

# **Noise levels received by endangered killer whales *Orcinus orca* before and after implementation of vessel regulations**

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## **Text S1**

### **Alternative model structure for addressing correlation between vessel count and distance**

Vessel count and vessel distance were moderately correlated with one another. Mechanistically, this is likely due to spatial restrictions around whales during vessel based whale watching. That is, as vessel counts increased, the average vessel distance also had to increase. Therefore, vessel distance was regressed against vessel count and the residuals of the regression were used as the transformed distance variable (rDistance). Vessel distance was considered a dependent variable of vessel count given the mechanistic spatial restrictions of vessels while whale-watching and not because vessel distance was assumed to be a less important variable on noise levels (Graham 2003). Results from model selection illustrate that even when collinearity between vessel count and distance is removed from the model structure, there is not a distance effect additional to the contribution that is already present through its relationship with vessel count. Model selection followed the same steps and the top-ranking model included year, log vessel count, vessel speed and animal ID (Table S2) as in the top-ranking model presented in Table 3 (main paper).

## References

Graham MH (2003) Confronting multicollinearity in ecological multiple regression. *Ecology* 84:2809-2815 <https://doi.org/10.1890/02-3114>

Table S1. Fixed and random effects on noise level considered during model selection.  
 \*Indicates effect was the transformed residual resulting from the main variable regressed on the correlated effect, see Text S1 above for details. Number of levels for each factor are include in parentheses.

| Effect                | Form (levels)                             | Type   |
|-----------------------|---|--------|
| Year                  | numeric, factor (4), before/after reg (2) | fixed  |
| Country               | factor (2)                                | fixed  |
| Vessel count          | linear, log <sub>10</sub>                 | fixed  |
| rVessel distance*     | linear, log <sub>10</sub>                 | fixed  |
| Vessel speed category | factor (4)                                | fixed  |
| Sex                   | factor (2)                                | fixed  |
| Age class             | factor (2)                                | fixed  |
| Deployment Min        | linear, log <sub>10</sub>                 | fixed  |
| Animal ID             | factor (24)                               | random |
| Tag ID                | factor (8)                                | random |

Table S2. Model selection results for mixed effects model. All models included (1|animalID) as a random effect. rDistance indicates residual transformation of the distance effect from the regression of vessel distance on log vessel count.

| Model | Fixed effects   | $\Delta AIC_i$ |
|-------|---|----------------|
| 1     | Year*country, logcount, rDistance, speed, age, sex, logdeployMin  | 13.4           |
| 2     | Year, country, logcount, rDistance, speed, age, sex, logdeployMin | 8.8            |
| 3     | Year, logcount, rDistance, speed, age, sex, logdeployMin          | 6.8            |
| 4     | Year, logcount, rDistance, speed, sex, logdeployMin               | 4.9            |
| 5     | Year, logcount, speed, sex, logdeployMin                          | 3.0            |
| 6     | Year, logcount, speed, sex  | 1.4            |
| 7     | Year, logcount, speed   | 0.0            |