## **ICES CM 2016/C:509**

## Higher vulnerability and lower resilience of fish in estuaries worldwide matches higher <u>exposure to human threats</u>

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## Abstract:

Despite the high productivity and value of estuarine ecosystems, their biodiversity, functioning and services are threatened by continuously increasing human activities in and around estuaries. We conducted the first comprehensive global analysis of the exposure of biodiversity in transition ecosystems, namely estuaries, to threats from multiple ecosystems. We used a comprehensive database on fish assemblages of estuaries distributed worldwide, on their functional traits reflecting vulnerability and resilience, as well as on the environmental features, human pressures and protection level of the analysed estuaries, adjacent marine and freshwater ecosystems. A strong geographical pattern in threats was evident and higher values were found in estuaries at higher latitudes (concomitantly with lower sea surface temperature - SST), whilst threat values were only weakly correlated with the other analyzed environmental variables. The vulnerability and resilience traits were correlated in the sampled fish assemblages. The proportion of fishes with low vulnerability (or high resilience) in estuarine assemblages strongly decreased with latitude and threats, and increased with SST; meanwhile the proportions of fishes with higher vulnerability (or lower resilience) showed the opposite pattern. In addition, the relationship of fish vulnerability (or resilience) in estuaries with the other analyzed environmental variables was weaker and less consistent across categories. We similarly explored the patterns of protected areas in marine, estuarine and freshwater ecosystems. The match between higher vulnerability (and lower resilience) of fish in estuaries worldwide and higher exposure to human threats should be taken into account in the definition of global conservation strategies.

**Keywords:** functional diversity, traits, biodiversity loss, ecosystem functioning, ecosystem services.

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