Institution: University of Glasgow

Unit of Assessment: Unit 5, Biological Sciences

Title of case study: Introducing a new strategic framework for assessing the impact of marine renewable energy developments on seabirds

1. Summary of the impact

There is a potential conflict between the expansion of marine renewable energy developments, such as offshore wind farms, and seabird conservation. An Environmental Impact Assessment (EIA) must be carried out before planning permission can be granted for such projects. Working with environmental consultancies and key statutory bodies, Professor Furness at the University of Glasgow developed a clear, systematic and widely accepted framework for assessing the impact of wind, wave and tidal projects on seabird populations. This framework has expedited the project development process and lessened potential risks to seabirds, meeting conservation requirements while benefiting all those involved in renewable energy projects by reducing the risk of misjudgements in the impact assessment process.

2. Underpinning research

Research led by Professor Robert Furness (Professor of Seabird and Fishing Interactions, 1978–2011; Senior Research Fellow, 2011–present) at the University of Glasgow has focused on the ecology and conservation of seabirds in Scotland, particularly regarding population dynamics and distribution, and the effect of man-made factors on these populations. A key development in this regard was research to develop quantitative means to assess such conflicts.

Developing expertise in the impact of marine renewables on seabirds

Between 2002 and 2008, Furness chaired an international panel of experts in marine ecology (IAPEME), advising the Danish Government on monitoring the impacts of demonstration offshore marine wind farms. As a result of this work Furness recognised the need to develop appropriate expertise in the UK and worked with Professor Dan Haydon (Professor of Population Ecology and Epidemiology, 2004–present), with funding from Scottish Natural Heritage (SNH), to develop methods to assess the impacts of UK-based wind farms on seabird breeding success.

Between 2007 and 2009, the Glasgow team led by Furness evaluated the barrier-effect that marine wind farms present to natural migratory patterns of seabirds, for which there was no previous methodology.[1] The work was done in collaboration with Professor Anthony Fox and Dr Mark Desholm (Aarhus University, Denmark) who provided surveillance radar data on migrating seabirds collected from the Danish Nysted offshore wind farm before and after construction. The distance flown by birds to avoid the wind farm was calculated from these data and the energy cost of this (based on bird mass and dimensions) determined using software-based movement modelling. The Glasgow team generated migration scenarios for the common eider, to model the cost of their response to Nysted, and the effect of a larger (or multiple) wind farms. This showed that while the energy consumed avoiding a single wind farm (of 72 turbines) proved minimal; the cumulative impact of avoiding multiple wind farms along a migration route could increase energy consumption and potentially impact a population.[1]

Developing a framework to assess impacts of marine renewables on seabirds

In research undertaken in 2011, Furness devised a framework for quantifying the vulnerability of Scottish seabirds to offshore wind farms, tidal turbines and wave energy devices.[2,3] This followed the approach of an earlier framework, developed between 1998 and 2000 by Furness in collaboration with Dr Mark Tasker (Programme Leader, Joint Nature Conservation Committee) which had been developed to quantitatively assess the effect of reduced sandeel stock biomass on the breeding success of different seabird species.[4] This involved generating a 'vulnerability index' (described in more detail below) to score seabird species on various ecological and environmental parameters, providing a means to rank seabird vulnerabilities with respect to a given impact. The research identified regions where seabird breeding success was threatened by reduced food supplies due to industrial fishing.[1] It was also one of the first times such a vulnerability scale had been applied to identify the key locations where conflicts arise between man-made factors,

providing a useful and accepted approach for identifying such impacts on seabirds.

Whilst the original framework assessed impacts on breeding success, the new framework focussed more on impacts that affect adult survival. Seabirds are typically long-lived and produce few offspring, thus factors that affect adult birds have a significant impact on population dynamics. The new framework considered factors affecting the conservation status of the bird species, such as conservation importance under the 2009 European Commission Birds Directive, the percentage of the biogeographic population located in Scotland, adult survival rate and UK threat status. A further set of parameters were then used to represent behaviours that affect the vulnerability of seabird populations to the marine renewable development. These parameters varied depending upon the particular type of development being assessed, but for example with offshore wind farms these took account of flight height, flight manoeuvrability, amount of time spent in flight, and nocturnal flying habits. Each parameter was then scored using a five-point scale, from very high vulnerability (5), through to no vulnerability (0). The numerical scores were summed to yield a vulnerability score, and used to rank seabird populations at greatest risk, either with respect to collision with wind farm turbines or displacement/disturbance by them. These indicated that herring gulls, black-backed gulls and northern gannets were most at risk of collision and divers such as the black-throated diver, and common scoters were most at risk of displacement.[2]

Scoring parameters required information drawn from an extensive review of the scientific literature, and was refined in response to feedback from other expert seabird ecologists. Furness's own research with international colleagues helped contribute to this, including work to determine the foraging ranges, migration routes and wintering areas of adult seabirds, including northern gannets and great skuas (both of which are designated 'conservation priority' under the 2009 Birds Directive).[5]

The approach to vulnerability indices for tidal and wave energy devices followed a similar methodology, but substituted parameters on seabird behaviours pertinent to these devices, e.g. drowning risk, diving depth, foraging locations of bird species. These indicated that birds such as black guillemot, razorbill and shag were most vulnerable to tidal turbines, whereas divers, razorbills and common scoters were vulnerable to wave energy.[3] The research showed that despite the large number of different seabird populations occupying Scottish waters, only a relative few need be considered as part of EIA. It identified the key species to assess for each renewable type, showing that tidal array generators represented the lowest hazard to seabirds, but also showed that changes in migration behaviour observed in recent years are more likely attributable to changes in fish stocks and fisheries than marine renewables developments.[5]

3. References to the research

1. Masden E. A., Haydon D. T., Fox A. D., Furness R. W., Bullman R., Desholm M. (2009) Barriers to movement: Impacts of wind farms on migrating birds. *ICES J Mar Sci* 66: 746–753.
2. Furness, R.W., Wade, H., Masden, E.A. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. *J Environ Manage* 119: 56–66. doi:10.1016/j.jenvman.2013.01.025.
3. Furness, R.W., Wade, H., Robbins, A.M.C., Masden, E.A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. *ICES J Mar Sci,* 69: 1466–1479. doi:10.1093/icesjms/fss131.
4. Furness, R.W. and Tasker, M.L. 2000. Seabird-fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance and identification of key areas for sensitive seabirds in the North Sea. *Mar Ecol Prog Ser* 202: 253–264. doi:10.3354/meps202253.
5. Kubetzki, U., Garthe, S., Fifield, D., Mendel, B. and Furness, R.W. 2009. Individual migratory schedules and wintering areas of northern gannets. *Mar Ecol Prog Ser,* 391: 257–265. doi:10.3354/meps08254.

4. Details of the impact

The UK has pledged to derive 15% of its energy from renewable sources by 2020. Key to

achieving this target is the development of offshore marine renewable energy devices in Scottish waters. Scotland holds one quarter of Europe's potential offshore wind resources, and the power density achievable in Scottish waters has resulted in the world's largest concentration of wave and tidal energy devices currently under development and testing. A potential conflict therefore exists between offshore renewable energy developments (such as wind farms, tidal and wave energy) and seabird conservation. Before such developments can be approved, Environmental Impact Assessments (EIA) must be carried out to assess the potential impact on wildlife and the environment. These assessments require that those seabird species most at risk from such developments are identified.

Research by Furness described above has helped to strengthen the work of environmental consultancies specialising in the assessment of the impact of renewables on birds. It has also produced a robust methodology to assist developers and provide guidance to statutory bodies, mitigating conflicts between marine development and conservation.

Environmental consultancy

In August 2011, Furness was recruited as a consultant to the environmental consultancy MacArthur Green Ltd.[1] in recognition of his expertise in seabird ecology and conservation. Furness's expertise has considerably strengthened the work of this consultancy, particularly in industry guidance work that required a specialist in seabird conservation. This has resulted in several significant commissions with industry-wide impact, some of which are described in subsequent sections.

> "*MacArthur Green was involved in Marine and Offshore projects before Bob started however I was keen to expand this part of the company and Bob's skills and experience fitted our need perfectly. Bob has brought considerable value to MacArthur Green through his already well established reputation for excellence in his field. This has led to us growing our work in marine ornithology considerably*." – Director, MacArthur Green Ltd.[a]

Developing guidance on Ornithological Environmental Impact Assessments

In 2012, Prof Furness, through his consultancy role with MacArthur Green Ltd, was commissioned to review the sensitivity of seabirds in Scottish waters to offshore windfarms (by statutory regulator Marine Scotland)[b] and to tidal turbine and wave energy devices (by statutory advisor Scottish Natural Heritage).[c] Marine Scotland is responsible for marine licensing and enforcement in the Scottish coastal region on behalf of the Scottish Government. Scottish Natural Heritage (SNH) is one of several statutory advisors to Marine Scotland, and is responsible for providing advice to developers on the scope of EIAs, and for reviewing EIAs as part of the planning consent process.

Furness's reports, the research within which was published,[2,3] identified criteria for quantifying the vulnerability of Scottish seabirds based on ecological and behavioural data, and also draw upon earlier University of Glasgow research described above.[1,4,5] The two reports identified which few seabirds could be adversely affected by these developments, and which (all but a few) did not need to be considered by ornithological surveys.

> "*The report on tidal and wave energy devices was useful because it was commissioned by the regulators themselves, undertaken by a respected ornithologist and had a very definitive set of recommendations with regards potential impacts of wave energy converters. Such research undertaken by developers would not necessarily inform a consensus approach at the strategic level. The peer reviewed nature of both the underpinning vulnerability indices, and the final publication based on the report has added significant credibility to the guidance*." – Project (EIA) Manager, Pelamis Wave Energy Ltd.[d] (one of the leading technology prospects for Scottish renewables)

As these reports had been commissioned and endorsed at the statutory level by Marine Scotland and SNH, the guidance provides consistent advice at the highest level across the industry. This benefits stakeholders at all levels including landowners, the Crown Estate (who lease the seabed), renewable power developers (and the environmental consultants they commission), conservation

groups such as the RSPB, and other statutory advisory bodies such as the Joint National Conservancy Council (JNCC).

Application of the research reports

SNH has used the research reports to assist the applications review process (consenting) by identifying those species most susceptible to impact, and to guide the advice they provide in statutory responses to Marine Scotland. It also uses them to challenge statements in EIAs where a given bird species has been incorrectly described as invulnerable, and to shape advice on monitoring bird-related impacts to existing or planned research proposals. The influence of this research[2,3] is evident in the fact that it has been cited in 15 applications (for offshore wind, wave or tidal developments in Scotland) since first reported in 2012, representing over half of the marine renewable schemes on which SNH have been consulted.[e]

> "*[T]hese are the best guides we have to potential sensitivity [of seabirds to renewables], and so both we and the developers will continue to use them to guide the ornithological content and focus of the EIA process*." – Policy & Advice Manager (Marine Renewables), SNH.[f]

Establishing a framework for Cumulative Impact Assessments

In addition to EIAs undertaken for single development sites, cumulative impact assessments (CIAs) are necessary to look at the cumulative impacts of all developments in a given region on vulnerable seabird species. This will become increasingly important as the number of developments increase, and there had been a lack of standardised methodologies for assessing CIAs, particularly with regard to seabirds.

In 2012, Furness contributed to a report by Wetlands Trust (Consulting) Ltd., commissioned by the Crown Estate, to perform a population viability analysis of northern gannets in the UK, with the aim of assessing the cumulative impacts of existing and consented wind farms. This also drew on University of Glasgow research to identify strengths and weaknesses to different approaches for monitoring bird populations movements.[1,5] The report was prepared on behalf of a wider stakeholder consortium, the Strategic Ornithological Support Services (SOSS), which represents the marine planning regulators (Marine Scotland), advisors (SNH, JNCC), land-owner (The Crown Estate) and renewables developers.[f] It therefore provides guidance at the highest strategic level.

In 2013, Furness and MacArthur Green Ltd. developed a methodological framework for the CIA for the Pentland Firth and Orkney Waters wave and tidal projects.[g] This built upon Furness's framework for assessing the vulnerabilities to seabirds of such projects in EIAs.[3] The report was commissioned by The Crown Estate on behalf of a project steering group comprising the same stakeholders involved in SOSS, and was intended to accelerate and de-risk the development of renewables at a strategic level.[g]

5. Sources to corroborate the impact

a. Statement provided by Director, MacArthur Green Ltd., Glasgow; available on request.
b. Furness, R. & Wade, H. (2012) Vulnerability of Scottish seabirds to offshore wind turbines. Commissioned by Marine Scotland.
c. MacArthur Green Ltd. (Furness, R.) & Wade, H. (2012) Vulnerability of Scottish seabird populations to tidal turbines and wave energy devices. Commissioned by Scottish Natural Heritage.
d. Statement provided by Project development manager, Pelamis Wave Energy, Edinburgh; available on request.
e. Wildfowl & Wetlands Trust (Consulting) Ltd. (2012) Gannet Population Viability Analysis: Demographic data, population model and outputs. Commissioned by The Crown Estate on behalf of the Strategic Ornithological Support Services (SOSS) steering group.
f. Statement provided by Policy & Advice Manager – Marine Renewables, Scottish Natural Heritage; available on request.
g. MacArthur Green (2013). Ornithological Cumulative Impact Assessment Framework: Pentland Firth and Orkney Waters Wave and Tidal Projects. Report commissioned by The Crown Estate. David MacArthur, Professor Bob Furness, Dr Mark Trinder & Kirsty MacArthur