This ShagDataReadme.doc file was generated on 2021-03-22 by Astrid A. Carlsen

**GENERAL INFORMATION**

**1. Title of Dataset:**

TDR and GPS data of Dive behaviour in European Shags *Phalacrocorax aristotelis.*

**2. Author Information**

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**3. Date of data collection:**

Every year during breeding season in June-July from 2013-2018.

Earliest date June 22., latest date July 16., total span of 25 days.

**4. Geographic location of data collection:**

The Sklinna archipelago, situated about 20km off the coast of Vikna in Trøndelag, Central-Norway (65°12’N 10°59’E), holds one of the largest shag colonies in Norway with ca. 2,000 breeding pairs in 2017.

**5. Funding sources that supported the collection of the data:**

This study was carried out as part of the SEAPOP programme (www.seapop.no), which is financed by the Norwegian Ministry of Environment via its Environmental Agency, the Norwegian Ministry of Petroleum and Energy via the Research Council of Norway (Grant no. 192141), and the Norwegian Oil and Gas Association. This work was also partially supported by the Research Council of Norway (SFF-III 223257/F50).

**SHARING/ACCESS INFORMATION**

**1. Licenses/restrictions placed on the data:**

None

**2. Links to publications that cite or use the data:**

Not available.

**DATA & FILE OVERVIEW**

**1. File List:**

Mc\_d1.rsd

**2. Relationship between files, if important:**

Within\_ID.rds: Full dataset, including mean centred within-ID parameters for within-ID analyses.

For among-ID analyses, the 3rd row of each individual was extracted.

**METHODOLOGICAL and DATA-SPECIFIC INFORMATION:**

-See table of parameters and Data Collection and Data handling below.

|  |  |  |  |
| --- | --- | --- | --- |
| Column | Parameter | Unit | Description |
| *Maxdep* | *Maximum depth* | Meter | The deepest vertical distance from surface in meters per dive. |
| *Divetim* | *Total dive duration* | Sec | Total time spent underwater in a dive, including *descent duration,* *bottom duration* and *ascent direction*. |
| *Desctim* | *Descent duration* | Sec | Time spent in vertical movement descending. |
| *Botttim* | *Bottom duration* | Sec | Time spent in horizontal movement per dive. |
| *Asctim* | *Ascent duration* | Sec | Time spent in vertical movement ascending. |
| *Predive.dur* | *Pre-dive duration* | Sec | Time period spent on the surface before each dive, with surface durations >360 secs excluded – see definition for *bout length* below. |
| *Postdive.dur* | *Post dive duration* | Sec | Time spent on the surface after each dive,with surface durations not corrected for length |
| *Postdive.dur2* | *Post-dive duration* | Sec | Time spent on the surface after each dive,with surface durations >360 secs excluded – see definition for *bout length* below. |
| *boutlength* | *Bout* | n | A sequence of consecutive dives by an individual, defined by all *pre-* and *post-dive* *durations* being < 360s (see methods). Bout length is given in number of dives within a bout. |
| *Boutname* | *Bout ID* | Factor | Factorial label for each bout of dives, for identifying dives that belong to the same foraging bout within a trip from the nest. |
| *Divetype* | *Dive type* | Factor | Dives with versus without a bottom duration - see definitions for *V-shaped* (*No Bottom Duration) dives* versus *U-shaped (With Bottom Duration) dives*. |
| *0* | *V-shaped dives* | Factor | Dives with no *bottom duration*, assumed to be sampling dives involving searching for prey but no active foraging. Binomial value 0. |
| *1* | *U-shaped dives* | Factor | Dives that included *bottom duration*, assumed to be hunting dives involving the active pursuit and capture of prey. Binomial value 1. |
| Year | Year | Factor | Identifier for the 6 years of data collection from 2013-2018. |
| ID | Individual (ID) | Factor | Individual identity by ring number. |
| Ydate | Day | n | Dive date, a continuous label for each day of the season regardless of year, from June 22nd to July 16th (range 25d). |
| sublocation | Location | Factor | Label for the 24 different locations determined from clusters of dives around areas with similar geographical features – see methods. Because locations first were divided into large general areas (location) we here provide the parameter sublocation as a more precise within-location. See methods for more detail. |
| Recap\_mass | Body mass | Gram | Body mass at recapture and detachment of loggers |
| mc\_ | (parameters) |  | Given parameter values mean centred around zero within the individual (ID) for each row. |
| m\_ | (parameters) |  | Mean value of individual for given parameter. |
| (parameter)2 | (parameters) |  | Squared term of parameter value (OBS! Except in postdive.dur2, see above) |
| (parameters)3 | (parameters) |  | Cubic term of parameter value |
| Log. (parameters) | (parameters) |  | Natural logarithm of parameter value. |
| pre(parameters) | (parameters) |  | The previous row’s value of each parameter, for temporal autocorrelation effect size estimations. |

## All variables in dataset

## [1] "Year" "ID" "Sex" "Date\_start"

## [5] "Time\_start" "recap\_mass" "StartTime" "EndTime"

## [9] "DateTime" "desctim" "botttim" "asctim"

## [13] "divetim" "maxdep" "postdive.dur" "divedate"

## [17] "traveltime" "mass2" "divetype" "location"

## [21] "sublocation" "postdive.dur2" "predive.dur" "recap\_mass2"

## [25] "mass3" "divetim2" "traveltime2" "botttim2"

## [29] "desctim2" "asctim2" "predive.dur2" "postdive.dur3"

## [33] "maxdep2" "d.speed" "a.speed" "ydate"

## [37] "ydate2" "DCB" "DCA" "n"

## [41] "boutname" "diven" "diven2" "boutlength"

## [45] "dtinterv" "dtinterv2" "ttinterv" "ttinterv2"

## [49] "DCA2" "log.postdive.dur2" "log.divetim" "log.traveltime"

## [53] "log.botttim" "log.predive.dur" "log.desctim" "log.asctim"

## [57] "divegroup" "dt\_run" "runID" "run\_length"

## [61] "bout\_quart" "m\_run\_diven" "logpredive.dur" "logpostdive.dur2"

## [65] "logdivetim" "predivetim" "predesctim" "prebotttim"

## [69] "preasctim" "predivetype" "predd\_t2" "predd\_t3"

## [73] "predd\_t4" "log.predivetim" "log.predd\_t2" "log.predd\_t3"

## [77] "log.predd\_t4" "log.predesctim" "log.prebotttim" "log.preasctim"

## [81] "log.boutlength" "DCBr" "DCAr" "m\_diven"

## [85] "mc.diven" "log.diven" "m\_log.diven" "mc.log.diven"

## [89] "m\_predive.dur" "mc.predive.dur" "m\_desctim" "mc.desctim"

## [93] "m\_asctim" "mc.asctim" "m\_postdive.dur2" "mc.postdive.dur2"

## [97] "m\_divetype" "mc.divetype" "m\_predivetype" "mc.predivetype"

## [101] "log.m\_predive.dur" "log.m\_postdive.dur2" "log.m\_desctim" "log.m\_asctim"

## [105] "log.recap\_mass" "m\_log.predive.dur" "mc.log.predive.dur" "m\_log.desctim"

## [109] "mc.log.desctim" "m\_log.asctim" "mc.log.asctim" "m\_log.postdive.dur2"

## [113] "mc.log.postdive.dur2" "m\_log.boutlength" "mc.log.boutlength" "m\_maxdep"

## [117] "mc.maxdep" "log.m\_maxdep" "log.maxdep" "m\_log.maxdep"

## [121] "mc.log.maxdep"

## *Data collection*

The fieldwork was conducted during June-July 2013-2018, including 78 birds (39 pairs) over 6 different breeding seasons. Chick rearing shags were chosen based on their nest accessibility and how ‘protective’ the pairs were, as those that aggressively stayed around the nest were easier to capture/recapture. Parental birds were fitted with loggers when nestlings were approximately 5-35 days old. Nestling age was determined using morphological criteria determined from control nests (from nesting areas in similar habitat within the Sklinna colony) checked every fifth day. The shags were captured and then recaptured at their nest by hand or using snares. Each individual was fitted with a GPS-logger (i-gotU GT-120, Mobile Action Technology, re-fitted in heat-shrink tubes) and Time Depth Recorders (TDR, G5, CEFAS Technology). TDR-loggers were attached to the GPS logger prior to instrumentation, and the loggers were attached to 3-4 middle tail feathers using TESA® tape. The maximum logger deployment weight was 30.6g, corresponding to 1.6% and 1.8% of mean body mass of males and females, respectively. The GPS loggers recorded location (± 10m) every 30 sec, and the TDR recorded water depth below (± 0.1m) every second. The loggers were removed during recapture after approximately 2-5 days. Deployment of loggers normally required less than 3 min of handling and retrieval less than 10 min, and no disturbance effects were noted in either adults or their chicks. In cases where there were signs of parental disturbance in the form of decreased nestling provisioning, then the second parent was not captured, and so these pairs were not included in the study.

The sex of adults was determined initially by body size features and ultimately via their vocalizations (Koffijberg and Van Eerden, 1995; Cramp and Simmons, 1977), because males and females made very distinct types of calls whilst defending the nest at our approach (Snow, 1960). At capture, body mass was obtained using a Pesola spring balance (accuracy ± 10g). Both adults in the pair were fitted with recording instruments during the same breeding season, although not overlapping in time, usually within only a few days of each other. At recapture, biometric measures were obtained (wing length (ruler ± 1mm), head and bill length (digital calliper ± 1mm) and body mass (see above)). Adult female average mass was 1610g (range 1370-1860g), whilst average adult male mass was 1920g (range 1660-2280g). Growth data (i.e. capture- recapture difference in chick weight) were collected for all nests during the time of recording and these measurements were compared to the control area within the same colony (see above) containing 50 nests where adults were not fitted with loggers. There was rarely indication of parents reducing their provisioning rates or changing any patterns of nestling feeding while fitted with loggers. There were no obvious differences in the number of surviving chicks in experimental versus neighbouring control nests, aside from impeded survival due to gull predation.

*Data handling*

Data handling and simulations was programmed in R 3.5.1 (R Core Team, 2018) and the TDR raw data was analysed with the package DiveMove (Luque, 2007). The total number of dives in this study was 46,103. The surface for dives was calibrated at ±1m, so that no dive movement less than 1m depth was counted as a real dive, which helped to remove possible non-foraging ‘cleaning’ dives (Christensen-Dalsgaard *et al*., 2017). The time submerged during foraging dives was divided into vertical descents and ascents involving <1m horizontal movement versus >1m horizontal movements. Such horizontal movement was calibrated with the package DiveMove’s Zero-Offset Corrected (ZOC) method (Luque, 2007), smoothed using ±4m depth filters, and registered as dive bottom duration. Dives were classified into two types according to the presence/absence of this horizontal dive bottom duration: U-shaped (with a horizontal dive bottom) versus V-shaped (with no horizontal dive bottom) dives (see Supplementary Materials A1). Pre- and post-dive durations at the surface longer than 360s were used to separate dive bouts (i.e. distinct sequences of successive dives at one location) whenever surface durations were too long to be explained by simple replenishment of O2 storages or momentary resting within a dive bout. GPS coordinates for each dive were assigned as the closest coordinates recorded within 30 secs before and/or after the dive (i.e. GPS locations could not be recorded during dives). GPS data were processed using R library ggmap (Kahle and Wickham, 2013). Merging, combining, and sorting of the data set was preformed using the package dplyr (Wickham *et al.*, 2018), and plots were generated by ggplot2 (Wickham, 2016). A total 24 ‘locations’ were identified as distinct places where most dives occurred (i.e. clusters of dives surrounded by areas with no dives), and distinguished as areas of uniform average depth and foraging conditions as determined from a topographical base map by Kystverket (<https://kart.kystverket.no/>). GPS coordinates were thus abbreviated to 2 decimal labels based on these dive locations, whilst the geographical size and number of observations varied between locations.

The dataset is published at <https://doi.org/10.5061/dryad.p8cz8w9q1>.