A BEST PRACTICE FRAMEWORK TO RECONCILE FULL-SCALE MARINE RENEWABLE ENERGY DEPLOYMENTS WITH MARINE NATURA 2000 SITES

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Abstract-
As the marine renewable energy industry is now rapidly scaling up from single devices to arrays of multiple turbines, this paper brings science and law together to investigate how the mechanisms of adaptive management can be best applied under the appropriate assessment procedure of the Habitats Directive to provide regulators with the best scientific knowledge about the ecological risks of full-scale deployments on marine Natura 2000 species.

Keywords- adaptive management, conservation objectives, Natura 2000 species, appropriate assessment, Habitats Directive, marine renewable energy**.**

I. INTRODUCTION

Licensing processes represent a significant regulatory obstacle to many developers of marine renewable energy (MRE) projects due to current uncertainties regarding the ecological impacts of these nascent technologies [1].

Given the nascent nature of MRE technologies and complexity of marine ecosystems, environmental risks associated with the MRE sector will continue to be driven by uncertainty. Regardless of whether a proposed MRE project is located within marine Natura 2000 sites, a project may create a risk to qualifying species of Natura 2000 sites. Spatial areas of connectivity with marine protected sites may extend over hundreds of kilometres reflecting the foraging and migratory use of the marine environment by species. Adverse effects may therefore occur outside the vicinity of Natura 2000 sites as a result of physical interactions, collisions and non-lethal disturbances (i.e. noise disturbance, chronic disruption of animals' behaviours) on mobile marine protected species.

As the industry is moving forward, there is an urgent need to 'safely' generate more empirical data to provide regulators with best scientific knowledge about the potential impacts of full-scale deployments at the species population-level [2]. Although modelling studies and empirical evidence collected at single devices may assist with predicting risks associated with commercial-scale arrays, the Annex IV 2016 State of the Science Report stresses that it is unlikely that risk will 'scale in a simple linear fashion' as the number of devices increase [2]. Evaluating and managing the full effects of multiple turbines on marine protected species may not be possible until array deployment data are actually collected through *in situ* monitoring [3].

The recent 2017 Ocean Energy Forward Look report indicates that 'reduced uncertainty around population-level effects' of real-scale deployments 'will help streamline future consenting processes and help ensure that project level data gathering requirements are proportionate to the potential risks posed by the development'[4].

Although the Habitats Directive[1] does not put a general ban on new developments, the inflexible approach to the precautionary principle prescribed by the European Court of Justice (CJEU) is particularly ill-suited to reduce scientific uncertainties.

Under Article 6(3) of the Habitats Directive, any marine renewable energy project that is likely to have a significant effect on a Natura 2000 site must be subject to an appropriate assessment of its implication for the site's conservation objectives. Developers shall provide sufficient evidence in their Natura Impact Assessments reports to allow competent authorities to undertake an appropriate assessment. To be lawfully conducted, an appropriate assessment must identify beforehand, and in the light of *best scientific knowledge*, the likely significant effects of new offshore projects on Natura 2000 sites. The CJEU has given an important doctrinal role to the precautionary principle. Article 6(3) has been interpreted by the CJEU in such a way that, before granting development consents, competent licensing authorities must satify themselves *beyond all reasonable scientific doubt* that new developments will not significantly impact upon the integrity of nearby marine Natura 2000 sites.[2] By requiring determination beyond all reasonable scientific doubt before development consents can be granted, the Court has erected an important 'impediment' to the establishment of best scientific knowledge in the appropriate assessment procedure.

[1] Directive 92/43/ECC of the Council of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora [1992] OJ L 206/7
[2] Case C-127/02 *Waddenzee* [2004] ECR I-07405, para.59

Adaptive management may be the best methodology to deliver the best conservation outcomes. By offering an opportunity for control and feedback, this approach provides regulators and developers with the best scientific knowledge that is required to deploy and operate full-scale MRE projects within the confines of Natura 2000 sites' conservation objectives.

Federal and state environmental agencies in the United-States (US) and Canada have adopted adaptive management as a standard practice to address situation of environmental uncertainty in their permitting systems. This approach has been described as a 'most powerful tool to produce best scientific knowledge under the U.S. NEPA and Endangered Species Act [5]. In Canada, the Supreme Court of Nova Scotia recently allowed two tidal energy demonstration turbines operated by Cape Sharp Tidal Venture Ltd to be installed in the Bay of Fundy on the ground that, despite the existence of gaps in baseline data, the adaptive management approach was not adopted as a 'bureaucratic convenience' but as a practical response to addresses these uncertainties.[3]

Moreover, the Canadian Government has been recently reviewing Canadian environmental legislation to further support the integration of adaptive management into environmental assessment and regulatory processes[6].

In Europe, adaptive management has also been trialed to reduce scientific uncertainty associated with single devices and limited number of devices, including the SeaGen (Northern Ireland), DataStream (Wales) and Meygen (Scotland). Despite this, adaptive management remains an exception rather than the standard and there is no established legal basis for its implementation in EU Nature Conservation Law.

This paper considers the utility of using adaptive management as a methodology to scale up the industry without adversely affecting the conservation objectives of Natura 2000 sites. It first briefly describes the procedure of adaptive management. Using examples from the U.S. case law under the Endangered Species Act, the paper will then suggest how the mechanisms of adaptive management could be more robustly incorporated into the 'appropriate assessment' procedure of the Habitats Directive.

Marine renewable energy (MRE) refers to tidal and wave energy sources. The findings of this paper may also be relevant to other technologies that are not fully 'technology-ready' including floating offshore wind.

At first glance, the author needs to stress that adaptive management may not be appropriate for highly sensitive marine species.

[3] *Bay of Fundy Inshore Fisherman's Association v. Nova Scotia (Environment),* 2016 NSSC 286, para. 58

II. RESEARCH ELABORATION

Through a traditional doctrinal approach to legal research, this research reconciles law and ecological science to investigate how the literal scope of the Habitats Directive and contemporary developments in scientific methodologies can bring best scientific evidence to regulators through the techniques of adaptive management.

III. RESULTS & FINDINGS

A. The procedure of adaptive management

Many environmentalists have asserted that the only feasible option to manage uncertainty in dynamic natural resources is adaptive management [7]. Forty years after Holling's seminal contribution, *Environmental Management and Assessment* [7], there is still a broad consensus, even among lawyers, whereby uncertainty in environmental assessment procedures can be better managed by embedding the principles of adaptive management [8].

Adaptive management is defined as a "learning-by-doing" management process. The approach has been applied as a systematic approach for adapting and improving management actions by learning from ecosystems monitoring [9]. It is not a trial and error approach, but rather a process that promotes learning through careful design of environmental monitoring and iterative adaptation of management to take into account new scientific data [10]. The most definitive definition of adaptive management is provided by the U.S Department of Interior:

> "A flexible decision-making process that can be adjusted in the face of uncertainties as outcomes from management actions and other events become more understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process"[11].

From a procedural aspect, adaptive management is a cyclical process of environmental assessment, problems identification, implementation, feedback monitoring, evaluation and adjustment of management decisions based on monitoring results [12].

When applied to the MRE sector, an adaptive approach to planning and licensing requires regulatory decision-makers to accept a certain level of uncertainty as to the effects of a proposed development, whilst allowing uncertainty to be reduced in the post-licensing phase through statistically robust environmental monitoring, evaluation of monitoring data, and revision of licensing conditions. An adaptive management plan (AMP) incorporating relevant management objectives, management measures (i.e. mitigation measures) and a monitoring protocol must be

established collaboratively between developers, regulatory decision-maker and relevant environmental advisors with the aim of reducing data gaps and scientific uncertainties identified in pre-consenting environmental surveys. Management objectives in AMPs may be formulated in term of thresholds of 'acceptable effects' on marine ecosystems[1]. These thresholds may, for example, include a target level of population abundance and distribution in the impact area, maximum level of noise disturbance, a threshold for collision-related mortalities or maximum range of noise-induced displacement above which animals' fitness might be adversely affected. Mitigation measures are elaborated accordingly to ensure that the effects resulting from the placement and operation of multiple turbines do not exceed these thresholds.

Environmental monitoring programmes (EMP) must be designed accordingly with relevant scientific advisors and environmental authorities to check the correctness of model predictions. *Follow-up* monitoring is a fundamental element of adaptive management to provide information on ecosystems' behaviors before and after deployments. If the results of monitoring indicate that a critical threshold of acceptable impact/ change is being approached, mitigation must be reinforced accordingly. On the other hand, if monitoring data show that risks have been overestimated in pre-consenting surveys, mitigation measures should then be reduced and progressively removed in subsequent management decisions.

To date, an example of best practice in the EU may be the Meygen tidal energy project in Pentland Firth (Scotland). Meygen has been consented by the Scottish Ministers (i.e. Marine Scotland) in a staged manner with the requirements to establish and submit an Environmental Management Plan and an Environmental Monitoring Programme to Marine Scotland for each stage of the development. In the Section 36 consent, Marine Scotland has made the approval of the subsequent development phases conditional upon the Company deploying the turbines in stages with the Phase one being limited to six turbines. In order to avoid significant adverse effect, Marine Scotland has required that full and detailed monitoring of the turbines deployed under phase one must be carried out to ensure that the approval of subsequent phases of the development is done with full knowledge of the impacts and implications of the turbines for Natura 2000 features. In 2017, Marine Scotland granted consent for the deployment of two further turbines in addition to the six presently permitted.

The Annex IV 2016 report stresses that adaptive management approaches implemented on the basis of a threshold of acceptable impact at the population level require the ability to determine how animals are actually behaving in an environment with multiple turbines. Since more empirical evidence is now being gained from monitoring activities at single devices and small arrays (i.e. Meygen), best available knowledge needs to be fed into future adaptive management plans to ensure that real-scale deployments do not breach specific population thresholds.

B. Consenting and managing marine renewable energy projects within the confines of Natura 2000 sites' conservation objectives

The Birds and Habitats Directives are not explicitly threshold-based but they become so as their implementation requires the achievement of favourable conservation status of species and natural habitats of European Interest and the definition of conservation objectives in designated Natura 2000 sites.

The appropriate assessment procedure of Article 6(3) aims to determine whether the identified significant effects on conservation objectives of Natura 2000 sites are such that these will affect the ecological integrity of the sites. Competent licensing authorities can only agree to a project after having ascertained that it will not adversely affect the integrity of the site. EU guidance indicates that a decision as to whether a development adversely affects the integrity of a site should focus on and be limited to the site's conservation objectives [13]. In methodological guidance on Article 6(3), the EU Commission provided the 'integrity of site checklist'[14] to assist developers with determining whether a project will adversely affect the integrity of a site.

No further indication has been given by the EU Commission or EU judiciary about how 'large' or likely to occur a predicted impact on Natura 2000 sites and their qualifying features must be for the integrity of the sites to be adversely affected [15].

How much is too much? A determination of whether the integrity of Natura 2000 sites is to be adversely affected by a development involves assessing whether such a proposal will create long-term effects on a species population of Natura 2000 sites such that it would jeopardize the achievement of sites' conservation objectives [16].

Site-specific cconservation objectives dictate the notion of 'adverse effect on the integrity of the site' and as such, they may provide explicit thresholds against which threshold-based adaptive management can be implemented in compliance with the requirements of the Habitats Directive.

A threshold-based approach to environmental monitoring and adaptive management should in turn, be explicitly designed to ensure that the direct (lethal) and indirect (non-lethal) impacts of consented MRE projects on Natura 2000 protected species remain within the limits of the specified sites' conservation objectives.

This exercise requires setting limits/ thresholds of 'acceptable' effects at the population-level having regard to the specified conservation objectives of Natura 2000 sites.

'Acceptable' refers to the precautionary level of biological effects in relation to a MRE development that animals of a species can reasonably incur without jeopardizing the achievement of conservation objectives prescribed for this species. Thresholds of acceptable impacts are site-specific and must be informed by sites' conservation objectives, species ecology and population conservation status (i.e. favourable, declining) [17]. For each threshold of acceptable impacts, early-warning indicators must be rigorously defined accordingly to guide the design of an environmental monitoring programme.

Here, we rely on the monitoring guidance elaborated for marine mammals by Hawkins *et al*., [17] and Fleishman *et al*.[18]. Hawkins *et al*., argue that monitoring indicators should be those for which there is sufficient understanding of cause-and-effect relationships between measurable effects (i.e. collisions, physiological effects or displacement) and animals' vital rates (i.e. capabilities to survive and reproduce). Careful understanding of the mechanisms by which risks associated with a development may have meaningful biological effects on animals' health, and ultimately on a species population, [19] is necessary to identify key indicators for monitoring. The nature of impacts, either direct/ lethal (i.e. collision, entanglement, hearing damages) or indirect and non-lethal (i.e. disruption of behaviour, physiological effects) determine the indicators for threshold detection in monitoring programmes.

For each of these indicators or variables, acceptable scale of behavioural changes or physiological effects (magnitude of animals' response) must be defined to inform early-warning trigger points at which adaptation of licence conditions is warranted to avoid crossing thresholds of population effects on Natura 2000 species. This implies quantifying the size of behavioural and physiological changes that will have meaningful biological consequences on animals' vital rates.

For example, 'acceptable' effects may include a maximum displacement ranges above which animals' fitness will be affected, a maximum level of noise exposure above which noise disturbance is projected to cause a Permanent or Temporary Threshold Shift, or maximum number of mortalities by collisions above which there will be an impact on population dynamics of species protected by Natura 2000 sites.

Post-consenting science plays the lead role in providing data on potential changes in animals' behaviours and physiology. A steady flow of monitoring data is therefore critical to inform decision-makers about how animals of a Natura 2000 protected species are behaving in an environment with multiple turbines. Statistically robust *follow-up* monitoring must be designed to assist decision-makers and developers with detecting meaningful behavioural and physiological changes that, if sustained, may affect animals' fitness. Monitoring activities must follow the 'Before-After-Control Impact' methodology to account for changes in physiology and animals' behaviours prior to installation (baseline monitoring), during the construction and during the operational phase. If routine monitoring data indicate that the levels of behavioural/ physiological changes and associated biological effects are such that a pre-determined threshold of acceptable impact is being approached, these tipping points should trigger a reinforcement of existing protective measures or adoption of additional mitigation measures. On the other hand, if the monitoring data show that risks have been overestimated, mitigation measures should then be reduced and progressively removed in subsequent management decisions.

The exact location of a threshold of acceptable impact/ changes is often unknown or difficult to quantify with certainty. Such a level of 'acceptable risk' is not prescribed in law nor can it be derived from case law and accordingly must be determined on a case-by-case examination of the conservation objectives [1].

Modelling frameworks to derive population-level impacts from both lethal impacts and non-lethal effects of disturbances have been developed and could be used for setting scientifically sound thresholds having regards to sites' conservation objectives. By way of example, the Interim Population Consequence of Disturbance (iPCoD) [20] has been developed to inform regulatory consenting about the population implications of noise-induced disturbances, hearing damage and collisions on marine mammals during construction and operation of offshore wind farms.[4] This predictive modelling framework is still hampered by significant data limitations. As an interim approach, iPCoD heavily relies on expert elicitations to address data and knowledge gaps [21].

In this connection, the 'Ocean Energy Forward Look' report identifies the need for 'additional work to ascertain thresholds that fully meet the requirements' of the Habitats Directive as a "high" priority research area to address consenting risks [4]. Scientific projects are currently underway to identify 'best monitoring practices' for population assessment together with relevant monitoring variables and data type required to detect early warnings of population effects in the IPCoD framework [22]. Progress in scientific methods will progressively increase levels of confidence necessary to authorise commercial-scale arrays under adaptive management protocols. As rightly observed by Lusseau, IPCoD may then be well suited in an adaptive management scheme where monitoring allows for expert opinions to be progressively replaced by new observational and empirical evidence to decrease uncertainty [23]. New empirical data must be used to refine thresholds of acceptable population impacts and review management of operational MRE projects accordingly.

[4] See revised version of the report: Harwood J., King S.L., (2017). The Sensitivity of UK Marine Mammals Populations to Marine Renewables Developments – Revised Version. Report number SMRUC-MSS-2017-005

Uncertainty in modelling outputs should warrant precautionary margins when setting thresholds of acceptable effects [24]. The size of precautionary margins can be informed by a number of factors including risk appetite of regulators, the conservation value of the affected species and the levels of confidence in population modelling outputs.[24].

C. Legal feasibility of adaptive management under Article 6(3): Learning from the jurisprudence practice of U.S Courts under the Endangered Species Act

From a legal perspective, it is questionable whether the implementation of adaptive management would be in line with the strict approach to precaution prescribed by the CJEU under the Habitats Directive [25].

Commission v. Germany[5] is one of the landmark decisions in which the CJEU sets out the standard of judicial scrutiny to be applied to adaptive management practices. The CJEU held that an *ex-post* environmental monitoring programme, implemented in the post-consenting phase to reduce uncertainty and assess the effectiveness of mitigation measures, cannot be considered as sufficient to meet the legal requirement of the Article 6(3) insofar as at the time the authorisation was granted, the mitigation measure [together with the monitoring programme] could not guarantee beyond reasonable doubt that that plant would not adversely affect the integrity of the site'.[6] In the reasoning of the Court, the 'impact assessment itself did not contain definitive data regarding the effectiveness of the fish ladder, [...] its effectiveness could only be confirmed following several years of monitoring'.[7] In other words, the German authorities were not entitled to apply any iterative elements of adaptive management in their consenting procedures. Although this decision centres on a coal-fired plant, similar reasoning may be upheld with respect to MRE projects.

By systematically requiring certainty at the time of decision-making, judicial interpretation of Article 6(3) significantly limits opportunities to reduce scientific uncertainty through *follow-up* environmental monitoring and adaptive management techniques.

As discussed before, to be lawfully conducted, the CJEU has repeatedly emphasized that appropriate assessments must rely on the 'best scientific knowledge in the field'.[8] Interestingly, the CJEU case law puts science at the forefront of decision-making[9] but precludes any opportunities to incorporate scientific advances under the appropriate assessment procedure. As observed by Hanna *et al.*, 'as mitigation activities are carried out, an adaptive management approach could be used to evaluate the effectiveness of the mitigation actions, learn from these experiences, and reduce overall scientific uncertainty by informing future developments'[12]. The approach to precaution prescribed by the CJEU would systematically hamper such a learning-based approach under the appropriate assessment procedure of the Habitats Directive.

A sound method of relying on *best scientific knowledge* is via the principles of adaptive management. *Follow-up* monitoring and adaptation management in the context of Article 6(3) may give an opportunity of control and feedback allowing for scientific errors and modelling predictions to be corrected in post-licensing on the basis of real time scientific data.

The author suggests that the European Union could learn from the jurisprudence practice of U.S Courts under the Endangered Species Act.

U.S Courts have defined a number of substantive legal criteria that adaptive management plans shall satisfy to meet the requirement of 'no jeopardy' under the Endangered Species Act (ESA). The authorization criteria of the ESA are relatively similar to those of the Habitats Directive. The ESA aims to ensure that proposed actions do not jeopardize endangered or threatened species or result in the destruction or adverse modification of habitat of such species before an authorization can be granted. [10] 'Jeopardy' is defined as engaging in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the survival and recovery of a listed species by reducing the reproduction numbers or distribution of that species.[11] Similarly, the ESA explicitly requires the use of best scientific and commercial data available.[12] Both legal instruments have also been criticized for being too strict [26].

As a short background, to be lawfully conducted, mitigation measures in an adaptive management framework must be 'reasonably specific, certain to occur, and capable of implementation; they must be subject to deadlines or otherwise enforceable obligations; and most important, they must address the threats to the species in a way that satisfies the jeopardy and adverse modification standards'.[13] Mitigation measures must be 'clearly detailed, enforceable and applicable in determined timeframes.[14] These must be within the Federal Agency's power to implement. In other words, competent agencies must have authority over the implementation of mitigation actions. Furthermore, monitoring requirements must be designed to evaluate the success or failure of mitigation measures. The court made it

[5] Case C-142/16 *Commission v. Germany* [2017] ECLI: EU:C: 2017:301
[6] Ibid., paras. 37-43
[7] Ibid., para. 37
[8] Case C-258/11 *Peter Sweetman* [2013] ECR-0000, para. 40
[9] Case C-258/11 *Peter Sweetman* [2013] ECR-0000, para. 40
[10] Endangered Species Act (ESA), section 7(2)
[11] Code of Federal Regulations, Title 50, para 402.02
[12] ESA, section 7(2)
[13] *Center for Biological Diversity v. Rumsfeld*, 198 F. Supp. 2d. 1139 (D. Az. 2002)
[14] *Pacific Coast of Fishermen's Associations v. Gutierrez,* 606F. Supp. 1122 (E.D. Cal. 2008)

clear that 'simply reporting project implementation is not a meaningful assessment of the success or failure of the mitigation measures'. [15]

These judicial requirements have been constantly reiterated in US case law [27]. In *Natural Resources Defense Council v. Kempthrone*, the Eastern District Court of California rejected an AMP under the ESA on the ground that, although adaptive management was 'within the agency's discretion to choose and employ [...], the absence of any definite, certain or enforceable criteria or standards make its use arbitrary and capricious under the totality of the circumstances'.[16] In this case, monitoring requirements were clear but the AMP provided for a discretionary and unenforceable mitigation process whereby actions *could* be taken if the thresholds (i.e. number of fish killed and spawning rate) were crossed. Competent agencies must demonstrate 'clear, definite commitment of resources' to act in the face of new scientific evidence.[17] This includes identifying clear thresholds which if exceeded, lead to a 'clear and enforceable requirement' to adjust mitigation practice.[18]

These criteria may be transferred to inform the legality of adaptive management practices in the context of the appropriate assessment procedure of the Habitats Directive. To pass the legal test of 'no reasonable scientific doubt' under the Habitats Directive, AMPs will still have to exhibit sufficient level of certainty regarding the efficiency of monitoring methodologies and mitigation measures. In addition, AMPs must contain clear and enforceable requirements in terms of monitoring activities and mitigation measures. The iterative phase of adaptive management programmes must be linked to definite and measurable trigger point or acceptable thresholds of changes at which revision of mitigation or operating conditions must be warranted. These thresholds shall not be exceeded to ensure that an operating deployment does not undermine the achievement of the conservation objectives of this site. If these thresholds are approached, AMPs shall provide for a non-discretionary mandate to take enforceable actions necessary to adjust/re-evaluate mitigation responses accordingly.

In practice however, identifying specific trigger points (or thresholds of acceptable effects) is particularly challenging. Permitting a project to proceed within the framework of adaptive management involves a certain acceptance of risk that the deterioration of natural habitats or collision or disturbance with a protected species might occur despite the application of mitigation measures. A key challenge for developers and regulators will be to determine the thresholds of risk which are 'acceptable' having regard to Natura 2000 sites' conservation objectives.

Le Lièvre, O'Hagan *et al*., argued elsewhere that in order for threshold-based adaptive management to be applied in compliance with Article 6(3), the need for a flexible approach to risk may need to be recognised in the Natura 2000 statutory conservation objectives [1]. In order to increase our understanding about the interactions of Natura 2000 species with an environment of multiple turbines, it may be necessary for the tolerance of risks to be reflected in the conservation objectives. Conservation objectives dictate the notion of 'integrity' of Natura 2000 sites. Conservation objectives are not determined by Courts but by scientists that understand the role of adaptive management in increasing the predictive capacity of environmental assessment under the Habitats Directive system. Adaptive management could thus, for example be stipulated under statutory conservation objectives as a requirement that critical species thresholds (necessary to meet conservation objectives) are not exceeded and these thresholds can be determined through the process of adaptive management.

IV. CONCLUSION

As a preliminary conclusion, the author argues that the Habitats Directive may already provide a 'ready-made' framework to consent future array-scale MRE projects under adaptive management protocols.

Article 6(2) establishes a general obligation to take 'appropriate steps' to avoid, in Natura 2000 sites, deterioration of natural habitats and disturbance of species. The CJEU has consistently relied on Article 6(2) to impose a non-discretionary obligation on competent authorities to iteratively review planning permissions of consented projects which had not been made subject to the appropriate assessment procedure of Article 6(3), due of having been authorised before the inclusion of a site on the SCIs list.[19]

In two recent seminal decisions, the Court has implicitly acknowledged that an obligation to iteratively review the implications of consented projects that have been lawfully assessed in compliance with the procedural requirements of Article 6(3) may also arise from Article 6(2)[20] to prevent further degradation of natural habitats and disturbances of species of Natura 2000 sites. If such interpretation of Article 6(2) is to be upheld by the CJEU in subsequent case law, Article 6(2) may provide a relevant legal basis to inform the legality of adaptive management practices in future planning permissions. Adaptive management is not a 'one-size-fit-all' approach. The approach may not be appropriate for highly sensitive and endangered species. The conservation

[15] *Center for Biological Diversity v. Rumsfeld*, *Op. cit*., para. 1154
[16] *Natural Resources Defense Council v. Kempthrone*, 506 F. Supp. 2d 322 (E.D. Cal. 2007)
[17] *National Wildlife Federation v. National Marine Fisheries Service*, 524 F. 3d 917 (9th Circ. 2008)
[18] *Natural Resources Defense Council v. Kempthrone, Op. cit.*
[19] Case C-226/08 *Stadt Papenburg* [2010] ECR I-131, para. 49; Case C-404/09 *Commission v Spain* [2011] ECR I-11853, para. 125
[20] *Waddenzee*, para. 37; Case C-6/04 *Commission v United Kingdom* [2005] ECR I-9056., para. 58

status of the species concerned should therefore be used to inform the 'risk appetite' of regulators and developers. Where there is significant uncertainty as to the impact of a development on a declining species, a low threshold of risk tolerance must be preferred. Additional scientific research should be urgently conducted to tackle important issues associated with an adaptive approach to licensing. Future research should be geared towards designing statistically robust survey and monitoring methodologies capable of effectively detecting changes in marine protected species.

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