PhD Studentship at the University of Glasgow: Causes and Consequences of Individual Variation in Aerobic Scope and its Association with Immune Response

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Background and Motivation: The immune response is enormously important for defending animals against infection but the physiological costs of this response remain largely unknown.

While there is some evidence that mounting an immune response increases energy expenditure, the extent of these costs and the underlying mechanisms are not understood.

The study of aerobic scope - the difference between an animal's baseline and maximal levels of aerobic metabolism - is a promising framework for investigating these costs.

Any aerobic capacity directed toward a given oxygen-consuming physiological process results in a reduced ability to perform all others.

Immune function, however, has been completely overlooked in this context.

Both immune function and aerobic scope can connect environmental factors with behaviour, life-history strategies and ultimately individual fitness, but a direct relationship between the immune system and aerobic scope has never been investigated.

This studentship will therefore investigate trade-offs between immune function and other sources of oxygen demand within individual animals.

Fish are a vital component of biodiversity but have been ignored in terms of immunoecological research. This project will therefore lead to a range of further experimental and theoretical studies investigating the role of the immune response in physiological ecology, life-history variation, and responses to environmental change in fish.

For instance, several environmental pollutants stimulate the immune response of fish and likely cause a decrease in aerobic scope and probably compromise growth and swimming ability.

The interactive effects of temperature increase and hypoxia on immune function and aerobic scope are also critical avenues for future research likely to stem from this project.

One potential application is aquaculture where growth maximises profit but the trade-off between the immune response and growth is not understood.

Another direction for applications is sports medicine; if intense exercise reduces immune function, understanding the underlying mechanisms would be valuable.

Fish are ideal for studying this area because they can be subjected to treatments not possible in humans.

Objectives: This project will address four main **questions:**

1) How does an immune response affect metabolic rate, aerobic scope, and swimming ability?
2) How does intense exercise affect immune function in relation to aerobic scope in individuals?
3) How are aerobic scope and behavioural personality traits related to immune function?
4) Is there a trade-off between immune function and growth rate within an animal's aerobic scope?

Training Opportunities: This project integrates aspects of animal physiology, behaviour, ecology, and evolution and therefore provides broad training.

In addition, as the examination of fish immunology from an ecophysiological perspective is virtually non-existent to date, this project would provide the student with unique training opportunities and a chance to establish a distinctive niche of research expertise.
, histology).
Specifically, the student will receive training in a number of diverse skills including the

measurement of metabolic rate using
respirometry,
the measurement of locomotor performance,
behavioural
observation, and techniques associated with measuring immune responses to infection at the cellular level (eg flow
cytometry,
histology).

The student will also gain general experience in experimental design and statistical analyses.

,590 pa + full fees) **Funding Details:** NERC standard stipend (ë 13 590 pa + full fees)

Duration: 3 years (6 month extension available under some circumstances)

Eligibility: The candidate must have been ordinarily resident in the UK throughout the three-year period preceding the date of application for an award, not wholly or mainly for the purposes of full time education. Applicants should have received a grade of 2:1 (B) or equivalent in their undergraduate degree; applicants who do not meet this threshold but have completed other postgraduate training programme s might be considered.

More details described here:
http://www.nerc.ac.uk/funding/ application / studentships / studentbook2010.pdf

How to apply: Full CV + contact details of at least two referees.
Cover letter indicating motives and qualifications for undertaking the proposed program
Who to Send Applications to - Lorna Kennedy (@ lorna.kennedy glasgow.ac.uk)
Closing Date - January 20, 2011

Please also see details on the College of Medical, Veterinary and Life Sciences Graduate school website
(http://www.gla.ac.uk/ colleges / mvls / graduateschool / informationforprospectivestudents /)
Note: The Institute of Biodiversity, Animal Health, and Comparative Medicine is advertising four NERC studentships this year in the realistic expectation that two or three of the most competitive applicants will be funded.

Further Information: To obtain more detailed information about the project, please contact the

primary project supervisor, Shaun Killen
(Shaun.Killen @ glasgow.ac.uk).

Relevant Publications by the Supervisory Team:

1.Killen, SS, Marras, S., Steffensen, JF, & McKenzie, DJ 2011. Aerobic capacity influences the spatial position of individuals within fish schools.

Proceedings of the Royal Society B.

279: 357-364.

2.Killen, SS, Marras, S., Ryan, MR, Domenici, P, & McKenzie, DJ 2011. A relationship between metabolic rate and risk-taking
behaviour is revealed during hypoxia in juvenile European sea bass.

Functional Ecology.
Doi: 10.1111/j.1365-2435.2011.
01920.x

3.Killen, SS, Marras, S., and McKenzie, DJ 2011. Fuel, fasting, fear: routine metabolic rate and food deprivation exert synergistic effects on risk-taking in individual juvenile European sea bass. Journal of Animal Ecology. 80: 1024-1033.

4.Killen, SS, Costa, I., Brown, JA, & Gamperl, AK 2007. Little left in the tank: metabolic scaling in marine teleosts and its implications for aerobic scope.

Proceedings of the Royal Society B.

274: 431-438.

5.Bize, P., Diaz, C. & LindstrЖm, J. In Press. copying in a wild bird. Experimental evidence that adult antipredator
behaviour
is heritable and not influenced by
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copying in a wild bird.

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TGG 2010: Frequency-dependent social dominance in a color polymorphic
cichlid
fish.

Evolution.

64:2797-2807.
7.LindstrЖm, J., Pike, TW, Blount, JD & Metcalfe, NB 2009: Optimization of resource allocation can explain the temporal dynamics and honesty of sexual signals.

American Naturalist.

174:515-525.
8.Pike, TW, Samanta, M., LindstrЖm, J. & Royle, NJ 2008: Behavioural phenotype affects social interactions in an animal network.

Proceedings of the Royal Society B.

275:2515-2520.
9.Gharbi, K., Glover, KA, Stone, LC, MacDonald, ES, Matthews, L., Grimholt, U. & Stear, MJ 2009. in
Atlantic salmon.
Genetic dissection of
MHC-associated
susceptibility to
Lepeophtheirus
salmonis
in Atlantic salmon.

BMC Genetics, 10: 1471-2156.
, F., Mainland, I., Kao, RR, Pemberton, JM, Beraldi , D., Stear , MJ et. 10.Chessa, B., Pereira, F., Arnaud, F., Amorim, A.,
Goyache,
F., Mainland, I., Kao, RR, Pemberton, JM,
Beraldi,
D.,
Stear,
MJ et.

al.

2009.

Revealing the history of sheep domestication using retrovirus integrations.

Science.

324: 532-536.

11.Bishop, SC & Stear, MJ 2003. Modeling of host genetics and resistance to infectious diseases: understanding and controlling nematode infections.

Veterinary Parasitology.

115: 147-166.

12.Strain, SAJ & Stear, MJ 2001. The influence of protein supplementation on the immune response to Haemonchus contortus. Parasite Immunology.

23: 527-531.