

DEVELOPING STANDARD FOR MODELING AND DESCRIBING CEPHALOPOD GROWTH

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Organization and presentations

The single report in this volume from this workshop provided a 'checksum' bioenergetic spreadsheet model that can be run to see if growth and aging data are reasonable, *i.e.*, all energetic parameters 'add up'. It can incorporate a wide variety of other data on feeding and metabolic rates, for example, to fine tune it for particular kinds of cephalopods. It was used as a guide to prepare manuscripts subsequently published in Marine and Freshwater Research as described below. This model is not the way most people think about aging and growth, but whatever data or model you can think of can fit into this model. Nathalie Moltschaniwskyj and Eric Grist provided help keeping the models honest as statistical advisors for fitting particular more traditional datasets to the model.

17 February 2003

0900 Ron O'Dor - Energy balance growth models: Applications to cephalopods
 1000 Introductions by all participants
 1100 Formation of groups to discuss and assemble data on major cephalopod groups.

Octopods - Jayson Semmens and Robin Rigby coordinating

Cuttlefish - Jean-Paul Robin coordinating

Myopsids - George Jackson and Natalie Moltschaniwskyj coordinating

Oegopsids - Sasha Arkhipkin coordinating

1300 Paul Rodhouse, Evolution of growth traits in cephalopods

1315 Gretta Pecl, Effects of size on growth potential

1330 Sasha Arkhipkin, Asymptotic vs. non-asymptotic: which type of growth in squid

1345 Robert Wakeford, Growth and assessment

1430 Re-form cephalopod groups. Begin data assembly

18 February 2003

0900 Jean-Paul Robin, Sepia review

0920 Geo. Jackson, Myopsid review

0940 Sasha Arkhipkin, Oegopsid review

1000 Natalie Moltschaniwskyj, Biochemistry of growth

1100 Discussion Groups:

1. Continue major group data assembly

2. Problem identification and solutions 1300

Jayson Semmens and James Wood, Octopus review

1330 Eric Grist, Is the sudden shift from exponential growth determined by an energy balance requirement?

1400 Chingus Nigmatullin, Maturity patterns and growth.

1430 Erica Vidal - Influence of temperature and food availability on the rate of yolk absorption, survival and growth of *Loligo opalescens* hatchlings.

1530 New models

Susuma Segawa, $W^{0.9}$ metabolic rate scaling for many cephalopods

Natalie Moltschaniwskyj, *Euprymna tasmanica*

1630 Where should we go now?

Recognized *Sepioteuthis lessoniana* as best studied species based on:

- extensive culture
- feeding rates
- conversion efficiencies
- validated statoliths
- validated gladii
- spatial growth
- temporal growth

It is thus a key species for checksum analysis and the future of fully validated future growth studies.

Post-workshop publication.

While the workshop raised interesting issues and stimulated thought on cephalopod growth it

also served as a stepping stone for future published research. Thus discussions and work carried out both during and after the Phuket meeting resulted in a special issue of *Marine and Freshwater Research*, Volume 55 (4) on cephalopod growth, edited by George D. Jackson and Dugald J. McGlashan and published in 2004. This publication represented a major synopsis of cephalopod growth and included a series of both data papers and selected reviews. Thus the workshop served as an important mechanism to document some of the latest research and provide a synopsis of cephalopod research.

The special issue encompassed a general introduction that provided a context to the state of research on cephalopod growth and how the Phuket meeting provided the forum to advance the knowledge in this field (Jackson, 2004). Five of the papers were dedicated reviews on: the effect of temperature on squid growth (Forsythe, 2004), growth and longevity in oegopsid squid (Arkhipkin, 2004), life histories of myopsid squid (Jackson, 2004) patterns, variability and physiology of octopus growth (Semmens *et al.*, 2004) and understanding growth processes in cephalopods from a variety of biological levels (Moltschaniwskyj 2004). Two of the papers were theoretical in nature and provided models of cephalopod growth (Pecl

et al., 2004, Grist and Jackson, 2004). These will hopefully provide the basis for future development and refinement of cephalopod growth models. Lastly, five papers in the special issue were focused data papers dealing with specific aspects of cephalopod growth. These included statolith microstructure in hatchling *Illex argentinus* paralarvae (Sakai *et al.*, 2004) and growth patterns in the early life cycle of *Sepia pharaonis* (Minton, 2004). Three of the five data papers focused on various aspects on the biology of the southern Australian loliginid squid *Sepioteuthis australis*. These were, variability in growth, somatic condition and reproductive condition of *S. australis* (Ho *et al.*, 2004), the relationships between season of hatching, growth and condition of *S. australis* (Pecl, 2004) and the effects of genetic and environmental factors on growth of *S. australis* in both southern Australia and northern New Zealand (Triantafillos, 2004).

We again thank the organizers of both the CIAC symposium and associated workshops for providing an exciting scientific environment for advancement of cephalopod biology. We hope that the results from the growth workshop have helped to advance the field and have encouraged further research for areas in which more questions were raised than there were answers.

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