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Localised adaptation makes some oysters more resilient to climate change than others

Olympia oysters (*Ostrea lurida*) have been shown to adapt to local environments that are as little as 20 km apart, and these adaptations can be passed on to offspring. In this study, oysters that originated from less saline areas tended to be more resilient to extremely low saline conditions than oysters from more saline areas. Since episodes of reduced salinity are a predicted effect of climate change in the San Francisco Bay area under study, the authors say their findings could be useful for future conservation and restoration efforts.

Local adaptation in estuarine and marine species may have been overlooked due to assumptions based on the effect sea currents have on sperm, eggs and the juveniles of some species. Many marine invertebrates, such as mussels and oysters, are born via broadcast spawning in open water and have planktonic life stages, which means that juveniles may be at the whim of tides and currents, which should increase the randomness and variability of their dispersal. This study finds that very localised adaptation is measurable in adult populations, suggesting that populations may not be dispersed as widely as previously thought, or that environmental conditions lead to only some oysters surviving each generation.

In the first experiment, researchers selected three sites in the San Francisco Bay that had differing salt levels (salinity): Oyster Point, Berkeley, and Loch Lomond (in order of high to low salinity). Oysters were taken from each of these sites, bred for one generation in laboratory conditions, then moved back into each location, and survival was monitored.

At two of the three sites, local populations had better survival rates than oysters originally from the other sites, even after two generations of laboratory breeding. For example, oysters originating from Loch Lomond had survival rates in their home area 22.6% higher than oysters from Berkeley and 12.5% higher than oysters from Oyster point. Oysters originating from Oyster Point had survival rates 14.8% higher than those from Berkeley and 13.5% higher than those from Loch Lomond in their home area.

In a follow-up experiment, oysters were taken from Oyster Point, Loch Lomond and a third site called Marshall located in Tomales Bay, a narrow inlet of the Pacific Ocean in Northern California. The oysters were reared in the laboratory for two generations and then subjected to controlled low salinity conditions.

Overall, second-generation oysters from all sites reared in low salinity conditions (5 parts per thousand) had a 67.5% lower survival rate than those reared in higher salinity conditions (34 ppt). In particular, the oysters from Loch Lomond (the site with the lowest salinity) did the best in the low salinity conditions, with survival rates 14.7% higher than oysters from Oyster Point and 14% higher than those from Marshall (the highest salinity site). Importantly, these differences in resilience were occurring between populations of the *same species*. The authors say these results are suggestive of local adaptation, but the low significance of some of the results (due to low survival rates) means that this area of study would benefit from further work.

Identifying hospitable environments and resilient local populations could prove useful to future conservation schemes. Survival rates at the Berkeley site were the highest overall, which suggests it may be a good site for restoration projects, whereas oysters from Loch Lomond may be selected for conservation due to their higher tolerance to low salinity conditions. These adaptations will become more important in the face of climate change, since oysters able to adapt may be more robust to future salinity changes.