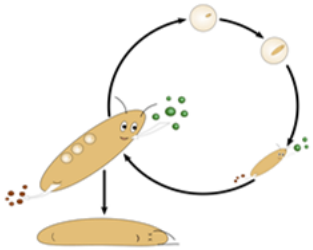
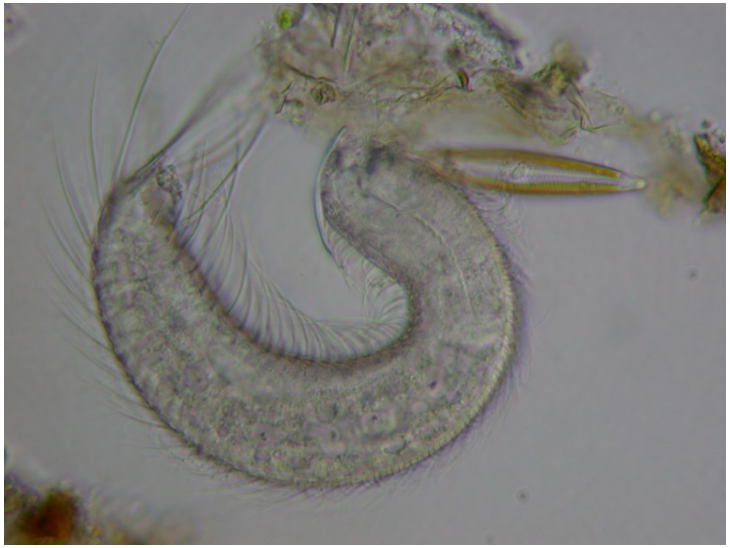


DEB2019 1-12 April 2019 / Brest (France)

Sixth International Symposium and Thematic School
on DEB theory for metabolic organization

What did we learn from the Add_my_Pet data base?



Chaetonotus zelinkai shares with DEB applications that it is very common, but few biologists heard about it

Bas.Kooijman@vu.nl

Brest, 2019/04/10-12
https://deb2019.sciencesconf.org

Contents

- What is AmP?
- Why AmP?
- Reasons to let AmP grow rapidly
- AmP 2017 *vs* 2019
- What did we learn in 10 yr AmP?
- AmP use
- Future developments

What is AmP?

- Name inspired by Wikipedia-type of setup for data-base,
  with curator team in forefront and development into
  direction of a referenced scientific online journal

- Started at 2009/02/12 as part of the DEB course, with a practical part here in Brest

- Database for referenced data, DEB parameters, code, implied properties of animals

- AmP/AmPtool/DEBtool is written in
  (APL, Octave, Excell), Matlab, html, javascript, perl, bibtex, postscript, R, C
  both AmPtool and DEBtool have 4000 files, AmP has 1780 entries

- Platforms: Internet (DEBlab, DEBnet, DEBwiki), GitHub, Zotero, Overleaf, Skype

- Info-flow: DEBvideos youtube channel, Moocs, DEBlist,
  Twitter, Facebook, Researchgate, Symposia, Workshops, special issues,

Marques et al 2018
Plos Comp Biol e1006100

Why AmP?

- the world is at risk: we urgently need to get better control on sustainability (apply DEB theory via AmP)
- Why would you want to know the name of a species?

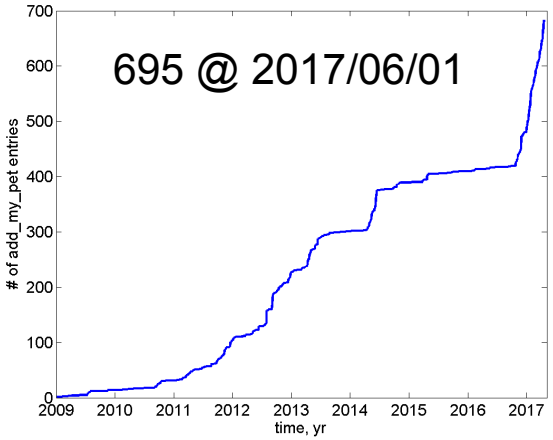
  To google for properties! (ticket to existing knowledge)

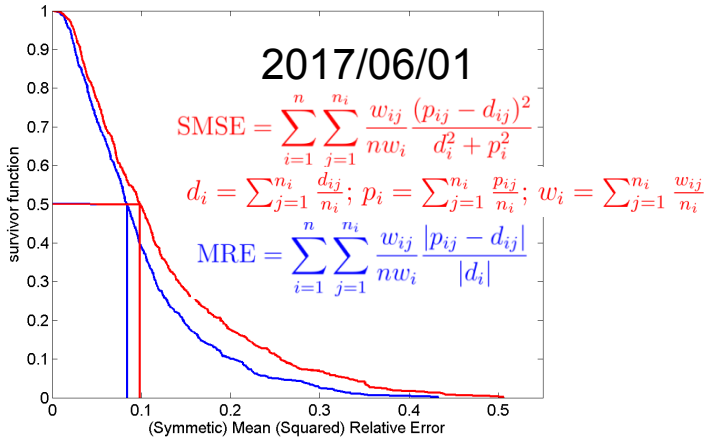
  Why would you want to know DEB parameters of a species?

  To predict properties (that were not measured before)!
- get pars by fitting multiple data sets simultaneously (κ: growth & reproduction)
- comparison of species on the basis of parameter values
- develop tools to avoid good fit for wrong reasons (learning in practice, pseudo-data, context)
- DEB course exercise to stimulate post-course applications (targeting PhD students)

Fundamental difference between description and analysis

AmP entries & fit

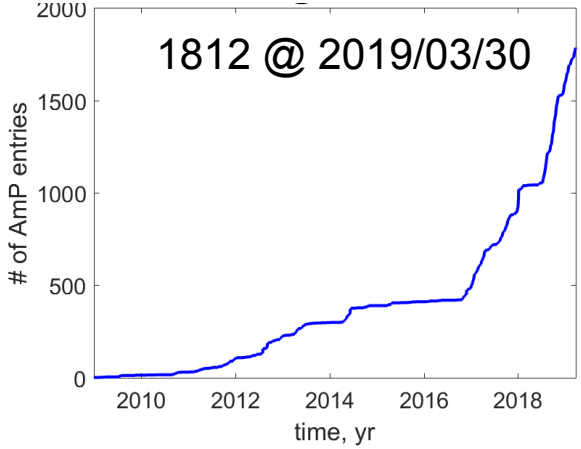


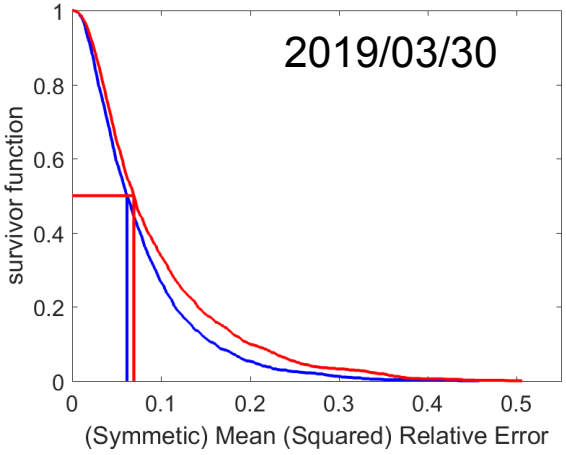


$$\mathrm{SMSE} = \sum_{i=1}^{n} \sum_{j=1}^{n_i} \frac{w_{ij}}{n w_i} \frac{(p_{ij} - d_{ij})^2}{d_i^2 + p_i^2}$$

$$d_i = \sum_{j=1}^{n_i} \frac{d_{ij}}{n_i}; \; p_i = \sum_{j=1}^{n_i} \frac{p_{ij}}{n_i}; \; w_i = \sum_{j=1}^{n_i} \frac{w_{ij}}{n_i}$$

$$\mathrm{MRE} = \sum_{i=1}^{n} \sum_{j=1}^{n_i} \frac{w_{ij}}{n w_i} \frac{|p_{ij} - d_{ij}|}{|d_i|}$$





Reason to let AmP grow rapidly

- understand variation in parameter values
  ([p_M] = 1400 J/d.cm^3 for daphnids, but 20 J/d.cm^3 for fish at 20C)

- test generality of DEB theory
  (new model-varieties in family structure, such as ssj model)
- stimulate contributions from others
  (more appealing to add to a large collection: coherence as means of long-term survival)
- enhance applications (fisheries, culturing, bioconservation, climate change, ecotox)
- eco-evolutionary patterns in parameter values
  (body size-variation, acceleration, waste-to-hurry, supply-demand, altricial-precocial)

- ease parameter estimation by comparison (multiple species)
- transition of website from VU to .. (Naturalis?)
- links with other large websites to enhance longterm survival (EoL, ADW)
- do something useful with old data
- test claims by evolution-theorists on optimality
- last but not least: I learn a lot about properties of species

Difference between AmP at DEB2017 and DEB2019

- then 700, now 1806; more cases with f(t), T(t): integration of estimation and environmental trajectory reconstruction
- changes in the curator team; curation reports/procedure: modular setup
- allStat & allEco on GitHub: eco-coding + selection/visualization functions
- better knowledge of pars and patterns: better context for par-evaluation (151 entries in archive)
- revisions of some basic functions: temperature correction for >1 parameters, maturity for large l_p
- updates on evolutionary tree (detailed trees change more frequently)
- searching in tree, links from entries to list & tree
- links to large websites/data-bases
  general: Catalog of Life, Taxonomicon, EoL, ADW, Wiki, WoRMS,
  specialized: molluscabase, fishbase, amphibiaweb, reptile-database, avibase, msw3, AnAge
- use of clade to identify AmP entries that are most related to one that is not in the collection (Taxonomicon, CoL)
- improved presentation/documentation/archiving/searching: bib's, citation, manual (DEBwiki, AmPtool)
  prt_results_my_pet for iteration results; prt_report_my_pet with searching, comparing species, color coding excentricity
  self-made tree with distribution of statistics; pedigree with statistics
- improved algorithms; confidence intervals based on loss-function profiles
- multi-species parameter estimation, augmented loss functions

Par estimation in context

- DEB parameters can only be estimated from several data sets simultaneously (growth/reproduction/feeding)

- Parameter values must make evo-eco sense: comparison with other species

- Can be estimated for a set of species simultaneously: parameter values can be shared, different or something in between (reduced variance), augmented loss functions

w's	weights
d's	data
p's	predictions
θ's	parameters

$$F_{sb} = \sum_{i=1}^{n} \sum_{j=1}^{n_j} \frac{w_{ij}}{n_j} \frac{(d_{ij} - p_{ij})^2}{d_i^2 + p_j^2} + \sum_{k=1}^{N} \frac{w_k \mathrm{var}(\theta_k)}{\mathrm{mean}(\theta_k)^2} \quad \text{with } d_i = \sum_{j=1}^{n_i} \frac{d_{ij}}{n_i} \quad \text{and } p_i = \sum_{j=1}^{n_i} \frac{p_{ij}}{n_i}$$

- Links between parameter values and eco-labels

What did we learn in 10 yr AmP?

- Metabolism of all animals follows the same DEB rules

  apart from covariation rules:

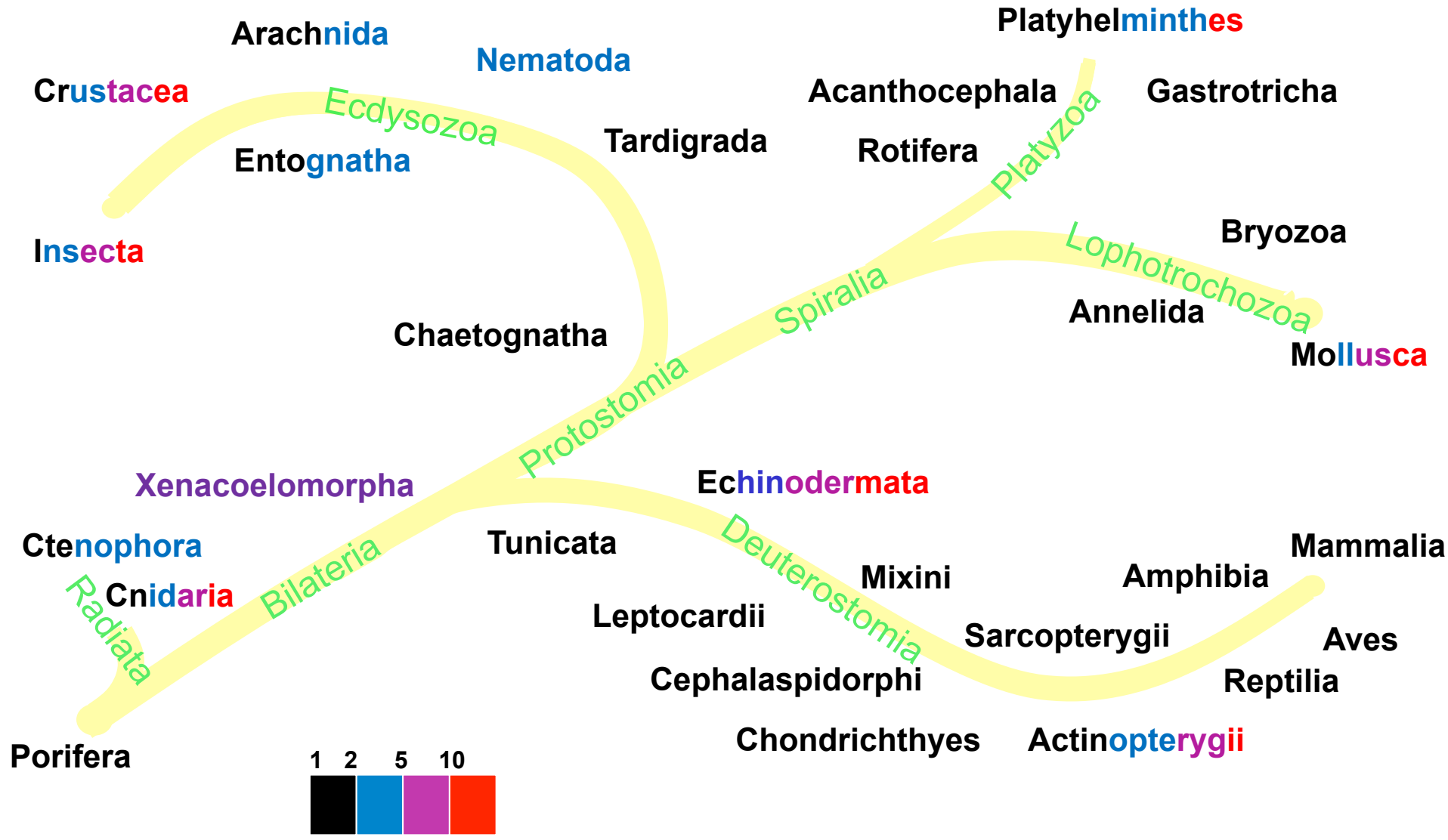
  waste-to-hurry, acceleration, supply-demand & altricial-precocial spectra

  κ is beta-distributed because p_A and p_M are Weibull distributed and has mean 0.9

  E_{Hb} easily deviates from covariation rules, especially for aquatic species with larvae

- Parameter identification is complex and requires context
- Completeness of available data is low
- Data in the literature is frequently inconsistent
- Wide acceptance grows slowly, but will be inevitable
- Development of applications is not easy, requires multidisciplinary appraoches, but no alternatives exist
- Progress is fast

Acceleration



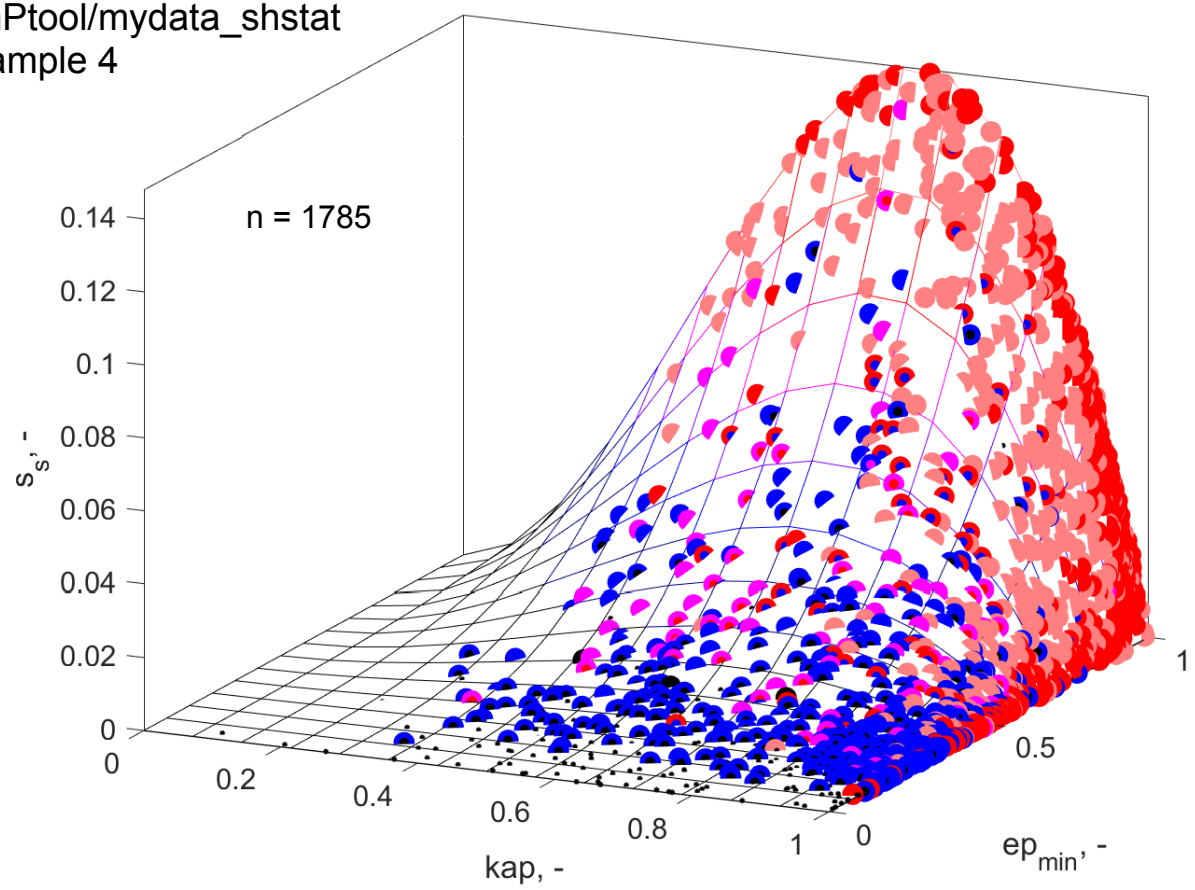
Supply-demand spectrum

Supply	Demand
eat what is available	eat what is needed
high half saturation coefficient	low half saturation coefficient
can handle large range of intake	can handle small range of intake
reserve density varies wildly	reserve density varies little
large range of ultimate sizes	small range of ultimate sizes
survives some shrinking well	survives shrinking badly
physiological birth control	behavioural birth control
low peak metabolic rate	high peak metabolic rate
open circulatory system	closed circulatory system
iso- & centro-lecithal eggs	a- & telo-lecithal eggs
rather passive, simple behaviour	rather active, complex behaviour
sensors less developed	sensors well developed
typically ectothermic	typically endothermic
evolutionary original	evolved from supply systems
has demand components (maintenance)	has supply components (some food must be available)

Lika et al 2014
J. Theor Biol. **354**:35-47

Supply-demand spectrum

AmPtool/mydata_shstat
example 4

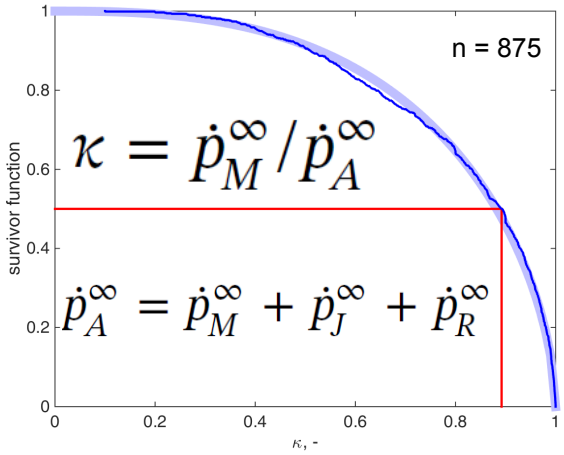


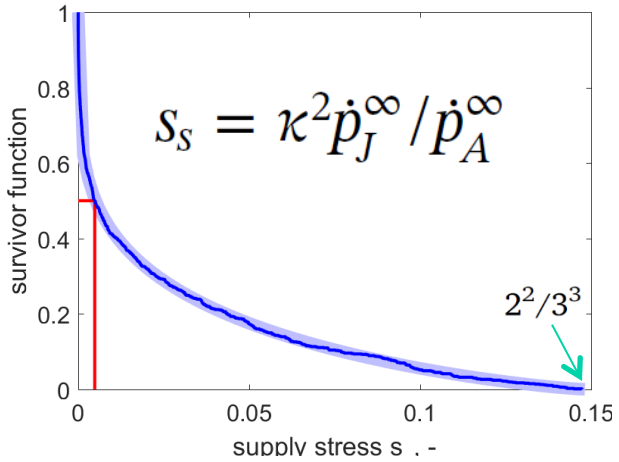
ep_{min}: scaled func resp such that growth ceases at puberty
s_s: supply stress
kap: allocation fraction to soma

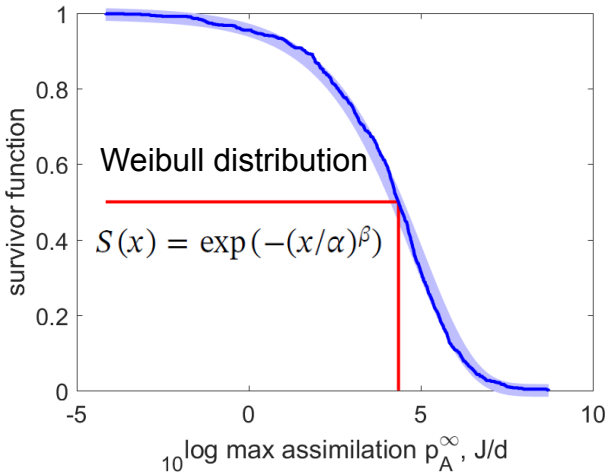
The small deviations from the surface $s_s(\kappa, e_p^{min}) = e_p^3 \kappa^2 (1-\kappa)$ are caused by acceleration s_M dependeng on food level

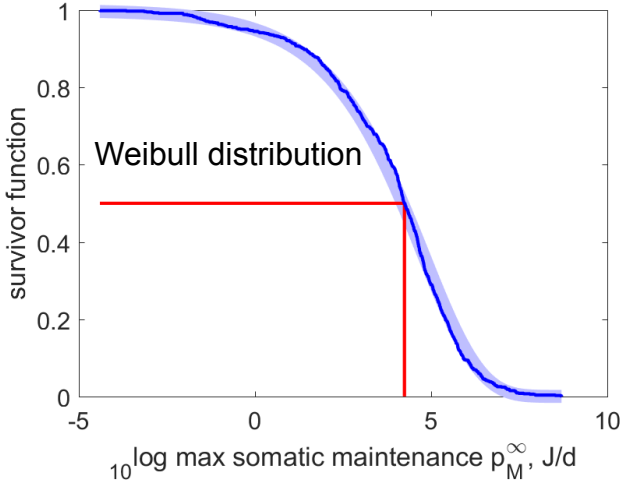
puberty is controlled by E_H^p but s_s and kap don´t directly relate to E_H^p

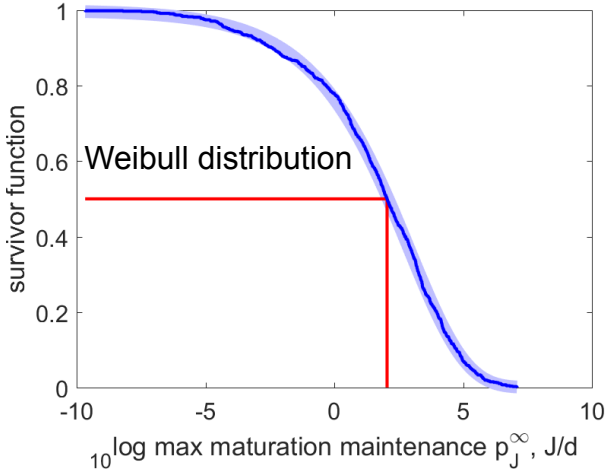
K and s_s are β-distributed

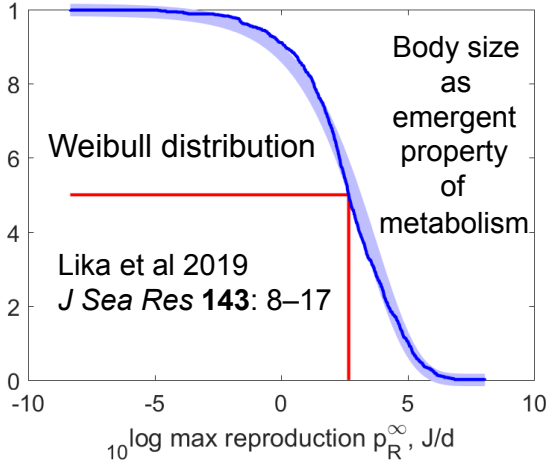












Altricial - Precocial spectra

Altricial vs precocial evolution

Both birds and mammals evolved 250 Ma ago

Birds: precocial → altricial

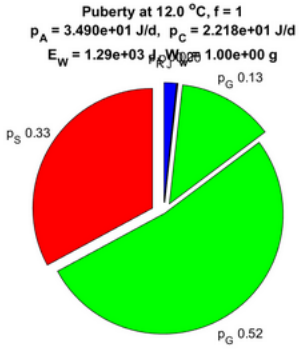
big terrestrial eggs: expensive insoluble (non-toxic) nitrogen waste
nesting from ground → trees: small eggs, parental care

Mammals: altricial → precocial

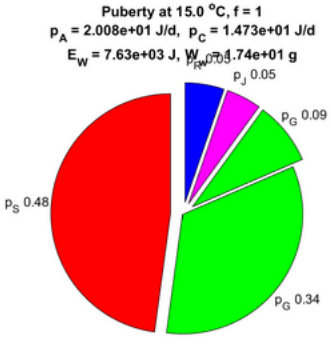
small terrestrial eggs: inexpensive but rather toxic nitrogen waste
from egg → foetal development 30 Ma ago: larger neonates

Augustine et al 2019
J Sea Res **143**: 27-34

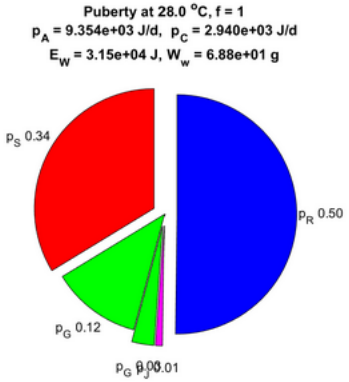
Budget diversity



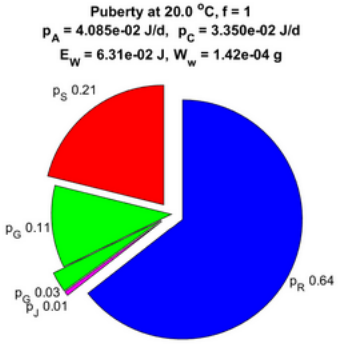
Haliclona oculata
Mermaid's glove



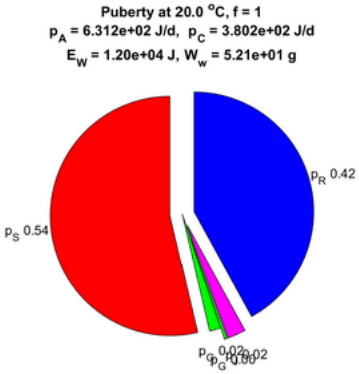
Ptilosarcus gurneyi
Orange sea pen



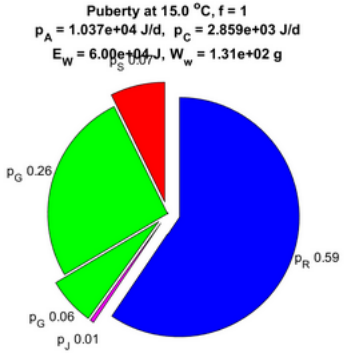
Chironex fleckeri
Sea wasp



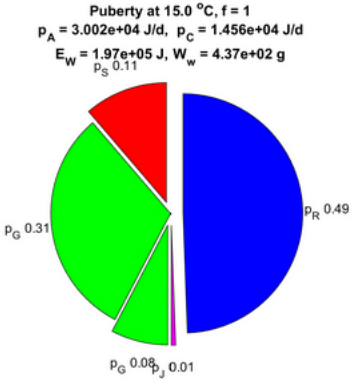
Hydra viridissima
Green hydra



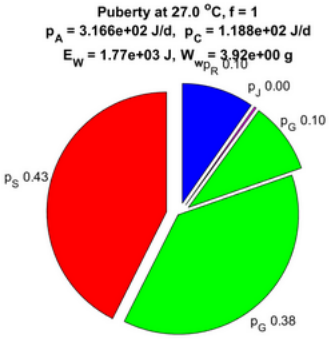
Pelagia noctiluca
Mauve stinger



Cyanea capillata
Lion's mane jellyfish



Rhizostoma octopus
Barrel jellyfish



Mastigias papua
Spotted jelly

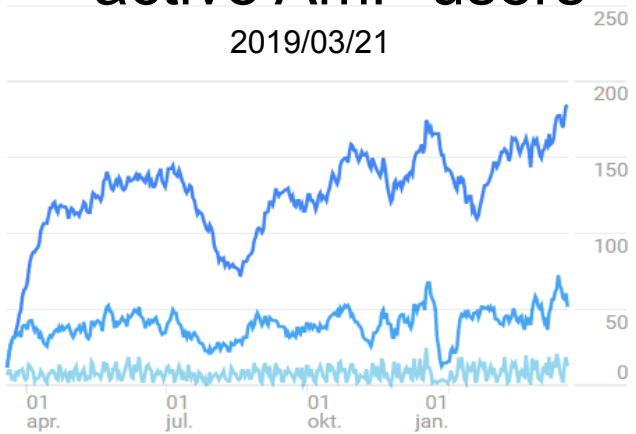
Situation at puberty: maintenance, growth, reproduction

AmP use

active AmP users

from Google

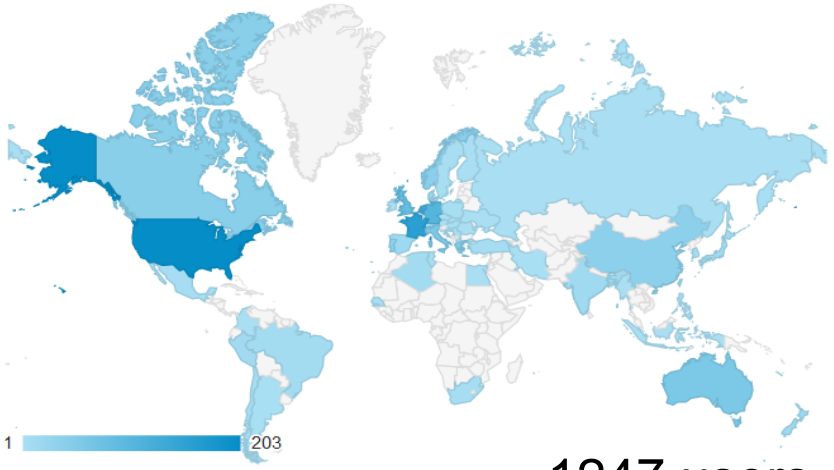
2019/03/21



per month

per week

per day

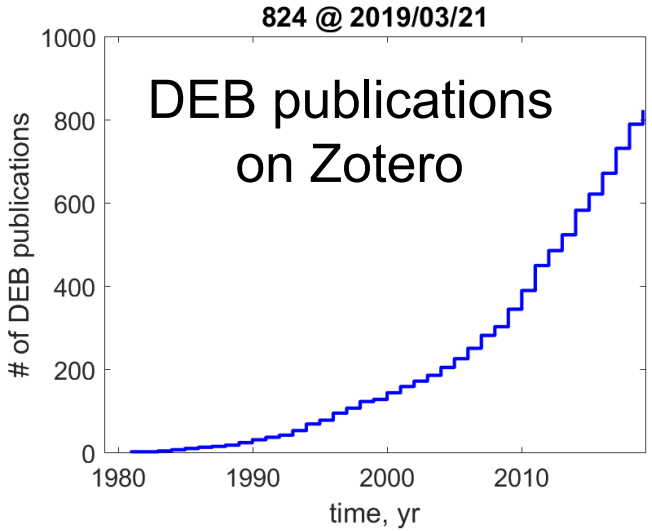


1247 users

2018/03-2019/03

DEB special issues

2006 *J Sea Res* **56** (2)
2009 *J Sea Res* **62** (2,3)
2010 *Phil Trans R Soc*
2011 *J Sea Res* **65** (1)
2014 *J Sea Res* **94**
2019 *J Sea Res* **143**
2020 *Ecol Mod*



DEB symposia

2009 Brest
2011 Lisbon
2013 Texel
2015 Marseille
2017 Tromsø
2019 Brest

Future developments of AmP

- doi's for accepted entries
- upgrading of existing entries
- development of methods to deal with many parameters in context
- popDyn
- NicheMapR
- Ecotox applications
- transfer of website to a museum-type institute

Thank you

Organizors: thank you for the invitation
Audience: thank you for your attention

Download slides
https://www.bio.vu.nl/thb/users/bas/lectures/

Add-my-Pet
https://www.bio.vu.nl/thb/deb/deblab/add_my_pet/

Questions are welcome