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Proposal Review 2 : 2127466

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Agency Name:	National Science Foundation
Agency Tracking Number:	**2127466**
Organization:	
NSF Program:	OCE Postdoctoral Fellowships
PI/PD:	Gatins, Remy
Application Title:	OCE-PRF-Deleterious mutational load in climate driven marine range expansions
Rating:	Good

Review

Summary

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

Strengths: The proposed project aims to address the question whether the hypothesis that deleterious mutations accumulate at expansion fronts holds true for marine organisms, and whether fishing selection additionally introduces more deleterious mutations. For this purpose, the West Atlantic population of sea bass, which is expanding into the Gulf of Maine due to warming, will be studied using population genomic and phenotypic approaches, and additional a computer simulation will be carried out which incorporates fishing as a variable through random removal of population members (further lowering Ne). Overall the proposal is well put together and clearly lays out the objectives, hypotheses, and approaches (in form of model equations). The proposed methodology and tools (genomics and modelling) are well researched and likely to produce the desired data sets in the timeframe proposed. Resources seem adequate and the project will benefit from pre-existing samples which can be resequenced. The fit between PI and sponsor is explained well, with prior expertise of the PI in the field of population genomics in the framework of their (yet unpublished) dissertation. The strengths of the proposal lie in objectives 1 and 3 as independent work packages, whereas objective 2 is linked to objective 1.

Weaknesses: (i) The proposed paradigm challenge only would occur if the results differ from the expectation that the expansion load model can be applied to marine organisms. There's a circular argument here as to what the paradigm challenge would be exactly in that case, and how it can lead to the expected benefits for marine conservation planning and management.
(ii) Objective 2 proposes to use body condition and some associated traits as phenotypic indicators for expansion load. The justification to do this,

despite that body condition in ectotherms is highly plastic with temperature, is to include temperature (which one - as rapid temperature changes cause the range expansion in the first place?) as a covariable. The problem with this will be that temperature varies along the same north-south gradient as the expanding population edge - it is unlikely that effects of these can be disentangled ("collinearity" was mentioned but the problem not resolved satisfactorily in the proposal). Perhaps a phenotypic variable more linked to mutational load and less plastic would be preferable to body condition, such as fluctuating asymmetry. (iii) The proposal promises to integrate negative effects of expansion load with that exerted by fisheries (shown in teleosts in Rolland et al., 2020). I believe a weakness of the proposal is that the actual pressure through fisheries on the sea bass population will not be investigated - it should be possible to spatially and temporally quantify this, perhaps through catch data or fishing routes (globalfishingwatch.org). Instead it is only used as a modelling parameter in Objective 3 but without input from such real-world data as will be available for deleterious mutation load. Since fisheries exert size selection and are spatially heterogeneous, this parameter might look very different to the proposed model which randomly removes individuals from the population. Not including actual fisheries effects into Objectives 1 and 2, might also obscure their effect on the mutation load data - since the population center might for example be located in a more heavily fished area than the population edge.

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

Strengths: The proposed benefit of the study is that general mechanistic models for expansion loads can be applied to marine organisms, and that the new model integrating expansion load and effect of fisheries can be used as management and conservation tools. The proposed integration with NOAA and various fisheries organisations is well thought out and will lead to direct benefits to these stakeholders. Outreach activities are planned for K-12 groups as well as undergraduate students.
Weaknesses: The PI has a hispanic background, but the envisioned outreach activities are not clearly defined as to how they may benefit the representation of underrepresented minorities as they don't seem to be targeted in that way. They also come across as a bit of a mixed bag- it would have been more convincing to propose a defined set of well planned activities with a well defined target group, to make sure that the research project and its significance will be used to engage students in K-12 and undergraduates and/or underrepresented minorities. Perhaps also consider to include a evaluation survey activity where it can be assessed whether learning objectives are achieved.

Please evaluate the strengths and
weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if
applicable

Summary Statement

Overall this is a well-written project with a well matched team. There is demonstrable expertise in terms of the genomics and data analysis methods for both PI and supervisor, yet somewhat tampered by the fact that the PI only has one first-author publication and none related to their PhD project yet. More publications would have made the connection between the PI's expertise and proposed project stronger. The topic is interesting, timely and relevant as it would lead to better understanding of the population genetic processes in response to climate change-induced shifts of a commercially important species. The risks lie foremost in Objective 2 which in my opinion isn't making the best case for why the selected phenotypic trait should be linked to the presumed higher mutation load and not temperature-induced plasticity, and secondly for a proposal focusing on the impact of fishing, this aspect is underrepresented throughout. Broader impacts are strong with regards to the connection to organisations related to fisheries, and somewhat less well defined for the proposed outreach activities.