Tidal Turbine Technology within a Marine Protected Area in Northern Ireland, UK

The Brief in brief

This case study examines science informed decision-making processes amidst the potential conflicts of interest between the installation of a hi-tech underwater tidal turbine to supply renewable energy and responsibilities to protect marine biodiversity and associated ecosystem services. It illustrates how an adaptive management approach that takes account of a cumulative gain in scientific knowledge can provide a powerful means of successfully arguing to ensure biodiversity protection and human well-being, while still supporting energy, technological and commercial goals.

Context

The world's first commercial scale open stream underwater tidal turbine, SeaGen, has been constructed and operated in the strong tidal flow at the entrance to Strangford Lough on the east coast of County Down, Northern Ireland (Figure 1). The Lough supports a recognised wealth of marine and coastal biodiversity, and has many different designations of nature conservation status, at national and EU levels. These include Special Protection Area (SPA), Special Area of Conservation (SAC) and Natura 2000 site status [1]. Also, the area is important for its landscape, recreational use, some commercial fishing and a diversity of other ecosystem services. The dual importance of the necessity to increase renewable energy output, with the associated extra benefits of hi-tech and industrial advances, while at the same time ensuring the continued essential role of the Protected Area for marine biodiversity conservation and the provision of a wide range of ecosystem services, created a spectrum of potential conflicts of policy interests that was new and complex.

Figure 1. The SeaGen tidal turbine with its rotors withdrawn above sea-level

Early in the turbine negotiations, stakeholders agreed that an adaptive management approach would be adopted. Adaptive management is a repetitive process in which uncertainty surrounding environmental effects of a human activity is reduced progressively by carefully managed, science-led monitoring of agreed indicators of environmental impacts. From the very beginning, risks and needs of the different interest groups are continually re-assessed in the light of new information and balanced within an agreed management framework. The successful application of this approach was central to the entire turbine project [2]. It allowed the precautionary principle to be exercised throughout both the construction and operation phases of the turbine development. Many different stakeholders have been involved and the establishment of two formal, nested stakeholder bodies created a platform for consultation. From a wide-ranging list of registered interested parties, this case study identified and then focused on a small, central group of actors for biodiversity protection and human well-being, each of whom was present throughout the entire time of the turbine development. The stakeholder groups thus represented cover Governmental Departments/Agencies, NGOs, academic research and also local residents/cultural interests.

Arguments

A wide variety of potential direct and indirect negative impacts of the marine turbine on biodiversity and on human well-being were identified at the early stages, during an initial independent Environmental Impact Assessment in 2004-2005 [3]. Each of these possible impacts was a potential argument to be considered throughout the negotiations and decision-making processes surrounding the turbine development.

<table>
<tr><td>Potential negative impacts on biodiversity</td><td colspan="2">Protected habitats (general)
Protected species (general)
Birds
Marine mammals
Sharks/elasmobranchs (cartilaginous fish)
Teleost (bony) fish
Shellfish (molluscs, crustaceans)
Benthic communities
Plankton communities
Cabling to land, electrical fields, abrasion
Noise/vibration: effects on marine animals</td></tr>
<tr><td rowspan="5">Potential negative impacts on humans, including ecosystem services</td><td>Regulating</td><td>Nutrient cycling/food web dynamics
Water quality (sediment, waste remediation)</td></tr>
<tr><td rowspan="2">Cultural</td><td>Nature watching
Recreational boating/fishing</td></tr>
<tr><td>Landscape/seascape quality
Boating navigation/access</td></tr>
<tr><td>Provisioning</td><td>Commercial fishing – bony fish
Commercial fishing (pot fishing)</td></tr>
<tr><td>Human well-being</td><td>Noise/vibration: effects on humans
Tidal hydrodynamics (currents etc)</td></tr>
</table>

Table 1. Broad classification of the potential negative environmental impacts of the marine turbine that are considered in the case study, as identified from reports and consultations with stakeholders. Note that some of the categories can overlap.

The impacts and corresponding arguments fall into a number of groups (Table 1). There are those that mainly reflect the particular aspects of biodiversity under consideration and/or the policy involved. Thus, there are issues concerning the Protected Area status of Strangford Lough in general and then, more specifically in relation to the protection of particular habitats and species or wider taxonomic groups (here particularly marine mammals – seals, dolphins, whales and also diving and other birds). Equally, there are impacts that are more specifically related to the provision of ecosystem services, including commercial fishing (mainly pot-fishing for shellfish such as lobster, scampi and crabs), recreation and landscape character. Finally, arguments arising from impacts defined by physical parameters, such as noise and vibration, hydrodynamics or water quality and sediment content, though physical by nature, considerably overlap with, but also complement the biological and ecosystem service provision parameters.

Framing

All of the arguments for biodiversity were based on the potential negative impacts of the turbine and thus their framing was inherently negative. However, they were all compiled and presented by, as well as aimed at, experts who had a high level of underlying scientific expertise and knowledge of policy. Thus the arguments were all framed to appeal to informed logic. Importantly, such framing incorporated the cumulative gain of scientific knowledge along the time line, as results from new research and monitoring became available. This temporal framing explicitly encompassed the planning, constructional and operational phases of the turbine development. Also, the arguments were all spatially framed to address explicitly the single marine turbine at the particular site.

Processes: Temporal dynamics of arguments

The potential negative impacts of the turbine on biodiversity and ecosystem services/human well-being were identified early in the timeline. However, their usage and relative importance as arguments changed as the turbine development proceeded, particularly in response to the cumulative gain in scientific knowledge, as documented in an EU Habitats Directive Article 6 Assessment Report in 2008 [4] and in an independent Final Report of a continuous Monitoring Programme in 2011 [5]. Some arguments became more dominating (and successful) while other arguments declined in their profile through mitigation management or by new understanding that the particular risks were of lesser importance. Arguments that particularly accumulated strength and dominance along the time line all involved direct risks to specific aspects of biodiversity. For example, the argument of risk to resident seal populations and the parallel but more widely applicable argument of risks of animal collisions with the turbine rotor blades (not only seals, but also other marine mammals, such as dolphins, whales and other animal groups including basking sharks and diving bird species), became particularly dominant. Similarly for the EU protected species status of the harbour (or common) seal. Also arguments centred on Protected Area status, including benthic and HD listed habitats and the argument of negative impacts of acoustic/vibration disturbance to animals, first from the construction and then from the operation of the turbine, at least maintained, and mostly increased their profiles along the time line. In the other direction, arguments that decreased with time included the risks to: sharks/elasmobranchs, shellfish and fisheries, birds and biodiversity posed by electro-magnetic fields, cable scraping the seabed and energy removal by the turbine from the tidal flow, as these were all either mitigated or found from the monitoring to have negligible impact.

Effectiveness

Considered over the entire case, all of the negative impact arguments identified may be regarded as having a high level of potential effectiveness. All arguments fed into the monitoring and research timeline so that argumentation matched and tracked the levels of scientific understanding as the project developed. This meant that an initial broad palette of arguments with the potential to be effective evolved and focussed into a smaller set of arguments that were observed to be persistent and effective throughout the decision-making.

All of the persistent and effective arguments are clearly oriented to biodiversity (protection) or include aspects of biodiversity as a component, while arguments arising from the negative impacts of the turbine on ecosystem services and human well-being are noticeably peripheral. Further, the arguments tended to converge into bundles that provided mutual support for each other, even though the content or framing may have differed.

As a primary example, arguments about negative impacts of the turbine on the seal populations maintained a particularly high profile throughout. Seals may appear simply as charismatic species capable of attracting public attention. However, and most importantly, in addition to their aesthetic appeal, the seals are the subjects of a set of further arguments. Particularly, the risk of collisions with the rotating blades of the turbine (a risk shared with other animals), together with the fact that the harbour seal is listed in the Annexes of the Habitats Directive and thus protection of the species is legally obligatory. This bundling is in contrast to all the other organisms present: no other species or community or habitat type offered such a strong combination of arguments.

Transferability

This case study has a number of important elements that are of wide general applicability, transferable to many situations involving the environmental impacts of human activities on biodiversity and on ecosystem service provision. Undoubtedly, the innovative "adaptive management approach" played a crucial role in maintaining a strong adherence to the precautionary principle for biodiversity protection while also permitting the turbine project to proceed. This case study provides an important, clearly documented example of the advantages of such a strategy, which is widely applicable to environmental impact assessments in general as well as to biodiversity protection issues in particular. Closely associated with this success of the adaptive management strategy is the general importance of (i) strong stakeholder involvement with an efficient platform and infrastructure to facilitate regular consultations between the parties, (ii) strong scientific backup, incorporating recognition of the needs of research and monitoring and the cumulative gain of scientific knowledge over time. Also, identification and utilisation of bundles of arguments that may be different, but are observed to be mutually supportive, thus increasing their overall effectiveness (e.g. the arguments surrounding the seals), is an important general point that may be applicable to many different situations.

Of course, there are many aspects of the case that are extremely specific and cannot be transferred to other situations. Certainly, there are those that arise from the unique physical and biological characteristics of the very local site and its set of ecosystem services and human usage. But of much greater significance is that the entire project is centred upon a single turbine and its management at a well-known location. Although this single turbine may be generally regarded as having negligible effect on marine biodiversity or other ecosystem services, the results cannot be used to extrapolate to situations of arrays of many such turbines as envisaged at other coastal sites. Such extrapolation would be potentially extremely dangerous for biodiversity protection as much larger areas of seabed are involved and the arguments for biodiversity protection and the provision of associated ecosystem services may encompass many new aspects requiring new research.

Lessons learned

- **An adaptive management approach to biodiversity and environmental impact issues, implemented from the beginning, can prove highly beneficial in argument negotiations, upholding the precautionary principle while incorporating different stakeholder views and goals.**
- **High stakeholder involvement in all parts of the decision-making processes is essential and requires an efficient platform and infrastructure to facilitate regular consultations.**
- **Strong scientific backup is necessary to provide a sound evidence base (e.g. for designing and implementing monitoring strategies, new research).**
- **Argumentation and decision-making need to track and take account of the cumulative gain in scientific knowledge over time**
- **Bundles of arguments that combine different facets of the issues at hand can be mutually supportive and be more effective than the single arguments in isolation.**
- **In this case study, arguments involving aspects of biodiversity conservation, whether directly or indirectly, were clearly more widely recognised and utilised more effectively than those that addressed ecosystem services and human well-being.**
- **Extrapolation of even the most rigorous scientific monitoring information to different situations at different localities (in this instance a single turbine compared to large arrays of turbines planned at other locations) is inappropriate and likely to be detrimental for biodiversity protection unless supported by relevant new research effort.**

References

1. Joint Nature Conservation Committee
http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0016618
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