Fitness costs and benefits of ultraviolet radiation exposure in marine pelagic copepods - DTU Orbit (09/11/2017)

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Life-history theory predicts that organisms should allocate energy throughout their life such that they maximize their fitness. Copepod zooplankton are known to accumulate sunscreens (so-called mycosporine-like amino acids, MAAs) and antioxidant carotenoids to mitigate negative effects of ultraviolet radiation (UVR), but it is not well known how this affects their fitness. We followed cohorts of the marine copepod Acartia tonsa and assessed how fitness was affected by UVR exposure and a diet rich in UVR-protective sunscreens. Several fitness components including somatic growth, egg quality and nauplii production (larvae) were negatively affected by UVR, whereas other components such as size at maturity, survival and length of life were not. Nauplii production through low egg quality was the most influential life-history parameter that changed in response to UVR. There was interaction between fitness costs and food source. If copepods were fed a diet rich in UVR-screening MAAs, they were able to maintain and even increase their fitness even though they were exposed to otherwise detrimental radiation. Levels of UVR-protective carotenoids were low in the studied species and a meta-analysis revealed that marine copepods in general have much lower - by an order of magnitude - levels of carotenoids than freshwater species, while levels of MAAs are similar between the two habitats. We conclude that allocation to different fitness components to some extent is plastic although egg quality is by far the most influential factor, and this is an example of how environmental variability affects overall fitness. Fitness costs associated with UVR exposure in the absence of UVR-screening MAAs were present. Other costs such as costs for accumulating MAAs were not detected, and if present, they were outweighed by a stimulated fitness in combined UVR and MAA treatments challenging the common model that inducible defences (such as accumulation of MAAs) should come with a cost. Low levels of carotenoids in marine systems suggest high predation pressures on pigmented specimens. Accumulation of nonpigmented MAAs could hence be a key adaptation for surface-dwelling marine zooplankton to maintain or even increase their fitness when exposed to detrimental radiation

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