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Low oxygen water concentrations can help to counteract the negative effects of warming on mitochondrial efficiency in fish

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Global warming leads not only to a progressive increase in average temperature, but also to an increase in extreme events such as heat waves. Heat waves are characterized by an acute increase of temperatures, lasts only a few hours to days, which prevent the organism to fully acclimatize. Heat waves might be especially challenging for aquatic animals as warming water is associated to decreases in the availability of oxygen.

Aerobic metabolism in aquatic ectotherms, such as fish, is highly dependent on their environment. The slightest environmental variation in temperature or oxygen availability can lead to immediate changes of their aerobic metabolism. Thus, acute variations in temperature and oxygen availability could lead to immediate responses of mitochondrial metabolism. We hypothesize that acute changes in temperature and oxygen availability will alter the mitochondrion ability to fuel the cell energy demand in ATP.

We measured the effects of acute *in vitro* variations in temperature and oxygen availability on the mitochondrial efficiency to produce ATP (estimated as ATP/O ratio) of red muscle mitochondria of seabass *Dicentrarchus labrax*. We found that warming decreased ATP/O ratio, whereas decline in O₂ availability tended to increase this ratio. These opposite effects of warming and decline in O₂ lead to a partial compensation of ATP/O ratio *in vitro*: combined warming and declined of O₂ availability did not significantly alter the ATP/O ratio.

Our results seem to indicate that the mitochondrial passive plasticity could help fish to maintain cell levels in ATP in events of heat waves. Thus, predictions on decline of aquatic ectotherms performance due to heat waves could be as not severe, since these predictions are often based on oxygen consumption, without taking into account the ATP production.