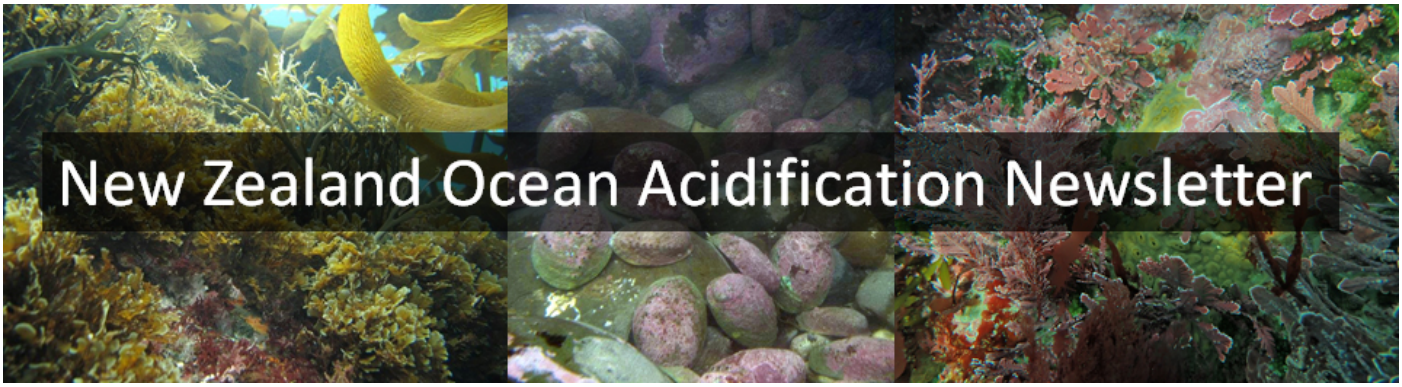
#65– July 2020 (http://nzoac.nz/)



Local News

14th annual New Zealand Ocean Acidification Conference – Dunedin Feb 2021

The 14th annual New Zealand Ocean Acidification Conference will be held in Dunedin during the week of February 8th (final dates TBC). We are aware that institutional restrictions on travel may limit the ability of some of our members to attend, so we are considering a mix of virtual and live sessions. To assist the NZOAC in planning, please send Christina McGraw (christina.mcgraw@otago.ac.nz) a short e-mail indicating whether you plan to attend in person or would prefer virtual options.

CALL FOR SUBMISSIONS

Anthology of Climate Change Poetry from Aotearoa New Zealand

Jordan Hamel, Rebecca Hawkes, Erik Kennedy, and Essa Ranapiri are editing an anthology of climate change poetry to be published by Auckland University Press.

We want your poems, new or previously published, that speak in some way to climate change - no matter how direct or oblique. Send us your poetry on any climate issue, be it the changing face of the whenua, climate justice, fire or flood, routes to decolonised survival, or doomsday prep for hot girl summers.
Not every poem needs to be a direct climate manifesto. We are equally interested in undercurrents, shaping the ways that climate issues emerge in discussions of other subjects. We want poems that shout, whisper, engage, observe, sing, subvert or do any other number of things that poems can do.

We are seeking poems from people who live in New Zealand or have a stong connection to this place. Māori, Pasifika and other indigenous poets are strongly encouraged to submit. We also strongly encourage rangatahi to submit - youth are going to be the most affected by climate change and your voices are the ones we should all be listening to. We are committed to publishing a variety of new, emerging, established and underrepresented voices. If you have something to say about the changing world, we want to hear from you.

We welcome submissions entirely in te reo Māori or English, as well as submissions that contain multiple languages. We also welcome submissions from poets who work in a wide range of media and formats.

Please send your submissions, including a brief bio and contact details, to *climatechangepoetry@gmail.com* by 5 October 2020. Please limit your submission to 5 poems. If your submission includes previously published material, please include the publication details.

Please share this call for submissions widely. We want to hear from a range of voices.

Jordan, Rebecca, Erik, & Essa.

AUCKLAND UNIVERSITY PRESS

Selection of recent papers

Elevated temperature and CO2 have positive effects on the growth and survival of larval Australasian snapper. Ocean Rising water temperature and increased uptake of CO2 by the ocean are predicted to have widespread impacts on marine species. However, the effects are likely to vary, depending on a species' sensitivity and the geographical location of the population. Here, we investigated the potential effects of elevated temperature and pCO2 on larval growth and survival in a New Zealand population of the Australasian snapper, Chrysophyrs auratus. Eggs and larvae were reared in a fully cross-factored experiment (18 °C and 22 °C/pCO2 440 and 1040 µatm) to 16 days post hatch (dph). Morphologies at 1 dph and 16 dph were significantly affected by temperature, but not CO2. At 1dph, larvae at 22 °C were longer (7%) and had larger muscle depth at vent (14%), but had reduced yolk (65%) and oil globule size (16%). Reduced yolk reserves in recently hatched larvae suggests

higher metabolic demands in warmer water. At 16 dph, larvae at elevated temperature were longer (12%) and muscle depth at vent was larger (64%). Conversely, survival was primarily affected by CO2 rather than temperature. Survivorship at 1 dph and 16 dph was 24% and 54% higher, respectively, under elevated CO2 compared with ambient conditions. Elevated temperature increased survival (24%) at 1 dph, but not at 16 dph. These results suggest that projected climate change scenarios may have an overall positive effect on early life history growth and survival in this population of C. auratus. This could benefit recruitment success, but needs to be weighed against negative effects of elevated CO2 on metabolic rates and swimming performance observed in other studies on the same population.

McMahon S. J., Parsons D. M., Donelson J. M., Pether S. M. J. & Munday P. L., in press. Elevated temperature and CO2 have positive effects on the growth and survival of larval Australasian snapper. *Marine Environmental Research*. Article (subscription required).

An uncertain future: effects of ocean acidification and elevated temperature on a New Zealand snapper (Chrysophrys a uratus) population. Anthropogenicc CO2 emissions are warming and acidifying Earth's oceans, which is likely to lead to a variety of effects on marine ecosystems. Fish populations will be vulnerable to this change, and there is now substantial evidence of the direct and indirect effects of climate change on fish. There is also a growing effort to conceptualise the effects of climate change on fish within population models. In the present study knowledge about the response of New Zealand snapper to warming and acidification was incorporated within a stock assessment model. Specifically, a previous tank experiment on larval snapper suggested both positive and negative effects, and otolith increment analysis on wild snapper indicated that growth may initially increase, followed by a potential decline as temperatures continue to warm. As a result of this uncertainty, sensitivity analysis was performed by varying average virgin recruitment (R0) by ±30%, adult growth by ±6%, but adjusting mean size at recruitment by +48% as we had better evidence for this increase. Overall adjustments to R0 had the biggest impact on the future yield (at a management target of 40% of an unfished population) of the Hauraki Gulf snapper fishery. The most negative scenario suggested a 29% decrease in fishery yield, while the most optimistic scenario suggested a 44% increase. While largely uncertain, these results provide some scope for predicting future impacts on the snapper fishery. Given that snapper is a species where the response to climate change has been specifically investigated, increasing uncertainty in a future where climate change and other stressors interact in complex and unpredictable ways is likely to be an important consideration for the management of nearly all fish populations.

Parsons D. M., Bian R., McKenzie J. R., McMahon S. J., Pether S. & Munday P. L., in press. An uncertain future: effects of ocean acidification and elevated temperature on a New Zealand snapper (Chrysophrys a uratus) population. *Marine Environmental Research*. Article (subscription required).

Physiological feeding rates and cilia suppression in blue mussels (Mytilus edulis) with increased levels of dissolved carbon dioxide. Gills of marine bivalves, the organs that mediate water flow for feeding and other physiological functions, are exposed to increasing levels of carbon dioxide (CO2) in seawater, in response to ocean acidification (OA). We examined the effects of elevated dissolved CO2 upon filtration and feeding behavior of the blue mussel, Mytilus edulis, under field conditions and in laboratory studies. We further investigated possible changes in cilia beat function in response to elevated dissolved CO2. Physiological filtration and feeding variables measured; included clearance, filtration, organic ingestion, and assimilation rates and selection efficiency, which decreased with increasing CO2. Absorption efficiency was not affected by dissolved CO2. Cilia beat frequency declined in excised lateral cilia (lc) exposed to increasing CO2 levels, which appears to account for decreased clearance rates observed in field and laboratory experiments. Our data suggest that under conditions of increased CO2 blue mussels will experience changes in physiological filtration, feeding rates, and cilia beat function that could have consequences for fitness and performance.

Meseck S. L., Sennefelder G., Krisak M. & Wikfors G. H., 2020. Physiological feeding rates and cilia suppression in blue mussels (Mytilus edulis) with increased levels of dissolved carbon dioxide. *Ecological Indicators* 117: 106675. doi: 10.1016/j.ecolind.2020.106675. Article.

Amelioration of ocean acidification and warming effects through physiological buffering of a macroalgae. Concurrent anthropogenic global climate change and ocean acidification are expected to have a negative impact on calcifying marine organisms. While knowledge of biological responses of organisms to oceanic stress has emerged from single-species experiments, these do not capture ecologically relevant scenarios where the potential for multi-organism physiological interactions is assessed. Marine algae provide an interesting case study, as their photosynthetic activity elevates pH in the surrounding microenvironment, potentially buffering more acidic conditions for associated epiphytes. We present findings that indicate increased tolerance of an important epiphytic foraminifera, Marginopora vertebralis, to the effects of increased temperature (±3°C) and p CO2 (~1,000 µatm) when associated with its common algal host, Laurencia intricata . Specimens of M. vertebralis were incubated for 15 days in flow-through aquaria simulating current and end-of-century temperature and pH conditions. Physiological measures of growth (change in wet weight), calcification (measured change in total alkalinity in closed bottles), photochemical efficiency (Fv/Fm), total chlorophyll, photosynthesis (oxygen flux), and respiration were determined. When incubated in isolation, M. vertebralis exhibited reduced growth in end-of-century projections of ocean

acidification conditions, while calcification rates were lowest in the high-temperature, low-pH treatment. Interestingly, association with L. intricata ameliorated these stress effects with the growth and calcification rates of M. vertebralis being similar to those observed in ambient conditions. Total chlorophyll levels in M. vertebralis decreased when in association with L. intricata , while maximum photochemical efficiency increased in ambient conditions. Net production estimates remained similar between M. vertebralis in isolation and in association with L. intricata , although both production and respiration rates of M. vertebralis were significantly higher when associated with L. intricata . These results indicate that the association with L. intricata increases the resilience of M. vertebralis to climate change stress, providing one of the first examples of physiological buffering by a marine alga that can ameliorate the negative effects of changing ocean conditions.

Doo S. S., Leplastrier A., Graba-Landry A., Harianto J., Coleman R. A. & Byrne M., in press. Amelioration of ocean acidification and warming effects through physiological buffering of a macroalgae. *Ecology and Evolution*. Article.

The impacts of ocean acidification on marine ecosystems and reliant human communities. Rising atmospheric carbon dioxide (CO2) levels, from fossil fuel combustion and deforestation, along with agriculture and land-use practices are causing wholesale increases in seawater CO2 and inorganic carbon levels; reductions in pH; and alterations in acid-base chemistry of estuarine, coastal, and surface open-ocean waters. On the basis of laboratory experiments and field studies of naturally elevated CO2 marine environments, widespread biological impacts of human-driven ocean acidification have been posited, ranging from changes in organism physiology and population dynamics to altered communities and ecosystems. Acidification, in conjunction with other climate change–related environmental stresses, particularly under future climate change and further elevated atmospheric CO2 levels, potentially puts at risk many of the valuable ecosystem services that the ocean provides to society, such as fisheries, aquaculture, and shoreline protection. This review emphasizes both current scientific understanding and knowledge gaps, highlighting directions for future research and recognizing the information needs of policymakers and stakeholders.

Doney S. C., Busch D. S., Cooley S. R. & Kroeker K. J., in press. The impacts of ocean acidification on marine ecosystems and reliant human communities. *Annual Review of Environment and Resources*. Article (subscription required).

Effects of seawater salinity and pH on cellular metabolism and enzyme activities in biomineralizing tissues of marine bivalves. Molluscan shell formation is a complex energy demanding process sensitive to the shifts in seawater $CaCO_3$ saturation due to changes in salinity and pH. We studied the effects of salinity and pH on energy demand and enzyme activities of biomineralizing cells of the Pacific oyster (*Crassostrea gigas)* and the hard-shell clam (*Mercenaria mercenaria)*. Adult animals were exposed for 14 days to high (30), intermediate (18), or low (10) salinity at either high (8.0-8.2) or low (7.8) pH. Basal metabolic cost as well as the energy cost of the biomineralization-related cellular processes were determined in isolated mantle edge cells and hemocytes. The total metabolic rates were similar in the hemocytes of the two studied species, but considerably higher in the mantle cells of *C. gigas* compared with those of *M. mercenaria.* Cellular respiration was unaffected by salinity in the clams' cells, while in oysters' cells the highest respiration rate was observed at intermediate salinity (18). In both studied species, low pH suppressed cellular respiration. Low pH led to an upregulation of Na^+/K^+ ATPase activity in biomineralizing cells of oysters and clams. Activities of Ca^{2+} ATPase and H^+ ATPase, as well as the cellular energy costs of Ca^{2+} and H^+ transport in the biomineralizing cells were insensitive to the variation in salinity and pH in the clams and oysters. Species-specific variability in cellular response to low salinity and pH indicates that the disturbance of shell formation under these conditions has different underlying mechanisms in the two studied species.

Ivanina A. V., Jarrett A., Bell T., Rimkevicius T., Beniash E. & Sokolova I. M., in press. Effects of seawater salinity and pH on cellular metabolism and enzyme activities in biomineralizing tissues of marine bivalves. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*. Article (subscription required).

Abalone populations are most sensitive to environmental stress effects on adult individuals. Marine organisms are exposed to stressors associated with climate change throughout their life cycle, but a majority of studies focus on responses in single life stages, typically early ones. Here, we examined how negative impacts from stressors associated with climate change, ocean acidification, and pollution can act across multiple life stages to influence long-term population dynamics and decrease resilience to mass mortality events. We used a continuous-size-structured density-dependent model for abalone (*Haliotis* spp.), calcifying mollusks that support valuable fisheries, to explore the sensitivity of stock abundance and annual catch to potential changes in growth, survival, and fecundity across the organism's lifespan. Our model predicts that decreased recruitment from lowered fertilization success or larval survival has small negative impacts on the population, and that stock size and fishery performance are much more sensitive to changes in parameters that affect the size or survival of adults. Sensitivity to impacts on subadults and juveniles is also important for the population, though less so than for adults. Importantly, likelihood of recovery following mortality events showed more pronounced sensitivity to most possible parameter impacts, greater than the effects on equilibrium density or catch. Our results suggest that future experiments on environmental stressors should focus on multiple life stages to capture effects on population structure and dynamics, particularly for species with size-dependent fecundity.

Aalto E. A., Barry J. P., Boch C. A., Litvin S. Y., Micheli F., Woodson C. B. & De Leo G. A., 2020. Abalone populations are most sensitive to environmental stress effects on adult individuals. *Marine Ecology Progress Series* 643:75-85. Article (subscription required)