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NEWS

The 2016 Journal of Experimental Biology Outstanding Paper Prize shortlist and winner

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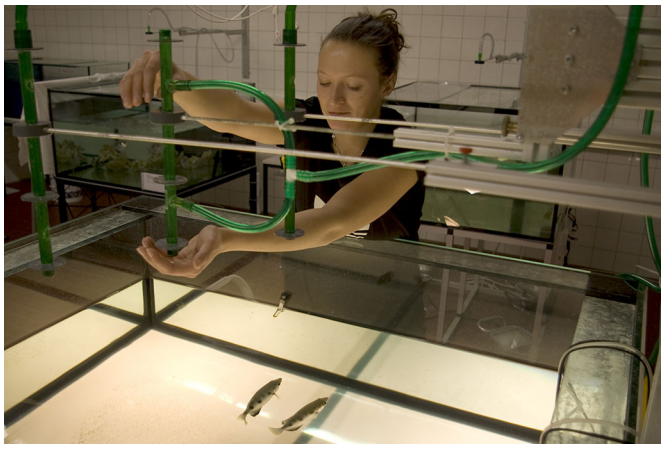
Early career researchers are the lifeblood of science, from the hours of labour they invest in the field and at lab benches to the promise of the future discoveries that they will make. Few publications would progress beyond the concept stage without their diligence and determination. However, pressure on the current generation of aspiring young scientists is mounting, with cuts in funding, short-term contracts and an ever more competitive jobs market making the risks of embarking on a career in research increasingly precarious. Yet these obstacles do not seem to have deterred many of the brightest inquisitive minds of the current generation from joining today's cohort of graduate students and postdocs as they make their first forays into the world of discovery.

With the intention of nurturing the careers of the next generation of researchers and Principal Investigators, the Editors of Journal of Experimental Biology established the JEB Outstanding Paper Prize in 2005 to recognise the creativity and industry of the graduate students and postdocs (of no more than 5 years' standing) that made the most significant contributions to an outstanding paper published during the current year. 'I published my first papers in JEB and greatly appreciated the gentle and mature encouragement given by the then Editor, John Treherne, and the anonymous reviewers. It is important to continue the tradition', says JEB Editor Julian Dow. This year, the JEB Editorial team, led by Editor-in-Chief Hans Hoppeler, has nominated a shortlist of nine articles for consideration for the 2016 JEB Outstanding Paper Prize.

Warm acclimation improves hypoxia tolerance in *Fundulus heteroclitus*

In the first shortlisted paper, lead scientist Trish Schulte, from the University of British Columbia (UBC), Canada, and her team of graduate student researchers addressed the problem of how ectotherms deal with the twin challenges of increasing hypoxia and temperatures in their environments. 'This issue is important to me because human activities are having very large impacts on both temperature and oxygen levels in aquatic environments', says Schulte, recalling how young researchers Tara McBryan and Tim Healy developed new approaches to find out how the fish responded as oxygen levels fell while the temperature increased. 'Tara and Tim worked together very closely to bring this experiment to a very successful conclusion', says Schulte. Explaining how the duo showed that increasing temperatures could protect killifish against the damaging effects of hypoxia, Schulte smiles and says, 'The wonderful thing about working with graduate students is they bring boundless energy and a willingness to try new things'.



Caroline Reinel worked with Stefan Schuster on the shortlisted paper 'Archerfish fast-start decisions can take an additional variable into account'. Photo credit: Peter Machnik.

Archerfish fast-start decisions can take an additional variable into account

Paying tribute to his junior colleague Caroline Reinel, Stefan Schuster, from University of Bayreuth, Germany, recalls how he was impressed by 'her patience, her extremely thoughtful way of running the experiments and her talents of dealing with the mathematics', as she systematically identified the key parameters that allow hunting archerfish to capture insects after dislodging them from their perches with a jet of water. Schuster describes how Reinel identified that the vertical speed of the falling prey is a key component of the fish's calculation. Going on to explain that inclusion of this additional parameter should have impaired the fish's decision-making, Schuster says, 'Yet the quality of the decisions neither declined nor did the decision require more time'. As this discovery contrasts with our current understanding of decision-making – where increasing the number of variables reduces either the speed of response or the accuracy of the prediction – Schuster says, 'This is completely at odds with what the field seems to see as a universal feature of decision-making'. Having nominated the paper for the shortlist, JEB Editor Ken Lukowiak endorses the research, adding, 'I have always been fascinated by how the fish hunts and obtains its prey, and this is a great paper on how to study decision-making'.

Introducing a novel mechanism to control heart rate in the ancestral Pacific hagfish

In another paper led by a UBC team, Tony Farrell, in collaboration with Martin Tresguerres, from the Scripps Institution of

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Box 1: 2016 Journal of Experimental Biology Outstanding Paper Prize shortlist

De Meyer, J., Christiaens, J. and Adriaens, D. (2016). Diet-induced phenotypic plasticity in European eel (*Anguilla anguilla*). *J. Exp. Biol.* **219**, 354-363.

McBryan, T. L., Healy, T. M., Haakons, K. L. and Schulte, P. M. (2016). Warm acclimation improves hypoxia tolerance in *Fundulus heteroclitus*. *J. Exp. Biol.* **219**, 474-484.

Ostwald, M. M., Smith, M. L. and Seeley, T. D. (2016). The behavioral regulation of thirst, water collection and water storage in honey bee colonies. *J. Exp. Biol.* **219**, 2156-2165.

Reinel, C. P. and Schuster, S. (2016). Archerfish fast-start decisions can take an additional variable into account. *J. Exp. Biol.* **219**, 2844-2855.

Rosendale, A. J., Romick-Rosendale, L. E., Watanabe, M., Dunlevy, M. E. and Benoit, J. B. (2016). Mechanistic underpinnings of dehydration stress in the American dog tick revealed through RNA-Seq and metabolomics. *J. Exp. Biol.* **219**,1808-1819.

Stewart, W. J., Tian, F.-B., Akanyeti, O., Walker, C. J. and Liao, J. C. (2016). Refuging rainbow trout selectively exploit flows behind tandem cylinders. *J. Exp. Biol.* **219**, 2182-2191.

Thomsen, J., Himmerkus, N., Holland, N., Sartoris, F.-J., Bleich, M. and Tresguerres, M. (2016). Ammonia excretion in mytilid mussels is facilitated by ciliary beating. *J. Exp. Biol.* **219**, 2300-2310.

von Uckermann, G., Lambert, F. M., Combes, D., Straka, H. and Simmers, J. (2016). Adaptive plasticity of spino-extraocular motor coupling during locomotion in metamorphosing *Xenopus laevis*. *J. Exp. Biol.* **219**, 1110-1121.

Wilson, C. M., Roa, J. N., Cox, G. K., Tresguerres, M. and Farrell, A. P. (2016). Introducing a novel mechanism to control heart rate in the ancestral Pacific hagfish. *J. Exp. Biol.* **219**, 3227-3236.

Oceanography, USA, and their team of young researchers published the remarkable discovery that hagfish use an intriguing and novel mechanism to regulate heart rate. Explaining that most vertebrates rely on their autonomic nervous system to regulate cardiac contraction, Farrell says, 'Hagfishes are so primitive their heart has no nerves to control heart rate'. Intrigued by the mechanism that may regulate the heart in this ancient species, graduate students Christopher Wilson and Jinae Roa produced convincing evidence that heart rate is accelerated by the humble bicarbonate ion and mediated through the soluble form of the enzyme adenylyl cyclase,

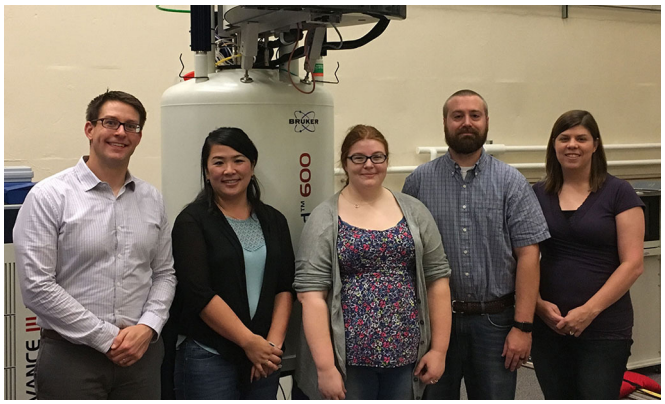
Chris Wilson worked with Tony Farrell, Jinae Roa and Martin Tresguerres on 'Introducing a novel mechanism to control heart rate in the ancestral Pacific hagfish'. Photo credit: Julian Larrea.

William Stewart worked in Jimmy Liao's laboratory on 'Refuging rainbow trout selectively exploit flows behind tandem cylinders'. Photo credit: Julie Walker.

which the team found distributed throughout the heart muscle. 'Both graduate students made an outstanding scientific contribution and totally deserve co-lead authorship', says Farrell, adding that he was impressed by their ability to 'think outside of the box, work hard and trust one another'.

Refuging rainbow trout selectively exploit flows behind tandem cylinders

Moving up the evolutionary tree, Jimmy Liao, along with his team at the Whitney Laboratory for Marine Bioscience at the University of Florida, USA, continued his long-standing investigation of how fish exploit turbulence behind obstacles in flowing water. 'In 2003, I discovered that fish can surf eddies shed behind single cylinders under the right hydrodynamic conditions', says Liao, explaining that this trick allows the animals to retain their position behind individual objects at very low energy costs. Intrigued by the complexity of the flows that fish encounter in real rivers, Liao and postdoc William Stewart investigated the turbulence generated by pairs of obstacles in the flow and found that increasing the separation disrupted the rhythmic eddies produced by two closely separated structures. This, in turn, disrupted the fish's ability to catch an almost free ride when settled behind an obstruction, and nominating JEB Editor Andrew Biewener says, '[This study] shows that trout can sense variation in the pattern and strength of vortices shed from objects'.



Joshua Benoit (left) and colleagues Miki Watanabe, Megan Dunlevy, Andrew Rosendale and Lindsey Romick-Rosendale, who worked together on 'Mechanistic underpinnings of dehydration stress in the American dog tick revealed through RNA-Seq and metabolomics'. Photo credit: Josh Benoit.

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Madeleine Ostwald worked with Michael Smith and Tom Seeley on their shortlisted paper, 'The behavioral regulation of thirst, water collection and water storage in honey bee colonies'. Photo credit: Tom Seeley.

Ammonia excretion in mytilid mussels is facilitated by ciliary beating

Continuing the theme of turbulence, but on a smaller scale, the next shortlisted paper investigated how mussels excrete ammonia. According to PI Martin Tresguerres, little was known about waste excretion in this ecologically pivotal species until Jörn Thomsen joined his lab as a new postdoc. Having discovered that the molluscs exploit the gentle currents generated by cilia to wash waste ammonia away from the excretory plicate organ, Tresguerres says, 'Jörn did an outstanding job in every aspect', and JEB Editor Steve Perry adds, 'I was fascinated by the idea that a sessile organism is able to couple the water flow generated for filter feeding from beating cilia with excretion of nitrogenous waste'.

Diet-induced phenotypic plasticity in European eel (*Anguilla anguilla*)

Still in the aquatic realm, lead researcher Dominique Adriaens, from Ghent University, Belgium, recalls how the paper that he co-authored with graduate student Jens De Meyer and Joachim Christiaens was inspired by the observation that adult European eels can be divided into two clear groups: one with wide heads and the other with narrow heads. Testing the theory that the eels' choice of diet may determine their head shape, De Meyer fed one group of glass eels a diet of hard microscopic crustaceans while a second group was restricted to a softer diet of blood worms and copepods. 'We had no idea whether the eels in the different treatment groups would take in the provided food items in sufficient quantities to make the comparison possible', recalls Adriaens. However, De Meyer's patience was rewarded 5 months later, when the young eels developed the same head-shape distribution as the adults. 'I was highly impressed… Jens has proven to be motivated and efficient. He asks the right questions, translates them into the proper experimental design and does the analyses and interpretation in a mature and efficient manner', says Adriaens.

Postdocs Francois Lambert and Géraldine von Uckermann worked on the 2016 JEB Outstanding Paper Prize winning article, 'Adaptive plasticity of spino-extraocular motor coupling during locomotion in metamorphosing *Xenopus laevis*'. Photo credits: Loïc Grattier, CNRS 5287 (left) and Géraldine von Uckermann (right).

Adaptive plasticity of spino-extraocular motor coupling during locomotion in metamorphosing *Xenopus*

Focusing on another creature that transforms from a fully aquatic lifestyle into an air-breather, John Simmers, from the Université Bordeaux, France, and a team of co-authors including postdocs Géraldine von Uckermann and François Lambert addressed the problem of how metamorphosing frogs control eye movements as they change from wriggling fish-like swimmers into mini adults propelled by their newly developed hindlegs. The two postdocs had previously shown that copies of the nerve signals (efferent signals) that drive the tadpoles' swimming motion coordinate the horizontal swivelling eye motions that allow tadpoles to hold a steady gaze while swimming. They had also discovered that the efferent signals that drive the propulsive leg-kick also control the convergent eye motion that is necessary to stabilise the vision of swimming frogs. In their shortlisted paper, the duo revealed how visual control shifts gradually from the tadpole swimming pattern during the early stages of metamorphosis to the adult swimming pattern at completion of the transformation. 'The experiments described in this paper were technically extremely difficult', says Simmers, adding that the youthful drive and enthusiasm of the two young scientists was a key factor in their success. 'Both displayed an impressive ability to "think on their feet" during experimentation', he says.

Mechanistic underpinnings of dehydration stress in the American dog tick revealed through RNA-seq and metabolomics

While water has been the home of many of the organisms featured in this year's Outstanding Paper shortlist, water conservation is the theme of the next paper, which tackled the strategies used by ticks to avoid desiccation. 'Ticks spend most of their life off-host, where desiccation can be a major threat to their survival', says PI Joshua Benoit, who led the study with Andrew Rosendale and Megan Dunlevy, from the University of Cincinnati, USA, which identified the genes that are activated by ticks in response to dehydration. Recalling how the pair of young scientists coordinated the metabolomics component of the study with researchers at the Cincinnati Children's Hospital Medical Center, in addition to mastering RNA-sequencing-based transcriptomics and direct physiological assays, Benoit says, 'Andrew and Megan were very careful and meticulous throughout the studies and showed ingenuity in designing new experiments'.

The behavioural regulation of thirst, water collection and water storage in honey bee colonies

Concluding the shortlist, Tom Seeley, from Cornell University, USA – working with undergraduate researcher Madeleine Ostwald

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and graduate student Michael Smith – investigated how a superorganism comprising thousands of bees recognises the sensation of thirst. 'We were attracted to this mystery because it is important to unravel how the members of a social insect colony work together', says Seeley. The team discovered that water collector bees start foraging when thirsty colony mates begin to beg for water, and Seeley recalls Ostwald's dedication as she meticulously recorded the water collectors' behaviour over multiple 6 h observation periods. In addition, he commends Smith's courage in risking stings from angry bees when collecting the insects to measure their crop contents. 'Both students were a class act throughout', says Seeley, recalling their dedication and commitment.

And the winner is…

Considering the strengths of this year's shortlist, Editor-in-Chief Hans Hoppeler is delighted that it showcases many principles at the core of the journal's ethos. And while it is never easy to select a single paper from such a diverse field, Hoppeler and his team of Editors are happy to announce that the 2016 JEB Outstanding Paper Prize is awarded to Géraldine von Uckermann and François Lambert for their work on 'Adaptive plasticity of spino-extraocular motor coupling during locomotion in metamorphosing *Xenopus laevis*'.

Nominating Editor Michael Dickinson commended the winning paper, and said, '[It] combined the study of an important phenomenon in neuroscience [(efferent copies)] with the most fascinating feature of metamorphosis'. As clear examples of the efferent copy phenomenon are quite rare, Dickinson says, 'von Uckermann and colleagues not only provided a compelling example, but they show how the internal signal must change within a developmental and ethological context'.

Speaking on behalf of his team, PI John Simmers said, 'We are all absolutely thrilled'. He also recalled how von Uckermann painstakingly measured the efference copy signals produced by swimming activity at various stages of the tadpoles' metamorphosis while she recorded from the nerves that control eye movements, and how Lambert developed the techniques that permitted him to film the tadpoles' eye movements in response to the efferent signals associated with swimming motion. 'The experiments performed in this study represented a real *tour de force*', says Simmers, who wishes both young scientists well and says, 'I am confident that the drive and rigour coupled with the intellectual and technical prowess that they needed to succeed in this biological study will serve as a springboard to highly successful careers, whether within or beyond the field of scientific research'.

With a long tradition of supporting young scientists, the journal hopes that the recognition offered by a nomination for the Outstanding Paper Prize will assist scientists in the early stages of their careers, and JEB Editor Steve Perry says, 'Our goal at JEB is to bring these junior rising stars into the foreground because they will certainly be our future scientific leaders'.