Precaution in Principle
and the
Evolution of Avoidance
Aly McCluskie
Let’s start with what we do know.....
The development of renewable energy has a crucial role in mitigating the effects of climate change.
Birds are affected by wind farms

- Habitat change/loss (positive or negative)
- Changes in prey or predators (positive or negative)
- Disturbance causing displacement or altered behaviour
- Collision with structures
- Additional energy cost of avoiding structures
What is the Precautionary Principle?

“Primum non nocere”

“First, do no harm”.

“Where uncertainty still exists we must give the environment the benefit of the doubt.” (Former Norwegian Prime Minister Jan P. Syse)
What is the Precautionary Principle?

Included in the 1992 Rio Declaration, Principle 15, “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”

Enshrined in EU Legislation in 2000 with the aim of ensuring a higher level of environmental protection through preventative decision-taking in the case of risk
Preliminary Conditions

The European Commission stresses that the precautionary principle may only be invoked in the event of a potential risk and that it can never justify arbitrary decisions.

The precautionary principle may only be invoked when the three preliminary conditions are met:

- identification of potentially adverse effects;
- evaluation of the scientific data available;
- assessment of the extent of scientific uncertainty.
What is uncertainty?

“There are almost as many definitions of uncertainty as there are treatments of the subject”*

For this talk we define it as a lack of knowledge, or incomplete information about a particular subject.

In order to manage uncertainty it must first be identified

Hierarchy of Uncertainty

Uncertainty in Assessment

Level 1
- Random
- Systematic

Level 2
- Knowledge
  - Decision Making
  - Linguistic

Level 3
- Habitat Loss
- Collision
- Barrier Effects
- Disturbance

Level 4
- Process
- Data and Parameters
- Model Structure
- Model Output

Milner-Gulland and Shea (2017) identified a number of “Uncertainty traps”

- Ignoring uncertainty: “Put it in the too difficult box”
- Acknowledging uncertainty: “Plough on”
- Focussing on trivial uncertainties: “Fiddle whilst Rome burns”
- Believing models or rules of thumb: “Hubris”
- Sidestepping uncertainty: “Unclear objectives”
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Acknowledging Uncertainty, but ploughing on regardless

Foraging Ranges and SPA Apportioning

- Typically data from Thaxter et al., (2012) used to determine whether wind farm is within foraging range of an SPA
- Mean maximum value is sometimes used, (although maximum would be more precautionary)
- Tracking studies utilise so few individuals that maximum ranges should not be seen as extremes
Kittiwake foraging ranges
Flamborough and Filey coast SPA

Kittiwake foraging ranges

Mean max foraging range (60km)
Flamborough and Filey coast SPA

- Mean max foraging range (60km)
- Max foraging range (120km)

Kittiwake foraging ranges
Flamborough and Filey coast SPA

Tracked foraging ranges (2017)

Kittiwake foraging ranges
Some Tracking Conclusions

It is best to use colony specific tracking data, or a Wakefield et al., type modelling approach
not because it is the most precautionary approach....
but because it is the most correct.
Maximum, let alone mean maximum is unlikely to be precautionary if based on other colonies
Focussing on trivial uncertainties: Fiddle whilst Rome burns. Collision Risk Modelling
Hubris: Believing your models or rules of thumb are telling you the truth.

Potential Biological Removal (PBR)

A method for detecting overharvesting of exploited animal populations and unsustainable additional mortality of other kinds.

Can be performed for bird populations using very few data.
- minimum current population size
- estimates of two demographic rates:
  - the mean age at first breeding
  - mean annual adult survival.

Uses the equation based upon Dillingham & Fletcher (2008)

\[
PBR = 0.5 \, N_{\text{min}} \, f \, (\lambda_{\text{max}} - 1)
\]

\(N_{\text{min}}\) is a value of estimated population size
\(\lambda_{\text{max}}\) is first estimated from adult survival and mean age at first breeding
\(f\) is a “recovery factor”.
Problems with PBR

• it does not quantify the impact of additional mortality on population size
• is not appropriate to practical applications in wind farm assessments because of inadequate knowledge about density dependence
• depends upon a choice of a recovery factor \( f \) which is not supported by empirical evidence

The choice of recovery factor is usually said to be “precautionary”, but no value can be precautionary if the assessment method is so flawed
Hubris: Believing your models or rules of thumb are telling you the truth.
Acceptable Biological Change
“I am not convinced that a sea bird “appropriate assessment”, however skillful, however conscientious, can aspire in the present state of knowledge to be more than a kind of structured haruspication”
Some conclusions

- It is not enough to just keep saying “precaution”, precaution must be applied, and in proportion to the level of uncertainty.
- In order to reduce precaution we must be realistic about uncertainty.
- Understanding the extent of uncertainty is needed to understand the level of precaution required.
- Research should focus on reducing uncertainty, not on reducing precaution or reducing consenting risk. Rather these should be the result of reducing uncertainty.
Work to Reduce Uncertainty

Offshore Renewables Joint Industry Partnership
ScotMER
EOWDC Research and Monitoring
Ongoing tracking studies
BTO UHI CEH
The Evolution of Avoidance
A Precautionary Tale

In assessment, there can be broadly two realities; modelled reality and biological reality. Our aim is to achieve the greatest amount of convergence between them.
The Band Model.

Developed by SNH. Has a lot of detail about the turbine parameters, but very rough biological behavioural detail. Always intended just to provide very broad brush indication of risk.

<table>
<thead>
<tr>
<th>Input variable</th>
<th>Baseline’</th>
<th>Baseline ± 10%</th>
<th>Collision risk</th>
<th>Revised collisions</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. chord (m)</td>
<td>5.00</td>
<td>5.50</td>
<td>0.153</td>
<td>0.063</td>
<td>5.62</td>
</tr>
<tr>
<td>Pitch angle (°)</td>
<td>30.00</td>
<td>33.00</td>
<td>0.150</td>
<td>0.062</td>
<td>3.55</td>
</tr>
<tr>
<td>Bird length (m)</td>
<td>1.21</td>
<td>1.33</td>
<td>0.151</td>
<td>0.063</td>
<td>4.24</td>
</tr>
<tr>
<td>Wingspan (m)</td>
<td>1.96</td>
<td>2.16</td>
<td>0.147</td>
<td>0.061</td>
<td>1.48</td>
</tr>
<tr>
<td>Bird speed (m/s)</td>
<td>20.00</td>
<td>18.00</td>
<td>0.158</td>
<td>0.065</td>
<td>9.07</td>
</tr>
<tr>
<td>Rotor diameter (m)</td>
<td>92.00</td>
<td>82.80</td>
<td>0.150</td>
<td>0.062</td>
<td>3.55</td>
</tr>
<tr>
<td>Rotation speed (/s)</td>
<td>3.00</td>
<td>2.70</td>
<td>0.158</td>
<td>0.065</td>
<td>9.07</td>
</tr>
<tr>
<td>Bird count</td>
<td>109.00</td>
<td>120.00</td>
<td>0.145</td>
<td>0.066</td>
<td>10.20</td>
</tr>
<tr>
<td>Avoidance rate</td>
<td>0.9962</td>
<td>0.897</td>
<td>0.145</td>
<td>1.628</td>
<td>2613.19</td>
</tr>
</tbody>
</table>
SOSS 2012.
The extended model and first Cook et al review.
Bill Band intervenes:

He pointed out that you could not use the same Avoidance Rate for the basic and extended model.
Liz Masden’s CRM version
2\textsuperscript{nd} Cook et al Avoidance Rate review.

\[ Avoidance \ Rate = 1 - \left( \frac{\text{observed collision rate}}{\text{predicted collision rate}} \right) \]
Meanwhile, Keith Hamer and Ian Cleasby were tracking gannets....
Recent work

Has had focus on:
1. Avoidance Rate
2. Improving the input parameters
3. Improving the model
From onshore studies there is evidence that modelled predictions do not always match observed collision rates (Ferrer et al. 2012; de Lucas et al. 2008)

Underpinning the Band model is the calculation of $p_{Coll}$

The ORJIP BCA study was the first time that it had been possible to validate the calculation of $p_{Coll}$

Estimates of $p_{Coll}$ from Thanet are between 0.07 and 0.12.

The actual proportion of birds passing through the rotor swept area that collided was 0.4; approximately four times that predicted

Important caveats:
- Very small sample size (of actual collisions!)
- This is not in any way a criticism of the quantity and quality of the data collected through the BCA, although questions remain…
Improving input parameters.

Particularly flight speed, flight height and nocturnal activity. We can use biotelemetry, Laser Range Finder, and LiDAR. There remain questions around the calculation of flux
Improving the model itself, Shiny app.
Some CRM Conclusions

There should be focus not just on improving certainty around avoidance rate but also around the other input parameters.

Reducing the uncertainty around these will increase confidence in the outputs of the CRM and thereby decrease the need for precaution.

But all this may be a distraction from fundamental flaws in the modelling process.

Repetition of “precaution” in the description of input parameters will not dilute these flaws.
It is often argued that offshore wind farm assessments are over-precautionary, and therefore we should reduce precaution. But there is precaution because of all the uncertainty. Our primary aim should be to reduce the uncertainty not precaution.

More certain assessments of developments can be made, to the benefit of sustainable offshore renewable industry and internationally important populations of seabirds.
Thank you