 1999). However, there were few birds at the site prior to construction so no ornithology studies were considered feasible (Krohn 2001).

Table 3. Offshore wind farm EIA's relating to birds

Site & country[1]	Build year	No. tur-bines/dist. offshore	Key bird species	Type of bird study	Developer , Comments, & Reference/Website[1]
OPERATIONAL PROJECTS					
Nogersund (SE)	1990	1 x 220 kW, 250m	Coastal landbird migrants	Visual study of experimental turbine	Fewer birds within 500m (Percival 2001)
Blyth Harbour (UK – England)	1992	9 x 300 kW, onshore	Cormorant, eider and gulls	Post-construction monitoring	Blyth Harbour Commission, HMZ Belgium NV, Border Wind (AMEC). Collisions decreased to near zero after construction (Percival 2001, Still et al 1994 & 1997) http://www.amec.com/wind/where/where_2ndlevel.asp?pageid=8034
Ijsselmeer-Lely (NL) [2]	1994	2 x 500 kW, 800m	Roosts of tufted duck & pochard	Post-construction flight activity by radar tracking	Birds flew around turbines even in darkness (Percival 2001)
Tuno Knob (DK)	1995	10 x 500 kW, 6km	Eider & common scoter	Detailed pre- and post-construction disturbance & flight activity study	Midtkraft. No significant disturbance, changes due to prey species movements, avoidance by flying birds (Percival 2001) http://www.windpower.dk/tour/env/birdsoff.htm
Middle-grunden (DK)	2000	20 x 2MW, 2 km	Mute swan, 5 duck species, goldeneye, red breasted merganser, & gulls	Pre and post construction monitoring.	Copenhagen Environment and Energy Office, Copenhagen Electricity Company. Minor influence on birds, limited to construction period. www.middelgrund.com
Utgrunden (SE)	2000	7 x 1.5 MW, 8km	Eider	Pre-construction and post-construction	Eider avoid flying through the wind farm. Gov't go-ahead July 2004. (Pettersson & Stalin 2001). www.airicole.com
Blyth Off-shore (UK - England)	2000	2 x 2 MW, 800m	Seabirds	Pre-construction and post-construction monitoring	AMEC, Powergen Renewables, Shell Renewables and Nuon. No "seabirds at sea" surveys. Night vision & video studies have begun. (Border Wind 1998, Simon et al 2001) http://www.amec.com/wind/where/where_2ndlevel.asp?pageid=8035

Carnsore Pt. (IRL) [2]	2002	14 x 865 kW, onshore	Ireland's largest tern colony nearby	EIS looked at flight paths of terns through site to sea.	ESB. Wind farm operational. No significant impacts predicted but monitoring required (An Bord Pleanála 2000)
Arklow Bank (IRL)	2003 on-wards	200 x 2.6 MW, 8 – 13 km	Little gulls, red-throated divers	EIS plus ongoing monitoring until 5 years after completion	Airtricity & GE Wind Energy Potentially significant impacts to be assessed by monitoring (Coveney & Phalan 2001, Cox 2002) ..http://www.iwea.com/offshore/index.html www.marine.gov.ie
North Hoyle (UK – Wales)	2003	30 x 2 MW 6 – 8 km	Red-throated divers & common scoters	EIS completed.	National Wind Power (NWP). No significant impacts due to distance from bird concentrations (NWP Offshore Ltd. 2002, Robinson 2001). Construction commenced April 2003, first generation from the project November 2003 .http://www.natwindpower.co.uk/northhoyle/index.htm
Horns Rev (DK)	2002	80 x 1.8 MW, 14 km	Divers, gannets, gulls, terns & auks	EIS for large scale experimental wind farm. Post construction monitoring	Elsam. Building complete & wind farm now in operation. Low numbers of birds on site. Negligible impacts seen during construction year (2002) monitoring. (Techwise 2003, Christensen 2001, Elsamprojekt A/S 2000, Noer et al 2000) www.hornsrev.dk
Nysted (at Rodsand) (DK)	2003	72 x 2.1 MW, 10 km	Cormorant, red-breasted merganser & eider	EIS for large scale experimental wind farm	SEAS Transmission A/S, ENERGI E2. Migratory routes pass through the windfarm. Monitoring planned to measure any possible impacts (NERI 2001, SEAS Distribution 2000). Building finished in 2003 www.nystedhavmoellepark.dk
Scroby Sands (UK - England)	2003 - 2004	30 x 2 MW, 2.5km	Little terns & migratory waterfowl	EIS completed for wind farm on inter tidal offshore bank	Powergen Renewables & Vestas. No significant impacts predicted but no "seabirds at sea" surveys. (Harris 1999, Percival & Percival 2000, Powergen Renewables Offshore Wind Ltd. 2001, Watson et al. 1995) Work began October 2003 and commissioning is expected to take place during autumn 2004.Due to be operational November 2004.http://www.powergenplc.com/powergen_renewables/scroby_sands.asp

CONFIRMED PROJECTS					
Kentish Flats (UK – England)	2004	30 x 3 MW, 10km	Seabirds & migrants	EIS completed	Global Renewable Energy Partners. Predicted that impacts will not be significant, due principally to small numbers of birds. (Global Renewable Energy Partners 2002), www.kentishflats.co.uk
Rhyl Flats (UK - Wales)	2005	30 x 2.5-5 MW 8 km	Red-throated divers & common scoters	EIS completed	National Wind Power Ltd (NWP). No significant effects predicted. (Celtic Offshore Wind Ltd, 2002) http://www.natwindpower.co.uk/index.htm
Gunfleet Sands (UK – England)	2005	30 x 3.6 MW, 7 km	Gulls, common scoter, red throated diver. Also migratory landbirds	EIS. Post construction monitoring	GE Wind Energy. No significant impact predicted – species occur in moderate to low numbers. Not a key habitat for seabirds. GE Wind Energy 2002, Approved. The project is expected to be in operation in 2005 http://www.gunfleetsands.co.uk/EIA.htm
Burbo Bank (UK - England)	2005	30 x 3MW 6km	Divers, cormorant, red breasted merganser, common scoter, little gull, common tern, auks	EIS. Aerial and boat surveys. Monitoring.	SeaScape Energy Ltd. Impacts predicted to be of low significance. (SeaScape Energy Ltd 2002) The construction of the wind farm is expected to take place in 2005. http://www.seascape-energy.co.uk/env_statement.html
Robin Rigg (UK -Scotland)	2005	60 x 3.6 MW 9.5km	Red-throated divers & common scoters	EIS submitted July 2002	Solway Offshore Ltd, Offshore Energy Resources Ltd (OERL). No significant effects predicted but monitoring programme recommended http://www.offshorewindfarms.co.uk/sites.html
Near Shore Windpark (NL)	2005	c. 50 x 2 MW, 8km	Local seabirds & migratory landbirds	Monitoring and evaluation programme of ecological effects of experimental park	NoordzeeWind (Shell/Nuon alliance). Baseline studies currently underway. Construction and first effect reports expected in autumn 2005. (S. Dirksen pers comm). http://www.ez.nl/beleid/ext_frame.asp?site=/beleid/home_ond/nsw/english.htm
Butendiek (DE)	2005	80 x 3 MW, 16-34 km	Divers, little gulls, terns, ducks	EIA. Bird counts by ship and by air, radar and nocturnal acoustic migration investigations.	Butendiek GmbH & Co. Permission granted December 2002 but objection raised by conservation organisations in April 2003. BioConsult SH/GFN mbH. 2002, www.butendiek.de

Inner Dowsing (UK - England)	2005	30 x 3MW 5 km	Divers, gannets, terns & waterfowl	EIS including seabirds at sea surveys	Offshore Wind Power Ltd. Significance of any impacts judged to be moderate/low – site and surrounding areas have low populations of birds. (Offshore Wind Power Ltd 2002) It is envisaged that if successful, work on the project will begin in 2005http://www.offshore-wind-power.com/projects/the-environment.htm
Lynn Offshore (UK - England)	2005 (earliest)	30 x 3MW 5km	Divers, gannets, dark-bellied brent goose, shelduck, wigeon, eider, common scoter, lapwing, dunlin, turnstone, great skua, little gull, tern species, guillemot	EIS. Seabirds at sea surveys.	AMEC. No significant impacts upon birds predicted as a result of construction, operation and decommissioning of the wind farm. (AMEC 2002) http://www.amec.com/wind/where/where_2ndlevel.asp?pageid=8039
Borkum West (DE)	2006-2012	208 x 5MW, 43-50km			Prokon Nord. Permission granted 2001. Pilot phase planned for 2006. Completion phase: installation steps from 2008 to 2012 http://www.prokonnord.de/eng_index.html
Lillgrund, Oresund (SE)	2006	48 x 1.5 MW, 7 km	Wintering seaduck & migratory landbirds	Pre,during , post construction monitoring project in place	Monitoring started autumn 2001. Initial reports expected in late 2003. (Green & Nilsson 2001)
PLANNED PROJECTS					
Shell Flats (UK – England)	2005	90 x 3.6 MW 7 km	Common scoters & red-throated divers	EIS. Seabirds at sea surveys. Aerial surveys	Cirrus Energy. Disturbance effects by maintenance visits may have significant effects (RSK Environmental Ltd.)
Nantucket (Mass. USA)	2005-2006	130 x 2.5 MW, 8 km	Roseate terns, piping plovers, seaduck, migratory landbirds	EIS equivalent	Cape Wind. Concerns raised are similar to those in Europe. Developers predict low impacts. (Clarke 2001). Construction planned 2006. .http://www.capewind.org/protecting/enstu02.htm
Kish Bank (IRL)	2006?	100 x 2.5 MW 10km	Seabirds (including Roseate Terns)	"Seabirds at sea" study for EIS	Kish Consortium. (Farrier et al 1999, Newton & Crowe 1999) http://www.iwea.com/offshore/index.html
Codling Bank (IRL)	From 2006 ??	220 x 2.5 MW 14.5km	Shearwaters, auks and gulls	"Seabirds at sea" study for EIS	Harland & Wolff Licences Ltd. No significant impacts predicted. Coveney Wildlife Consulting Ltd 2002. http://www.iwea.com/offshore/index.html

Dunkerque (F)	???	9 x 2 MW, 9km	Terns, divers, grebes, sea duck	ESAS survey methods.	Surveys done from a very low boat. Up to 100 turbines later. No decision on monitoring (Raevel 2001)Further 2 turbines erected in 2003.
Redcar (at Teeside)	???	30 x 3.6MW 1.6km	Little tern, sandwich tern, knot, redshank. Greater 20,000 birds	EIS completed	EDF Energy Ltd. RSPB objection due to collision risk and disturbance www.edfenergy.com
Vlakte Raan North (BE)	n/a	26 x 3-3.6 MW, 16-20km	Red-throated diver, little gull, great-crested grebe, sandwich & common terns	Seabirds EIS submitted November 2002.	Fina Eolia NV. Most significant impacts predicted for red-throated divers and little gulls during operation. Before, during and after monitoring. (Stienen et al. 2002). REJECTED

Footnotes
[1] This review is updated according to information available on the web.
[2] These two onshore windfarms are included because assessments of potential effects on seabirds were done.

References

AMEC 2002. Lynn Offshore Wind Farm Non Technical Summary
An Bord Pleanála. 2000. Grant of planning permission for 14 wind turbines at Carnsore Point & Inspector's Oral Hearing Report. An Bord Paella, Dublin.
BioConsult SH/GFN mbH. June 2002. Offshore-Burger-Windpark Butendiek Environmental Impact Assessment, English Summary.
Border Wind Ltd. 1998. Environmental Statement to accompany application for FEPA license to construct offshore wind farm on North Spit, Blyth, Northumberland. Border Wind Ltd., Hexham.
Celtic Offshore Wind Ltd. 2002. Rhyl Flats Offshore Wind Farm Environmental Statement March 2002.
Christensen TK. 2001. Base-line investigations of birds in relation to an offshore wind farm at Horns Rev. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Clarke JJ. 2001 Cape Wind Project Nantucket Sound. Massachusetts Audubon Society.
Coveney Wildlife Consulting Ltd. 2002. 'Birds' in: Offshore Wind Farm at Codling Bank, Environmental Statement. Natural Power.
Coveney J & Phalan B. 2001. Arklow Bank Seabird and Marine Mammal Survey July 2000 – June 2001.
Cox A. 2002. Foreshore Lease between the Minister for the Marine and Sure Partners Ltd..
Donszelmann E & van Schalkwijk M. 2001. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Elsamprojekt A/S. 2000. Horns Rev offshore wind farm – summary of EIA report – May 2002.
Farrier D, Forde A & O'Connor D. 1999. First Irish Offshore Wind Farm. In Irish Sea Renewable Resources, pp. 25-27. Irish Sea Forum Report No. 23. Liverpool University Press.
Global Renewable Energy Partners. 2002. Kentish Flats Offshore Wind Farm – Non Technical Summary – August 2002
Green M & Nilsson L. 2001. Birds and offshore wind farms in southern Oresund. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Harris R. 1999. A further field survey of the little terns of the Scroby Sands area, Great Yarmouth. Econet Ltd. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex L.
Newton, S.F. & Crowe, O. 1999. Kish Bank:a Preliminary Assessment of its Ornithological Importance. Birdwatch Ireland Conservation Report No 99/8
NERI (National Environmental Research Institute – Denmark) 2001. Base-line investigations of birds in relation to an offshore wind farm at Rodsand: Results and Conclusions 2001
Noer H, Christensen TK, Clauseger I & Petersen IK. 2000. Effects on birds of an offshore wind park at Horns Rev: environmental impact assessment. National Environmental Research Institute, Denmark.
National Wind Power (NWP) Offshore Ltd. 2002. North Hoyle offshore windfarm environment statement – non technical summary.
Offshore Wind Power Ltd. 2002. Inner Dowsing Offshore Wind Farm Volume 1 Non Technical Summary
Percival SM. 2001. Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/REP DTI/Pub URN 01/1434. UK Dept. of Trade and Industry.
Percival S & Percival T. 2000. Ornithological assessment of the proposed offshore wind farm at Scroby Sands. Norfolk. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex M.
Pettersson J & Stalin T. 2001. How the offshore wind farms influence the birds life – a study out at sea in southern Kalmar Sound, in southeast Sweden. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Powergen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement.
Raevel P. 2001. Ship-based censuses along the NW France coast in order to assess the impacts of a future offshore windpark. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Robinson P. 2001. Common scoter *Melanitta nigra* and wind farm development in the Irish Sea. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

RSK Environmental Ltd. 2003. Shell Flat offshore windfarm environmental impact statement. Helsby England.
SEAS Distribution. 2000. Rodsand offshore wind farm EIA – summary report – July 2000. Haslev, Denmark.
SeaScape Energy Ltd. 2002. Burbo Offshore Wind Farm, Volume 1: Non Technical Summary – September 2002
Simon LE, Painter A & Little B. 2001. The Blyth Offshore wind farm. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.
Stienen EWM, Van Waeyenberge J & Kuijken E. November 2002. Seabirds at the Northern Part of 'De Vlakte Van De Raan', Environmental Impact Study on the Effects of an Offshore Wind farm on Seabirds. Institute of Nature Conservation, Brussels.
Still D, Little B, Lawrence SG, Carver H. 1994. The birds of Blyth Harbour. In Elliot G (ed.) Wind energy conversion 1994 – proceedings of the 16th British Wind Energy Association conference, pp. 241-248. Mechanical Engineering Publications, London.
Still D, Painter S, Lawrence S, Little B, Mark T. 1997. Blyth Harbour Wind Farms and Birds. European Wind Energy Conference, Dublin
Techwise. 2003. Elsam Offshore Wind Farm, Horns Rev. Annual Status Report for the Environmental Monitoring Programme 1 January 2002 – 31 December 2002. April 2003.
Tractebel. 2001. Etude d'incidence sure l'environment en vue de l'obtention d'une autorisation et d'un permis pour la construction et l'exploitation d'un parc de turbines eoliennes – resume non technique.
Watson H, Rondell G, Brown E. 1995. A field survey of little terns for the Scroby Sands Area, Great Yarmouth. Ecosurveys Ltd. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex L.

Space page 6 of 6 for Table 1 Offshore[1] wind farm EIA's relating to birds

A 10 turbine project at Tunø Knob in Denmark, off the eastern coast of Jutland, was built in 1995. It is widely cited by industry as showing that offshore wind farms have little impact on birds although some industry quotes (e.g. Krohn 2001) do recognise the need for additional studies at other wind farm sites which hold different bird species. At Tunø Knob, assessment of bird impacts focused on two species of sea duck: eider and common scoter. The former occurred in large numbers in the vicinity of the wind farm. Initially, it was believed that the wind farm caused a decline in duck usage of the area. However, further studies showed that the changes in duck usage of the site were related to changes in the distribution of their mollusc prey species and not due to the wind farm. In addition, the changes in the prey species distribution was not linked to the effects of the wind farm. More recent studies at this site have shown that flight movements of these species tend to avoid the site at night by up to 1.5 km. This reduced their risk of collision (Percival 2001 and references therein).

4.2.5 Middelgrunden

The Middelgrunden wind farm near Copenhagen has 20 turbines generating 40 MW and went into service in June 2001. In the Middelgrunden Environmental Statement (ES), the predicted impacts are rather vague and comprise as follows: *Construction Impacts* 1. impacts of sediment disturbance on diving birds' ability to find food in the immediate area of the wind farm during construction, and 2. disturbance effects from noise and lighting during the construction phase. It is assumed that birds will avoid the area during construction but due to the low numbers of birds using the Middelgrunden area the impacts are not seen as significant. *Operational Impacts* 1. Disturbance through movement of turbines: a worst case is assumed where all birds avoid using the area in the vicinity of the wind farm (up to an unspecified distance) for foraging and roosting. In this case 200-300 birds would be affected with up to 10 pairs of breeding birds having reduced foraging area available to them. This was not considered significant. In addition it was considered that after 2-5 years mussels and other molluscs attaching themselves to the base of turbines would provide additional food for those birds that did venture into the site. 2. Collision risk: it is stated in the ES that previous study has shown that collision risk presented by turbines is minimal as birds avoid individual turbines or the site as a whole. In addition the ES states that studies show that larger turbines such as those at Middelgrunden present less of a risk than smaller ones do. Bearing in mind the low number of birds using the site collision risks are considered insignificant (Associated Press 2001, Voland & Hansen 2000, www.middelgrunden.dk).

4.2.6 Utgrunden

In 2000 seven turbines were built some 8km offshore at Utgrunden in the Kalmar Sound in Sweden. The main species in the area were eider duck, of which between half and 1 million migrate through the area in spring and autumn. In tail winds more than 70% of the birds flew below 10m and this increased to greater than 90% in other winds. Only some 2% of the ducks flew within 1km of the turbines and these increased their altitude to 150 to 300m to clear the 105m turbines (Petterson & Stalin 2001). In the autumn of 2002 a permit application and an EIA were submitted to the Environmental Court in Sweden with a view to expanding the existing wind park by 24 turbines. Construction is planned for 2004.

4.2.7 Blyth Offshore

Two turbines located 1 km off Blyth Harbour in Northumberland, went into operation late in 2000. This is a different project from the nine turbine Blyth Harbour breakwater installation. The environmental statement for the offshore project considered that there would be no significant impacts on coastal birds and their shoreline habitats. These habitats have been designated or proposed for designation as a Special Protection Area under the EU Birds Directive, and as a wetland of international importance under the Ramsar Convention. The environmental statement does not include any direct assessment of impacts on the site's marine birds. Night vision & video studies have begun to assess this (Border Wind 1998, British Wind Energy Association 2002, Simon *et al* 2001).

4.2.8 Carnsore Point in Wexford

The project comprises 14 turbines producing 12 MW on an 84 ha site at Carnsore point, the south easternmost corner of the country. After requesting an EIS, Wexford Co. Council rejected the proposal, though not in relation to its impact on seabirds. This rejection was then appealed to An Bord Pleanála, which included the possible impact on seabirds in its assessment. The board's inspector recommended refusal of planning permission but again not in relation to seabirds. However, the board overruled the inspector and granted permission. They attached a condition that *"bird surveys and monitoring of bird casualties be carried out"* to evaluate the effect of the development on the area's fauna.

Concerns about seabird impacts arose because the wind farm site is just to the east of a coastal lagoon called Ladys Island Lake. This holds Ireland's largest tern colony with 50 – 140 pairs of roseate terns (averaging about 10% of the north west European population), over 1,000 pairs of sandwich terns, 400 – 500 pairs of common/arctic terns and over 500 pairs of black-headed gulls (Newton & Crowe 2000). As a result, the lagoon and its islets have been designated as SPAs under the EU Birds Directive. They are also protected under the 1976 Wildlife Act.

The terns and gulls nest on two islets at the north end of the lagoon. BirdWatch Ireland carried out a study of the terns' flight lines to the sea for the EIS. This showed that terns accessed the sea mainly by flying south along the lake, but that 7 to 29% of them cut across land in a north easterly direction (although not normally through the wind farm site). In view of this result, both BirdWatch Ireland and Dúchas, were satisfied that the project would not have significant effects on the terns. However, both recommended monitoring during construction and operation, a position endorsed by An Bord Pleanála. This wind farm is now operational.

4.2.9 Arklow Bank, Wicklow

In August 2003, Airtricity and GE began the construction of an offshore wind farm of 200 turbines or 520 MW on the Arklow Bank off Co Wicklow. The Bank, which runs roughly parallel to the coast, is 26km long, 1.6 to 1.7km wide and, at its centre, 13km from Arklow Pier. It is a sandy ridge with rocky outcrops in water of 0 to 20m depth. To date, seven turbines have been installed and they became operational in late summer 2004. The turbines towers are 73m high and the blades are 52m long, with a minimum height of 21m above the sea.

Fieldwork was done using well established JNCC methods for surveying birds and marine mammals at sea. The project's EIS and the subsequent pre-construction monitoring found that the most sensitive species were red-throated divers and little gulls. In a worst-case scenario, both species could be subject to potentially significant displacement effects and the divers could be subject to collision effects. The monitoring programme will continue through the construction period and for five years after completion of the project to assess if these effects take place and to distinguish them from natural variability. The main mitigation measure is to construct the windfarm during the summer, when wintering concentrations are not present.

4.2.10 North Hoyle in Wales

Construction on the North Hoyle offshore wind farm began in April 2003. It is located approximately 7.5km from the North Wales coast off Prestatyn and Rhyl. It consists of thirty 3MW turbines, generating up to 90MW of electricity and meeting 1.5% of Welsh electricity demand. The UK Government has a target of generating 10% of UK electricity energy supplies from renewable sources by 2010.

The North Hoyle site possesses a number of attributes as a location for an offshore wind farm, including an excellent wind resource and no known environmental sensitivities. No significant environmental impacts have been identified. The site is beyond the foraging range and water depths preferentially selected by most of the important seabird populations in the bay. Surveys on the North Hoyle site have not identified any bird population sizes that could require European designation. Surveys during 2000/2001 have identified wintering populations of common scoter and red-throated diver in the Liverpool Bay, however North Hoyle is of negligible importance as a feeding area for these birds during the breeding season. No significant movements of important populations through North Hoyle have been observed or would be expected. (NWP Offshore Ltd. 2002)

The River Clwyd, which lies along the cabling route, is a non-statutory wildlife site, noted for migrant and wintering populations of county importance of a number of water-bird species. The impact on bird populations on the Clwyd Estuary and Floodplain Wildlife Site will be short term, confined to the construction period, with no effect beyond the calendar year of construction.

The overall conclusion is that the North Hoyle offshore wind farm will not significantly affect bird populations (NWP Offshore Ltd. 2002).

4.2.11 Horns Rev in Denmark

Horns Rev is 14 km west-south-west of Blavands Huk on the west coast of Denmark. 80 x 1.8 MW turbines are now in operation on a 27.5 km^2 site in water depths of 6.5 to 13m. Along with the Rødsand project (see below), this is one of two large demonstration projects. They represent the next stage in the development of Denmark's offshore wind industry after the Vindeby and Tunø Knob projects. Denmark's long term goal is that wind power will produce up to 50% of the country's electricity needs by 2030, or 5,500 MW of installed capacity. Of this some 4,000 MW will be generated offshore (Lemming 1999). The next step in the programme was a further three offshore wind farms of similar size off the east coast of Jutland. However, following the change of government in late 2001, these additional projects have been put on hold pending review of the offshore wind energy policy and support mechanism.

The Danish Energy Agency's approval for the Horns Rev project requires "*a programme for monitoring environmental impacts during the construction and the following initial phase of operation*" with particular attention to waterbirds and migrating birds. Of "*decisive importance*" was the requirement that natural variability should not mask effects. A detailed assessment of the likely impacts of this project on birds was published (Christensen 2001, Elsamprojekt A/S 2000, Noer *et al.* 2000). Work reported on to date covers two years of base-line monitoring from 1999 to 2001, and monitoring during construction of the wind farm in 2002. The last turbine at Horns Rev was put into operation in December 2002.

During base-line monitoring, nine aerial and three ship surveys were made of 1,700 km^2 surrounding the site. The most important species observed were eider and common scoter but these were concentrated on the coastal edge of the survey box in less than 6m of water. They were virtually absent from Horns Rev and the surrounding offshore waters.

Black-throated or red-throated divers, gannets, kittiwakes, sandwich terns, common or arctic terns, and guillemots or razorbills were the most numerous species in the survey box. However, the authors considered that, in the absence of an adequate mathematical model to take account of various biases that might arise during data collection, they could not calculate species densities.

The distribution of the seabird species was variable and this was thought to reflect variable prey fish distributions. Large numbers of lesser black-backed, herring and great black-backed gulls were often observed associated with fishing boats. Smaller numbers of skuas (mainly arctic skuas) were also observed. Most of these species occurred in disproportionately low numbers on the 1.6% of the Horns Rev study area occupied by the wind farm site. The exceptions to this were divers and kittiwake, which occurred, in roughly proportionate numbers. However, the sample sizes for these two species were small at 8 out of 554 and 11 out of 1,118 birds on site respectively.

The potential impacts were considered to be physical effects on habitats, disturbance/avoidance effects and collision risk. The impacts on habitats were considered to be insignificant in that the turbines' "footprint" will only be 0.3% of the 27.5 km^2 site and thus be too small to be measurable. Equally it is predicted that any reef habitat development around the turbine bases will not have a measurable impact on bird populations. Lastly it is considered that the laying of the connecting cable, which will pass through protected areas as it nears the coast, will have negligible effects – provided it is laid outside the common scoter moulting season of July to September.

Because of the low numbers of birds using Horns Rev, it was considered that even if there was complete avoidance of the site, the impact would be negligible. Analysis of bird usage out to 4km from the site, a very conservative worst case avoidance scenario, indicates that 7 to 10% of divers, kittiwakes, terns and auks from the entire study area, and 13% of gannets, would be affected. Apart from birds simply avoiding the wind farm, the other potential source of disturbance is use of helicopters for access and maintenance. Helicopters are known to cause significant disturbance impacts in some situations.

It was judged that the risk of collisions between wind turbines and seabirds is poorly documented. It was considered that actively hunting species such as gannets and skuas would be most likely to approach the turbines if they were pursuing fish and seabirds, respectively. Notwithstanding the poor knowledge base, it was considered that the collision risk would not have a negative impact on species populations.

Monitoring during the year of construction showed that although there were slight differences in bird exploitation of the wind farm area and the 2km and 4km zones around it, the bird numbers within and close to the wind farm area were not consistently and significantly reduced (Techwise 2003). Divers and auks did occur in significantly lower numbers at distances of more than 2.5km from the construction activities, while herring gull showed a significant attraction to the wind farm area and the 2km and 4km zones around it. In any case, very low numbers of birds were recorded at the wind farm site during base-line monitoring, and so any birds affected are unlikely to be of any biological relevance compared to the size of the total populations of the species known to occur in the greater Horns Rev area.

4.2.12 Nysted at Rodsand in Denmark

The summary of the environmental statement for the proposed Rodsand wind farm has been accessed (SEAS Distribution 2000). At this site, 72 x 2.1 MW turbines are planned in water depths of 6.5 to 9m at the edge of the Femer Belt strait separating south eastern Denmark from northern Germany. The wind farm site is some 10 km offshore and is just outside a large bay that is protected under the EU Birds and Habitats Directives, under the Ramsar Convention and by national nature reserve regulations. The cable route will pass through this protected area.

The key bird species using the area are cormorants and two duck species, red-breasted merganser and eider. In addition, much larger numbers of eider migrate through the area. It is considered that direct impacts on habitats will be minimal and that construction will have only temporary impacts. Some 10% of cormorants, eiders and gulls flying past a nearby observation site were at rotor height but it is not known if this applies at the wind farm site.

The Rodsand EIA concluded that it was not possible to determine if avoidance or collision effects would be significant as these could only be measured by monitoring once the wind farm was built. To maintain environmental compliance with the project's licence, monitoring of birds and seals and further investigation of the cable habitats is proposed up to and during construction. During the early years of the operating phase, it is proposed to add habitat studies of the wind farm site and assessments of the impacts of noise on fauna.

4.2.13 Scroby Sands in England

It consists of 30 turbines, generating 60MW on a shallow sandbank called Scroby Sands some 3km off Great Yarmouth in Norfolk. Construction began in October 2003 and commissioning took place during autumn 2004. The wind farm was built on the shallow but submerged northern section of the Sands. Parts of the southern section are tidal. Initial consultations identified as the most important ornithological issue a colony of 200 – 300 pairs of little terns on the coast opposite the Sands. There was also concern about collisions between the turbines and migratory waterfowl as they arrive at and depart from nearby coastal wetlands. These breeding and wintering sites are SPAs under the EU Birds Directive.

Surveys of the feeding usage of the Sands by little terns were done in 1995 and 1999. These showed that up to one third of the colony fed in an area of sheltered water at low tide 1 – 2 km south of the wind farm site. Less significant numbers of common terns also fed there. It was concluded that there would be no significant impact given the separation between the feeding area and the wind farm. It was also noted that little terns nest in close proximity to a coastal wind farm in Cumbria. It was recommended however that monitoring of the little terns should continue after the wind farm is built.

Worst case analyses were done of the collision risk for bean geese and Bewick's swans, the most sensitive of the migratory waterfowl species in the area. Up to 310 and 750, respectively, might pass through the site twice a year. The analysis demonstrated insignificant collision risks. Risks to migrating landbirds were also considered to be negligible.

Assessment of the significance of the site for seabirds was done by a desk analysis of previous JNCC seabird survey results. This showed the numbers in the area were very low and therefore any losses due to disturbance or collisions would be insignificant. It was also concluded that the 15 plus red-throated divers in the area would be unlikely to be significantly disturbed on the basis that the species nests close to onshore turbines in Orkney (Harris 1999, Percival & Percival 2000, Powergen Renewables Offshore Wind Ltd. 2001, Watson et al. 1995). However, no seabird survey was done of the site. This may be a weakness in the assessment given that standard JNCC type surveys may not have surveyed the shallow Sands area adequately.

4.3 Confirmed Projects

4.3.1 Kentish Flats (England)

Kentish Flats wind farm was given the go ahead in March 2003. The Danish power company Elsam purchased the project from Global Renewable Energy Partners in November 2003. Geological surveys to finalise foundation design were carried out at the site in February and March of 2004, and the erection of the turbines is expected to begin in the April 2005. Commissioning is expected in August 2005.

The use of the Kentish Flats wind farm site by bird species has been investigated by site specific bird surveys which will continue throughout the planning and construction phase. The assessment of impacts on bird species has concluded that significant effects on the feeding, roosting, breeding or migratory behaviour of all bird species through disturbance or collision will not be significant, due principally to the small numbers of birds recorded at the site. A possible exception is the potential for feeding diver species to be disturbed during the construction phase as a result of piling operations, if they occur in the main diver season between November and March. Suggestions for mitigation will reduce this impact so that it is not considered significant. Noise generated by cabling operations could disturb wading bird species, but mitigation is offered, suggesting avoiding the sensitive roosting and over-wintering periods. Numerous sites around the Thames Estuary coastline are designated for their conservation interest. No direct impacts on any of these sites will occur as a result of construction operation or decommissioning, with the exception of the potential impacts on the bird species just mentioned, which have been suitably mitigated.(Global Renewable Energy Partners 2002.)

4.3.2 Rhyl Flats in Wales

National Wind Power Limited (NWP) has completed the purchase of the offshore wind farm site at Rhyl Flats, approximately 10km off the North Wales coast. The project was initially developed by Celtic Offshore Wind Power Ltd (COWL). The wind farm was given the go-ahead in December 2002 and will supply up to 150MW of renewable energy into the existing North Wales electricity network.

Potential impacts on birds include disturbance to or permanent loss of foraging habitat, risk of bird collisions with operating turbines, and the creation of a barrier by the row of turbines However, significant changes were made to the layout during 2002 (mainly for landscape reasons), and this should also reduce the barrier effect of the turbines for common scoter, which feed landward of the wind farm. It is also possible that there will be creation of new marine habitat around the turbine bases which may create new foraging habitat for birds.

The EIA concluded that there may be some general disturbance effects during construction when birds normally using the area will maintain a stand-off distance from the works, but that in general the effects during operation will be limited and are not considered to be significant, particularly as the wind farm development will not give rise to any impacts on sites designated for nature conservation interest.

With the exception of cormorant (a fish eating species), few species are considered likely to forage in the area of the wind farm because of its distance from the shore and the depth of water.

Common scoter, which occur in nationally important numbers in the study area, is the main benthic feeding bird species which could be affected by habitat loss. However, significant impacts are not predicted because benthic habitat loss will be small; their preferred food source is scarce in the location of the wind farm and numbers are low in the months when most construction activity is likely to take place (April to August). Moulting common scoter could be affected by laying of the subsea cable. However, the work period will be short.

Modelling indicates that collision risk is greatest for red-throated divers, but that no significant impacts are likely. Proposed lighting for the site has been designed to reduce the risk of attracting birds to the turbines. Bird flight lines are not expected to be significantly affected as there will be a gap of 335m between rotor blades which will reduce the risk of a barrier effect from the turbines.

The findings of ongoing research studies will be used to refine mitigation details as necessary.

As part of the EIA, the impacts of the proposed wind farm at Rhyl Flats have been assessed in conjunction with another wind farm project proposed at North Hoyle. The development of both the North Hoyle and the Rhyl Flats offshore wind farms will result in a slight increase in the extent and intensity of the effects on seascape and landscape character, compared to the development of either project on its own. It has been found however that these heightened impacts relate to altered views in the Colwyn Bay, and to terrestrial archaeology. No other potential negative cumulative impacts are predicted. (Celtic Offshore Wind Power 2002)

4.3.3 Gunfleet Sands (England)

Provided the planning application is successful, construction is anticipated to begin in 2004.

23 boat surveys were undertaken at the Gunfleet Sands site in South-eastern England between October 2001 and June 2002. The survey information to date indicates that the Gunfleet Sands are used by a variety of marine or semi-marine species of birds and that they occur in low to moderate numbers. Thus, the 5km by 2km area occupied by the development does not represent a key or unique habitat for the marine birds of the wider Thames estuary. The choice of this site for the development avoids the more sensitive mudflat and saltings habitats used by waders and wildfowl of the Essex coast. Flight line records indicate that the project is unlikely to alter the movements of these groups of birds along the Essex coast. (http://www.gunfleetsands.co.uk/EIAStudiesBirdSurvey.htm)

4.3.4 Burbo Bank in England

In July 2003, the Burbo Bank Offshore Wind Farm in Liverpool Bay was granted consent to build in 2005. Key species considered in surveys of the site included common scoter, red-throated diver, common tern, cormorant, red-breasted merganser, auks and little gulls.

With the exception of red-throated diver, the significance of impacts on all species and groups of species was assessed as being low to very low. Although the risks of impacts on red-throated divers were considered to be low, the high sensitivity of the species led the ornithological consultants to conclude that the significance of impacts should be regarded as being of medium level, rather than low. Overall it was deemed that Burbo Offshore will not have a significant effect on bird populations within, or passing through, Liverpool Bay. (Seascape Energy Ltd. 2002).

4.3.5 Robin Rigg (Scotland)

The wind farm would be capable of generating 180 megawatts of electricity, meeting about 25% of Scotland's 2010 Kyoto target. The turbines would be in Scottish waters, meaning the Scottish Executive will be the planning authority, although the electricity would flow south. The £200m wind farm would interconnect with the United Utilities distribution network in Cumbria, via a sub-sea cable. The turbines would be built on Robin Rigg, a shallow sandbank approximately 6.4 miles from the Scottish coast and 7.1 miles from the English coast. Construction would be expected to last about 18 months. (http://www.theherald.co.uk/news/archive/10-4-19102-23-55-48.html)

Direct (causally linked to the development without any intermediary factor) and indirect (involving at least one intermediary process) ecological effects were assessed based on the Environmental Assessment Regulations 1999 and on the Institute of Environmental Assessment guidelines. Potential direct effects were identified as loss of habitat, and collision. The direct loss of habitat through the construction of the turbine bases and cabling would be of such a small scale that they will clearly not be significant in terms of their impact on bird habitats. For most species the magnitude of the collision risk was deemed to be negligible, and none of the overall collision risks that would be likely to result from the proposed Solway offshore wind farm were deemed to be significant. In terms of indirect effects, the wind farm could potentially affect the local bird populations by disturbing them and displacing them from an area around the turbines. However, disturbance would affect at most regionally important numbers of most species concerned, and the wind farm does not provide any particularly important ecological resource for these bird populations. For the two species that occur in the study area in nationally important numbers, red-throated diver and common scoter, displacement zones of more than 5km and 3km respectively would be needed to create a significant impact. Given that the maximum distance displacement that has been demonstrated at existing wind farms is 800m, it is concluded that disturbance to these species would be very unlikely.

The mitigation measures proposed include maximising the distance from internationally and nationally important nature conservation sites, avoiding known bird concentrations and maximising distance from nationally and regionally important seabird breeding colonies.

Ongoing monitoring is proposed.

4.3.6 Near Shore Windpark in the Netherlands

The Dutch government aims to generate 10% of its energy from renewable sources by 2020. It is anticipated that offshore wind farms will make a significant contribution to this goal, and the Near Shore Windpark is a large scale pilot project. Construction is expected to begin in 2004, with operation in 2005, and so the first effect studies should begin around autumn 2005.

The aim of the windpark is to get practical information on the feasibility and ecological effects of offshore wind farms. It will have about 50 turbines and will be located 8km out to sea. The 'before and after' monitoring and evaluation programme is currently underway and will assess the level of collisions, the changes in behaviour of local birds and the changes in flight patterns of migratory birds. The programme was agreed with government, voluntary bodies and experts. The planned methods are radar studies, a platform observatory and collision monitoring. Studies are underway on methods to detect collisions by sound, vibrations or infrared cameras combined with video cameras to identify species. If the monitoring and evaluation programme shows severe ecological effects, the park will be dismantled (Donszelmann & van Schalkwijk 2001).

4.3.7 Butendiek in Germany

Butendiek is one of two approved German offshore wind farm projects, and if realised will consist of 80 turbines over 35 square kilometres in the Eastern German Bight area of the North Sea. The EIA (BioConsult SH/GFN 2002) states that the proposed site "lies within an important location for roosting birds (Important Bird Area - IBA), as well as inside a defined potential marine protection area". In November 2002, NABU (Birdlife International's German partner) included the area in a list of IBAs and potential Natura 2000 sites (which are protected under the EU Birds and Habitat directives) for the German Exclusive Economic Zone (EEZ - includes all waters outside the 12 sea-mile zone which still belong to the national territory).

The ecological importance of the site was evaluated in the EIA using a scale of nine classifications. Classifications 6-9 are of above average importance. The proposed area of the wind park was classified as 9 ('Important for the whole North Sea and North Atlantic') for divers and pink-footed geese as an important wintering area and migration route. An average of 1 diver/km^2 was recorded in March and April. The highest recorded density, recorded on two specific days, was 1.9 diver/km^2. The average density of divers in the Eastern German Bight is 1.9 diver/km^2.

A classification of 8 ('Important for the German Bay') was assigned to harbour porpoises due to the numbers present and the importance of the area as a calving ground. Numbers were low in winter months but were distinctly higher in spring and summer, with the highest density of 3.7 harbour porpoises/km^2 being recorded in May 2001. A classification of 8 was also assigned to little gulls, which roost and pass through the area in internationally important numbers. On the spring migration densities of little gulls were 0.7 little gulls/ km^2. Wintering densities were lower at 0.2 little gulls/ km^2.

The overall assessment was that the risk and intensity of negative effects was intermediate for divers during operation of the wind farm, and intermediate for harbour porpoises during construction. All other effects were deemed to be of low risk and intensity. The report states that "despite the indisputable high conservation values for the proposed site, the proposed wind park can be classified as ecologically compatible and not harmful to the environment".

The project was given the go-ahead in December 2002. Following this, NABU launched a complaint against the Butendiek wind farm in April 2003, stating the importance of the area for seabirds such as divers, terns and ducks and for a number of marine mammal species. As a result the European Commission is currently investigating the Butendiek wind farm in relation to possible breaches of EU environmental law. NABU and the Federal Agency for Nature Conservation (BfN) state that the Eastern German Bight fulfils all scientific criteria for designation under both the Birds and Habitats directives. Currently there are at least 3 other wind farms planned in the Eastern German Bight. The extraction of sand and gravel is planned on more than 120 square kilometres in & around the Eastern German Bight IBA.

4.3.8 Inner Dowsing (England)

At the Inner Dowsing Offshore wind farm, located 5-7km off the Lincolnshire coast, the principle finding is that the site and surrounding areas surveyed have low populations of birds. The most likely impacts upon species of conservation concern are potential disturbance during construction work to divers feeding within the wind farm area from November to March, and potential disturbance during construction work to gannets feeding within the wind farm area in November and early July. (Offshore Wind Power Ltd. 2002).

4.3.9 Lynn Offshore (England)

This development is proposed off the coast of Skegness, Lincolnshire. Based upon the first nine months of data there are no recommendations on areas of ornithological interest to be avoided, as there are no significant impacts predicted upon birds from the construction, operation and decommissioning of the Lynn Offshore wind farm.

Monopiling work, if required, will be avoided during the peak diver season (from November to March), and the peak gannet periods in November. For work during early July, gannet numbers will be observed and where a critical threshold is reached, ornithological advice will be taken.

Neither divers, gannets, guillemots nor any other species seen within the wind farm study area are expected to be displaced in their distributions once the wind farm is built. No mitigation measures are therefore currently considered necessary for flight line disruption potentially caused by the operation of the wind farm.

Collision risks are considered to be insignificant as birds take avoidance action whenever possible. (AMEC 2002)

4.3.10 Borkum West in Germany

Borkum West is located in the North Sea approximately 45km north of the East Frisian island Borkum. The wind farm is being developed by Prokon Nord Energiessysteme GmbH and was given the go-ahead in November 2001. The project is divided into a pilot phase during which it is planned to build 12 turbines, followed by a completion phase with 208 turbines. The pilot phase will serve to investigate technical and nature conservancy issues associated with the project.

Before, during and after construction monitoring will take place. Surveys started in late summer 2000 (http://www.prokonnord.de/eng_index.html), and according to Prokon Nord, “Nature conservancy places (important bird areas, national parks etc) are not situated inside the area.” A “non-conflicting area” (in environmental terms) has been selected for the development. In addition, measures will be taken to minimise environmental impacts, such as avoiding the use of toxic coatings and construction during environmentally sensitive periods.

4.3.11 Lilligrund in Sweden

This 48 turbine project will be located in the southern Oresund near the new bridge between Denmark and Sweden. It will lie 7 km from the Swedish coast and 9 km from Denmark. The southern Oresund is an important staging and wintering area for waterfowl with a maximum of 40,000 present off the Swedish coast in autumn. Large numbers of migratory landbirds also pass through the site.

A bird monitoring programme began in the autumn of 2001. There have been some delays, with the project in relation to design, so baseline studies are ongoing. Construction is expected to begin in 2004. The aims are to monitor the bird presence before, during and after construction of the wind farm and to assess the behaviour of migratory birds as they pass (Green & Nilsson 2001).

4.4 Planned Projects

4.4.1 Introduction

Currently, information on possible impacts on birds of some 7 proposed offshore wind farms is available (Table 3). If these projects are granted permission, they are scheduled to begin construction from 2005 onwards. Two are in England at Shell flats and Redcar, the last of the UK offshore Round 1 projects (three Round 1 projects that have been given the go-ahead are not reviewed here – these are Barrow, Scarwearther Sands and Cromer). The next of the seven planned projects is in France off Dunkerque. Four were proposed off Belgium, however the licences were refused for three of these (Vlakte Raan, Vlakte Raan North and Wenduinebank). The application procedure for the other proposal at Thorntonbank is still underway. Two projects are proposed in Ireland on the Kish and the Codling Bank. The first non-European project was proposed at Nantucket, Massachusetts in the USA.

The Irish, American and Belgian projects are large with numbers of turbines exceeding or close to three figures. The UK projects are medium sized with 30 turbines. The French project is the smallest. The key bird species at each project and the proposed bird survey and monitoring programmes are summarised in Table 3**.**

There are numerous other offshore wind farm proposals world-wide, for which information about impacts on birds is not yet available. In particular, there are proposals to generate about 7,200 MW of electricity from about 1,500 to 2,000 turbines in three areas around England by about 2010. These are in Liverpool Bay, off the Thames and off the Wash. Initial environmental investigations of these proposals is underway.

4.4.2 Shell Flat in England

Cirrus Energy is proposing to develop an offshore wind farm on the Shell Flat sandbank between Blackpool and Cleveleys on the west coast of England (RSK Environment Ltd 2003). Construction is planned to commence in 2005, with power generation commencing in summer 2005. It is currently anticipated that decommissioning will occur in 2027. The project will comprise of 90 wind turbines of between 2 and 5MW each.

Aerial and boat-based surveys were undertaken to determine numbers and distribution of offshore birdlife. Aerial surveys in 2000/2001 and 2001/2002 confirmed the large population of common scoter, a sea duck, occurring within Liverpool Bay. The majority of these birds were recorded on Shell Flat and the counts suggest that the area holds a common scoter population of international importance, and the species shows a very strong tendency to select the area of the wind farm site by preference to other parts of the study area. Red-throated diver numbers reached numbers of national importance within the bay though they showed a tendency to avoid the wind farm area.

Potential impacts during construction and operation are identified in the EIS. During construction, habitat loss associated with turbine installation will be very low so impacts on benthic marine fauna is also expected to be low, as is, therefore, the impact on birds through reduced food supplies. Construction can be scheduled to avoid the July-August period when moulting scoters are most sensitive and occur in large numbers.

During operation, it is likely that there will be a reduction in the density of birds (principally scoters) using the Shell Flat area for several reasons, including avoidance of the turbine structures, disturbance caused by the noise of operating turbines but primarily by the movement of maintenance vehicles. Information collected shows that scoters are disturbed and fly away when vessels come to within an average of 344m from them, with larger flocks being more wary than smaller ones. When scoters are disturbed they tend to be displaced over considerable distances. Operational disturbance could be reduced with maintenance procedures designed around the scoter, by considering the number of boats used, their size, colour, speed and routes to and around the site. The magnitude of the disturbance effect cannot be predicted with certainty, although it could be very significant if mitigation were unsuccessful.

While there are no data on the rates of bird collisions with turbines located in offshore wind farms, most studies in other settings, including coastal locations, indicate very low rates of mortality arising from collisions. Evidence from height observations suggest that scoters fly predominantly at a height which would not bring them into contact with the rotors.

The cumulative impact from the proposed wind farm on birds is predicted to be negative. The other proposed wind farms in the area will reduce the extent of displacement habitat available. The main effects are predicted for common scoter and red-throated diver, for whom cumulative effects are potentially very high.

The RSPB is currently objecting to the Shell Flat scheme because it supports very large numbers of wintering common scoters, a sea duck that is on the UK 'red list' of species of conservation concern (British Birds 2004, www.rspb.org.uk).

4.4.3 USA – Nantucket Sound

The Cape Wind project at the Nantucket Sound, Massachusetts consists of approximately 170 tower-mounted wind turbines over an area approximately 25 square nautical miles in size. Concerns exist over the large scale of the project. These concerns are heightened in light of the large concentrations of birds found in the project area, and because of the many unknown factors regarding the avian use of the Sound as a whole. The key species include the federally endangered roseate tern and the threatened piping plover, as well as wintering seaducks and migrating passerine species. It was suggested that additional bird and habitat surveys be conducted to enable a more robust risk assessment, and that intensive, small scale monitoring projects be pursued prior to full scale construction of the overall project. (Clarke 2001). Developers however predict relatively little change to the avian population as a result of the installation and operation of the wind park. They state that the issue of bird collisions with turbines has been studied extensively at about a dozen wind parks in the US and no population impacts have been documented. Additional field investigations, including aerial studies, late autumn-winter studies and evaluation of other offshore wind parks have been commissioned to continue to gather site-specific data (http://www.capewind.org/protecting/enstu02.htm). Construction is expected in 2005.

4.4.4 Codling Bank (Ireland)

The Codling wind park would be a 220 turbine offshore wind farm at the Codling Bank, 13km off the east coast of Ireland between Greystones and Wicklow. The site would be constructed over 3-7 phases, each phase lasting spring and autumn of a single year. A recommendation was made for survey work comprising monthly boat surveys until construction started, twice-monthly surveys during construction and monthly surveys for another 3 years post construction. Pre-construction monthly surveys were carried out between April 2001 and March 2003 (Coveney Wildlife Consulting Ltd. 2002).

The Codling Bank area is not considered to be of particular sensitivity for birds (Coveney Wildlife Consulting Ltd. 2002). The nearest protected area for breeding or overwintering birds lies on the coast at the Murrough, more than 13km from the wind farm. Nevertheless comprehensive boat and aircraft bird surveys were carried out over an area of more than 580 km^2 to allow a full picture to be formed of the importance of the Codling Bank and the wider area for bird populations of the Irish Sea.

The key species identified in the study area include Manx shearwater, guillemot, razorbill, shag and gannet. The most important potential impacts were considered to be disturbance of the birds through construction activity and through movement and noise from wind turbines during the operating period, subsequent displacement of birds from the wind farm area, and collision risks with turbine blades. Collision risks for migrating birds were considered along with resident species.

The response of many of the seabirds recorded in the wind farm area to wind turbines is not well understood. However, since the wind farm area does not contain higher concentrations of seabirds than surrounding areas of the Irish Sea, in the absolute worst case assumption that all birds using the site would not use it during construction and operation, and moreover would not find other suitable areas, there would be no significant effect on the global or Irish Sea population of any species.

Collision risks on birds have been broadly estimated through observation of flight heights. At highest tides the minimum distance of rotor blades over the sea surface would be 30m. Collision risks would be negligible or zero for the four most important species in the Study Area: during monthly surveys 100% of flying Manx shearwaters, guillemot, and shags, and 99% of razorbills, flew at heights below 7m. More detailed analysis of collision risks for species that were observed flying over 7m during surveys (but not necessarily above 30m) - namely kittiwakes and gannets - showed that these species were unlikely to be at significant risk of collision with turbine blades.

4.4.5 Redcar at Teeside

EDF Energy are proposing a 30 turbine wind farm with 3.6 MW 1.6 km off the Tees at Redcar in north east England. The site is close to an area on the coast that is designated as an SPA under the EU Birds Directive because it holds in excess of 20,000 waterfowl. The Royal Society for the Protection of Birds, which a major voluntary conservation body in the UK, are objecting because they consider that alternative locations were not properly considered, there was insufficient evidence to conclude that there will be no adverse effect on the wildlife importance of SPA, the potential risk of birds colliding with the turbines was not properly assessed and because of potential disturbance to common scoters from the estimated 200+ maintenance visits that would be required to the turbines each year.

4.4.6 Vlakte Raan North (Belgium)

Fina Eolia propose to develop a 36 turbine wind farm in the northern part of the Vlakte van de Raan in Belgian territorial waters (Stienen *et al.* 2002). The turbines would lie in four lines perpendicular to the coastline, at a distance of between 16-20 km from the coast. Application procedures are currently underway.

Potential effects during the construction phase have been sited in the EIS as significant disturbance of the marine avifauna (Stienen *et al.* 2002). “Species that are sensitive to disturbance such as red-throated divers and great crested grebes will temporarily avoid the area. Other species (including gulls and terns) may benefit from the activities as a result of the temporary availability of food (because of the seabed being churned up and the increased ship activity).” A barrier effect and collisions are also sited as possible effects as early as the construction phase. Overall the effect on marine avifauna during construction is deemed to be “moderately negative”, “considering the temporary nature of the activities”. Furthermore, if the activities are carried out during spring and summer (May-July), “the effect on species sensitive to disturbance will be negligible”.

Seabird densities in the northern part of the Vlakte van de Raan are comparable to average densities on the entire Belgian Continental Shelf (BCS). Large gulls (particularly lesser black-backed gull) dominate the species composition of the area, and so during the operating phase most collisions are expected by these birds. It is also stated however that the distribution of most gull species depends to a large extent on the presence of fishing vessels. Because fishing vessels will avoid the wind farm, gull collisions might be significantly lower than expected based on current numbers present in the area.

Considering less numerous but internationally important species, the area is of great importance for red-throated divers (winter), great crested grebe (winter), little gulls (spring and autumn), sandwich tern (summer) and common tern (summer and autumn). Overall (taking into account the effects of both disturbance and collision as well as the national and international conservation status of the species), the potential effect of the wind farm on marine avifauna during the operational phase is deemed to be strongly negative for red-throated diver and little gull and negative for great crested grebe, sandwich tern and common tern.

The wind farm is of very high importance to migrating red-throated divers as well as wintering birds, and it is also of very high importance to migrating little gulls. Both species are of high conservation concern. The area is important for wintering and migrating great crested grebes but this species is less sensitive to disturbance and has no internationally protected status. The wind farm area is important for foraging and migrating sandwich terns. The disturbance effect will probably be low for the foraging birds but collisions and a barrier effect can be expected during migration. Finally, the wind farm area is of minor importance as a foraging area for common terns but constitutes an important part of the migration pathway of this species. Mitigation measures are suggested and before, during and after monitoring is proposed. This project has now been rejected.

4.5 Guidelines on ecological risk assessment of offshore wind farms

While actual experience of assessment of the impacts of offshore wind farms on seabirds is scanty, several reports have been published with guidance on how these impacts might be measured, mitigated and monitored. (Table 4 gives the key points from various guidelines and overview reports on ecological risk assessment of offshore wind farms). Perhaps the most comprehensive is Greenpeace's assessment of the ecological considerations that should be taken into account in developing an offshore wind industry in the North Sea (Söker et al 2000).

Scottish Natural Heritage have drafted a methodology for assessing the ornithological impacts of onshore and offshore wind farms and have agreed much of it with the British Wind Energy Association (SNH 2001). Variants of this have also been produced for English Nature (Percival 1988), the Irish Sea (Percival 1999), and English and Welsh offshore windfarms (Percival 2001). Others have been developed by BirdWatch Ireland (BirdWatch Ireland 2000, Galvin 2001), the Countryside Council for Wales (Hill et al 1999) and the German Federal Nature Conservation Agency (von Nordheim 2000). In addition, views on the impacts of offshore windfarms on birds from 17 developer, consultant and research organisations across 13 European countries have been collated (Henderson et al 2001).

A recent report entitled "Wind farms and birds: An analysis of the effects of wind-farms on birds, and guidance on environmental assessment criteria and site selection issues" was written by BirdLife International on behalf of the Bern Convention (Langston & Pullan 2003). In the analysis of effects, direct habitat loss is generally predicted to be small scale offshore, however, increasingly large wind farms, especially on feeding areas such as sandbanks in shallow waters, may give cause for concern and habitat change or damage may be significant. The potential cumulative effects of multiple installations are also of concern. The guidelines on assessment and site selection are outlined in Table 4.

Relating to legal matters, several of the reports highlight the requirement to comply with the EIA Directives. If SPAs or SACs are going to be affected, there is an additional necessity to comply with the Birds and Habitats Directives. This means that impacts have to be judged in the context of maintaining the integrity of the designated areas and the populations they hold. This is a stricter test than simply requiring no impacts on the population as a whole. In addition, some advocate assessment at earlier stages such as a Strategic Environmental Assessment (SEA) of the region and the overall place of the industry in it. This has been a legal requirement from June 2004 when the SEA directive comes into force. Greenpeace advocate a strong research programme on the environmental issues associated with offshore wind farms to reduce these uncertainties as the industry grows. They also advocate a scoping review at the start of the EIA process. While these are not legal requirements, their implementation will reduce concerns that might slow the growth of the industry.

Next come recommendations on doing the EIA itself. It should cover all stages of the project from installation and connection through operation and maintenance and finally dismantling. Assessment is required of potential impacts on birds and marine mammals from direct loss of habitat to the turbine bases and indirect loss of habitats due to disturbance. Additionally, potential collision impacts on birds need to be quantified. In most cases, the indirect loss of habitat is considered to be potentially the most serious. There may also be positive impacts due to the slowing of climate change. However, it is not likely that this can be measured for any one project. A second positive impact that some of these guidelines have identified may be an increased knowledge of species and their conservation needs in previously little studied habitats.

Impact assessment should proceed through a number of phases starting with desk studies of existing information, followed by field surveys to fill gaps. Such surveys will normally need to be done over at least a year and some recommend at least two years (e.g. Galvin 2001). Survey information then needs to be combined with assessment of effects to identify any significant adverse impacts on the more sensitive species. If such impacts are identified, then mitigation measures will be required to offset these, especially in SPAs or SACs. These can range from the structure of the turbine, to installation of appropriate lighting and foghorns to construction at the least sensitive time of the year, to minimisation of disturbance. If these do not deal with significant adverse impacts, then it may not be possible to proceed with the project, as it is unlikely that habitat compensatory measures can be implemented in the marine environment. In this regard, however, it should be noted that some early assessments may have taken an over-cautious approach in recommending that turbines and potentially sensitive species be separated by at least 800m (Percival 1998). On the other hand, in Germany it has been recommended that initial offshore projects should have no more than 10 – 15 turbines because of the paucity of knowledge about their impacts (von Nordheim 2000).

In conclusion, it is generally agreed that a strong monitoring programme focusing on the most sensitive species will be essential to build up a body of experience on the assessment of the ecological impacts of offshore wind farms. This should operate through the assessment and construction phases and into the operational phase.

Table 4. Guidelines and overviews on ecological risk assessment of offshore wind farms

Region/ Country	Prepared By	Key Points	Reference/ Website
Ireland	Birdwatch Ireland	• Important species include true seabirds, divers and the more sensitive seaducks (a very large flock of common scoters occurs off the Wexford coast and smaller flocks are usually present off Arklow and the North Wicklow/South Dublin coast. These can be present from late summer and throughout the winter period) • Bird data will have to be sufficiently robust to account for seasonal and annual variation and the variation caused by tidal movements and weather patterns. • A monitoring program must provide sufficient data in order to identify and fully understand the interactions between birds, invertebrates and fish	(Birdwatch Ireland 2000)
Irish Sea	RSPB	• Wind farms should not be located in a position that will adversely affect sites of national or international wildlife importance • EIS for individual projects should be *additional* to a strategic environmental assessment of offshore electricity generation, in order to enable the cumulative impact of a number of projects to be established.	(RSPB 2000)
Europe	CA-OWEE	• A summary of existing views on offshore wind farms is given • Ecological monitoring programmes/Before-After-Impact-Studies are highly desirable in order to judge effects on birds.	(CA-OWEE 2001) http://www.offshorewindenergy.org/
Europe	British Wind Energy Association	• Careful site selection • Quantitative assessment of effects, based on sound scientific data • Appropriate habitat enhancement/mitigation measures to demonstrate that conservation benefits outweigh any risks	(Percival 1998)
UK	British Wildlife Magazine	• Agreement between developers and conservation agencies of criteria by which sites may be selected to avoid bird issues • Agreement on assessment methodology where adverse effects may occur. Eg. determining habitat loss in a zone around the turbines to predict disturbance effects, detailed site specific data on bird flight patterns, numbers and behaviour to assess collision risk.	(Percival 2000)
UK	Department of Trade	• English Nature suggested defining potentially vulnerable areas as 1km around important gull and tern colonies, and 20km around other important seabird colonies.	(Percival 2001)

Region/ Country	Prepared By	Key Points	Reference/ Website
	and Industry, UK	• Recommended to maintain as much distance as possible from important estuarine bird sites • Turbines should ideally be unlit. If this is unavoidable then appropriate lighting should be used • More data are required on the distribution and abundance of offshore birds. Study of bird-habitat relationships to predict likely sensitive areas for key species • Ecological studies for species sensitive to (1)small increases in mortality rates (2)effects of habitat loss through disturbance • Standardised methodologies for assessment and monitoring of effects	
UK	English Nature, RSPB, WWF UK, BWEA	• Developers should be made aware of migration routes, local flight paths, foraging areas, wetland and upland areas of high ornithological importance • Development should respect and where possible further the objectives and targets identified for priority habitats and species listed in the UK Biodiversity Action Plan • Consideration of the potential impacts of wind farms on coastal processes • Early consultation between developers and conservation organisations may enable avoidance or mitigation measures to be identified • Monitoring programmes should cover a sufficient time period, should include a process to review the results & implement immediate remedial action as required • Research urgently needed to improve understanding of the generic impacts of wind farms	(Harley et al)
UK	Scottish National Heritage	• Individual wind farms have unique environmental and engineering features. These combine with species present to create issues which should be addressed individually • Key species likely to be sensitive include raptors, divers, geese, waders, raven & red kite • Many studies lack adequate control/baseline data • Avoidance by birds may incur higher energetic costs – this could become a critical factor in breeding success. • Evaluate risk of population decline or local extinction for species	(Gill & Townsley 1996)

Region/ Country	Prepared By	Key Points	Reference/ Website
German Baltic Sea & North Sea	German Federal Nature Conservation Agency	• Conclusive statements not yet possible, although potential risks can be considered • Precautionary approach (laid down in the OSPAR and Helsinki Conventions) should be stringently followed. Offshore wind farms with 100 or more single turbines should not be permitted for the moment. • Study results should be shared among countries developing offshore wind energy	(Von Nordheim 2000) http://www.coastalguide.org/windpower/von_nordheim.html
German North Sea	University of Kiel & Helgoland Avian Res. Station	• A research study that develops a "vulnerability index" to assess which seabirds were the likely to be affected by offshore wind turbines. • The index is based on 9 factors, flight manoeuvrability, flight altitude, % of time flying, nocturnal flight activity, sensitivity to disturbance by boats and helicopters, flexibility of habitat use, population size, adult survival rate, & European conservation status • Divers, cormorant and scoters had the highest sensitivity while gulls were the least sensitive species • Species sensitivity data was combined with survey data from the survey area to identify the most sensitive areas. This showed that area nearer to the coast were the most sensitive.	
North Sea	Greenpeace	• Environmental impact has to be investigated for all phases of a project's life-cycle including installation, connection of the wind farm to the grid, normal operation, maintenance and dismantling after service life • The time for erecting a wind turbine should be reduced and movements of vessels minimised. If there are different techniques available for installation of foundations and wind turbines, their effect on birds should be compared to minimize impairment • The main collision risk for migrating birds will arise in unfavourable visibility conditions. The disturbance of birds may be variable in time subject to feeding and migrating pattern. For very rare species even small numbers of losses may represent a severe impact. Intensity of migration declines with distance from the coast, therefore the collision risk is greater in near shore waters • Variations in the spatial distribution & density of wind turbines per unit area may be of importance. Where flight paths cross wind farms, measures should be taken to enable birds to follow their route with a small detour. Gaps in the arrangements of turbines	(Soker et al. 2000)

Region/ Country	**Prepared By**	**Key Points**	**Reference/ Website**
		may act as corridors (they need to be several kilometers wide). It is however preferable to minimize the total surface area of the wind farm. Especially long line shaped wind farms create a higher risk of disturbance. Dense clusters of turbines with gaps between them should be the best configuration • It is not clear whether wind turbines should be illuminated when seeking a way to minimize the collision impact – signal lights may make obstacles clear but could also attract birds • Take locations of favourable feeding areas into account by placing turbines in waters as deep as possible	
General	Friends of the Earth	• Location is a crucial issue	http://www.foe.co.uk/pubsinfo/briefings/html/19990916111754.html
General	By BirdLife Inter-national on behalf of the Bern Convention	• Wind farm developments that have the potential for damaging effects on wild birds or the wider environment, or in areas where there is uncertainty as to the potential effects, require a robust EIA. • Standardised study methods in the wind farm area and in a reference area, to ensure comparability, are essential as is consistency in their application before, during and after construction (BACI – Before After Control Impact). • It is recommended that a minimum one-year baseline field study should be undertaken to determine the use of the study-area by birds and to identify which, if any, species may be adversely affected by wind farm construction. • Post-construction monitoring needs to enable short and long-term effects and impacts to be distinguished and provide the information to enable them to be satisfactorily addressed. • The following species are included in a list of birds considered to be particularly sensitive, or potentially so, to wind farms, although in many cases there is a lack of impact studies to date: *Gaviidae* – divers, *Sulidae* – gannets and boobies, shag *Phalacrocorax aristotelis*, *Sternidae* - terns, *Alcidae* – alcids/auks and *Passeriformes* – especially nocturnal migrants. Gulls, including little gulls and kittiwakes, are not included in the list.	Langston & Pullan 2003

Region/ Country	Prepared By	Key Points	Reference/ Website
		• There is a strong consensus that location is critically important to avoid deleterious impacts of wind farms on birds. There should be precautionary avoidance of locating wind farms in statutorily designated or qualifying international or national sites for nature conservation (e.g. SPAs, SACs, Important Bird Areas - IBAs), or other areas with large concentrations of birds, such as migration crossing points. • There is an urgent need for statutory marine protected areas to be identified and designated • As part of effective regional planning, there is a need to identify species and areas of concern, to map potential no-go locations for wind energy development on the basis of nature conservation concerns. This may require the collection of additional information, especially offshore. • There need to be incentives to ongoing technological development to maximise efficiency of wind turbines and to reduce dependency on the limited shallow water habitats offshore.	
USA	National Renewable Energy Laboratory	• Careful evaluation of how life-history parameters could interact to influence population persistence can be used to approximate the influence of wind energy developments on bird populations • A standard protocol is described to document bird behaviour and fatalities resulting from existing wind power developments. • Studies of bird use at wind power developments must be conducted throughout the year and in various weather conditions • Investigate the role that equipment type has on bird behaviour and deaths	(Morrison et al. 1998)

References

BirdWatch Ireland. 2000. Guidelines for ornithological monitoring programmes conducted for offshore windfarm developments. Unpublished document..

CA-OWEE (Concerted Action on Offshore Wind Energy in Europe). 2001. Social acceptance, environmental impact and politics. Unpublished documtent.

Garthe S & Huppop O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. J. Applied Ecology, 41:724-734.

Gill JP & Townsley M. 1996. Review of the impacts of wind farms and other aerial structures upon birds. Final report to Scottish Natural Heritage Contract RASD/137/96 IBB

Harley M, Drewitt A, Gilliland P, Cleary B, Langston R, Marsh R, Burges D, Marais M, Shears C. 2001. Wind farm development and nature conservation – A guidance document for nature conservation organisations and developers when consulting over wind farm proposals in England. Published by WWF UK as a combined report by English Nature, RSPB, WWF UK and BWEA.

Langston RHW & Pullan JD. September 2003. Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and guidance on Environmental Assessment Criteria and Site Selection Issues. Report written by BirdLife International on behalf of the Bern Convention.

Morrison ML. 1998. Avian Risk and Fatality Protocol. National Renewable Energy Laboratory, US Department of Energy.

Morrison ML, Pollack KH Oberg AL & Sinclair, KC. 1998. Predicting the response of bird populations to wind energy-related deaths. National Renewable Energy Laboratory, Golden Colorado.

Percival SM. 1998. Birds & wind turbines: managing potential planning issues. Proceeding of the 20th British Wind Energy Conference, 1998, pp. 345-350

Percival SM. 2000. Bird and wind turbines in Britain. British Wildlife, October 2000:9-15

Percival SM. 2001. Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/REP DTI/Pub URN 01/1434. UK Dept. of Trade and Industry.

Royal Society for the Protection of Birds, UK 2000. Unpublished document.

Söker H, Rehfeldt K, Santjer F, Strack M & Schreiber M. 2000. Offshore wind energy in the North Sea - technical possibilities and ecological considerations - a study for Greenpeace.

Von Nordheim H. 2000. Wind turbines in offshore areas - a new technique and its possible impacts on environment, nature and landscapes

5 Assessment of the potential effects of the proposed windfarm on birds

5.1 Introduction

The assessment methodology is based on a system developed by Scottish Natural Heritage (SNH) and the British Wind Energy Association for the assessment of the ornithological effects of wind farms (Percival et al. 1999). This methodology was used at a proposed wind farm in the Solway Firth (Robin Rigg Offshore Wind Farm Environmental Statement 2002) and was slightly modified for the EIA for a proposed wind farm on the Codling Bank (Coveney Wildlife Consulting Ltd. 2002), just south of the Kish/Bray Bank. In this report, the methodology has been further modified by the development of numerical criteria for the assessment of the sensitivity of the species concerned. These numerical criteria have also been adjusted to take account of the conservation status of the species.

Negative effects are defined as effects that are detrimental to the nature conservation value of any component of the ecosystem and anything that might reduce that component's viability at the site. Positive effects are defined as those that increase conservation value and which improve a component's viability. Only negative effects are considered in this assessment.

Any effects have been further defined as direct (those that are causally linked to the development without any intermediary factor) or indirect (those involving at least one intermediary process). Only direct effects are considered in this assessment as any indirect effects are not considered to be separately measurable.

5.2 Methodology

5.2.1 Bird Units (BU) & milli Bird Units (mBU)

To allow quantitative species comparisons and assessment of the aggregate bird usage of the Study Area, the concept of "bird units" (**BU**) was developed. For each species, one BU is defined as 1% of its biogeographical population. The idea of using 1% of the biogeographical population as a threshold value for assigning "international importance" to a site has been well established by Wetlands International in the context of the Ramsar Convention on the conservation of wetlands (Colhoun 2001, and references therein). However, the bird unit concept and its use in the analyses in this report was developed by Coveney Wildlife Consulting Ltd. JNCC have also ranked species by their biogeographical populations in identifying vulnerable concentrations (Webb et al. 1995).

BUs for most of the species treated here are based on the biogeographical population data published by Wetlands International (Delany & Scott 2002). For seabird species not covered by Wetlands International, population data from Seabirds 2000 survey (Mitchell et al. 2004). In calculating the BUs population estimates based nos of breeding pairs are converted from pairs to individuals and 50% is added to allow for non-breeders. The breeding populations of two species that nest in groups on cliffs, guillemot and razorbill, can only be estimated in individuals. These numbers are converted to pairs by multiplying by 0.67 and then treated as before to get BUs

As one BU is quite a high threshold, it was normally more convenient to use milli bird units (**mBU**s) for plotting on charts. The mBU values are **directly comparable** between charts – to the extent that the biogeographical populations have been accurately measured.

5.2.2 Regional Bird Units (RBU)

In addition to using 1% of the biogeographical population as the threshold value for international importance, a threshold of 1% of a country's population is used to define national importance (Colhoun 2001). For this study, it was considered more appropriate to use Irish Sea populations rather than national ones as the basis for this threshold. This is because national populations would include birds breeding on the west coast of Ireland. These populations are much further from the Irish Sea than the seabird populations breeding on British coasts from the Mull of Kintyre southwest Scotland to Skokholm Island off Milford Haven. These Irish Sea populations were used as the basis for "Regional Bird Units" (**RBU**s). Where available, 1 RBU was plotted on the species charts to allow the results to be put in a regional context.

However, RBUs differ from BUs in a fundamental way. BUs are based on a species' biogeographical population. By definition, this is 100 BUs for each species and BUs are comparable across the species' range and between species. In contrast, RBUs are based on the proportion of the species' biogeographical population that happens to occur in the reference regional area, this case the Irish Sea. As this proportion differs from species to species, RBUs cannot be compared between species and are thus not appropriate for the quantitative analyses that can be performed using BUs.

In summary, mBUs and BUs can be compared from chart to chart. However, they cannot be compared with RBUs nor can RBUs be compared between charts.

5.2.3 Determination of significance

The criteria used for the determination of the significance of the ecological effects are summarised in Table 5 and Table 6 below.

Table 5. Ranking of the Sensitivity of the Ecological Components of the Site[1].

Sen-sitivity	Thresholds					
	Green Species		Amber Species[2]		Red Species[3]	
	mBU	RBU	mBU	RBU	mBU	RBU
Very High	1,000	10	500	5	100	1
High[3]	200 – 999	2 - 9.9	100 - 499	1 - 4.9	20 - 99	0.2 - 0.9
Medium[3]	40 – 199	0.4 - 1.9	20 - 99	0.2 - 0.9	4 - 9.9	0.04 - 0.19
Low[3]	10 – 39	0.1 - 0.39	5 - 19	0.05 - 0.19	1 - 3.9	0.01 - 0.039

[1] Modified from the SNH/BWEA guidelines (Percival et al. 1999) to take account of the threat status of Irish species (Newton et al. 1999).

[2] Amber species are judged to be twice as sensitive, and red species ten times as sensitive, as green species.

[3] The thresholds for high and medium sensitivity are set at five times lower than the lower threshold for the next highest category, and four times lower for low sensitivity.

Table 6. Ranking of the Magnitudes of the Ecological Effects[1]

Magnitude	**Definition**
Very High	Total loss or very major alteration to key elements or features of the baseline (pre-development) conditions such that post-development character or composition or attributes would be fundamentally changed and may be lost from the site altogether – defined as more than 67% of population or habitat lost
High	Major alteration i.e. 34 to 67% of population or habitat lost.
Medium	Loss or alteration to one or more key elements or features i.e. 11 to 33% of population/habitat lost.
Low	Minor shift away from baseline conditions, i.e. 1 to 10% of population/habitat lost.
None or negligible	Very slight change from baseline condition i.e. less than 1% of population/habitat lost

[1] Modified from the SNH/BWEA guidelines (Percival et al. 1999). The threshold for very high was reduced from 80% to 67%. The threshold for high was increased from 20% to 34%. Medium was changed from 5 - 20% to 11- 33% and Low was changed from 1-5% to 1 – 10%.

The combined assessment of the magnitude of an effect and the sensitivity of the site (or any component of the ecosystem) have been cross-tabulated to assess the overall significance of that effect (Table 7). The significance of the effects are related to the Habitats Directive and the Environmental Protection Agency (EPA) system in Table 8.

The calculations to convert the numbers of birds to mBUs and RBUs, the various adjustments of these, and the applications of the rules in the tables in this section (5.2) were all done and stored in an Excel spreadsheet.

Table 7. Matrix of Magnitude of Effects & Sensitivities Used to Get Significant Effects.

SENSITIVITY (→) **MAGNITUDE OF EFFECT (↓)**	**Low**	**Medium**	**High**	**Very High**
Very High	None	**High**	**Very high**	**Very high**
High	None	*Medium*	**High[1]**	**Very high**
Medium	None	*Medium*	*Medium[2]*	**High[1]**
Low	None	Low	Low	*Medium*
None	None	None	None	None

[1] Modified from very high in SNH/BWEA guidelines (Percival *et al* 1999)

[2] Modified from high in SNH/BWEA guidelines (Percival *et al* 1999)

Table 8. Relating the Significance of Effects to the Habitats Directive and the EPA system

Class of Effect	Significance of Effect[1]	Significant Adverse Effect[2]	Significance of Impact[3]
1	**Very high**	**Yes**	**Profound**
2	**High**	**Yes**	**Significant**
3	*Medium*	*Possible*	*Moderate*
4	Low	No	Slight
5	None	No	Imperceptible

[1] From Table 7

[2] As defined in Article 6 of the Habitats Directive (92/43/EEC)

[3] As defined by the EPA (2002)

The interpretation of the classes of effect is as follows:

• **Classes 1** and **2** represent a significant effect on bird populations and could warrant refusal of a planning proposal.

• **Class 3** represents a potentially significant effect that requires careful individual assessment. Such an effect could warrant planning refusal, but it may be of a scale that can be resolved by revised design or appropriate mitigation.

• **Classes 4** and **5** are not normally of concern, though normal design care should be exercised to minimise effects.

5.3 Assessment of Effects

5.3.1 Introduction

The review of assessments of effects on birds of other wind farm projects (see page 29) has shown that wind farms generally do not have significant effects on birds, with the possible exception of a few inappropriately sited projects. However, the suite of seabird species on the Kish and Bray Banks have not yet been exposed to a wind farm. Therefore, it is not possible to quantify the level of risk to which they will be exposed. Instead, a four step process has been undertaken to estimate maximum potential risk to the species. Firstly, the numbers of birds at risk in various scenarios have been quantified from the baseline data. Secondly, these numbers were then adjusted to take account of the conservation status of the species involved. This gives the sensitivity of the local populations. Next, judgements were made on the magnitude of likely effects. Finally, the sensitivities and magnitudes were combined to allow the significance of the risks to the birds to be assessed. (Table 10).

5.3.2 Quantification of the numbers of birds at risk

A conservative approach was taken by basing the estimate on the peak population estimates using the area as reported in Table 2 of the survey report (Percival et al 2002). This gives worst case scenarios in the unlikely event that the wind turbines would displace all of the birds from the Bank. An assessment of the effects of collisions was not done because estimates of numbers of birds flying in the turbine zone was not provided. However, such numbers are normally low for most species.

5.3.3 Assessment of the potential effects of disturbance

5.3.3.1 Determination of sensitivity of bird populations in relation to disturbance

Table 9 gives the estimated peak numbers of birds at risk, which are used to allocate the sensitivity ranking to each species. The sensitivities of the seabird populations that were calculated are linked to the magnitude of the potential effects in the next section to estimate the potential significance of the effects of the windfarm

Peak numbers were chosen, because they give a worse 'worst case' scenario than average numbers do. It should also be noted that these peak numbers are those recorded in the whole boat survey area, which extends up to 3km east and west of the Bank, approximately. If the sensitivity of the species in this worst case scenario was low or none they were not further considered.

Eleven species had medium, high or very high sensitivities. By far the most significant is roseate tern, the only species with a very high sensitivity. This occurs because of their very low population and red conservation status. Therefore, even the estimated peak of 28 birds in the central area still ranked as very highly sensitive. However, the estimated average numbers in the central area of about 4 birds reduced their sensitivity in this area to high.

When peak numbers on the whole Bank are considered, four other species are highly sensitive, Manx shearwater, common tern, guillemot and razorbill. High sensitivity was retained only by common tern for average numbers on the entire Bank but this dropped to medium for peak and average numbers in the centre of the surveyed area.

Six species, great northern diver, cormorant, shag, great black-backed gull, kittiwake, and Arctic tern had medium sensitivities when peak numbers on the whole study area were considered but these dropped to low or none when peak numbers in the central area were considered.

The last column of Table 9 compares the survey report's assessment of the conservation importance of the bird numbers recorded with the sensitivities calculated here. The general trends are similar. The differences that arise are because the method in this report takes account of the species conservation status. For example, shag and kittiwake attained national status in the survey report but they are only of medium sensitivity because of their green conservation status.

Table 9. Worst case estimate of nos. of birds at risk and the resulting sensitivities

Species	Conser-vation Status [1]	Peak Nos. of Birds recorded [2,3]	Peak Nos. as adjusted mBUs [4]	Sensi-tivity [5]	Survey Assess-ment [6]
Red-throated Diver	Amber	2.0	0.4	None	Local
Great Northern Diver	Green	3.0	60.0	Medium	None
peak nos central area[7]		0.6	12.0	Low	n/a
average nos on central area		0.1	1.4	None	n/a
Fulmar	Green	42.0	0.4	None	None-
Manx Shearwater	Amber	3,764.0	666.2	**High**	**National**
average nos on bank		697.4	123.4	Medium	n/a
peak nos on central area		752.8	133.2	Medium	n/a
average nos on central area		139.5	24.7	Low	n/a
Gannet	Amber	107.0	18.3	Low	Regional
Cormorant	Amber	81.0	135.0	Medium	Regional
peak nos on central area		16.2	27.0	None	n/a
Shag	Green	293.0	122.1	Medium	**National**
peak nos on central area		58.6	24.4	Low	n/a
Brent Goose	Amber	0.0	0.0	None	n/a
Common Scoter	Amber	31.0	3.9	None	Local
Arctic Skua	Green	19.0	25.3	Low	Regional
Great Skua	Green	3.0	6.3	None	None
Little Gull	Amber	5.0	11.9	Low	Local
Black-headed Gull	Amber	8.0	0.2	None	Local
Common Gull	Amber	39.0	27.5	Low	Local
Herring Gull	Amber	113.0	20.5	Low	None
Lesser Black-backed Gull	Green	5.0	0.9	None	None
Great Black-backed Gull	Green	171.0	72.8	Medium	None
Peak nos on central area		34.2	14.6	Low	n/a
Kittiwake	Green	4,382.0	52.2	Medium	**National**
peak nos on central area		876.4	10.4	Low	n/a
Arctic Tern	Amber	144.0	64.0	Medium	Local
peak nos on central area		28.8	12.8	Low	n/a
Common Tern	Amber	583.0	613.7	**High**	**National**
average nos on bank		164.3	345.9	**High**	n/a

Species	Conser-vation Status [1]	Peak Nos. of Birds recorded [2,3]	Peak Nos. as adjusted mBUs [4]	Sensi-tivity [5]	Survey Assess-ment [6]
peak nos on central area	Amber	116.6	122.7	Medium	n/a
average nos on central area		32.9	69.2	Medium	n/a
Roseate Tern	**Red**	282.0	56,400.0	**V. High**	**Int'l**
average nos on bank		43.6	8714.3	**V. High**	n/a
peak nos on central area		28.2	5640.0	**V. High**	n/a
average nos on central area		4.4	871.4	**High**	n/a
Little Tern	Amber	0.0	0.0	None	n/a
Guillemot	Amber	14,218.0	332.6	**High**	**National**
average nos on bank		3,687.6	86.3	Medium	n/a
peak nos on central area		2843.6	66.5	Medium	n/a
average nos on central area		737.5	17.3	Low	n/a
Razorbill	Amber	3,110.0	391.2	**High**	**National**
average nos on ban		491.3	61.8	Medium	n/a
peak nos on central area		622.0	78.2	Medium	n/a
average nos on central area		98.3	12.4	Low	

[1] According to BirdWatch Ireland's "red amber green" categorisation of Irish birds. "**Red**" is defined as of high conservation concern, "**amber**" as of medium conservation concern and "**green**" as of no conservation concern (Newton et al. 1999).

[2] From Table 1 of Percival et al 2002 – the peak numbers recorded in the boat study area.

[3] For each species, the first row shows the sensitivity for the peak numbers on the whole Bank. Where the sensitivity was "Medium", "High", or "V. High", additional sensitivities are given for some or all of the following cases:- *average nos on bank*, *peak nos on the central area* and *average nos on central area*. The average numbers on the Bank were calculated by dividing the numbers recorded on all surveys by the number of surveys that were done, i.e. 14. Peak numbers in the central area area were calculated by dividing the peak numbers on the Bank by five, for all species except roseate tern. A factor of five was selected because the central area area occupies about 20% of the Bank and examination of the maps in the survey report (Percival et al 2002) showed that most species used this part of the Bank approximately in proportion the fraction of the whole Bank that it occupies. The factor used for roseate tern was 10, because of their disproportionate preference for the northern end of the Bank.

[4] mBUs, milli Bird Units are as defined in Table 2. mBU values have been adjusted in two ways. Firstly, they have been multiplied by factors of 2 or 10, respectively, if the species has amber or red conservation status as detailed in Table 5. Where the sensitivity ranking for mBUs was higher than for RBUs, the former was used because mBUs are derived from the international population of the species. In the reverse cases, where RBU sensitivity was one class higher, the mBU values were further multiplied by two for amber species to calculate the final sensitivity. Where RBU sensitivity was two classes higher, the mBU values were further multiplied by four for amber species and two for green species. Where RBU sensitivity was three classes higher, the mBU values were further multiplied by six for amber species and three for green species.

[5] Sensitivity is determined according to the adjusted mBU values as detailed in Table 5. Note that the adjusted mBU values already take in to account the species conservation status and any adjustment required if the RBU sensitivity is higher. Therefore, the scale in Table 5 that applies here is the mBU scale for green species.

[6] The survey's conservation was based on the peak numbers recorded in the whole survey area (Percival et al, 2002). n/a = not available.

[7] The "central area" is defined as the 20% of the survey area bounded by the following grid co-ordinates: (339000,224000), (340000,224000), (340500,220500), (339000,219750)

5.3.3.2 Determination of the magnitude of the effect in relation to disturbance

Although often referred to as an indirect consequence of disturbance or displacement, habitat loss is considered here to be a direct effect in the absence of any evidence of mechanisms of indirect effect, such as disturbance of prey species.

The key step here is scoring the magnitude of the effects on species involved (Table 10). Essentially this a judgement call on how much the wind farm will reduce the use of the site by the species concerned during construction, operation and decommissioning. In making the judgement of the level of risk to birds, the following factors were taken into account:

- The importance of the site in the species' overall ecology.
- Experience of assessing effects on the similar suite of species on the Codling & Arklow Bank (CWC 2002, 2003).
- In deciding on the magnitudes of effects, account was also taken of recently published similar method of assessing the sensitivity of species to wind turbines in German offshore waters in the North Sea (Garthe & Huppop, 2004).
- Most bird species are generally tolerant of non-threatening disturbance and inert structures that do not directly affect them.
- With the exception of roseate tern, the European populations of the regularly occurring seabird species in the study area are generally stable or increasing since the reduction in direct human exploitation over the last several decades. Even oil spills and large bycatches of seabirds in nets have not caused long term declines at the population level (Hutchinson 1989, Newton *et al.* 1999, Tucker & Heath 1994).
- The major causes of seabird declines have been active human exploitation, introduction of alien predators to nesting sites, disturbance of nesting sites (del Hoyo et al 1992), and more recently, bycatches of albatrosses on long line fisheries in the southern oceans (Anon 2001).
- The general increase in seabirds contrasts notably with the decline of western European farmland birds. The decline of the latter is due to agricultural intensification (Newton *et al.* 1999).

In summary, seabirds have declined in response to human persecution or disturbance, the introduction of predators, or due to the presence of a destructive "pull factor" in the case of albatrosses. The human and predator factors are not relevant to wind farms and it is very difficult to see why wind farms might have a destructive "pull factor" for the seabirds in the Irish Sea.

Table 10. Worst case estimates of potentially significant displacement effects on birds

Species (see footnotes on next page)	**Sensitivity** [1]	**Maximum magnitude of effect**[2]	**Maximum significance**[3]	**Potentially Significant effect**[4]
Great Northern Diver	Medium	**High**	Medium	Possibly
peak nos on central area	Low	**High**	Low	Possibly
average nos on central area	None	**High**	None	No
Manx Shearwater	**High**	Low	Low	No
average nos on bank	Medium	Low	Low	No
peak nos on central area	Medium	Low	Low	No
average nos on central area	Low	Low	None	No
Cormorant	Medium	Medium	Medium	Possibly
peak nos on central area	Low	Medium	Low	No
Shag	Medium	Medium	Medium	Possibly
peak nos on central area	Low	Medium	Low	No
Great Black-backed Gull	Medium	Medium	Medium	Possibly
Peak nos on central area	Low	Medium	Low	No
Kittiwake	Medium	Low	Low	No
peak nos on central area	Low	Low	None	No
Arctic Tern	Medium	Low	Low	No
peak nos on central area	Low	Low	None	No
Common Tern	**High**	Low	Low	No
average nos on bank	**High**	Low	Low	No
peak nos on central area	Medium	Low	Low	No
average nos on central area	Medium	Low	Low	No
Roseate Tern	**V. High**	Medium	**High**	**Yes**
average nos on bank	**V. High**	Medium	**High**	**Yes**
peak nos on central area	**V. High**	Medium	**High**	**Yes**
average nos on central area	**High**	Medium	Medium	Possibly
Guillemot	**High**	Medium	Medium	Possibly
average nos on bank	Medium	Medium	Medium	Possibly
peak nos on central area	Medium	Medium	Medium	Possibly
average nos on central area	Low	Medium	Low	No

Razorbill	**High**	Medium	Medium	Possibly
average nos on ban	Medium	Medium	Medium	Possibly
peak nos on central area	Medium	Medium	Medium	Possibly
average nos on central area	Low	Medium	Low	No

[1] From Table 9

[2] See Table 6 for definitions of the magnitude rankings. Judgement on the appropriate rank for individual species based on the ecology of the species' use of the Bank.

[3] Significance is based on the combined assessment of the sensitivity of the species and the magnitude of the effect, as per the matrix in Table 7.

[4] Where 'Maximum Significance' is very high or high, it considered to be significant in the context of the EIA and Habitats Directives. Because of the uncertainty in assessing the magnitude of the effects, only potential significance can be given. Cross-linkages between the significance of effects established here & those defined by the Irish EPA and the EU Habitats Directive are given in Table 8.

Having taken all of the above factors into account, only one species remained where the potential effects are significant in a worst case scenario based on the numbers of birds observed on the field survey. This is the roseate tern where very high or high sensitivities combine with medium magnitudes of effects. In contrast to the other two tern species, where the magnitude of effects were judged to be low at maximum, roseate tern was scored at medium magnitude because the effects of the loss of even low numbers of birds could have on this threatened population. As always, however, it must be stressed that there are no obvious reasons why wind turbines should cause roseate terns to be displaced from the Bank.

Potentially highly significant effects are possible in a worst case scenario when peak numbers on the whole Bank are assessed, when average numbers on the whole Bank are considered, and when peak numbers on central area are taken into account. However, the potential effects on the average numbers, i.e. 4.4. birds, using the central area area are only possibly significant in a worst case scenario. As virtually all of the roseate tern usage is to the north of the central area area, it is considered that construction on, and south of, the central area will not have significant effects on the roseate terns. However, areas to the North of the central area will need to be carefully assessed for possible effects on roseate terns in the light of the results of monitoring before and during construction.

The maximum magnitude of effects was judged to be medium or less for all other species other than great northern diver. When combined with the sensitivities for these other species, there remained possibly significant potential effects on cormorant, shag, great black-backed gull, guillemot and razorbill in a worst case scenario. It is considered that such effects on these species would not warrant the refusal of permission for turbines on any part of the Bank. However, a monitoring programme should be put in place to verify this prediction.

The high potential effects on great northern diver, combined with the medium sensitivity of the species at the level of all birds on the Bank, combine to give possibly significant potential effect. However, it should be remembered that all of this derives from a peak count in the entire Bank area of just three birds. The reason that this low number feeds through to a non-negligible effect is because of the low threshold of just 50 birds for a bird unit. Despite the answer given by the assessment process, it is considered that a worst case effect involving the loss of the Bank to just three individuals of a species with a secure conservation status is not significant.

It is assumed that decommissioning effects will be similar to construction effects at most. Therefore, they are not assessed separately from construction effects. However, this should be reviewed prior to decommissioning. Increased disturbance during construction and decommissioning from, e.g. boat activity, was not assessed separately to disturbance during operation on the assumption that a relatively small number of turbines will be constructed or decommissioned at any one time and that this will take place during the summer. Species that are known to be sensitive to boat disturbance, such as divers and scoters, were recorded in small numbers and mainly during the winter.

5.3.4 Collision effects

The report on the field survey data did not give breakdowns of the proportions of high flying birds (Percival et al 2002). Therefore a full assessment of the potential effects due to collisions was not carried out. However, data from the Arklow Bank (CWC 2003) has shown that the vast majority of species fly at less than 7m above the sea and of those above this height most are below the rotor zone on the Arklow Bank, which is from 21m up. Therefore, collision effects were predicted to insignificant at the conservation level. In particular, the high numbers of species such as Manx shearwater, guillemot and razorbill fly almost virtually exclusively at altitudes of less than 7m over the open sea. Terns on the Arklow Band do tend to fly higher when they are hunting for prey items to dive on, but this is still normally at altitudes of less than 20m.

Given that the rotor zone on the Kish and Bray Banks will be from 40 m up, it is considered that the issue of collisions is even less likely to be significant than on the Arklow Bank. Further monitoring of the Kish/Bray project should confirm the flight height predictions and from this, the low likelihood of collision effects.

5.3.5 Direct habitat loss effects

The direct loss of habitat from construction of turbines bases and cabling is considered to be insignificant, due to the very small percentage (much less than 1%) of the wind farm site that would be so occupied.

5.4 Overview of assessment of possible effects on birds

This assessment agrees with the field survey report's conclusions about the relative importance of the northern part of the Bank. Assessment of the survey work's results for the rest of the Bank predicts that there will be no significant effects on birds on the central and southern parts of the Kish/Bray Bank.

The assessment is limited by the following 3 factors:-

- The field survey report only gives numerical data for the whole of the Bank. The maps do show various species preferences for different parts of the bank, in particular terns' preference for the northern end and, to a lesser extent, the razorbills' preference for the southern end. Use of actual breakdowns of the numbers of birds recorded in the different parts of the Bank would slightly refine the results but it would be very unlikely that there would be any change in the conclusions.

- It is not possible to numerically assess what are assumed to be very unlikely but catastrophic worst case scenarios - e.g. large numbers of Roseate Terns colliding with rotors in foggy weather. However, fog normally tends to occur in calm conditions when the rotors would not be turning. Furthermore, roseate terns generally fly at heights of less than 12m, well below the rotor which will be 40 m above the water.

- The lack of survey data for January and February 2002 means that the possibility that the Kish Bank is used by large numbers of wintering little gulls cannot be ruled out. They use the Arklow Bank area in large nos. in November, December and April (CWC 2003) but make little use of the Codling Bank (CWC 2002). It is not known where they go in the January to March period. In some years, as was the case in 2002, large numbers appear on the coast between Wicklow and Dublin Bay. Therefore, they may have been using the Kish Bank also. While potentially important, it is important to stress that conservation concerns for Little Gulls are much less than for Roseate Terns. Furthermore, it is considered that the magnitudes of any effects on this species are likely to be low, a view also taken for the species in the North Sea (Garthe & Huppop 2004).

5.5 Mitigation measures

5.5.1 Mitigation measures during construction

The following planned mitigation measures should be implemented :-

- Construction work should commence as early as possible in the spring and with a projected completion date prior to the end of August. In the light of the results of monitoring of Roseate Tern activity, this measure may be modified as construction progresses

- As indicated in paragraph 5.3.3.2., careful assessment of possible effects on the areas to the North of the Central Area will be required prior to, and during, construction. Construction will take place over several seasons, starting at the South of the Bray Bank, and on-going monitoring and assessment will ensure that potential impacts on the Roseate Tern can be collated and quantified. Adherence to this monitoring regime will minimise potential effects.

- The use of fast boats and helicopters should be minimised to reduce disturbance to birds. Except in emergencies such use should also be kept to set routes, especially outside the Wind Farm Area.

- All best practice measures should be taken to avoid pollution, particularly by oil and litter.

- Best practices during construction should be employed to minimise footprints, sediment disturbance and pollution.

5.5.2 Mitigation measures during operation

In addition to measures 1 to 4 above, lighting should be designed to minimise bird collisions during conditions of poor visibility. The number of lights should be minimised. Fog horns are considered unnecessary as it would not be possible to assess if they had any effect in the conditions in which they would be operational. If technology for the acoustic detection of collisions with rotors becomes available, it should be considered for installation.

5.6 Monitoring

Once the project is approved, monitoring should be begun again to increase the amount of pre-construction baseline data. This should comprise monthly boat surveys, except for the critical tern periods in May, August and September, when the frequency should be twice monthly. It should be done in the same way as in 2001/02 to ensure the comparability of results.

There should also be weekly counts at dusk and dawn of the tern roost site on the Merrion and Sandymount Strand in Dublin Bay from late July to the end of September. It is likely that the terns which use the Kish/Bray Bank roost on the Strand in the evenings. The counts should be coordinated with watches from the Dalkey coast to determine the terns' flight directions.

6 References & Appendices

AMEC 2002. Lynn Offshore Wind Farm Non Technical Summary

Anon. 2000. Environmental impact assessment: investigation of marine mammals in relation to the establishment of a marine wind farm on Horns Reef. Fisheries & Maritime Museum Esbjerg, Ornis Consult A/S Copenhagen, Zoological Museum, Copenhagen. http://www.ens.dk/nyt/hoeringer/vindhornsrev/baggrundsmateriale/rapport_12.pdf

Associated Press. 2001. World's largest offshore windmill park opens. http://stacks.msnbc.com/news/569228.asp?cp1=1

Barrios L & Rodriguez A. 2004. Behavioural and environmental correlates at soaring-bird mortality at on-shore wind turbines. L. Appl. Ecol. 41:72-81.

Begg GS & Reid JB. 1997. Spatial variation in seabird density at a shallow sea tidal mixing front in the Irish Sea. ICES J. Of Marine Science 54: 552-565.

BioConsult SH/GFN mbH. June 2002. Offshore-Burger-Windpark Butendiek Environmental Impact Assessment, English Summary.

BirdWatch Ireland. 2000. Guidelines for ornithological monitoring programmes conducted for offshore windfarm developments. Unpublished.

Border Wind Ltd. for Greenpeace. 1998. Offshore wind energy – building a new industry for Britain. Border Wind Ltd., Hexham. http://www.bwea.com/offshoregpbw.pdf

British Birds 2004. RSPB threatens legal action against wind farms. Vol 97, No. 4, pp 205. April 2004.

British Wind Energy Association (BWEA). 2002. Offshore wind energy. http://www.offshorewindfarms.co.uk/sites.html

Casey S, Moore N, Ryan L, Merne OJ, Coveney JA & del Nevo A. 1995. The roseate tern conservation project on Rockabill, Co. Dublin: a six year review 1989-1994. In Irish Birds 5 (No. 3): 251-264. Irish Wildbird Conservancy, Dublin.

Celtic offshore wind power Ltd. 2002. XXXX ref to be completed

Christensen TK. 2001. Base-line investigations of birds in relation to an offshore wind farm at Horns Rev. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

Clarke 2001. XXX cape wind project ref to be completed.

Colhoun K. 2001. I-WeBS Report 1998-99 – Report of the fifth winter of the Irish Wetland Birds Survey. BirdWatch Ireland, Dublin.

Coveney J & Phalan B. 2001. Arklow Bank Seabird and Marine Mammal Survey July 2000 – June 2001. Prepared for Fehily Timoney & Company, Cork for the EIS for the Arklow Bank windfarm.

Coveney Wildlife Consulting Ltd. 2002. 'Birds' in: Offshore Wind Farm at Codling Bank, Environmental Statement. Natural Power.

Coveney Wildlife Consulting Ltd. 2003. Arklow Bank Seabird and Marine Mammal Survey, Years 1-3: July 2000 – June 2003. Coveney Wildlife Consulting, unpublished report.

Cramp S, Bourne WRP, Saunders D. 1974. The seabirds of Britain and Ireland. Taplinger, New York.

Cramp S. & Simmons K.E.L. (eds.) 1982. Handbook of the birds of Europe, the Middle East and North Africa : the birds of the Western Palearctic. Volume 3: Waders to Gulls. Oxford University Press, Oxford.

del Hoyo J, Elliot A & Sargatal J. (eds.) 1992. Handbook of the birds of the World. Vol. 1: Ostrich to ducks. & Vol. 3: Hoatzin to auks. Lynx Edicions, Barcelona.

Delany S & Scott DA.. 2002. Waterbird Population Estimates – Third Edition.Wetlands International Global Series No. 12, Wageningen, The Netherlands.

Donszelmann E & van Schalkwijk M. 2001. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

Evans B & Manville A. 1999. Avian mortality at communications towers. American Ornithologists Union 119th meeting August 1999.

Friends of the Earth. 1999. Special briefing wind power. http://www.foe.co.uk/pubsinfo/briefings/html/19990916111754.html

Galvin P. 2001. BirdWatch Ireland policy on wind farms. BirdWatch Ireland, Dublin.

Garthe S & Huppop O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. J. Applied Ecology, 41:724-734.

Gill JP & Townsley M. 1996. Review of the impacts of wind farms and other aerial structures upon birds. Final report to Scottish Natural Heritage Contract RASD/137/96 IBB

Gittings T & Delany. 1996. A pre-breeding census of common scoter in Ireland in 1995. Irish Birds 4:413-422.

Global Renewable Energy Partners. 2002. Kentish Flats Offshore Wind Farm – Non Technical Summary – August 2002

Gordon J & Tyack PL. unpublished. Acoustic techniques for studying cetaceans.

Green M & Nilsson L. 2001. Birds and offshore wind farms in southern Oresund. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

Hagemeijer EJM & Blair MJ (eds.) 1997. The EBCC Atlas of European breeding birds: Their distribution and abundance. T & AD Poyser, London.

Hannon C, Berrow SD & Newton SF. 1997. The status and distribution of breeding Sandwich *Sterna sandvicensis*, Roseate *S. dougallii*, Common *S. hirundo*, Arctic *S. paradisea* and Little Terns *S. albifrons* in Ireland in 1995. Irish Birds 4: 1-22.

Harris R. 1999. A further field survey of the little terns of the Scroby Sands area Great Yarmouth. Econet Ltd. Great Yarmouth. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex L.

Henderson AR, Morgan C, Barthelmie R, Smith B, Sørensen HC & Stubbe E. 2001. Concerted action on offshore wind energy in Europe (CA-OWEE). Social acceptance, environmental impact and politics. European Commission Project NNE5-1999-00562. Available from www.offshorewindenergy.org

Hill MI, Eno NC & Minto P. 1999. Nature conservation and landscape impacts of offshore wind farms. In *Irish Sea Renewable Resources, pp. 53-63*. Irish Sea Forum Report No. 23. Liverpool University Press

Hutchinson CD. 1989. Birds in Ireland. T&AD Poyser, Calton

Jaque LB & Marti-Montes R. July 1995. Effects of Wind Turbine Power Plants on the Avifauna in the Campo de Gibraltar Region, Summary of Final Report. Sociedad Espanola de Ornitologia (SEO/Birdlife).

Krohn S. 2001. Offshore wind energy - full speed ahead. Danish Wind Turbine Manufacturers Association. http://www.windpower.dk/articles/offshore.htm

Langston RHW & Pullan JD. September 2003. Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and guidance on Environmental Assessment Criteria and Site Selection Issues. Report written by BirdLife International on behalf of the Bern Convention.

Lack P. 1986. The atlas of wintering birds in Britain and Ireland. T&AD Poyser, Calton.

Lemming J. 1999. A Danish perspective on offshore wind farms. In Irish Sea Renewable Resources, pp. 33-42. Irish Sea Forum Report No. 23. Liverpool University Press.

Lloyd C, ML Tasker & K Partridge. 1991. The Status of Seabirds in Britain and Ireland. T & AD Poyser, London.

Madden B & Ruttledge RF. 1993. Little gulls in Ireland, 1970 – 1991. Irish Birds 5: 23-34

Maljkovic A. 2003. Terns break all records: Kilcoole epic. Wings 30 Autumn 2003, p9

McAdams D.G, Milne P., Dempsey E. 2000. Forty-Seventh Irish Bird report, 1999. Irish birds Vol. 6: 447-608.

McMillan A. 1998. The wintering birds of Kilcoole/ Newcastle marshes 1987/88. IN Cooney T, Madden B, O'Donnell M O'Flanagan C (Eds.). East coast Bird report 1987, Irish Wildbird conservancy, Dublin.

Merne OJ. 1987. Recent changes in breeding seabird populations in counties Dublin and Wicklow. In Cooney T, Madden B, O'Donnell M, O'Flanagan C (Eds.) Irish East Coast Bird Report 1987, Irish Wildbird Conservancy, Dublin.

Merne OJ & Madden B. 1999. Breeding seabirds of Lambay, Co. Dublin. Irish Birds 6: 345-358.

Milne P. 2002. Rare bird news: January – March. Wings 25:22.

Mitchell PI, Newton SF, Ratcliffe N & Dunn TE. 2004. Seabird populations of Britain and Ireland. T&AD Poyser, London.

Morrison ML, Pollack KH Oberg AL & Sinclair, KC. 1998. Predicting the response of bird populations to wind energy-related deaths. National Renewable Energy Laboratory, Golden Colorado.

Morrison ML. 1998. Avian Risk and Fatality Protocol. National Renewable Energy Laboratory, US Department of Energy.

Nairn R, Partridge K, Moore J & Elliot R. 1995. The southeast coast of Ireland – an environmental appraisal. Marathon Petroleum Ireland, Cork.

Neau P, Pages J-M. 1999. Bird survey of the Port-La-Nouvelle wind farm. 1999 European Wind Energy Conference.

Newton S. 2001. Wings. No. 23 Winter 2001, Great Skua Breeds.

Newton SF & O Crowe. 1999. Kish Bank: a preliminary assessment of its ornithological importance. BirdWatch Ireland, Dublin

Newton SF & O Crowe. 2000. Roseate Terns – the natural connection. A conservation/research project linking Ireland and Wales. BirdWatch Ireland, Dublin.

Newton S, Donaghy A, Allen D & Gibbons D. 1999. Birds of conservation concern. Irish Birds 6:333-344.

Noer H, Christensen TK, Clauseger I & Petersen IK. 2000. Effects on birds of an offshore wind park at Horns Rev: environmental impact assessment. National Environmental Research Institute, Denmark. http://www.ens.dk/nyt/hoeringer/vindhornsrev/baggrundsmateriale/rapport_18.pdf

NWP off shore LTd –xxxxx ref to be completed

Offshore Wind Power Ltd. 2002. Inner Dowsing Offshore Wind Farm Volume 1 Non Technical Summary

Percival S., Archer E. & Cranswick P. 2002. Kish Bank proposed offshore windfarm – progress report no. 2 on seabird surveys Sept. 2001 – Sept 2002. Unpublished report for Saorgus Energy Ltd.

Percival SM. 1998. Birds & wind turbines: managing potential planning issues. Proceeding of the 20th British Wind Energy Conference, 1998, pp. 345-350

Percival SM. 1999. Ornithological impacts of offshore windfarms. In *Irish Sea Renewable Resources*, pp. 64-71. Irish Sea Forum Report No. 23. Liverpool University Press.

Percival SM. 2001. Assessment of the effects of offshore wind farms on birds. ETSU W/13/00565/REP DTI/Pub URN 01/1434. UK Dept. of Trade and Industry.

Percival SM, Band B & Leeming T. 1999. Assessing the ornithological effects of wind farms: developing a standard methodology. Proceedings of the 21st British Wind Energy Association Conference 161-166.

Percival SM & Percival T. 1998. Breeding waders at the Nasudden wind farm Gotland, Sweden. Report to National Wind Power, Ltd.

Percival S & Percival T. 2000. Ornithological assessment of the proposed offshore wind farm at Scroby Sands. Norfolk. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex M.

Petersen IK. 2001. Aerial surveys of birds, methodology and results. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

Pettersson J & Stalin T. 2001. How the offshore wind farms influence the birds life – a study out at sea in southern Kalmar Sound, in southeast Sweden. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

Phillips JF. 1994. The effects of a wind farm on the upland breeding communities of Bryn Titli, Mid-Wales: 1993-1994. Royal Society for the Protection of Birds, Powys.

Pollock CM, Mavor R, Weir C, Reid A, White RW, Tasker ML, Webb, A, Reid JB. 2000. The distribution of seabirds and marine mammals in the Atlantic Frontier north and west of Scotland. JNCC, Aberdeen.

Pollock C, Reid J, Webb A, Tasker M. 1997. The distribution of seabirds and cetaceans in the waters around Ireland. JNCC, Peterborough.

Powergen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement. See also http://www.powergenrenewables.com/scrobysandsproject.htm

Robin Rigg Offshore Wind Farm Environmental Statement 2002

Robinson P. 2001. Common scoter *Melanitta nigra* and wind farm development in the Irish Sea. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark.

RSK Environment Ltd. 2003. Shell Flat Offshore Wind farm Environmental Impact Statement Non Technical Summary. Helsby, England.

SeaScape Energy Ltd. 2002. Burbo Offshore Wind Farm, Volume 1: Non Technical Summary September 2002

Scottish National Heritage (SNH). 2001. Methodology for assessing the effects of wind farms on ornithological interests. Unpublished.

Simon LE, Painter A & Little B. 2001. The Blyth Offshore wind farm. In*: International Workshop on Birds and Offshore Windfarms, November 2001*. National Environmental Research Institute, Denmark

Snow DW & Perrins CM. 1998. The birds of the Western Palearctic concise edition. Oxford University Press.

Söker H, Rehfeldt K, Santjer F, Strack M & Schreiber M. 2000. Offshore wind energy in the North Sea - technical possibilities and ecological considerations - a study for Greenpeace.

Stienen EWM, Van Waeyenberge J & Kuijken E. November 2002. Seabirds at the Northern Part of 'De Vlakte Van De Raan', Environmental Impact Study on the Effects of an Offshore Wind farm on Seabirds. Institute of Nature Conservation, Brussels.

Still D, Little B, Lawrence SG, Carver H. 1994. The birds of Blyth Harbour. In Elliot G (ed.) Wind energy conversion 1994 – proceedings of the 16th British Wind Energy Association conference, pp. 241-248. Mechanical Engineering Publications, London.

Still D, Painter S, Lawrence S, Little B, Mark T. 1997. Blyth Harbour Wind Farms and Birds. European Wind Energy Conference, Dublin.

Stone CJ, Webb A, Tasker ML. 1994. The distribution of Manx shearwaters Puffinus puffinus in northwest European waters. Bird Study 41: 170-180

Tucker GM & Heath MF. 1994. Birds in Europe: their conservation status. Cambridge, UK: BirdLife Conservation Series No. 3).

Volund P & Hansen J. 2000. Middelgrunden offshore wind farm installed year 2000. Owens 2000, Ikraftv/SEAS – Denmark. http://www.middelgrunden.dk

Von Nordheim H. 2000. Wind turbines in offshore areas - a new technique and its possible impacts on environment, nature and landscapes. http://www.coastalguide.org/windpower/von_nordheim.html

Watson H, Rondell G, Brown E. 1995. A field survey of little terns for the Scroby Sands Area, Great Yarmouth. Ecosurveys Ltd. In PowerGen Renewables Offshore Wind Ltd. 2001. Scroby Sands Wind Farm Environmental Statement, Annex L.

Webb A, Stronach A, Tasker ML & Stone CJ. 1995. Vulnerable concentrations of seabirds south and west of Britain. JNCC, Peterborough.

Whelehan J. 1995. Little Gulls at Wicklow Town. Irish East Coast Bird Report 1994. Irish Wildbird Conservancy, Dublin.

Whilde 1993. Threatened mammals, birds, amphibians and fish in Ireland. Irish red data book 2: vertebrates. HMSO, Belfast.

Williams W. 2004. When blade meets bat. Scientific American, February 2004.

Winkelman JE. 1994. Bird/wind turbine investigation in Europe. In Proceedings of the national avian-wind power planning meeting, pp. 43-47. LGL LTD, Ontario.

6.1 Appendix 1: Abbreviations & definitions of terms used

An Bord Pleanála	The Irish planning authority.
Annex I	See SPA (birds) and SAC (habitats).
Biogeographic population	Well-defined subspecies or population, often the population of the NE Atlantic region. For the species in this report, estimates of this populations are from Wetlands International (Delany & Scott 2002) or from Seabird 2000 (Mitchell et al. 2004).
Bird Unit (BU)	1% of the biogeographic population of a species. See also **RBU** and **mBU**.
Birds Directive	See SPA
BirdWatch Ireland	One of the main Irish voluntary nature conservation organisations. Formerly called Irish Wildbird Conservancy

CA-OWEE	Concerted Action on Offshore Wind Energy in Europe
cetacean	General term for whale, dolphin or porpoise.
CWC	Coveney Wildlife Consulting Ltd.
Duchás	See NPWS.
EIA	Environmental Impact Assessment.
EIS	Environmental Impact Statement.
EPA	Environmental Protection Agency
EU	European Union.
Habitats Directive	See SAC
JNCC	Joint Nature Conservation Committee A. UK statutory conservation body, whose Seabird at Sea team is responsible for surveys of seabirds and marine mammals in the NE Atlantic.
km	Kilometre(s).
mBU	**milli-Bird Unit**, or 0.001% of the biogeographic population (see **BU**).
MW	Megawatt(s), or one million watts. One watt (a unit of power) is equal to one joule per second; the power dissipated by a current of one ampere flowing across a potential difference of one volt.
Natura 2000	The combined suite of SPAs and SACs
NPWS	The National Parks and Wildlife, now part of the Dept. of the Environment and Local Government. Formerly known as Duchás.
Ramsar site	Internationally important wetland under the Ramsar Convention.
RBU	**Regional Bird Unit**, 1% of the Irish Sea population of a bird species.
SAC	Special Area of Conservation, designated for habitats listed on Annex I of and species listed on Annex II the EU Habitats Directive (92/43/EEC) as transposed into Irish law via the European Communities (Natural Habitats) Regulations, 1997 (S.I. 94 of 1997).
S.I.	Statutory Instrument (also known as "Regulations"), i.e. secondary legislation used to implement e.g. the Habitats and EIA Directives in Ireland.
sp.	Species, e.g. "small gull sp." means an unidentified species of small gull.
SPA	Special Protection Area, designated for bird species listed on Annex I of the EU Wild Birds Directive (79/409/EEC) and for migratory species, as transposed into Irish law through the European Communities (Conservation of Wild Birds) Regulations (various dates) and the Natural Habitats Regulations.
SPEC	Bird Species of European Conservation Concern. SPEC 2 and 3 species have an unfavourable European conservation status and have their global populations concentrated and not concentrated in Europe, respectively.

6.2 Appendix 2: Scientific names of species mentioned

Birds		Kittiwake	*Rissa tridactyla*
Arctic Skua	*Stercorarius parasiticus*	Lesser Black-backed Gull	*Larus fuscus*
Arctic Tern	*Sterna paradisaea*	Little Auk	*Alle alle*
Bewick's Swan	*Cygnus columbianus*	Little Gull	*Larus minutus*
Black Guillemot	*Cepphus grylle*	Little Tern	*Sterna albifrons*
Black-headed Gull	*Larus ridibundus*	Red Kite	*Milvus Milvus*
Black-throated Diver	*Gavia arctica*	Manx Shearwater	*Puffinus puffinus*
Common Gull	*Larus canus*	Mediterranean Shearwater	*Puffinus yelkoun*
Common Scoter	*Melanitta nigra*	Pomarine Skua	*Stercorarius pomarinus*
Common Tern	*Sterna hirundo*	Puffin	*Fratercula arctica*
Cormorant	*Phalacrocorax carbo*	Razorbill	*Alca torda*
Cory's Shearwater	*Calonectris dimedea*	Red-breasted Merganser	*Mergus serrator*
Eider	*Somateria mollissima*	Red-throated Diver	*Gavia stellata*
Fulmar	*Fulmarus glacialis*	Roseate Tern	*Sterna dougallii*
Gannet	*Morus bassanus*	Sandwich Tern	*Sterna sandvicensis*
Golden Eagle	*Aquila chrysaetos*	Shag	*Phalacrocorax aristotelis*
Great Black-backed Gull	*Larus marinus*	Sooty Shearwater	*Puffinus griseus*
Great Crested Grebe	*Podiceps Cristatus*	Storm Petrel	*Hydrobates pelagicus*
Great Northern Diver	*Gavia immer*	**Mammals**	
Great Skua	*Stercorarius skua*	Common Seal	*Phoca vitulina*
Great Skua	*Stercorarius skua*	Grey Seal	*Halichoerus grypus*
Guillemot	*Uria aalge*	Harbour Porpoise	*Phocoena phocoena*
Herring Gull	*Larus argentatus*	Minke Whale	*Balaenoptera acutorostrata*