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Editorial Open Access

Reprotoxicity of Global Warming in Marine Species

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Editorial

The fast growth of industrialization and other anthropogenic activities is generating chemical pollution posing at risk the entire marine environment. In particular modifications of either marine temperature or pH are creating a crescent alarm in the scientific community [1]. The accumulation of greenhouse gases in the atmosphere resulted from the last 40 years in the Earth's average temperature increase of 0.75°C/1.4°F [2,3] which is the global warming that is changing the planet climate. Among the effects generated by temperature increase literature reports melt of artic ice, desertification of some areas and change of weather accompanied by precipitations and increased flooding [4,5]. These changes in turn may exert serious repercussion on the sea level rise and the frequency of strong cyclones.

Global warming is a process induced by a change in the chemistry of carbonate. In normal situations carbon dioxide [CO2] is produced by either photosynthesis and respiration and in long term scale by geological processes, however an excess of CO2 is generated by fuel burning, manufacturing applications and deforestation [6].

Temperature increase may impact physiological cell processes, cellular homeostasis and metabolic pathways of living organisms. In recent years, many studies have been addressed to demonstrate that high sea water temperature induces physiological and reproductive disorders in marine biota even threating the survival of the species.

Reproduction is a complex process of cell to cell interaction which leads to the formation of a new individual. Reproductive success, mainly based on the gamete physiology, is essential to ensure the persistence of future marine populations.

It has been ascertained that sea water temperature may alter some physiological functions and reproductive output of marine species determining shift in the structure and spatial organization of populations.

Many studies demonstrated toxicity to reproductive and developmental processes of marine animals induced by temperature rise. In the marine polychaete *Ophryotrocha labronica* multi-generational exposure to warming caused a series of developmental disorders as increase in juvenile developmental rate and a decrease in reproductive body size and fecundity [7]. Similarly in the Mediterranean coral, *Balanophyllia europaea*, reproductive potential varied significantly in relation to different temperatures showing loss of oocytes during gametogenesis and the impossibility of oocytes to reach maturity, possibly due to inhibition of metabolic processes [8]. That gamete quality is at the basis of reproductive success is well known. In mussels we recently showed that by exposing adults of the mussel *Mytilus galloprovincialis* to increased thermal stress resulted in the impairment of several sperm quality parameters which underlie fertilization competence. In fact, a significant reduction in concentration, a biphasic pattern of motility and mitochondrial membrane potential, a decrease in the intracellular calcium concentration and an increase in lipid peroxidation and DNA fragmentation were reported, suggesting that an increasing global temperature may shift the breeding season of this species significantly impacting mussel production and commercialization [9].

A peculiar sensitivity to water temperature has been identified also in reproductive processes of marine fishes with a consequent decline in reproductive outcome of different species. As an example, in Atlantic Cod temperature elevation by several degrees during embryonic and larval developmental stages significantly alters the miRNA profile, both in short and long-term [10]. Due to the important roles of miRNA, authors believe that a further rise in seas temperature might affect life cycle and history of Atlantic cod.

In support of the high vulnerability, other scientists also reported an impairment of offspring sex ratios in marine fish. However these authors also highlighted a greater plasticity of reproductive attributes, if related to one of two generation observed. In support of this transgenerational resilience, recent studies reported controversial findings, identifying an improved reproductive capacity in coral reef teleost under a gradual increase in temperature across generations [11,12]. The ability of some species to first tolerate and then adjust their physiology to rising ocean temperatures is supposed to be part of a strategy for evolutionary adaptation needed to avoid extinction [13]. Surprisingly in fact, warming enhanced fertilization even at low sperm levels through stimulation of sperm motility and reduced water viscosity in the echinoid *Sterechinus neumayeri*, confirming resilient capability of marine species to near-future ocean warming [14].

How marine species are capable for plastic and adaptive responses is a topic issue, however, nonetheless some studies support them, it is unclear what are the mechanisms that underlie species acclimatization to global changes.

In changing ocean abiotic stressors as warming and acidification may act in synergy. Interestingly, it has been shown that moderate warming diminishes the negative impact of acidification on calcification, hypercapnia and larval growth in some species [15,16] whereas different impacts are exerted by both the stressors depending on the capacity of species to calcify [1].

Conclusion

Today's society benefits from the exploitation of marine resources. Impacts related to global warming on marine environment are growing up in many important sectors as fisheries, rearing and aquaculture of fishes, crustaceans, mollusks, and other organisms. However, the main worrying adverse effects are those that influence reproductive fitness and survival of all the marine species in turn threatening the whole marine ecosystem. Charles Darwin who is considered "the father of