# Package: BayesFR (via r-universe)

June 23, 2026

**Title** Fitting Functional Responses in 1- and 2-Prey Systems

**Version** 1.0.1

**Description** Easy application of Bayesian inference for functional responses via 'brms'. This package allows to fit various FR models for single- and multi-prey experiments by providing nonlinear prediction functions for 'brms'. It uses dynamical prediction models to correct for prey depletion. The 'brms' framework facilitates statistical modeling and enables users to conveniently incorporate covariates such as temperature gradients, experimental treatment variables, or random effects that account for grouping in experimental units. Default 'brms' functions make it easy to perform model checking, model comparison and hypothesis testing. Potential statistical issues with data from feeding trials, such as overdispersion, can be resolved by effortlessly switching between likelihood functions. This package, together with its tutorials, should provide students and researchers with a comprehensive and integrated statistical framework for easily testing their hypotheses on trophic interactions. References: Rosenbaum and Rall (2018) <doi:10.1111/2041-210X.13039>; Rosenbaum et al. (2024) <doi:10.1111/2041-210X.14372>.

**License** GPL (>= 3)

**Encoding** UTF-8

**URL** https://github.com/benjamin-rosenbaum/BayesFR

**BugReports** https://github.com/benjamin-rosenbaum/BayesFR/issues

**LazyData** TRUE

**Imports** brms, ggplot2, tidyr

**Depends** R (>= 3.5)

**Config/roxygen2/version** 8.0.0

**Suggests** knitr, rmarkdown, testthat (>= 3.0.0)

**Config/testthat/edition** 3

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** https://cran.r-universe.dev

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# Contents

## convert_2sp_to_long *Convert 2-prey data to long format*

### Description

brms requires univariate response values here. Transforms one row with bivariate (NE1,NE2) to two rows with NE=NE1 and NE=NE2, respectively. Species identity of focal prey is saved in column ID, initial abundance of focal prey in column N0, and initial abundance of non-focal, alternative prey in column N0.alt

### Usage

```
convert_2sp_to_long(df)
```

### Arguments

| | |
|---|---|
| `df` | data frame with at least these columns named: N01, N02, NE1, NE2 |

### Value

The transformed data frame

## df_Archer_et_al_2019_JAE *Example dataset for prey mortality*

### Description

Feeding experiment data from Archer et al. (2019a) were downloaded from Dryad (Archer et al. 2019b). Eaten prey were not replaced during the experiment. Includes data for housefly larvae (Limnophora riparia) and caddisfly larva (Potamophylax cingulatus) feeding on blackfly larvae (Simuliidae). Due to prey background mortality, control experiments without predators were performed, too. Includes a temperature gradient and data from 2 settings (lab/field) and from 2 years.

### Usage

```
data(df_Archer_et_al_2019_JAE)
```

### Format

A data frame with 580 rows and 9 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**P0** Number of predators (0 or 1)

**Time** Duration (h)

**Predator** Predator species or control

**Prey** Prey species

**Temperature** Experimental temperature

**Setting** laboratory or field

**Year** 2013 or 2015

### Source

Archer L. C., Sohlström E. H., Gallo B., Jochum M., Woodward G., Kordas R. L., Rall B. C. & O'Gorman E. J. (2019a). Consistent temperature dependence of functional response parameters and their use in predicting population abundance. *Journal of Animal Ecology*, 88:1670-1683. https://doi.org/10.1111/1365-2656.13060

Archer L. C., Sohlström E. H., Gallo B., Jochum M., Woodward G., Kordas R. L., Rall B. C. & O'Gorman E. J. (2019b). Consistent temperature dependence of functional response parameters and their use in predicting population abundance. *Dryad Digital Repository*. https://doi.org/10.5061/dryad.tr4v447

### Examples

```
data(df_Archer_et_al_2019_JAE)
head(df_Archer_et_al_2019_JAE)
```

---

`df_Colton_1987_1_ECOLOGY`

## *Example dataset for multi-species FR with 2 prey*

---

### Description

Feeding experiment data from Colton (1987) were downloaded from Figshare (Novak & Stouffer 2020). Eaten prey were not replaced during the experiment. Includes data for 10th???instar naiads of a damselfly feeding on a cladoceran (Simocephalus serrulatus, species 1) and a copepod (Diaptomus spatulocrenatus, species 2).

### Usage

```
data(df_Colton_1987_1_ECOLOGY)
```

### Format

A data frame with 108 rows and 6 variables:

**N01** Number of initial prey, species 1

**N02** Number of initial prey, species 2

**NE1** Number of eaten prey, species 1

**NE2** Number of eaten prey, species 2

**P0** Number of predators (1)

**Time** Duration (h)

## Details

A single typo (720) was corrected (120).

## Source

Colton, T.F. (1987). Extending functional response models to include a second prey type: an experimental test. *Ecology*, 68: 900-912. https://doi.org/10.2307/1938361

Novak, M., & Stouffer, D. (2020). Data extracted for "Hidden layers of density dependence in consumer feeding rates." *Figshare*. https://doi.org/10.6084/m9.figshare.12830792

## Examples

```
data(df_Colton_1987_1_ECOLOGY)
head(df_Colton_1987_1_ECOLOGY)
```

---

`df_Cuthbert_et_al_2020_ECOL_EVOL`

*Example dataset for categorical predictors*

---

## Description

Feeding experiment data from Cuthbert et al. (2020a) were downloaded from Dryad (Cuthbert et al. 2020b). Eaten prey were not replaced during the experiment. Includes data for two fish species (largemouth bass and bluegill) feeding on tilapia. Both predator and prey were categorized in three size classes, each, with a full factorial treatment.

## Usage

```
data(df_Cuthbert_et_al_2020_ECOL_EVOL)
```

## Format

A data frame with 358 rows and 7 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**PredSize** Predator size class

**PreySize** Prey size class

## Source

Cuthbert R. N., Wassermann R. J., Dalu T., Kaiser H., Weyl O. L. F., Dick J. T. A., Sentis A., McCoy M. W., & Alexander M.E. (2020a). *Influence of intra- and interspecific variation in predator-prey body size ratios on trophic interaction strengths. *Ecology and Evolution*, 10:5946-5962. https://doi.org/10.1002/ece3.6332

Cuthbert R. N., Wassermann R. J., Dalu T., Kaiser H., Weyl O. L. F., Dick J. T. A., Sentis A., McCoy M. W., & Alexander M.E. (2020b). Influence of intra- and interspecific variation in predator-prey body size ratios on trophic interaction strengths. *Dryad Digital Repository*. https://doi.org/10.5061/dryad.7m0cfxppt

## Examples

```
data(df_Cuthbert_et_al_2020_ECOL_EVOL)
head(df_Cuthbert_et_al_2020_ECOL_EVOL)
```

---

`df_Davidson_et_al_2021_FUN_ECOL` *Example dataset for continuous predictors*

---

## Description

Feeding experiment data from Davidson et al. (2021) were downloaded from Dryad (Davidson et al. 2020). Eaten prey were not replaced during the experiment. Includes data for two dragonfly nymph species (Pachydiplax and Erythemis) feeding on mosquito larvae. Experiments were performed on a temperature gradient, and predator size was measured, too.

## Usage

```
data(df_Davidson_et_al_2021_FUN_ECOL)
```

## Format

A data frame with 91 rows and 7 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**Temperature** Experimental temperature

**HeadWidth** Predator size

### Source

Davidson A. T., Hamman, E. A., McCoy M. W., and Vonesh J. R. (2021). Asymmetrical effects of temperature on stage-structured predator-prey interactions. *Functional Ecology* 35: 1041-1054. https://doi.org/10.1111/1365-2435.13777

Davidson A. T., Hamman, E. A., McCoy M. W., and Vonesh J. R. (2020). Asymmetrical effects of temperature on stage-structured predator-prey interactions. *Dryad Digital Repository*. https://doi.org/10.5061/dryad.j6q573nd4

### Examples

```
data(df_Davidson_et_al_2021_FUN_ECOL)
head(df_Davidson_et_al_2021_FUN_ECOL)
```

---

## df_Hossie_and_Murray_2010_OECOLOGIA

*Feeding experiments without prey replacement*

---

### Description

Feeding experiment data from Hossie and Murray (2010) downloaded from the FoRAGE database (Uiterwaal et al. 2022). Eaten prey were not replaced during the experiment. Includes data for a dragonfly nymph predator feeding on tadpoles in three leaf litter treatments.

### Usage

```
data(df_Hossie_and_Murray_2010_OECOLOGIA)
```

### Format

A data frame with 91 rows and 6 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**ID** Leaf litter treatment

### Source

Hossie T. J. and Murray D. S. (2010). You can't run but you can hide: refuge use in frog tadpoles elicits density-dependent predation by dragonfly larvae. *Oecologia*, 163, 395-404. https://doi.org/10.1007/s00442-010-1568-6

Uiterwaal S. F., Lagerstrom I. T., Lyon S. R., and DeLong, J. P. (2022). FoRAGE Database: A Compilation of Functional Responses for Consumers and Parasitoids. *Ecology* 103(7): e3706. https://doi.org/10.1002/ecy.3706

FoRAGE database V5 (2024). https://doi.org/10.5063/F1RX99KB

## Examples

```
data(df_Hossie_and_Murray_2010_OECOLOGIA)
head(df_Hossie_and_Murray_2010_OECOLOGIA)
```

---

df_Michalko_and_Pekar_2017_AM_NAT
*Feeding experiments with prey replacement*

---

## Description

Feeding experiment data from Michalko and Pekar (2017) downloaded from the FoRAGE database (Uiterwaal et al. 2022). Eaten prey were replaced during the experiment. Includes three predator-prey combinations with a top predator (Philodromus buchari), a mesopredator (Dictyna spp.) and a pest (C. pyri).

## Usage

```
data(df_Michalko_and_Pekar_2017_AM_NAT)
```

## Format

A data frame with 63 rows and 6 variables:

**N0** Number of constant prey

**NE** Number of eaten prey

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**ID** Predator-prey combination

## Source

Michalko R. and Pekar S. (2017). The Behavioral Type of a Top Predator Drives the Short-Term Dynamic of Intraguild Predation. *American Naturalist*, 189, 242-253. https://doi.org/10.1086/690501

Uiterwaal S. F., Lagerstrom I. T., Lyon S. R., and DeLong, J. P. (2022). FoRAGE Database: A Compilation of Functional Responses for Consumers and Parasitoids. *Ecology* 103(7): e3706. https://doi.org/10.1002/ecy.3706

FoRAGE database V5 (2024). https://doi.org/10.5063/F1RX99KB

## Examples

```
data(df_Michalko_and_Pekar_2017_AM_NAT)
head(df_Michalko_and_Pekar_2017_AM_NAT)
```

`df_Papanikolaou_et_al_2021_ECOL_EVOL`
*Example dataset for testing predator interference models*

### Description

Feeding experiment data from Papanikolaou et al. (2021a) downloaded from Dryad (Papanikolaou et al. 2021b). Eaten prey were not replaced during the experiment. Includes data for two mirid predators (1st and 5th instar nymphs) feeding on Pyralidae eggs. Includes four predator treatments with 1,2,3 or 4 predators, each.

### Usage

```
data(df_Papanikolaou_et_al_2021_ECOL_EVOL)
```

### Format

A data frame with 327 rows and 7 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**P0** Number of predator individuals

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**ID** 1st or 5th instar nymphs

### Source

Papanikolaou N.E., Dervisoglou S., Fantinou A., Kypraios T., Giakoumaki V., Perdikis D. (2021a). Predator size affects the intensity of mutual interference in a predatory mirid. *Ecology and Evolution* 2021(11): 1342???1351. https://doi.org/10.1002/ece3.7137

Papanikolaou N.E., Dervisoglou S., Fantinou A., Kypraios T., Giakoumaki V., Perdikis D. (2021b). Data from: Predator size affects the intensity of mutual interference in a predatory mirid. *Dryad* https://doi.org/10.5061/dryad.2ngf1vhmj

### Examples

```
data(df_Papanikolaou_et_al_2021_ECOL_EVOL)
head(df_Papanikolaou_et_al_2021_ECOL_EVOL)
```

`df_Schroeder_et_al_2016_OEC`
*Example dataset for random effects (predator individual)*

## Description

Feeding experiment data from Schr??der et al. (2016) were downloaded from Figshare (Kalinkat et al. 2025) under CC BY 4.0. Eaten prey were not replaced during the experiments (2 minutes). Includes data for least killifish (Heterandria formosa, 49 individuals) feeding on nauplii (Artemia salina). Predator individuals were re-used and predator ID was recorded for each trial. Also includes predator size.

## Usage

```
data(df_Schroeder_et_al_2016_OEC)
```

## Format

A data frame with 686 rows and 8 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**Time** Duration (h): 2 min

**ID** Predator individual ID

**Size** Predator individual size (mm)

**Predator** Predator species

**Prey** Prey species

**Trial.time** Trials performed in the morning or evening

## Source

Schröder A., Kalinkat G. & Arlinghaus R. (2016). Individual variation in functional response parameters is explained by body size but not by behavioural types in a poeciliid fish. *Oecologia*, 88:1670???1683. https://doi.org/10.1007/s00442-016-3701-7

Kalinkat G., Schröder A. & Arlinghaus R. (2025). Individual variation in functional response parameters is explained by body size but not by behavioural types in a poeciliid fish. *Figshare*. https://doi.org/10.6084/m9.figshare.24665880

## Examples

```
data(df_Schroeder_et_al_2016_OEC)
head(df_Schroeder_et_al_2016_OEC)
```

`df_Sentis_et_al_2017_GLOBAL_CHANGE_BIOLOGY`
*Example dataset for testing type 2 vs. type 3*

### Description

Feeding experiment data from Sentis et al. (2017) downloaded from the FoRAGE database (Uiterwaal et al. 2022). Eaten prey were not replaced during the experiment. Includes data for three aquatic insect larvae predators feeding on Daphnia prey in two temperature treatments.

### Usage

```
data(df_Sentis_et_al_2017_GLOBAL_CHANGE_BIOLOGY)
```

### Format

A data frame with 327 rows and 7 variables:

**N0** Number of initial prey

**NE** Number of eaten prey

**Time** Duration (h)

**Predator** Predator species

**Prey** Prey species

**ID** Predator-Temperature combination

**Temperature** Temperature treatment

### Source

Sentis A., Gemard C., Jaugeon B., and Boukal D. S. (2017). Predator diversity and environmental change modify the strengths of trophic and nontrophic interactions. *Global Change Biology*, 23: 2629-2640. https://doi.org/10.1111/gcb.13560

Uiterwaal S. F., Lagerstrom I. T., Lyon S. R., and DeLong, J. P. (2022). FoRAGE Database: A Compilation of Functional Responses for Consumers and Parasitoids. *Ecology* 103(7): e3706. https://doi.org/10.1002/ecy.3706

FoRAGE database V5 (2024). https://doi.org/10.5063/F1RX99KB

### Examples

```
data(df_Sentis_et_al_2017_GLOBAL_CHANGE_BIOLOGY)
head(df_Sentis_et_al_2017_GLOBAL_CHANGE_BIOLOGY)
```

MS_Type2H_dyn_code *Type 2 multi-species FR without replacement*

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the 2-prey ODE

$$\frac{dN_1}{dt} = -\frac{a_1 N_1}{1 + a_1 h_1 N_1 + a_2 h_2 N_2} P$$
$$\frac{dN_2}{dt} = -\frac{a_2 N_2}{1 + a_1 h_1 N_1 + a_2 h_2 N_2} P$$

to compute number of eaten prey, see Rosenbaum et al. (2024).

## Usage

```
MS_Type2H_dyn_code
```

## Details

Usage in brms formula:

```
~ MS_Type2H_dyn(N0, N0.alt, ID, P, Time, a1, a2, h1, h2)
```

| | |
|---|---|
| `N0` | initial number of focal prey species |
| `N0.alt` | initial number of alternative prey species |
| `ID` | ID of focal species (1 or 2) |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a1` | attack rate for prey species 1 |
| `a2` | attack rate for prey species 2 |
| `h1` | handling time for prey species 1 |
| `h2` | handling time for prey species 2 |

Requires the data to be in a specific "long" format. Use the function `convert_2sp_to_long()` to transform from a dataframe with columns N01, N02, NE1, NE2

## Value

Number of eaten prey

## References

Rosenbaum, B., Li, J., Hirt, M. R., Ryser, R., & Brose, U. (2024). Towards understanding interactions in a complex world: Design and analysis of multi-species functional response experiments. *Methods in Ecology and Evolution,* 15, 1704-1719. https://doi.org/10.1111/2041-210X.14372

`MS_Type3H_dyn_code` *Type 3 multi-species FR without replacement*

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the 2-prey ODE

$$\frac{dN_1}{dt} = -\frac{b_1 N_1^{1+q}}{1 + b_1 h_1 N_1^{1+q} + b_2 h_2 N_2^{1+q}} P$$

$$\frac{dN_2}{dt} = -\frac{b_2 N_2^{1+q}}{1 + b_1 h_1 N_1^{1+q} + b_2 h_2 N_2^{1+q}} P$$

to compute number of eaten prey, see Rosenbaum et al. (2024).

## Usage

```
MS_Type3H_dyn_code
```

## Details

Usage in brms formula:

```
~ MS_Type3H_dyn(N0, N0.alt, ID, P, Time, b1, b2, h1, h2, q)
```

| | |
|---|---|
| `N0` | initial number of focal prey species |
| `N0.alt` | initial number of alternative prey species |
| `ID` | ID of focal species (1 or 2) |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b1` | attack coefficient for prey species 1 |
| `b2` | attack coefficient for prey species 2 |
| `h1` | handling time for prey species 1 |
| `h2` | handling time for prey species 2 |
| `q` | attack rate exponent |

Requires the data to be in a specific "long" format. Use the function `convert_2sp_to_long()` to transform from a dataframe with columns N01, N02, NE1, NE2

## Value

Number of eaten prey

## References

Rosenbaum, B., Li, J., Hirt, M. R., Ryser, R., & Brose, U. (2024). Towards understanding interactions in a complex world: Design and analysis of multi-species functional response experiments. *Methods in Ecology and Evolution,* 15, 1704-1719. https://doi.org/10.1111/2041-210X.14372

`MS_TypeY_dyn_code` *Yodzis FR without replacement*

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the 2-prey ODE

$$\frac{dN_1}{dt} = -\frac{w_1 a_1 N_1^{1+r}}{(w_1 N_1^r + (1-w_1) N_2^r) + w_1 a_1 h_1 N_1^{1+r} + (1-w_1) a_2 h_2 N_2^{1+r}} P$$
$$\frac{dN_2}{dt} = -\frac{(1-w_1) a_2 N_2^{1+r}}{(w_1 N_1^r + (1-w_1) N_2^r) + w_1 a_1 h_1 N_1^{1+r} + (1-w_1) a_2 h_2 N_2^{1+r}} P$$

to compute number of eaten prey, see Rosenbaum et al. (2024).

## Usage

```
MS_TypeY_dyn_code
```

## Details

Usage in brms formula:

```
~ MS_TypeY_dyn(N0, N0.alt, ID, P, Time, a1, a2, h1, h2, w1, r)
```

| | |
|---|---|
| `N0` | initial number of focal prey species |
| `N0.alt` | initial number of alternative prey species |
| `ID` | ID of focal species (1 or 2) |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a1` | attack rate for prey species 1 |
| `a2` | attack rate for prey species 2 |
| `h1` | handling time for prey species 1 |
| `h2` | handling time for prey species 2 |
| `w1` | preference weight for species 1 in multi-prey |
| `r` | additional exponent in multi-prey only |

Requires the data to be in a specific "long" format. Use the function `convert_2sp_to_long()` to transform from a dataframe with columns N01, N02, NE1, NE2

## Value

Number of eaten prey

## References

Rosenbaum, B., Li, J., Hirt, M. R., Ryser, R., & Brose, U. (2024). Towards understanding interactions in a complex world: Design and analysis of multi-species functional response experiments. *Methods in Ecology and Evolution,* 15, 1704-1719. https://doi.org/10.1111/2041-210X.14372

`MS_TypeZ_dyn_code` *Generalized switching FR without replacement*

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the 2-prey ODE

$$\frac{dN_1}{dt} = -\frac{w_1 b_1 N_1^{1+q+r}}{(w_1 N_1^r + (1-w_1)N_2^r) + w_1 b_1 h_1 N_1^{1+q+r} + (1-w_1) b_2 h_2 N_2^{1+q+r}} P$$

$$\frac{dN_2}{dt} = -\frac{(1-w_1) b_2 N_2^{1+q+r}}{(w_1 N_1^r + (1-w_1)N_2^r) + w_1 b_1 h_1 N_1^{1+q+r} + (1-w_1) b_2 h_2 N_2^{1+q+r}} P$$

to compute number of eaten prey, see Rosenbaum et al. (2024).

## Usage

```
MS_TypeZ_dyn_code
```

## Details

Usage in brms formula:

```
~ MS_TypeZ_dyn(N0, N0.alt, ID, P, Time, b1, b2, h1, h2, w1, q, r)
```

- `N0` initial number of focal prey species
- `N0.alt` initial number of alternative prey species
- `ID` ID of focal species (1 or 2)
- `P` number of predators
- `Time` duration of the experiment
- `b1` attack coefficient for prey species 1
- `b2` attack coefficient for prey species 2
- `h1` handling time for prey species 1
- `h2` handling time for prey species 2
- `w1` preference weight for species 1 in multi-prey
- `q` attack rate exponent
- `r` additional exponent in multi-prey only

Requires the data to be in a specific "long" format. Use the function `convert_2sp_to_long()` to transform from a dataframe with columns N01, N02, NE1, NE2

## Value

Number of eaten prey

### References

Rosenbaum, B., Li, J., Hirt, M. R., Ryser, R., & Brose, U. (2024). Towards understanding interactions in a complex world: Design and analysis of multi-species functional response experiments. *Methods in Ecology and Evolution,* 15, 1704-1719. https://doi.org/10.1111/2041-210X.14372

---

## `Type1_dyn_code` *Type 1 FR with prey depletion*

---

### Description

Contains Stan function of the same name as character string. Uses analytical solution (exponential function) of the ODE

$$\frac{dN}{dt} = -aNP$$

to compute number of eaten prey.

### Usage

```
Type1_dyn_code
```

### Details

Usage in brms formula:

`~ Type1_dyn(N, P, Time, a)`

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a` | attack rate |

### Value

Number of eaten prey

---

## `Type1_fix_code` *Type 1 FR with prey replacement*

---

### Description

Contains Stan function of the same name as character string. Number of eaten prey:

$$N_E = aNPT$$

### Usage

```
Type1_fix_code
```

### Details

Usage in brms formula:

```
~ Type1_fix(N, P, Time, a)
```

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a` | attack rate |

### Value

Number of eaten prey

---

## `Type2BD_dyn_code` *Functional response models with predator interference*

---

### Description

Contains Stan function of the same name as character string. Uses analytical solution of the **Beddington-DeAngelis** model

$$\frac{dN}{dt} = -\frac{aN}{1 + c(P-1) + ahN} P$$

to compute number of eaten prey. Rogers random predator equation with LambertW function is used with modified attack rates. Predator interference affects attack rates only.

### Usage

```
Type2BD_dyn_code
```

### Details

Usage in brms formula:

```
~ Type2BD_dyn(N, P, Time, a, h, c)
```

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a` | attack rate for P=1 |
| `h` | handling time |
| `c` | predator interference coefficient |

## Value

Number of eaten prey

---

Type2CM_dyn_code *Functional response models with predator interference*

---

## Description

Contains Stan function of the same name as character string. Uses analytical solution of the **Crowley-Martin** model

$$\frac{dN}{dt} = -\frac{aN}{(1 + ahN)(1 + c(P - 1))}P$$

to compute number of eaten prey. Rogers random predator equation with LambertW function is used with modified attack rates and handling times. Predator interference affects attack rates and handling times, both.

## Usage

```
Type2CM_dyn_code
```

## Details

Usage in brms formula:

```
~ Type2CM_dyn(N, P, Time, a, h, c)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| a | attack rate for P=1 |
| h | handling time |
| c | predator interference coefficient |

## Value

Number of eaten prey

`Type2H_dyn_code` *Type 2 FR (Holling) with prey depletion*

## Description

Contains Stan function of the same name as character string. Uses analytical solution (Rogers random predator equation with LambertW function) of the ODE

$$\frac{dN}{dt} = -\frac{aN}{1 + ahN}P$$

to compute number of eaten prey.

## Usage

```
Type2H_dyn_code
```

## Details

Usage in brms formula:

```
~ Type2H_dyn(N, P, Time, a, h)
```

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `a` | attack rate |
| `h` | handling time |

## Value

Number of eaten prey

`Type2H_fix_code` *Type 2 FR (Holling) with prey replacement*

## Description

Contains Stan function of the same name as character string. Number of eaten prey:

$$N_E = \frac{aN}{1 + ahN}PT$$

## Usage

```
Type2H_fix_code
```

### Details

Usage in brms formula:

```
~ Type2H_fix(N, P, Time, a, h)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| a | attack rate |
| h | handling time |

### Value

Number of eaten prey

---

## Type2HV_dyn_code — *Functional response models with predator interference*

---

### Description

Contains Stan function of the same name as character string. Uses analytical solution of the **Hassell-Varley** model

$$\frac{dN}{dt} = -\frac{aN}{P^c + ahN}P$$

to compute number of eaten prey. Rogers random predator equation with LambertW function is used with modified attack rates. Predator interference affects attack rates only.

### Usage

```
Type2HV_dyn_code
```

### Details

Usage in brms formula:

```
~ Type2HV_dyn(N, P, Time, a, h, c)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| a | attack rate for P=1 |
| h | handling time |
| c | predator interference coefficient |

### Value

Number of eaten prey

## `Type3GenH_dyn_code` *Generalized type 3 FR (Holling) with prey depletion*

### Description

Contains Stan function of the same name as character string. Uses numerical solution of the ODE

$$\frac{dN}{dt} = -\frac{bN^{1+q}}{1 + bhN^{1+q}}P$$

to compute number of eaten prey.

### Usage

```
Type3GenH_dyn_code
```

### Details

Usage in brms formula:

`~ Type3GenH_dyn(N, P, Time, b, h, q)`

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b` | attack coefficient |
| `q` | attack exponent |
| `h` | handling time |

### Value

Number of eaten prey

## `Type3GenH_fix_code` *Generalized type 3 FR (Holling) with prey replacement*

### Description

Contains Stan function of the same name as character string. Number of eaten prey:

$$N_E = \frac{bN^{1+q}}{1 + bhN^{1+q}}PT$$

### Usage

```
Type3GenH_fix_code
```

## Details

Usage in brms formula:

`~ Type3GenH_fix(N, P, Time, b, h, q)`

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b` | attack coefficient |
| `q` | attack exponent |
| `h` | handling time |

## Value

Number of eaten prey

---

`Type3GenH_mort_dyn_code` *Functional response models with prey mortality*

---

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the generalized type 3 ODE with an additional mortality term

$$\frac{dN}{dt} = -\frac{bN^{1+q}}{1 + bhN^{1+q}}P - mN$$

to compute number of eaten / dead prey. It can compute predictions for feeding trials (observations with `P>0`) and also control treatments (`P=0`), for which the ODE reduces to

$$\frac{dN}{dt} = -mN$$

The exponent `q` can be fixed for fitting type 2 responses (`q=0`) or type 3 responses (`q=1`), which both do not have an analytical solution with additional and prey mortality have to be predicted using the ODE.

## Usage

```
Type3GenH_mort_dyn_code
```

## Details

Usage in brms formula:

`~ Type3GenH_dyn(N, P, Time, b, h, q, m)`

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b` | attack coefficient |
| `q` | attack exponent |
| `h` | handling time |
| `m` | mortality rate |

Type 2 functional response:

```
~ Type3GenH_dyn(N, P, Time, a, h, 0, m)
```

Type 3 functional response:

```
~ Type3GenH_dyn(N, P, Time, b, h, 1, m)
```

## Value

Number of eaten prey

---

`Type3H_dyn_code` *Type 3 FR (Holling) with prey depletion*

---

## Description

Contains Stan function of the same name as character string. Uses analytical solution (quadratic equation) of the ODE

$$\frac{dN}{dt} = -\frac{bN^2}{1 + bhN^2}P$$

to compute number of eaten prey.

## Usage

```
Type3H_dyn_code
```

## Details

Usage in brms formula:

```
~ Type3H_dyn(N, P, Time, b, h)
```

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b` | attack coefficient |
| `h` | handling time |

### Value

Number of eaten prey

---

## Type3H_fix_code *Type 3 FR (Holling) with prey replacement*

---

### Description

Contains Stan function of the same name as character string. Number of eaten prey:

$$N_E = \frac{bN^2}{1 + bhN^2} PT$$

### Usage

```
Type3H_fix_code
```

### Details

Usage in brms formula:

```
~ Type3H_fix(N, P, Time, b, h)
```

| | |
|---|---|
| `N` | initial number of prey |
| `P` | number of predators |
| `Time` | duration of the experiment |
| `b` | attack coefficient |
| `h` | handling time |

### Value

Number of eaten prey

---

## TypeGenBD_dyn_code *Functional response models with predator interference*

---

### Description

Contains Stan function of the same name as character string. Uses numerical solution of the **(generalized) Beddington-DeAngelis** model

$$\frac{dN}{dt} = -\frac{bN^{1+q}}{1 + c(P-1) + bhN^{1+q}} P$$

to compute number of eaten prey. Predator interference affects attack rates only.

## Usage

```
TypeGenBD_dyn_code
```

## Details

The exponent q can be fixed for fitting type 2 responses (q=0) or type 3 responses (q=1).

Usage in brms formula:

```
~ TypeGenBD_dyn(N, P, Time, b, h, q, c)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| b | attack coefficient for P=1 |
| q | attack exponent |
| h | handling time |
| c | predator interference coefficient |

Type 2 functional response:

```
~ TypeGenBD_dyn(N, P, Time, a, h, 0, c)
```

Type 3 functional response:

```
~ TypeGenBD_dyn(N, P, Time, b, h, 1, c)
```

## Value

Number of eaten prey

---

`TypeGenCM_dyn_code` *Functional response models with predator interference*

---

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the **(generalized) Crowley-Martin** model

$$\frac{dN}{dt} = -\frac{bN^{1+q}}{(1 + bhN^{1+q})(1 + c(P - 1))}P$$

to compute number of eaten prey. Predator interference affects attack rates and handling times, both.

## Usage

```
TypeGenCM_dyn_code
```

## Details

The exponent q can be fixed for fitting type 2 responses (q=0) or type 3 responses (q=1).

Usage in brms formula:

```
~ TypeGenCM_dyn(N, P, Time, b, h, q, c)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| b | attack coefficient for P=1 |
| q | attack exponent |
| h | handling time |
| c | predator interference coefficient |

Type 2 functional response:

```
~ TypeGenCM_dyn(N, P, Time, a, h, 0, c)
```

Type 3 functional response:

```
~ TypeGenCM_dyn(N, P, Time, b, h, 1, c)
```

## Value

Number of eaten prey

---

TypeGenHV_dyn_code *Functional response models with predator interference*

---

## Description

Contains Stan function of the same name as character string. Uses numerical solution of the **(generalized) Hassell-Varley** model

$$\frac{dN}{dt} = -\frac{bN^{1+q}}{P^c + bhN^{1+q}}P$$

to compute number of eaten prey. Predator interference affects attack rates only.

## Usage

```
TypeGenHV_dyn_code
```

### Details

The exponent q can be fixed for fitting type 2 responses (q=0) or type 3 responses (q=1).

Usage in brms formula:

```
~ TypeGenHV_dyn(N, P, Time, b, h, q, c)
```

| | |
|---|---|
| N | initial number of prey |
| P | number of predators |
| Time | duration of the experiment |
| b | attack coefficient for P=1 |
| q | attack exponent |
| h | handling time |
| c | predator interference coefficient |

Type 2 functional response:

```
~ TypeGenHV_dyn(N, P, Time, a, h, 0, c)
```

Type 3 functional response:

```
~ TypeGenHV_dyn(N, P, Time, b, h, 1, c)
```

### Value

Number of eaten prey

# Index