

# Package ‘flying’

May 8, 2026

**Type** Package

**Title** Simulation of Bird Flight Range

**Version** 0.1.3

**Description** Functions for range estimation in birds based on Pennycuick (2008) and Pennycuick (1975), 'Flight' program which compliments Pennycuick (2008) requires manual entry of birds which can be tedious when there are thousands of birds to estimate. Implemented are two ODE methods discussed in Pennycuick (1975) and time-marching computation method "constant muscle mass" as in Pennycuick (1998). See Pennycuick (1975, ISBN:978-0-12-249405-5), Pennycuick (1998) <doi:10.1006/jtbi.1997.0572>, and Pennycuick (2008, ISBN:9780080557816).

**License** Apache License

**Encoding** UTF-8

**LazyData** true

**Imports** utils, Rcpp (>= 1.0.2), knitr, kableExtra, rmarkdown

**Suggests** testthat, covr

**RoxygenNote** 7.0.0

**Depends** R (>= 2.10)

**VignetteBuilder** knitr

**Collate** 'RcppExports.R' 'birds\_documentation.R'  
'constant\_muscle\_mass.R' 'constant\_specific\_power.R'  
'constant\_specific\_work.R' 'control.R' 'method\_2.R'  
'method\_1.R' 'input\_match.R' 'lookup\_table2.R'  
'misc\_functions.R' 'flight\_simulation.R' 'flying.R' 'migrate.R'  
'zzz.R'

**LinkingTo** Rcpp

**NeedsCompilation** yes

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**Repository** CRAN

**Date/Publication** 2020-02-13 15:50:08 UTC

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birds	<i>Sample 28 birds</i>
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### Description

Preset birds data, extracted from Flight program. Fat mass percentage generated randomly where zero.

### Usage

birds

### Format

A data frame with 28 observations and 5 variables not counting the name.

**Scientific.name** Name of bird species

**Empty.mass** Body mass in Kg. Includes fuel. All-up mass with crop empty. Not to be confused with lean mass.

**Wing.span** Length of wings spread out in metres

**Fat.mass** Mass of fat that is consumable as fuel in Kg

**Order** Order of the species (passerine vs non-passerine)

**Wing.area** Area of both wing projected on a flat surface in metres squared

**Muscle.mass** Mass in Kg. of flight muscles

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flysim	<i>Range Estimation</i>
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### Description

Practical range estimation of birds using methods in Pennycuik (1975) Mechanics of Flight. These methods are based on Breguet equations.

### Usage

```
flysim(file, header = TRUE, sep = ",", quote = "\"", dec = ".",
       fill = TRUE, comment.char = "#", ..., data = NULL,
       settings = list())
```

**Arguments**

file	Arguments for path to data.
header	Logical. If TRUE use first row as column headers
sep	separator
quote	The set of quoting characters. see read.csv
dec	The character used in the file for decimal points.
fill	See read.csv
comment.char	For more details see read.csv
...	further arguments see read.csv
data	A data frame.
settings	A list for re-defining constants. See details.

**Details**

The option \*settings takes the arguments (those particularly required by this function)

- ppc: Profile power constant
- eFat: Energy content of fuel from fat
- g: Acceleration due to gravity
- mce: Mechanical conversion efficiency [0,1]
- ipf: Induced power factor
- vcp: Ventilation and circulation power
- airDensity: Air density at cruising altitude
- bdc: Body drag coefficient
- alpha: Basal metabolism factors in passerines and non passerines
- delta: Basal metabolism factors in passerines and non passerines  $\alpha * \text{bodyMass}^{\delta}$

**Value**

S3 class object with range estimates based on methods defined and settings used

- range estimates (Km)
- settings used
- data

**Author(s)**

Brian Masinde

**Examples**

```
flysim(data = birds, settings = list(eFat = 3.89*10^7))  
flysim(data = birds, settings = list(airDensity = 0.905))
```

migrate

*Range Estimation***Description**

Practical range estimation of birds using methods in Pennycuick (1998) and Pennycuick (2008).

**Usage**

```
migrate(file, header = TRUE, sep = ",", quote = "\"", dec = ".",
        fill = TRUE, comment.char = "#", ...,
        data = NULL, settings = list(), method = "cmm",
        speed_control = "constant_speed", protein_met = 0)
```

**Arguments**

file	The name of the file which the data are to read from
header	Logical. If TRUE use first row as column headers
sep	separator
quote	The set of quoting characters. see read.csv
dec	The character used in the file for decimal points
fill	See read.csv
comment.char	For more details see read.csv
...	further arguments see read.csv
data	A data frame
settings	A list for re-defining constants. See details
method	Methods for fuel management
speed_control	One of two speed control methods. By default <i>constant_speed</i> is used. <i>vmp_constant</i> is the alternative. The former holds the true airspeed constant while the latter holds the ratio of true airspeed and minimum power speed constant
protein_met	Percentage of energy attributed to protein and metabolism

**Details**

The option *\*control* takes the following arguments

- ppc: Profile power constant
- eFat: Energy content of fuel from fat
- eProtein: Energy content of protein
- g: Acceleration due to gravity
- mce: Mechanical conversion efficiency [0,1]
- ipf: Induced power factor

- vcp: Ventilation and circulation power
- airDensity: Air density at cruising altitude
- bdc: Body drag coefficient
- alpha: Basal metabolism factors in passerines and non passerines
- delta: Basal metabolism factors in passerines and non passerines  $\alpha \cdot \text{bodyMass}^{\delta}$
- invPower
- speedRatio: True air speed to minimum power speed ratio
- muscDensity: Density of the flight muscles.
- phr: Protein hydration ratio

**Value**

S3 class object with range estimates based on methods defined and settings

- data as a data frame
- range estimates (Km)
- fuel
- settings (named vector)

**Author(s)**

Brian Masinde

**Examples**

```
migrate(data = birds, settings = list(eFat = 3.89*10^7))  
migrate(data = birds, method = "cmm", settings = list(airDensity = 0.905))
```

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