Commentary on candidate evidence

Candidate 1

An investigation into the effects of temperature on the cirral beating rate of barnacles

The evidence for this candidate has achieved the following marks for each section of this course assessment component.

Section		Mark awarded	Comments on project report
1.	**Abstract (1 mark)** A brief abstract stating the main aim(s) and overall findings/conclusion(s).	1/1	The abstract follows the contents page. The aim and findings are clearly stated. The findings are consistent with the conclusion. **1/1**
2.	**Introduction (5 marks)**		
	a) A clear statement of aim(s) together with relevant hypotheses.	1/1	The aim is clearly stated. A null hypothesis is given along with one testable prediction. These are given at the end of the introduction.
	b) An account of the underlying biology, with justification of the biological importance of the project. ♦ The account of underlying biology is relevant. ♦ Biological terms/ideas are explained clearly and accurately. ♦ Biological terms/ideas are at an appropriate depth. ♦ The biological importance is justified.	2/4	Well-sourced background information on barnacles is included, which is mostly relevant. It demonstrates engagement with relevant scientific literature and explores the biological reasons for cirral beating at an appropriate depth. Although there is some attempt to link the study to a local situation, the importance is not justified very convincingly. The account of the underlying biology given, is repetitive and lacks coherence. Poor sequencing of information makes it

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			difficult to follow. There are also some errors in the biology, for example, the classification. **3/5**
3.	**Procedures (9 marks)**		
	a) Procedures are appropriate to aim(s).	1/1	
	b) Procedure(s) described in sufficient detail to allow the investigation to be repeated.	1/2	In broad terms the procedures are repeatable. However, some useful details are omitted: the species of barnacle is not specified, the criteria used to determine what constitutes one cirral beat has not been described and the position of the middle and lower zones of the shore is not clear, as the transect length is not given.
	c) Appropriate controls are identified.	1/1	Appropriate justification is given for having no negative control in this investigation.
	d) Control of confounding variables is described.	0/1	Control and monitoring of some confounding variables is described but there is no indication of how long barnacles were in the trays and whether or not this was controlled. There is no description of the acclimatisation of barnacles to each new temperature.
	e) Sample size is appropriate.	1/1	Seven barnacles at each temperature is an appropriate sample size.
	f) Independent replication is described and a separate data set(s) is provided.	1/1	A description is given of how independent replication was carried out and a separate data set is provided.

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	g) Justification of how the pilot study informed the final procedure(s).	1/1	Justification of how their pilot study informed the final procedures is given in the description of how the sample size was determined.
	h) Procedures show complexity, creativity or accuracy.	1/1	The use of systematic sampling adds to the complexity of the protocol, and a creative method of controlling temperature whilst maintaining salinity has been used. **7/9**
4.	**Results (6 marks)**		
	(a) Data is relevant to the aim(s).	1/1	
	(b) Raw data is recorded and within the limits of accuracy of measurement.	1/1	The raw data is provided in the appendix and is as described in the procedures.
	(c) Results presented appropriately.	1/1	Tables and line graphs are appropriate for the data.
	(d) Overall results calculated and presented.	0/1	Although the overall results have been calculated by combining the two data sets and presented in a table, these have not been presented as a single line graph. The 'combined results graph' still treats the replicates separately.
	(e) Presentation of tables and graphs is correct and accurate.		
	♦ Tables are of sufficient quality - headings/units and correct mean/average values.	1/1	The table headings are clear and the units are correct. Mean values have been calculated correctly.
	♦ Graphs are of sufficient quality - scales/labels/units/clarity and accuracy of plotting.	1/1	Scales, labels and units are correct. The plotting is clear and accurate. **5/6**

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5.	**Discussion (conclusion(s) and evaluation) (7 marks)**		
	(a) Conclusion(s) relevant to the aim(s) and supported by data in the report.	0/1	The conclusion relates to the aim but is not supported by the data in the report; the reference to the beating rate 'reaching an optimum' is incorrect.
	(b) Conclusion(s) is valid.	0/1	The uncertain control of the time that the barnacles were exposed to the different temperatures, compromises the validity.
	(c) Evaluation of procedures with justification on: ♦ means by which accurate measurements were achieved/sources of error in measurement and their impact on the results ♦ why the sample size was appropriate and how independent replication was achieved ♦ how the controls contributed to the overall validity of the investigation ♦ how confounding variables were controlled or monitored and their impact on the validity of results ♦ solutions to problems and reasoning behind modifications to procedures in light of the pilot study	1/2	A good discussion of two areas, with some justification is given: ♦ need for systematic sampling of rocks and random sampling of barnacles to avoid bias is well explained ♦ consideration of the importance of controlling/monitoring salinity and oxygen levels as confounding variables The discussion of modifications made to the procedures is weak, and the candidate has missed the opportunity to discuss the use of travelling means in determining the appropriate sample size.

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	(d) Results analysed and interpreted, and findings discussed critically and scientifically, including: ♦ analysis of results ♦ interpretation of results ♦ critical and scientific discussion of the finding(s)	0/3	The discussions of each area are not robust enough to allow any marks to be awarded. ♦ In the analysis there is a failure to show how the variation was low between replicates or within repeats. Some data would have been useful here. ♦ The interpretation of results is weak. The trend is restated but the experimental data is not used to link the trend to the biological reasons given. ♦ More links could have been made to the background biology. Only a speculative statement about the impact of global warming on barnacles is made. **1/7**
6.	**Presentation (2 marks)** (a) Appropriate structure, with informative title, contents page and page numbers. (b) References cited in the text and listed using a Harvard or Vancouver referencing system.	1/1 0/1	A Vancouver referencing system has been used. The references are cited correctly but in each of the listings some of the required information is missing. **1/2**
			Total 18/30