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Jury Member Report – Doctor of Philosophy thesis.

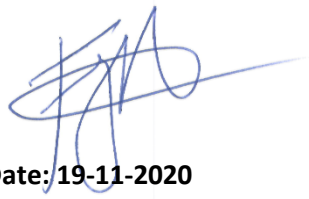
Name of Candidate: Valentina Burskaia

PhD Program: Life Sciences

Title of Thesis: Positive selection in parallel evolution

Supervisor: Associate Professor Georgii Bazykin

Name of the Reviewer:

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:**  **Date: 19-11-2020**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense. *If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.*
Reviewer's Report

This is a solid thesis that details the efforts of two directions of research: to study the frequency of parallel evolution in protein sequences (using three groups of animals) and to look for a pattern matching amino acid changes in mitochondrial genomes with phenotypic changes in birds. The first venue of research revealed very interesting and exiting results, the second was more emblematic of the usual outcome of research projects, yielding mostly negative results, and, therefore, was quite fitting for a PhD thesis.

I found the questions to be interesting and the methodology appropriate. I especially complement the candidate on the extensive efforts to take into account various confounding factors in the first part of the work (alignment, errors, trees, etc) – it is a very solid piece of work.

The pattern of more nonsynonymous parallel substitutions (than synonymous ones) in amphipods is a great discovery. The candidate is leaning on positive selection as the underlying mechanism, in part seemingly convinced by the pattern that polymorphisms at those sites seem to have lower frequency than synonymous polymorphisms.

Here is a thought process that I would like the candidate to refute during the defense. Suppose that a protein sequence starting in one point in genotype space (so just a single sequence) can only evolve one amino acid at a time. When one substitution happens then another one opens up for evolution, etc. Essentially, between two points in sequence space, A (the starting point) and B (some distant point) there is only a single path to traverse. Suppose then while this path is being traversed, the sequence randomly duplicates and the duplicates evolve independently (these duplications would be speciation events). If synonymous sites in this sequence can do what they will, wouldn't one see the same access of parallel nonsynonymous substitutions as has been observed in amphipods?

Methods/Concepts question: was the phylogeny reconstructed using nucleotide sequences or amino acid sequences? If the latter, then perhaps synonymous sites created hemiplasies of amino acids. It would me good to see that the phylogenies are not dependent on whether nucleotides or amino acids are used for phylogeny reconstruction.

Minor issues:

Start of Section 3.1. I do not think that the candidate really means this here: "a substitution between a pair of species can only be neutral, and if the fitness landscape is invariant, an identical substitution at this site between other two species is also expected to occur at the neutral rate." I think what the candidate means is that if selection is invariant.

Section 1.2, implications of the work, revealed Russian-thesis-style modesty. Starting it with methods is rather self-deprecating. I think that the work brings more to our knowledge than the candidate revealed there.

The thesis was well-written, but in parts was not grammatically or stylistically perfect, or native-speaker level. This is something to work on in the future.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*
☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*
☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*