



# Strategic impact assessment of offshore wind power in Norway

## *impacts on seabirds*

Svein-Håkon Lorentsen  
Signe Christensen-Dalsgaard  
Roel May



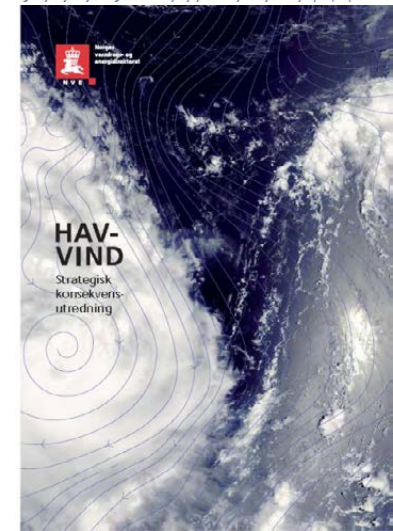
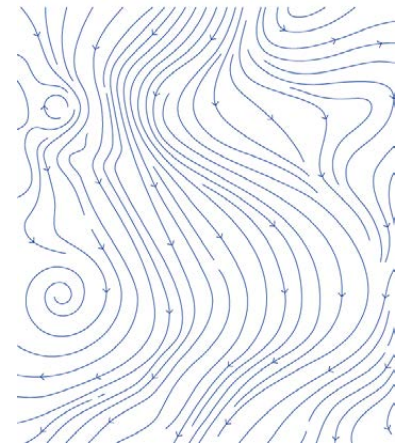


# Offshore Wind Power in Norway

- 2007** **White Paper on climate change**
- develop a national strategy for offshore renewable energy
  - include legal aspects
- 2010** **Offshore Energy Act**
- screening for areas to be included in a strategic environmental impact assessment
  - strategic environmental assessment
  - opening of the areas for license applications
  - application with project-specific environmental impact assessment
- 2010** **Report: «Offshore Wind Power in Norway. Proposed areas for strategic environmental assessment»**
- 2013** **Report: «Offshore Wind Power in Norway. Strategic Environmental Assessment»**

OFFSHORE WIND POWER IN NORWAY

Proposed areas for strategic environmental assessment





# Compilation of Seabird Knowledge derived from Monitoring Data

616 Offshore vindenergianlegg og sjøfugl

## Oppløst screening av potensielle konfliktråder på nasjonal skala Seabird screening for areas suitable for the establishment of offshore wind-power plants

Silje Christensen-Dalsgaard  
Eirik H. Sævi  
Frank Hønsen  
Geir Helge Systad

NINA RAPPORT

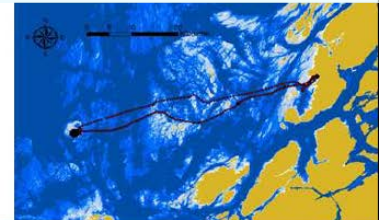
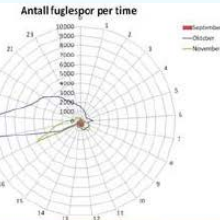


825 Fagrapport til strategisk konsekvensutredning av fornybar energiproduksjon til havs - sjøfugl

## Assessment of site-specific consequences for seabirds and bird migration

Stine M. Gjesdal, Silje Christensen-Dalsgaard, Eirik H. Sævi, Frank Hønsen, Geir Helge Systad, Follstad, Magdalene Langset, Roel May, Espen Lie Dahl og Øyvind Hamre

NINA RAPPORT

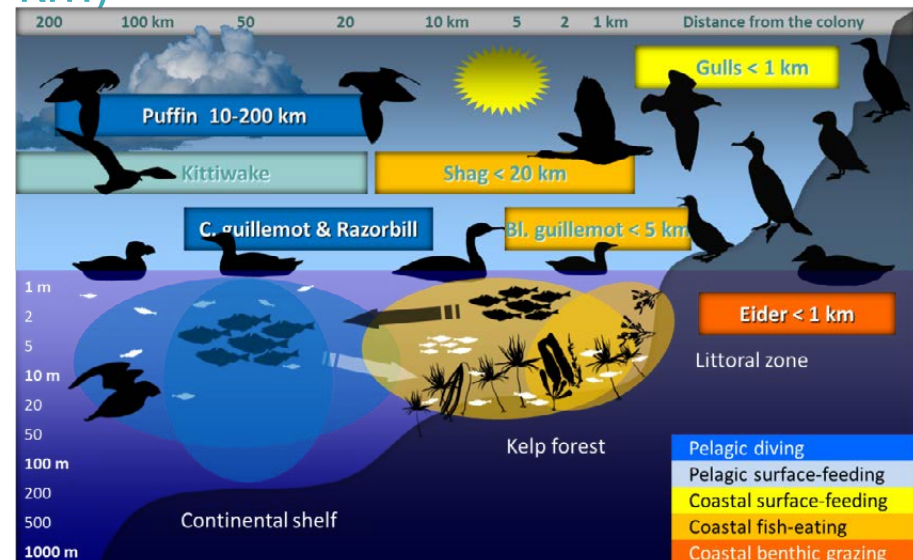


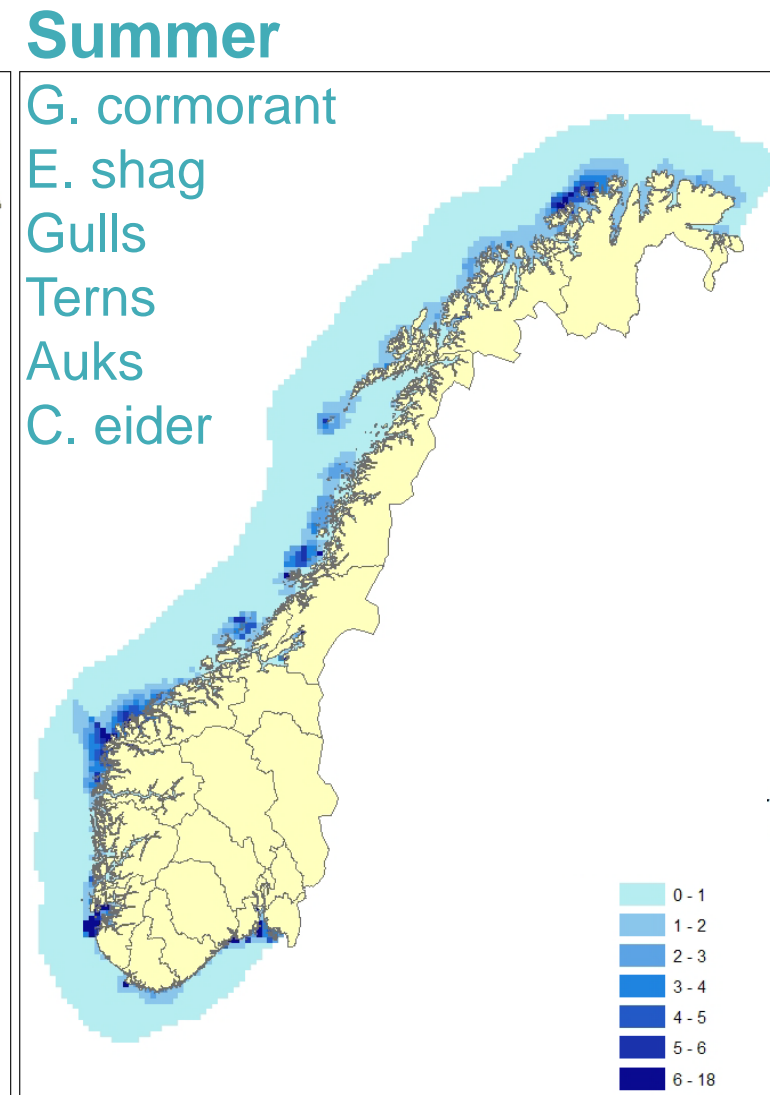
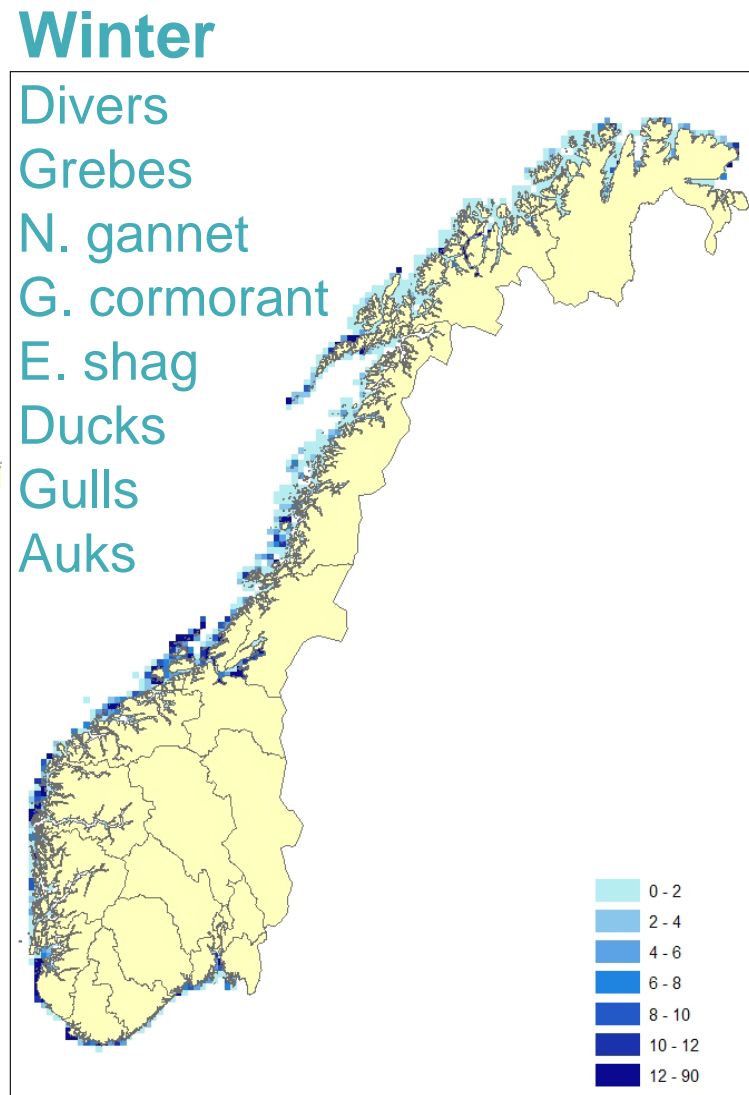
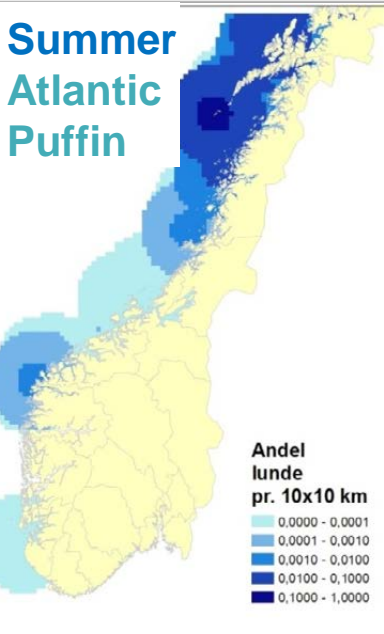
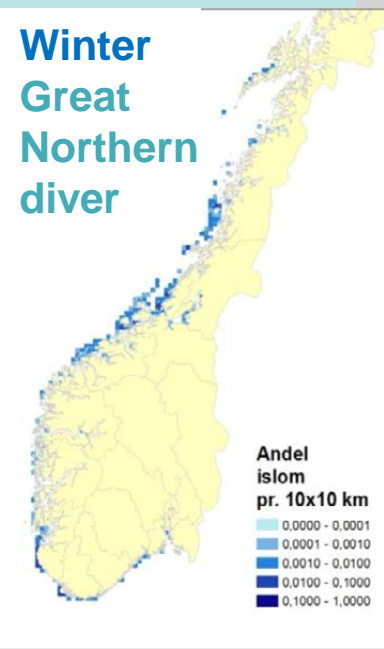


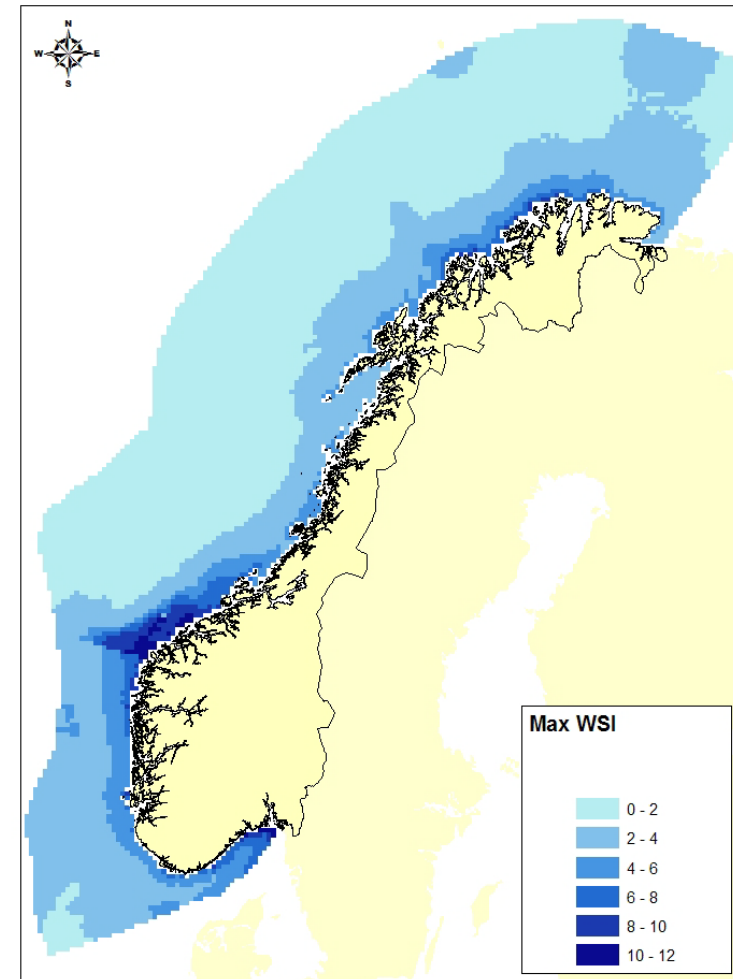
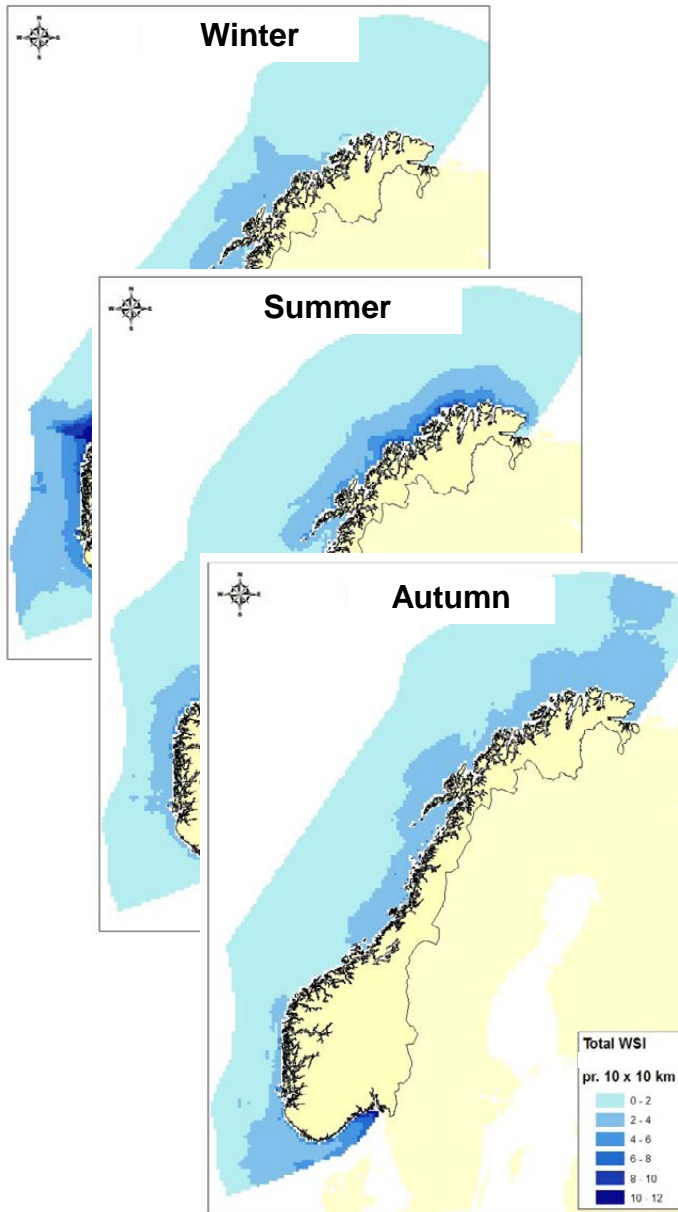
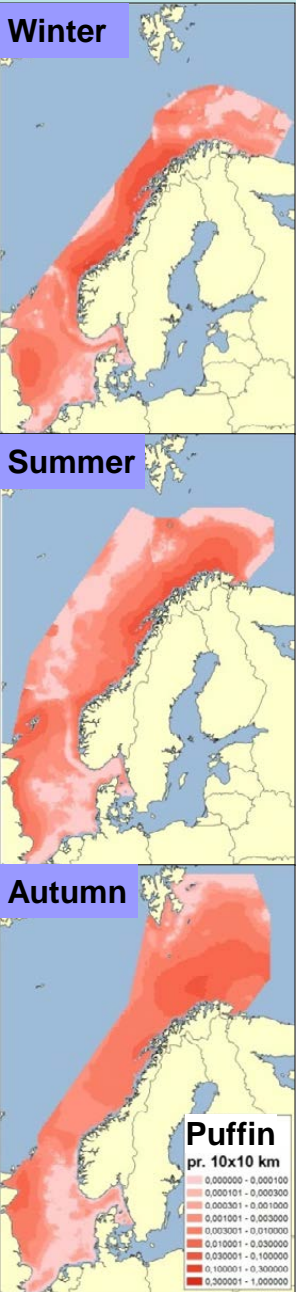
# Screening of Conflict Areas

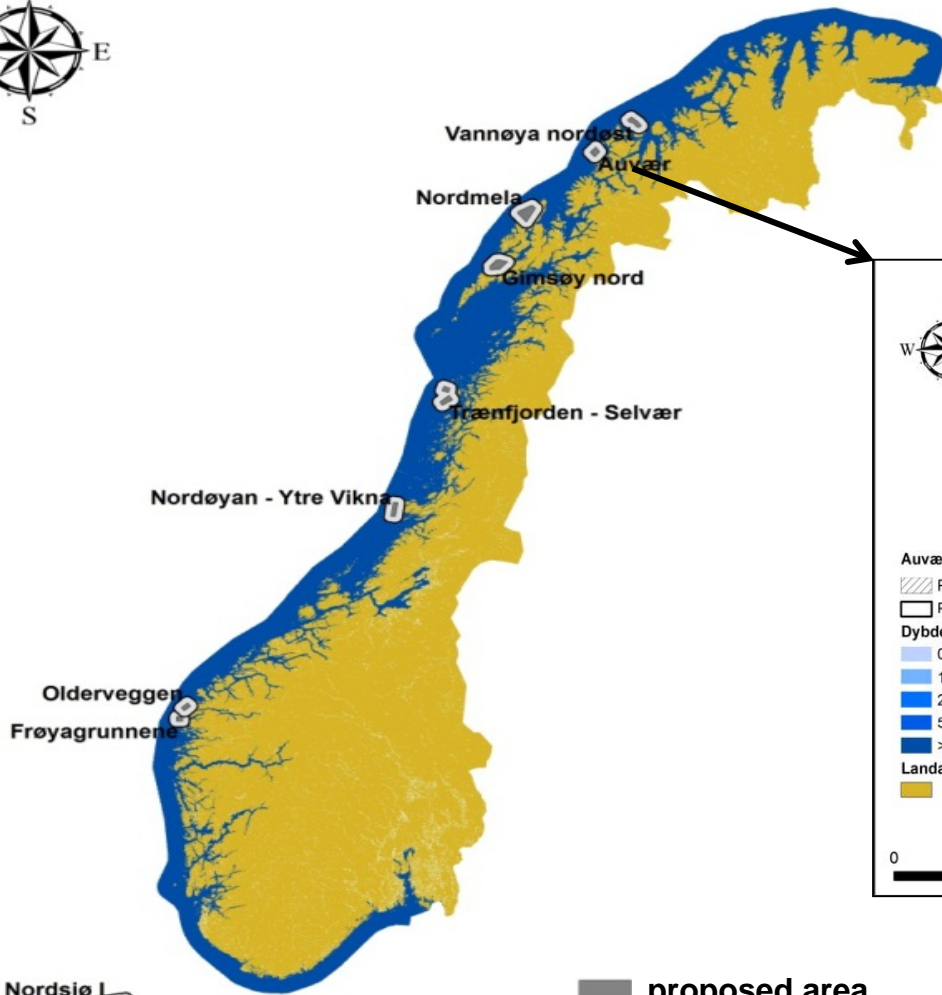


- Application to North Sea, Norwegian Sea and Barents Sea
  - Based on the long-term monitoring programme SEAPOP
  
- Species- and site-specific:
  - Adaptation of the Seabirds Sensitivity Index (SSI)
  - Employing ranging buffers (5-100 km)
  - Spatio-temporal differentiation:
    - Coastal seabird counts
    - Open sea counts
  
    - Breeding season
    - Autumn season
    - Winter season

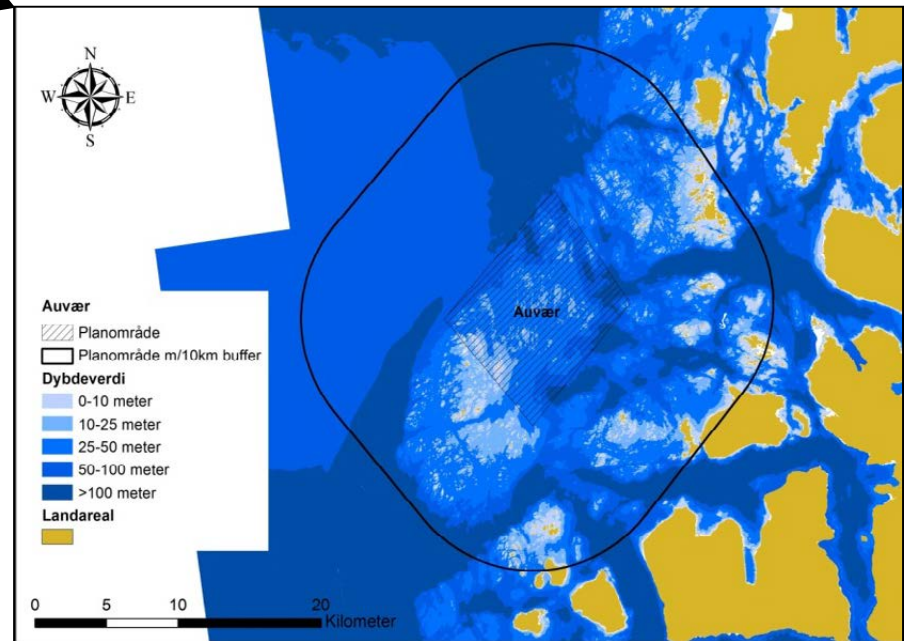








10 Proposed areas to assess



Sørlige Nordsjø I  
Sørlige Nordsjø II

proposed area  
10km buffer

400 Km



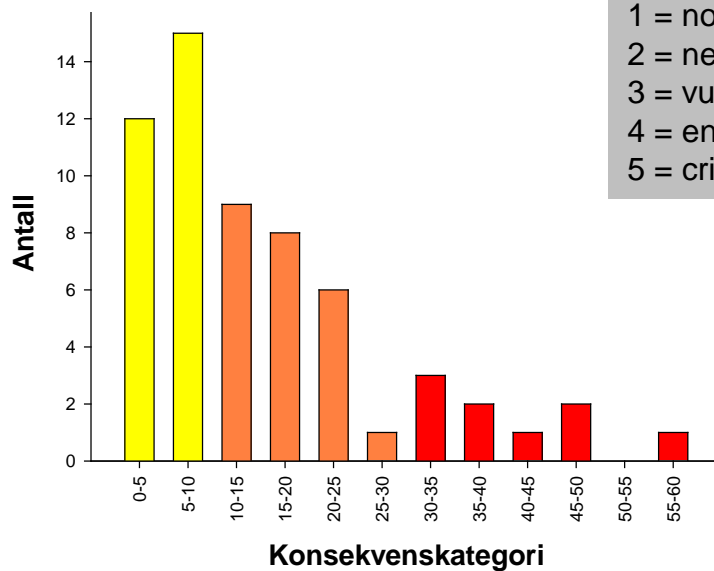
# Strategic Assessment for Seabirds

- From sensitivity to impact assessment – Methodology
- Included themes:
  - Distribution of seabirds
    - Breeding
    - Wintering
  - Area use for chosen species and sites
  - Bird migration at chosen sites
  - Theoretical barrier impacts
  - Impacts from oil spills / boat traffic





**Impact = Sensitivity index \* Red List status \* Proportion within proposed area**



1 = not threatened  
 2 = near threatened (NT)  
 3 = vulnerable (VU)  
 4 = endangered (EN)  
 5 = critically endangered (CR)

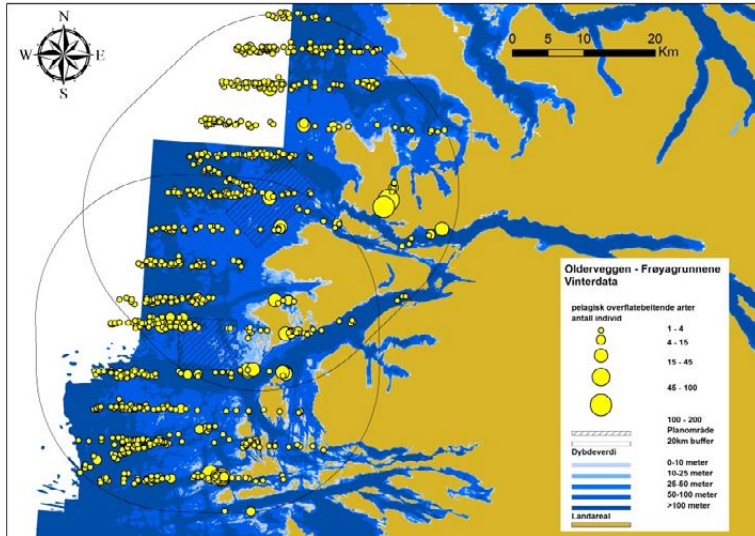
1 = < 1 % of the regional population  
 2 = 1-5 % of the regional population  
 3 = 5-10 % of the regional population  
 4 = > 10 % of the regional population

Criteria	Impact			
	None	Low	Medium	High
1	Detectable impact			
2	Visible damage to habitats			
3	Proportion of population affected			
4	Reduction in breeding success			
5	Adult mortality			

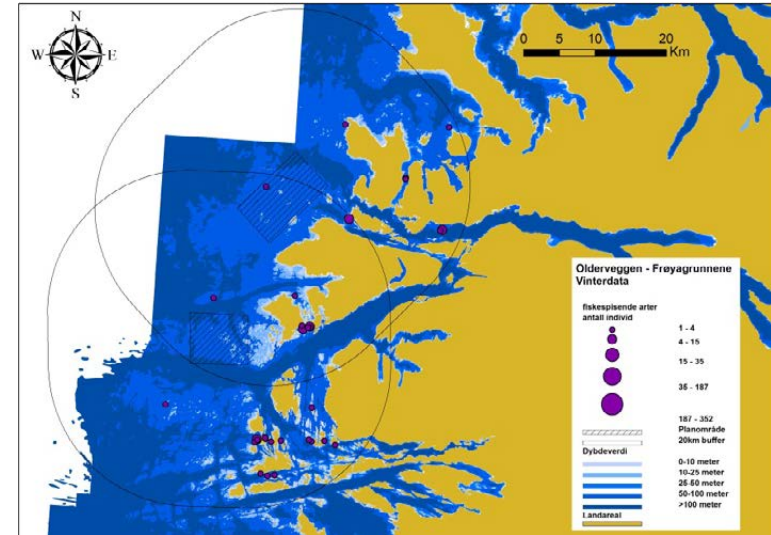
Factor	Code	Description
Uncertainty	1	Low
	2	Medium
	3	High
Knowledge base	*	Insufficient
	**	Average
	***	Good



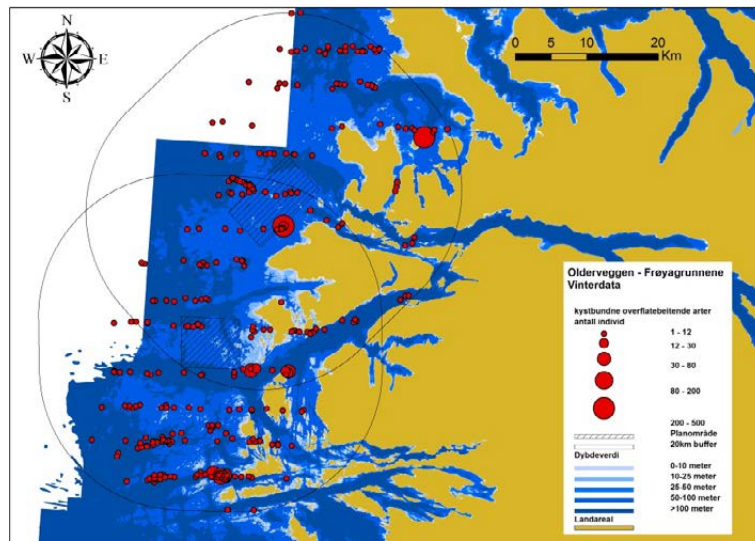
## Pelagic surface-feeding species



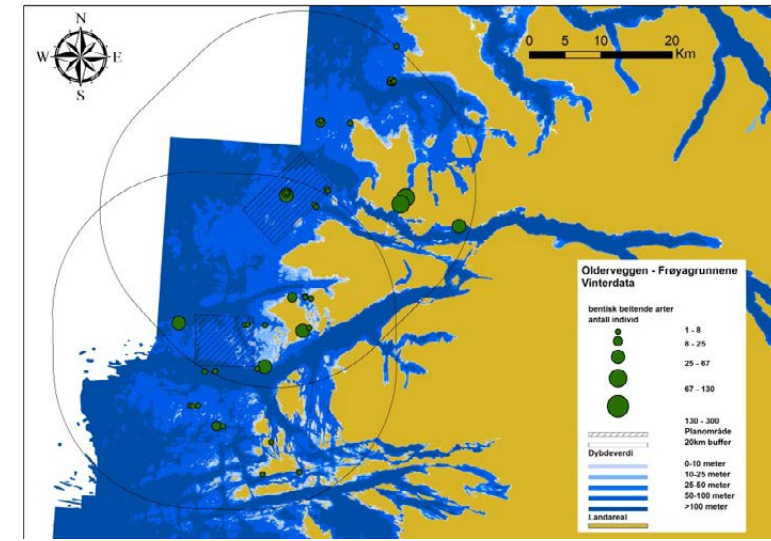
## Coastal fish-eating species



## Coastal surface-feeding species



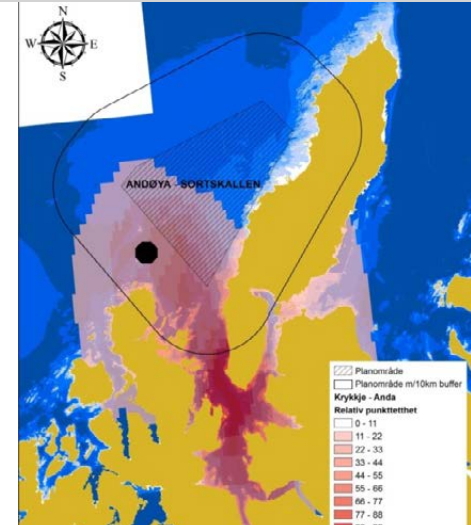
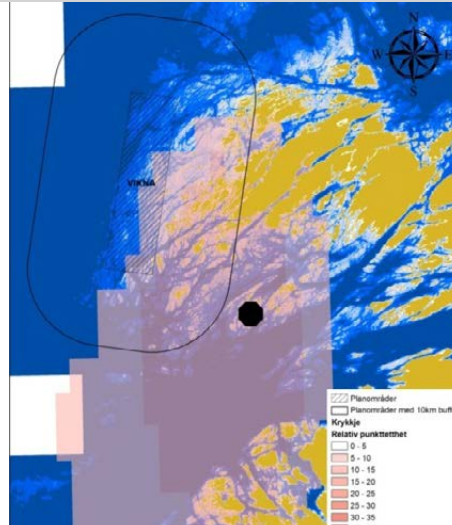
## Benthic grazing species



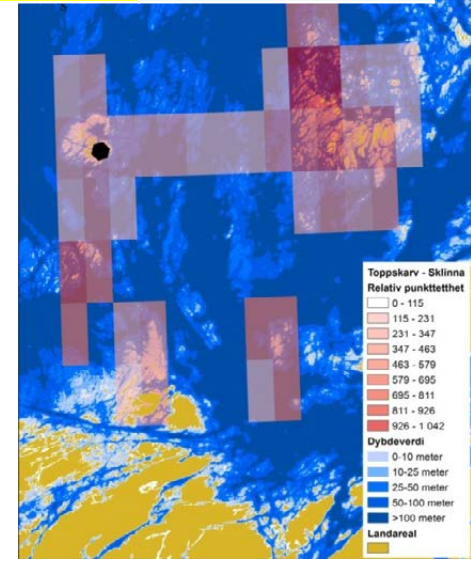
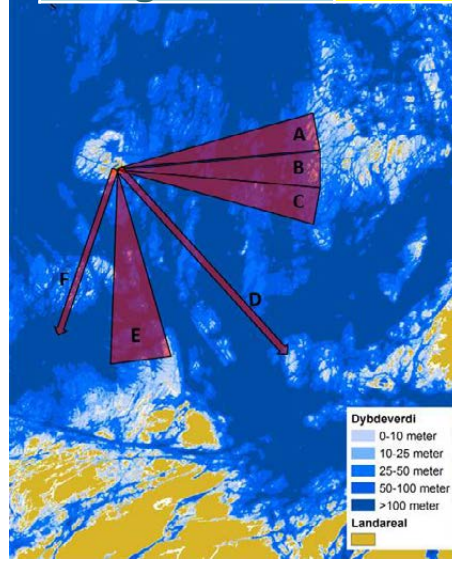


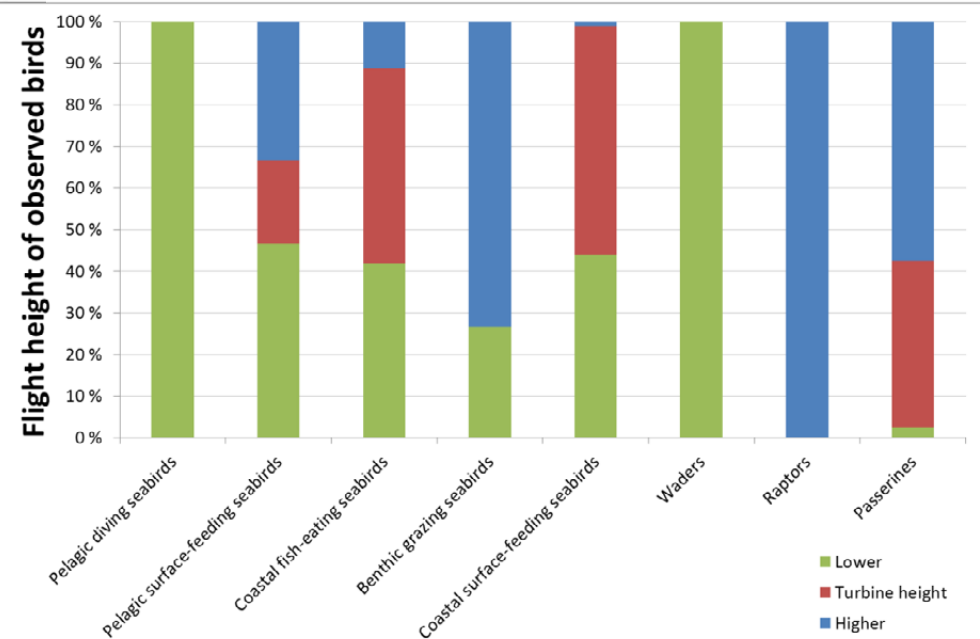
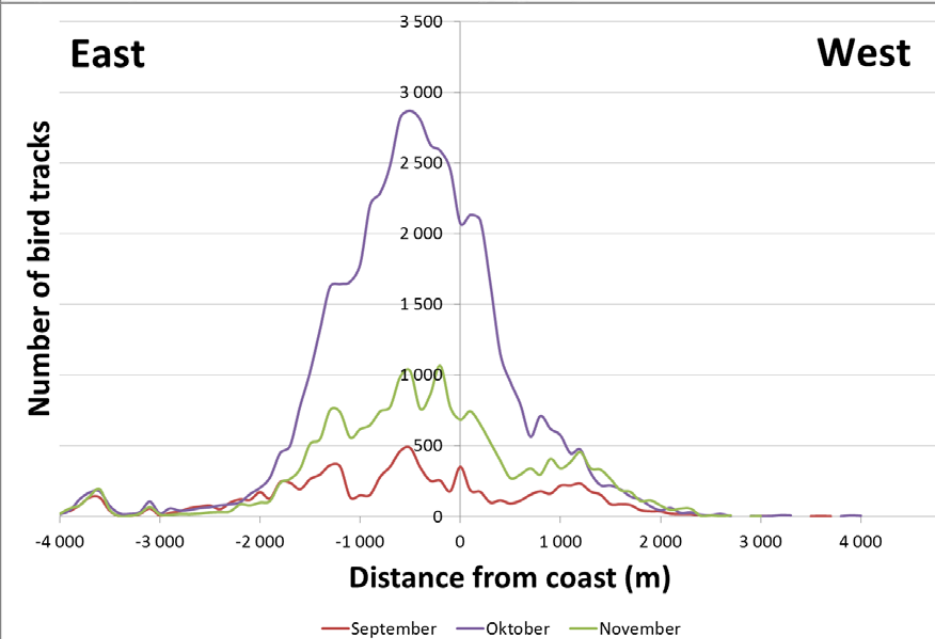
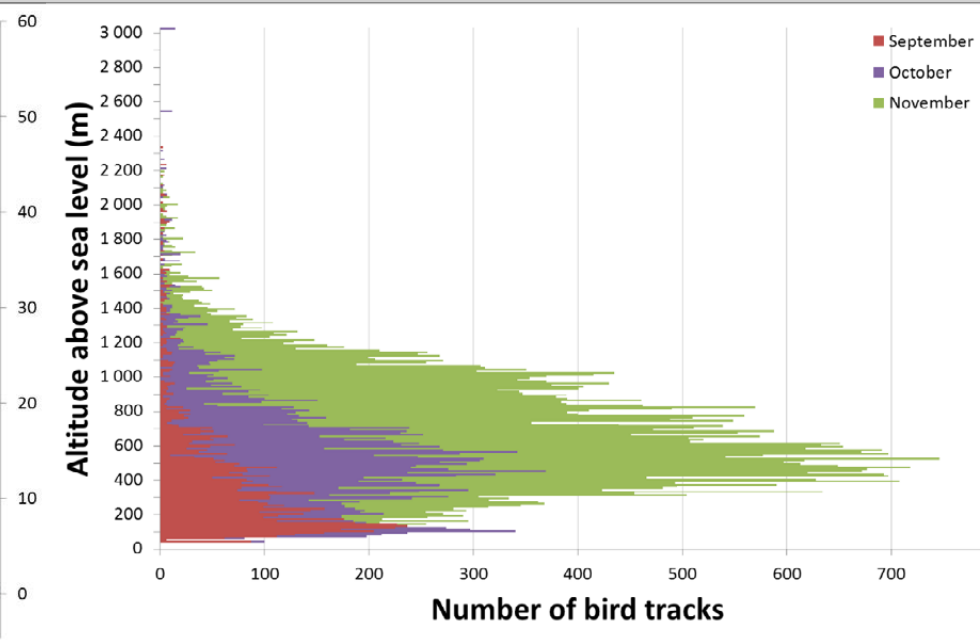
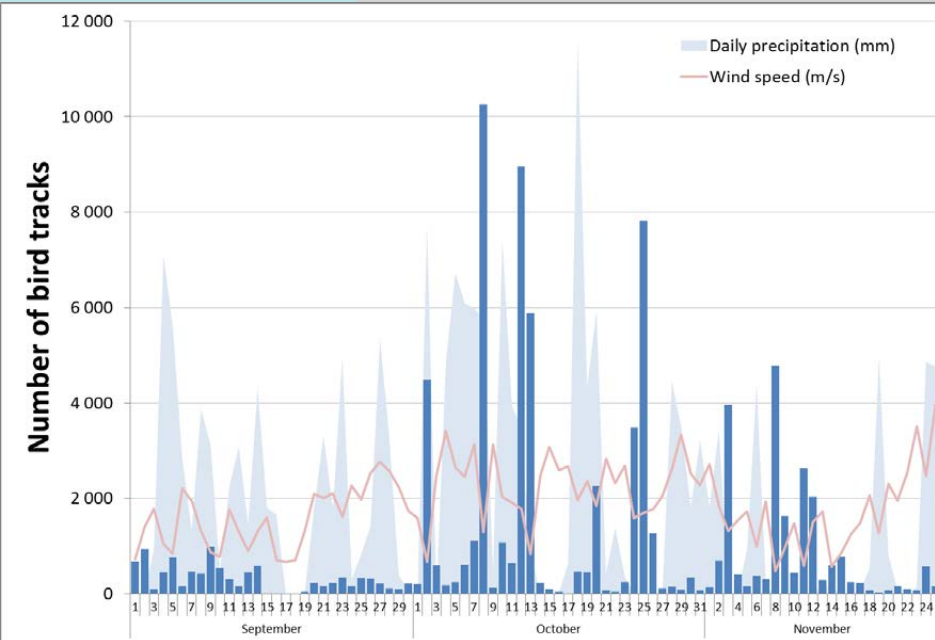
## Area

Art	Sørlig Nordsjø I og II	Frøyagrunnene	Older 19s	Nordøyen - Ytter Vigene	Trænfjorden - Se	Gimsøy nord	N	Auvær	Vannøy nordøst
Smålom		M <sup>1***</sup>	L <sup>1***</sup>	M <sup>1***</sup>	L <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>		
Storlom			L <sup>1***</sup>			L <sup>1***</sup>	L <sup>1***</sup>		
Islom		M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>
Gulelrei		M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>
Grønstrøperækker		L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>				
Hornsvyk		L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>		L <sup>3***</sup>			
Havhest	L <sup>1***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>
Havul	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	S <sup>2***</sup>	M <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>
Storskjælv		L <sup>2***</sup>	L <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	M <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>
Toppskjælv		L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>
Grånås		L <sup>3***</sup>		L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	M <sup>3***</sup>	
Havørn		L <sup>1***</sup>	L <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	L <sup>1***</sup>		
Ærfugl		M <sup>1***</sup>	M <sup>1***</sup>	S <sup>1***</sup>	L <sup>1***</sup>	M <sup>1***</sup>	L <sup>1***</sup>	M <sup>1***</sup>	L <sup>1***</sup>
Prøvefugl						M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>
Svartand		S <sup>1***</sup>	S <sup>1***</sup>	M <sup>1***</sup>	L <sup>1***</sup>	L <sup>1***</sup>			
Sjæl				S <sup>2***</sup>					
Laksand						L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>
Silur		L <sup>2***</sup>	L <sup>2***</sup>	M <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>			
Tylo		M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>
Stor		L <sup>3***</sup>	L <sup>3***</sup>						
Fiskemåke	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>
Silur	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>
Grønåke	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>
Svartel	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>
Krykkje	L <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>	M <sup>3***</sup>
Makrell	L <sup>1***</sup>	S <sup>1***</sup>		S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	M <sup>1***</sup>		
Rødnebbterne	L <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>	S <sup>1***</sup>
Teis		L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>	L <sup>3***</sup>
	L <sup>2***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>
Lomvi	L <sup>2***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	M <sup>1***</sup>	M <sup>1***</sup>
Alkekonge	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>	L <sup>2***</sup>
Lunde	L <sup>2***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>	L <sup>2***</sup>	M <sup>1***</sup>
% L	100	68	62	48	58	62	50	50	55
% M	0	21	31	38	35	28	46	45	40
% S	0	11	8	14	8	10	4	5	5



	Nordøyan – Ytre Vikna	Nordmela
Kittiwake	Low/Medium <sup>2**</sup>	Low/Medium <sup>2**</sup>
Shag	Low <sup>1**</sup>	---







Proposed Area	Impact
Sørlig Nordsjø I	Low <sup>3*</sup>
Sørlig Nordsjø II	Low <sup>3*</sup>
Frøyagrunnene	Medium <sup>2**</sup>
Olderveggen	Medium <sup>2**</sup>
Nordøyan – Ytre Vikna	Low <sup>3*</sup>
Trænfjorden – Selvær	High <sup>3*</sup>
Gimsøy Nord	Low <sup>3*</sup>
Nordmela	Medium <sup>3*</sup>
Auvær	Low <sup>3*</sup>
Vannøya Nordøst	Medium <sup>3*</sup>



Proposed Area	Shape (S)		Orientation (O)		Dist. to coast (C)		Impact (T)	
Sørlig Nordsjø I	0.12	1	0.71	3	*	1	2.08	Low
Sørlig Nordsjø II	0.18	1	0.97	3	*	1	1.44	Low
Frøyagrunnene	0.12	1	1.00	3	0.67	3	2.08	Medium
Olderveggen	0.15	1	0.71	3	0.67	3	2.08	Medium
Nordøyan – Ytre Vikna	0.28	1	0.26	1	0.99	3	1.44	Low
Trænfjorden – Selvær	0.40	2	0.71	3	0.96	3	2.62	High
Gimsøy Nord	0.14	1	0.87	3	0.82	3	2.08	Medium
Nordmela	0.16	1	0.50	2	0.80	3	1.82	Medium
Auvær	0.13	1	0.00	1	0.60	2	1.26	Low
Vannøya Nordøst	0.23	1	0.71	3	0.95	3	1.44	Medium

**Shape:** *relationship between surface area (A) and circumference (O)*

→ small circumference = small barrier effect

$$S = 1 - \left( (2 \cdot \pi \cdot \sqrt{A/\pi}) / O \right)$$

**Orientation:** → perpendicular to migration = larger impact

$$O = |\sin NS|$$

**Dist. to coast:** → coastal = larger impact

$$C = 1 - (D^- / (D^+ - D^-))$$

**Total impact:**  $T = (S \cdot O \cdot C)^{1/3}$



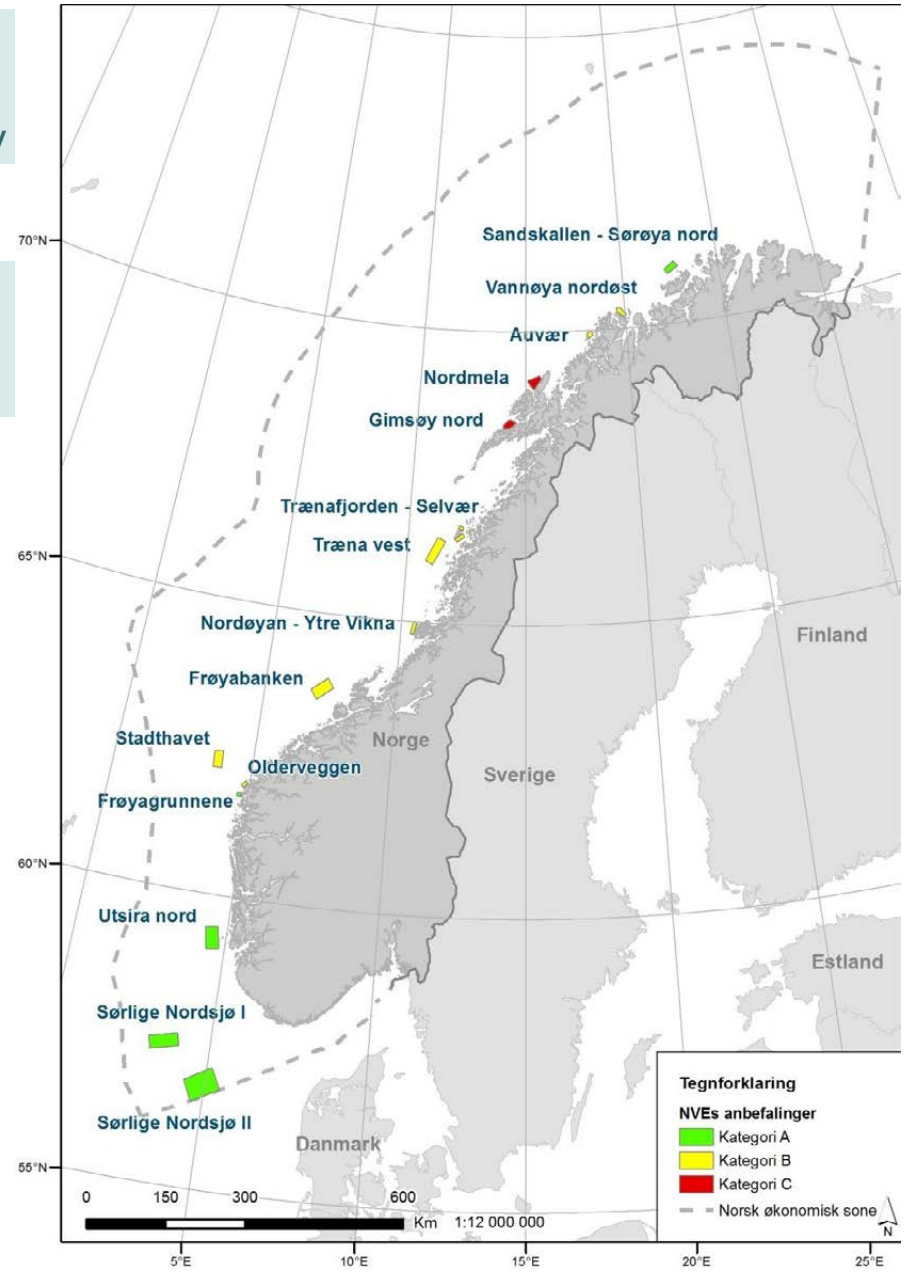
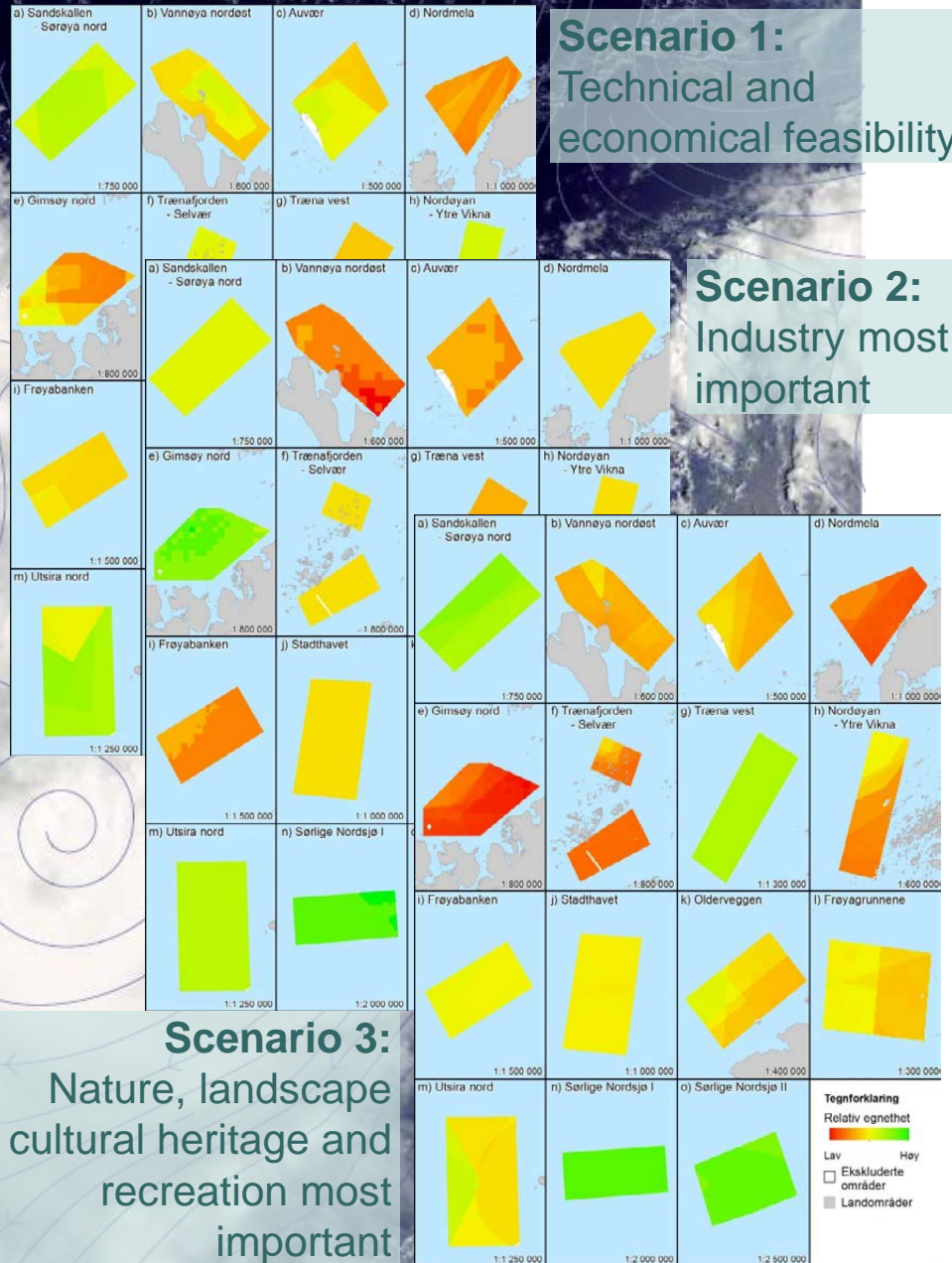
Proposed area	Auks	Diving sea ducks	Overall
Sørlig Nordsjø I og II	Low		Low
Frøyagrunnene	Low	Medium	Medium
Olderveggen	Medium	High	High
Nordøyan – Ytre Vikna	Medium	High	High
Trænfjorden-Selvær	Medium	Low	Medium
Gimsøy nord	Low	Medium	Medium
Nordmela	Medium	Medium	Medium
Auvær	Medium	Medium	Medium
Vannøya nordøst	Medium	Medium	Medium





# Overall impact assessment for seabirds

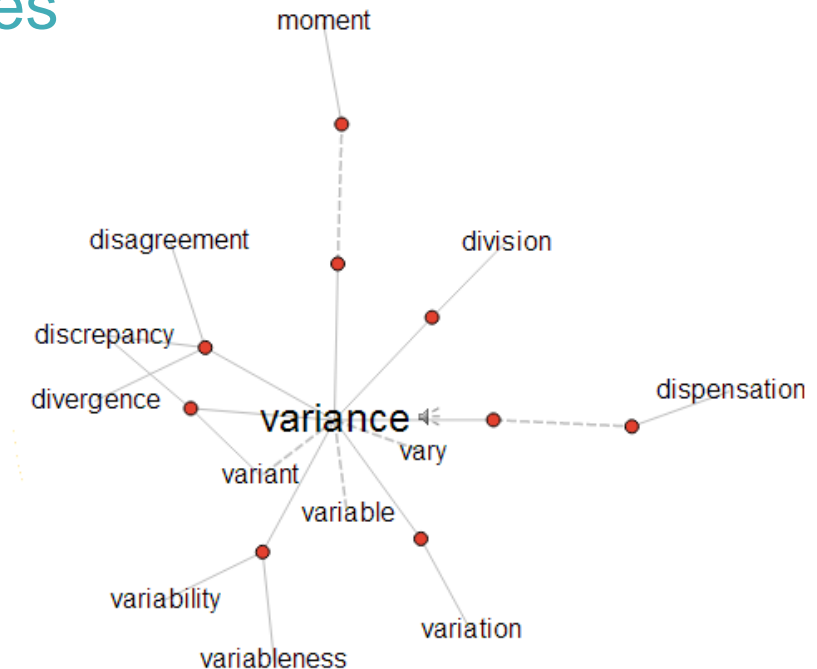
Proposed area	Presence of seabirds			Habitat use	Migration	Barrier effects	Oil spills / boat	Overall impact
	Construction	Operation	Decommissioning					
Sørlig Nordsjø I & II	Low	Low	Low		Low	Low	Low	Low
Frøyagrunnene	Low	Low	Low		Medium	Medium	Medium	Low
Olderveggen	Medium	Medium	Medium		Medium	Medium	High	Medium
Nordøyan – Ytre Vikna	High	Medium	High	L/M	Low	Low	High	Medium
Trænfjorden – Selvær	Medium	Medium	Medium		High	High	Medium	Medium
Gimsøy nord	High	High	High		Low	Medium	Medium	Medium
Nordmela	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Auvær	Medium	Medium	Medium		Low	Low	Medium	Medium
Vannøya nordøst	Medium	Medium	Medium		Medium	Medium	Medium	Medium





# Future monitoring...

- Value of long-term monitoring programmes (SEAPOPOP)
- General lack of knowledge on bird migration
- Pre- and post-construction studies
- SSS-specificity and variation!





This study was financed by



Norwegian Water Resources and Energy  
Directorate

Background data was obtained through



The seabird registry and The Norwegian  
monitoring programme for seabirds

Background data collection financed by



Norwegian Environment Agency



Thank you for your attention!