



Do porpoises have a biological clock?

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Background and methods

We studied porpoises in the Arctic (figure 1), to find out if their acoustic behavior is restricted by an internal biological clock (24 hours), or if they can adjust to variation in day length.



Figure 1 – Study area in Norway

Most animals have an endogenous biological clock which regulates circadian rhythms in (e.g.) metabolism and general activity¹. Only a few species are able to turn off their biological clock. Some polar animals (such as reindeer and penguins) can adjust their rhythm to variation in light condition². In the Arctic, the sun does not set in summer or rise in winter.

Diurnal patterns have been found in porpoise activity³, but it is unknown whether such patterns are the result of endogenous biological clocks⁴.

Porpoise sound production was recorded during autumn (figure 2) in a fjord in Arctic Norway (69.55°N 18.73°E) with five C-Pods. We performed a regression analysis (GAMMs) to identify the influence of several covariates on the number of porpoise detections per hour. We used a forward model selection, based on model likelihood cross validation. Correlation factors for temporal autocorrelation were included in the models.

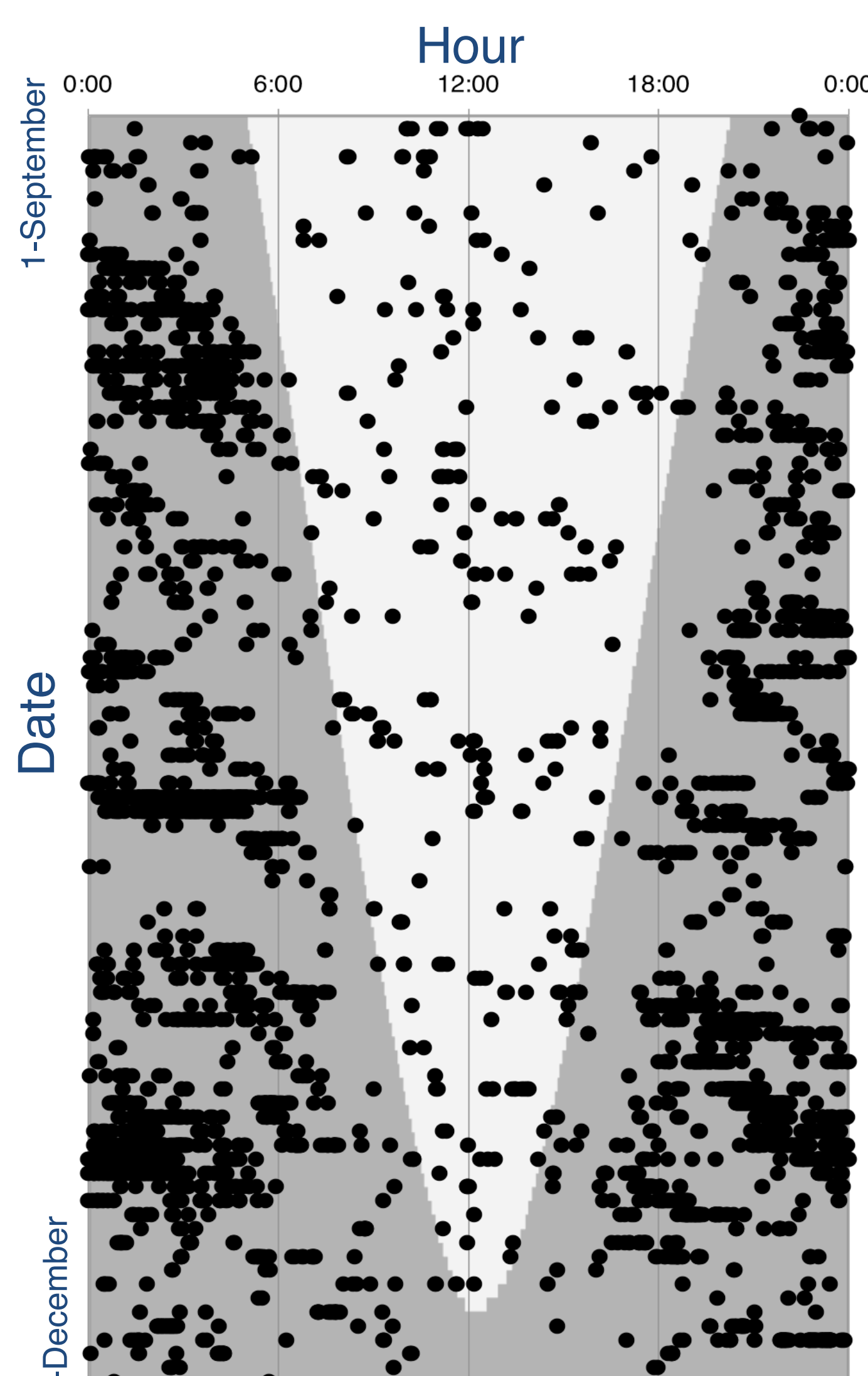
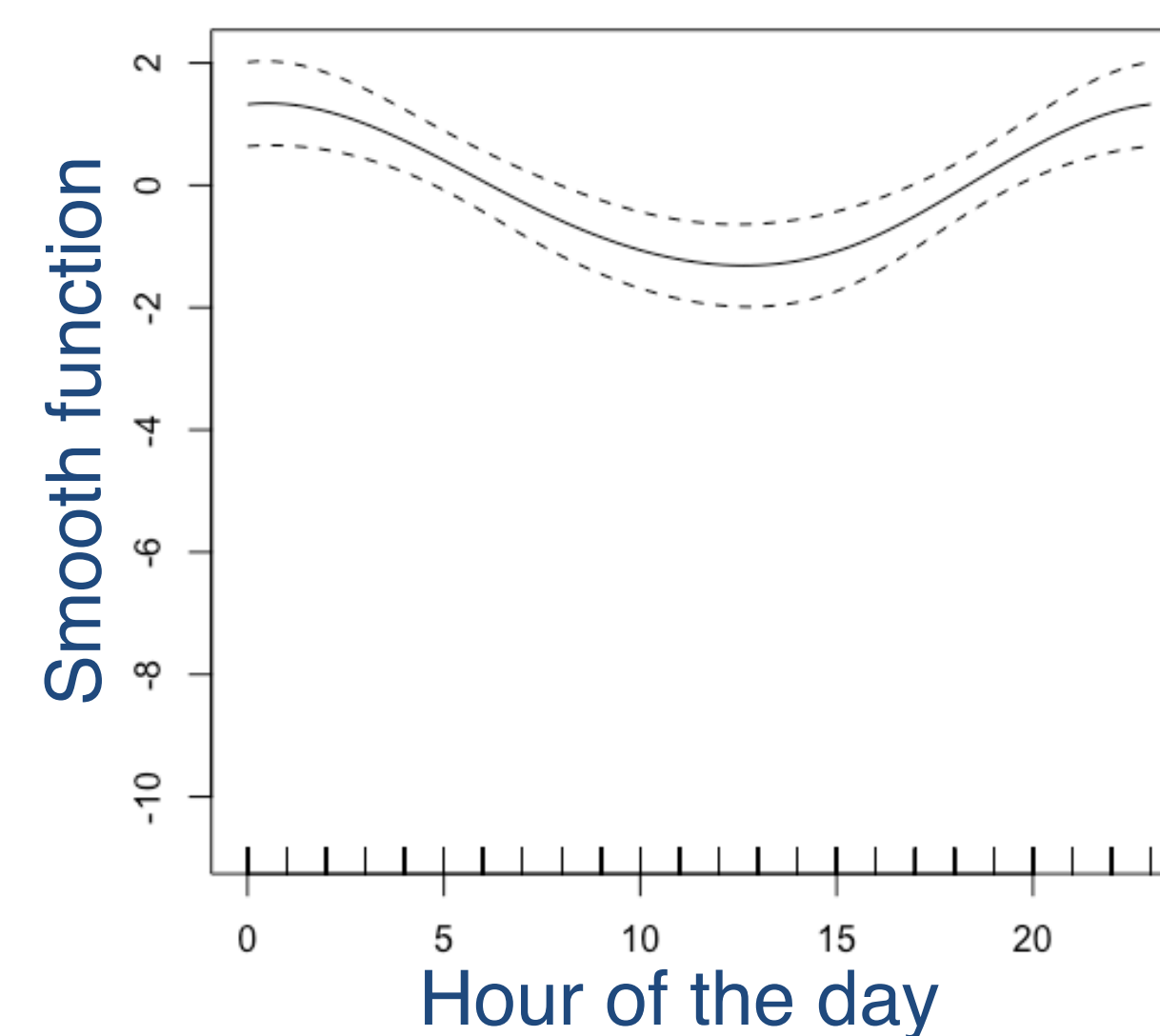


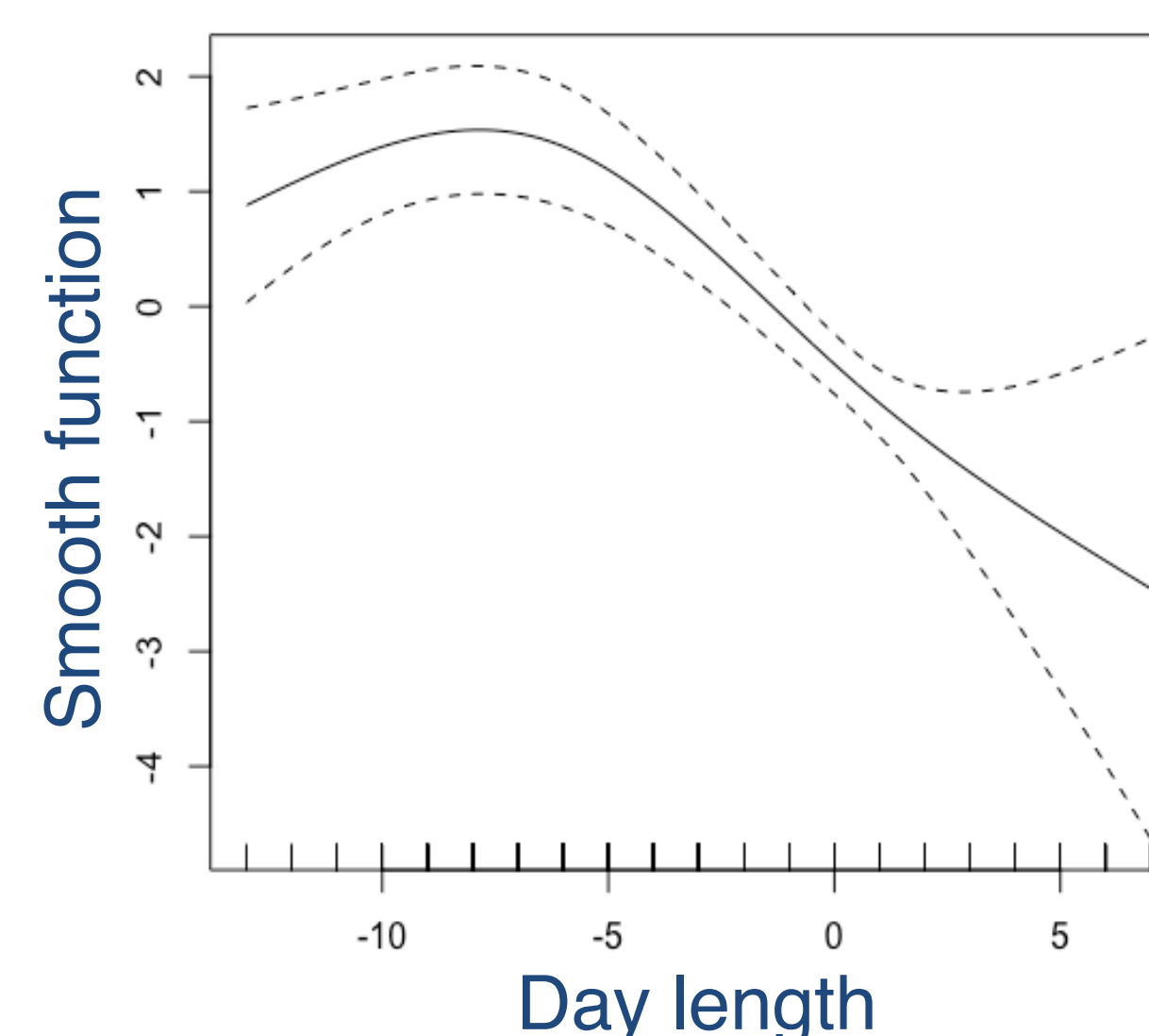
Figure 2 – Porpoise detections and day length in the study area (C-Pod 2)

Results



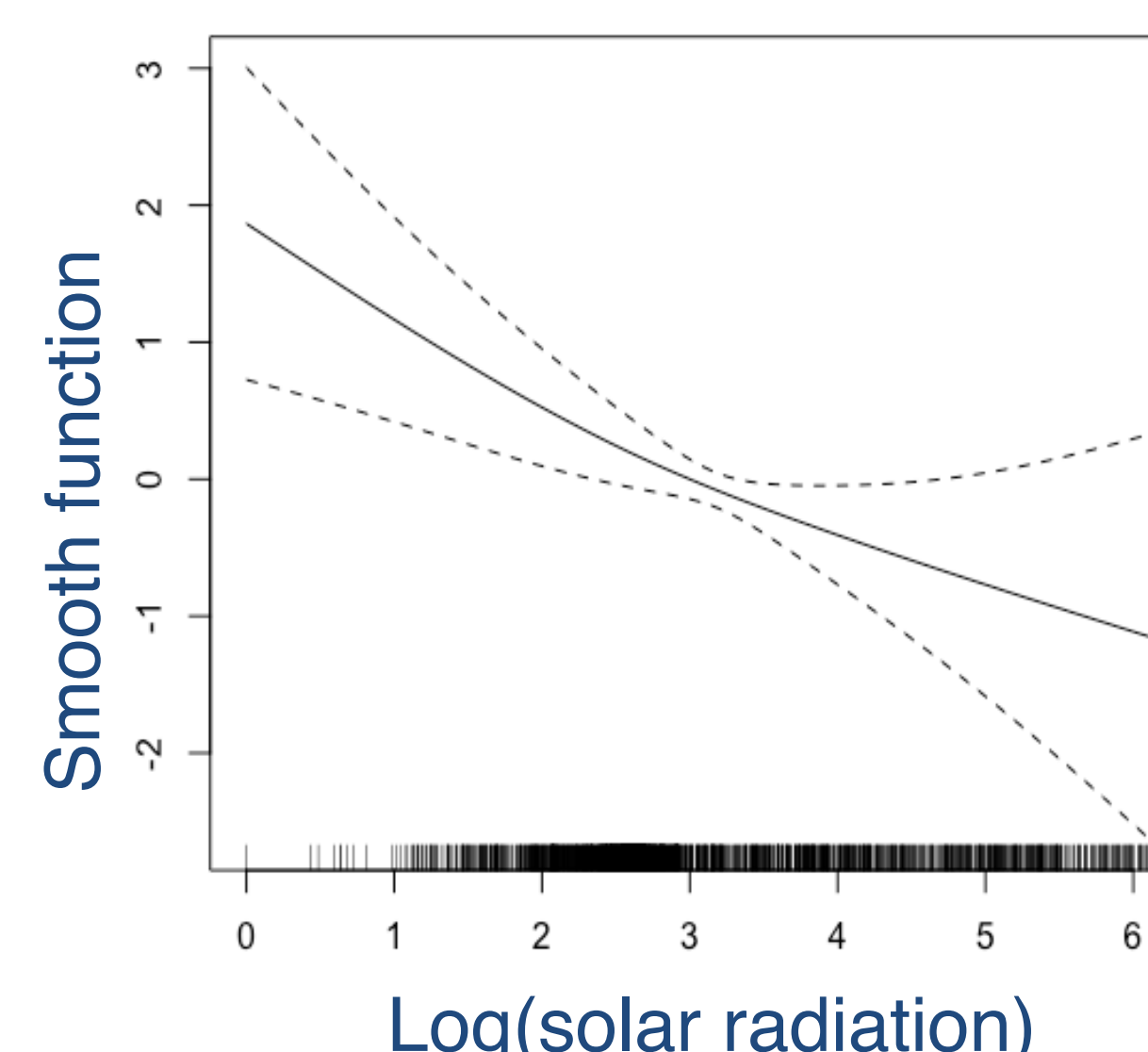
Best model covariate C-Pod 1: **“Hour of the day”**
($p = 0.000227$, $edf = 1.81$)

This indicates a biological clock, since day length and light were weaker covariates.



Best model covariate C-Pods 2 & 3: **“Day length”**
($p = 4.91e-07$, $edf = 2.581$)
($p = 3.28e-05$, $edf = 2.624$)

This indicates porpoises can adjust their diurnal rhythm according to day length.



Best model covariate C-Pod 4: **“Solar radiation” (log)**
($P = 0.0267$, $edf = 1.524$)

This indicates that porpoises produce more sound when it is dark, regardless of the time.

The best model for the last C-Pod contained both day length and hour of the day. Both were significant, but day length had a reverse relationship with the detections per hour. Perhaps this is due to the fact that this C-Pod recorded much less data, compared to the other C-Pods.

The angle of the C-Pod was also a strong covariate. In all models, because the porpoise detection capacity of C-Pods is reduced in strong currents.

Discussion

- Our data indicates that porpoise activity is driven by of an endogenous circadian rhythm (a.k.a. biological clock).
- However, porpoises can deviate from this 24 hour rhythm, as day length has a strong influence on the porpoise detections per hour.



Figure 3 – Porpoise (*Phocoena phocoena*)

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