Appendix 1. Stability selection

Methods

We applied stability selection (Meinshausen and Bühlmann 2010, Shah and Samworth 2013) to identify base-learners, and thus covariates, that were commonly selected in the majority of 100 random subsamples of the data. We set the number of selected base-learners per boosting model (q) to 35 and established an upper bound of two for the per-family error rate (PFER; Meinshausen and Bühlmann 2010, Shah and Samworth 2013, see also Hofner et al. 2015 for details in the context of boosting) which, given the 48 base-learners in the occupancy and count models (see Equation 1 in manuscript), corresponded to an upper bound of $\alpha = 0.042$ for the per-comparison error rate. **Benjamin: can you check my calculation? Also, should we explain why we chose $q = 35$, or describe complementary pairs subsampling and our choice of unimodal vs. r-concavity assumptions for the two model type (occupancy vs. count)? Any other relevant details to include?**

Results

Occupancy models

Given our specifications ($q = 35$; PFER upper-bound = 2), only base-learners selected in all 100 subsamples (i.e., $\hat{\pi} = 1$) were identified as stable (Figure 1.1).

Count models

Given our specifications ($q = 35$; PFER upper-bound = 2), only base-learners selected in at least 90 of the 100 subsamples (i.e., $\hat{\pi} = 0.9$) were identified as stable; this threshold applies to the selection of base-learners for the conditional mean (μ) and conditional overdispersion (σ).

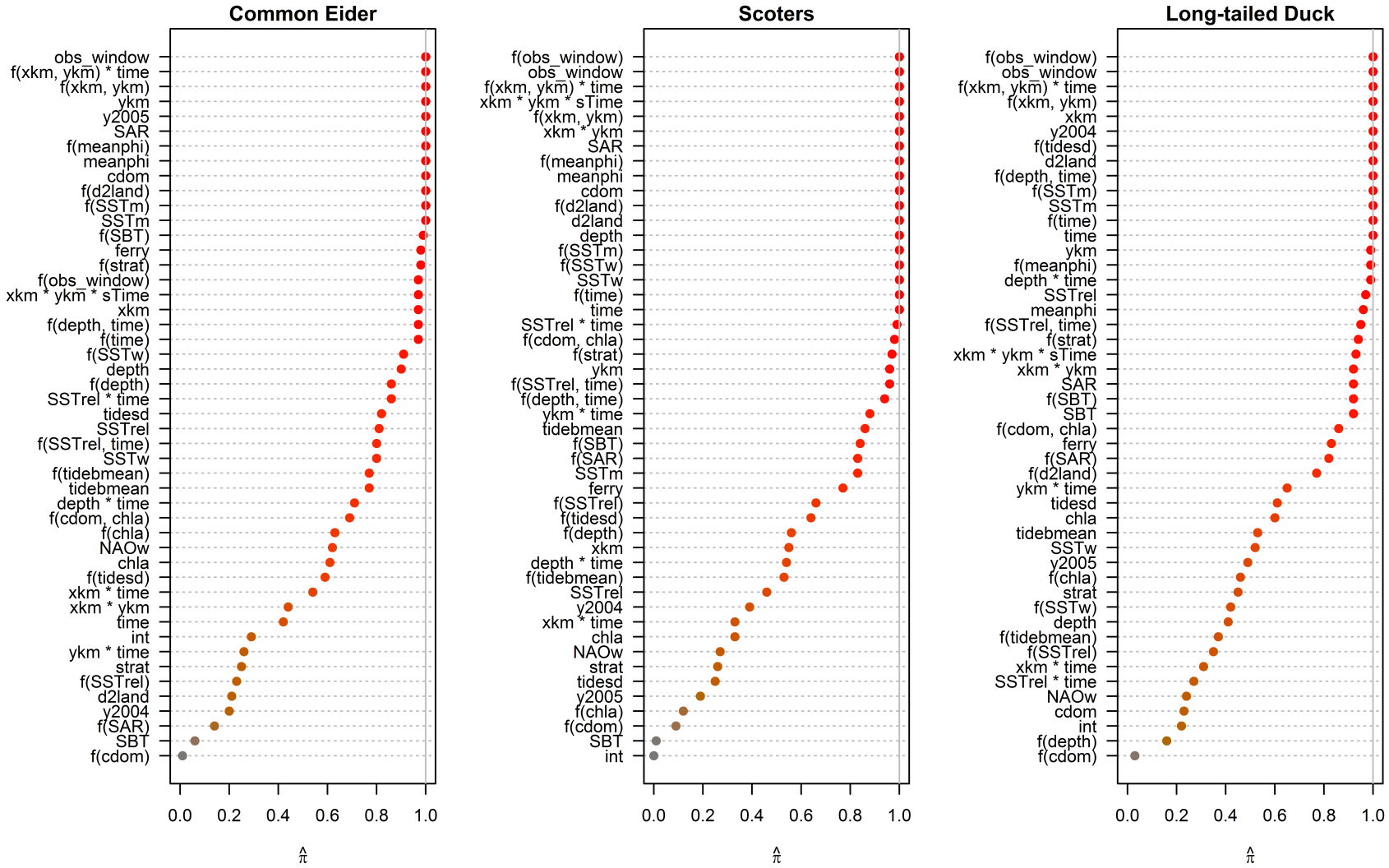

Figure 1.1 Stability selection using complementary pairs subsampling and unimodality assumption for sea duck occupancy models. The number of selected base-learners in each model run was set to $q = 35$. Base-learners with selection frequencies above the threshold ($\hat{\pi}$; vertical gray line) were considered stable with upper bound PFER = 2.

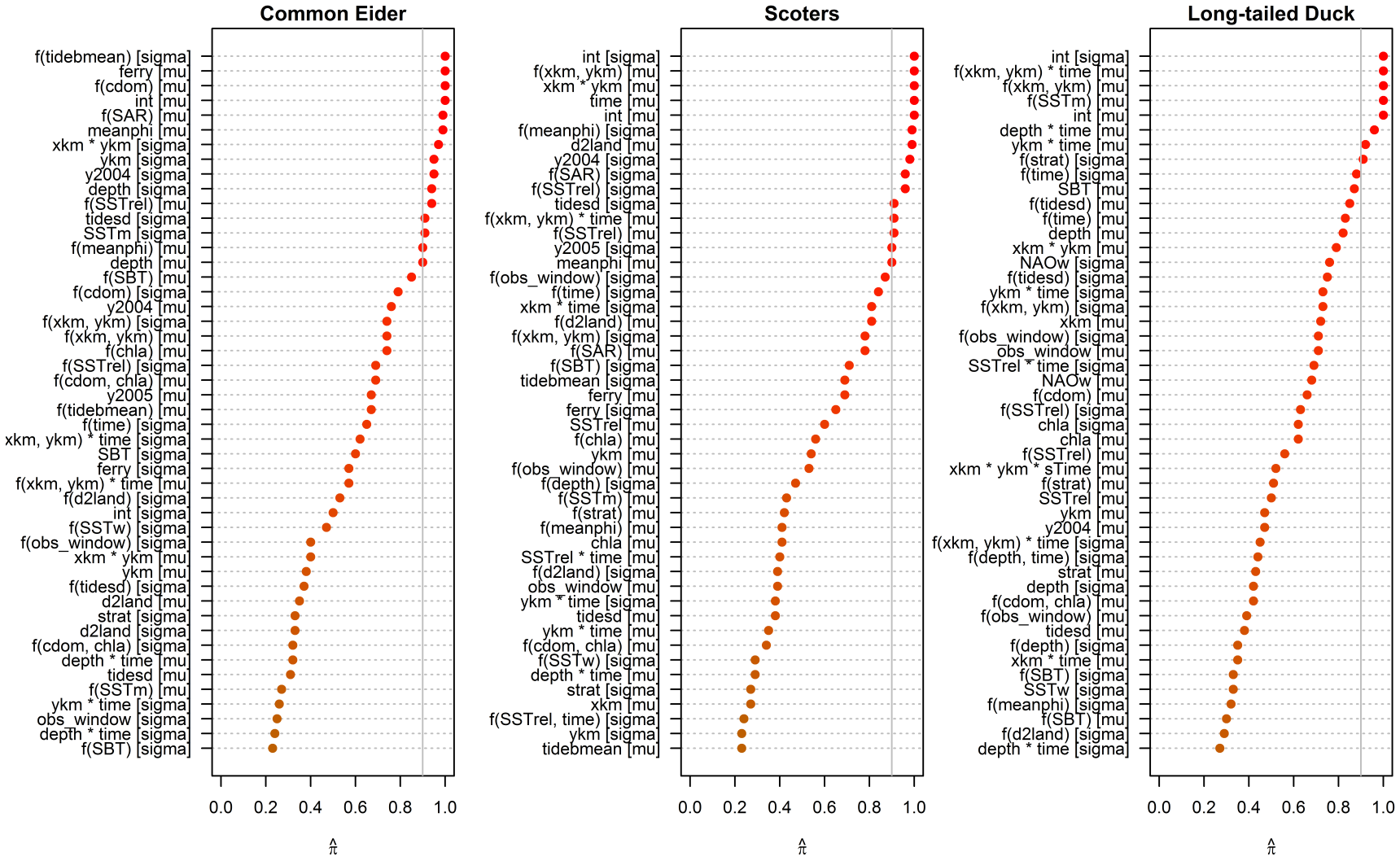

Figure 1.2 Stability selection using complementary pairs subsampling and r-concavity assumption for sea duck conditional count models. The number of selected base-learners in each model run was set to $q = 35$. Base-learners with selection frequencies above the threshold ($\hat{\pi}$; vertical gray line) were considered stable with upper bound PFER = 2. Only the top 48 base-learners are illustrated. Brackets indicate the parameter (conditional mean, *mu*, or overdispersion, *sigma*) to which the base-learner applies.

Literature cited

Hofner, B., L. Boccuto, and M. Göker. 2015. Controlling false discoveries in high-dimensional situations: Boosting with stability selection. BMC Bioinformatics in press.

Meinshausen, N., and P. Bühlmann. 2010. Stability selection (with discussion). Journal of the Royal Statistical Society: Series B (Statistical Methodology) 72:417–473.

Shah, R. D., and R. J. Samworth. 2013. Variable selection with error control: Another look at stability selection. Journal of the Royal Statistical Society: Series B (Statistical Methodology) 75:55–80.