A Generalised Method to estimate Megafauna Biomass from Seabed Photographs: a Volumetric Approach

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Marine Imaging Workshop 2017

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National Oceanography Centre
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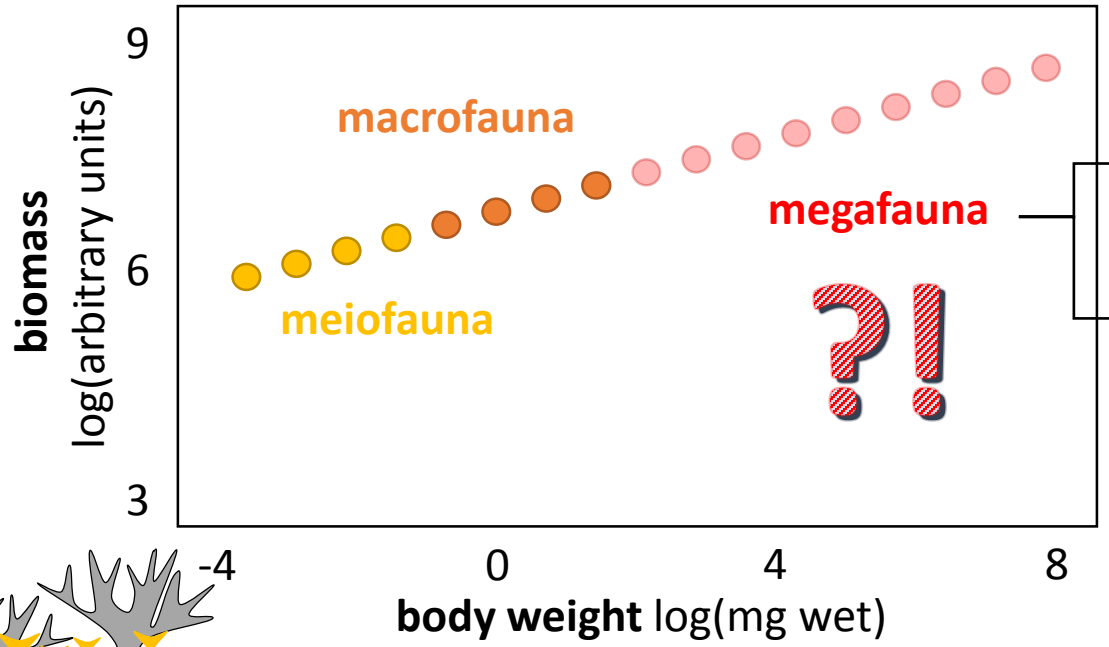
Why estimate fauna biomass?

key ecological variable

health of an ecosystem ↔ **stocks** and **flows** of **C**



assuming
- **1 trophic level** holds
- **substantial amount** of biomass

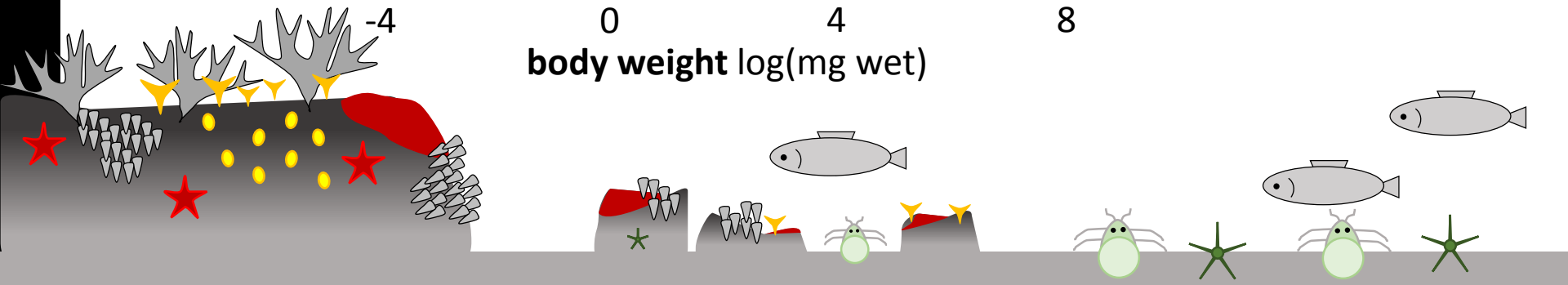


figure modified from Bett (2013)

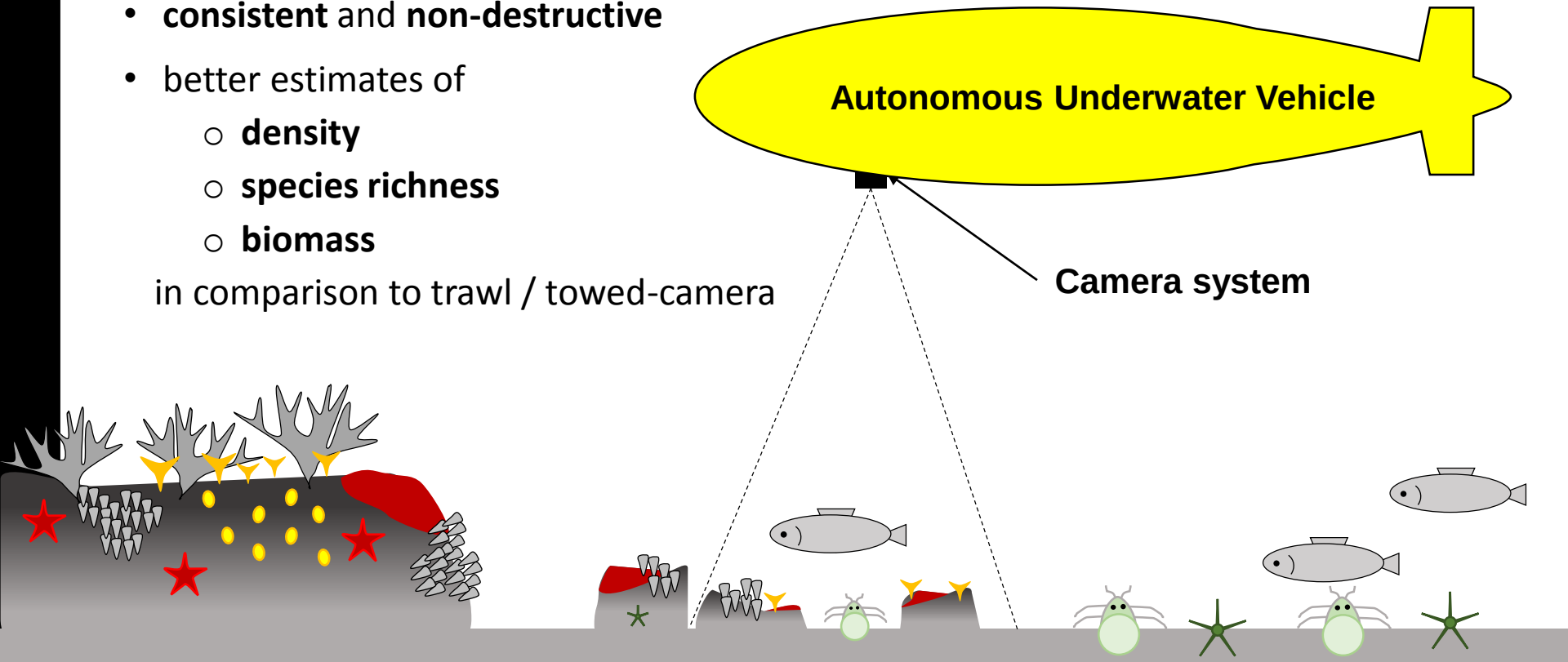
Why and **how** estimate **mega**fauna biomass?

from data collection…

AUV-photography to assess megafauna assemblages, advantages:

- **large amount** of **high quality** data over **km-scale** area
- across wide **range of habitats**
- **consistent** and **non-destructive**
- better estimates of
  - **density**
  - **species richness**
  - **biomass**

  in comparison to trawl / towed-camera



e.g., Morris et al. (2014); Durden et al. (2016); Benoist et al. (in prep.)

Why and **how** estimate **mega**fauna biomass?

…to biomass estimation

Biomass_L-W

empirical Length-Weight relationships

specific to taxon / life-stage / sex / preservation state

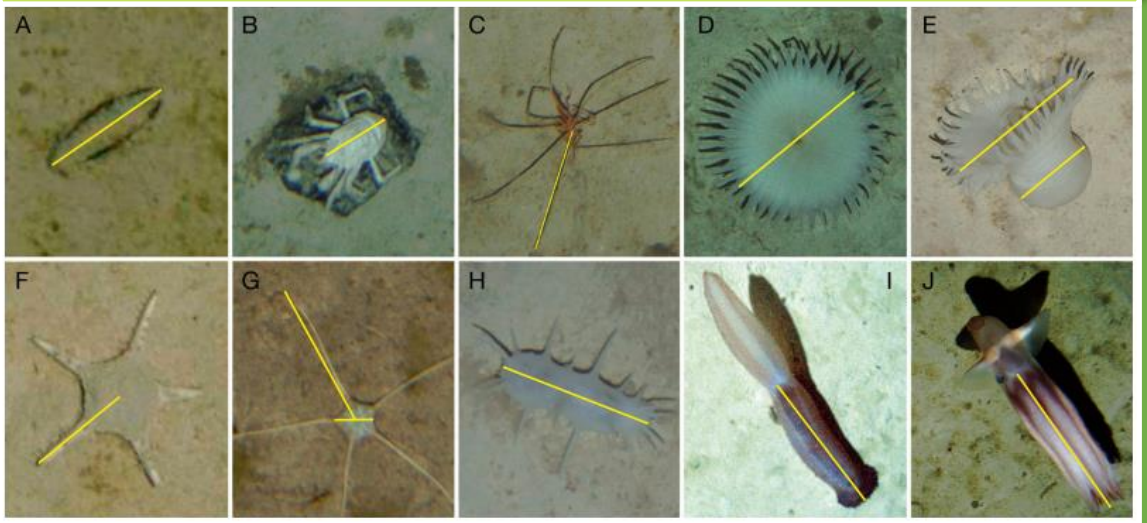
$$B_{L-W} = a \times sL^{b}$$

B_{L-W}, body weight
sL, standard length
a and **b**, constants

Poster !

Improving the estimation of deep-sea megabenthos biomass: dimension to wet weight conversions for abyssal invertebrates

Jennifer M. Durden[1,2*], B.J. Bett[1], T. Horton[1], A. Serpell-Stevens[1], K.J. Morris[1], D.S.M. Billett[1], H.A. Ruhl[1]

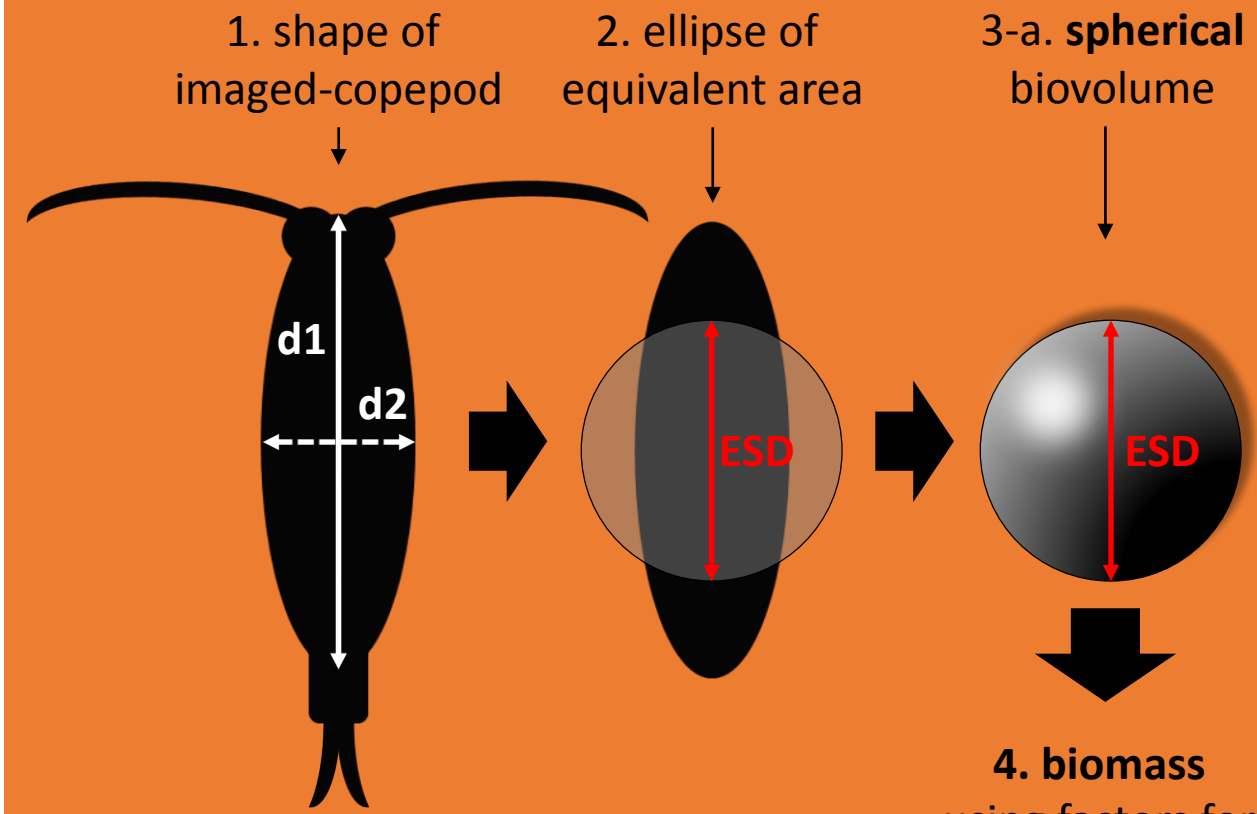


Durden et al. (2016)

Why and **how** estimate **mega**fauna biomass?

…to biomass estimation

Biomass_L-W | **Biomass_vol**

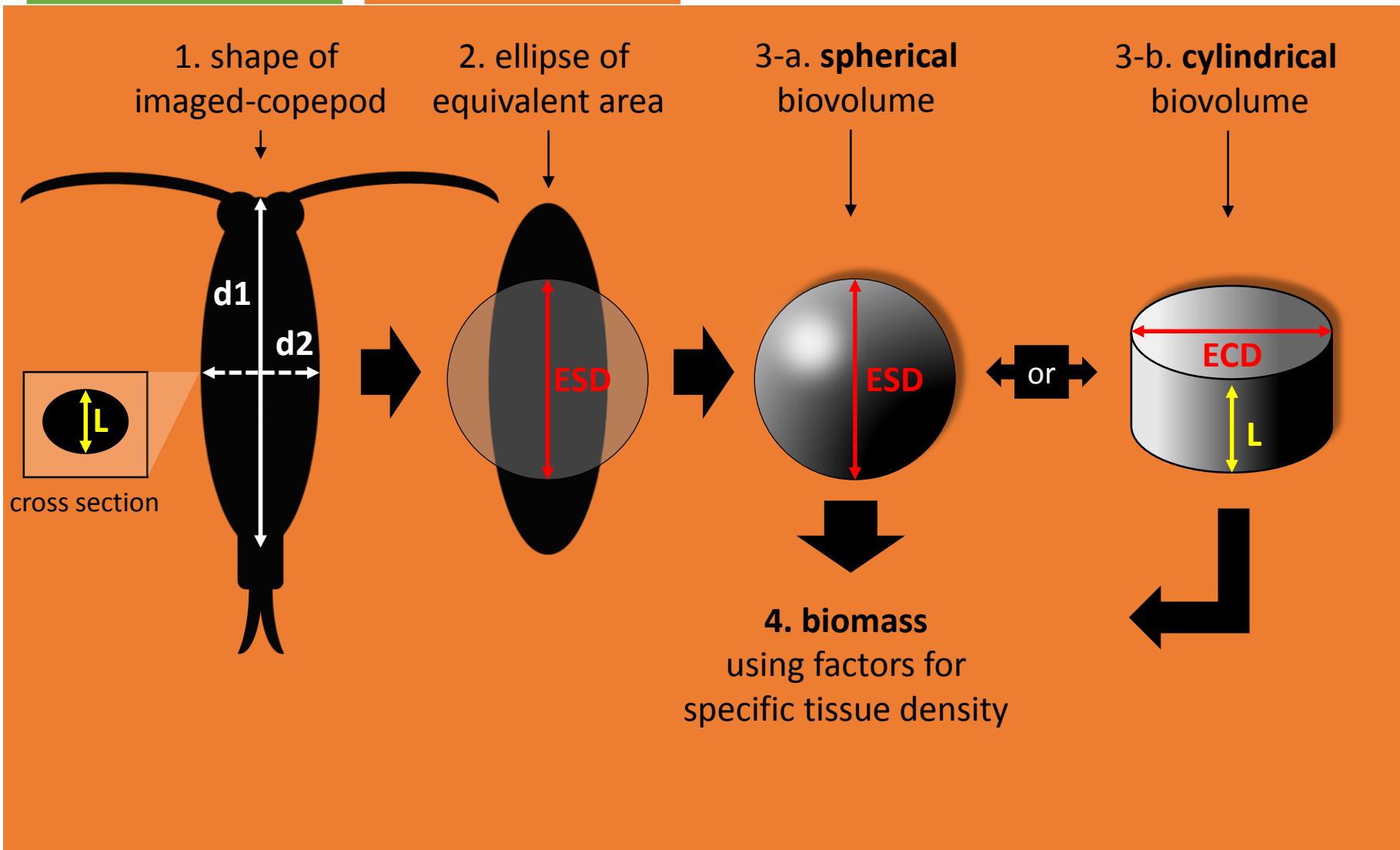


e.g., Alcaraz et al. (2003); Di Mauro et al. (2011)

Why and **how** estimate **mega**fauna biomass?

…to biomass estimation

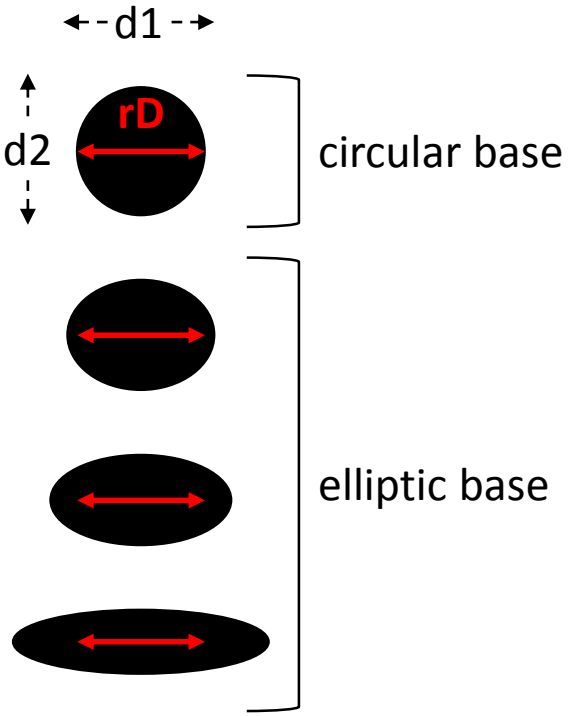
Biomass_L-W | **Biomass_vol**



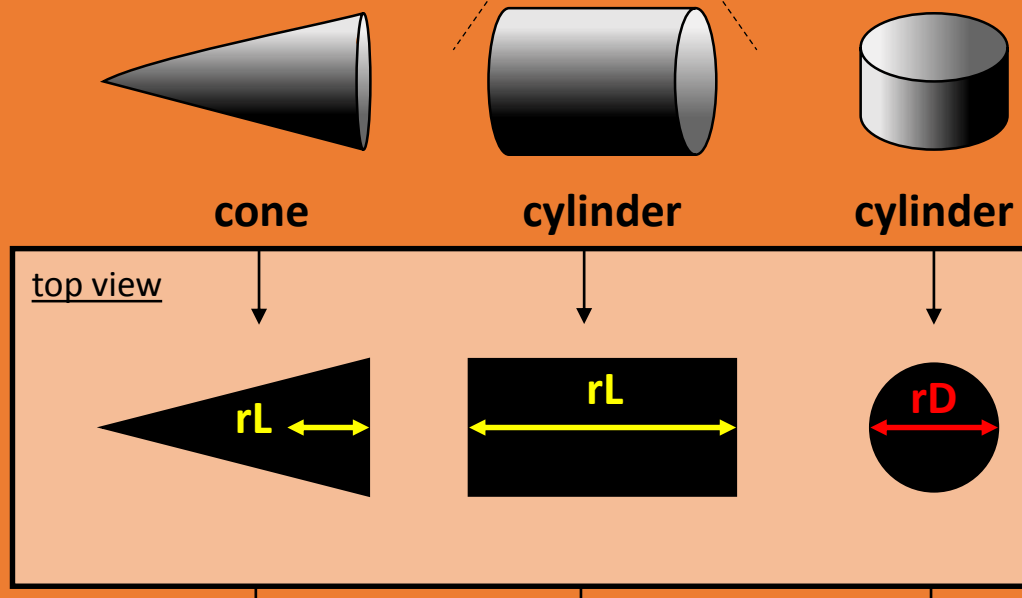
Generalised method applied to megafauna

Biomass_L-W | **Biomass_vol**

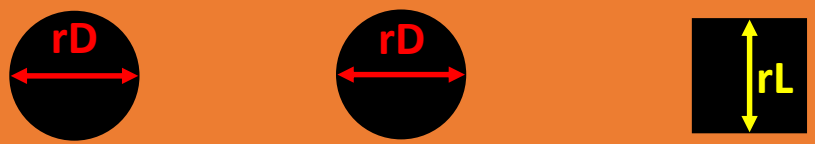
Base measurement



rD depends on ratio d1 / d2



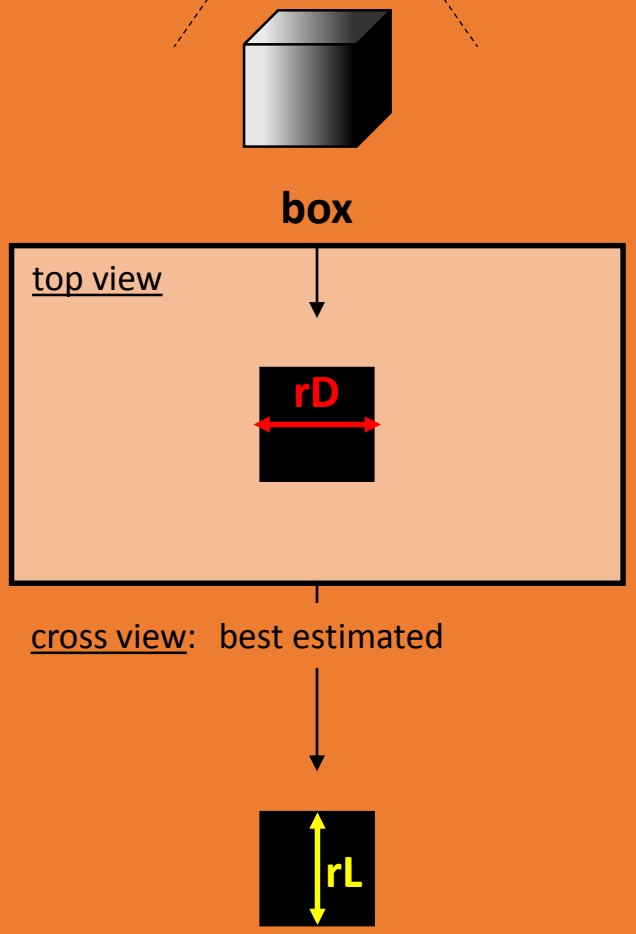
cross view: best estimated based on knowledge of general animal morphology

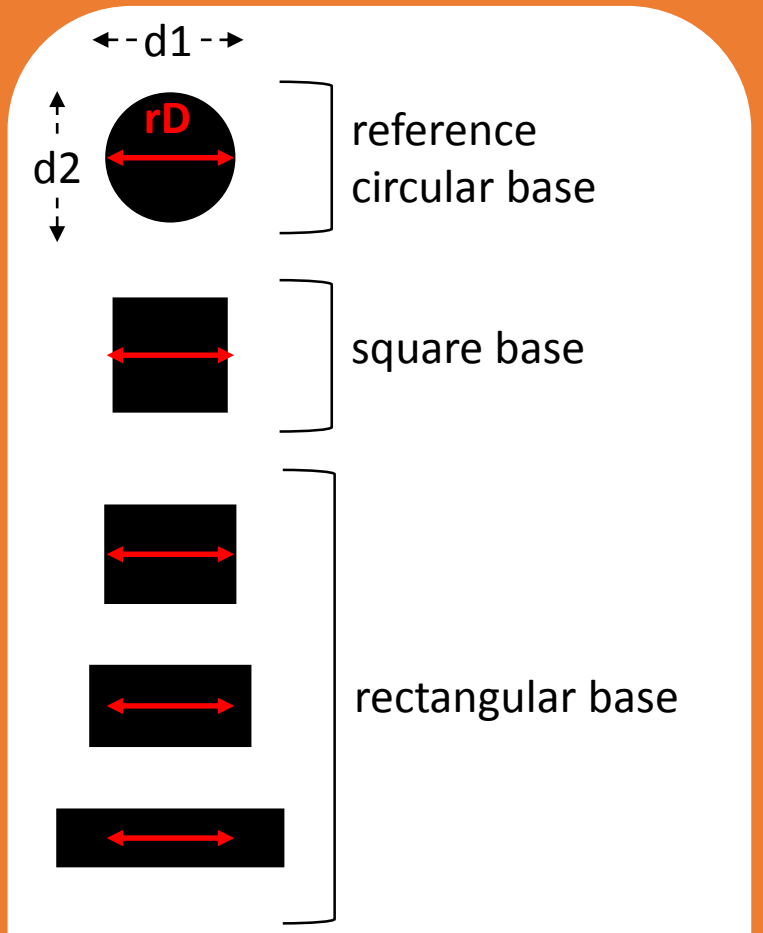


Generalised method applied to megafauna

Biomass_L-W

Biomass_vol





rD depends on ratio d1 / d2

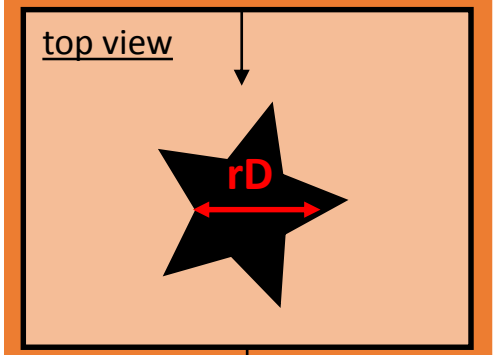
Generalised method applied to megafauna

Biomass_L-W

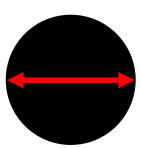
Biomass_vol

star

top view

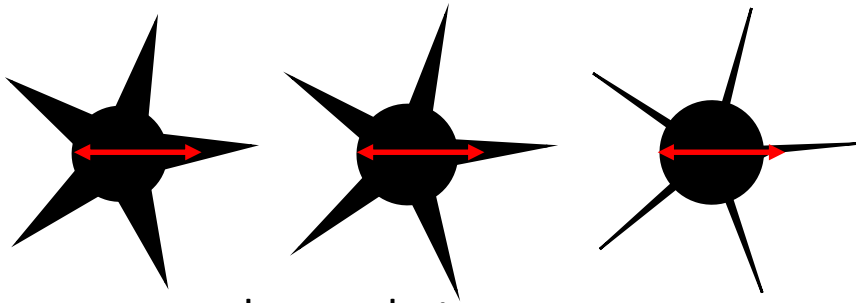


cross view: best estimated



reference
circular base

rD depends on ratio L_{arm} / D_{disc}



and space between arms

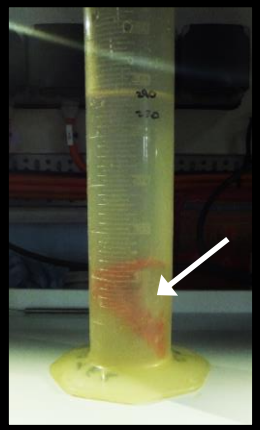
Method validation

fresh data collection…

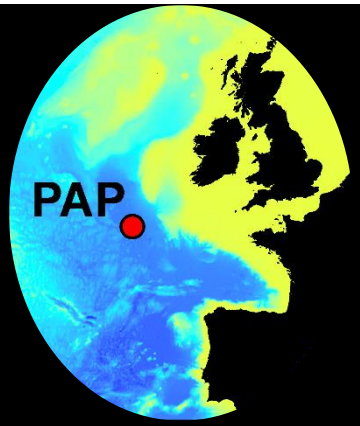
Biomass_L-W | **Biomass_vol** | **Fresh data**

1 relationship between fresh body Weight and Volume

body weight (g fwt)



body volume (ml)



DY050 *Discovery*
April 2016

2 compare B_{L-W} *vs* B_{vol}

photograph (‘*in situ*’ position)

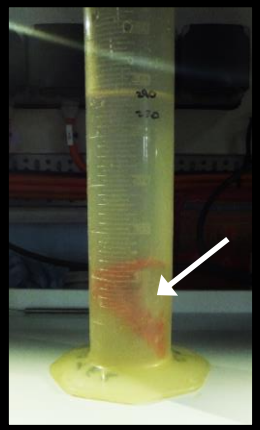
Method validation

..results

Biomass_L-W | **Biomass_vol** | **Fresh data**

1 relationship between fresh body Weight and Volume

body weight (g fwt)

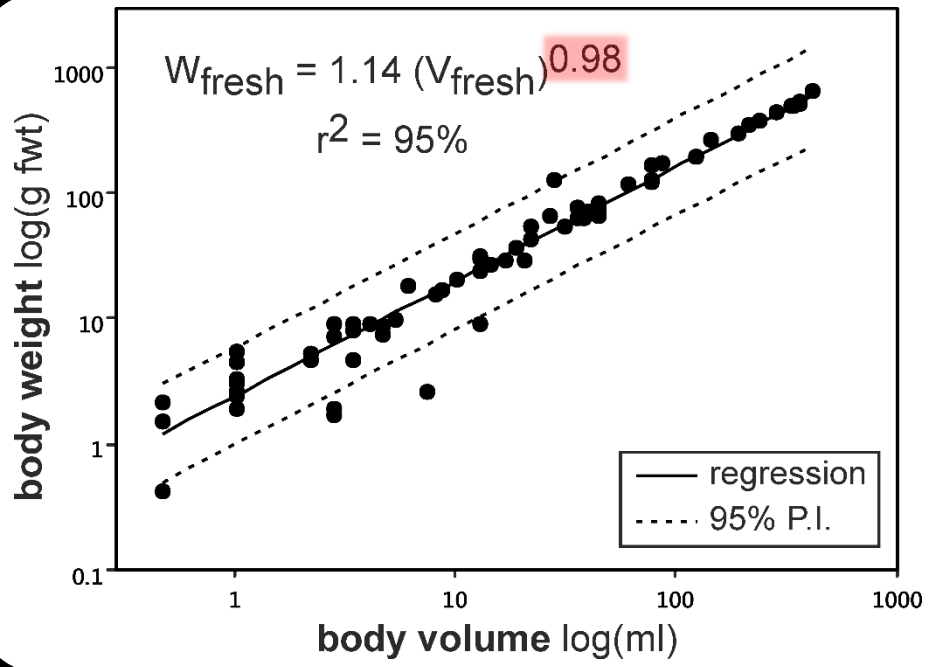


body volume (ml)

body volume: good proxy for body weight

2 compare $B_{L\text{-}W}$ *vs* B_{vol}

photograph (‘*in situ*’ position)



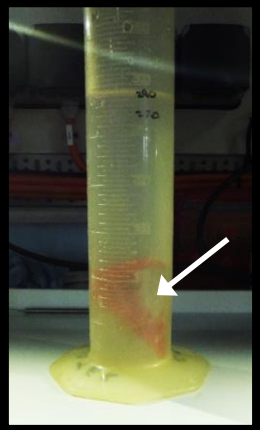
Method validation

..results

Biomass_L-W | **Biomass_vol** | **Fresh data** | **Photo. data**

1 relationship between fresh body Weight and Volume

body weight (g fwt)

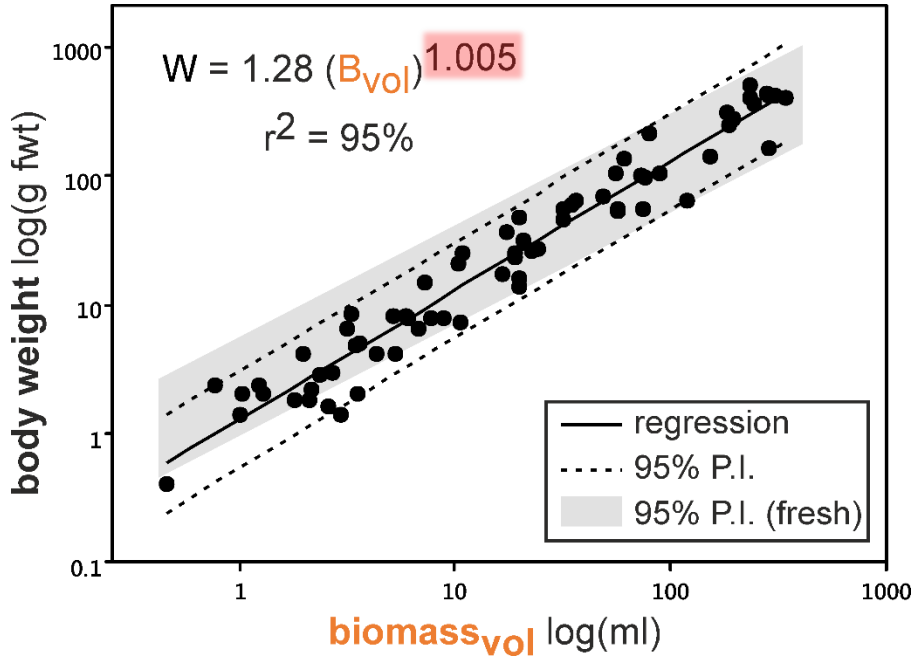


body volume (ml)

no sig. diff. between physical and photographic data

2 compare B_{L-W} *vs* B_{vol}

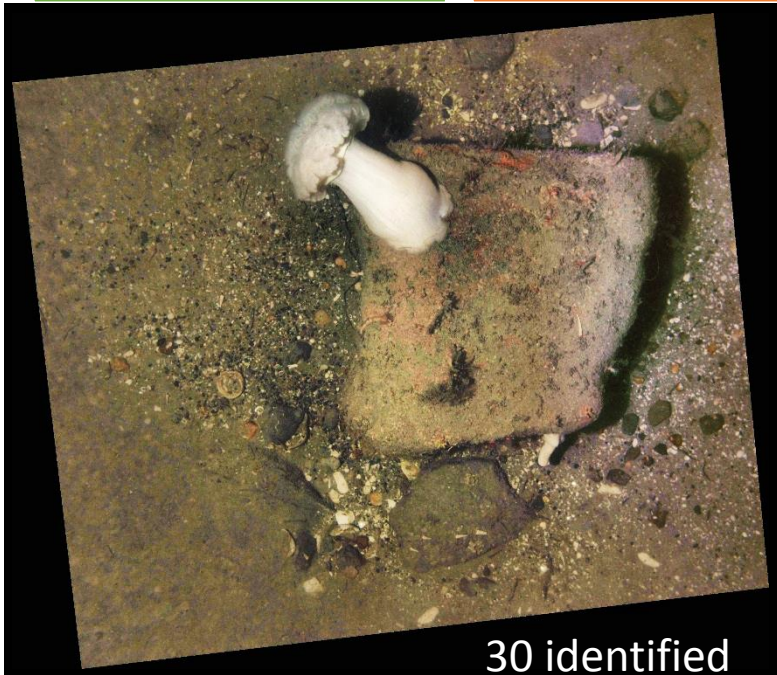
photograph (‘*in situ*’ position)



Study case

photographic data

Biomass_L-W | **Biomass_vol** | **Fresh data** | **Photo. data**



mosaic habitats

4160 pictures annotated

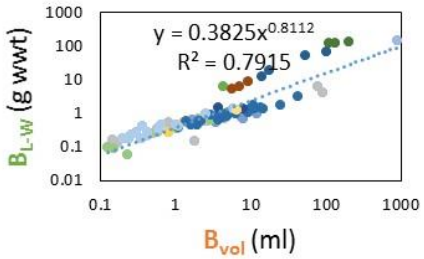
c. 4000 m^2

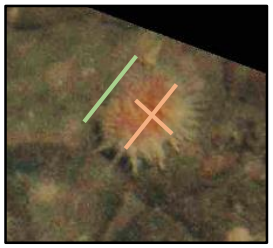
DY034 *Discovery*
August 2015

3000 ind.
92 morphotypes

- 30 identified to species
  - 23 with L-W available
  - 7 with no L-W available
- 62 morphotypes
  - 45 with L-W of most resembling species
  - 17 with no L-W available

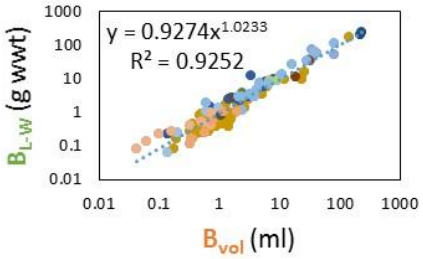
'vertical cylinder' type

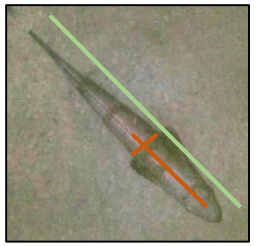




paired t-test: p = 0.09
t-test: p = 0.18

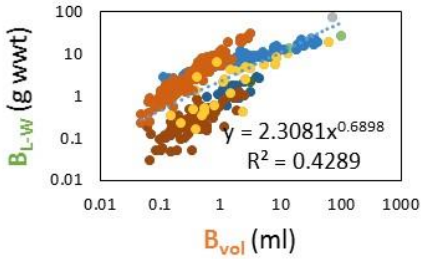
'conical' type

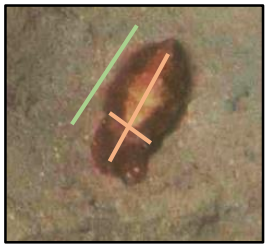




paired t-test: p = 0.13
t-test: p = 0.01

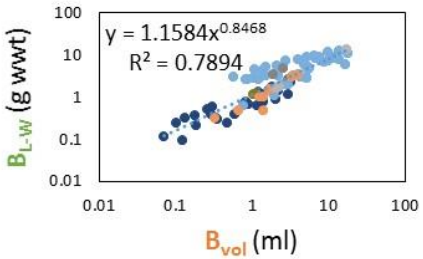
'horizontal cylinder' type

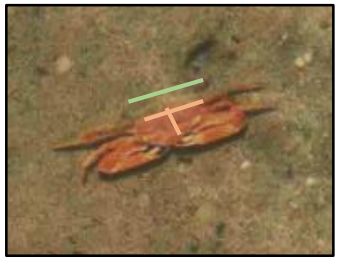




paired t-test: p < 0.005
t-test: p = 0.01

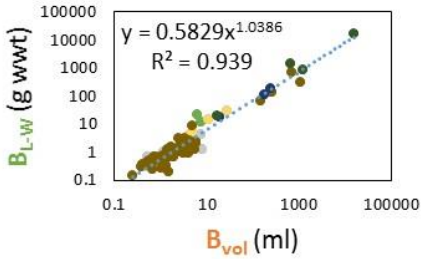
'box' type

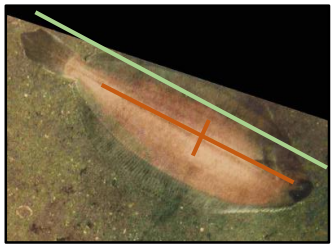




paired t-test: p = 0.68
t-test: p = 0.86

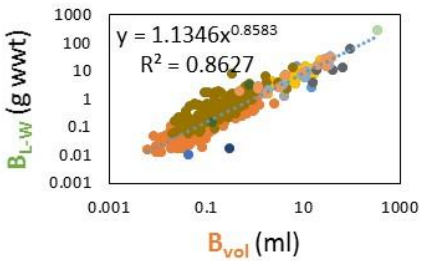
'flat cylinder' type

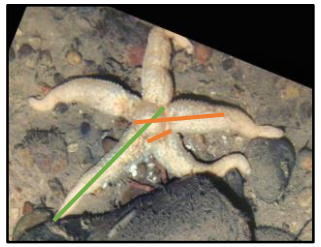




paired t-test: p = 0.57
t-test: p = 0.95

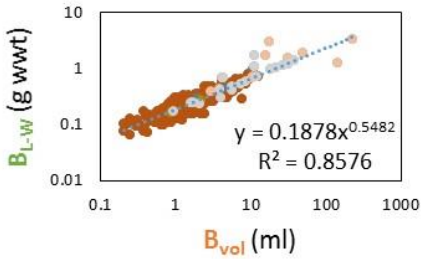
'star' type

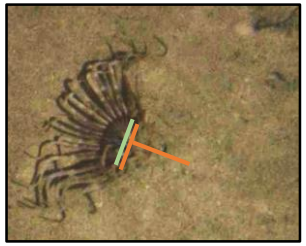




paired t-test: p = 0.01
t-test: p = 0.60

'burrowing tube' type





paired t-test: p < 0.005
t-test: < 0.005

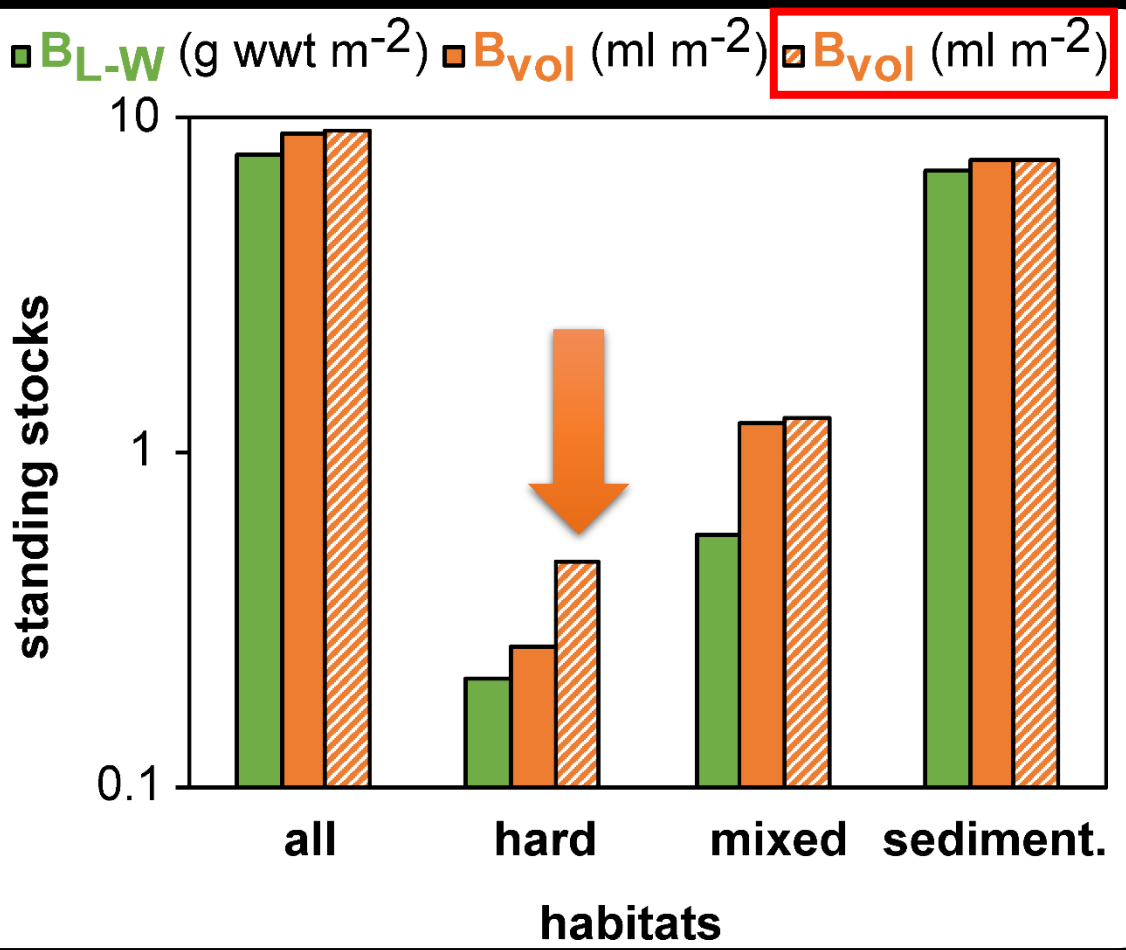
generally, no difference between B_{L-W} and B_{vol}

Study case

..results

Biomass_L-W | Biomass_vol | Fresh data | Photo. data

including colonial / encrusting



Conclusion

1. **Biovolume** is a good **proxy for body mass**

2. Volumetric approach:
   - provides **reliable estimates of megabenthic biomass**
   - covers a **wider range of taxa** i.e., when no L-W relationship available

3. Limits:
   - **estimation of one dimension when not visible**
   - **physical estimates of sessile specimen?**

PAP

CS

Clarion Clipperton Zone

Erik Simon-Lledo's poster no. 29!

Noelie M.A. Benoist

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Marine Imaging Workshop 2017

GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, 21-24 February 2017

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