

# MS Cumulative Effects Framework

# WORKSHOPS



## Session I: 10:00 – 12:30

Time	Agenda Item
09:45	Zoom open, ready for sharp 10:00 start
10:00 - 10:05	Housekeeping
10:05 - 10:15	Intro to Workshop D - aims & structure
10:15 - 10:30	Part 1 – Summary of stakeholder engagements (workshops A, B, C and Technical Working Groups) <ul style="list-style-type: none"> <li>- Reminder of aims of each workshop</li> <li>- Summary of main outcomes</li> </ul>
10:30 – 11:00	Presentation of CEF functionality <ul style="list-style-type: none"> <li>- Presentation of marine mammal functionality</li> <li>- Feedback</li> </ul>
11:00 - 11:15	BREAK
11:15 – 12:30	Presentation of CEF functionality <ul style="list-style-type: none"> <li>- Presentation of seabird functionality</li> <li>- Feedback</li> </ul>

## Session II: 13:30 – 15:30

Time	Agenda Item
13:30 – 14:00	<b>Data Library</b> <ul style="list-style-type: none"> <li>- Presentation</li> <li>- Feedback</li> </ul>
14:00 – 14:30	<b>User Interface</b> <ul style="list-style-type: none"> <li>- Presentation</li> </ul>
14:30 – 14:45	BREAK
14:45 – 15:15	<b>User Interface</b> <ul style="list-style-type: none"> <li>- Feedback</li> </ul>
15:15 – 15:30	<b>Summary and next steps</b> <ul style="list-style-type: none"> <li>- Survey for final feedback (to be sent to all participants)</li> <li>- Submit feedback via project email</li> <li>- <b>Deadline for all feedback December 31st</b></li> </ul>
15:30	Close

# WORKSHOPS

WORKSHOP	WHEN	WHO
A User Stories	August 19-20th	Government, consultants, developers
B Datastore Content	Sept. 14th & 16th	Specialists
C Datastore QA	Nov. 25th	Specialists
D Interface	Dec. 15th	End users

# Tech Working Groups

TWG	WHEN	WHAT
Density Data	September 28th	Agree types and sources of bird density data
Consensus defaults	November 10th	Agree what parameters should have defaults and what these should be
Mammals	November 16th	Consistent methods for project-level effects, iPCoD model, additional species
Uncertainty, cumulative effects	November 18th	How to combine effects across windfarms, and propagate uncertainty

# WORKSHOP A

<b>Action</b>	<b>Benefits</b>
<b>Play around with potentially different sequences of development</b>	<b>Would allow consultants/developers to identify if any projects have a disproportional impact on the assessment</b>

# WORKSHOP A

## Functionality

**Central repository for all relevant seabirds and windfarm data. Agreed values for:**

- **Wind farm design parameters**
- **Seabird monthly densities in flight and at sea**
- **Seabird data such as flight heights, speeds etc**
- **Default model parameters (e.g. for CRM; avoidance rate, nocturnal activity, etc, and for displacement agreed displacement rates etc)**
- **Default regional population size and SPA citations**
- **Seabird demographic rates either regionally, colony, or generic.**

# WORKSHOP B

- Need for generic data in addition to project (ES) data for birds: MERP
- SNCBs to review draft datastore: agreements on data post-ES
- Not feasible to agree all parameters for birds: discuss further in later TWG
- Identified sources of default parameters for mammals (demographics, MU abundances)

# WORKSHOP C

- No R knowledge required; metadata visible (pdf?)
- Audit of user choices; transparency and repeatability
- Consider how changes to stand-alone tools replicated within CEF



# TWG: Density Data (birds)

- Clear description of MERP maps and input data
- Additional MERP maps for key species
- Means to assess when to revert to MERP
- Include data to all buffer 'zones' included in ES

# TWG: Consensus defaults (birds)

- Mapping functionality within CEF to choose relevant counts
- All colonies not only SPAs
- Generic seasons but with option to deviate
- Include site-specific flight heights where available, option to revert to generic

# TWG: Mammals

- Project level impacts; consistent approaches. OUTSIDE SCOPE CEF
- Best source for piling schedules (MNR, compliance reporting)
- Default: EIA predicted impacts

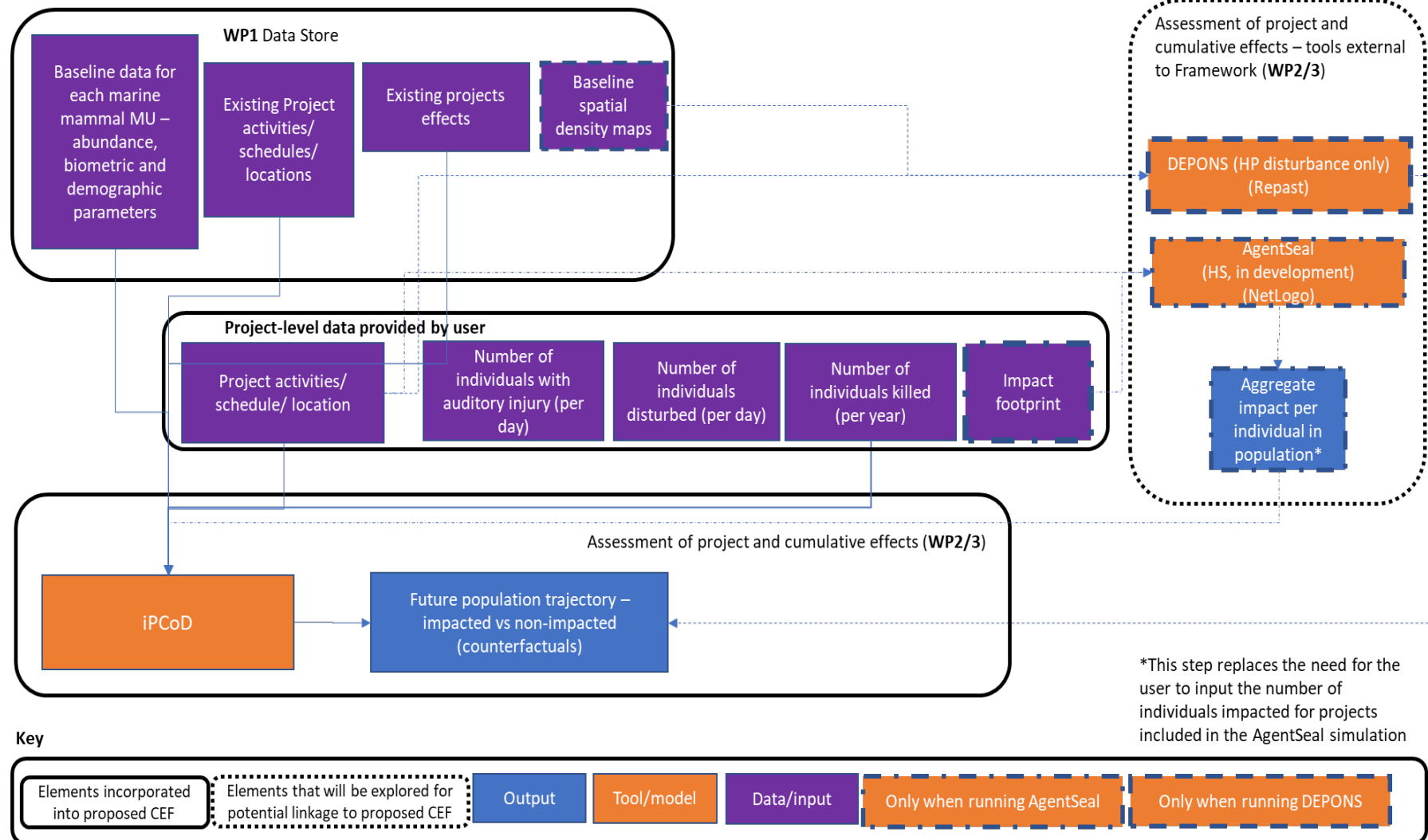
# TWG: Cumulative effects & uncertainty (birds)

- Different tools measure uncertainty to different extents
- Simulations can provide propagation of uncertainty
- Variability vs uncertainty not always clear
- Double counting of displacement and collision: kittiwake and gannet.
- Displacement effects; which season does mortality occur?



# Marine Mammal Approach

# Introduction



# User selection on interface

- 1.1 **Taxa** – select from seabirds or **marine mammals**
- 1.2 **Species** – select from dropdown list of **harbour porpoise, grey seal, harbour seal, minke whale, or bottlenose dolphin**. Only one species can be selected at a time. Users will need to run the model 5 separate times to model a set of defined ORE impacts once on each species.

# Species-specific inputs

## Inputs to parameterise a species-specific run of iPCoD



- Population parameters
- Incorporating density dependence
- Scenario-specific parameters
- Piling schedule
- Piling parameters

## Inputs to define the output results from iPCoD

- Model simulation parameters
- Summary statistics options
- Visualisation options
- Uncertainty





# Population parameters

Description	User-defined project level 	Data Library 
Abundance (for MU)	MUs can be user-defined	<ul style="list-style-type: none"> <li>IAMMWG Cetacean MU</li> <li>SCOS 2020 SMU</li> </ul>
Annual survival rate for adults/juv/pups or calves	Users can change any of the defaults populated from the Data Library	Defaults in Data Library  Default is 0.5  Default is 1000
Age at which females give birth for the first time		
Fecundity rate		
Proportion of population that is female		
Threshold for the implementation of demographic stochasticity		



# Incorporating density dependence

Description	User-defined project level <input checked="" type="checkbox"/>	Data Library <input checked="" type="checkbox"/>
Fecundity rate at population size	Density dependence has only been tested for harbour seals in Moray Firth MU. Not generally recommended for other species/MUs	Defaults in Data Library  Default is that density dependence is not modelled, and z is set to 0
Max possible value for fecundity		
Carrying capacity for the population		
Fecundity rate when the population is at carrying capacity		
Shape of density dependent relationship		



# Scenario-specific parameters

Description	User-defined project level 	Data Library 
No. individuals predicted to experience disturbance/PTS on 1 day of piling	Can be inputted by user. Defaults are currently stored within iPCoD code	Include all OWF projects constructed/submitted from 2016 onwards
Proportion of vulnerable subpopulation		Default will be EIA predicted numbers (work in progress)
Which season an impact affects animals		
Whether disturbed animals will avoid other piling operations		Where possible, multiple scenarios from projects will be included



# Piling schedule

Description	User-defined project level 	Data Library 
A calendar of the timing of pile driving activity	Piling schedule will be developed from the EIA information on piling programme	Previous projects piling schedules  Piling reports (from e.g. MNR)  Default - Used when <i>only</i> impacts from collisions are modelled. (i.e. when pile_years = 0)

# Piling parameters

Description	User-defined project level 	Data Library 
No. piling years	(If user sets years=0, only collisions are modelled)	
No. piling operations being modelled		
Which operations will affect each vulnerable population		

# Model simulation parameters

Description	User-defined project level 	Data Library 
No. years to run simulation over	Defaults currently stored in iPCoD code	Defaults could be stored in Data Library
No. replicates of simulation		

# Inputs to define results output

Description	User-defined project level <input checked="" type="checkbox"/>	Data Library <input type="checkbox"/>
Median, min, max, IQR of the ratio of impacted to un-impacted population size	Probably a series of tick-boxes on an interface page	
Centile for un-impacted population which matches the 50th centile for the impacted population		
Graphical outputs options to visualise the simulation		
.csv file of output matrix showing impacted/unimpacted trajectories		

# Work in progress



# Scenario-specific parameters

- *numDt/numPT*) Data Library will include all OWF projects constructed/submitted from 2016 onwards.
- Wherever possible, multiple scenarios from projects will be included in the Data Library – including outputs from most likely and worst case scenarios but resource available may limit this ability for all projects. The Library will be designed in a way that makes it easier to add in additional scenarios.
- (*numDt/numPT*) Desirable for users to be able to input their own recalculated values if they have independently recalculated projects impacts using a consistent methodology but CEF will not do this for users and default will be EIA predicted numbers.

# Impact footprint & versioning

- AgentSeal (and possibly DEPONS) are being tested to be part of the iPCoD framework. A preliminary version *may* be included within the updated version of the CEF iPCoD
- These don't change the inputs of iPCoD
- However, additional inputs may be included in the CEF to allow AgentSeal/DEPONS to run remotely from the CEF interface.
- The current version of iPCoD is v5.2 with updates in development
- All of the above are pending decisions to be taken by the project team

# Default outputs name

- Currently naming output files from the model run of iPCoD is user-defined in the R code.
- Users also manually alter the `summary_statistics` R file to decide on which results should be output.
- For CEF implementation, naming convention will be automatic, and the layout/format of the model results will be user-defined before the model is run.

# Key points from TWG discussions

# Uncertainty

- Data from EIAs have associated uncertainty. For the current tool the uncertainty may need to be displayed in a quantitative way.
- The variance in the 1,000 replicate matched population trajectories provide measure of uncertainty - how best to visualise/output this?
- Uncertainty gets bigger when doing cumulative assessments – worst case to more realistic scenarios can be included in Data Library. Up to users to justify which scenarios are modelled.

# Out of scope for this iteration of CEF

- Comparing expert elicitation with Dynamic Energy Budget (DEB) models
- Additional species (white-beaked & Risso's dolphins)
- Additional sources of impact (e.g. seismic and shipping)
- Partitioning uncertainty to contributory sources (e.g. distinguishing between uncertainty from demographic parameters and individual disturbed from piling)

# **PROPOSED APPROACH - SEABIRDS**

**Tools**



**ORJIP Sensitivity Mapping Tool**

Displacement & collision risk tools:  
Displacement Matrix  
sCRM  
SeabORD (potentially linked to sCRM)

Apportioning tools:  
SNH apportioning tool  
BDMPS  
MSS apportioning tool

**Annual effects**

**NE/JNCC PVA tool**

**Longer-term impacts, e.g. PVA metrics**

# Key features

# Key features

- Ability to run tools in the ways they are currently used in HRA and EIA
- Ability to link SeabORD with other assessment tools
- Ability to run each tool separately
- Ability to easily explore the impacts of changing inputs
- Default values suggested for almost all inputs, based on selection of species
- Alignment of default values with those in existing tools (e.g. NE PVA tool, sCRM)
- Clear audit trail

Species

	NE PVA	MISS App	SeabORD	SCRMI	ORJIP Sens	CEFF
Arctic skua	X			X		
Arctic tern				X		
Atlantic Puffin	X	X	X	X	X	X
Black-headed Gull				X		
Black-legged Kittiwake	X	X	X	X	X	X
Black-throated Diver	X			X		
Common Guillemot	X	X	X	X	X	X
Common Gull				X		
Common Scoter	X			X		
Common Tern	X			X		
Cormorant	X			X		
Eider				X		
European Shag	X	X		X	X	X

	NE PVA	MISS App	SeabORD	SCRMI	ORJIP Sens	CEFF
European storm petrel					X	
Great Black-Backed Gull	X	X	X	X	X	X
Greak Skua					X	
Herring Gull	X	X	X	X	X	X
Lesser Bl.-Backed Gull	X	X	X	X	X	X
Little Auk				X		
Little Gull				X		
Little Tern	X					
Manx Shearwater				X		
Northern Fulmar	X			X	X	
Northern Gannet	X	X	X	X	X	X
Razorbill	X	X	X	X	X	X
Red-throated Diver	X			X		
Sandwich tern	X			X		X

Structure

# Part 1. Context

- 1.1 **Taxa:** Seabirds or Marine Mammals
- 1.2 **Species:** users select from drop down list  
**With option to select “generic seabird species”**
- 1.3 **Purpose:** Risk assessment, Spatial Planning, PVA only

# Part 1. Context

**Next questions are only relevant if the purpose is “Risk assessment”:**

1.4 **Impact mechanisms: Collision, Displacement, Both**

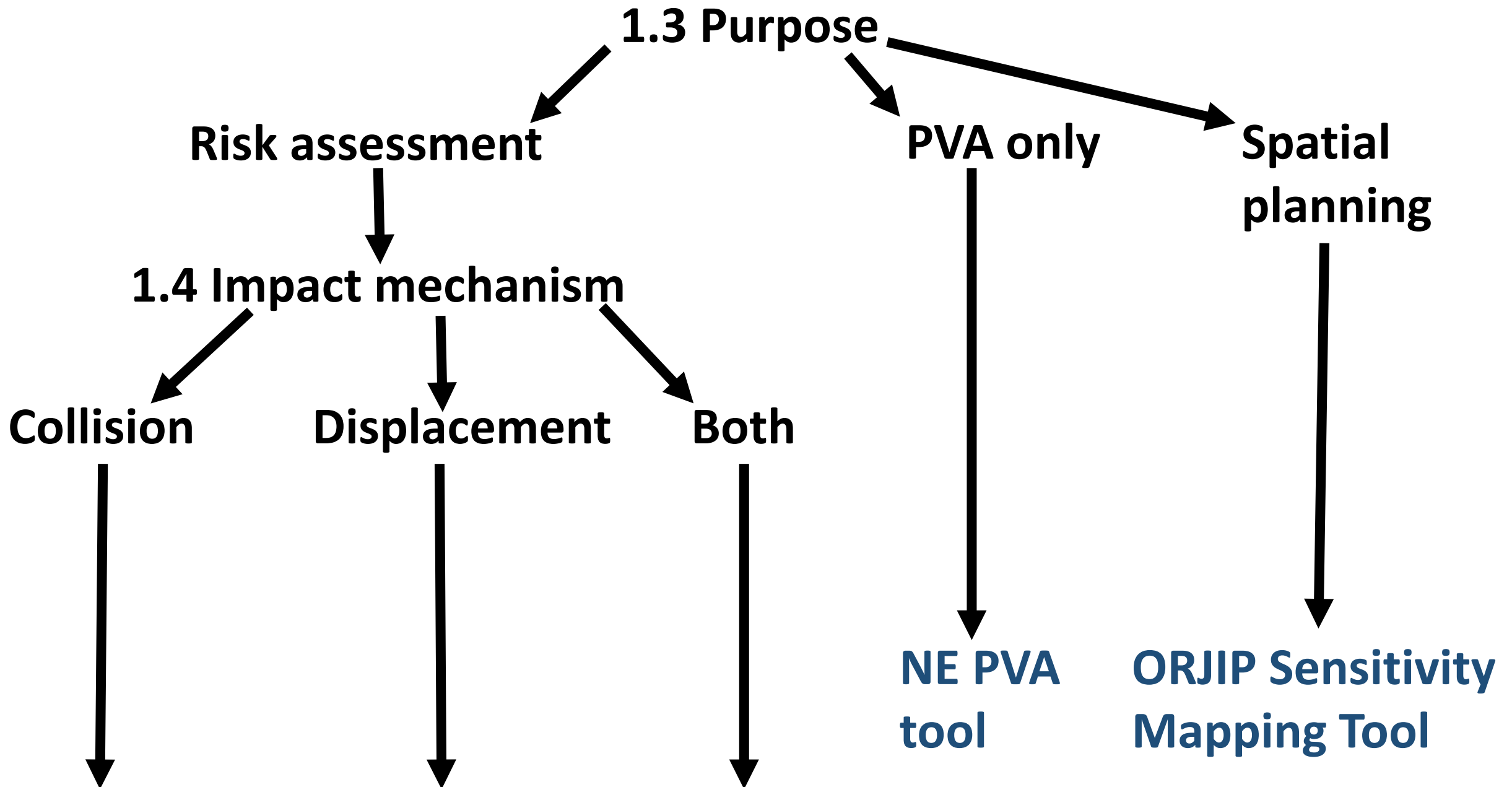
1.5 **Seasons: Breeding, Non-breeding, Both, Monthly**

**With option to change default breeding season definitions**

1.6 **Apportioning type: No apportioning, Apportioning solely to remove non-SPA colonies, Apportioning to SPAs**

1.7 **Output type: Annual effects and PVA, Annual effects only**





# Collision...

1.5 Season	1.6 Apportioning	1.7 Output type	Set of tools the CEF will use
Breeding	None	Annual effects only	sCRM
		Annual effects & PVA	sCRM and NE PVA
	Apportioning	Annual effects only	1) sCRM, SNH apportioning 2) sCRM, MSS apportioning
		Annual effects & PVA	1) sCRM, SNH apportioning and NE PVA 2) sCRM, MSS apportioning and NE PVA
Non-breeding	None	Annual effects only	sCRM
		Annual effects & PVA	sCRM and NE PVA
	Apportioning	Annual effects only	sCRM, BDMPS
		Annual effects & PVA	sCRM, BDMPS, and NE PVA

# Displacement...

1.5 Season	1.6 Apportioning	1.7 Output type	Set of tools the CEF will use
Breeding	None	Annual effects only	D Matrix
		Annual effects & PVA	D Matrix and NE PVA
	Apportioning	Annual effects only	1) D Matrix and SNH apportioning 2) D Matrix and MSS apportioning 3) SeabORD
		Annual effects & PVA	1) D Matrix, SNH apportioning and NE PVA 2) D Matrix, MSS apportioning and NE PVA 3) SeabORD
Non-breeding	None	Annual effects only	D Matrix
		Annual effects & PVA	D Matrix and NE PVA
	Apportioning	Annual effects only	D Matrix, BDMPS
		Annual effects & PVA	D Matrix, BDMPS, and NE PVA

# Collision and displacement...

1.5 Season	1.6 Apportioning	1.7 Output type	Set of tools the CEF will use
Breeding	None	Annual effects only	sCRM and D Matrix
		Annual effects & PVA	sCRM, D Matrix and NE PVA
	Apportioning	Annual effects only	1) sCRM, D Matrix and SNH apportioning 2) sCRM, D Matrix and MSS apportioning 3) sCRM and SeabORD (unlinked) 4) sCRM and SeabORD (linked)
		Annual effects & PVA	1) sCRM, D Matrix, SNH apportioning and NE PVA 2) sCRM, D Matrix and MSS apportioning and NE 3) sCRM, Original SeabORD and NE PVA 4) sCRM, Extended SeabORD and NE PVA
Non-breeding	None	Annual effects only	sCRM and D Matrix
		Annual effects & PVA	sCRM, D Matrix and NE PVA
	Apportioning	Annual effects only	sCRM, D Matrix and BDMPS
		Annual effects & PVA	sCRM, D Matrix, BDMPS and NE PVA

# Part 2. Selection of tools

**Only relevant based on some selections in Part 1:**

**2.1 Displacement tool to use in the breeding season:**

**Displacement Matrix, SeabORD (linked with sCRM) or SeabORD (unlinked to sCRM)**

**2.2 Tool to use for apportioning in the breeding season:**

**SNH Apportioning Tool or MSS Apportioning Tool**

# Part 3. Turbine and wind farm features

- 3.1 Select one or more existing projects (from a drop-down list), and potentially add one or more new projects
- 3.2 For each project, specify whether existing estimates of annual effects should be used, or the assessment tools re-run
- 3.3 Project-level density data  
Project-level data, MERP maps, or Wakefield et al. (2017) maps

**For existing projects, annual effects or project-level data are taken from the Data Library; for new projects they are specified by the user**

# Part 3. Turbine and wind farm features

**3.4 Footprints (shapefile): one for each project**

**3.5 Buffer**

If collision and displacement, a separate buffer for each

Option to specify whether, if data are unavailable for selected buffer, the values should be extrapolated from available data

**3.6 Features related to collision (if considering collision)**

These are the “Turbine and wind farm features” in the sCRM

**3.7 Operational period (if running PVA)**

Start and end year

# Part 4. Collision

**This part is only used if considering collision**

## **4.1 Species features related to collision**

**These are the “Species features” in the sCRM**

## **4.2 sCRM technical parameters**

**Number of iterations, large array correction**



# Part 5. Displacement

**This part is only used if considering displacement**

## **5.1 Displacement rate**

**With option to provide standard deviation if available**

## **5.2 Displacement mortality rate (if using Displacement Matrix)**

**With option to provide standard deviation if available**

## **5.3 Displacement Matrix approach (if using Displacement Matrix)**

**Fixed inputs, grid of values, stochastic (uniform), stochastic (normal)**

# Part 6. Populations and apportioning

**This part is only used if considering apportioning or running SeabORD**

**6.1 Foraging range**

**6.2 Population selection**

**Specify a table giving the name, location and most recent size of each population to consider, including non-SPA colonies to be considered for initial stage of apportioning**

**Users can either upload the table, or use a map-based interface to create a suggestion version of it using SMP data, which they can then modify (if needed) and approve**

# Part 7. SeabORD

**This part is only used if running SeabORD**

## **7.1 SeabORD options:**

**Wakefield et al. (2017) maps, Distance decay, Upload GPS map**

## **7.2 Decay parameter (if using “distance decay” option in SeabORD)**

## **7.3 Bird density maps for SeabORD (if using SeabORD)**

**Upload a file for each population**

# Part 8. PVA

**This part is only used if running a PVA**

## 8.1 Basic PVA information

As in the NE PVA tool, except that if “risk assessment” is the purpose only the “Simulation” option is available

## 8.2 Baseline demographic parameters

As in the NE PVA tool, except that initial population sizes have already been specified (at Part 5)

## 8.3 Impacts

Largely pre-populated by annual effects specified at (Part 6)

Users include annual effects, where option was for these to be user-specified

There will be an option to specify one additional “non-project” impact – this can be used to account for impacts from other stressors

## 8.4 Run

# Running of tools

If “spatial planning” is selected at Part 1, the ORJIP Sensitivity Mapping Tool will be run directly

The sCRM will be run after Part 4

The Displacement Matrix will be run after Part 5

The apportioning tools (SNH, MSS, BDMPS) will be run after Part 6

SeabORD will be run after Part 7

The NE PVA tool will be run after Part 8

# Outputs

## **Spatial planning:**

**Based on ORJIP Sensitivity Mapping Tool**

## **Annual effects:**

**Based on outputs from sCRM and SeabORD, and compiled table of annual effects (after apportioning)**

## **PVA:**

**Based on outputs from NE PVA tool**

# Outputs

## Diagnostic checks:

e.g.

1. do specified foraging ranges differ from those in Woodward et al?
2. Is the wind farm close to a boundary between BDMPS regions?
3. Do mean densities implied by GPS data and colony sizes compare against those from at sea survey data? (when running SeabORD)

## Uncertainty table:

Table showing which tools uncertainty has been quantified for, and how

**Work in progress**



# Work in progress

## **1. Population selection via map-based interface:**

Still assessing the viability of doing this, based on population-level information within the Data Library (SPA polygons, SMP and Seabird 2000 data)

## **2. Seasonal definitions:**

Still working on defaults for these, and looking at feasibility of allowing these to be population-specific

## **3. Foraging ranges:**

Looking at feasibility of allowing these to be population-specific

# Work in progress

## **4. Displacement rates:**

Looking at feasibility of allowing these to vary between projects, and, for a particular project, to vary between the footprint and buffer

## **5. Automating and updating BDMPS:**

Still working on how to do this, and looking at feasibility of allowing users to modify colony sizes or seasonal definitions

For this afternoon

# For this afternoon

**1. Is there a need to apply a quality filter to values in the Data Library when running tools (e.g. in relation to density data?)**

**2. Population selection via map-based interface:**

Still assessing the viability of doing this, based on population-level information within the Data Library (SPA polygons, SMP and Seabird 2000 data)

**3. Points in the framework where users need to manually view outputs to date, and manually intervene to continue to the next step**

**Key points for discussion**

# **Key points for discussion**

- 1. Inclusion of species not originally listed in CEF tender**
- 2. What to do in situations where user wants to run a buffer, but data are not available for this buffer?**
- 3. Dealing with overlap of buffers when considering in-combination assessments**

# **Key points for discussion**

- 5. Accounting for non-SPA colonies in apportioning**
- 6. Dealing with immature birds in assessments**
- 7. Displacement outside the chick rearing period, but within the breeding season, when running SeabORD**