Package 'FlyingR'

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Type Package

Title Simulation of Bird Flight Range

Version 0.2.3

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 hundreds of birds to estimate. Implemented are two ODE methods discussed in Pennycuick (1975) and time-marching computation methods as in Pennycuick (1998) and Pennycuick (2008). 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),

Suggests testthat, covr, knitr, kableExtra, rmarkdown, dplyr, ggplot2

RoxygenNote 7.3.2

Depends R (>= 2.10)

VignetteBuilder knitr

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LinkingTo Rcpp

URL https://github.com/BMasinde/FlyingR

BugReports https://github.com/BMasinde/FlyingR/issues

NeedsCompilation yes

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Repository CRAN

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Contents

`birds` *Sample 28 birds*

Description

Preset birds data, extracted from Flight Pennycuick(2008). 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 (fat mass). In this case the crops were empty but otherwise one should always use the all-up mass (body mass + crop)

Wing.span Length of wings spread out in meters

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

Order Order of the species (passerine = 1 vs non-passerine = 2)

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

Muscle.mass Mass in Kg. of flight muscles

curlew_sandpiper *Curlew Sandpiper Data*

Description

A sample of 12 individuals observed in lab conditions over five days at the University of Gdansk. Birds were fed ad-libitum with mealworm larvae Tenebrio molitor. To determine the maximum body mass gain sandpipers were weighed every day in the morning

Usage

```
curlew_sandpiper
```

Format

A dataframe with 60 rows and 9 columns:

day Day of observation of bird

name Unique name of individual bird

empty mass Body mass in Kg. of the birds

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

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

Wing.span Length of wings spread out in meters

order Order of the species (passerine = 1 vs non-passerine = 2)

Muscle.mass Mass in Kg. of flight muscles calculated as 0.17 fraction of body mass

flysim *Range Estimation*

Description

Practical range estimation of birds using methods in Pennycuick (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
- fed: 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*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(fatEnergy = 3.89*10^7))
flysim(data = birds,  settings = list(airDensity = 0.905))
```

garden_wablers *Garden Wablers Data*

Description

A subset of data on Garden Wablers captured during autumn migration across several ringing stations in along the southern eastern migration flyway (See Ożarowska, A. 2015).

Usage

```
garden_wablers
```

Format

A dataframe with 119 rows and 9 columns:

Region Region of ringing station where bird was captured for measurements

body mass Body mass in Kg. of the birds

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

Wing.span Length of wings spread out in meters

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

Muscle.mass Mass in Kg. of flight muscles calculated as 0.17 fraction of body mass

taxon Order of the species (passerine = 1 vs non-passerine = 2)

lesser_whitethroats *Lesser Whitethroats Data*

Description

A subset of data on Lesser Whitethroats captured during autumn migration across several ringing stations in along the southern eastern migration flyway (See Ożarowska, A. 2015).

Usage

```
lesser_whitethroats
```

Format

A dataframe with 84 rows and 9 columns:

Region Region of ringing station where bird was captured for measurements

body mass Body mass in Kg. of the birds

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

Wing.span Length of wings spread out in meters

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

Muscle.mass Mass in Kg. of flight muscles calculated as 0.17 fraction of body mass

taxon Order of the species (passerine = 1 vs non-passerine = 2)

`migrate` *Range Estimation*

Description

Practical range estimation of birds using methods from Pennycuick (2008).

Usage

```
migrate(file, header = TRUE, sep = ",", quote = "\"", dec = ".",
               fill = TRUE, comment.char = "", ...,
               data = NULL, settings = list(), method = "cmm",
               speed_control = 1, min_energy_protein = 0.05)
```

Arguments

`file`	Path to file where data resides.
`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 with required columns: body mass (Kg), fat mass (Kg), muscle mass (Kg), wing span (m), wing area (m^2), order / taxon (passerines = 1, non passerines = 2).
`settings`	A list for re-defining constants. See details for these with default values from Pennycuick(2008) and Pennycuick(1998).
`method`	Methods for protein energy consumption from muscle mass

`speed_control` One of two speed control methods. By default *1* is used. *0* is the alternative. The former holds the true airspeed constant while the latter holds the ratio of true airspeed to the minimum power speed constant (V:Vmp constant).

`min_energy_protein`
Percentage of energy attributed to protein due to metabolism. Default value is 5 percent (0.05). If method "csw" or "csp" is chosen, 2 would be attained from consuming protein in the airframe mass.

Details

The option *control takes the following arguments

- ppc: Profile power constant (8.4).
- fed: Energy content of fuel from fat (3.9E+07).
- ped: Energy content of protein (1.8E+07).
- g: Acceleration due to gravity (9.81).
- mce: Mechanical conversion efficiency [0,1]. Efficiency at which mechanical power is converted to chemical power (0.23).
- ipf: Induced power factor (1.2).
- vcp: Ventilation and circulation power (1.1).
- airDensity: Air density at cruising altitude (1.00).
- bdc: Body drag coefficient (0.1).
- alpha: Basal metabolism factors in passerines and non passerines (6.25, 3.79).
- delta: Basal metabolism factors in passerines and non passerines (0.724, 0.723) alpha*bodyMass^delta.
- mipd: Inverse power density of the mitochondria (1.2E-06).
- speedRatio: True air speed to minimum power speed ratio (1.2).
- muscDensity: Density of the flight muscles (1060).
- phr: Protein hydration ratio (2.2). Whenever protein is consumed from the muscle mass some amount of water is lost in the process. This water is estimated as the mass of dry protein time the phr.

Value

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

- range estimates (Km)
- remaining body mass (Kg)
- remaining fat mass (Kg)
- remaining muscle mass (Kg)
- minimum power speed at start of flight (m/s)
- minimum power speed at end of flight (m/s)
- taxon (order)

Author(s)

Brian Masinde

Examples

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

`stopover.mass.calculator`

Stopover mass calculator

Description

During stop-overs birds replenish fat mass. Using simplifications from Lindström 1991. The implementation here is simplistic in that muscle mass is not restored as theory and field experiments have shown.

Usage

```
stopover.mass.calculator(bodyMass, fatMass, taxon, duration)
```

Arguments

`bodyMass`	left-over after running function migrate
`fatMass`	left-over after running function migrate
`taxon`	(or order) classified into two categories (passerines and non-passerines)
`duration`	number of hours spent at stop-over site. This must be an integer see example

Value

fat_mass, body_mass

Examples

```
stopover.mass.calculator(bodyMass = c(2.2, 3.4), fatMass = c(0.34, 0.42),
taxon = c(1,2), duration = 36L)
```

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