Quantitative approach to predict the combined effect of warming and acidification on performance of key invertebrates in the Gulf of Saint Lawrence

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Human-driven global changes have, and will keep having, important effects on marine organisms. Ocean acidification and warming alter organisms' physiology with consequences on overall performance. Predicting how these changes will affect individuals, populations and ecosystems is a major challenge with important implications to sustainable management of marine resources. Quantitative approaches to project the combined impact of warming and acidification remain scarce, mainly because of technical challenges associated with laboratory manipulations. In fact, most experimental studies only include a few levels of each treatment, which makes it difficult to determine the exact shape of the relationships between performance and the environmental variables, as well as interactions between temperature and pH; this information is essential to the implementation of mathematical tools such as non-linear averaging and scale-transition theory.

The backbone of this project is the availability of a unique infrastructure in the wet laboratories of the Maurice-Lamontagne Institute. We built an experimental system that allows simultaneously manipulation of temperature and pH in 60 totally independent tanks. The system uses an automated mechanism to mix cold and warm water to adjust temperature between 2 and 32°C within ± 0.2 of the target value. Each tank is also equipped with an automated CO_2 bubbling system to manipulate pH with a precision of ± 0.01. The main objective of the project is to develop, calibrate and test quantitative approaches to predict performance of species of commercial and conservation interest under different scenarios of temperature and pH variability. Many invertebrate species could be studied, including coastal and deep-water organisms. For example, work could be done with crustaceans (lobsters, snow crabs, rock crabs, green crabs, or northern shrimps), bivalves (scallops, oysters, or mussels), gastropods (whelks or periwinkles), echinoderms (sea urchins or sea cucumbers), as well as flagship species of deep-water marine refuges (sea pens and sponges). Performance indicators will be selected according to the life-history of the target species and may include survival, growth, reproduction, metabolic rates (respirometry), food consumption, shell calcification, or any other variables of interest.