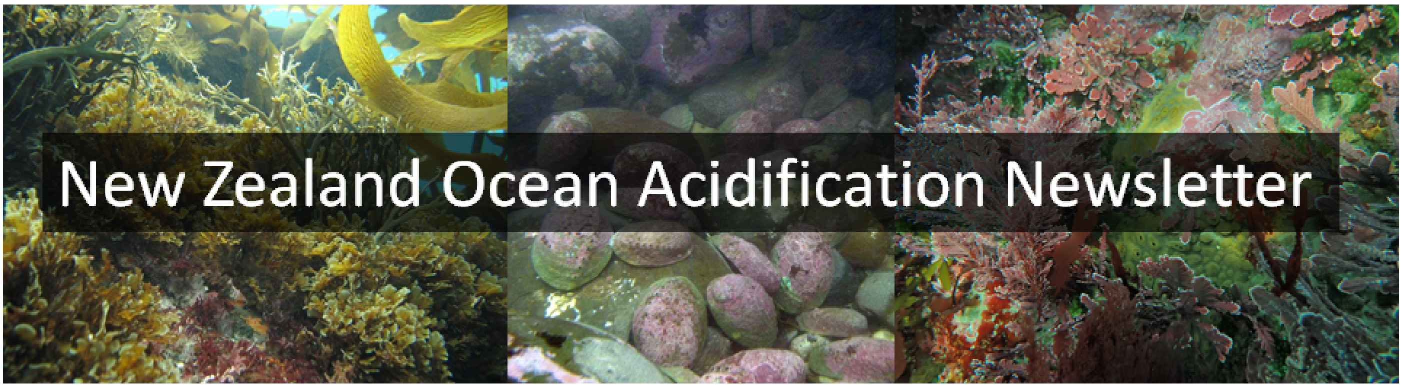
#61 – November-December 2019 (http://nzoac.nz/)



Local News

Message to NZOA-ON sampling partners

Thank you for sampling for us, we really appreciate all the work you put into our network.

We did work up all the samples and up dated the website, please find attached the data of your site or you can go onto the website to look at all the other data.

https://marinedata.niwa.co.nz/nzoa-on-map/

If there are any questions please don't hesitate to ask. thanks again and have a nice day

Judith + Kim

Reminder - 2020 New Zealand Ocean Acidification Conference

17–18th February, 2020
Victoria University of Wellington

The 2020 New Zealand Ocean Acidification Conference will be held in Wellington on the 17th to 18th of February at Victoria University. Abstract submissions are now closed, but registration to attend only is still open. Please see previous version of the newsletter for details on registration or contact Christopher.cornwall@vuw.ac.nz

Reminder - NZOAC post-conference workshop:

19 February, 2020
9:30 – 4:00
Victoria University of Wellington

How will biota respond to a changing ocean?
A best practice guide for multiple drivers research

Christina M. McGraw (University of Otago, Department of Chemistry) and Christopher Cornwall (Victoria University, School of Biological Sciences)

Spaces are limited in this free workshop.

To register, e-mail christina.mcgraw@otago.ac.nz by January 31st.

International News and jobs

Job opportunity: Project technical assistant – New Zealand Pacific Partnership on Ocean Acidification

Applications are invited for the following position with SPREP at Apia. The Secretariat has an exciting and challenging opportunity for qualified professionals who are interested to be part of one of the world's leading regional environmental organisations based in Apia, Samoa with about 100 staff recruited from around the world.

Applications Close: Friday, 17 January 2020

Full details on responsibilities, requirements, remuneration packages and lodging an application can be obtained from the Employment section of our website: http://www.sprep.org or by contacting Marion Tuipulotu-Chan Chui on telephone: +685 21929 Ext. 328, Fax: +685 20231, or direct Email: marionc@sprep.org.
More information.

Selection of recent papers

Varying reproductive success under ocean warming and acidification across giant kelp (Macrocystis pyrifera) populations. Understanding how climate change may influence ecosystems depends substantially on its effects on foundation species, such as the ecologically important giant kelp (Macrocystis pyrifera). Despite its broad distribution along strong temperature and pH gradients and strong barriers to dispersal, the potential for local adaptation to climate change variables among kelp populations remains poorly understood. We assessed this potential by exposing giant kelp early life stages from genetically disparate populations in Chile and California to current and projected temperature and pH levels in common garden experiments. We observed high resistance at the haploid life stage to elevated temperatures with developmental failure appearing at the egg and sporophyte production stages among Chilean and high-latitude California populations, suggesting a greater vulnerability to climate- or ENSO-driven warming events. Additionally, populations that experience low pH events via strong upwelling, internal waves, or estuarine processes, produced more eggs per female under experimental low-pH conditions, which could increase fertilization success. These results enhance our ability to predict population extinctions and ecosystem range shifts under projected declines in ocean pH and increases in ocean temperature.

Hollarsmith J. A., Buschmann A. H., Camus C. & Grosholz E. D., 2020. Varying reproductive success under ocean warming and acidification across giant kelp (Macrocystis pyrifera) populations. *Journal of Experimental Marine Biology and Ecology* 522: 151247. doi: 10.1016/j.jembe.2019.151247. Article (subscription required).

Season affects strength and direction of the interactive impacts of ocean warming and biotic stress in a coastal seaweed ecosystem. The plea for using more "realistic," community-level, investigations to assess the ecological impacts of global change has recently intensified. Such experiments are typically more complex, longer, more expensive, and harder to interpret than simple organism-level benchtop experiments. Are they worth the extra effort? Using outdoor mesocosms, we investigated the effects of ocean warming (OW) and acidification (OA), their combination (OAW), and their natural fluctuations on coastal communities of the western Baltic Sea during all four seasons. These communities are dominated by the perennial and canopy-forming macrophyte Fucus vesiculosus—an important ecosystem engineer Baltic-wide. We, additionally, assessed the direct response of organisms to temperature and pH in benchtop experiments, and examined how well organism-level responses can predict community-level responses to the dominant driver, OW. OW affected the mesocosm communities substantially stronger than acidification. OW provoked structural and functional shifts in the community that differed in strength and direction among seasons. The organism-level response to OW matched well the community-level response of a given species only under warm and cold thermal stress, that is, in summer and winter. In other seasons, shifts in biotic interactions masked the direct OW effects. The combination of direct OW effects and OW-driven shifts of biotic interactions is likely to jeopardize the future of the habitat-forming macroalga F. vesiculosus in the Baltic Sea. Furthermore, we conclude that seasonal mesocosm experiments are essential for our understanding of global change impact because they take into account the important fluctuations of abiotic and biotic pressures.

Wahl M., Werner F. J., Buchholz B., Raddatz S., Graiff A., Matthiessen B., Karsten U., Hiebenthal C., Hamer J., Ito M., Gülzow E., Rilov G. & Guy-Haim T., in press. Season affects strength and direction of the interactive impacts of ocean warming and biotic stress in a coastal seaweed ecosystem. *Limnology and Oceanography*. Article.

The effects of long-term exposure to low pH on the skeletal microstructure of the sea urchin Heliocidaris erythrogramma. Anthropogenic CO2 – driven ocean acidification (OA) is causing a decrease in seawater pH and the saturation state of calcium carbonate minerals, compromising the ability of calcifying species to produce and maintain their skeletons. Sea urchins are ecologically important calcifying species and we investigated the impacts of long-term (9 month) exposure to near-future OA (Ambient – pHNBS 8.01; OA – pHNBS 7.6) on the skeleton microstructure of Heliocidaris erythrogramma using scanning electron microscopy (SEM), micro-computed tomography (μCT) and nanoindentation. SEM revealed that the youngest plates (apical plates) which had likely grown in experimental conditions had larger pores in the OA group (pore surface area ~ 72% larger) compared with those of urchins maintained in ambient pH. High-resolution, μCT 3-D reconstructions of the apical plates revealed that the experimental OA treatment urchins had a ~14% greater porosity and ~17% less biomineral, suggesting an inability to finely regulate skeletogenesis. The mid-test ambital plates established prior to this study did not show any OA associated change in porosity. Nanoindentation of the apical plates indicated that OA reduced skeletal hardness and elasticity. Stereom pore size is a key trait of the sea urchin endoskeleton and increased porosity in H. erythrogramma is likely to impact its biological functions as well as its biomechanical capacity to defend against predation and physical disturbances.

Johnson R., Harianto J., Thomson M. & Byrne M., 2020. The effects of long-term exposure to low pH on the skeletal microstructure of the sea urchin Heliocidaris erythrogramma. *Journal of Experimental Marine Biology and Ecology* 523: 151250. doi: 10.1016/j.jembe.2019.151250. Article (subscription required).

Could ocean acidification influence epiphytism? A comparison of carbon-use strategies between Fucus vesiculosus and its epiphytes in the Baltic Sea. Reduced seawater pH due to elevated carbon dioxide (CO2), a process known as ocean acidification (OA), is a globally significant environmental issue. OA is predicted to influence a range of ecosystem processes, but little is known about how changing seawater carbon chemistry could influence the extent and impacts of epiphytism. In the brackish Baltic Sea, increased epiphytism is associated with coastal eutrophication and the potential for OA to interact with this relationship remains unclear. This study focuses on slow-growing perennial algae Fucus vesiculosus—which is one of the most important habitat-forming species in the Baltic Sea—and two of its most common and abundant filamentous epiphytes Ceramium tenuicorne and Pylaiella littoralis. Material for this study was collected from Estonian coastal waters. The aim of the research was to determine which carbon acquisition strategies these species possess, which could indicate how they respond to predicted changes in seawater chemistry due to elevated CO2. Carbon-use strategies in macroalgae were determined by analyzing natural carbon isotope signatures (δ13C), pH drift experiments, and photosynthesis vs. dissolved inorganic carbon (P vs. DIC) curves. Our results showed that although F. vesiculosus and its filamentous epiphytes all possess a carbon concentrating mechanism (CCM), the potential species-specific variation in the CCMs operation will favor C. tenuicorne over F. vesiculosus and P. littoralis in a future high CO2 world.

Albert G., Hepburn C. D., Pajusalu L., Paalme T., Pritchard D. W. & Martin G., in press. Could ocean acidification influence epiphytism? A comparison of carbon-use strategies between Fucus vesiculosus and its epiphytes in the Baltic Sea. *Journal of Applied Phycology*. Article (subscription required).

Ecological effects of elevated CO2 on marine and freshwater fishes: from individual to community effects. Research over the past decade has shown that climate-change relevant CO2 levels can affect the growth, development and survival of some fishes during early life. There are also wide-ranging effects on behavior that could alter performance and survivorship of some species. Yet, there is also substantial variation in the sensitivity of fishes to elevated CO2, both among and within species. This chapter explores the current understanding of ecological effects of projected future CO2 levels on marine and freshwater fishes, including major knowledge gaps and uncertainties, and interactions with other stressors such as global warming. While laboratory experiments show that elevated CO2 can affect ecologically important traits of some species, we are not yet able to predict which species are sensitive and which are tolerant to higher CO2 levels. Moreover, the impacts of elevated CO2 on ecologically relevant traits can depend on food availability and interact with elevated temperature and other stressors in unexpected ways. New studies also demonstrate that natural CO2 variation and ecological complexity can mitigate some of the negative effects of elevated CO2 observed in simplified laboratory experiments. Finally, studies at natural CO2 seeps suggest that indirect effects of elevated CO2 on food resources and habitats may have larger effects on fish populations than the direct effects of elevated CO2 on individual performance.

Munday P. L., Jarrold M. D. & Nagelkerken I., 2019. Ecological effects of elevated CO2 on marine and freshwater fishes: from individual to community effects. In: Grosell M., Munday P. L., Farrell A. P., Brauner C. J. (Eds.), *Fish Physiology*, 27 pp 323-368. Elsevier. Chapter (subscription required).

Ocean acidification as a multiple driver: how interactions between changing seawater carbonate parameters affect marine life. 'Multiple drivers' (also termed 'multiple stressors') is the term used to describe the cumulative effects of multiple environmental factors on organisms or ecosystems. Here, we consider ocean acidification as a multiple driver because many inorganic carbon parameters are changing simultaneously, including total dissolved inorganic carbon, CO2, HCO3–, CO32–, H+ and CaCO3 saturation state. With the rapid expansion of ocean acidification research has come a greater understanding of the complexity and intricacies of how these simultaneous changes to the seawater carbonate system are affecting marine life. We start by clarifying key terms used by chemists and biologists to describe the changing seawater inorganic carbon system. Then, using key groups of non-calcifying (fish, seaweeds, diatoms) and calcifying (coralline algae, coccolithophores, corals, molluscs) organisms, we consider how various physiological processes are affected by different components of the carbonate system.

Hurd C. L., Beardall J., Comeau S., Cornwall C. E., Havenhand J. N., Munday P. L., Parker L. M., Raven J. A. & McGraw C. M., in press. Ocean acidification as a multiple driver: how interactions between changing seawater carbonate parameters affect marine life. *Marine and Freshwater Research*. Article (subscription required).

Parental acclimation to future ocean conditions increases development rates but decreases survival in sea urchin larvae. Environmental conditions experienced by parents can have lasting effects on offspring. For some marine organisms, parental acclimation may attenuate the negative effects observed in offspring exposed to the same conditions. Here, development of the coral reef sea urchin Echinometra sp. A was examined in larvae derived from parents acclimated for 20 months in either present-day conditions or those predicted for the year 2100 (+ 2 °C/pH 7.8). Egg size was measured, and larval morphology, survival and respiration were quantified in larvae raised in present-day (26 °C/pH 8.1) and 2100 (28 °C/pH 7.8) treatments to near settlement to determine whether parental acclimation promotes greater resilience to climate change stressors. Although there was no difference in egg size, larvae from 2100 parents were generally larger and more developmentally advanced than those derived from present-day parents. However, negative carryover effects reduced survival in offspring of parents acclimated to 2100 conditions. At 15 days post-fertilization, survival of offspring derived from 2100 parents was 50.6% and 43.7% when raised in present-day and 2100 conditions, respectively, compared to 59.9% and 64.6% in offspring derived from present-day parents. When raised in 2100 conditions, respiration declined by 36.8% in larvae derived from present-day parents, while respiration rates of larvae from 2100 parents increased by 109%, suggesting that carryover effects may be associated with higher energy consumption and physiological stress in larvae from 2100 parents. Although parental acclimation enhanced growth of larvae in early development, overall, negative carryover effects outweighed potential benefits of parental acclimation to ocean warming and acidification in this species.

Karelitz S., Lamare M., Patel F., Gemmell N. & Uthicke S., 2020. Parental acclimation to future ocean conditions increases development rates but decreases survival in sea urchin larvae. *Marine Biology* 167: 2. doi: 10.1007/s00227-019-3610-5. Article (subscription required).