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NEWS

Cassondra Williams wins 2011 JEB Outstanding Paper Prize

The Editors of *The Journal of Experimental Biology* are pleased to announce that Dr Cassondra Williams is the winner of this year's JEB Outstanding Paper Prize. Awarded in memory of Bob Boutillier (JEB Editor in Chief 1994–2003), the prize recognises the junior author who made the most significant contribution to an outstanding paper. 'Over the year, we note all the truly outstanding contributions and the selection is then made by a vote of all of the Editors', explains Hans Hoppeler, JEB Editor-in-Chief. 'This year the papers selected for the Outstanding Paper Prize final came from very different areas of comparative research, and we hope that the award promotes the best of comparative physiology to showcase that there is real interesting science beyond transgenes', he adds. The short list can be seen at the end of this article.

In 2011, Williams was the lead author on the article 'What triggers the aerobic dive limit? Patterns of muscle oxygen depletion during dives of emperor penguins' (Williams et al., 2011) with Jessica Meir and Paul Ponganis. 'I can't tell you how surprised and excited I was when I heard; it was amazing', recalls Williams. Ponganis, the principal investigator on the paper, an anaesthesiologist and leading diving physiologist, reacted by saying, 'I was honoured and immediately reflected on how proud I was of Cassondra for taking on and conducting so challenging a project as part of her PhD thesis.' Reflecting on the paper, JEB Editor Raul Suarez says, 'I was profoundly impressed by this work because it provides answers to long-standing physiological questions through the application of cutting edge techniques and instrumentation using free-living charismatic animals.'

Cassondra Williams, winner of the 2011 JEB Outstanding Paper Prize.

Williams' career has not followed a conventional scientific path. 'My undergraduate degrees were in business finance and international relations. Then I went to law school, practised law for a while in Los Angeles and then decided I wanted something different', she recalls. Returning to study at Purdue University, Williams undertook a Masters degree in Biology, studying sea turtle behaviour. But even then her interests really lay in the physiology of diving. After advice and encouragement from Jerry Kooyman, at the University of California at San Diego, USA, and several other scientists, Williams read Ponganis's work and eventually got in touch with him. 'They said Paul is doing some really ground-breaking work in diving physiology', recalls Williams. 'I was in Costa Rica at the time that I contacted him. He wanted to interview me in person so I flew from Costa Rica to San Diego and everything just fell into place. All paths led to Paul', she adds.

Joining Ponganis's Scripps Institution of Oceanography laboratory in July 2005, Williams immediately began working on the problem of oxygen storage in the muscles of diving mammals. She explains that diving animals initially power a dive aerobically by consuming the oxygen stores that they descend with. However, when the stores are no longer sufficient to sustain aerobic metabolism, the animals switch to anaerobic metabolism at a point known as the aerobic dive limit. Yet no one was sure which of the three oxygen stores – the blood, lungs and myoglobin in muscle – was responsible for triggering this switch. Explaining that diving animals were thought to isolate their muscle from the circulatory system, leaving the tissue unable to replenish its oxygen supply during the course of a dive, Ponganis and Williams wondered whether depleted muscle oxygen triggers the aerobic dive limit.

Designing a spectrophotometer that could be implanted on the pectoralis muscle of penguins to measure oxygen saturation while the animals were diving, Williams set about answering the question. 'The challenge was to design a probe that would be small enough to not interfere with normal diving activity but would not be too fragile to withstand the movement and impact of entries and exits into and out of the water', explains Ponganis. 'Not having a background in engineering I did a lot of research on instruments that were similar to what we wanted to design and then I started from scratch by identifying and testing the parts that we needed', Williams recalls. She also visited Antarctica with Ponganis to understand the challenges of working at subzero temperatures. 'For example, battery life in an environment that is so cold changes a lot', she says. However, after 2 years of painstaking design and testing, Williams and her colleagues, Ponganis and Jessica Meir, were ready to head south to deploy the instrument on freely foraging penguins.

Setting up an operating theatre on the sea ice, Ponganis and Williams implanted the spectrophotometer probe on the pectoralis muscles of 16 emperor penguins. Recalling working on the ice, Williams laughs and says, 'It's a little odd when you are doing surgery and you hear penguins calling in the background.' Then the duo allowed the birds to recover before releasing them at an isolated ice hole and crossing their fingers that the birds would return.

Fortunately, all of the birds successfully returned to the ice hole and, after carefully removing the probe and downloading the information from the dataloggers, Williams realised that she had useable data from 50 dives. Returning to California, she was finally able to begin analysing the oxygen levels in the penguins' pectoralis muscles to find out how they manage their precious oxygen stores.

Plotting the muscle oxygen profiles from the earlier dives, Williams found that the muscle's oxygen saturation dropped gradually until the oxygen stores were exhausted, at which point

the animal switched to anaerobic metabolism. The muscle oxygen store was triggering the aerobic dive limit in emperor penguins.

However, while analysing some of the later dives, Williams and Ponganis realised that after initially falling, the oxygen saturation plateaued. ‘This was consistent with maintenance of some blood flow and oxygen delivery to the muscle during dives’, explains Ponganis. ‘It was incredibly exciting to find that both patterns occur in one species’, remembers Williams.

The team also calculated muscle oxygen consumption rate for dives with the first oxygen depletion pattern and was amazed to see that it was only 12.4 ml O_2 kg^{-1} muscle min^{-1}: one-tenth the value calculated for penguins swimming maximally in an artificial flume and only 2–3 times their resting metabolic rate. ‘I think this metabolic rate is impressive. You can see how hard they are working underwater but they are efficient swimmers and very hydrodynamic’, says Williams.

Recalling working with Williams, Ponganis adds, ‘Cassondra is an intelligent, enthusiastic person who is very dedicated in her work. She is smart, learns quickly and is very thorough, leaving nothing to chance, so it was a pleasure to work with her.’

Since completing her PhD in June 2011, Williams has joined Jim Hicks’ lab at the University of California, Irvine, where she is continuing her interest in diving physiology, this time focusing on marine and freshwater turtles. Asked whether she may return to law in the future, Williams laughed and said, ‘Law holds no more attraction for me, but I definitely would like to continue doing physiology at a research or academic institution. It has been the most exciting time of my life and I wouldn’t want to give it up, even for the lucrative money of law.’

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JEB Outstanding Paper Prize Short List, 2011

Cheng, B., Deng, X. and Hedrick, T. L. (2011). The mechanics and control of pitching manoeuvres in a freely flying hawkmoth (*Manduca sexta*). *J. Exp. Biol.* **214**, 4092-4106.

Eliason, C. M. and Shawkey, M. D. (2011). Decreased hydrophobicity of iridescent feathers: a potential cost of shiny plumage. *J. Exp. Biol.* **214**, 2157-2163.

McCoole, M. D., Baer, K. N. and Christie, A. E. (2011). Histaminergic signaling in the central nervous system of *Daphnia* and a role for it in the control of phototactic behavior. *J. Exp. Biol.* **214**, 1773-1782.

Naeger, N. L., Van Nest, B. N., Johnson, J. N., Boyd, S. D., Southey, B. R., Rodriguez-Zas, S. L., Moore, D. and Robinson, G. E. (2011). Neurogenomic signatures of spatiotemporal memories in time-trained forager honey bees. *J. Exp. Biol.* **214**, 979-987.

Ragland, G. J., Egan, S. P., Feder, J. L., Berlocher, S. H. and Hahn, D. A. (2011). Developmental trajectories of gene expression reveal candidates for diapause termination: a key life-history transition in the apple maggot fly *Rhagoletis pomonella*. *J. Exp. Biol.* **214**, 3948-3959.

Schwanz, L., Warner, D. A., McGaugh, S., Di Terlizzi, R. and Bronikowski, A. (2011). State-dependent physiological maintenance in a long-lived ectotherm, the painted turtle (*Chrysemys picta*). *J. Exp. Biol.* **214**, 88-97.

Steck, K., Hansson, B. S. and Knaden, M. (2011). Desert ants benefit from combining visual and olfactory landmarks. *J. Exp. Biol.* **214**, 1307-1312.

Williams, C. L., Meir, J. U. and Ponganis, P. J. (2011). What triggers the aerobic dive limit? Patterns of muscle oxygen depletion during dives of emperor penguins. *J. Exp. Biol.* **214**, 1802-1812.