# Functional significance of highly variable colouration in the shore skink (*Oligosoma smithi*)

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor in Philosophy

in

Ecology

at Massey University, Albany, New Zealand

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2017

# ABSTRACT

Variation in animal colouration is attributed to several biological functions, a key one being camouflage. Background-matching is a camouflage strategy where prey conceal themselves from predators by resembling their immediate backgrounds. Achieving optimal background-matching can be challenging, particularly in 1) visual backgrounds that form a mosaic caused by spatial variations in habitat characteristics, and 2) varying predator abundance or behaviour. Additionally, crypsis can be affected by alternative and potentially antagonistic functions, such as intraspecific signalling and thermoregulation. This thesis aimed to investigate the selective processes that affect prey colouration for background-matching in a heterogeneous environment. Specifically, I focused on the influence of habitat gradients, predator behaviour, and the potential conflict between camouflage requirements and thermoregulation or intraspecific signalling. Firstly, I conducted a detailed survey on the colour and colour patterns of a wild shore skink population (*Oligosoma smithi*) within a continuous heterogeneous habitat at Tāwharanui Regional Park. This population's body colouration showed a significant association with a vegetation gradient, consistent with selection for background-matching. However, field experiments also revealed that predation risk for the more common colour pattern variants was double that of the rarer variant's regardless of background type, consistent with predictions for apostatic selection (negative frequency-dependent selection). Secondly, I demonstrated that population colouration can respond to a change of habitat. One year after a translocation of shore skinks to an island habitat with a disjunct two-patch background, the population's colours matched the simple substrate type (bare rocky stones) more than the complex substrate (high vegetation cover on sand). Skinks were darker, less intense in colour, and had lower colour pattern diversity compared to the founder and source populations at Tāwharanui. This study highlighted the potential significance of considering camouflage requirements of a species in human-induced translocations. Thirdly, in an analysis of seasonal effects to camouflage, I found no evidence that background-matching in the Tāwharanui population was compromised by differences in body colours between breeding and non-breeding seasons. This is likely because colours associated with intraspecific signalling (i.e. that exhibited age-dependence and sexual dichromatism) were located in the ventral body regions of skinks that would typically be hidden from predators. Finally, across 17 populations, shore skink colouration showed patterns of spatial variation consistent with thermal melanism (thermoregulation) and island syndrome. Despite the strong correlation of maximum

monthly temperature on colours and latitude on colour patterns, I suggest that the significantly darker island populations were caused by a combination of local adaptation (i.e. crypsis) and non-selective forces (e.g., genetic drift). Overall, my thesis provides new insight on how different selection processes maintain dramatic colouration within a species, and marks the first quantitative research on colouration in New Zealand reptiles.

# ACKNOWLEDGEMENTS

The success of one person is never achieved by his or her own, and with this I am the same. I am humbled by the amount of support and opportunities that were given by many people along the way. First and foremost, I would like to thank my supervisors, Jim Dale, Devi Stuart-Fox and Dianne Brunton. Their continual encouragement, support, and advices have been extremely valuable. I feel like I have grown a lot professionally from the lessons I learned from them during this candidacy. I express my gratitude for the fees scholarship support from INMS (Gaven Martin) during my candidacy.

There are many (people and institutions) who gave a variety of support in different parts of my study:

Chapter Two: We thank field volunteers for help and support: Massey University (MU) Albany ecology group (C. Wedding, B. Barr, M. Barry, M. Delaney, D. van Winkel); Auckland Regional Council (ARC): G. Ussher, M. Maitland; Tāwharanui Open Sanctuary Society Inc.; Supporters Of Tiritiri Matangi; Department of Conservation (DOC); Ngäti Manuhiri; Ngäti Paoa; and Ngäti Whanaunga. We also thank J. Endler for Matlab scripts used for photo calibration. Work was approved under MU Animal Ethics (MUAE07/113), DOC wildlife translocation permit (DOCDM-73616) and ARC research permit 2005. This work was supported by the by Auckland Regional Council and Massey University. M. Baling was also funded by Supporters Of Tiritiri Matangi staff grant (2007), James-Sharon Watson Conservation Trust (2007), Lovell and Bery Clark Scholarship (2014) and Claude McCarthy Fellowship (2014).

Chapter Three: We thank for all help and support given by field volunteers, Massey University Albany ecology research group (C. Wedding, B. Barr, M. Barry, M. Delaney, D. van Winkel), Auckland Council (G. Ussher, M. Maitland); Tāwharanui Open Sanctuary Society Inc., Department of Conservation, Ngäti Manuhiri, & Ngäti Paoa. We also thank J. Endler for Matlab scripts used for photo calibration; T. Bowala, and Y. Yildrim for constructive comments. Project funding was provided by Auckland Council. M.B. was supported by James-Sharon Watson Conservation Trust, Lovell and Bery Clark Scholarship and Claude McCarthy Fellowship.

Chapter Four: We thank for all help and support from staff and volunteers in the field (B. Barr, M. Barry, D. H. Brunton, A. Harmer, C. Wedding, W. Ji, D. van Winkel), volunteers for creating the lizard models (L. Bütikofer, C. Chawla, B. Kreigenhofer, Y. Liu, Naren, O.

Ormano, Y. Yildrim, R. Yulo), D. Thomas for scanning 3D skink model, B. Dixon for 3D printing of the skink replicas, B. Reinke, Auckland Council (M. Maitland), Tāwharanui Open Sanctuary Society Inc, Ngäti Manuhiri, and New Zealand Department of Conservation. Wildlife and animal ethics permits were approved from New Zealand's Department of Conservation (DOCDM-73616, AK-33640-FAU), Auckland Regional Council (research permit 2005), Auckland Council (CS39A) and Massey University Animal Ethics Committee (MUAEC07/113, MUAEC12/26). MB was funded by the Society for Research on Amphibians and Reptiles in New Zealand (SRARNZ) Herpetological Research Award, Lovell and Berys Clark Scholarship, Claude McCarthy Fellowship and Auckland Regional Council. JD was funded by the College of Sciences, Massey University.

Chapter Five: We would like to thank for field volunteers and support: Massey University MU (M. Barry, D.H. Brunton, L. Bütikofer, M. Delaney, B. Evans, J. Laycock, M. Roper, M. Strickett, W. Webb), K. Corbett, D. Craddock, J. Fitter, R. Hallet, S. Hallet, J. Laffont, S. Sinclair, C. Wedding; New Zealand Department of Conservation DOC (L. Adams, G. Atkins, T. Bliss, N. Brown, R. Chappell, B. Kappers, P. Livingstone, J. Lucas, A. Kirk, G. Moorcroft, C. Moretti, K. Owens); Matakohe-Limestone Island (B. Buhler); Auckland Council (M. Maitland, M. Puckett); Bay of Plenty Regional Council; Bream Head Conservation Trust (C. Mitchell, P. Mitchell); EcoQuest Education Foundation (R. Longman-Sinclar, C. Longman-Sinclair); Ngätiwai Trust Board (C. Stone), Ngäti Whatua, Nga Rima O Kaipara, Ngäti Manuhiri, Ngäti Rehua, Ngäti Maru, Ngati Whanaunga, Ngäti Awa and Rurima Trust (B. Hughes, D. Hunia, TK Merito); NIWA (A. Tait, B. Liley); Ecogene (J. Allwood, R. Howitt, F. Molinia). We also thank D. Aguirre and L. Liggins for stats analyses advice; and Y. Yildrim and D. Pang for constructive comments. Work was approved under DOC permit AK-33640-FAU, Auckland Council Research Permit CS39, and MU Animal Ethics Committee no. 12/26. M. Baling was funded by Harriette Jenkins Award 2012, New Zealand Federation of Graduate Women Postgraduate Fellowship 2013, Lovell and Bery Clark Scholarship 2014, and the Institute of Natural and Mathematical Sciences.

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I would like to give my thanks to others that gave alternate means of support, their company, the many talks and discussions through the years: Theresa Alipia, David Aguirre, Christophe Amiot, Pete Anderson, Daryl Andrews, Manuela Barry, Tharu Bowala, Luca Butikofer, Chavi Chawla, Elena Colombi, Cheryl Cross, Vanessa Cross, Vesna Davidovic, Catia Demilglio, Natasha Dougherty, Chaitanya Gokhale, Aaron Harmer, Heather Hendrickson, Weihong Ji, Colleen Keelty, Brigitte Kreigenhofer, Hayley Kim, Vicky Kim,

Jenny Laycock, Libby Liggins, Yunhao Liu, Anil Malhotra, Honour McCann, Freda McKisch, Naren, Luis Ortiz Catedral, Kevin Parker,Matt Pawley, Jo Peace, Philippe Remigi, Jessica Patino, Michelle Roper, Caroline Rose, Araceli Samaniego, Evelyn Sattlegger, Idan and Dana Shapira, Su Sinclair, Karen Stockin, Christina Straub, Daniel Thomas, Wesley Webb, Jacqui Wairepo, Annette Warbrooke, Chris Wedding, Anne Wignall, Mike Yap, Yeserin Yildrim, and Megan Young. Extra thank yous to Deborah Pang, Tharu Bowala and Yeserin Yildrim for all those last edits to the manuscripts!

Not forgetting the rock climbing crew who kept my sanity in check: Christie Ahn, Doug Atkinson, Gabriella Beans, Foo Hui Chien, Kenja Fyers, Micah Fyers, Peter Ham, Richard Kim, Brigitte Kreigenhofer; Manu Lange, Zhuowei Lim, Debra Pang, Geoffrey Shen, Victor Savelyev, Jenny Shim, James Speedy, Kyu Shim, Jung Hoo Shin, Yeserin Yildrim. Thank you for all the fun climbing/ bouldering sessions and unforgettable trips.

A special thank you to my family: my parents, Barling Layat Supen and Florence Leong, who have greatly influenced my curiosity of life, love of nature, science and education. Thank you for your unconditional support in everything that I do. My brothers, Robin Barling and Ewen Barling, what would I do without your company, and conversations on food and pop culture. Finally, to Richard Kim, the one who has been giving his support every other way that he can. Thank you for being on-belay: accompanying me during my late night writes, catching when I fall, and constantly checking that that I have enough to eat, exercise and rest, especially in the last legs of this journey.

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