Revision plan

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Data from Boddy et al. 2012.

There exist two data-files:

1. Supplement to the published article available at https://onlinelibrary.wiley.com/action/downloadSupplement?
   doi=10.1111%2Fj.1420-9101.2012.02491.x&file=JEB__2491__sm__TableS1.xlsx. This data-file does not
   contain measurement errors but contains the trait values used in the paper.
2. data-file available on dryad https://datadryad.org/bitstream/handle/10255/dryad.37960/brain__body__
   database_v2.txt?sequence=1. This data-file contains individual counts and standard deviation estimates
   for some of the species.

Join the two files according to species name:

```r
data.BoddyEtAl.1.file <- download.file(
  "https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1111%2Fj.1420-9101.2012.02491.x&fil
  destfile = tmppath("jeb_2491_sm_tables1.xlsx"))

cat("File downloaded to ", tmppath("jeb_2491_sm_tables1.xlsx"), "\n")

# read the data into a data.table
data.BoddyEtAl.1 <- as.data.table(read_excel(tmppath("jeb_2491_sm_tables1.xlsx")))

# use species names without spaes to annotate the tips
data.BoddyEtAl.1[, SpeciesName2:=sapply(`Species Name`, function(sn) gsub(" ", "_", sn))]

data.BoddyEtAl.1 <- data.BoddyEtAl.1[, list(SpeciesName2,
                                            `Species Name`,
                                            Order,
                                            `Brain Mass (g)`,
                                            `Body Mass (g)`,
                                            Reference,
                                            Notes)]

setkey(data.BoddyEtAl.1, SpeciesName2)
# the one species that was not included in the tree provided by
# Prof. Dr. Joerg Stelling was Microtus_pennsylvanicus
#data.BoddyEtAl.1 <- data.BoddyEtAl.1[SpeciesName2 != "Microtus_pennsylvanicus"]

data.BoddyEtAl.2.file <- download.file(
  "https://datadryad.org/bitstream/handle/10255/dryad.37960/brain_body_database_v2.txt?sequence=1",
  destfile = tmppath("brain_body_database_v2.txt"))

cat("File downloaded to ", tmppath("brain_body_database_v2.txt"), "\n")

data.BoddyEtAl.2 <- as.data.table(read.table(tmppath("brain_body_database_v2.txt"), header = TRUE, sep =
```

Species names consist of two words separated by a space. We concatenate them and replace the space by an underscore to avoid possible bugs due to spaces in later procedures. The same ids will be used as tip.labels in the phylogenetic tree.

```r
# SpeciesName2 will be the key column in both tables
data.BoddyEtAl.2[, SpeciesName2:=sapply(
  Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.,
  function(sn) gsub(" ", "_", sn))]

# problem: There is no 1-to-1 mapping between SpeciesName2 in data.BoddyEtAl.2 and
# data.BoddyEtAl.1.
# This returns 51 entries
setdiff(data.BoddyEtAl.1$SpeciesName2, data.BoddyEtAl.2$SpeciesName2)
```

```
##  [1] "Aethomys_namaquensis"      "Agouti_paca"
##  [3] "Arctocephalus_pusillus"    "Arvicola_terrestris"
##  [5] "Balaenoptera_borealis"     "Chaerephon_pumila"
##  [7] "Clethrionomys_gapperi"     "Clethrionomys_glareolus"
##  [9] "Clethrionomys_rufocanus"   "Clethrionomys_rutilus"
## [11] "Cynopterus_horsfieldi"     "Dasycercus_byrnei"
## [13] "Funisciurus_pyrropus"      "Galagoides_demidoff"
## [15] "Gazella_thomsonii"         "Gerbillus_campestris"
## [17] "Gerbillus_dasyurus"        "Hydrochaeris_hydrochaeris"
## [19] "Hylobates_syndactylus"     "Lobodon_carcinophagus"
## [21] "Megaptera_novaeangliae"    "Melomys_levipes"
## [23] "Melomys_rubex"             "Mimon_crenulatum"
## [25] "Miniopterus_schreibersi"   "Murexia_rothschildi"
## [27] "Myomys_daltoni"            "Myotis_bechsteini"
## [29] "Myotis_daubentoni"         "Myoxus_glis"
## [31] "Nannospalax_ehrenbergi"    "Ornithorhynchus_anatinus"
## [33] "Otaria_byronia"            "Pappogeomys_gymnurus"
## [35] "Phacochoerus_aethiopicus"  "Phoca_caspica"
## [37] "Phoca_fasciata"            "Phoca_hispida"
## [39] "Phoca_sibirica"            "Pogonomelomys_sevia"
## [41] "Procolobus_badius"         "Rousettus_egyptiacus"
## [43] "Sminthopsis_laniger"       "Spermophilus_franklinii"
## [45] "Stenomys_niobe"            "Stenomys_verecundus"
## [47] "Tachyglossus_aculeatus"    "Tamiops_macclellandi"
## [49] "Tatera_afra"               "Tatera_brantsii"
## [51] "Zaglossus_bruijni"
```

```r
data.BoddyEtAl.2[, SpeciesName3:=sapply(
  Species.Name..from.original.article.,
  function(sn) gsub(" ", "_", sn))]

data.BoddyEtAl.2[SpeciesName3 %in% setdiff(data.BoddyEtAl.1$SpeciesName2,
                                           data.BoddyEtAl.2$SpeciesName2),
                 SpeciesName2:=SpeciesName3]

# This returns 26 entries
setdiff(data.BoddyEtAl.1$SpeciesName2, data.BoddyEtAl.2$SpeciesName2)
```

```
##  [1] "Arctocephalus_pusillus"    "Balaenoptera_borealis"
##  [3] "Chaerephon_pumila"         "Cynopterus_horsfieldi"
##  [5] "Dasycercus_byrnei"         "Funisciurus_pyrropus"
##  [7] "Galagoides_demidoff"       "Gazella_thomsonii"
##  [9] "Megaptera_novaeangliae"    "Mimon_crenulatum"
## [11] "Myomys_daltoni"            "Myotis_bechsteini"
```

```
## [13] "Myotis_daubentoni"       "Ornithorhynchus_anatinus"
## [15] "Phacochoerus_aethiopicus" "Pogonomelomys_sevia"
## [17] "Procolobus_badius"        "Rousettus_egyptiacus"
## [19] "Sminthopsis_laniger"      "Spermophilus_franklinii"
## [21] "Stenomys_niobe"           "Stenomys_verecundus"
## [23] "Tachyglossus_aculeatus"   "Tamiops_macclellandi"
## [25] "Tatera_brantsii"          "Zaglossus_bruijni"
```

```r
missingNamesInData.BoddyEtAl.2 <-
  setdiff(data.BoddyEtAl.1$SpeciesName2, data.BoddyEtAl.2$SpeciesName2)
for(i in seq_along(missingNamesInData.BoddyEtAl.2)) {
  name <- missingNamesInData.BoddyEtAl.2[i]
  cat("i:", i, ", data.BoddyEtAl.1$SpeciesName2:", name, "\n")
  name1 <- strsplit(name, split="_")[[1]][1]
  name2 <- strsplit(name, split="_")[[1]][2]
  # find matches in data.BoddyEtAl.2 according to first letter in name1 and first 3 letters in name2
  cat("data.BoddyEtAl.1:\n")
  print(data.BoddyEtAl.1[SpeciesName2==name])
  cat("data.BoddyEtAl.2:\n")
  Is <- data.BoddyEtAl.2[, .I[sapply(seq_along(SpeciesName2), function(j) {
    sn2 <- SpeciesName2[j]
    updn <- Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.[j]
    orign <- Species.Name..from.original.article.[j]

    (!sn2 %in% data.BoddyEtAl.1$SpeciesName2) &&
      ((length(grep(substr(name1, 1, 1), sn2)) > 0 &&
        length(grep(substr(name2, 1, 3), sn2)) > 0) ||
         (length(grep(substr(name1, 1, 1), updn)) > 0 &&
            length(grep(paste0(" ", substr(name2, 1, 3)), updn)) > 0) ||
         (length(grep(substr(name1, 1, 1), orign)) > 0 &&
            length(grep(paste0(" ", substr(name2, 1, 3)), orign)) > 0))
  })]]
  print(data.BoddyEtAl.2[Is, cbind(I=Is, .SD)])
  cat("\n===========================================================================\n")
}
```

```
## i: 1 , data.BoddyEtAl.1$SpeciesName2: Arctocephalus_pusillus
## data.BoddyEtAl.1:
##             SpeciesName2        Species Name     Order Brain Mass (g)
## 1: Arctocephalus_pusillus Arctocephalus pusillus Carnivora      369.375
##    Body Mass (g)        Reference Notes
## 1:       178750 Bininda-Emonds 2000  <NA>
## data.BoddyEtAl.2:
##     I
## 1: 87
## 2: 88
## 3: 89
## 4: 90
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                             Arctocephalus pusillus
## 2:                                             Arctocephalus pusillus
## 3:                                             Arctocephalus pusillus
## 4:                                             Arctocephalus pusillus
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:     Arctocephalus pusillus doriferus Carnivora          NA
```

```
## 2:       Arctocephalus pusillus pusillus Carnivora           NA
## 3:      Arctocephalus pusillus doriferus Carnivora           NA
## 4:       Arctocephalus pusillus pusillus Carnivora           NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                             NA          352.5
## 2:                             NA          322.5
## 3:                             NA          425.0
## 4:                             NA          377.5
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA         78000
## 2:                            NA         78000
## 3:                            NA        279500
## 4:                            NA        279500
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class
## 1:                           NA   F               1     Adult
## 2:                           NA   F               1     Adult
## 3:                           NA   M               1     Adult
## 4:                           NA   M               1     Adult
##                Source Notes          SpeciesName2
## 1: Bininda-Emonds 2000       Arctocephalus_pusillus_
## 2: Bininda-Emonds 2000       Arctocephalus_pusillus_
## 3: Bininda-Emonds 2000       Arctocephalus_pusillus_
## 4: Bininda-Emonds 2000       Arctocephalus_pusillus_
##                     SpeciesName3
## 1: Arctocephalus_pusillus_doriferus
## 2:  Arctocephalus_pusillus_pusillus
## 3: Arctocephalus_pusillus_doriferus
## 4:  Arctocephalus_pusillus_pusillus
##
## ============================================================================
## i: 2 , data.BoddyEtAl.1$SpeciesName2: Balaenoptera_borealis
## data.BoddyEtAl.1:
##            SpeciesName2         Species Name          Order
## 1: Balaenoptera_borealis Balaenoptera borealis Cetartiodactyla
##    Brain Mass (g) Body Mass (g)                              Reference
## 1:           4900      36666667 Jacobs & Jensen 1964; Silva & Downing 1995
##    Notes
## 1:  <NA>
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## ============================================================================
## i: 3 , data.BoddyEtAl.1$SpeciesName2: Chaerephon_pumila
## data.BoddyEtAl.1:
##         SpeciesName2      Species Name      Order Brain Mass (g)
## 1: Chaerephon_pumila Chaerephon pumila Chiroptera           0.29
##    Body Mass (g)          Reference Notes
## 1:          13.3 Pirlot & Stephan 1970  <NA>
## data.BoddyEtAl.2:
##      I
## 1: 347
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                          Chaerephon pumilus
##    Species.Name..from.original.article.     Order Brain.Volume
```

```
## 1:                  Chaerophon limbatus Chiroptera              NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           0.29
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          13.3
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>               4     Adult
##                   Source Notes        SpeciesName2       SpeciesName3
## 1: Pirlot & Stephan 1970       Chaerophon_pumilus Chaerophon_limbatus
##
## ==========================================================================
## i: 4 , data.BoddyEtAl.1$SpeciesName2: Cynopterus_horsfieldi
## data.BoddyEtAl.1:
##              SpeciesName2         Species Name     Order Brain Mass (g)
## 1: Cynopterus_horsfieldi Cynopterus horsfieldi Chiroptera         1.23
##    Body Mass (g)          Reference Notes
## 1:            53 Pirlot & Stephan 1970  <NA>
## data.BoddyEtAl.2:
##      I
## 1: 432
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                             Cynopterus horsfieldii
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:          Cynopterus horsfeldii Chiroptera           NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           1.23
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA            53
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>              15     Adult
##                   Source Notes        SpeciesName2
## 1: Pirlot & Stephan 1970       Cynopterus_horsfieldii
##          SpeciesName3
## 1: Cynopterus_horsfeldii
##
## ==========================================================================
## i: 5 , data.BoddyEtAl.1$SpeciesName2: Dasycercus_byrnei
## data.BoddyEtAl.1:
##         SpeciesName2    Species Name           Order Brain Mass (g)
## 1: Dasycercus_byrnei Dasycercus byrnei Dasyuromorphia        1.554
##    Body Mass (g)                  Reference Notes
## 1:          98.4 Ashwell 2007; Silva & Downing 1995  <NA>
## data.BoddyEtAl.2:
##      I
## 1: 457
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                               Dasyuroides byrnei
##    Species.Name..from.original.article.      Order Brain.Volume
## 1:            Dasyuroides byrnei Dasyuromorphia          1.5
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                            0.19          1.554
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA           98.4
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
```

```
## 1:                                     25.1 <NA>               13     Adult
##         Source                                   Notes       SpeciesName2
## 1: Ashwell 2007 Age class estimated from body mass Dasyuroides_byrnei
##         SpeciesName3
## 1: Dasyuroides_byrnei
##
## ============================================================================
## i: 6 , data.BoddyEtAl.1$SpeciesName2: Funisciurus_pyrropus
## data.BoddyEtAl.1:
##          SpeciesName2        Species Name    Order Brain Mass (g)
## 1: Funisciurus_pyrropus Funisciurus pyrropus Rodentia         4.38
##    Body Mass (g) Reference
## 1:          200 Mace 1981
##                                                                    Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
##      I
## 1: 644
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                   Funisciurus pyrrhopus
##    Species.Name..from.original.article.   Order Brain.Volume
## 1:                 Funisciurus pyrrhops Rodentia          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           4.38
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          200
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class    Source
## 1:                           NA M&F              NA    Adult Mace 1981
##                                                                    Notes
## 1: "Brain mass corrected, subtracted 0.59g from brain weight, see Isler 2006"
##          SpeciesName2        SpeciesName3
## 1: Funisciurus_pyrrhopus Funisciurus_pyrrhops
##
## ============================================================================
## i: 7 , data.BoddyEtAl.1$SpeciesName2: Galagoides_demidoff
## data.BoddyEtAl.1:
##          SpeciesName2        Species Name    Order Brain Mass (g)
## 1: Galagoides_demidoff Galagoides demidoff Primates         3.38
##    Body Mass (g)                      Reference Notes
## 1:           81 Stephan 1981; Silva & Downing 1995  <NA>
## data.BoddyEtAl.2:
##      I
## 1: 645
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                      Galago demidoff
##    Species.Name..from.original.article.   Order Brain.Volume
## 1:                 Galago demidovii Primates          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           3.38
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA           81
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>               2    Adult
##         Source                                   Notes       SpeciesName2
```

```
## 1: Stephan 1981 Age class estimated from body mass Galago_demidoff
##        SpeciesName3
## 1: Galago_demidovii
##
## ============================================================================
## i: 8 , data.BoddyEtAl.1$SpeciesName2: Gazella_thomsonii
## data.BoddyEtAl.1:
##          SpeciesName2      Species Name           Order Brain Mass (g)
## 1: Gazella_thomsonii Gazella thomsonii Cetartiodactyla          91.8
##    Body Mass (g)                            Reference Notes
## 1:        24370 Crile & Quiring 1940; Silva & Downing 1995  <NA>
## data.BoddyEtAl.2:
##      I
## 1: 616
## 2: 617
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                          Eudorcas thomsonii
## 2:                                          Eudorcas thomsonii
##    Species.Name..from.original.article.       Order Brain.Volume
## 1:              Gazella thomsoni Cetartiodactyla         NA
## 2:              Gazella thomsoni Cetartiodactyla         NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                            NA          54.61
## 2:                            NA          91.80
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                          NA         2430
## 2:                          NA        24370
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class
## 1:                          NA   F               1    Infant
## 2:                          NA   M               2     Adult
##             Source                             Notes
## 1: Crile & Quiring 1940
## 2: Crile & Quiring 1940 Age class estimated from body mass
##         SpeciesName2     SpeciesName3
## 1: Eudorcas_thomsonii Gazella_thomsoni
## 2: Eudorcas_thomsonii Gazella_thomsoni
##
## ============================================================================
## i: 9 , data.BoddyEtAl.1$SpeciesName2: Megaptera_novaeangliae
## data.BoddyEtAl.1:
##              SpeciesName2          Species Name          Order
## 1: Megaptera_novaeangliae Megaptera novaeangliae Cetartiodactyla
##    Brain Mass (g) Body Mass (g)                                  Reference
## 1:         6100      30050000 Jacobs & Jensen 1964; Silva & Downing 1995
##    Notes
## 1:  <NA>
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## ============================================================================
## i: 10 , data.BoddyEtAl.1$SpeciesName2: Mimon_crenulatum
## data.BoddyEtAl.1:
##        SpeciesName2     Species Name     Order Brain Mass (g)
## 1: Mimon_crenulatum Mimon crenulatum Chiroptera          0.34
```

```
##    Body Mass (g)              Reference Notes
## 1:          14.8 Pirlot & Stephan 1970   <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1148
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                           Mimon crenulatum
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:                  Mimon crenulatum  Chiroptera          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                             NA           0.34
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                           NA          14.8
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                          NA <NA>               5     Adult
##                 Source Notes     SpeciesName2       SpeciesName3
## 1: Pirlot & Stephan 1970     Mimon_crenulatum_ Mimon_crenulatum_
##
## =============================================================================
## i: 11 , data.BoddyEtAl.1$SpeciesName2: Myomys_daltoni
## data.BoddyEtAl.1:
##       SpeciesName2   Species Name    Order Brain Mass (g) Body Mass (g)
## 1: Myomys_daltoni Myomys daltoni Rodentia          0.68            35
##    Reference
## 1: Mace 1981
##                                                                   Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## =============================================================================
## i: 12 , data.BoddyEtAl.1$SpeciesName2: Myotis_bechsteini
## data.BoddyEtAl.1:
##         SpeciesName2      Species Name     Order Brain Mass (g)
## 1: Myotis_bechsteini Myotis bechsteini Chiroptera         0.265
##    Body Mass (g)            Reference Notes
## 1:          7.5 Pirlot & Stephan 1970   <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1197
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                           Myotis bechsteinii
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:                 Myotis bechsteinii Chiroptera          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                             NA          0.265
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                           NA           7.5
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                          NA <NA>               2     Adult
##                 Source Notes     SpeciesName2       SpeciesName3
## 1: Pirlot & Stephan 1970     Myotis_bechsteinii Myotis_bechsteinii
##
## =============================================================================
```

```
## i: 13 , data.BoddyEtAl.1$SpeciesName2: Myotis_daubentoni
## data.BoddyEtAl.1:
##         SpeciesName2     Species Name      Order Brain Mass (g)
## 1: Myotis_daubentoni Myotis daubentoni Chiroptera           0.23
##    Body Mass (g)           Reference Notes
## 1:            7 Pirlot & Stephan 1970  <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1200
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                               Myotis daubentonii
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:               Myotis daubentonii Chiroptera          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                            NA          0.23
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                           NA             7
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>               1     Adult
##                Source Notes       SpeciesName2      SpeciesName3
## 1: Pirlot & Stephan 1970      Myotis_daubentonii Myotis_daubentonii
##
## ============================================================================
## i: 14 , data.BoddyEtAl.1$SpeciesName2: Ornithorhynchus_anatinus
## data.BoddyEtAl.1:
##                 SpeciesName2             Species Name        Order
## 1: Ornithorhynchus_anatinus Ornithorhynchus anatinus Monotremata
##    Brain Mass (g) Body Mass (g)    Reference Notes
## 1:       10.08323          1389 Macrini 2006  <NA>
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## ============================================================================
## i: 15 , data.BoddyEtAl.1$SpeciesName2: Phacochoerus_aethiopicus
## data.BoddyEtAl.1:
##                 SpeciesName2             Species Name           Order
## 1: Phacochoerus_aethiopicus Phacochoerus aethiopicus Cetartiodactyla
##    Brain Mass (g) Body Mass (g)                            Reference
## 1:            125         65320 Crile & Quiring 1940; Silva & Downing 1995
##    Notes
## 1:  <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1469
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                             Phacochoerus aethiopicus
##    Species.Name..from.original.article.        Order Brain.Volume
## 1:         Phacochoerus aethiopicus Cetartiodactyla          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                            NA           125
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                           NA         65320
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class
## 1:                           NA   M               1     Adult
```

```
##                   Source                              Notes
## 1: Crile & Quiring 1940 Age class estimated from body mass
##                 SpeciesName2              SpeciesName3
## 1: Phacochoerus_aethiopicus_ Phacochoerus_aethiopicus_
## 
## =======================================================================
## i: 16 , data.BoddyEtAl.1$SpeciesName2: Pogonomelomys_sevia
## data.BoddyEtAl.1:
##           SpeciesName2       Species Name    Order Brain Mass (g)
## 1: Pogonomelomys_sevia Pogonomelomys sevia Rodentia          1.49
##    Body Mass (g) Reference
## 1:          61.4 Mace 1981
##                                                                    Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
##    I
## 1: 1
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                        Abeomelomys sevia
##    Species.Name..from.original.article.   Order Brain.Volume
## 1:                       Pogomys sevia Rodentia           NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           1.49
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          61.4
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class    Source
## 1:                           NA M&F              NA     Adult Mace 1981
##                                                                    Notes
## 1: "Brain mass corrected, subtracted 0.59g from brain weight, see Isler 2006"
##         SpeciesName2 SpeciesName3
## 1: Abeomelomys_sevia Pogomys_sevia
## 
## =======================================================================
## i: 17 , data.BoddyEtAl.1$SpeciesName2: Procolobus_badius
## data.BoddyEtAl.1:
##         SpeciesName2      Species Name    Order Brain Mass (g)
## 1: Procolobus_badius Procolobus badius Primates            78
##    Body Mass (g)                      Reference Notes
## 1:          7000 Stephan 1981; Silva & Downing 1995  <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1508
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                      Piliocolobus badius
##    Species.Name..from.original.article.   Order Brain.Volume
## 1:                       Colobus badius Primates           NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA             78
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          7000
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>               2     Adult
##         Source                              Notes         SpeciesName2
## 1: Stephan 1981 Age class estimated from body mass Piliocolobus_badius
```

```
##         SpeciesName3
## 1: Colobus_badius
##
## ===========================================================================
## i: 18 , data.BoddyEtAl.1$SpeciesName2: Rousettus_egyptiacus
## data.BoddyEtAl.1:
##              SpeciesName2          Species Name       Order Brain Mass (g)
## 1: Rousettus_egyptiacus Rousettus egyptiacus Chiroptera             2.6
##    Body Mass (g)            Reference Notes
## 1:          130 Pirlot & Stephan 1970  <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1663
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                  Rousettus aegyptiacus
##    Species.Name..from.original.article.     Order Brain.Volume
## 1:             Rousettus aegyptiacus Chiroptera          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA            2.6
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          130
##    Body.Mass.Standard.Deviation  Sex No..Individuals Age.Class
## 1:                           NA <NA>                5     Adult
##               Source Notes          SpeciesName2          SpeciesName3
## 1: Pirlot & Stephan 1970     Rousettus_aegyptiacus Rousettus_aegyptiacus
##
## ===========================================================================
## i: 19 , data.BoddyEtAl.1$SpeciesName2: Sminthopsis_laniger
## data.BoddyEtAl.1:
##            SpeciesName2          Species Name          Order Brain Mass (g)
## 1: Sminthopsis_laniger Sminthopsis laniger Dasyuromorphia        0.48692
##    Body Mass (g)                       Reference Notes
## 1:         17.8 Ashwell 2007; Silva & Downing 1995  <NA>
## data.BoddyEtAl.2:
##       I
## 1: 1834
## 2: 1835
## 3: 1836
## 4: 1837
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                  Symphalangus syndactylus
## 2:                                                  Symphalangus syndactylus
## 3:                                                  Symphalangus syndactylus
## 4:                                                  Symphalangus syndactylus
##    Species.Name..from.original.article.    Order Brain.Volume
## 1:            Symphalangus syndactylus Primates          NA
## 2:            Symphalangus syndactylus Primates          NA
## 3:            Symphalangus syndactylus Primates          NA
## 4:            Symphalangus syndactylus Primates          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA          128.0
## 2:                              NA          139.5
## 3:                              NA          133.0
## 4:                              NA          138.7
```

```
##      Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                             NA         11793
## 2:                             NA         12701
## 3:                             NA         12744
## 4:                             NA         11450
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class
## 1:                           NA   F               1     Adult
## 2:                           NA   F               1     Adult
## 3:                           NA   M               1     Adult
## 4:                           NA   M               1     Adult
##                       Source
## 1:           Hrdlicka 1925
## 2:           Hrdlicka 1925
## 3:           Hrdlicka 1925
## 4: Sherwood data/this study
##                                                                    Notes
## 1:          Weighed about 6 months after laying in preservative (10% formalin)
## 2:
## 3:          Weighed about 6 months after laying in preservative (10% formalin)
## 4: Estimated age of species: 33y; Body mass estimated from Silva & Downing 1995
##                SpeciesName2             SpeciesName3
## 1: Symphalangus_syndactylus Symphalangus_syndactylus
## 2: Symphalangus_syndactylus Symphalangus_syndactylus
## 3: Symphalangus_syndactylus Symphalangus_syndactylus
## 4: Symphalangus_syndactylus Symphalangus_syndactylus
##
## ===========================================================================
## i: 20 , data.BoddyEtAl.1$SpeciesName2: Spermophilus_franklinii
## data.BoddyEtAl.1:
##                SpeciesName2          Species Name    Order Brain Mass (g)
## 1: Spermophilus_franklinii Spermophilus franklinii Rodentia         3.82
##    Body Mass (g) Reference
## 1:         455.5 Mace 1981
##                                                                    Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
##       I
## 1: 1777
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                  Spermophilus franklinli
##    Species.Name..from.original.article.    Order Brain.Volume
## 1:            Spermophilus franklinli Rodentia           NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           3.82
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA         455.5
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class    Source
## 1:                           NA M&F              NA     Adult Mace 1981
##                                                                    Notes
## 1: "Brain mass corrected, subtracted 0.59g from brain weight, see Isler 2006"
##                SpeciesName2             SpeciesName3
## 1: Spermophilus_franklinli Spermophilus_franklinli
##
## ===========================================================================
```

```
## i: 21 , data.BoddyEtAl.1$SpeciesName2: Stenomys_niobe
## data.BoddyEtAl.1:
##      SpeciesName2   Species Name    Order Brain Mass (g) Body Mass (g)
## 1: Stenomys_niobe Stenomys niobe Rodentia           1.1          42.1
##    Reference
## 1: Mace 1981
##                                                                  Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## =============================================================================
## i: 22 , data.BoddyEtAl.1$SpeciesName2: Stenomys_verecundus
## data.BoddyEtAl.1:
##            SpeciesName2        Species Name    Order Brain Mass (g)
## 1: Stenomys_verecundus Stenomys verecundus Rodentia           1.48
##    Body Mass (g) Reference
## 1:          59.4 Mace 1981
##                                                                  Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## =============================================================================
## i: 23 , data.BoddyEtAl.1$SpeciesName2: Tachyglossus_aculeatus
## data.BoddyEtAl.1:
##              SpeciesName2            Species Name       Order
## 1: Tachyglossus_aculeatus Tachyglossus aculeatus Monotremata
##    Brain Mass (g) Body Mass (g)    Reference Notes
## 1:       20.73437          4250 Macrini 2006  <NA>
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## =============================================================================
## i: 24 , data.BoddyEtAl.1$SpeciesName2: Tamiops_macclellandi
## data.BoddyEtAl.1:
##            SpeciesName2         Species Name    Order Brain Mass (g)
## 1: Tamiops_macclellandi Tamiops macclellandi Rodentia           1.95
##    Body Mass (g) Reference
## 1:            39 Mace 1981
##                                                                  Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
##       I
## 1: 1866
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                                     Tamiops macclellandii
##    Species.Name..from.original.article.    Order Brain.Volume
## 1:             Tamiops macclellandii Rodentia          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           1.95
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA           39
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class    Source
```

```
## 1:                            NA M&F              NA     Adult Mace 1981
##                                                                      Notes
## 1: "Brain mass corrected, subtracted 0.59g from brain weight, see Isler 2006"
##            SpeciesName2         SpeciesName3
## 1: Tamiops_macclellandii Tamiops_macclellandii
##
## ==========================================================================
## i: 25 , data.BoddyEtAl.1$SpeciesName2: Tatera_brantsii
## data.BoddyEtAl.1:
##        SpeciesName2    Species Name    Order Brain Mass (g) Body Mass (g)
## 1: Tatera_brantsii Tatera brantsii Rodentia         1.56          91.7
##    Reference
## 1: Mace 1981
##                                                                     Notes
## 1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## data.BoddyEtAl.2:
##      I
## 1: 666
##    Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of.the.World.
## 1:                                        Gerbilliscus brantsii
##    Species.Name..from.original.article.    Order Brain.Volume
## 1:                      Tatera brantsi Rodentia          NA
##    Brain.Volume.Standard.Deviation Brain.Mass..g.
## 1:                              NA           1.56
##    Brain.Mass.Standard.Deviation Body.Mass..g.
## 1:                            NA          91.7
##    Body.Mass.Standard.Deviation Sex No..Individuals Age.Class    Source
## 1:                           NA M&F              NA     Adult Mace 1981
##                                                                      Notes
## 1: "Brain mass corrected, subtracted 0.59g from brain weight, see Isler 2006"
##            SpeciesName2    SpeciesName3
## 1: Gerbilliscus_brantsii Tatera_brantsi
##
## ==========================================================================
## i: 26 , data.BoddyEtAl.1$SpeciesName2: Zaglossus_bruijni
## data.BoddyEtAl.1:
##         SpeciesName2      Species Name      Order Brain Mass (g)
## 1: Zaglossus_bruijni Zaglossus bruijni Monotremata      37.34677
##    Body Mass (g)    Reference Notes
## 1:          7500 Macrini 2006  <NA>
## data.BoddyEtAl.2:
## Empty data.table (0 rows) of 17 cols: I,Updated.Species.Name..from.Wilson...Reeder.Mammal.Species.of
##
## ==========================================================================
```

```r
# manually found matches

manual.Match <- list()

manual.Match[["Arctocephalus_pusillus"]] <- 87:90
manual.Match[["Chaerephon_pumila"]] <- 347
manual.Match[["Cynopterus_horsfieldi"]] <- 432
manual.Match[["Dasycercus_byrnei"]] <- 457
manual.Match[["Funisciurus_pyrropus"]] <- 644
```

```r
manual.Match[["Galagoides_demidoff"]] <- 645
manual.Match[["Gazella_thomsonii"]] <- 616:617
manual.Match[["Mimon_crenulatum"]] <- 1148
manual.Match[["Myotis_bechsteini"]] <- 1197
manual.Match[["Myotis_daubentoni"]] <- 1200
manual.Match[["Phacochoerus_aethiopicus"]] <- 1469
manual.Match[["Pogonomelomys_sevia"]] <- 1
manual.Match[["Procolobus_badius"]] <- 1508
manual.Match[["Rousettus_egyptiacus"]] <- 1663
manual.Match[["Spermophilus_franklinii"]] <- 1777
manual.Match[["Tamiops_macclellandi"]] <- 1866
manual.Match[["Tatera_brantsii"]] <- 666
manual.Match[["Myomys_daltoni"]] <- 1556
manual.Match[["Sminthopsis_laniger"]] <- 48
manual.Match[["Stenomys_niobe"]] <- 1632
manual.Match[["Stenomys_verecundus"]] <- 1645

for(name in names(manual.Match)) {
  data.BoddyEtAl.2[manual.Match[[name]], SpeciesName2:=name]
  data.BoddyEtAl.1[
    list(name),
    Notes:=paste0(Notes[!is.na(Notes)],
                  "; Mitov: Manual match with lines ",
                  toString(manual.Match[[name]]),
                  " in data.BoddyEtAl.2. ")]
}
```

```r
# only 5 entries left without a matching row in data.BoddyEtAl.2
data.BoddyEtAl.1[
  list(setdiff(data.BoddyEtAl.1$SpeciesName2, data.BoddyEtAl.2$SpeciesName2))]
```

```
##                  SpeciesName2              Species Name         Order
## 1:     Balaenoptera_borealis     Balaenoptera borealis Cetartiodactyla
## 2:    Megaptera_novaeangliae    Megaptera novaeangliae Cetartiodactyla
## 3: Ornithorhynchus_anatinus Ornithorhynchus anatinus     Monotremata
## 4:    Tachyglossus_aculeatus    Tachyglossus aculeatus     Monotremata
## 5:           Zaglossus_bruijni          Zaglossus bruijni     Monotremata
##     Brain Mass (g) Body Mass (g)                                Reference
## 1:     4900.00000      36666667 Jacobs & Jensen 1964; Silva & Downing 1995
## 2:     6100.00000      30050000 Jacobs & Jensen 1964; Silva & Downing 1995
## 3:       10.08323          1389                               Macrini 2006
## 4:       20.73437          4250                               Macrini 2006
## 5:       37.34677          7500                               Macrini 2006
##     Notes
## 1:  <NA>
## 2:  <NA>
## 3:  <NA>
## 4:  <NA>
## 5:  <NA>
```

According to Boddy et. Al. 2012, only measurements from adult and non-emaciated individuals were used. The measurements for a given species have been averaged over males and females. For Rodentias reported in Mace et Al. 1981, a correction to the Brain-mass was done by subtracting 0.59 grams following the prescription from Isler & van Schaik 2006 (Boddy et Al. 2012).

We begin by filtering out the "emaciated" and the non-adult measurements from data.BodyEtAl.2:

```r
data.BoddyEtAl.2 <- data.BoddyEtAl.2[
  setdiff(seq_len(.N), grep("emaciated", Notes))][
    Age.Class=="Adult",
    list(
      SpeciesName2,
      Order = Order,
      Brain.Mass..g., Brain.Mass.SD = Brain.Mass.Standard.Deviation,
      Body.Mass..g., Body.Mass.SD = Body.Mass.Standard.Deviation,
      Sex, No..Individuals, Source, Notes)]

setkey(data.BoddyEtAl.2, SpeciesName2)
```

The Order Erinaceomorpha'' for 13 of the measurements in data.BodyEtAl.2 differred from the Order for the corresponding species in data.BodyEtAl.1. We correct for this by taking for true the orderEulypotiphla" stated in data.BodyEtAl.1:

```r
# to see which measurements have differring order:
data.BoddyEtAl.2[
  data.BoddyEtAl.1[, list(SpeciesName2, Order)]][Order!=i.Order]
```

```
##               SpeciesName2          Order Brain.Mass..g. Brain.Mass.SD
##  1:   Atelerix_albiventris   Erinaceomorpha           2.24            NA
##  2:        Atelerix_algirus   Erinaceomorpha           3.20            NA
##  3:     Erinaceus_europaeus   Erinaceomorpha           2.26            NA
##  4:     Erinaceus_europaeus   Erinaceomorpha           3.77            NA
##  5:     Erinaceus_europaeus   Erinaceomorpha           3.35            NA
##  6:     Erinaceus_europaeus   Erinaceomorpha           6.50            NA
##  7:     Erinaceus_europaeus   Erinaceomorpha           3.60            NA
##  8:     Erinaceus_europaeus   Erinaceomorpha           3.50            NA
##  9:     Erinaceus_europaeus   Erinaceomorpha           3.00            NA
## 10:     Erinaceus_europaeus   Erinaceomorpha           3.30            NA
## 11:     Erinaceus_europaeus   Erinaceomorpha           3.50            NA
## 12:     Erinaceus_europaeus   Erinaceomorpha           3.30            NA
## 13:     Erinaceus_europaeus   Erinaceomorpha           3.50            NA
## 14:     Erinaceus_europaeus   Erinaceomorpha           3.00            NA
## 15:     Hemiechinus_auritus   Erinaceomorpha           1.90            NA
## 16: Tragelaphus_eurycerus Cetartiodactyla         389.00            NA
##     Body.Mass..g. Body.Mass.SD  Sex No..Individuals
##  1:         280.0           NA  M&F               NA
##  2:         790.0           NA <NA>                3
##  3:         372.0           NA <NA>                1
##  4:         697.0           NA  M&F               NA
##  5:         860.0           NA <NA>                5
##  6:         718.0           NA <NA>                1
##  7:         669.0           NA <NA>                1
##  8:         515.0           NA <NA>                1
##  9:         497.8           NA <NA>                1
## 10:         925.0           NA <NA>                1
## 11:         920.0           NA <NA>                1
## 12:         985.0           NA <NA>                1
## 13:         448.0           NA <NA>                1
## 14:         690.0           NA <NA>                1
## 15:         250.0           NA <NA>                3
```

```
## 16:      253000.0         NA    F             NA
##                          Source
##  1:              Mace 1981
##  2:           Stephan 1981
##  3:        Glendenning 1998
##  4:              Mace 1981
##  5:           Stephan 1981
##  6:           Warncke 1908
##  7:           Warncke 1908
##  8:           Warncke 1908
##  9:           Warncke 1908
## 10:           Warncke 1908
## 11:           Warncke 1908
## 12:           Warncke 1908
## 13:           Warncke 1908
## 14:           Warncke 1908
## 15:           Stephan 1981
## 16: Sherwood data/this study
##                                                              Notes
##  1:
##  2:                              Age class estimated from body mass
##  3:
##  4:
##  5:                              Age class estimated from body mass
##  6:
##  7:
##  8:
##  9:
## 10:
## 11:
## 12:
## 13:
## 14:
## 15:                              Age class estimated from body mass
## 16: Estimated age of species: 9.5 y; Body mass estimated from Silva & Downing 1995
##              i.Order
##  1:    Eulipotyphla
##  2:    Eulipotyphla
##  3:    Eulipotyphla
##  4:    Eulipotyphla
##  5:    Eulipotyphla
##  6:    Eulipotyphla
##  7:    Eulipotyphla
##  8:    Eulipotyphla
##  9:    Eulipotyphla
## 10:    Eulipotyphla
## 11:    Eulipotyphla
## 12:    Eulipotyphla
## 13:    Eulipotyphla
## 14:    Eulipotyphla
## 15:    Eulipotyphla
## 16: Cetartiodactyla
```

```r
# delete the Order column from data.BoddyEtAl.2
data.BoddyEtAl.2[, Order:=NULL]

data.BoddyEtAl.2 <- data.BoddyEtAl.2[
  data.BoddyEtAl.1[, list(SpeciesName2, Order)]]
```

```r
# 8
data.BoddyEtAl.2[, list(
  Brain.Mass..g. = mean(Brain.Mass..g., na.rm = TRUE),
  Body.Mass..g. = mean(Body.Mass..g., na.rm = TRUE)),
  keyby = SpeciesName2][data.BoddyEtAl.1][is.na(Body.Mass..g.) | is.na(Brain.Mass..g.)]
```

```
##              SpeciesName2 Brain.Mass..g. Body.Mass..g.
## 1:            Agouti_paca           28.9           NaN
## 2:    Balaenoptera_borealis          NaN           NaN
## 3:    Balaenoptera_physalus          NaN           NaN
## 4:     Hylobates_syndactylus         NaN           NaN
## 5:   Megaptera_novaeangliae          NaN           NaN
## 6: Ornithorhynchus_anatinus          NaN           NaN
## 7:    Tachyglossus_aculeatus         NaN           NaN
## 8:        Zaglossus_bruijni          NaN           NaN
##            Species Name          Order Brain Mass (g) Body Mass (g)
## 1:            Agouti paca       Rodentia       35.21667          4607
## 2:    Balaenoptera borealis Cetartiodactyla  4900.00000      36666667
## 3:    Balaenoptera physalus Cetartiodactyla  5100.00000      62500000
## 4:     Hylobates syndactylus       Primates    134.80000         12172
## 5:   Megaptera novaeangliae Cetartiodactyla  6100.00000      30050000
## 6: Ornithorhynchus anatinus    Monotremata     10.08323          1389
## 7:    Tachyglossus aculeatus    Monotremata     20.73437          4250
## 8:        Zaglossus bruijni    Monotremata     37.34677          7500
##                                      Reference Notes
## 1:            Crile & Quiring 1940; Warncke 1908  <NA>
## 2:          Jacobs & Jensen 1964; Silva & Downing 1995  <NA>
## 3:          Jacobs & Jensen 1964; Silva & Downing 1995  <NA>
## 4: Hrdlicka 1925; Sherwood/this study; Silva & Downing 1995  <NA>
## 5:          Jacobs & Jensen 1964; Silva & Downing 1995  <NA>
## 6:                              Macrini 2006  <NA>
## 7:                              Macrini 2006  <NA>
## 8:                              Macrini 2006  <NA>
```

```r
# 579
data.BoddyEtAl.2[, list(Brain.Mass..g. = mean(Brain.Mass..g.),
                 Body.Mass..g. = mean(Body.Mass..g.)),
          keyby = SpeciesName2][data.BoddyEtAl.1][
          !is.na(Body.Mass..g.) & !is.na(Brain.Mass..g.) &
            abs(Body.Mass..g.-`Body Mass (g)`) <= .1 &
              abs(Brain.Mass..g.-`Brain Mass (g)`) <= 0.001]
```

```
##              SpeciesName2 Brain.Mass..g. Body.Mass..g.
##   1:        Acomys_wilsoni      0.5800000      18.50000
##   2:     Aepyceros_melampus    175.0000000   57610.00000
##   3:     Aeromys_tephromelas    10.3400000    1189.00000
##   4: Aethomys_chrysophilus      1.2500000     117.00000
##   5:        Aethomys_hindei      1.4200000     146.30000
##  ---
```

```
## 575:        Xerus_rutilus       5.0900000     317.50000
## 576: Zalophus_californianus   405.0000000   91000.00000
## 577:       Zapus_hudsonius       0.5493667      17.46667
## 578:        Zapus_princeps       0.5000000      24.50000
## 579:   Zygogeomys_trichopus       3.9471600     545.00000
##                Species Name         Order Brain Mass (g) Body Mass (g)
##   1:          Acomys wilsoni      Rodentia     0.5800000      18.50000
##   2:      Aepyceros melampus Cetartiodactyla   175.0000000   57610.00000
##   3:     Aeromys tephromelas      Rodentia    10.3400000    1189.00000
##   4:  Aethomys chrysophilus      Rodentia     1.2500000     117.00000
##   5:         Aethomys hindei      Rodentia     1.4200000     146.30000
##  ---
## 575:          Xerus rutilus      Rodentia     5.0900000     317.50000
## 576: Zalophus californianus     Carnivora   405.0000000   91000.00000
## 577:         Zapus hudsonius      Rodentia     0.5493667      17.46667
## 578:          Zapus princeps      Rodentia     0.5000000      24.50000
## 579:    Zygogeomys trichopus      Rodentia     3.9471600     545.00000
##                                            Reference
##   1:                Mace 1981, Silva & Downing 1995
##   2:         Crile & Quiring 1940, Silva & Downing 1995
##   3:                                        Mace 1981
##   4:                                        Mace 1981
##   5:                                        Mace 1981
##  ---
## 575:                                        Mace 1981
## 576:                             Bininda-Emonds 2000
## 577: Mace 1981; Crile & Quiring 1940; Silva & Downing 1995
## 578:                                        Mace 1981
## 579:                                      Hafner 1984
##                                                                    Notes
##   1: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##   2:                                                                  <NA>
##   3: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##   4: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##   5: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##  ---
## 575: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 576:                                                                  <NA>
## 577: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 578: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 579:                                                                  <NA>
```

```r
# 44
data.BoddyEtAl.2[, list(Brain.Mass..g. = mean(Brain.Mass..g., na.rm = TRUE),
                  Body.Mass..g. = mean(Body.Mass..g., na.rm = TRUE)),
              keyby = SpeciesName2][data.BoddyEtAl.1][
              abs(Body.Mass..g. - `Body Mass (g)`) > .1 |
                abs(Brain.Mass..g. - `Brain Mass (g)`) > 0.001]
```

```
##           SpeciesName2 Brain.Mass..g. Body.Mass..g.
## 1:          Agouti_paca      28.900000           NaN
## 2:        Aplodontia_rufa       6.450000     743.00000
## 3:      Callithrix_pygmaea      4.650000     134.75000
## 4:      Castor_canadensis     44.355000   22635.00000
## 5:        Cavia_porcellus       4.775000     460.75000
```

```
##  6:         Cheirogaleus_medius     3.346667      179.66667
##  7:        Chlorocebus_aethiops    57.235000     2932.00000
##  8:         Cynomys_ludovicianus     5.485000     1021.75000
##  9:        Dasypus_novemcinctus     8.180000     3495.66667
## 10:          Dipodomys_merriami     0.863320       37.93333
## 11:         Erinaceus_europaeus     3.548333      691.40000
## 12:              Eulemur_macaco    23.075000     1887.12500
## 13:         Galago_senegalensis     5.225000      277.75000
## 14:             Geomys_bursarius     1.668720      189.83333
## 15:             Gorilla_gorilla   444.590909   118159.09091
## 16: Hydrochaeris_hydrochaeris    63.000000    18150.00000
## 17:         Hylobates_muelleri   101.800000     5700.00000
## 18:          Isoodon_macrourus     2.379560      415.30500
## 19:      Leontopithecus_rosalia    13.240000      512.37500
## 20:                Macaca_maura   110.566667     6515.00000
## 21:              Macaca_mulatta    84.564760     4481.50000
## 22:             Microtus_arvalis     0.570000       30.40000
## 23:       Microtus_pennsylvanicus     0.770000       37.30000
## 24:       Nannospalax_ehrenbergi     0.510000       50.00000
## 25:                 Nasua_narica    33.735000     3324.50000
## 26:          Nycticebus_coucang    11.776000      717.40000
## 27:       Odocoileus_virginianus   185.000000    39673.33333
## 28:           Ondatra_zibethicus     4.730000     1372.90000
## 29:              Pan_troglodytes   354.807516    60433.15789
## 30: Paradoxurus_hermaphroditus    28.200000     2500.00000
## 31:                Procyon_lotor    37.650000     4809.00000
## 32:                 Ratufa_indica    11.500000     1472.50000
## 33:          Saimiri_boliviensis    24.100000      750.00000
## 34:           Scalopus_aquaticus     1.025000       46.30000
## 35:          Sciurus_carolinensis     7.180000      469.12500
## 36:           Sciurus_granatensis     5.910000      343.50000
## 37:                Sorex_araneus     0.200000       10.30000
## 38:       Tamandua_tetradactyla    30.000000     5030.00000
## 39:             Tenrec_ecaudatus     2.570000      832.00000
## 40:            Thomomys_talpoides     1.539080      105.65000
## 41:                 Tupaia_glis     2.610000      157.50000
## 42:           Tursiops_truncatus  1564.737802   162407.40741
## 43:              Ursus_maritimus   388.000000   193430.00000
## 44:                Vulpes_vulpes    49.100000     5972.84314
##                   SpeciesName2 Brain.Mass..g. Body.Mass..g.
##                   Species Name           Order Brain Mass (g)
##  1:                 Agouti paca        Rodentia      35.216667
##  2:               Aplodontia rufa      Rodentia       7.040000
##  3:             Callithrix pygmaea     Primates       4.640000
##  4:             Castor canadensis      Rodentia      52.210000
##  5:               Cavia porcellus      Rodentia       4.833333
##  6:             Cheirogaleus medius    Primates       3.343333
##  7:            Chlorocebus aethiops    Primates      64.133333
##  8:             Cynomys ludovicianus   Rodentia       6.010000
##  9:            Dasypus novemcinctus    Xenarthra      8.500000
## 10:              Dipodomys merriami    Rodentia       1.099980
## 11:             Erinaceus europaeus  Eulipotyphla    3.665455
## 12:                 Eulemur macaco    Primates      22.600000
## 13:             Galago senegalensis    Primates       5.900000
```

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```
## 14:         Geomys bursarius       Rodentia      1.828080
## 15:          Gorilla gorilla       Primates    454.550000
## 16: Hydrochaeris hydrochaeris       Rodentia     75.000000
## 17:        Hylobates muelleri       Primates     95.312500
## 18:         Isoodon macrourus Peramelemorphia      4.579120
## 19:     Leontopithecus rosalia      Primates     13.050000
## 20:              Macaca maura       Primates     94.480000
## 21:            Macaca mulatta       Primates     87.994178
## 22:           Microtus arvalis      Rodentia      0.550000
## 23:     Microtus pennsylvanicus     Rodentia      0.742000
## 24:     Nannospalax ehrenbergi      Rodentia      1.880000
## 25:              Nasua narica     Carnivora     44.170000
## 26:         Nycticebus coucang      Primates     12.742500
## 27:    Odocoileus virginianus Cetartiodactyla    210.000000
## 28:         Ondatra zibethicus      Rodentia      5.030000
## 29:            Pan troglodytes      Primates    354.809659
## 30: Paradoxurus hermaphroditus     Carnivora     25.950000
## 31:             Procyon lotor     Carnivora     41.066667
## 32:              Ratufa indica      Rodentia     11.400000
## 33:        Saimiri boliviensis      Primates     24.060000
## 34:         Scalopus aquaticus   Eulipotyphla      1.480000
## 35:       Sciurus carolinensis      Rodentia      7.410000
## 36:        Sciurus granatensis      Rodentia      5.910000
## 37:              Sorex araneus   Eulipotyphla      0.225000
## 38:     Tamandua tetradactyla      Xenarthra     27.500000
## 39:           Tenrec ecaudatus   Afrosoricida      2.835000
## 40:          Thomomys talpoides      Rodentia      1.244080
## 41:               Tupaia glis     Scandentia      3.200000
## 42:        Tursiops truncatus Cetartiodactyla   1572.996826
## 43:            Ursus maritimus     Carnivora    507.000000
## 44:              Vulpes vulpes     Carnivora     49.640000
##                    Species Name          Order Brain Mass (g)
##      Body Mass (g)
##  1:     4607.00000
##  2:      806.00000
##  3:      134.75000
##  4:    27670.00000
##  5:      476.00000
##  6:      179.66667
##  7:     3452.66667
##  8:      793.50000
##  9:     2743.50000
## 10:       39.40000
## 11:      720.43636
## 12:     2086.16667
## 13:      300.33333
## 14:      197.25000
## 15:   120975.00000
## 16:    28500.00000
## 17:     5954.87500
## 18:      822.00000
## 19:      512.37500
## 20:     6846.00000
## 21:     4612.77778
```

```
## 22:        30.40000
## 23:        30.13333
## 24:       197.00000
## 25:      6250.00000
## 26:       655.50000
## 27:     65090.00000
## 28:      1136.45000
## 29:     60433.15789
## 30:      2773.50000
## 31:      4975.66667
## 32:      1935.00000
## 33:       750.00000
## 34:        39.60000
## 35:       503.16667
## 36:       400.00000
## 37:         8.90000
## 38:      4361.00000
## 39:       907.00000
## 40:       105.65000
## 41:       170.00000
## 42:    170480.00000
## 43:    317000.00000
## 44:      3722.70588
##      Body Mass (g)
##
## 1:                                                     Crile & Quiring 1940; War
## 2:
## 3:                          Stephan 1981; Sherwood/this study; Silva & Dow
## 4:                                                            Crile & Qu
## 5:                          Crile & Quiring 1940; Warncke 1908; Silva & Dow
## 6:                          Stephan 1981; Sherwood/this study; Silva & Dow
## 7:                                                        Bronson 1981; War
## 8:
## 9:                                                            Crile & Qu
## 10:                                                           Hafner 1984,
## 11:                               Mace 1981; Warncke 1908; Silva & Dow
## 12:                                                    Hrdlicka 1925; War
## 13:                     Crile & Quiring 1940; Stephan 1981; Warncke 1908; Silva & Dow
## 14:                                                           Hafner 1984,
## 15:                     Hrdlicka 1925; Stephan 1981; Sherwood/this study; Silva & Dow
## 16:                                           Count 1947; Silva & Dow
## 17:                          Hrdlicka 1925; Sherwood/this study;
## 18:                                             Ashwell 2007; Silva & Dow
## 19:                     Sherwood/this study; Warncke 1908; Silva & Dow
## 20:                     Sherwood/this study; Warncke 1908; Silva & Dow
## 21:     Bronson 1981; Crile & Quiring 1940; Hrdlicka 1925; Rilling 1999; Stephan 1981; Silva & Dow
## 22:
## 23:                          Crile & Quiring 1940; Mace 1981; Silva & Dow
## 24:
## 25:                                     Crile & Quiring 1940; Silva & Dow
## 26:                     Sherwood/this study; Silva & Downing 1995; Stephan 1981; War
## 27:                                     Crile & Quiring 1940; Silva & Dow
## 28:                                     Crile & Quiring 1940; Silva & Dow
## 29: Crile & Quiring 1940; Hrdlicka 1925; Rilling 1999; Sherwood/this study; Silva & Downing 1995; Sto
```

```
## 30:                                                        Warncke 1908; Silva & Dow
## 31:                                    Crile & Quiring 1940; Silva & Dow
## 32:                                                                    Wai
## 33:                                  Sherwood/this study; Silva & Dow
## 34:
## 35:                                    Count 1947; Mace 1981; Silva & Dow
## 36:
## 37:                               Mace 1981; Silva & Downing 1995; Sto
## 38:                  Crile & Quiring 1940; Sherwood/this study; Silva & Dow
## 39:                        Silva & Downing 1995; Stephan 1981; Wai
## 40:                                              Hafner 1984,
## 41:                               Stephan 1981; Silva & Dow
## 42:                                 Marino 2000; Ridgway e
## 43:                                   Count 1947; Crile & Qui
## 44:                     Crile & Quiring 1940; Warncke 1908; Silva & Dow
##
##                                                           Notes
##  1:                                                        <NA>
##  2: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##  3:                                                        <NA>
##  4:                                                        <NA>
##  5:                                                        <NA>
##  6:                                                        <NA>
##  7:                                                        <NA>
##  8: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
##  9:                                                        <NA>
## 10: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 11:                                                        <NA>
## 12:                                                        <NA>
## 13:                                                        <NA>
## 14: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 15:                                                        <NA>
## 16:                                                        <NA>
## 17:                                                        <NA>
## 18:                                                        <NA>
## 19:                                                        <NA>
## 20:                                                        <NA>
## 21:                                                        <NA>
## 22: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 23: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 24: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 25:                                                        <NA>
## 26:                                                        <NA>
## 27:                                                        <NA>
## 28:                                                        <NA>
## 29:                                                        <NA>
## 30:                                                        <NA>
## 31:                                                        <NA>
## 32:                                                        <NA>
## 33:                                                        <NA>
## 34:                                                        <NA>
## 35: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 36: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 37:                                                        <NA>
```

```
## 38:                                                               <NA>
## 39:                                                               <NA>
## 40: Corrected body mass for Mace 1981 dataset, see Isler & van Schaik 2006
## 41:                                                               <NA>
## 42:                                                               <NA>
## 43:                                                               <NA>
## 44:                                                               <NA>
##                                                                  Notes
```

Correct brain mass from Rodentia measurements coming originally from Mace et al 1981, by subtracting 0.59
g

```r
data.BoddyEtAl.2[1:.N %in% grep("Mace", Source) & Order == "Rodentia", Brain.Mass..g.:=Brain.Mass..g. -
```

All species in data.BoddyEtAl.1 are present in the data.BoddyEtAl.2?

```r
# this should be TRUE
nrow(data.BoddyEtAl.1) == nrow(data.BoddyEtAl.2[list(data.BoddyEtAl.1$SpeciesName2), list(unique(Specie

# Calculate the standard error in grams for the species where standard deviation is measurable,
# i.e. for No..Individuals > 1.
data.BoddyEtAl.2[, Brain.Mass.Standard.Error:=Brain.Mass.Standard.Deviation/sqrt(No..Individuals)]
data.BoddyEtAl.2[, Body.Mass.Standard.Error:=Body.Mass.Standard.Deviation/sqrt(No..Individuals)]
```

A scatter-plot of the so estimated standard error shows two outliers for the body-mass

```r
par(mfrow=c(2,1))

data.BoddyEtAl.2[!sapply(Body.Mass.Standard.Error, is.na),
                 plot(Body.Mass..g., Body.Mass.Standard.Error)]

data.BoddyEtAl.2[!sapply(Brain.Mass.Standard.Error, is.na),
                 plot(Brain.Mass..g., Brain.Mass.Standard.Error)]

data.BoddyEtAl.2[!sapply(Body.Mass.Standard.Error, is.na) &
                   Body.Mass..g. < 6e5 &
                   Body.Mass.Standard.Error < 15000,
                 summary(lm(Body.Mass.Standard.Error~Body.Mass..g.))]

data.BoddyEtAl.2[!sapply(Brain.Mass.Standard.Error, is.na) & Brain.Mass.Standard.Error < 25,
                 summary(lm(Brain.Mass.Standard.Error~Brain.Mass..g.))]

data.BoddyEtAl.2[Body.Mass.Standard.Error < 200 & Body.Mass..g. > 6e5,]
data.BoddyEtAl.2[Brain.Mass.Standard.Error > 25,]


merge(
  data.BoddyEtAl,
  data.BoddyEtAl.2[, list(`Brain Mass (g)`= mean(Brain.Mass..g.),
                          `Body Mass (g)`= mean(Body.Mass..g.)#,
                          # Brain.Mass.Standard.Deviation,
                          # Body.Mass.Standard.Deviation,
                          # No..Individuals,
```

```r
                            # Sex,
                            #Age.Class
  ), keyby=list(SpeciesName2)],
  by = c("SpeciesName2"))

# download the mammal trees from Bininda-Emmonds 2007. The user running that
# code should have access to the following web-address:
trees <- read.nexus(
  "https://media.nature.com/original/nature-assets/nature/journal/v446/n7135/extref/nature05634-s2.txt"
)
# the mmammalST_bestDates tree containing 4510 tips and 2108 internal nodes
tree.big <- trees[[1]]

# prune all tips that are not found in data.BoddyEtAl
tree <- drop.tip(tree.big, tip = setdiff(tree.big$tip.label, data.BoddyEtAl[, SpeciesName2]))

# test that no terminal branches are of length zero : returns FALSE
# any(tree$edge[tree$edge.length==0, 2]<=629)
# delete branches of length 0
tree <- ladderize(di2multi(tree))
# segment long branches
while(TRUE) {
  points <- PCMTreeLocateMidpointsOnBranches(tree, 16)
  if(length(points$nodes) == 0) {
    break
  } else {
    tree <- PCMTreeInsertSingletons(tree, points$nodes, points$positions)
  }
}

usethis::use_data(tree, overwrite = TRUE)

data.BoddyEtAl[, SpeciesName2:=sapply(`Species Name`, function(sn) gsub(" ", "_", sn))]
data.BoddyEtAl <- data.BoddyEtAl[SpeciesName2%in%tree$tip.label]
data.BoddyEtAl[, lg_BodyMass:=log10(`Body Mass (g)`)]
data.BoddyEtAl[, lg_BrainMass:=log10(`Brain Mass (g)`)]
setkey(data.BoddyEtAl, SpeciesName2)
data.BoddyEtAl[list(tree$tip.label), node:=1:.N]
usethis::use_data(data.BoddyEtAl, overwrite = TRUE)

values <- data.BoddyEtAl[list(tree$tip.label), rbind(lg_BodyMass=lg_BodyMass, lg_BrainMass=lg_BrainMass)]
usethis::use_data(values, overwrite = TRUE)

load("Result_FineTuning_BestFit_MammalData_t6.RData")

library(PCMBase)

names(attributes(finalModel))
treeFinalModel <- attr(finalModel, "tree")

PCMTreeGetStartingNodesRegimes(treeFinalModel)

tree2 <- PCMTreeSetRegimes(tree, PCMTreeGetStartingNodesRegimes(treeFinalModel), inplace = FALSE)
```

```r
PCMTreeGetStartingNodesRegimes(treeFinalModel)
PCMTreeGetStartingNodesRegimes(tree2)

attr(finalModel, "X") <- values
attr(finalModel, "SE") <- values * 0.0
attr(finalModel, "tree") <- tree2

logLik(finalModel)
PCMLik(values, tree2, finalModel)
```