Supplementary Appendix 2

Data Manipulation

Capture-mark-recapture data of southern elephant seals from Macquarie Island are publicly available for download via: Dryad: https://doi.org/10.1111/1365-2656.12775 (Volzke 2021).

To shape these data into the appropriate format for demographic analysis, we used R Version 4.2.1 (R Core Team 2022) with RStudio 2022.07.01 (RStudio Team 2022) and the tidyverse (dplyr) package (Wickham et al. 2019).

```
dsights <- select(dsights, SEAL_ID, DATE_OBSERVED, MASTER_SEX = MASTER_SEX_CHECKED, MASTER_TAG_TYPE, SEAL_STATUS_ID, AGE_CLASS_ID)

dsights$DATE_OBSERVED <- strptime(dsights$DATE_OBSERVED,"%d/%m/%Y",tz="GMT")
dsights$SEAL_ID <- as.integer(dsights$SEAL_ID)
dsights$SEAL_STATUS_ID <- as.integer(dsights$SEAL_STATUS_ID)
dsights$AGE_CLASS_ID <- as.integer(dsights$AGE_CLASS_ID)

dsights$Year <- dsights$DATE_OBSERVED$year+1900
dsights$Month <- dsights$DATE_OBSERVED$mon+1
dsights$Season <- dsights$Year + ifelse(dsights$Month >= 9,1,0)

## Convert unknown Age Class to NA
dsights$AGE_CLASS_ID[!is.na(dsights$AGE_CLASS_ID) & dsights$AGE_CLASS_ID==99] <- NA
## Drop the seen dead for now
dsights <- dsights[is.na(dsights$AGE_CLASS_ID) | dsights$AGE_CLASS_ID!=50,]

dsights
## # A tibble: 242,043 × 9
##    SEAL_ID DATE_OBSERVED       MASTER_SEX MASTER_T…¹ SEAL_…² AGE_C…³  Year Month
##      <int> <dttm>              <chr>      <chr>        <int>   <int> <dbl> <dbl>
##  1   26744 2018-10-01 00:00:00 F          B               99      NA  2018    10
##  2   27269 2018-10-01 00:00:00 F          B               99      NA  2018    10
##  3   23438 2018-10-07 00:00:00 F          BT              99      NA  2018    10
##  4   25892 2018-10-07 00:00:00 F          BT              99      NA  2018    10
##  5   27258 2018-10-07 00:00:00 F          B               99      NA  2018    10
##  6   12815 2018-10-07 00:00:00 F          B               99      NA  2018    10
##  7    4058 2018-10-07 00:00:00 F          B               99      NA  2018    10
##  8   24630 2018-10-07 00:00:00 F          B               99      NA  2018    10
##  9   27456 2018-10-07 00:00:00 F          B               99      NA  2018    10
## 10   25653 2018-10-07 00:00:00 F          BT              99      NA  2018    10
## # … with 242,033 more rows, 1 more variable: Season <dbl>, and abbreviated
## #   variable names ¹MASTER_TAG_TYPE, ²SEAL_STATUS_ID, ³AGE_CLASS_ID
## # ℹ Use `print(n = ...)` to see more rows, and `colnames()` to see all variable names
```

```
dsights <- dsights %>%
  group_by(SEAL_ID) %>%
  arrange(SEAL_ID, DATE_OBSERVED) %>%
  mutate(AGE_CLASS_ID = as.numeric(AGE_CLASS_ID),
         TAGGED_AS_PUP = if_else(row_number()==1 & AGE_CLASS_ID<=10, TRUE, FALSE),
         TAGGED_AS_PUP = if_else(any(TAGGED_AS_PUP==TRUE), TRUE, FALSE)) %>%
  filter(TAGGED_AS_PUP == TRUE) %>% #filter out any seals not tagged as pups
  mutate(AGE = Season - min(Season),
         AGE_CLASS_ID = if_else(AGE_CLASS_ID == 40 & Month %in% c(8:9), 41, AGE_CLASS_ID)) #seen breeding

#filter out unknown sex individuals (167 in whole dataset)
dsights <- dsights %>%
  filter(MASTER_SEX!= "U")

#modern data subset
dmodern <- dsights %>%
  group_by(SEAL_ID) %>%
  arrange(SEAL_ID, DATE_OBSERVED) %>%
  mutate("TAG_Season" = min(Season)) %>%
  filter(TAG_Season > 1993, MASTER_TAG_TYPE == "B" | MASTER_TAG_TYPE == "BT") # branded seals only
dmodern
## # A tibble: 191,047 × 12
## # Groups:   SEAL_ID [14,008]
##    SEAL_ID DATE_OBSERVED       MASTER_SEX MASTER_T…¹ SEAL_…² AGE_C…³  Year Month
##      <int> <dttm>              <chr>      <chr>        <int>   <dbl> <dbl> <dbl>
##  1    2701 1993-10-04 00:00:00 M          BT              NA       1  1993    10
##  2    2701 1993-10-26 00:00:00 M          BT              NA       2  1993    10
##  3    2702 1993-10-04 00:00:00 F          BT              NA       1  1993    10
##  4    2702 1993-10-30 00:00:00 F          BT              NA       2  1993    10
##  5    2702 1997-12-19 00:00:00 F          BT              NA      30  1997    12
##  6    2702 1998-10-02 00:00:00 F          BT               2      40  1998    10
##  7    2702 1998-10-15 00:00:00 F          BT               2      40  1998    10
##  8    2702 1998-12-30 00:00:00 F          BT               8      40  1998    12
##  9    2702 1998-12-31 00:00:00 F          BT               8      40  1998    12
## 10    2702 1999-01-20 00:00:00 F          BT               8      40  1999     1
## # … with 191,037 more rows, 4 more variables: Season <dbl>,
## #   TAGGED_AS_PUP <lgl>, AGE <dbl>, TAG_Season <dbl>, and abbreviated variable
## #   names ¹MASTER_TAG_TYPE, ²SEAL_STATUS_ID, ³AGE_CLASS_ID
## # ℹ Use `print(n = ...)` to see more rows, and `colnames()` to see all variable names
```

Capture Histories (ch)

```
seasons <- sort(unique(dmodern$Season))
diff(seasons)
##  [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 4 1
dresight <- dmodern %>%
  group_by(SEAL_ID) %>%
  do(data.frame(ENCOUNTER_HIST=paste(as.numeric(seasons %in% .$Season),collapse=""),
                SEX=c(setdiff(unique(.$MASTER_SEX),"U"),"U")[1])) %>%
  as.data.frame()
head(dresight)
##   SEAL_ID          ENCOUNTER_HIST SEX
## 1    2701 10000000000000000000000   M
## 2    2702 10001111110111000000000   F
## 3    2703 10101011111110000000000   F
## 4    2705 10000000000000000000000   F
## 5    2706 10000000000000000000000   F
## 6    2707 10000000000000000000000   M
```

Prepare dresight for RMark analysis: Grouping variables must be factors and first row must be named ‘ch’

```
dresight <- dresight %>%
  select(ch = ENCOUNTER_HIST, SEAL_ID, SEX )%>%
  mutate(SEX = as.factor(SEX), SEAL_ID= as.factor(SEAL_ID))
head(dresight)
##                          ch SEAL_ID SEX
## 1 10000000000000000000000    2701   M
## 2 10001111110111000000000    2702   F
## 3 10101011111110000000000    2703   F
## 4 10000000000000000000000    2705   F
## 5 10000000000000000000000    2706   F
## 6 10000000000000000000000    2707   M
```

References

R Core Team. (2022). R: A Language and Environment for Statistical Computing. In. Vienna, Austria: R Foundation for Statistical Computing.

RStudio Team. (2022). RStudio: Integrated Development Environment for R. In. Boston, MA: RStudio, PBC.

Volzke, S. (2021). *Macquarie Island southern elephant seal demography*. Accessed 2022-11-08. Retrieved from: https://doi.org/10.5061/dryad.zpc866t7f

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