Supplementary material

Sharing the neighbourhood: Assessing the impact of kelp harvest on foraging behaviour of the European shag

Signe Christensen-Dalsgaard*¤[1], Jenny Mattisson¤[1], Kjell Magnus Norderhaug[2], Svein-Håkon Lorentsen[1]

[1] Norwegian Institute for Nature Research (NINA), Department of Terrestrial Ecology, PO Box 5685 Torgarden, 7485 Trondheim, Norway
[2]Institute of Marine Research (IMR), Nye Flødevigen vei 20, 4817 His, Norway.

*** Corresponding author:** Signe Christensen-Dalsgaard
Email: signe.dalsgaard@nina.no, Phone nr.: (+47) 945 424 07

¤ These authors contributed equally to this work

Table S1. Mean dive depth (meters) and dive duration (seconds) in control sites, impact site before harvest and impact sites up to 1 year after harvest (medium term effect). N represent number of unique sites and year combinations.

	N	**Dive depth** ($\bar{x}$ ± SE)	**Dive duration ($\bar{x}$ ± SE)**
Control	196	12.8 (0.62)	38.8 (1.22)
Impact before	205	12.8 (0.45)	40.9 (1.03)
Impact after	62	12.1 (0.78)	37.7 (1.69)

Table S2. BACI analysis with the parameter estimates and standard error from to similar zero-inflated linear mixed-effects models fitted to diving activity (squared number of dives) of European shags at Sklinna. Impact is represented by harvest of kelp and the original model is compared with one model were impact sites with harvested biomass being more than 10 tons were excluded. Here we show only the medium-term effect model (1-year post-harvest) as an example. Significance is shown as **p<0.01, *p<0.05.

Medium term models	**Original**		**Biomass >10 tons**	
Conditional Model	B	SE	β	SE
Intercept	-1.84**	0.086	-1.83**	0.084
Before vs After (BA)	0.27*	0.108	0.27*	0.105
Control vs Impact (CI)	0.001	0.095	0.01	0.095
% Kelp	3.73**	1.196	3.45**	1.174
% Kelp ^2	-1.49	1.115	-1.22	1.092
BA:CI	-0.17	0.126	-0.17	0.125
Zero-Inflated Model	B	SE	β	SE
Intercept	-4.27**	0.234	-4.23**	0.245
Before vs After (BA)	0.77*	0.377	0.67*	0.368
Control vs Impact (CI)	-0.13	0.295	-0.26	0.310
% Kelp	-7.85*	3.806	-7.07*	3.872
% Kelp ^2	1.01	3.689	0.45	3.721
BA:CI	-1.14*	0.481	-0.92*	0.487

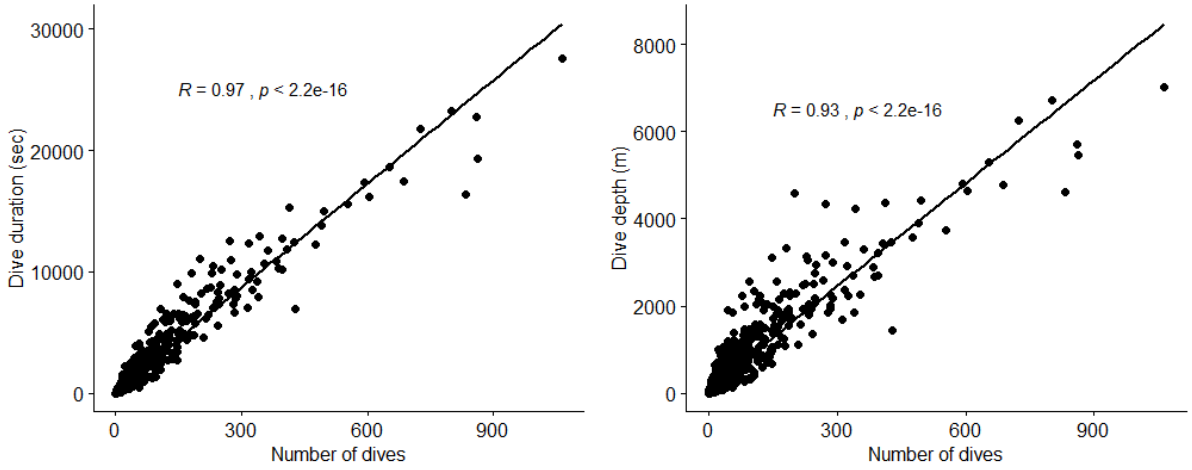

Figure S1. Correlation between number of dives, dive duration and dive depth (summarized per grid cell and year).

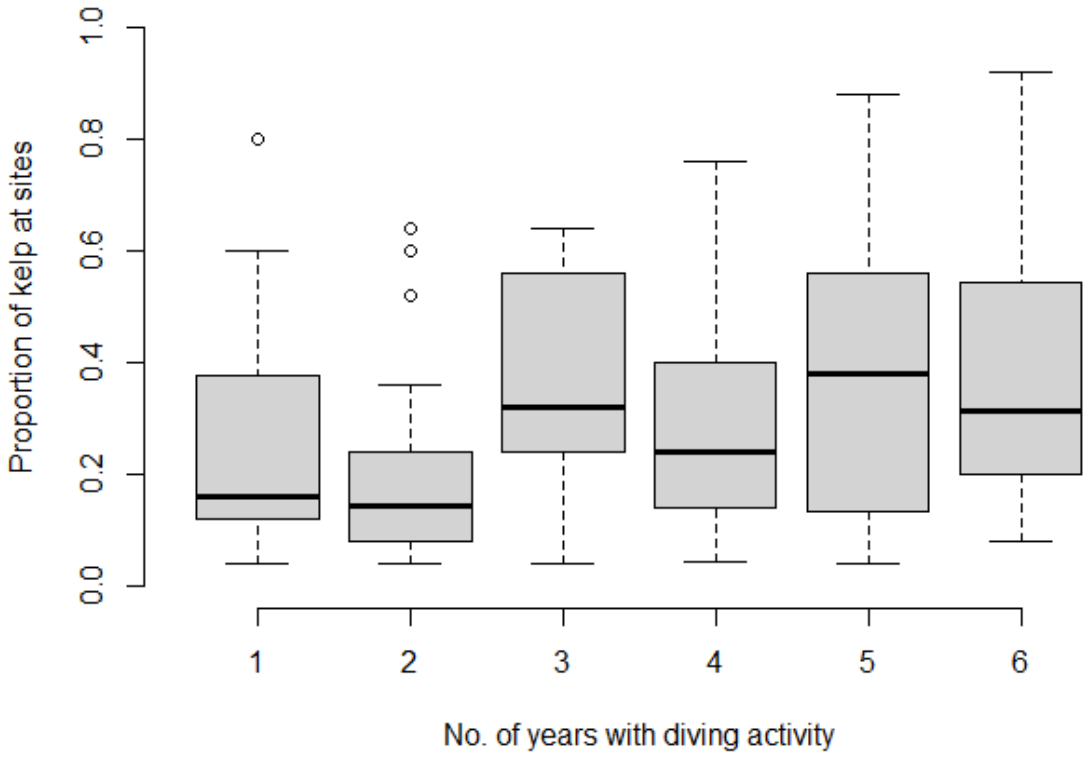

Figure S2. Proportion of kelp occurrence at sites with diving activity of shags in relation to the number of years of activity between 2013-2018 (i.e. max = 6 years).

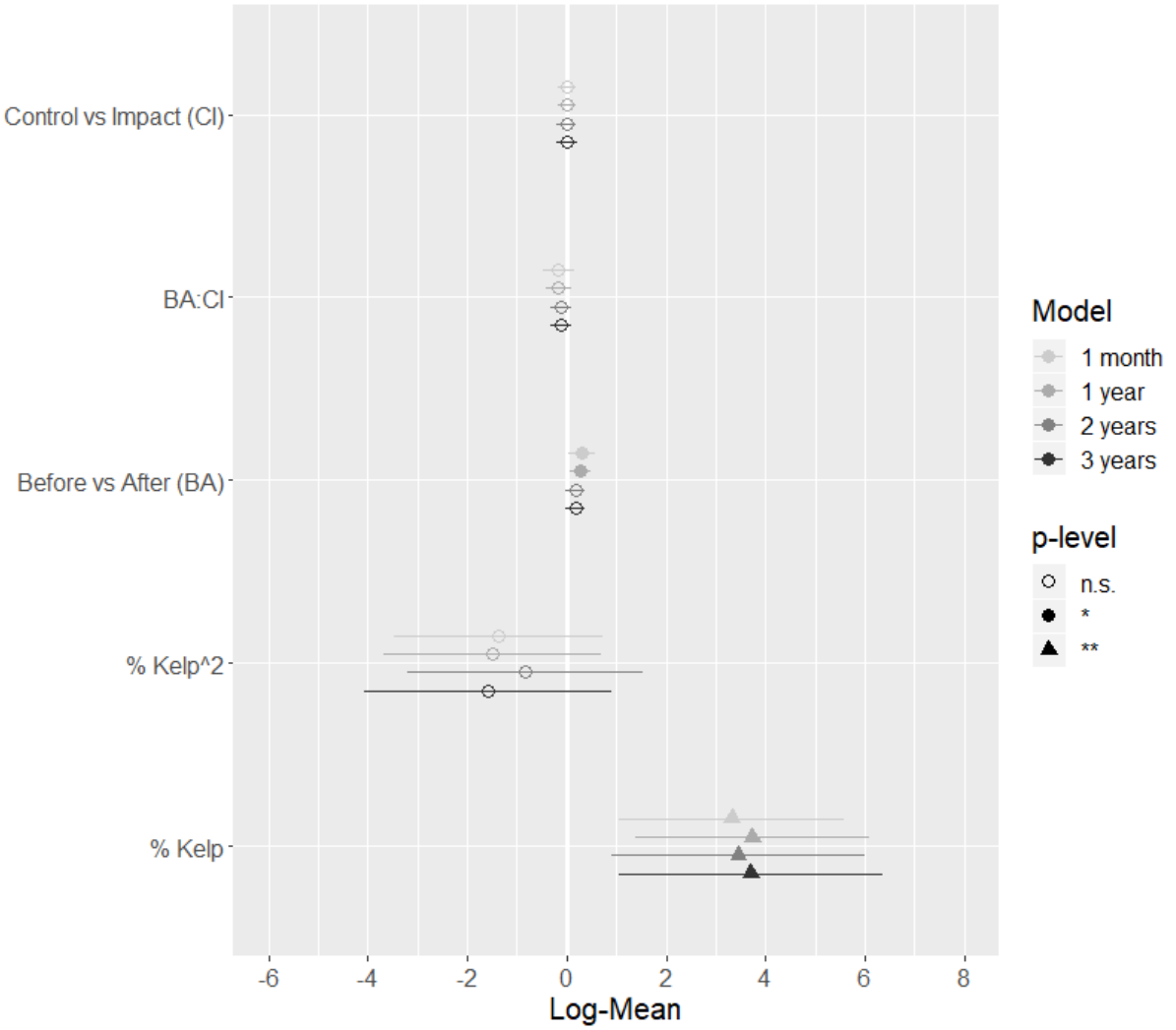

Figure S3. BACI analysis with the parameter estimates and standard error from four zero-inflated linear mixed-effects models fitted to diving activity (squared number of dives) of European shags at Sklinna. Impact is represented by harvest of kelp and the four model is subset to include different temporal scales (short term = 1 month, medium term = 1 year, Long term 1 = 2 years and Long term 2 = 3 years after harvest) Significance is shown as **p<0.01, *p<0.05.

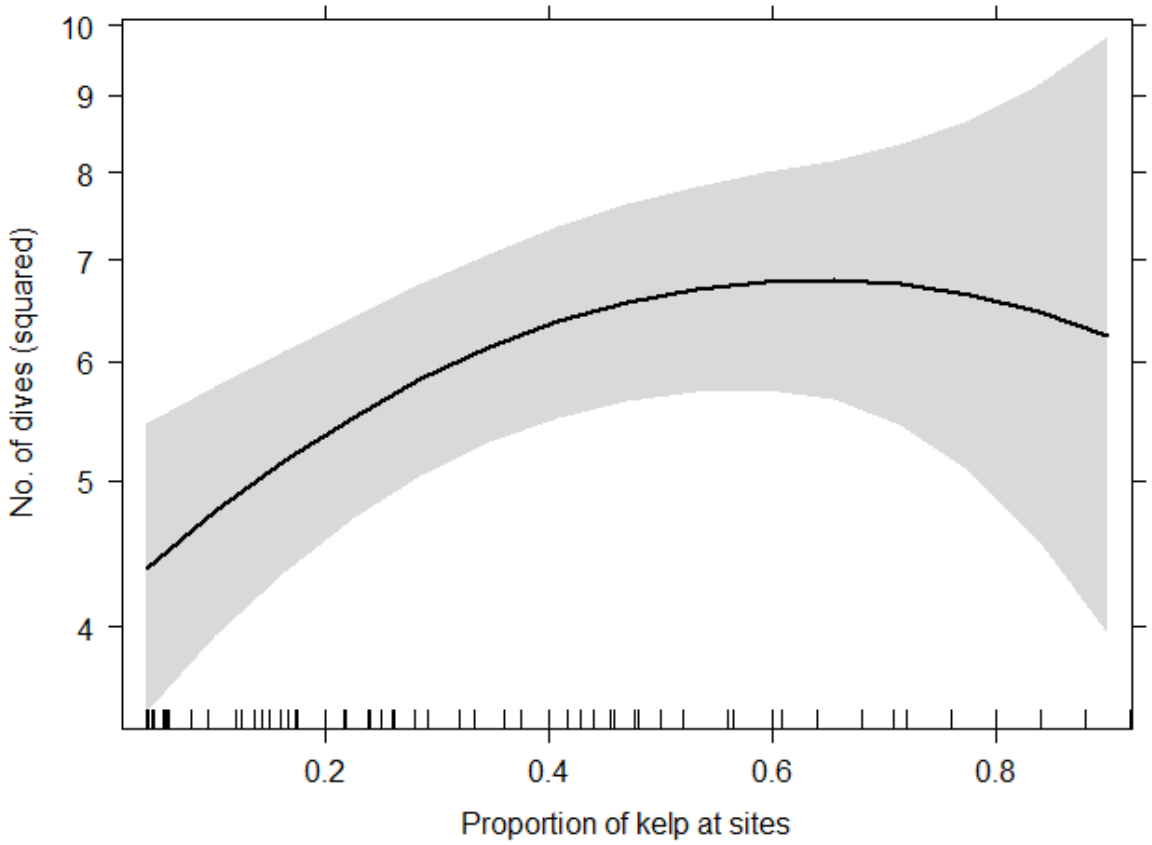

Figure S4. Number of dives within a site in relation to proportion of kelp present within the site from a BACI zero-inflated linear mixed-effects models fitted to diving activity (squared number of dives) of European shags at Sklinna where the after period is restricted to 1-year post harvest.

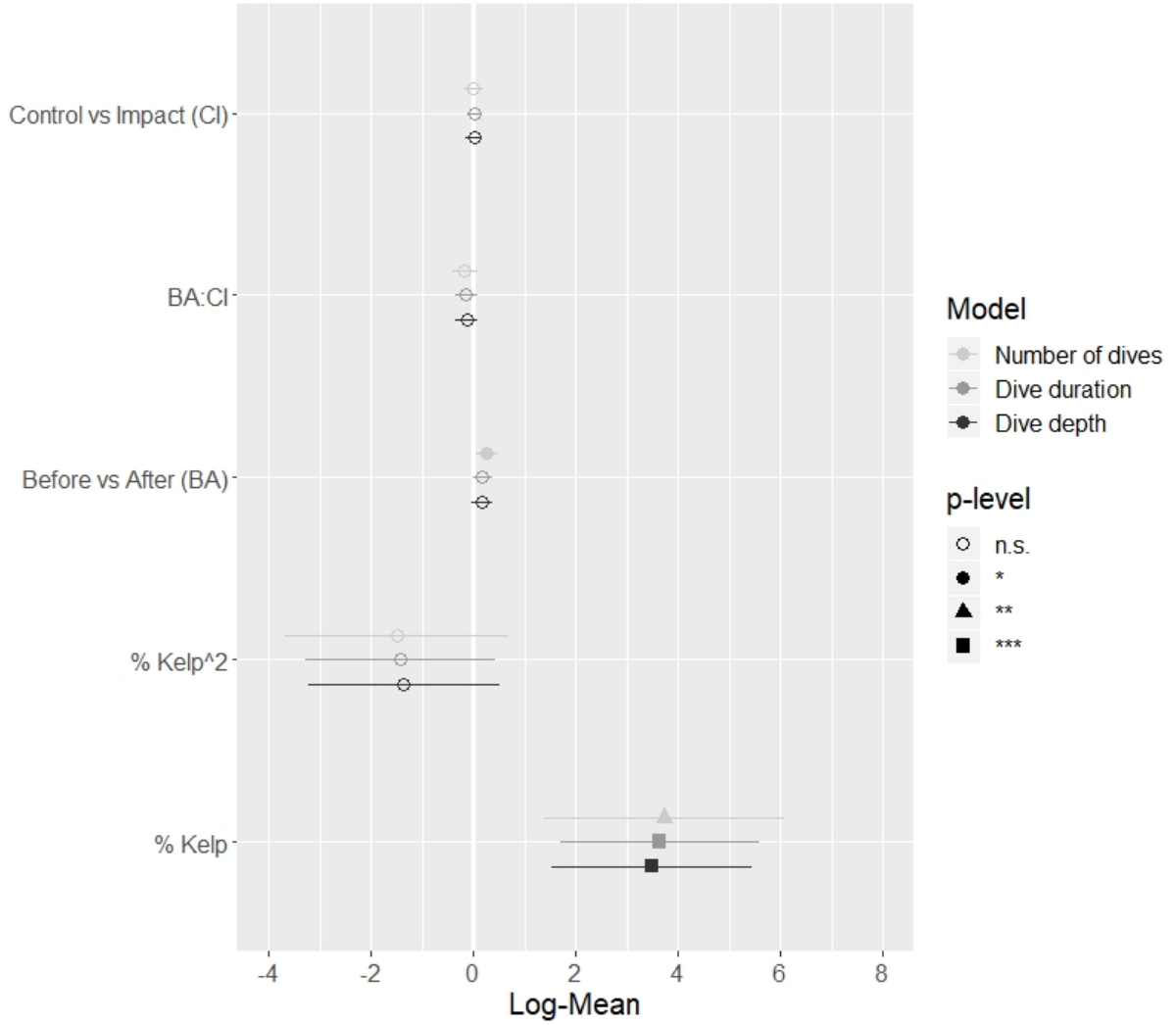

Figure S5. BACI analysis with the parameter estimates and standard error from three zero-inflated linear mixed-effects models fitted to three types of diving activity (squared number of dives, dive duration and dive depth) of European shags at Sklinna. Significance is shown as ***p<0.001, **p<0.01, *p<0.05.