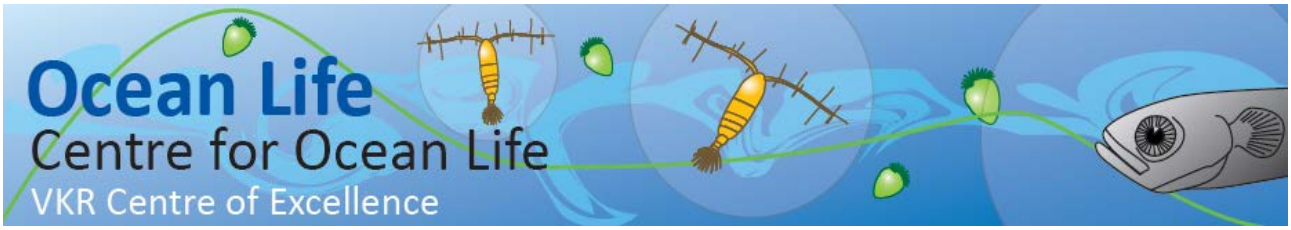

2015 annual report

This is the fourth annual report of the VKR center of Excellence *Centre for Ocean Life* (OceanLifeCentre.dk). Given the very extensive reporting at the beginning of the year, this report will be kept brief, as also instructed in the contract with the Villum Foundation. Publications and other activities have been listed in the appendices.

Centre staff and visitors

During 2015 we have had 18 young researchers (PhD and post docs) hired on Centre funds. This is also the year where the first PhD students start graduating from the Centre, and we have been able to celebrate 3 very successful PhD defences (See Appendix 6). (We had one graduate last year; a student partly funded by the Centre). In addition to the Centre-funded fellows, 8 post docs and PhDs financed by other funds work fully or partly with the Centre. We have been successful in levering Centre funds with other external funding, e.g., H.C Ørsted fellowships and postdoctoral fellowships funded by the Research council and the EU Marie Curie program. Finally, several international scientists and students have paid longer research visit to the Centre to work on joint projects. Professor Andrew Hirst at the Queen Mary University of London is an adjunct professor of the Centre with whom we have established a longer-term collaboration. See Appendix 1 for list of Centre staff, associates, and visiting students and researchers.

The significance of associated and visiting scientists and students is not only through their sometimes significant contribution to our projects but mainly to help create an international and dynamic working environment, which is vital to the health of the Centre.

Research activities

All individual student and post doc projects are briefly described on the Centre homepage (http://www.oceanlifecentre.dk/Projects.aspx) and abstracts of their presentations at the annual retreat (10-11 December 2015) are given in Appendix 8. Together they paint a picture of the progress of ongoing research activities. The overarching themes of the research are as described in the project proposal and as reported on in detail in the mid-term report. The work is organized under three themes; (I) *The individual – defining key traits and trade-offs*, (II) *Models- scaling from individual to ecosystem*, and (III) *Nature – analyses of patterns of traits*. Overall, the

progress and communication of the research within each of these themes is good and according to or ahead of the plan (see appendices 2-4 for list of publications and other dissemination activities).

Centre activities

The research in the Centre is mainly organized around PhD and post doc projects. Each student or post doc has two advisors, typically from complementary disciplines, and fellows and advisors typically meet once per week to work on the projects. Scientific discussions and presentation of progress in addition takes place in the following fora:

Weekly science meetings: Key to the coherence of the Centre is the weekly meetings where all students and post docs meet with PIs to discuss progress of their work and other topics of mutual interest. See the young researcher's evaluation of the meetings in Appendix 7.

Annual retreat: We had the fourth annual retreat 10-11 December 2015 at 'Søminestationen' at the Isefjord, with participation of almost all Centre members, students, and post docs, as well as a few international guests and an invited speaker, total 42 participants. All young researchers presented and discussed their research, we had a PI meeting, and the young researchers had a meeting to discuss the format of the weekly meetings and other Centre activities. See agenda for the retreat and abstracts of all presentations in Appendix 8

Working groups: Ad hoc working groups exploring specific problems have been established, e.g., *'Food web modelling'*, '*Fluid dynamics of zooplankton feedings'*, *'Zooplankton modelling*','*Trait biogeography'*, '*Phytoplankton defenses'*. Following the successful completion of the '*size in the ocean*-project, which was an interdisciplinary project involving most Centre members and which has resulted in 5 joint publications, we have initiated another joint project: '*Seasons in the ocean'*. The intention is to explore how the different life forms in the ocean deal with seasonal variation in the environment. The project includes theoretical modelling and collection of data to test model predictions.

International workshops and activities: As part of our dissemination activities we have taught, organized or co-organized various PhD summer schools, and international workshops and symposia session (see Appendix 5). In particular, we co-organized and participated in the workshop on 'Trait-based approaches to Ocean Life' (New England, October 2015), which was the follow up of the first workshop on this topic that the Centre organized in Copenhagen in 2013. The 3rd workshop is being planned to take place in Bergen, Norway in 2017, organized by the chair of our scientific board, Prof Øyvind Fiksen.

PI-group and Scientific board:

The PI-group has met on an ad hoc basis and have in addition had two dedicated meetings to discuss the future of the Centre (15 October) and evaluate the progress of the work (10/12). We met with most board members at the Trait workshop in New England, and therefore only two board members joined our annual retreat in December. Feedback from board members and interaction between PIs are both of fundamental importance to the wellbeing of the Centre.

Public Outreach

While scientific papers is the main product of the Centre (in addition to trained scientists), we emphasize the significance of communicating our science also to a broader audience. We consider this is an important element in the training of young researchers, since, whatever their future career, they will have to communicate their scientific knowledge to non-experts. They are consequently all encouraged to produce at least one popular articles based on their research. This goal is largely achieved (see examples in Appendix 4).

To further pursue this, we have in the past year organized a **Course on *'Ocean Literacy'*** for students and post docs, taught by visiting scientist Diana Payne. The course consisted of three sessions: (i) How to place your research in a societal context (and what career & proposal benefits), (ii) How to explain your research to non-experts? I, (iii) How to explain your research to non-experts? II.

We have this past year also organized an **International Workshop on 'Transatlantic Ocean Literacy'**(jointly with DTU Aqua and the European Environment Agency and funded by Styrelsen for Forskning og Innovation International Networking Program), 24-25th Sept 2015 in Copenhagen. Workshop program can be found here. The objective was to learn from the 15 yr experience of US partners and seek pragmatic means to insert Ocean Literacy in young marine researchers' workflow, in order to help them communicate their work more effectively, and draft more competitive research grants.

Appendices

1. Staff

Students and post docs: During 2015, the following fellows have been employed on Ocean Life funds

1. Terje Berge (WP 1.2, Post doc, February 2012-February 2015)
2. Sachia Jo Traving (WP 1.1, PhD student, February 2012, on maternal leave from March 2014)
3. Karin Olsson (WP 5.1, PhD student, March 2012; graduated 2015)
4. Navish Wadhwa (WP 2.1, PhD student, August 2012; graduated 2015)
5. Nis Sand Jacobsen (WP 3.2, PhD student, November 2012, Graduated 2015)
6. Irene Heilmann (WP 6, PhD , expected graduation 2016)
7. Philipp Brun (WP 4, PhD December 2013-2016)
8. Laurén Pécuchet (WP 3.4, PhD December 2013-2016)
9. Martin Lindegren (Senior scientist, February 2014-2016)
10. Mark Wejlemann Holm (WP 5.2, PhD student, hired April 2013-2016)
11. Lasse Tor Nielsen (WP 2.4, Post doc, hired March 2013; paternity leave December 2013-January 2014)
12. Hans van Someren Gréve (WP 2.1, PhD student, hired May 2014)
13. Kasia Kenitz (WP 6, Post Doc, September 2014)
14. Julia Dölger (WP 2.4, PhD student, December 2014)
15. Agnethe Hansen (WP 6, PhD student, December 2014)
16. Tim Dencker (WP3, PhD student, August 2015)
17. Marina Pančić (WP 1, PhD student, November 2015)
18. Nicolas Azaña Schnedler-Meyer (WP 6, PhD student, September 2014)

Their projects are briefly described on the Centre homepage
http://www.oceanlifecentre.dk/Projects.aspx

Other students and post docs: A number of additional students and post docs, funded by other sources, are working partly or entirely within the Centre and participate in the weekly and annual meetings, as well as in various working groups:

19. Anna Törnroos (Post doc, visiting 2014-2016; funded by EU BONUS-project BIO-C3)
20. Daniël van Denderen (Postdoc, September 2015-2017, funded by a HC Ørsted Fellowship)

21. Jiayi Xu (PhD student, December 2014-2017, funded by a Chinese state Fellowship)
22. Sofia Piltz (WP 6, Post doc, September 2014, co-financed by HC Ørsted Postdoctoral fellowship
23. Rodrigo Almeda (WP2, Postdoc, May 2014, co-Funded by the Danish Council for Independent Research and The EU Marie-Curie program)
24. Subhendu Chakraborty (WP 6, Post Doc, November 2014 Funded by the HC Ørsted program)
25. Rob van Gemert (PhD student, funded by MARmaED Marie Skłodowska-Curie International Training Network)

Their projects are briefly described on the Centre homepage: www.oceanlifecentre.dk/Projects.aspx

Visiting Scientists, adjunct professors. We have many scientists visiting the Centre for a few days or weeks, but in addition we have the following visitors actually working in the Centre for longer periods:

Dr. Philipp Neubauer, Dragonfly data science, New Zeeland, 19-29 May 2015

Post doc. Matt Burgess, University of California, Santa Barbera, USA, 15-17 June 2015

Professor Peter Tiselius, University of Gothenburg, Sweden, 25 August – 1 November 2015

Senior scientist Dr. Enric Saiz, CSIC, Barcelona, Spain, 25 August – 15 September 2015

PhD student, Curtis Horne, Queen Mary University of London, April – July 2015

Post doc Dr. Rudi Schuech, University of Lincoln, UK, 25-31 October

Assistant Professor Diana Payne, University of Connecticut, 15 September – 15 October

PhD student Christine Corlett Stawitz, University of Washington, USA, 20 Sept – 18 December

MSc student, Esther Beukhof, Wageningen University, Holland, 1. Oct 2015 – 15 Feb 2016.

Dr. Andrew G. Hirst is Adjunct Professor with the Centre and Senior Lecture at Queen Mary University of London.

2. Scientific publications

We list here only those of our publications that are related to Centre for Ocean Life. We distinguish between papers that are mainly funded by the Centre (marked with an *), and those contributed to the Centre. We include papers that are submitted or '*in press*', since are large fraction of our work is at that stage only.

1. Almeda R, Connelly TL, Buskey E (2015) *How much crude oil can zooplankton ingest? Estimating the quantity of dispersed crude oil defecated by planktonic copepods*. Environmental Pollution. doi:10.1016/j.envpol.2015.10.041.
2. Almeda R, Harvey TE, Connelly TL, Baca S, Buskey E (2015) *Influence of UVB radiation on the lethal and sublethal toxicity of dispersed crude oil to planktonic copepod nauplii*. Chemosphere (submitted)
3. *Andersen A, Wadhwa N, Kiørboe T (2015*) Quiet swimming at low Reynolds number*. Phys. Rev. E, 91: 042712. DOI:10.1103/PhysRevE.91.042712

(Featured by APS Physics Central: www.physicscentral.com/buzz/blog/index.cfm?postid=7102857878385272483)

4. *Andersen KH, Aksnes DL, Berge T, Fiksen Ø, Visser AW. (2015) *Modeling emergent trophic strategies in plankton*. J. Plankton Research 37(5) 862-868. doi:10.1093/plankt/fbv054
5. *Andersen KH, Berge T, Gonçalves RJ, Hartvig M, Heuschele J, Hylander S, Jacobsen NS, Lindemann C, Martens EA, Neuheimer AB, Olsson, Palacz K, Prowe F, Sainmont J, Traving SJ, Visser AW, Wadhwa N, Kiørboe T (2016) *Characteristic Sizes of Life in the Oceans, from Bacteria to Whales*. Annu. Rev. Mar. Sci. 2016. 8: in press. doi: 10.1146/annurev-marine-122414-034144
6. *Andersen KH, Beyer JE (2015): *Size structure, not metabolic scaling rules, determines fisheries reference points* Fish and Fisheries 16(1) 1-22.
7. *Andersen KH, Blanchard JL, Fulton EA, Gislason H, Jacobsen NS, van Kooten T (2015) *Assumptions behind size-based ecosystem models are realistic*. In press, ICES J Mar Sci Rev.
8. *Andersen KH, Brander K, Ravn-Jonsen LJ (2015). *Trade-offs between objectives for ecosystem management of fisheries.* Ecological Applications 25: 1390-1396.
9. *Andersen KH, Jacobsen NS, Farnsworth KD (2015) *The theoretical foundations for size spectrum models of fish communities*. Canadian Journal Fisheries Aquatic Sciences. doi:10.1139/cjfas-2015-0230
10. *Andersen KH, Jacobsen NS, Jansen TE, Beyer JE (2015) *Spatial cohort dynamics determines density dependant regulation in fish populations*. (In review) Fish and Fisheries.

11. *Berge T, Hansen PJ (resubmitted). *Role of the tertiary plastid of the predatory dinoflagellate Karlodinium armiger*. Marine Ecology Progress Series.

12. *Berge T, Chakraborty S, Hansen PJ, Andersen KH (2015) *Modelling succession of key resource harvesting traits of mixotrophic plankton populations*. (In review) ISME J

13. *Brun P, Kiørboe T, Payne M (2015) *Measuring evolutionary adaptations of phytoplankton with local field observations*. PNAS www.pnas.org/cgi/doi/10.1073/pnas.1513353112

14. *Brun P, Kiørboe T, Licandro P, Payne M (submitted) *The Predictive Skill of Species Distribution Models for Plankton in a Changing Climate*. Submitted.

15. *Brun P, Vogt M, Payne M, Gruber N, O'Brien C, Buitenhuis ET, Le Quéré C, Leblanc K, Luo YW (2015). *Ecological niches of open ocean phytoplankton taxa.* Limnol Oceanogr 60: 1020-1038

16. Burgess MG, Diekert FK, Jacobsen NS, Andersen KH, Gaines SD (2015). *Remaining questions in the case for balanced harvesting*. Fish Fish.: n/a–n/a. doi: 10.1111/faf.12123.

17. Chakraborty S (2015) *The influence of generalist predators in spatially extended predator-prey systems.* Ecological Complexity 23: 50-60.

18. Chakraborty S, Ramesh A, Dutta P (2015) *Toxic phytoplankton as a keystone species in aquatic ecosystems: Stable coexistence to biodiversity*. Oikos: in press. doi: 10.1111/oik.02322.

19. Chakraborty S, Kooi B, Biswas B, Chattopadhyay J (2015) *Revealing the role of predator interference in a predator-prey system with disease in prey population*. Ecological Complexity 21: 100-111.

20. *Chakraborty S, Nielsen L, Andersen KH (submitted) *Trophic strategies of plankton*. Submitted to American Naturalist.

21. Dickey-Collas, M., Hintzen, N. T., Nash, R. D. M., Schon, P.-J., and Payne, M. R. 2015. Quirky patterns in time-series of estimates of recruitment could be artefacts. ICES Journal of Marine Science, 72: 111–116

22. *Ergin FG, Watz BB, Wadhwa N (2015) *Pixel-accurate dynamic masking and flow measurements around small breaststroke-swimmers using long-distance MicroPIV*. Proceedings of the 11th International Symposium on Particle Image Velocimetry - PIV15, Santa Barbara, CA.

23. Ferreira ASA, Hátún H, Counillon F, Payne MR, Visser AW (2015). *Synoptic scale analysis of mechanisms driving surface chlorophyll dynamics in the North Atlantic*. Biogeosciences, 12(1), 3641-3653

24. Frisk C, Andersen KH, Temming A, Herrmann JP, Madsen KS, Kraus G (2015): *Environmental effects on sprat (Sprattus sprattus) physiology and growth at the distribution frontier: A bioenergetic modelling approach*. Ecological Modelling 299130–139.

25. *Glazier DS, Hirst AG, Atkinson D (2015) *Shape shifting predicts ontogenetic changes in metabolic scaling in diverse aquatic invertebrates.* Proceedings of the Royal Society B 282: 20142302. doi:10.1098/rspb.2014.2302

26. *Gonçalves RJ, Kiørboe T (2015) *Perceiving the algae: how feeding-current feeding copepods detect their non-motile prey*. Limnol Oceanogr 60: 1286–1297

27. *Hansen A, Visser AW (accepted). *Carbon export by vertically migrating zooplankton: an optimal behaviour model*. Limnol Oceanogr., accepted.

28. Heuschele J, Nemming L, Tolstrup L, Kiørboe T, Nylund GM, Selander E (submitted) *The sex specific metabolic footprint of Oithona davisae.* Submitted

29. *Hirst AG, Horne C, Atkinson D (in press) *Equal temperature-size responses of the sexes are widespread within arthropod species*. Proceedings of the Royal Society B

30. *Horne C, Hirst AG, Atkinson D (2015) *Temperature-size responses match latitudinal-size clines in arthropods, revealing critical differences between aquatic and terrestrial species.* Ecology Letters 18: 327-335. doi: 10.1111/ele.12413

31. *Horne C, Hirst A, Atkinson D, Neves A, Kiørboe T (submitted) *A global synthesis of seasonal temperature-size responses in copepods*. Submitted.

32. Huse G, MacKenzie BR, Trenkel V, Doray M, Nøttestad L, Oskarsson G (2015) *Spatially explicit estimates of stocks sizes, structure and biomass of herring and blue whiting, and catch data of bluefin tuna.* Earth System Science Data Discussions 7: 35-46. doi:10.5194/essd-7-35-2015 (OA)

33. Hylander S, Kiørboe T, Snoeijs P, Sommaruga R, Nielsen TG (2015) *Concentrations of sunscreens and antioxidant pigments in Arctic Calanus spp. in relation to ice cover, ultraviolet radiation, and the phytoplankton spring bloom*. Limnol Oceanogr 60: 2197-2206

34. *Jacobsen NS, Essington TE, Andersen KH (2015). *Comparing model predictions for ecosystem based management*. Can. J. Fish. Aquat. Sci. NRC Research Press. doi: 10.1139/cjfas-2014-0561.

35. Jaspers C, Møller LF, Kiørboe T (2015) *Egg production rates under variable food conditions and starvation in the comb jelly Mnemiopsis leidyi - insights to its invasion success in northern Europe*. J Plankton Res 37: 1011-1018. doi:10.1093/plankt/fbv017

36. Jónasdóttir SH, Visser AW, Richardson K, Heath MR. (2015) *Seasonal copepod lipid pump promotes carbon sequestration in the deep North Atlantic*. Proceedings of the National Academy Sciences. 112 no. 39: 12122–12126. doi:10.1073/pnas.1512110112

37. Kathena J, Thygesen UH, Nielsen A, Berg C (in press) *Hake Species (Merluccius capensis and M. paradoxus) Assessment in The Benguela Current Large Marine Ecosystem*. Envir. Devel. In press

38. *Kiørboe T (submitted) *Fluid dynamic constraints on resource acquisition in small pelagic organisms*. Submitted.

39. *Kiørboe T, Ceballos S, Thygesen UH (2015) *Interrelations between senescence, life history traits, and behaviour in planktonic copepods*. Ecology 96: 2225-2235

40. Kokkalis A, Thygesen UH, Nielsen A, Andersen KH (2015) *Limits to the reliability of size-based fishing status estimation for data-poor stocks*. Fisheries Research 171: 4-11

41. Kolding J, Jacobsen NS, Andersen KH, van Zwieten P (2015) *Maximizing fisheries yields while maintaining community structure*. Canadian Journal of Fisheries Aquatic Sciences.

42. *Lindegren M, Checkley DM Jr., Ohman MD, Koslow A, Goericke R. *Resilience and Stability of a Pelagic Marine Ecosystem.* Proceedings of the Royal Society B-Biological Sciences (accepted)

43. Lindemann C, Fiksen Ø, Andersen KH, Aksnes DL (in review) *Scaling laws in phytoplankton nutrient uptake*. (In review) Frontier of Marine Science.

44. Logue JB, Stedmon CA, Kellerman AM, Nielsen NJ, Andersson AF, Laudon H, Kritzberg ES (2015) *Experimental insights into the importance of aquatic bacterial community composition to the degradation of dissolved organic matter*. ISME J 1-13

45. *Mariani P, Krivan V, MacKenzie B, Mullon C (2015) *The migration game in habitat network: the case of tuna.* Theoretical Ecology, 2015 (in press)

46. Marschler C, Starke J, Sørensen MP, Gaididei Y, Christiansen PL (2016). *Pattern formation in annular systems of repulsive particles*. Physics Letters A 380, 166-170

47. *Martens EA, Wadhwa N, Nis S. Jacobsen NS, Christian Lindemann C, Andersen KH, Visser AW. (2015) *Size structures sensory hierarchy in ocean life*. Proceedings of the Royal Society B. 282: 20151346. http://dx.doi.org/10.1098/rspb.2015.1346

48. Maud J, Atkinson A, Hirst AG, Lindeque PK, Widdicombe CE, Harmer RA, McEvoy AJ, Cummings DC (2015) *How does Calanus helgolandicus maintain its population in a variable environment? Analysis of a 25-year time series from the English Channel.* Progress in Oceanography 137: 513-523

49. *Menden-Deuer S, Kiørboe T (submitted). *Small bugs with a big impact: linking plankton ecology with ecosystem processes*. Submitted.

50. *Neuheimer AB, Hartvig M, Heuschele J, Hylander S, Kiørboe T, Olsson K, Sainmont J, Andersen KH (2015) *Adult and offspring size in the ocean: A database of size metrics and conversion factor* (Data Paper) Ecology in press

51. *Neuheimer AB, Hartvig M, Heuschele J, Hylander S, Kiørboe T, Olsson K, Sainmont J, Andersen KH (2015) *Adult and offspring size in the ocean over 17 orders of magnitude follows two life history strategies*. Ecology 96: *in press*

52. Nielsen LT, Hansen PJ, Krock B, Vismann B (submitted) *Accumulation, transformation and breakdown of DSP toxins from the toxic dinoflagellate Dinophysis acuta in blue mussels, Mytilus edulis*. Submitted to Toxicon.

53. *Nielsen LT, Kiørboe T (2015) *Feeding currents facilitate a mixotrophic way of life*. ISME Journal, 9, 2117–2127, doi:10.1038/ismej.2015.27.

54. *Olsson K, Andersen KH: *Cannibalism as a selective force on offspring size*. In revision for Oikos.

55. Payne MR, Barange M, Cheung WWL, MacKenzie BR, Batchelder HP, Cormon X, Eddy TD, Fernandes JA, Hollowed AB, Jones MC, Link JS, Neubauer P, Ortiz I, Queirós AM, Paula JR (2015) *Uncertainties in projecting climate change impacts in marine ecosystems*. ICES J. Mar. Sci. (in press) doi:10.1093/icesjms/fsv231.

56. *Pécuchet L, Törnroos A, Lindegren M (submitted). *Patterns and drivers of fish community assembly in a large marine ecosystem*. Submitted.

57. *Pécuchet L, Törnroos A, Lindegren M (2015) *Environmental filtering drives functional diversity of fish communities in a large brackish marine ecosystem*. Marine Ecology-Progress Series (accepted)

58. Reygondeau G, Guidi L, Beaugrand G, Henson SA, Koubbi P, MacKenzie BR, Sutton T, Fioroni M, Maury O. *Global biogeochemical provinces of the mesopelagic zone*. Submitted to J. Biogeography.

59. Riisgaard K, Nielsen TG, Hansen PJ (2015) *Impact of elevated pH on Arctic spring bloom succession*. Marine Ecology Progress Series 530:63-75

60. Rullyanto A, Jónasdóttir SH, Visser, AW, (2015). *Advective loss of overwintering Calanus finmarchicus from the Faroe-Shetland channel*. Deep Sea Research Part I: Oceanographic Research Papers. 98, 76–82

61. *Sainmont J, Andersen KH, Thygesen UH, Fiksen Ø, Visser AW. (2015) *An effective algorithm for approximating adaptive behavior in seasonal environments*. Ecological Modelling. 311: 20-30

62. Schilder F, Bureau E, Santos I, Thomsen J, Starke J (2015). *Experimental Bifurcation Analysis – Continuation for Noise-Contaminated Zero Problems.* Journal of Sound and Vibration 358, 251-266

63. Selander E, Heuschele J, Nylund G, Pohnert G, Pavia H, Bjærke O, Pender-Healy L, Tiselius P, Kiørboe T (submitted). *Solid phase extraction and metabolic profiling of exudates from living copepods*. (in press)

64. *Sichlau MH, Thygesen UH, Nielsen EE, Kiørboe T (2015) *Mating success and sexual selection in a pelagic copepod, Temora longicornis: Evidence from paternity analyses*. Limnol. Oceanogr. 60: 600–610. doi: 10.1002/lno.10052

65. Thoisen C, Riisgaard K, Lundholm N, Nielsen TG, Hansen PJ (2015) *Effect of acidification on an Arctic phytoplankton community from Disko Bay, West Greenland*. Marine Ecology Progress Series 520: 21-34

66. *Traving SJ, Thygesen, UH, Riemann L, Stedmon CA (2015) *A model of extracellular enzymes in free-living microbes: which strategy pays off?* AEM 81:7385-7393

(Featured in the AEM Editorial Spotlight: http://aem.asm.org/content/81/21/7349.full)

67. Thygesen UH (submitted). *A diffusion approximation based on renewal processes with applications to strongly biased run-tumble motion* Bull. Math. Biol.

68. Thygesen, Sommer L, Evans K, Patterson TA (submitted) *Dynamic optimal foraging theory explains vertical migrations of bigeye tuna*. Ecology: submitted

69. *Tsoukali S, Olsson KH, Visser AW, MacKenzie BR. (submitted). *Lifetime fecundity dependence on size and reproductive mode in fish*. Canadian Journal of Fisheries and Aquatic Sciences

70. *Tsoukali S, Visser AW, MacKenzie BR. *Functional responses of North Atlantic fish eggs to increasing temperature.* Submitted to Marine Ecology Progress Series

71. *Törnroos A, Nordström MC, Aarnio K, Bonsdorff E. (2015) *Environmental context drives trophic trait plasticity in a key species, the tellinid clam* Macoma balthica *L*. Journal of Experimental Marine Biology and Ecology 472: 32-40

72. van Deurs M, Persson A, Lindegren M, Jacobsen C, Neuenfeldt S, Jørgensen C, Nilsson A. *Marine ecosystem connectivity: Migrant-resident interactions controlled by predator-prey size ratio and nutritional prey quality.* Journal of Animal Ecology (in review)

73. Visser AW, Nielsen TG, Middelboe M, Høyer JI, Markager S. (2015). *Oceanography and the base of the pelagic food web in the southern Indian Ocean*. Journal of Plankton Research. doi:10.1093/plankt/fbv019

74. *Zhang L, Andersen KH, Dieckmann U, Brännström Å (2015): *Four types of interference competition and their impacts on the ecology and evolution of size-structured populations and communities.* J. Theoretical Biology 380: 280-290.

3. Presentations at scientific meetings and institutions

1. Almeda R, van Someren Gréve H, Kiørboe T: *Behaviour-dependent predation risk in marine zooplankton: an experimental and modelling approach*. 2016 ASLO-Ocean Sciences Meeting. New Orleans, USA. February 2016 (submitted).
2. Almeda R, van Someren Gréve H, Kiørboe T: *Trade-offs in zooplankton feeding behaviour*. ICES/PICES 6th Zooplankton Production Symposium. Bergen, Norway. May 2016 (submitted).
3. Andersen A, Wadhwa N, Kiørboe T: *Quiet swimming at low Reynolds number*, 68th Annual Meeting of American Physical Society's Division of Fluid Dynamics, Boston, November 2015
4. Andersen KH: *Characteristic sizes of life in the ocean.* Mini-symposium, Wageningen, 3/8-2015
5. Andersen KH: *The theory behind fisheries reference points.* University of Washington, 28/4-2015
6. Andersen KH: *Size- and trait-based modelling for ecosystem-based fisheries management*. Princeton, 23/4-2015.
7. Andersen KH: *Size as a Master Trait*. Session at Trait-based approaches to Ocean Life (http://www.whoi.edu/workshop/traitworkshop2015). Waterville valley October 5-8

2015.

8. Andersen, Nielsen, Haaning, Aagaard & Kiørboe: *Hydrodynamics of Choanoflagellate Feeding*. Complex Motion in Fluids Summer School, Krogerup Højskole, August 2015 (poster)
9. Brun, Kiørboe & Payne: *The predictive potential of ecological niche models for plankton in the North Atlantic*. International symposium on "Effects of Climate Change on the World's Oceans", Santos, March 2015
10. Chakraborty & Andersen: *Correlation between organism size and trophic strategies*. Trait-based Approaches to Ocean Life, Waterville Valley, New Hampshire, USA, October 2015
11. Dölger, Andersen, Kiørboe & Bohr: *Optimal design of salps as gelatinous filter feeders*, DANSIS Research Seminar, Campus Lyngby, May 2015
12. Dölger, Nielsen, Kiørboe, Bohr & Andersen: *Feeding and Swimming of Flagellates*, Complex Motion in Fluids Summer School, Krogerup, August 2015
13. Dölger, Nielsen, Kiørboe, Bohr & Andersen: *Feeding and Swimming of Flagellates*, 68th Annual APS DFD Meeting, Boston, November 2015
14. Hirst A.G. et al.: *New insights from body surface area: A major trait in pelagic invertebrates*. Trait-Based Workshop: exploring traits of marine organisms, organised by Princeton / MIT, October 2015
15. Hirst A.G. et al.: *Body size patterns in contrasting ecological systems*. University of Saint Andrews, September 2015 (Invited)
16. Hirst, Horne, Atkinson & Kiørboe: *Upscaling phenotypic plasticity and physiological responses*. ASLO Aquatic Sciences Meeting, Granada, February 2015
17. Hylander, Kiørboe, Snoeijs Leijonmalm, Sommaruga & Nielsen: *Is there a trade-off between feeding and UV-exposure in Calanus species during the arctic spring bloom?* ASLO Aquatic Sciences Meeting, Granada, February 2015
18. Jackson GA, Visser AW: *Implications of zooplankton feeding type on particle fate as determined by individual based models*. Aquatic Sciences Meeting ASLO, Granada Spain. February 2015
19. Jacobsen NS, Andersen KH: *Size based models predict efficiency frontiers in large marine ecosystems.* American Fisheries Society, Portland, August 2015.
20. Jacobsen NS: *Can you catch a fish before it is mature?* Naturskyttsforeningen, Stockholm, Sweden. April 2015 (Invited)
21. Jonasdottir SH, Visser AW: *Calanus and the biological carbon pump.* Aquatic Sciences Meeting ASLO, Granada Spain. February 2015
22. Kenitz, Andersen, Mariani & Visser: *Vertical distribution of motile and non-motile phytoplankton and implications for the optimal feeding mode of zooplankton*. ASLO Aquatic Sciences Meeting, Granada, February 2015
23. Kenitz, Mariani, Visser & Andersen: *Optimal zooplankton feeding mode in a seasonally-stratified shelf sea*. Workshop on Trait-based Approached to Ocean Life, New

Hampshire, October 2015

24. Kiørboe: *Microscale Ocean Biophysics* – Kick off lecture at Aspen Center for Physics winter workshop, 10-16 January (Invited)

25. Kiørboe: *invited lecture at Trait-based approaches to Ocean Life (http://www.whoi.edu/workshop/traitworkshop2015).* Waterville valley October 5-8 2015.

26. Kiørboe & Goncalves: *Detecting the algae: How copepods detect their prey*. ASLO Aquatic Sciences Meeting, Granada, February 2015

27. Lindegren M: *A general note on functional biodiversity and why it matters using global fish data as an example*. Workshop on Functional Diversity of Baltic Zooplankton (FUNBAZOO) and other trophic levels, Hamburg, Germany, 23-25 November 2015.

28. Mariani: *Group formation and efficiency of migratory species* (talk). *Living systems: from interaction patterns to critical behavior,* Venezia, 16-19 September 2015

29. Mariani: *Group formation and efficiency of migratory species* (Poster presentation). Trait-based Approaches to Ocean Life international workshop, 5-8 Oct. 2015, Waterville Valley USA

30. Nielsen, Andersen & Kiørboe: *Dinoflagellates create flows that mediate feeding and nutrient uptake*. ASLO Aquatic Sciences Meeting, Granada, February 2015

31. Payne M: *Addressing uncertainty in projecting climate change impacts in marine ecosystems,* 3rd International Symposium on Effects of Climate Change on the World's Oceans, 21-27 March 2015, Santos, Brazil

32. Payne M: *A statistical approach to model uncertatinty,* 3rd International Symposium on Effects of Climate Change on the World's Oceans, 21-27 March 2015, Santos, Brazil

33. Payne M: *The roles of plasticity and adaptation in spawning time of Atlantic cod (Gadus morhua): Explaining phenology and making predictions in a changing climate,* 3rd International Symposium on Effects of Climate Change on the World's Oceans, 21-27 March 2015, Santos, Brazil

34. Payne M: *Climate change in the seasonal domain: Impacts on the phenology of marine ecosystems and their consequences,* 3rd International Symposium on Effects of Climate Change on the World's Oceans, 21-27 March 2015, Santos, Brazil

35. Payne M: *A Cascade of Warming Impacts Brings Bluefin Tuna to Greenland Waters,* 3rd International Symposium on Effects of Climate Change on the World's Oceans, 21-27 March 2015, Santos, Brazil

36. Payne M: *Towards Decadal Predictions of Marine Ecosystems: The NACLIM Experience,* Application of Seasonal to Decadal Climate Predictions for Marine Resource Management Workshop, 4 June 2015, Princeton, USA

37. Payne M: *Making and using predictions of species distribution to improve survey design,* ICES Annual Science Conference, 21-25 September 2015, Copenhagen, Denmark

38. Payne M: *Can we understand and predict the distribution of pelagic fish?* ICES Annual Science Conference, 21-25 September 2015, Copenhagen, Denmark

39. Pécuchet, Hidalgo & Lindegren: *Taxonomic and functional diversity patterns of fish assemblages in the European Seas* (poster). ICES Annual Science Conference, Copenhagen, Denmark, September 2015.

40. Pécuchet, Törnroos & Lindegren: *Environmental filtering drives functional diversity of fish assemblages in a temperate system.* ICES Annual Science Conference, Copenhagen, Denmark, September 2015.

41. Pécuchet, Törnroos & Lindegren: *Environmental filtering drives functional diversity of fish assemblages in a temperate system.* Third international Symposium on the Effects of climate change on the world's Oceans, Santos city, Brazil, March 2015.

42. Piltz S: *Are plankton discontinuous, smooth, or slow-fast (&furious)?* Invited minisymposium talk at the Society for Industrial and Applied Mathematics (SIAM) Applications of Dynamical Systems Conference, Snowbird, Utah, USA, May 2015

43. Piltz S: *Are plankton discontinuous, smooth, or slow-fast (&furious)?* Invited seminar talk at the BioComplexity Wednesday meeting, Niels Bohr Institute, University of Copenhagen, Denmark, May 2015

44. Schnedler-Meyer, Mariani & Kiørboe: *A model of fish and jellyfish competition*. Trait-based approaches to ocean life, New Hampshire, October 2015

45. Sichlau, Kiørboe, Nielsen & Thygesen: *Mating success and sexual selection in a pelagic copepod, Temora longicornis – Evidence from paternity analysis*. ASLO Aquatic Sciences Meeting, Granada, February 2015

46. Starke: *Equation-free analysis of collective behavior in particle models*, talk on invitation by Y. SUGIYAMA (Nagoya University, Japan), Symposium Group formation and control of collective bio-motions, Meiji Institute for Advanced Mathematical Science, Meiji University, Japan, October 2015

47. Starke: *Coarse analysis of complex systems by implicit methods*, talk on invitation by K. PAKDAMAN and P. BOURGINE, e-session "Mathematical modeling in biological complex systems" of the Complex Systems Digital Campus 15 World e-Conference (CS-DC'15), September 2015

48. Starke: *Numerical bifurcation analysis of the macroscopic behavior in multi-scale systems*,talk on invitation by R.Abgrall (Zürich), W. Hundsdorfer (Amsterdam), A. Meister (Kassel), T. Sonar (Braunschweig), Oberwolfach Workshop "Recent Developments in the Numerics of Nonlinear Hyperbolic Conservation Laws", September 2015

49. Starke: *Continuation for situations with noisy data*, talk on invitation by B. KRAUSKOPF (University of Auckland, New Zealand) and J. SIEBER (University of Exeter, UK), minisymposium Continuation methods and applications at EquaDiff 2015, Lyon, France, July 2015

50. Starke: *Non-standard traveling waves in traffic and pedestrian flow models*. SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, USA, invited talk in minisymposium The Behavior of Autonomous Agents in Diverse Applications on invitation by P. CARTER and A. VOLKENING (Brown University, USA), May 2015

51. Stedmon CA: *Shedding light on Life's leftovers: persistence of dissolved organic matter (DOM) in the ocean*. Microscale Ocean Biophysics – Aspen Center for Physics winter workshop, January 2015 (Invited)
52. Traving SJ, Bentzon-Tilia M, Knudsen-Leerbeck H, Mantikci M, Hansen JLS, Markager S, Riemann L: *Dynamics in microbial composition and functionality over a season in two contrasting estuarine systems*. SAME Aquatic Microbial Ecology - EMBO conference, Uppsala, Sweden, 23-28 August 2015
53. Traving SJ, Bentzon-Tilia M, Sørensen H, Knudsen-Leerbeck H, Mantikci M, Hansen JLS, Markager S, Riemann L: *Dynamics of microbial functions and communities over a season.* Danish Microbial Society, Denmark, 9 November 2015
54. Traving SJ, Bentzon-Tilia M, Sørensen H, Knudsen-Leerbeck H, Mantikci M, Hansen JLS, Markager S, Riemann L: *Dynamics of microbial functions and communities over a season in two estuarine systems*. PhD day, University Of Copenhagen, Denmark, 12 November 2015
55. Törnroos A: *Describing key traits and trade-offs of marine benthos: towards a mechanistic trait-based approach*. Trait-based approaches to Ocean Life, an international workshop, Waterville Valley Resort, New Hampshire, October 2015 (poster).
56. Törnroos A, Olsson J, Gårdmark A, Pécuchet L, Blomqvist M, Lindegren M, Bonsdorff E: *Long-term functional trends in Baltic Sea coastal macrofauna and fish.* ICES Annual Science Conference, Copenhagen, September 2015.
57. Törnroos A, Bonsdorff E: *Interpreting ecological functioning in coastal waters: spatial and temporal trait patterns across the Baltic Sea.* 10th Baltic Sea Science Congress, BSSC, Riga, June 2015.
58. van Someren Gréve, Almeda & Kiørboe: *Behaviour-dependent predation risk in marine planktonic copepods*. ASLO Aquatic Sciences Meeting, Granada, February 2015
59. Wadhwa N, Martens EA, Jacobsen NS, Lindemann C, Andersen KH, and Visser A: *Size matters: The interplay between sensing and size in aquatic environments*, Complex Motion in Fluids Summer School, Humlebæk, August 2015
60. Wadhwa N: *Hydrodynamics of swimming in zooplankton*, Dansis Research Seminar, Kongens Lyngby, May 2015
61. Wadhwa N: *Physical ecology of swimming in plankton*, University of Cambridge, Cambridge, March 2015
62. Wadhwa N: *Some hydrodynamic aspects of zooplankton ecology*, MPI for Terrestrial Microbiology, Marburg, February 2015

4. Public outreach activities

Popular articles

1. Kiørboe T (2015) *Planktons svømmeteknik er uovertruffen*. Videnskab.dk 28 Februar 2015. http://videnskab.dk/miljo-naturvidenskab/opdagelse-planktons-svommeteknik-er-uovertruffen
2. Kiørboe T & Nielsen LT (2015) *Hvordan fanger flagellater deres føde*? Videnskab.dk 13 juli 2015, http://videnskab.dk/miljo-naturvidenskab/forskere-afslorer-flagellaternes-hemmelighed
3. Kiørboe T, Ceballos S, Thygesen, UH (2015*) Behavior-Dependent Senescence in Pelagic Copepods*. Bulletin of the Ecological Society of America 96:651–653. http://dx.doi.org/10.1890/0012-9623-96.4.651
4. Neuheimer AB, Hartvig M, Heuschele J, Hylander S, Kiørboe T, Olsson KH, Sainmont J, Andersen KH (2015). *Offspring Size in Marine Animals*. Bulletin of the Ecological Society of America 96:662–663. http://dx.doi.org/10.1890/0012-9623-96.4.662
5. Traving SJ, Stedmon CA, Riemann L, Thygesen UH (2015) *Kulstof i havet – en tynd kop te?* Aktuel Naturvidenskab 5:14-17
6. Traving SJ (2015) *The Promise and Pitfalls of Extracellular Biochemistry*. Discover Magazine October 9 2015. http://blogs.discovermagazine.com/the-extremo-files/2015/10/09/the-promise-and-pitfalls-of-extracellular-biochemistry/#.Vk2YAb8YF2w
7. Törnroos A, (2015). *Høj funktionel rigdom trods få arter i Østersøen*. Aktuel Naturvidenskab. Submitted.
8. Wadhwa N, Kiørboe T, Andersen A (2015) *Hydrodynamics of stealthy propulsion by plankton*. Euromech Newsletter, in press

Popular lectures

1. Andersen KH: *Liv og død i havet*. "Hjernekassen", København 19 februar 2015
2. Andersen KH: *Liv og død i havet*. Open Air Academy, Brede, 24. maj 2015
3. Andersen KH: *Liv og død i havet*. Stege Rotary klub. 1. september 2015
4. Kiørboe: *Livet i havet*, København KVUC, 23 April, 2015
5. Kiørboe: *Livet i havet*, Roskilde Gymnasium, 24 September 2015
6. Kiørboe: *Havets usynlige liv*. Folkeuniversitetet v. Odense Universitet, 18 March, 2015
7. Kiørboe: *Havets usynlige liv*. Folkeuniversitetet v. Århus Universitet/Emdrup, 25 September, 2015
8. Kiørboe: *Havets usynlige liv*. Folkeuniversitetet i Sønderborg, 5 November, 2015
9. Kiørboe: *Mysterier, myter og andre historier om havets mikroskopiske liv*, Marinbiologisk Selskab, København, 9 December 2015
10. Lindegren M: *Fiskeriforvaltning, klimaendringer og forsuring av havene.* Nordisk råd sommarmöte (Miljø- og naturressursutvalget), Hirtshals, Danmark, 23 June 2015,

11. Lindegren M: *Climate, Fishing, and Fluctuations of Sardine and Anchovy in the California Current Ecosystem.* "Salongen" (Science and dinner), Lund, Sweden, 22 November 2015

5. Summer schools, symposia session, and workshops taught and/or organized

1. Andersen KH: Trait-based approaches to Ocean Life (http://www.whoi.edu/workshop/traitworkshop2015). Waterville valley October 5-8 2015 (co-organizer)
2. Kiørboe T: Aspen Center for Physics winter workshop: Microscale Ocean Biophysics, Aspen 10-16 January, (co-organizer)
3. Kiørboe T: Geilo-School on Cooperative particles: Patchy colloids, active matter and nanofluids. Geilo 16-26 March 2015 (Instructor)
4. Kiørboe T: ASLO Granada 22-27 February) session: Small bugs with big impact: linking plankton ecology with ecosystem processes (co-organizer)
5. Kiørboe T: ASLO Granada 22-27 February) session: Life at small scale: Microscale insights into aquatic systems (co-organizer)
6. Piltz S: National Institute for Mathematical and Biological Synthesis (NiMBioS) Research Collaboration Workshop for Women in Mathematical Biology, University of Tennessee, USA, June 2015 (participation via application and through a selection process).
7. Piltz S: Organising and guest lecturing a 2-day course programme on mathematical modelling of phytoplankton populations for third-year undergraduate course Arctic Ecology and Population Biology, University Centre in Svalbard, Norway, October 2015.
8. Starke J: 4 days course, Numerical bifurcation analysis and its applications, RheinMain University of Applied Sciences in Wiesbaden, Germany, on invitation by E. GEHRIG and T. LORENZ, 3-4/2015 (Instructor)

6. Students graduated

MSc thesis

Rob van Gemert: Fisheries selectivity and balanced harvesting: the influence of late-in-life density dependence, defended on 10 July 2015.

PhD thesis

Karin Olsson: When bigger is better – a theoretical and empirical examination of factors contributing to selection on offspring size in fish, defended 18 June 2015.

Nawish Wadhwa: Zooplankton Hydrodynamics – An investigation into the physics of aquatic interactions, defended 22 Oct. 2015.

Nis Sand Jacobsen: Big fish or small fish: size based methods to evaluate direct and indirect ecosystem effects of fishing, defended 27 Nov. 2015.

7. Awards

Philipp Brun: Best Early Career Scientist Presentation for Brun, Kiørboe & Payne: The predictive potential of ecological niche models for plankton in the North Atlantic. International symposium on "Effects of Climate Change on the World's Oceans", Santos, March 2015.

Thomas Kiørboe: Hageman Gold medal, May 2015

Martin Lindegren: VKR Young Investigators Award

7. Young Researchers report

Young researchers meeting, Søminestationen, 10th December 2015

Ocean life (OL) meetings: The ocean life meetings were a major topic in the young researchers meeting. Overall, we appreciate the meetings and see them as a good way to practice presenting in front of an audience. Furthermore, wrapping one's own project into a presentation helps to develop a consistent and interesting story for a manuscript, and we gain new knowledge by attending the diverse presentations.

However, since the scope of the science covered in the OL meetings is so broad, there is a danger that young researchers cannot relate very well to certain topics and do not feel capable of involving in the discussions. We agree that it should be the goal of the presenter to make her/his topic as accessible as possible to the broad audience, but this will only partially solve the problem.

One way to address this issue could be to reduce the length of the talks and, for example, have two speakers in one meeting. This year, we already made a step in this direction with the figure discussions in the spring semester and the 100 ecological questions in the fall. Alternative possibilities would be to

- have 2 persons leading a meeting and presenting a common topic from different perspectives. The topic could be associated with people's projects but it could also be something else. A nice example in this context was the outreach session held by Anna and Nis this year.

- pick up on the skills phonebook on the Wiki and strengthen the synergies in the center, i. e., who can I ask for expertise on which tools and how can we be more efficient by collaborating?

- promote more discussion sessions.

- have two speakers sharing a meeting with individual presentations, as was done a few times this year.

We note that similar issues have already been raised in previous young researcher meetings. A list of potential alternative meeting formats that resulted from these discussions is still on the Wiki and complements our suggestions above. However, on the long run the format tended to return to long presentations. We all have little time and many things to accomplish, and therefore an ideal meeting format should not only be interesting to the audience, but also beneficial for the presenter.

In conclusion, part of the solution of finding an ideal OL meeting format may be to experiment and keep trying new things. The presenters should have their freedom in setting up the meetings, but it's also their responsibility to adjust to the broad audience.

Other suggestions/criticisms:

Collaborations: The group of researchers associated with the center is unique in the diversity of backgrounds and expertise on trait-based marine ecology. It is therefore an ideal environment to establish powerful (cross-disciplinary) collaborations. To some extent such collaborations exist, for example, the project of Lasse and Julia on dinoflagellate hydrodynamics or the group around Martin Lindegren working mainly on fish traits. Other members of the center, however, are rather isolated and would appreciate being more integrated, in particular in projects where they could collaborate with other young researchers. The seasonality project is one nice way to foster such collaborations, but it is outside of our core activities. Planning for close cross-disciplinary collaborations already when young researcher positions are designed could be an efficient way to bind the group closer together, especially if such collaborations include scientists associated with different themes (Themes I II & III). Such set-ups could also include collaborators from outside the center which would help to increase our professional networks and to find future career options.

Lab equipment: Some of the lab tools are rather outdated and it would be nice to have some additional ones, such as a flow cytometer or inverted light microscopes.

Future of the center: It would be nice if the young researchers were informed regularly about the future of the center, as it was done by Thomas at the beginning of the annual meeting. We felt that this was done better this year than last year. If larger changes are coming up, it could also be an option to hold brief meetings in the style of the old section meetings, but also quick communications at the OL meetings are appreciated.

"Buddy" PhDs/post docs: Newly starting PhDs and post docs could be given a "buddy" – another young researcher who introduces them to the people and traditions at the center and whom they can ask upcoming questions – to facilitate their integration. A few of the young researchers have experience with such systems and find them very helpful.

MUS: We note that hardly any of the young researchers ever attended a "Medarbejderudviklingssamtale", although according to "Portalen" they would be mandatory once a year. We encourage the leaders of the center to arrange MUS once a year. These meetings can be a good opportunity to reflect on one's project, collaborations, meeting activities, future plans and career in general. Planning future applications in collaboration with the center could e.g. help to keep some of the young researchers associated with the center after finishing their PhDs/post docs.

8. 2015 Annual retreat: program and abstracts

Meeting agenda

4th annual meeting of the Centre for Ocean Life

Søminestationen (Holbæk), December 10th-11th 2015

Welcome to the 4th annual meeting of the Centre for Ocean Life!

Please find the program and the list of talks/posters with abstracts below.

For further information please contact Anna Törnroos (annto@aqua.dtu.dk).

Looking forward to seeing you all there!

The organizing committee: Julia, Agnethe, Anna & Philipp

Hour	Min	Thursday 10th	Friday 11th
8:00	00-15		Breakfast 60 min
	15-30		
	30-45		
	45-60		
9:00	00-15	Arrival (find a room etc.)	Erik Bonsdorff
	15-30		Philipp Brun
	30-45		Nicolas Schnedler-Meyer
	45-60	Thomas Kiørboe – Welcome and opening remarks	Coffee Break 15 min
10:00	00-15		Daniel van Denderen
	15-30	Lasse Tor Nielsen	Anna Törnroos
	30-45	Julia Dölger	Laurene Pecuchet
	45-60	Coffee Break 15 min	Tim Spaanheden Dencker
11:00	00-15	Marina Pancic	Coffee Break 15 min
	15-30	Agnethe Nøhr Hansen	Christine Stawitz
	30-45	Irene Heilmann	Nis Sand Jacobsen
	45-60	Sachia Jo Traving	Rob van Gemert
12:00	00-15	Lunch 60 min	Lunch 60 min
	15-30		
	30-45		
	45-60		
13:00	00-15	Keynote speaker 45 min Markus Pahlow	Ken – Wrap up 30 min
	15-30		
	30-45		Clean up & farewells
	45-60	Jiayi Xu	
14:00	00-15	Coffee Break 15 min	-End of the meeting-
	15-30	Hans van Someren Greve	
	30-45	Rodrigo Almeda	
	45-60	Mark Wejlemann Holm	
15:00	00-15	Coffee Break	
	15-30	Group discussion - future ideas for the Centre combined with walk	
	30-45		
	45-60		
16:00	00-15		
	15-30		
	30-45		
	45-60	Andre W. Visser – Seasonality in the Ocean	
17:00	00-15		
	15-30	Kasia Kenitz	
	30-45	Esther Beukhof	
	45-60	Poster and beer 30 min	
18:00	00-15		
	15-30	Board meeting & Young researchers meeting	
	30-45		

	45-60	
19:00	00-…	Dinner

Titles and abstracts of talks

Nis Sand Jacobsen	How efficiently are fisheries operating at the ecosystem level?	Like most natural resource management problems, managing fisheries presents tradeoffs between objectives (e.g. yields, profits, ecological objectives) that have to be weighed against one another. When navigating such conflicting objectives, a logical first target is Pareto efficiency- a state from which it is impossible to improve with respect to any objective without regressing with respect to at least one other objective. Here we use a novel calibration of size-based ecosystem models to investigate the ecosystem-level efficiency of fisheries management in five large marine ecosystems (LMEs) with respect to yield and an aggregate measure of ecosystem impact. In two of the LMEs. We find three of the ecosystems to be nearly efficient with respect to yield and ecosystem impact, whereas two could improve. In contrast, we find both LMEs (North Sea, Baltic Sea) quite inefficient with respect to economic rent and ecosystem impact, but that their efficiency is steadily improving. Our results suggest that single-species management can perform inefficiently at the ecosystem-scale.
Christine Stawitz	How diet preferences impact the size-structured community within a tropical lake	Tonlé Sap Lake in Cambodia is one of the most productive freshwater ecosystems in the world, with an estimated catch of 550-650K tons annually. The lake fish community is supported by both aquatic primary production and terrestrial input, which enters the system during flood periods and creates an additional, bacterial nutrient pathway. Over 500 fish species are estimated to reside in the lake, with some primarily dependent upon autotrophic and others dependent on bacterial food sources. Consumers of the bacterial input are contaminated by mercury, with contamination increasing with trophic level. We use a size-structured ecosystem model to understand the effect of relative availability of the two resources on growth rates, abundance, and harvest of fish species in Tonlé Sap. Additionally, we study the effect of targeted fishing on low-mercury species (i.e. autotrophic consumers) on the size-structure and composition of the lake fish community.
Julia Dölger	Feeding and Swimming of Haptophytes	Haptophytes are mixotrophic biflagellates. Many of them use their haptonema, a rod-like structure emerging from the front of the cell, for prey capture. With analytically calculated flows around model biflagellates with point forces located next to a no-slip sphere we investigate the hydrodynamics of swimming and feeding and the associated trade-offs in haptophytes. By comparison with morphologies, beat patterns and micro-PIV flow fields for two haptophyte species we find that their flagellar arrangements are rather optimized for fast swimming than for

		advective prey capture on the haptonema.
Marina Pancic	Benefits, cost, and tradeoffs of defense mechanisms in marine phytoplankton	Phytoplankton is a highly diverse group of photosynthetic organisms, which contributes to ~50% of the global CO_2 fixation, and concomitantly affects the biogeochemical cycles in the ocean due to their requirements for nutrients. The fact that many phytoplankton species coexist in the same space and at the same time on few resources, together with the strong top-down selective pressure, demands for identification of the traits that determine their ecological niche. In order to reduce predation from higher trophic levels, phytoplankton has developed a variety of physical and chemical defense mechanisms, and has additionally been found to be highly flexible in traits which affect their edibility. This project aims at identifying and quantifying benefits, costs and tradeoffs of those mechanisms, initially focusing on the thickness of silica walls in diatoms, since this morphological trait was found to be a plastic trait, and can be induced by the presence of herbivores.
Markus Pahlow	Optimality-based model of switching between motile and non-motile prey	A modelling analysis of mesocosm experiments in the Peru Upwelling region indicates different feeding behaviour of the ciliate community depending on dinoflagellate abundance. Owing to the absence of laboratory observations on ciliates, we used observations of copepod switching behaviour to derive optimal switching behaviour between motile and non-motile prey. The model requires only a slight modification of an existing optimality-based model for current feeders. While the model can explain individual switching behaviour, it fails to reproduce the mesocosm data. Thus, the feeding behaviour of zooplankton communities may differ fundamentally from that of individual populations.

Sachia Jo Traving	Dynamics in microbial composition and functionality over a season in two contrasting estuarine systems	In aquatic microbial ecology it remains unclear how bacterial community composition and dynamics are coupled to functionality, and whether this putative coupling varies over the season. In this study we address the questions if bacterial community composition can be linked to community function, and how this coupling is affected by environmental conditions during a season. Bacterial community composition and dynamics was determined using Illumina sequencing of the 16S gene. Community functions were assessed by carbon utilization profiles using 31 different carbon sources combined with activity patterns of five different extracellular enzymes. The community activity was estimated through respiration and bacterial production, which allowed the carbon use efficiency (CUE) to be calculated. The environment was characterized with special focus on the dissolved organic matter (DOM).
Andre W. Visser	Seasonality and the ecology of marine life	Nearly all marine ecosystems are modulated seasonally. This is particularly evident in boreal and temperate environments, in the annual cycles of primary production, with a period of intense productivity on an otherwise replete environment. This cycle of feast and famine imprints itself throughout the marine food web, from the pelagic to the bentos, from phytoplankton to zooplankton, fish and marine mammals and birds, and also to microbial processes, pathogens and parasites. Otimizing annual routines to best survive and make use of seasonal cycles is a fundamental evolutionary pressure on life in much of the world's oceans. Within Ocean Life, we have initiated an ambitious program to document seasonal patterns of marine life history strategies, focusing on activity, storage (and hibernation) and migration as key traits. These observations will be compared to a simple theoretical framework; to gauge how much of the observed patterns can be explained by optimized resource utilization.

Hans van Someren Greve	Behavior-dependent predation risk in marine planktonic copepods: an experimental and modelling approach	Zooplankton exhibit different motile behaviors related to feeding, swimming and mate searching. These differences in motility may imply different levels of predation risk, which may partially determine the structure of pelagic communities. Here, we experimentally test a behavior-dependent encounter model that considers fluid signal generation and perception as well as encounter velocities to predict predation risk in planktonic copepods. We use prey and predator motility characteristics obtained by video-observations as input to the model and conducted bottle incubation predation experiments to determine predation risk associated with i) differences in feeding strategy (active vs. passive feeders) and with ii) gender differences in mate searching behavior. Observed predation risk varied significantly with behavior and was well predicted by our model. Specifically, we found higher predation risk for copepods with active compared to passive feeding strategies, and higher predation risk in mate-searching males than in females. Overall, our results demonstrate that motile behavior is a key factor affecting predation risk in zooplankton.
Jiayi Xu	Long-term effects of the toxic dinoflagellate *Alexandrium tamarense* on copepods	This is a background introduction of my upcoming experiments which about the long-term toxic effects of *Alexandrium tamarense* on copepods. Many researches stated various long-term effects of cell toxin concentration, composition and toxicity of harmful algae on ingestion rate, egg production, hatching success and nauplius fitness of copepods. Our previous experiments described three completely different short-term (4 hours' exposure) feeding responses of *Temora longicornis* to three strains of *A. tamarense* which had various allelochemical activities, PSP toxin profiles and contents. Results showed no significant lethal or sublethal effects on *T. longicornis* during the first 4 hours' feeding on toxic *A. tamarense*. For the next stage, we are curious about whether there are any long-term toxic effects on copepods and their offspring by exposing to *A. tamarense* for several days or more.
Mark Wejlemann Holm	Resting eggs in copepods – trait related to temperature tolerance of adults?	The marine environment is ever changing. Depending on factors such a latitude and type of habitat these changes can be significant or undetectable for marine life. Changes in biotic and abiotic conditions can occur on small and large time scales, with the most important for many marine organisms being predictable seasonal cycles. Seasonal fluctuations in environmental conditions primarily depend on solar radiation, and hence temperature. Marine free-living copepods produce resting eggs to cope with these changes. Often resting eggs are thought of as a mechanism to cope with winter conditions, and thus low temperatures. However, 30% of the species, which presently are known to produce resting eggs, does so to cope with warm periods. Therefore, is the production of resting eggs a

		mechanism to cope with the low food availability during winter or is it a trait that is related to temperature tolerance of adult copepods?
Irene Heilmann	Predator-prey model with fitness taxis	I will present the basic idea for my next project. When predator-prey models are extended to include spatial dimensions we can have the classical Turing model. This model assumes animals move randomly, which surprisingly can create stable spatial patterns. We consider animals that do not move randomly, but instead move towards places where they have better fitness. The aim is to investigate the spatial patterns such a generalization can lead to.
Daniel van Denderen	Effects of bottom trawl fishing on benthic communities across habitats	Bottom trawl fishing has widespread impacts on benthic habitats and communities. We examined the effect of this anthropogenic disturbance on benthic species richness and community composition and function in different parts of the North Sea. We observed negative effects of trawling on richness in relatively speciose, deep areas with fine sediments. In these areas, trawling generally declined long-lived, hard-bodied and suspension-feeding organisms. Shallow areas with coarse bottoms had different community compositions, being composed of either small-sized, deposit-feeding animals, or, mobile scavengers and predators, and in these areas trawl effects were not found. These condition-dependent effects may help to identify areas that are more or less resilient to trawling and can support the development of management plans that account for the environmental effects of fishing.

Rodrigo Almeda	Trade-offs in zooplankton feeding behavior-experimental approach	Zooplankton has developed three different ways of collecting food: they can be ambush feeders that wait for prey to pass within their dining sphere; they can generate a feeding current and harvest prey that are entrained in the feeding current; or they are cruise feeders that capture prey that they encounter as they cruise through the water. We experimentally quantify the costs and benefits, "tradeoffs", in terms of feeding efficiency, predation mortality, and metabolic expenses, associated with these three main feeding behaviors in zooplankton. The copepods Temora longicornis (feeding-current feeder), Oithona nana (ambush feeder) and Centropages hamutus (cruising feeder) were used as model organisms. We will present our experimental results about how these trade-offs are interrelated and vary among feeding behaviours and optimal feeding strategies in zooplankton will be discussed.
Agnethe Nøhr Hansen	Estimating diatom size and Si content in response to environmental change	Diatoms are a class of unicellular phytoplankton that have the characteristic traits of a silicate shell and an internal vacuole. The aim of the model is to explore trade-off and fitness consequences of the physical traits; size, shell thickness and vacuole volume. The mechanisms involved in the trade-offs include uptake kinetics of nutrients, photosynthetic carbon uptake, cell density, sinking loss, grazer resistance, cost of growing and maintaining the silica shell and the vacuole. The aim is to develop a hypothetical framework within which the fitness of expressed diatom traits can be explored, and through which the seasonal succession of diatoms can be understood.
Laurene Pecuchet	Traits and life history strategies of fish assemblages in the European Seas	In this study, we investigated the spatial patterns and prevalence of traits and life history strategies of fish communities across Mediterranean and Atlantic ecosystems. These ecosystems provide a pronounced natural gradient in terms of e.g., temperature and productivity and are subjected to various anthropogenic pressures (fisheries, pollution). Based on the traits fecundity, offspring size and maximum length, species could be characterized into three strategies: opportunistic, periodic and equilibrium. There were clear spatial pattern in the different strategies prevalence. These spatial patterns could be related to the abiotic environment, notably temperature and depth, and the biotic environment, e.g. chlorophyll. The equilibrium strategies were prevailing in stable and predictable environment, while the opportunistic strategies were prevailing in environment with strong abiotic seasonality. This study demonstrates how traits and trades-offs, can be used to summarize species strategies into few key life history strategies and how it can be used to investigate communities' composition.

Esther Beukhof	Spatio-temporal patterns of fish trait diversity in the North Sea	North Sea demersal fishes form a well-studied community in terms of species diversity, community structure and composition, especially in the light of increasing fishing pressures of the previous century. However, less is known to what extent anthropogenic and environmental changes have impacted the functional diversity and composition of the community. Functional diversity is becoming an increasingly important aspect of biodiversity since it is believed to better explain and predict ecosystem functioning than species diversity does. It is calculated based on the functional traits and the range of their values that are present in the community. To better understand and explain patterns in functional diversity of the North Sea fish community, I study the underlying spatio-temporal patterns of several individual fish traits. The preliminary results of my analysis will be presented.
Anna Törnroos	Long-term functional trends and interactions in Baltic Sea coastal benthos and fish	The focus on single trophic levels or specific taxonomic groups, and the lack of knowledge on temporal variability of functional properties, is limiting our progress of understanding changes in marine systems. Here we addressed this by exploring the temporal (~ 40 years) pattern in functional structure of fish and benthic macrofauna in three Baltic Sea coastal areas (Kattegat, the Baltic Proper and the Bothnian Sea). We assembled trait information on six traits spanning morphology, life history, habitat and behaviour for > 200 macrofaunal taxa and > 40 fish taxa. To assess functional changes and potential shifts we analysed functional indices (richness, evenness and dispersion) on a community level in each area. The functional trends were also related to environmental variables measured on a local and regional scale (water temperature and salinity). In addition, we compared trends in specific traits between the two taxonomic levels in order to get a better understanding of interactions and couplings.
Nicolas Schnedler-Meyer	Global jellyfish patterns and responses to environmental forcing – insights from a mechanistic model.	Blooms of large pelagic jellyfish are notorious for causing losses in fisheries, infrastructure and tourism, and generally form alternative, less efficient pathways in marine food webs, limiting energy transfer into the higher trophic levels. In spite of being ubiquitous and abundant, jellyfish are diverse, difficult to sample and process, and have naturally fluctuating populations. This makes it hard to elucidate the key factors promoting jellyfish, especially when combined with the variety of circumstances surrounding local bloom cases. Nevertheless jellyfish share key traits which separates them from fish, and which potentially defines their role in marine ecosystems. Here we build on mechanistic descriptions of the link between individual feeding and environmental factors, to predict responses to eutrophication and fishing of an idealized food web containing jellyfish. The model is applied to the Large Marine Ecosystems

		and the obtained patterns are compared with other studies.
Philipp Brun	Signal of environmental regime in key traits of copepods	Pelagic copepods are ubiquitous from icy polar oceans to stratified tropical seas, dominating the mesozooplankton biomass across large areas. The success of this homogeneous group of crustaceans is only possible through efficient adaptations to the wide range of environmental conditions experienced. We argue that the signal of these adaptations is manifested in a few easily measurable key traits. We compiled a large dataset of ecologically relevant candidate traits and found body size, feeding activity, relative offspring size, and respiration rate to be proxies for its principal dimensions. We combine information on these four key traits with large observational datasets to produce trait distribution maps of pelagic copepod communities, and then test the relevance of these maps by using them to predict Longhurst's ecoregions. Besides improving our understanding of trait-environment relationships for copepods, our maps also represent a new baseline against which hypotheses and model predictions can be tested.
Lasse Tor Nielsen	Trade-offs in flagellar arrangements – why all the diversity?	All unicellular flagellates share the same basic missions of life: To survive and grow. The flagella are obviously crucial to both of these missions, yet flagellates show a profound diversity in flagellar arrangements and beat patterns. What are the trade-offs involved in flagella arrangement and beat pattern among unicellular protists? What are for instance the advantages (and disadvantages) of having multiple flagella instead of just one? Are some flagellar arrangments optimizing swimming and others feeding? Or are the two convergent? Is the flagellar arrangement coupled to trophic mode, so that heterotrophs primarily display one type and phototrophs another? We analyze flagella beat patterns and visualize the flow fields of unicellular flagellates with different flagellar arrangments in an attempt to identify traits and quantify trade-offs.

Tim Spaanheden Dencker	Functional diversity in the North Sea fish community	Contrary to taxonomic diversity's focus on species, functional diversity encompasses the range of functional traits in a given community. A review by Hooper *et al.* (2005) concluded that functional diversity often is better at explaining the relationship between biodiversity and ecosystem functioning. Yet, functional diversity has only recently moved into the spotlight, and there is still unchartered territory in terms of understanding the mechanisms behind it. In this study, I have explored the temporal and spatial dynamics of both taxonomic and functional diversity over a three-decade period in the North Sea fish community. The results show marked differences between hot and cold spots of species richness and functional richness, and a high degree of spatio-temporal variation over the 31-year study period.
Kasia Kenitz	Trophic trait cascade and seasonality in plankton traits – future directions	Plankton community in the English Channel is characterised by robust seasonal patterns in phytoplankton motility and zooplankton feeding traits. Non-motile diatoms bloom in spring, with dinoflagellates thriving in late summer. Feeding-current feeders target non-motile prey and reach their highest biomass in summer, following the spring diatom bloom. In contrast, passive ambushers peak in early spring and autumn. Model simulations reveal that the seasonal succession of zooplankton feeding traits is controlled by prey availability and the physical environment. Change in the optimal feeding mode driven by the physics may in fact be the driver reinforcing the seasonal succession of phytoplankton motility traits, hence illustrating the trophic trait cascade. The adaptive grazing model is a tool that provides a great insight into the mechanisms shaping plankton trait distribution across different physical regimes or latitudinal gradients. I will present ideas for further implementation and improvements required for model application across contrasting environments.

Titles and abstracts of posters

Anders Andersen	Hydrodynamics of Choanoflagellate Feeding	No abstract
Sofia Piltz	A minimalistic model for phytoplankton blooms	Inspired by analyses on satellite data, we develop a minimalistic model for phytoplankton blooms. Our model successfully reproduces qualitative patterns seen in the data. Our ongoing work involves comparing model predictions quantitatively with data for primary production and chlorophyll concentration collected in a fjord outside of Gothenburg between 1985 and 2012.
Brian MacKenzie	Predicting future shifts in herring spawning habitat in the North Sea	Herring (Clupea harengus) is one of the ecologically and commercially most important fish species in the North Sea. It produces benthic eggs at numerous sites along the British coast in the North Sea and English Channel. We used environmentally-drivenn GAMs to investigated how expected 21st century climate change could influence spawning time and location, and egg survival probability in the North Sea. Model predictions for the 2090s suggest earlier spawning for northern spawning areas and a shift towards later spawning time for a southern area (Downs). Alternatively, if the northern spawning components maintain their current spawning period via behavioural distributional changes, they would potentially face a narrower spatial distribution of suitable conditions for spawning compared to the currently known spawning locations. Expected egg survival will not likely change. These analyses illustrate processes how increasing temperatures associated with climate change could affect herring life history and ecology in the North Sea.