

Andrew Barron
Professor
Department of Biological Sciences
Email: andrew.barron@mq.edu.au
Phone: +61 2 9850 1310



Biography

Dr Barron is an Australian Research Council Future Fellow, and Deputy Head of the Department of Biological Sciences at Macquarie University. He is a neuroethologist, which is a discipline of neuroscience studying the neural mechanisms of natural animal behaviour. Most of his research focuses on insects, especially honey bees. Using advanced techniques to visualise, manipulate, map and record from the insect brain Barron's team has made important contributions to the understanding of fundamental behavioural systems such as cognition, navigation, social behaviour and learning and memory.

He also conducts research to improve honey bee health and welfare. He is studying how bees and bee colonies are impacted by pesticide and disease stressors, and how to best intervene to help bee colonies under stress.

Employment

Professor

Professor
Department of Biological Sciences
Macquarie University
26 Jan 2020 → present

Australian Research Council Future Fellow

Australian Research Council
Canberra, Australia
1 Jan 2015 → present

President, Australasian Society for the Study of Animal Behaviour

AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2012 → 1 Jan 2014

Vice-President, Australasian Society for the Study of Animal Behaviour

AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2010 → 1 Jan 2012

Treasurer, Australasian Society for the Study of Animal Behaviour

AUSTRALASIAN SOCIETY OF THE STUDY OF ANIMAL BEHAVIOUR
Australia
1 Jan 2008 → 1 Jan 2010

Postdoctoral Fellow, Research School of Biological Sciences

Australian National University
ACT 0200, Australia
1 Jan 2004 → 1 Jan 2007

Fullbright Postdoctoral Fellow

University of Illinois
Champaign, United States
1 Jan 2001 → 1 Jan 2004

Royal Society Postdoctoral Fellow

University of Sydney

2006, Australia

1 Jan 1999 → 1 Jan 2001

Research output

A hybrid compact neural architecture for visual place recognition

Chancan, M., Hernandez-Nunez, L., Narendra, A., Barron, A. B. & Milford, M., Apr 2020, In : IEEE Robotics and Automation Letters. 5, 2, p. 993-1000 8 p.

The miticide thymol in combination with trace levels of the neonicotinoid imidacloprid reduces visual learning performance in honey bees (*Apis mellifera*)

Colin, T., Plath, J. A., Klein, S., Vine, P., Devaud, J. M., Lihoreau, M., Meikle, W. G. & Barron, A. B., 27 Feb 2020, In : Apidologie. 11 p.

Prosociality and a sociosexual hypothesis for the evolution of same-sex attraction in humans

Barron, A. B. & Hare, B., 16 Jan 2020, In : Frontiers in Psychology. 10, p. 1-7 7 p., 2955.

The capping pheromones and putative biosynthetic pathways in worker and drone larvae of honey bees *Apis mellifera*

Qin, Q-H., He, X-J., Barron, A. B., Guo, L., Jiang, W-J. & Zeng, Z-J., Dec 2019, In : Apidologie. 50, 6, p. 793-803 11 p.

Long-term dynamics of honey bee colonies following exposure to chemical stress

Colin, T., Meikle, W. G., Paten, A. M. & Barron, A. B., 10 Aug 2019, In : Science of the Total Environment. 677, p. 660-670 11 p.

Traces of a neonicotinoid induce precocious foraging and reduce foraging performance in honey bees

Colin, T., Meikle, W. G., Wu, X. & Barron, A. B., 16 Jul 2019, In : Environmental Science and Technology. 53, 14, p. 8252-8261 10 p.

A maternal effect on queen production in honeybees

Wei, H., He, X. J., Liao, C. H., Wu, X. B., Jiang, W. J., Zhang, B., Zhou, L. B., Zhang, L. Z., Barron, A. B. & Zeng, Z. J., 8 Jul 2019, In : Current Biology. 29, 13, p. 2208-2213 9 p.

A comparison of honeybee (*Apis mellifera*) queen, worker and drone larvae by RNA-Seq

He, X. J., Jiang, W. J., Zhou, M., Barron, A. B. & Zeng, Z. J., Jun 2019, In : Insect Science. 26, 3, p. 499-509 11 p.

Honey bees increase their foraging performance and frequency of pollen trips through experience

Klein, S., Pasquaretta, C., He, X. J., Perry, C., Søvik, E., Devaud, J. M., Barron, A. B. & Lihoreau, M., 1 May 2019, In : Scientific Reports. 9, 1, p. 1-10 10 p., 6778.

Effects of thymol on European honey bee hygienic behaviour

Colin, T., Lim, M. Y., Quarrel, S. R., Allen, G. R. & Barron, A. B., 25 Apr 2019, In : Apidologie. 50, 2, p. 141-152 12 p.

Biogenic amine modulation of honey bee sociability and nestmate affiliation

Hewlett, S. E., Delahunt Smoleniec, J. D., Wareham, D. M., Pyne, T. M. & Barron, A. B., 25 Oct 2018, In : PLoS ONE. 13, 10, p. 1-18 18 p., e0205686.

The development of honey bee colonies assessed using a new semi-automated brood counting method: Combcount

Colin, T., Bruce, J., Meikle, W. G. & Barron, A. B., 16 Oct 2018, In : PLoS ONE. 13, 10, p. 1-14 14 p., e0205816.

Abstract concept learning in a simple neural network inspired by the insect brain

Cope, A. J., Vasilaki, E., Minors, D., Sabo, C., Marshall, J. A. R. & Barron, A. B., 17 Sep 2018, In : PLoS Computational Biology. 14, 9, p. 1-21 21 p., e1006435.

Short-term exposure to lambda-cyhalothrin negatively affects the survival and memory-related characteristics of worker bees *Apis mellifera*

Liao, C. H., He, X. J., Wang, Z. L., Barron, A. B., Zhang, B., Zeng, Z. J. & Wu, X. B., Jul 2018, In : Archives of Environmental Contamination and Toxicology. 75, 1, p. 59–65 7 p.

Using within-day hive weight changes to measure environmental effects on honey bee colonies

Meikle, W. G., Holst, N., Colin, T., Weiss, M., Carroll, M. J., McFrederick, Q. S. & Barron, A. B., 23 May 2018, In : PLoS ONE. 13, 5, p. 1-21 21 p., e0197589.

Relationship between brain plasticity, learning and foraging performance in honey bees

Cabirol, A., Cope, A. J., Barron, A. B. & Devaud, J. M., 30 Apr 2018, In : PLoS ONE. 13, 4, p. 1-18 18 p., e0196749.

Cocaine directly impairs memory extinction and alters brain DNA methylation dynamics in honey bees

Søvik, E., Berthier, P., Klare, W. P., Helliwell, P., Buckle, E. L. S., Plath, J. A., Barron, A. B. & Maleszka, R., 13 Feb 2018, In : Frontiers in Physiology. 9, FEB, p. 1-11 11 p., 79.

Honey bee (*Apis mellifera*) sociability and nestmate affiliation are dependent on the social environment experienced post-eclosion

Hewlett, S. E., Wareham, D. M. & Barron, A. B., 13 Feb 2018, In : Journal of Experimental Biology. 221, 3, p. 1-8 8 p., 173054.

Stress decreases pollen foraging performance in honeybees

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Cooperative defence operates by social modulation of biogenic amine levels in the honey bee brain

Nouvian, M., Mandal, S., Jamme, C., Claudianos, C., D'Ettoire, P., Reinhard, J., Barron, A. B. & Giurfa, M., 31 Jan 2018, In : Proceedings of the Royal Society B: Biological Sciences. 285, 1871, p. 1-9 9 p., 20172653.

The evolution of honey bee dance communication: A mechanistic perspective

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Experience during early adulthood shapes the learning capacities and the number of synaptic boutons in the mushroom bodies of honey bees (*Apis mellifera*)

Cabirol, A., Brooks, R., Groh, C., Barron, A. B. & Devaud, J. M., Oct 2017, In : Learning and Memory. 24, 10, p. 557-562 6 p.

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The frontiers of insect cognition

Perry, C. J., Barron, A. B. & Chittka, L., Aug 2017, In : Current Opinion in Behavioral Sciences. 16, p. 111-118 8 p.

Inter-individual variability in the foraging behaviour of traplining bumblebees

Klein, S., Pasquaretta, C., Barron, A. B., Devaud, J. M. & Lihoreau, M., 4 Jul 2017, In : Scientific Reports. 7, 1, p. 1-12 12 p., 4561.

***Drosophila* divalent metal ion transporter Malvolio is required in dopaminergic neurons for feeding decisions**

Søvik, E., Lamora, A., Seehra, G., Barron, A. B., Duncan, J. G. & Ben-Shahar, Y., Jun 2017, In : Genes, Brain and Behavior. 16, 5, p. 506-514 9 p.

Different roles for honey bee mushroom bodies and central complex in visual learning of colored lights in an aversive conditioning assay

Plath, J. A., Entler, B. V., Kirkerud, N. H., Schlegel, U., Galizia, C. G. & Barron, A. B., 30 May 2017, In : *Frontiers in Behavioral Neuroscience*. 11, p. 1-14 14 p., 98.

Learning, gustatory responsiveness and tyramine differences across nurse and forager honeybees

Scheiner, R., Reim, T., Søvik, E., Entler, B. V., Barron, A. B. & Thamm, M., 15 Apr 2017, In : *Journal of Experimental Biology*. 220, 8, p. 1443-1450 8 p.

Epigenetics and the evolution of instincts: instincts may evolve from learning and share the same cellular and molecular mechanisms

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Why bees are so vulnerable to environmental stressors

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Making a queen: an epigenetic analysis of the robustness of the honeybee (*Apis mellifera*) queen developmental pathway

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A Computational model of the integration of landmarks and motion in the insect central complex

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Neuropharmacological manipulation of restrained and free-flying honey bees, *Apis mellifera*

Søvik, E., Plath, J. A., Devaud, J. M. & Barron, A. B., 26 Nov 2016, In : *Journal of Visualized Experiments*. 117, p. 1-11 11 p., e54695.

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What insects can tell us about the origins of consciousness

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A systems approach to animal communication

Hebets, E. A., Barron, A. B., Balakrishnan, C. N., Hauber, M. E., Mason, P. H. & Hoke, K. L., 16 Mar 2016, In : *Proceedings of the Royal Society B: Biological Sciences*. 283, 1826, p. 1-10 10 p., 20152889.

Starving honey bee (*Apis mellifera*) larvae signal pheromonally to worker bees

He, X. J., Zhang, X. C., Jiang, W. J., Barron, A. B., Zhang, J. H. & Zeng, Z. J., 29 Feb 2016, In : *Scientific Reports*. 6, p. 1-9 9 p., 22359.

Accelerated behavioural development changes fine-scale search behaviour and spatial memory in honey bees (*Apis mellifera* L.)

Ushitani, T., Perry, C. J., Cheng, K. & Barron, A. B., 1 Feb 2016, In : *Journal of Experimental Biology*. 219, 3, p. 412-418 7 p.

Physiology of reproductive worker honey bees (*Apis mellifera*): insights for the development of the worker caste

Peso, M., Even, N., Søvik, E., Naeger, N. L., Robinson, G. E. & Barron, A. B., 1 Feb 2016, In : Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioral Physiology. 202, 2, p. 147-158 12 p.

Insect consciousness: commitments, conflicts and consequences

Klein, C. & Barron, A. B., 2016, In : Animal sentience. 1, 9, p. 1-12 12 p.

Insects have the capacity for subjective experience

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Current progress in understanding the functions of the insect central complex

Plath, J. A. & Barron, A. B., 10 Dec 2015, In : Current Opinion in Insect Science. 12, p. 11-18 8 p.

Decision-making and action selection in insects: inspiration from vertebrate-based theories

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Death of the bee hive: Understanding the failure of an insect society

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Embracing multiple definitions of learning

Barron, A. B., Hebets, E. A., Cleland, T. A., Fitzpatrick, C. L., Hauber, M. E. & Stevens, J. R., 1 Jul 2015, In : Trends in Neurosciences. 38, 7, p. 405-407 3 p.

Effects of the juvenile hormone analogue methoprene on rate of behavioural development, foraging performance and navigation in honey bees (*Apis mellifera*)

Chang, L. H., Barron, A. B. & Cheng, K., 1 Jun 2015, In : Journal of Experimental Biology. 218, 11, p. 1715-1724 10 p.

The value of artificial stimuli in behavioral research: making the case for egg rejection studies in avian brood parasitism

Hauber, M. E., Tong, L., Bán, M., Croston, R., Grim, T., Waterhouse, G. I. N., Shawkey, M. D., Barron, A. B. & Moskát, C., Jun 2015, In : Ethology. 121, 6, p. 521-528 8 p.

Pheromonal control: reconciling physiological mechanism with signalling theory

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Rapid behavioral maturation accelerates failure of stressed honey bee colonies

Perry, C. J., Søvik, E., Myerscough, M. R. & Barron, A. B., 17 Mar 2015, In : Proceedings of the National Academy of Sciences of the United States of America. 112, 11, p. 3427-3432 6 p.

Negative impact of manganese on honeybee foraging

Søvik, E., Perry, C. J., LaMora, A., Barron, A. B. & Ben-Shahar, Y., 1 Mar 2015, In : Biology Letters. 11, 3, p. 1-4 4 p., 20140989.

Insect reward systems: Comparing flies and bees

Søvik, E., Perry, C. J. & Barron, A. B., 2015, In : Advances in Insect Physiology. 48, p. 189-226 38 p.

Behavior and molecular physiology of nurses of worker and queen larvae in honey bees (*Apis mellifera*)

He, X. J., Tian, L. Q., Barron, A. B., Guan, C., Liu, H., Wu, X. B. & Zeng, Z. J., 1 Dec 2014, In : Journal of Asia-Pacific Entomology. 17, 4, p. 911-916 6 p.

Cocaine affects foraging behaviour and biogenic amine modulated behavioural reflexes in honey bees

Sovik, E., Even, N., Radford, C. W. & Barron, A. B., 2014, In : PeerJ. 2, p. 1-12 12 p., e662.

Differences in the phototaxis of pollen and nectar foraging honey bees are related to their octopamine brain titers
Scheiner, R., Toteva, A., Reim, T., Søvik, E. & Barron, A. B., 2014, In : *Frontiers in Physiology*. 5, p. 1-8 8 p., 116.

Epigenomics and the concept of degeneracy in biological systems

Maleszka, R., Mason, P. H. & Barron, A. B., 2014, In : *Briefings in Functional Genomics*. 13, 3, p. 191-202 12 p., elt050.

Genital evolution: why are females still understudied?

Ah-King, M., Barron, A. B. & Herberstein, M. E., 2014, In : *PLoS Biology*. 12, 5, p. 1-7 7 p., e1001851.

Peak shift in honey bee olfactory learning

Andrew, S. C., Perry, C. J., Barron, A. B., Berthon, K., Peralta, V. & Cheng, K., 2014, In : *Animal Cognition*. 17, 5, p. 1177-1186 10 p.

The effects of brood ester pheromone on foraging behaviour and colony growth in apicultural settings

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Honey bees selectively avoid difficult choices

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Invertebrate models in addiction research

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Dynamic modelling of honey bee (*Apis mellifera*) colony growth and failure

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A comparison of digital gene expression profiling and methyl DNA immunoprecipitation as methods for gene discovery in honeybee (*Apis mellifera*) behavioural genomic analyses

Guan, C., Barron, A. B., He, X. J., Wang, Z. L., Yan, W. Y. & Zeng, Z. J., 9 Sep 2013, In : *PLoS ONE*. 8, 9, p. 1-10 10 p., e73628.

Invertebrate learning and cognition: Relating phenomena to neural substrate

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Altruistic behavior by egg-laying worker honeybees

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Modelling food and population dynamics in honey bee colonies

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Neural mechanisms of reward in insects

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Assessment of flight activity and homing ability in Asian and European honey bee species, *Apis cerana* and *Apis mellifera*, measured with radio frequency tags

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Plenty of sex, but no sexuality in biology undergraduate curricula: How sexuality and variation in sexual behaviour are addressed in current biological teaching in relation to recent research findings

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A quantitative model of honey bee colony population dynamics

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The roles of dopamine and related compounds in reward-seeking behavior across animal phyla

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Effects of cocaine on honey bee dance behaviour

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Effect of age, behaviour and social environment on honey bee brain plasticity

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From social behavior to molecules: models and modules in the middle

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Learned host preferences

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The utility of behavioral models and modules in molecular analyses of social behavior

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Octopamine modulates honey bee dance behavior

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Division of labor in the honey bee (*Apis mellifera*): The role of tyramine β -hydroxylase

Lehman, H. K., Schulz, D. J., Barron, A. B., Wraight, L., Hardison, C., Whitney, S., Takeuchi, H., Paul, R. K. & Robinson, G. E., Jul 2006, In : Journal of Experimental Biology. 209, 14, p. 2774-2784 11 p.

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Selective modulation of task performance by octopamine in honey bee (*Apis mellifera*) division of labour

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Measuring the cost of worker reproduction in honeybees: Work tempo in an 'anarchic' line

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Genetic control of the honey bee (*Apis mellifera*) dance language: Segregating dance forms in a backcrossed colony

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A role for octopamine in honey bee division of labor

Schulz, D. J., Barron, A. B. & Robinson, G. E., 2002, In : Brain, Behavior and Evolution. 60, 6, p. 350-359 10 p.

Genetic control of the honeybee (*Apis mellifera*) dance language: Segregating dance forms in a backcrossed colony

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Policing of adult honey bees with activated ovaries is error prone

Dampney, J. R., Barron, A. B. & Oldroyd, B. P., 2002, In : Insectes Sociaux. 49, 3, p. 270-274 5 p.

Policing of adult honeybees with activated ovaries is error prone

Dampney, J. R., Barron, A. & Oldroyd, B. P., 2002, In : Insectes Sociaux. 49, 3, p. 270-275 6 p.

Social regulation of ovary activation in 'anarchistic' honey-bees (*Apis mellifera*)

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The life and death of Hopkins' host-selection principle

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Worker reproduction in honey-bees (*Apis*) and the anarchic syndrome: A review

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Behavioural induction in *Drosophila*: timing and specificity

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Pre-exposure affects the olfactory response of *Drosophila melanogaster* to menthol

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Awards

Projects

ActiveAI - active learning and selective attention for robust, transparent and efficient AI

Barron, A. & Philippides, A.

1/11/19 → 31/10/22

Analysing the neural mechanisms of animal cognition and behaviour

Narendra, A., Barron, A., Cheng, K., Hart, N. & Cornish, J.

1/01/16 → 31/12/16

An analysis of the distribution of degrees of intelligence across animal groups

Barron, A.

4/06/18 → 3/06/20

A new understanding of complex systems through study of self-assembled swarm architecture in ants

Reid, C. & Barron, A.

30/06/17 → ...

Automated Fluorescence Stereo Microscope

Narendra, A., Taylor, P., Lindsay, S., Barron, A., Herberstein, M., Hart, N., Williamson, J., Griffith, S., Whiting, M., Brock, G. & Jacob, D.

1/01/17 → ...

Biomolecular Discovery and Design Research Centre

Packer, N., Paulsen, I., Nevalainen, H., Haynes, P., Molloy, M., Atwell, B., Barron, A., Beggs, P., Bergquist, P. L., Brown, L., Cornish, J., Chung, R., De Deene, Y., Garcia-Bennett, A., Gillings, M., Goodchild, A., Guillemin, G., Hallinan, J., Hose, G., Jaschke, P., Mabbutt, B., Raftos, D., Ranganathan, S., Sofronov, G., Sunna, A., Tetu, S., Andersen, M., Willows, R., Ahn, C., Breen, E., Campbell, M., Care, A., Cordina, N., Curach, N., Everest Dass, A., Elbourne, L., Goold, H., Hassan, K., Kautto, L., Krisp, C., Kroukamp, H., Lee, A., Lin, C., Mackie, A., McKay, M., McQuade, L., Mirzaei, M., Mohamedali, A., Ostrowski, M., Parker, L., Pascovici, D., Penesyan, A., Shah, B., Sun, A., Thompson, E. & Williams, T.

1/01/17 → ...

Biosecurity Futures Research Centre

Taylor, P., Gillings, M., Raftos, D., Leishman, M., Sunna, A., Bishop, M., Barron, A., Beattie, A., Beaumont, L., Connally, R., Grech, A., Griffith, S., Guillemin, G., Hughes, L., Inglis, D., Jamie, I., Jamie, J., Lu, Y., Morelli De andrade, R., Nevalainen, H., Park, S. J., Perez, J., Power, M., Ranjan, R. & Vickery, K.

1/07/15 → ...

Combined gas chromatography/ electroantennogram detector for insect olfaction research

Taylor, P., Jamie, I., Herberstein, M., Kemp, D., Barron, A., Jamie, J., Akter, H., Adnan, S., Moadeli, T., Akter, K., Bakshi, D. & MQRES, M.

1/01/15 → 31/12/15

Comprehending and modelling the workings of the animal brain

Barron, A., MQRES (International), M. (. & MQRES, M.

1/06/15 → 31/12/20

MQRIS Small: Enhancing electrochemical recording techniques in the animal research facility

Cornish, J., Baracz, S., McMullan, S., Goodchild, A., Barron, A. & Hildreth, C.

1/01/18 → 31/12/18

Exploring neurogenomic adaptations to repeated cocaine exposure in honey bees

Barron, A.

22/10/08 → 21/10/09

Gene expression analysis system

Barron, A., Cheng, K., Taylor, P., Nelson, X. & Pryke, S.

1/01/08 → 31/12/08

High quality ultramicrotome for precision specimen preparation for optical and electron microscopy

Deng, W., Chung, R., Nevalainen, H., Phillips, J. K., McMorrnan, B. & Barron, A.

1/01/14 → 31/12/14

High Throughput Molecular Sample Processing Facility

Zakoshanski, I., Paulsen, I., Whiting, M., Power, M., Lanfear, R., Barron, A., Westoby, M., Warren, D., Van Sluyter, S., Clarke, T., Wunderlin, T., Ostrowski, M., Mazard, S. & Tetu, S.

4/02/15 → 31/12/15

Integrative analysis of honey bee colony function and performance (58-5342-3-004F: Developing the use of sensors to model bee colony dynamics and to monitor bee health, productivity and performance)

Barron, A. & Meikle, W.

1/07/13 → ...

Invertebrate olfaction facilities

Taylor, P., Herberstein, M., Barron, A., Weldon, C., Nelson, X. & Prenter, J.
1/01/09 → 31/12/09

Knowing what you don't know: analyzing the biology of metacognition and uncertainty in a simple model system

Solvi, C. & Barron, A.
1/06/11 → 1/06/14

Macquarie University Species Spectrum Research Center

Herberstein, M., Gillings, M., Jacob, D., Saintilan, N., Barron, A., Westoby, M., Sofronov, G. & Tetu, S.
1/01/17 → ...

Microbalance for integrative behavioral research

Taylor, P., Barron, A. & Weldon, C.
1/01/10 → 31/12/10

Molecular memory: how DNA methylation contributes to spatial memory

Maleszka, R., Cornish, J. & Barron, A.
1/01/10 → 31/12/12

Navigating brains: the neurobiology of spatial cognition

Cheng, K., Zeil, J., Narendra, A., Barron, A., Wehner, R. & MQRES, M.
30/06/15 → ...

Navigating brains: the neurocomputational foundations of insect spatial cognition

Cheng, K., Barron, A. & Wehner, R.
1/01/14 → 31/12/14

Neural adaptations for social harmony in bees

Barron, A.
1/01/08 → 31/12/08

Operant behavioural chambers for rat research

Cornish, J., Clemens, K., Staples, L., Goodchild, A., Haynes, P., Barron, A., Baillie, A. & Pilowsky, P.
1/01/11 → 31/12/11

Origin of Consciousness and it's Computational Applications in Machines (MQ Discretionary Scheme)

Barron, A., Klein, C., Balleine, B. W., Bell, G., Millford, M. & Van Swinderen, B.
12/02/18 → 31/12/18

Protecting vulnerable Australian honey bees

Barron, A.
25/07/17 → ...

The bionic bee brain

Barron, A.
19/06/15 → 24/08/15

The genomic response to colony disease stress in honey bees

Barron, A. & Gillings, M.
1/07/12 → 30/06/14

The molecular and cellular basis the memory in the honey bee

Barron, A.

1/08/09 → 30/07/11

Towards a Bionic Brain

Barron, A.

30/04/14 → 25/12/14

Understanding colony collapse: a social analysis of honey bee colony failure

Barron, A.

1/07/11 → 31/12/14

Understanding the functions of neural circuit changes in visual navigation

Kamhi, F., Narendra, A. & Barron, A.

1/01/17 → ...

Vulnerability to cocaine use: discovering common mechanisms conserved across animal phyla

Barron, A., Cornish, J. & Maleszka, R.

1/01/09 → 31/12/12