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Séminaire du plan national d'actions en faveur du Puffin des Baléares

24 au 26 juin 2024

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An integrated assessment of the bycatch mortality risk of the Balearic shearwater in the Bay of Biscay

Amaia Astarloa[1], Isabel García-Barón[1], Arkaitz Pedrajas[1], Jan Jaap Poos[2], Anna Rindorf[3], Maite Louzao[1]

1. AZTI Marine Research, Basque Research and Technology Alliance (BRTA), Spain
2. Wageningen University & Research, The Netherlands
3. Denmark Technical University, Denmark

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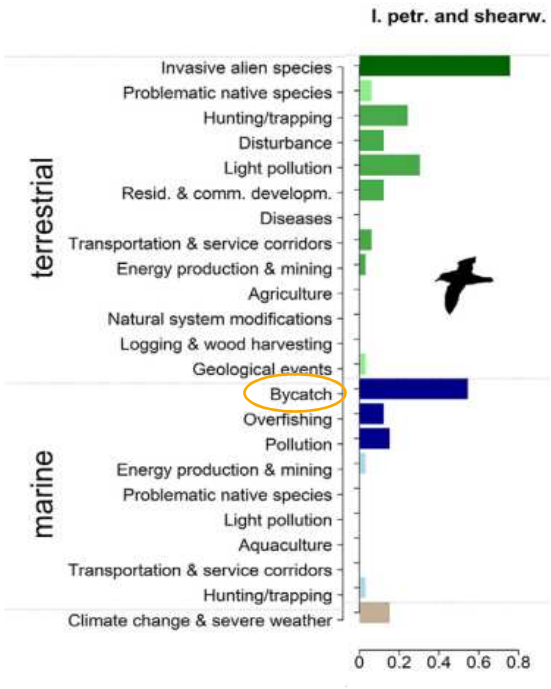
Background

- Bycatch of protected, endangered and threatened (PET) species is a major concern in the implementation of ecosystem-based fisheries management (EBFM)

- A key challenge in developing the scientific tools to support EBFM has been the scarcity of data

- One response to this has been the adoption of risk-based assessment methods that aim to evaluate the risk of fishing to marine populations



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Balearic shearwater and northern gannet bycatch risk assessment in Portuguese Continental Waters

Hélder Araújo[a,*], Pedro Correia-Rodrigues[a,b,c], Philippe Debru[d], Marisa Ferreira[a], José Vingada[a], Catarina Eira[a,e,f]

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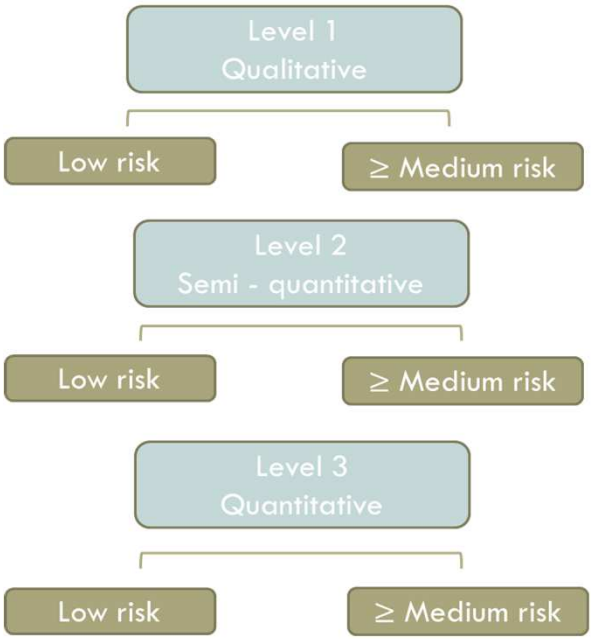
Ecological Risk Assessment for the Effects of Fishing



Hierarchical framework

Hobday et al. 2011

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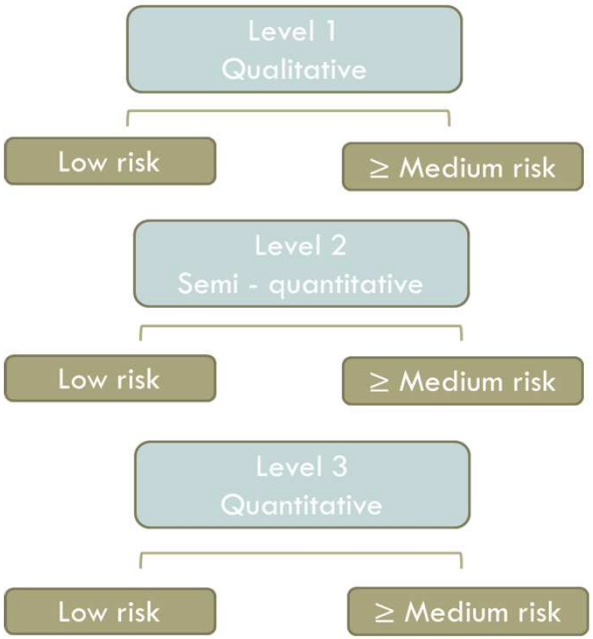

Expert judgment
Impact level is scored from negligible (score 1) to extreme (score 6)

Productivity-Susceptability Analysis (PSA)
Productivity and susceptibility attributes are scored from 1 (low risk) to 3 (high risk)

Quantitative methods
Stock assessment models
Population Viability Analysis
Ecopath/Ecosim ecosystem models
Reference points

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Productivity-Susceptability Analysis (PSA)

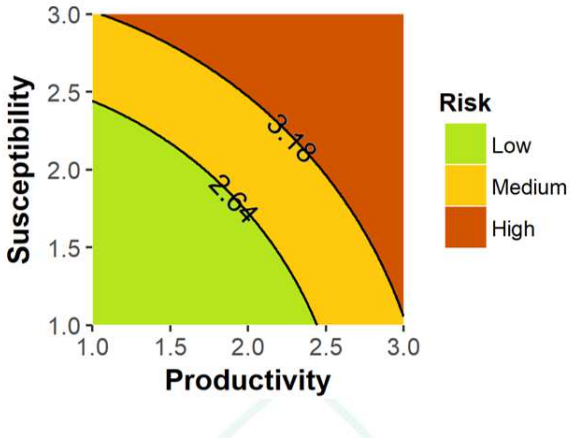
- Productivity (P)
  - Reproductive output and longevity
  - Scored from 1 (high productivity) to 3 (low productivity

$$\text{Productivity (P)} = \frac{\sum_{i=1}^{n} Xi}{n} = \frac{X1 + X2 + X3 + \ldots + Xn}{n}$$

- Susceptability (S)
  - Interaction between fishery and species
  - Scored from 1 (low interaction) to 3 (high interaction)

$$S = (a^2 \times e \times s^2 \times ple)^{1/8}$$

$$R = \sqrt{(P^2 + S^2)}$$



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Productivity-Susceptability Analysis (PSA)

- Productivity (P)

Productivity Attribute	Low prod. (score 3)	Medium prod. (score 2)	High prod. (score 1)
Life history strategy	Biennial breeding, multiple-egg clutches	Annual breeding, single-egg clutches	Annual breeding, multiple-egg clutches
Median age at first breeding	≥ 7.5 years	5-7.5 years	≤ 5 years

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Attribute	Attribute value	Source	Score	P
Life history strategy	Annual breeding, single-egg clutches	Oro et al. (2004)	**2**	**1.5**
Median age at first breeding	3-6 years	Genovart et al. (2016)	**1**	

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Productivity-Susceptability Analysis (PSA)

- Susceptability (S):
  - Availability (a)
  - Encounterability (e)
  - Selectivity (s)
  - Potential for lethal encounter (ple)
  - Exposure (ex)

Table 1
Productivity and susceptibility attributes, and scoring thresholds and criteria used to generate productivity and susceptibility scores, for cetacean species (from [32]).

	Attribute	High risk (score 3)	Moderate risk (score 2)	Low risk (score 1)
Susceptibility	Availability	> 30% Overlap between fishing activity & species distribution	10–30% Overlap between fishing activity and species distribution	< 10% overlap between fishing activity and species distribution
	Encounterability	Overlaps with fishery year round	Overlaps with fishery beyond the assessment period but not year round	Overlap limited to the assessment period
	Selectivity	High potential for capture	Moderate potential for capture	Low potential for capture
	Potential for lethal encounter	Interaction with gear likely to result in death	Interaction with gear likely to result in injury	Interaction with gear unlikely to result in injury or death
	Exposure	> 1 (exposure in cell 10 times mean exposure or more—based on species population and fishing activity)	0 (exposure in cell equalling mean exposure)	< −1 (exposure in cell less than one tenth of mean

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Species distribution and fishing effort needed

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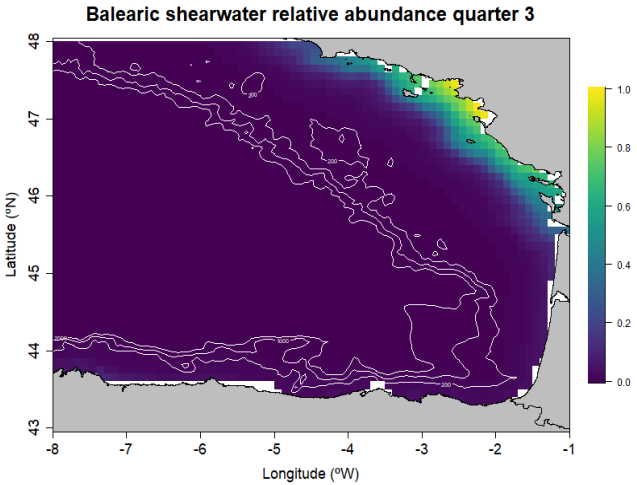
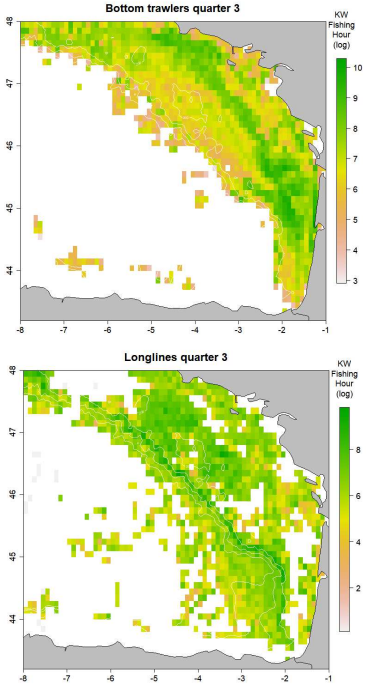
Balearic shearwater distribution and relative abundance 2013-2019

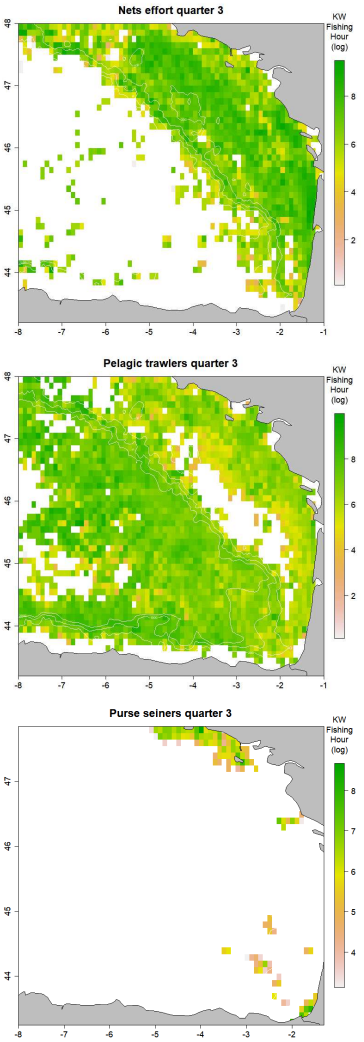


~ depth, distance to the coast, distance to the shelf break and chlorophyll-a concentration

Fishing effort 2009-2021



Fishing effort (log KW fishing Hours): nets (GNS, GTR), bottom trawlers (PTB, PTB, OTT, TBB) and pelagic trawlers (PTM, OTM) for quarter 3 (summer)



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Productivity-Susceptability Analysis (PSA)

- Susceptability (S):

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Species	Attribute	Gillnets	Bottom trawlers	Pelagic trawlers	Longline	Purse seine
		Q3	Q3	Q3	Q3	Q3
Balearic shearwaters	Availability	3	3	3	3	2
	Encounterability	3	3	3	3	3
	Selectivity	2	1	1	3	1
	PLE	3	3	3	3	2

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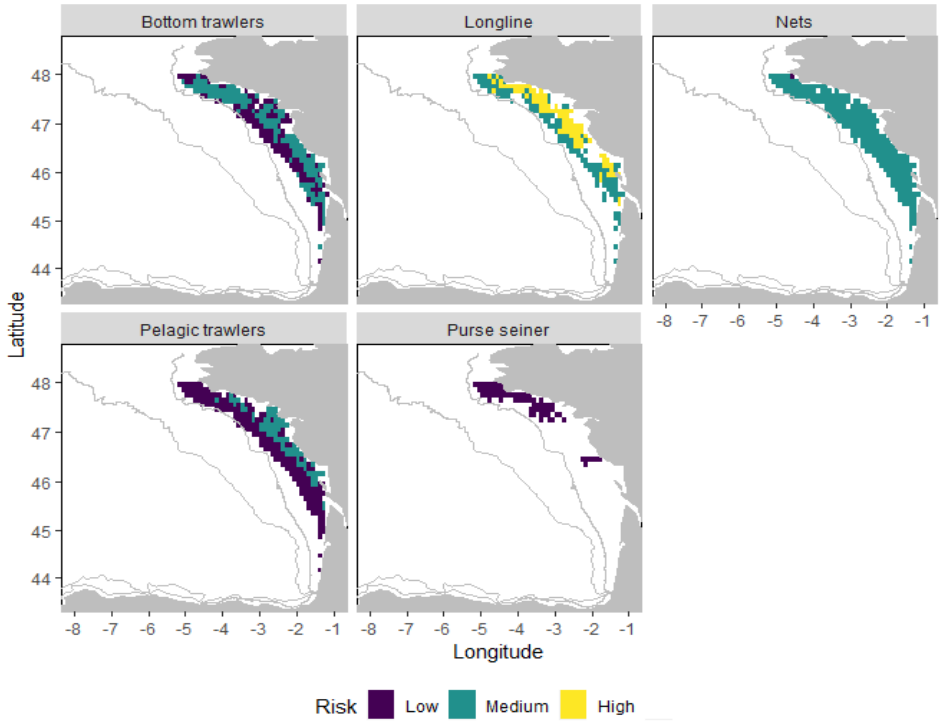

Bycatch risk:
Longline > Nets > Bottom trawlers > Pelagic trawlers > Purse seiner

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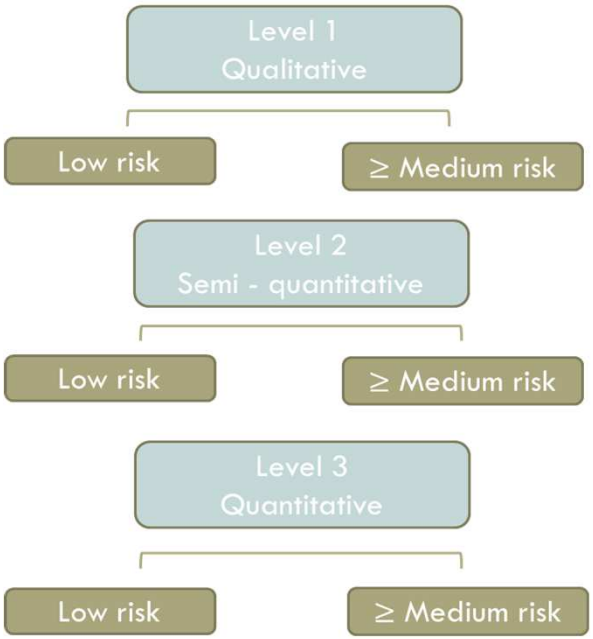

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Quantitative method: reference points

For the PBR calculation, we used: $$PBR = \frac{R_{max} N_{min} f}{2}$$

- The 20th percentile of the distribution of population size (Genovart et al. 2016). The population size was estimated based on coastal migrations counts (Arroyo et al. 2016) and ranged between 23780 and 26535 individuals (minimum value was taken here).
- Rmax = 0.101 (λmax -1)
- Fr=0.1, conservative value typical for endangered species (Genovart et al. 2016).

Species	*Method*	*N*	*Nmin*	*Rmax*	*Fr*	*Threshold*	*Organization*	*Reference*
Balearic shearwater	PBR	23780	19965	0.101	0.1	101	--	Genovart et al. (2016)

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Quantitative method: reference points

- Refence points (thresholds)
- Total bycatch mortalities

If mortality < threshold — Acceptable

If mortality > threshold — Unsustainable

Region	*Metier*	*DaS*	*Coverage*	*No. of animals*	*Rate*	*CI5-CI95*
Bay of Biscay and Iberian Coast	GTR	1730	--	5	0.002	0.001-0.005
	GNS	2875	--	4	0.001	0.0003-0.002
	OTB	1637	--	2	0.001	0-0.003
	LLS	364	--	1	0.002	0-0.008
Western Mediterranean Sea	LLD	2110	--	33	0.033	0.021-0.046

- Current bycatch data do not allow inferring total bycatch numbers from extrapolations of these data (ICES WGBYC 2022), although Genovart (2016) estimated that bycatch in Mediterranean longline was about the half of the total mortality of the species

- Bycatch in artisanal fisheries is rarely monitored -- underestimated