Seismic operations have variable effects on dive-cycle behavior of bowhead whales in the Beaufort Sea

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Supplement. Supplementary tables summarizing the results of the retrospective sensitivity analysis that was performed for each linear mixed effects (LME) model investigating the effect of seismic sounds on bowhead whale behavior. The LME models were fit to successively smaller cohorts of behavior data to investigate the variation in selection and significance of explanatory variables

Table S1a. Summary of results for the retrospective sensitivity analysis for the number of blows per surfacing of bowhead whales. •p < 0.1, *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

Model covariates & interaction terms		Full model	1980–1999	1980–1998	1980–1986	1980–1985	1980–1984	1980–1983	1980–1982	1980–1981
Season	Autumn[a]									
	Summer	***	***	***	***	***	***	***	***	***
Depth	<10 m[a]									
	10–19 m									
	20–49 m									
	50–199 m					*	*	***		
	>200 m	**	*	**	**	**	**	***		
Ice %	≤5%[a]									
	>5%	***	***	**	**	*			*	**
Seismic	**Undisturbed[a]**									
	Present	**	**	**	**			*		***
Activity	Forage[a]									
	Social			•	***	**	**	***	**	
	Travel			•		•	*	*		
Log(whales in 1 km)					**	**	**			***
Group size	1–2[a]									
	2–3					*	*	*	***	
	≥4									
Motion	None[a]									
	Fast	**	**	**	**	**	*	*		
	Moderate	•								•
	Slow									
	Changing	**	**	**	**	**	**	***	**	**
Seismic × Forage[a]										
	Seismic × Social	•	•	*	**	**	**			
	Seismic × Travel	*	**	**	*	*	*			
Seismic × Autumn[a]										
	Seismic × Summer							*		
Seismic × Log(whales in 1 km)		**	**	**					***	
R² coefficient based on likelihood ratio		0.135	0.152	0.145	0.181	0.140	0.115	0.211	0.350	0.394

[a]Baseline category for this variable

Table S1b. Summary of results for the retrospective sensitivity analysis for the median blow interval of bowhead whales. –: variable was not included in the model. •p < 0.1, *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

Model covariates & interaction terms		Full model	1980–1999	1980–1998	1980–1986	1980–1985	1980–1984	1980–1983	1980–1982	1980–1981
Season	Autumn[a]									
	Summer	*	**	**				•		
Depth	<10 m[a]									
	10–19 m	**	**	**	**	*				
	20–49 m	***	***	**	**	*				
	50–199 m	**	**	**	**				•	
	>200 m	*	*	*	*					
Ice %	≤5%[a]									
	>5%							*		**
Seismic	**Undisturbed[a]**									
	Present	***	***	***	***					***
Whale status	Non-calf[a]									
	Mother	***	***	***	**	**			•	
Activity	Forage[a]									
	Social						**	•		
	Travel	***	***	***	***	***	***	*		
Log(whales in 1 km)			•	*		*		*		
Group size	1–2[a]									
	2–3	***	***	***	***	***	***	***		
	≥4				*	*				
Aerial	None[a]									
	Present	**	*	***	***	***	***	***		
Motion	None[a]									
	Fast									•
	Moderate					•	*			
	Slow									
	Changing									
Seismic × Autumn[a]										
	Seismic × Summer	***	***	***	***	*				
Seismic × <10 m[a]										
	Seismic × 10–19 m	***	***	***	***			–		–
	Seismic × 20–49 m	***	***	***	***			–		–
	Seismic × 50–199 m							–		–
	Seismic × >200 m	*	**	*	**			–		–
Seismic × Forage[a]										
	Seismic × Social					•			*	***
	Seismic × Travel	*	**	**	**	**			*	**
Seismic × No aerial[a]										
	Seismic × Aerial	**	**	*						
Seismic × Log(whales in 1 km)									*	
Seismic × None/mill[a]										
	Seismic × Fast									
	Seismic × Moderate									•
	Seismic × Slow									
	Seismic × Changing									***
R² coefficient based on likelihood ratio		0.127	0.141	0.147	0.136	0.073	0.087	0.063	0.084	0.127

[a]Baseline category for this variable

Table S1c. Summary of results for the retrospective sensitivity analysis for the surface duration of bowhead whales. –: variable was not included in the model. •p < 0.1, *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

Model covariates & interaction terms		Full model	1980–1999	1980–1998	1980–1986	1980–1985	1980–1984	1980–1983	1980–1982	1980–1981
Season	Autumn[a]									
	Summer	*	**	**	***	**	***	***	*	***
Depth	<10 m[a]									
	10–19 m									
	20–49 m								–	–
	50–199 m	*	**	**	**	***	***	***	*	*
	>200 m	***	***	***	***	***	***	***	***	–
Ice %	≤5%[a]									
	>5%	**	**	*	*					
Seismic	**Undisturbed[a]**									
	Present	*	•	*	*					*
Whale status	Non-calf[a]									
	Mother	**		*	**					*
Activity	Forage[a]									
	Social		•	*	**	**	***	***	•	*
	Travel	**		*	**	***	***	**		
Log(whales in 1 km)			•	•	*	*	**	**	*	
Group size	1–2[a]									
	2–3								**	*
	≥4								•	
Motion	None[a]									
	Fast	***	***	***	***	***	***	***	***	***
	Moderate	***	***	***	***	***	***	***	•	•
	Slow	***	***	***	***	***	***	**	*	**
Seismic × Autumn[a]										
Seismic × Summer						*				
Seismic × Non-calf[a]										
Seismic × Mother									*	•
Seismic × <10 m[a]										
Seismic × 10–19 m										
Seismic × 20–49 m										
Seismic × 50–199 m				•						
Seismic × >200 m				**			**			
Seismic × Forage[a]										
Seismic × Social					•			**	*	
Seismic × Travel		***	***	***	***	***	**	**	**	
Seismic × Log(whales in 1 km)		*	•		•					
R^2 coefficient based on likelihood ratio		0.239	0.266	0.279	0.319	0.288	0.268	0.323	0.552	0.541

[a]Baseline category for this variable

Table S1d. Summary of results for the retrospective sensitivity analysis for the dive duration of bowhead whales. –: variable was not included in the model. •p < 0.1, *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001

Model covariates & interaction terms		Full Model	1980–1999	1980–1998	1980–1986	1980–1985	1980–1984	1980–1983	1980–1982	1980–1981
Season	Autumn[a]								•	**
	Summer					•				
Depth	<10 m[a]									
	10–19 m							*		
	20–49 m	•	*					*		
	50–199 m						*	***		
	>200 m	*	*			*	**	***		
Ice %	≤5%[a]									
	>5%	*	•	**	**	**	*			
Seismic	Undisturbed[a]									
	Present	**	**	***	**	**				
Whale status	Non-calf[a]									
	Mother	**	**	**	**				**	***
Activity	Forage[a]									
	Social	*	•							**
	Travel									**
Log(whales in 1 km)		*	**	**	**					•
Group size	1–2[a]									
	2–3	*	*	*	*				***	
	≥4					•			**	*
Seismic × Autumn[a]										
Seismic × Summer		*	*	**	*	***		*	–	–
Seismic × Forage[a]										–
Seismic × Social		*	**	*	*					–
Seismic × Travel		*	*	*	*	*			*	–
Seismic × Group size (1–2)[a]										
Seismic × 2–3							**	***		
Seismic × >4										
Seismic × Log(whales in 1 km)		*	*	*	*					
R² coefficient based on likelihood ratio		0.386	0.405	0.413	0.424	0.312	0.311	0.353	0.493	0.462

[a]Baseline category for this variable