Supplementary Material

Seasonal and individual variation in selection by feral cats for areas with widespread primary prey and alternative localised prey

Jennyffer Cruz\textsuperscript{A,C}, Chris Woolmore\textsuperscript{B}, M. Cecilia Latham\textsuperscript{A}, A. David M. Latham\textsuperscript{A}, Roger P. Pech\textsuperscript{A} and Dean P. Anderson\textsuperscript{A}

\textsuperscript{A}Landcare Research, Lincoln, Canterbury, New Zealand.
\textsuperscript{B}Department of Conservation, Christchurch, New Zealand.
\textsuperscript{C}Corresponding author. Email: cruzbernalj@landcarereresearch.co.nz
**Fig. S1.** Aerial photograph of the study site surrounding the Upper Ohau River, Mackenzie Basin, South Island, New Zealand. Coloured lines depict 100% minimum convex polygons encompassing locations of feral cats (*Felis catus*), using fixes every 2 h during (a) the breeding season (October–February) and (b) the non-breeding season (March–September) of black-fronted terns (*Chlidonias albostriatus*).
a) Breeding season
**Fig S2.** Spatial autocorrelation functions for feral cats (*Felis catus*) monitored near the Upper Ohau River, Mackenzie Basin, South Island, New Zealand during (a) the breeding season (October–February) and (b) the non-breeding season (March–September) of black-fronted terns (*Chlidonias albostriatus*).
Fig S3. Temporal autocorrelation functions for feral cats (*Felis catus*) monitored near the Upper Ohau River, Mackenzie Basin, South Island, New Zealand during (a) the breeding season (October–February) and (b) the non-breeding season (March–September) of black-fronted terns (*Chlidonias albostriatus*).
b)
R code

R code used to estimate Huber–White robust standard errors for fixed effects in seasonal mixed-effects resource selection functions (RSFs) evaluating resource selection by feral cats (*Felis catus*) living near a colony of black-fronted terns (*Chlidonias albostriatus*) in the Upper Ohau River of the South Island, New Zealand. Mixed-effects RSFs were estimated using package ‘lme4’ (version 1.0-5). The code is adapted from functions in the packages ‘sandwich’ (version 2.3) and ‘lmtest’ (version 0.9-33), following guidelines by Zeileis (2006).

```
# START OF CODE

bread.lmer <- function(obj, ...) {
  vcov(obj)
}

estfun.lmer <- function (obj, ...) {
  residuals(obj, type = 'working') * model.matrix(obj)
}

meat.lmer <- function(obj, adjust = FALSE, ...) {
  # corresponds to the Huber-White estimator
  psi <- estfun.lmer(obj)
  k <- NCOL(psi)
  n <- NROW(psi)
  rval <- crossprod(as.matrix(psi))/n
  if(adjust) rval <- n/(n - k) * rval
  rval
}

sandwich.lmer <- function(obj, bread. = bread.lmer, meat. = meat.lmer, ...) {
  if(is.function(bread.)) bread. <- bread.(obj)
  if(is.function(meat.)) meat. <- meat.(obj, ...)
  1/NROW(estfun.lmer(obj)) * (bread. %*% meat. %*% bread.)
}

coeftest.default.lmer <- function (x, vcov. = NULL, df = NULL, ...) {
  coef0 <- if ("stats4" %in% loadedNamespaces())
    stats4::coef
  else fixef
  vcov0 <- if ("stats4" %in% loadedNamespaces())
```
stats4::vcov
else vcov
est <- coef0(x)
if (is.null(vcov.))
  se <- vcov0(x)
else {
  if (is.function(vcov.))
    se <- vcov.(x)
  else se <- vcov.
}
se <- sqrt(diag(se))
if (lis.null(names(est)) && lis.null(names(se))) {
  if (length(unique(names(est))) == length(names(est)) &&
      length(unique(names(se))) == length(names(se))) {
    anames <- names(est)[names(est) %in% names(se)]
est <- est[anames]
    se <- se[anames]
  } }
} rval <- cbind(est, se)
cnames <- c("Estimate", "Std. Error")
colnames(rval) <- cnames
class(rval) <- "coeftest"
return(rval)

# END OF CODE

Reference