

Gordon Drummond Hastie

Sea Mammal Research Unit, University of St Andrews

PROFILE

I am a highly experienced marine scientist with over 25 years' experience studying the behaviour and physiology of marine predators. My research seeks to understand the behaviour and foraging mechanisms of predators in dynamic habitats, and the impacts of human activities on animals. I have developed the practical, management, and analytical skills required to lead multi-disciplinary research programs, and have a proven track record of securing funding and publishing in scientific journals.

CAREER HISTORY

Principal Research Fellow and Deputy Director, 2012 – Present
Sea Mammal Research Unit, University of St Andrews

I lead studies of the impacts of anthropogenic activities on marine mammals at the Sea Mammal Research Unit. This includes the impact of anthropogenic structures, their construction, operation and decommissioning, on marine predators, and behavioural responses by marine mammals to a range of underwater sounds. I also study the movements, foraging decisions, and energetics in marine air breathing predators, and have developed a number of remote technologies (e.g., multibeam sonar) for tracking marine animals underwater. Through this research, I maintain active collaborations with researchers from Universities throughout Europe and North America. I have secured funding (£3.2 million) and lead a research group with two full-time research staff and four PhD students. As a senior researcher on seal applied ecology, I am the Home Office License holder for the Sea Mammal Research Unit and provide high level advice to a range of regulatory and Governmental stakeholders.

Senior Research Scientist; SMRU Ltd 2007 – 2012

SMRU Ltd is a marine mammal research consultancy that is wholly owned by the University of St Andrews. My role was to secure and lead research contracts, including environmental impact assessments of anthropogenic activities (e.g. marine renewable devices, active sonar systems, vessels, and pile driving). My work included technical input in EIAs and developing environmental monitoring standards and protocols for a range of stakeholders. Further, I provided advice on the impacts of noise on marine mammals to a range of industrial and regulatory stakeholders, and led the development of analytical techniques to assess the biological consequences of anthropogenic noise on marine mammals. I secured funding (£1,066,900) and hired and line-managed three full-time consultancy staff.

Research Fellow; University of British Columbia 2003 – 2006

As part of an international collaborative study investigating the ecological role of marine predators in the North Pacific, I designed and led a research program to measure the diving energetics and behaviour by marine mammals. This project used trained sea lions in the open ocean; sea lions were trained to carry out a range of experimental tasks at sea. I developed the scientific program for the project and managed the "Open Water Research Station"; a floating laboratory that was a base for all aspects of animal

husbandry, training and research. I secured funding (£620,200), hired and managed 4 members of staff, and led the research team at the facility.

Research Fellow; University of Aberdeen

2001 – 2003

This collaborative study with Cornell Lab of Ornithology into the ecology of cetaceans had three objectives: to understand variation in baleen whale vocal behaviour in relation to environmental and anthropogenic determinants, to map the underwater sound profiles around floating oil production facilities, and to evaluate distribution patterns of odontocetes in relation to oceanographic features.

Research Assistant; University of Aberdeen

1996 – 1997

As part of a study of the aquatic reproductive strategies and acoustic communication of harbour seals, I calculated the underwater locations of vocalizing seals using passive acoustic localization techniques to understand their spatial and temporal distributions. In addition, I helped design a new video analysis technique to measure spatial aspects of animal groups.

Scientific Coordinator; International Fund for Animal Welfare

1994 – 1996

I led boat-based surveys for cetaceans throughout the temperate and tropical Atlantic and was responsible for crewmember training, construction of acoustic equipment, photo ID, and correspondence with local research, and government bodies.

EDUCATION

PhD (Zoology), University of Aberdeen

2002

Fine-scale aspects of habitat use and behaviour of bottlenose dolphins (*Tursiops truncatus*).

My PhD investigated the behaviour and the functional mechanisms underlying habitat use by bottlenose dolphins in highly tidal areas. Patterns of habitat selection and behaviour were measured, and context-specific vocal signals were localised to understand their diving behaviour and foraging mechanisms. The study also informed the conservation and management of dolphins around the UK. I developed a new specialized video montage technique and applied novel passive acoustic techniques to study the surface and diving behaviour of dolphins; as a result, I was awarded the *Frederic Fairfield Prize for Innovation in Marine Mammal Research*.

BSc Zoology, University of Aberdeen

1994

Thesis: Factors affecting the diet of the squid (*Loligo forbesi*) in Scottish waters.

POSITIONS OF RESPONSIBILITY

Animal Welfare and Ethics Committee Member at University of St Andrews

Home Office Project License holder for the Sea Mammal Research Unit

Scientific Committee Member for the Society for Marine Mammalogy

Chair of the Marine Alliance for Science and Technology Marine Renewable Energy Forum

Scientific Judge for the *Frederick Fairfield Award for Innovation* in the Society for Marine Mammalogy.

Reviewer for a wide range of scientific journals including *Aquatic Mammals*, *Biology Letters*, *Deep-Sea Research*, *Endangered Species Research*, *Ethology*, *Journal of Atmospheric and Oceanic Technology*, *Journal of Applied Ecology*, *Journal of Animal Ecology*, *Journal of the Marine Biological Association of the UK*, *Marine Biology*, *Marine Ecology Progress Series*, *Marine Pollution Bulletin*, *Marine Mammal Science*, and *Trends in Ecology and Evolution*.

Deputy Station Officer for HM Coastguard Coast Rescue Team



OTHER QUALIFICATIONS

- 2020 Home Office PPL Training Module.
- 2015 Home Office PIL Training Modules E1, L, and A
- 2011 Advanced Environmental Impact Assessment Certificate.
- 2011 Introduction to Distance Sampling Workshop, CREEM.
- 2009 Statistical Modelling Workshop, CREEM.
- 2008 Personal Survival Techniques Training.
- 2001 HM Coastguard Training – Leadership and Management Course for Station Officers.
- 1998 RYA Advanced Powerboat Certificate (Commercially endorsed).
- 1996 VHF Radio Operators License.
- 1990 Full clean UK driving License.



PUBLICATIONS

2023

Graham, I.M., Gillespie, D., Gkikopoulou, K.C., **Hastie, G.D.** & Thompson, P.M. (2023) Directional hydrophone clusters reveal evasive responses of small cetaceans to disturbance during construction at offshore windfarms. *Biology Letters*, **19**.

2022

Carter, M.I.D., Boehme, L., Cronin, M.A., Duck, C.D., Grecian, W.J., **Hastie, G.D.**, Jessopp, M., Matthiopoulos, J., McConnell, B.J., Miller, D.L., Morris, C.D., Moss, S.E.W., Thompson, D., Thompson, P.M. & Russell, D.J.F. (2022) Sympatric seals, satellite tracking and protected areas. *habitat-based distribution estimates for conservation and management*, **9**.

Gillespie, D.M., Oswald, M., **Hastie, G.D.** & Sparling, C.E. (2022) Marine mammal HiCUP. *a High Current Underwater Platform for the long-term monitoring of fine-scale marine mammal behaviour around tidal turbines*, **9**.

van Geel, N., Marr, T., **Hastie, G.D.** & Wilson, B. (2022) First reported observation of an apparent reproductive bottleneck x Risso's dolphin hybrid. *Aquatic Conservation: Marine and Freshwater Ecosystems*, **Early View**.

Harvey, J., Chudzinska, M., McConnell, B., **Hastie, G.D.** (2022). 'The Harbor Seal: The Most Ubiquitous Phocid in the Northern Hemisphere', in *Ethology and Behavioral Ecology of Phocids*, D.P. Costa and E.A. McHuron, Editors. Springer International Publishing: Cham. p. 363-400. https://doi.org/10.1007/978-3-030-88923-4_10

Findlay, CR, **Hastie, G.D.**, Farcas, A, Merchant, ND, Denise Risch, D, and Wilson, B. 2022. 'Exposure of individual harbour seals and waters surrounding protected habitats to acoustic deterrent noise from aquaculture'. *Aquatic Conservation: Marine and Freshwater Ecosystems*. <https://doi.org/10.1002/aqc.3800>

Gillespie, D, Oswald, M, **Hastie G.** & Sparling, C. 2022 'Marine mammal HiCUP: A High Current Underwater Platform for the long-term monitoring of fine-scale marine mammal behaviour around tidal turbines'. *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2022.850446>

Iorio-Merlo, V, Graham, I, Hewitt, R, Aarts, G, Pirotta, E, **Hastie, G.** & Thompson, P, In press, 'Prey encounters and spatial memory influence use of foraging patches in a marine central place forager', *Proceedings of the Royal Society B - Biological Sciences*. <https://doi.org/10.1098/rspb.2021.2261>

2021

Palmer, LE, Gillespie, DM, MacAulay, JDJ, Sparling, CE, Russell, DJF, **Hastie, G.D.**, 2021, 'Harbour porpoise (*Phocoena phocoena*) presence is reduced during tidal turbine operation', *Aquatic Conservation: Marine and Freshwater Ecosystems*. <http://doi.org/10.1002/aqc.3737>

Coles, D, Angeloudis, A, Greaves, D, **Hastie, G.D.**, Lewis, M, McNaughton, J, Miles, J, Neill, S, Piggott, M, Risch, D, Scott, B, Sparling, CE, Stallard, T, Thies, P, Walker, S, White, D, Wilden, R & Williamson, B 2021, 'A review of the UK and British Channel Islands practical tidal stream energy resource', *Proceedings of the Royal Society A - Mathematical, Physical & Engineering Sciences*. <https://doi.org/10.1098/rspa.2021.0469>

Bønnelycke, E-MS, **Hastie, G.D.**, Bennett, KAA, Kainerstorfer, JM, Milne, R, Moss, SEW, Ruesch, A, Wu, J & McKnight, JC 2021, 'Wearable near-infrared spectroscopy as a physiological monitoring tool for seals under anaesthesia', *Remote Sensing*, vol. 13, no. 18, 3553. <https://doi.org/10.3390/rs13183553>

Gillespie, DM, Palmer, LE, MacAulay, JDJ, Sparling, CE & **Hastie, GD** 2021, 'Harbour porpoises exhibit localized evasion of a tidal turbine', *Aquatic Conservation: Marine and Freshwater Ecosystems*, vol. 31, no. 9, pp. 2459-2468. <https://doi.org/10.1002/aqc.3660>

Onoufriou, JAR, Russell, DJF, Thompson, D, Moss, S & **Hastie, GD** 2021, 'Quantifying the effects of tidal turbine array operations on the distribution of marine mammals: implications for collision risk', *Renewable Energy*, vol. 180, pp. 157-165. <https://doi.org/10.1016/j.renene.2021.08.052>

Hastie, GD, Lepper, P, McKnight, C, Milne, R, Russell, DJF & Thompson, D 2021, 'Acoustic risk balancing by marine mammals: anthropogenic noise can influence the foraging decisions by seals', *Journal of Applied Ecology*, vol. Early View. <https://doi.org/10.1111/1365-2664.13931>

McKnight, C, Ruesch, A, Bennett, K, Bronkhorst, M, Balfour, ST, Moss, S, Milne, R, Tyack, PL, Kainerstorfer, J & **Hastie, GD** 2021, 'Shining new light on sensory brain activation and physiological measurement in seals using wearable optical technology', *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 376, no. 1830. <https://doi.org/10.1098/rstb.2020.0224>

McKnight, C, Mulder, E, Ruesch, A, Kainerstorfer, J, Wu, J, Hakimi, N, Balfour, ST, Bronkhorst, M, Horschig, J, Pernet, F, Sato, K, **Hastie, GD**, Tyack, PL & Schagatay, E 2021, 'When the human brain goes diving: using NIRS to measure cerebral and systemic cardiovascular responses to deep, breath-hold diving in elite freedivers', *Philosophical Transactions of the Royal Society B: Biological Sciences*, vol. 376, no. 1831. <https://doi.org/10.1098/rstb.2020.0349>

2020

Whyte, KF, Russell, DJF, Sparling, CE, Binnerts, B & **Hastie, GD** 2020, 'Estimating the effects of pile driving sounds on seals: pitfalls and possibilities', *Journal of the Acoustical Society of America*, vol. 147, no. 6, pp. 3948-3958. <https://doi.org/10.1121/10.0001408>

Gillespie, D, Palmer, L, MacAulay, J, Sparling, C & **Hastie, G** 2020, 'Passive acoustic methods for tracking the 3D movements of small cetaceans around marine structures', *PLoS ONE*, vol. 15, no. 5, e0229058. <https://doi.org/10.1371/journal.pone.0229058>

2019

Hastie, GD, Wu, G-M, Moss, S, Jepp, P, MacAulay, JDJ, Lee, A, Sparling, CE, Evers, CHM & Gillespie, DM 2019, 'Automated detection and tracking of marine mammals: a novel sonar tool for monitoring effects of marine industry', *Aquatic Conservation: Marine and Freshwater Ecosystems*, vol. 29, no. S1, pp. 119-130. <https://doi.org/10.1002/aqc.3103>

Hastie, G, Merchant, N, Goetz, T, Russell, DJF, Thompson, P & Janik, VM 2019, 'Effects of impulsive noise on marine mammals: investigating range-dependent risk', *Ecological Applications*, vol. 29, no. 5, e01906. <https://doi.org/10.1002/eap.1906>

Onoufriou, J, Brownlow, A, Moss, S, **Hastie, G** & Thompson, D 2019, 'Empirical determination of severe trauma in seals from collisions with tidal turbine blades', *Journal of Applied Ecology*, vol. Early View. <https://doi.org/10.1111/1365-2664.13388>

Hastie, GD, Bivins, M, Coram, A, Gordon, J, Jepp, P, MacAulay, J, Sparling, C & Gillespie, D 2019, 'Three-dimensional movements of harbour seals in a tidally energetic channel: application of a novel sonar tracking system', *Aquatic Conservation: Marine and Freshwater Ecosystems*, vol. 29, no. 4, pp. 564-575. <https://doi.org/10.1002/aqc.3017>

2018

Hastie, GD, Russell, DJF, Lepper, P, Elliott, J, Wilson, B, Benjamins, S & Thompson, D 2018, 'Harbour seals avoid tidal turbine noise: implications for collision risk', *Journal of Applied Ecology*, vol. 55, no. 2, pp. 684-693. <https://doi.org/10.1111/1365-2664.12981>

2017

Jones, EL, **Hastie, GD**, Smout, S, Onoufriou, J, Merchant, ND, Brookes, KL & Thompson, D 2017, 'Seals and shipping: quantifying population risk and individual exposure to vessel noise', *Journal of Applied Ecology*, vol. 54, no. 6, pp. 1930-1940. <https://doi.org/10.1111/1365-2664.12911>

Southall, B, Quick, NJ, **Hastie, GD**, Tyack, PL & Boyd, IL 2017, 'Mitigation of harm during a novel behavioural response study involving active sonar and wild cetaceans', *Journal of Cetacean Research and Management*, vol. 16, pp. 29-38.

Benjamins, S, van Geel, N, **Hastie, G**, Elliott, J & Wilson, B 2017, 'Harbour porpoise distribution can vary at small spatiotemporal scales in energetic habitats', *Deep Sea Research Part II: Topical Studies in Oceanography*, vol. 141, pp. 191-202. <https://doi.org/10.1016/j.dsr2.2016.07.002>

Graham, I, Pirotta, E, Merchant, N, Farcas, A, Barton, T, Cheney, B, **Hastie, GD** & Thompson, P 2017, 'Responses of bottlenose dolphins and harbor porpoises to impact and vibration piling noise during harbor construction', *Ecosphere*, vol. 8, no. 5, e01793. <https://doi.org/10.1002/ecs2.1793>

Rosen, D, Hindle, A, Fahlman, A, Gerlinsky, C, Goundie, E, **Hastie, GD**, Volpov, B & Trites, A 2017, 'Physiological constraints and energetic costs of diving behaviour in marine mammals: a review of studies using trained Steller sea lions diving in the open ocean', *Journal of Comparative Physiology B: Biochemical, Systems, and Environmental Physiology*, vol. 187, no. 1, pp. 29-50. <https://doi.org/10.1007/s00360-016-1035-8>

2016

Lucke, K, **Hastie, GD**, Ternes, K, McConnell, BJ, Moss, S, Russell, DJ, Weber, H & Janik, VM 2016, 'Aerial low frequency hearing in captive and free-ranging harbour seals (*Phoca vitulina*) using auditory brainstem responses', *Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioral Physiology*, vol. 202, no. 12, pp. 859-868. <https://doi.org/10.1007/s00359-016-1126-8>

Hastie, GD, Russell, DJ, Benjamins, S, Moss, S, Wilson, B & Thompson, D 2016, 'Dynamic habitat corridors for marine predators: intensive use of a coastal channel by harbour seals is modulated by tidal currents', *Behavioral Ecology and Sociobiology*, vol. 70, no. 12, pp. 2161-2174. <https://doi.org/10.1007/s00265-016-2219-7>

Russell, DJF, **Hastie, GD**, Thompson, D, Janik, VM, Hammond, PS, Scott-Hayward, LAS, Matthiopoulos, J, Jones, EL & McConnell, BJ 2016, 'Avoidance of wind farms by harbour seals is limited to pile driving activities', *Journal of Applied Ecology*, vol. 53, no. 6, pp. 1642-1652. <https://doi.org/10.1111/1365-2664.12678>

Hastie, GD, Russell, DJF, McConnell, BJ, Thompson, D & Janik, VM 2016, 'Multiple-pulse sounds and seals: results of a harbour seal (*Phoca vitulina*) telemetry study during windfarm construction', *Advances in Experimental Medicine and Biology*, vol. 875, pp. 425-430. https://doi.org/10.1007/978-1-4939-2981-8_50

Onoufriou, J, Jones, EL, **Hastie, GD** & Thompson, D 2016, Investigations into the interactions between harbour seals (*Phoca vitulina*) and vessels in the inner Moray Firth. *Scottish Marine and Freshwater Science*, no. 24, vol. 74, Scottish Government. <https://doi.org/10.7489/1805-1>

1998 - 2015

Benjamins, S, Dale, A, **Hastie, GD**, Waggitt, J, Lea, M-A, Scott, B & Wilson, B 2015, Confusion reigns? A review of marine megafauna interactions with tidal-stream environments. in RN Hughes, DJ Hughes, IP Smith & AC Dale (eds), *Oceanography and Marine Biology: An Annual Review*, vol. 53, CRC Press, pp. 1-54. <https://doi.org/10.1201/b18733-2>

Hastie, GD, Russell, DJF, McConnell, BJ, Moss, S, Thompson, D & Janik, VM 2015, 'Sound exposure in harbour seals during the installation of an offshore wind farm: predictions of auditory damage', *Journal of Applied Ecology*, vol. 52, no. 3, pp. 631-640. <https://doi.org/10.1111/1365-2664.12403>

Russell, DJF, Brasseur, S, Thompson, D, **Hastie, GD**, Janik, VM, Aarts, G, McClintock, BT, Matthiopoulos, J, Moss, S & McConnell, BJ 2014, 'Marine mammals trace anthropogenic structures at sea', *Current Biology*, vol. 24, no. 14, pp. R638-R639. <https://doi.org/10.1016/j.cub.2014.06.033>

Wilson, LJ, Burrows, M, **Hastie, GD** & Wilson, B 2014, 'Temporal variation and characterization of grunt sounds produced by Atlantic cod *Gadus morhua* and pollack *Pollachius pollachius* during the spawning season', *Journal of Fish Biology*, vol. 84, no. 4, pp. 1014-1030. <https://doi.org/10.1111/jfb.12342>

Hastie, GD, Donovan, CR, Gotz, T & Janik, VM 2014, 'Behavioral responses by grey seals (*Halichoerus grypus*) to high frequency sonar', *Marine Pollution Bulletin*, vol. 79, no. 1-2, pp. 205-210. <https://doi.org/10.1016/j.marpolbul.2013.12.013>

Hastie, GD, Gillespie, DM, Gordon, JCD, MacAulay, JDJ, McConnell, BJ & Sparling, CE 2014, Tracking technologies for quantifying marine mammal interactions with tidal turbines: pitfalls and possibilities. in M Shields & A Payne (eds), *Marine Renewable Energy Technology and Environmental Interactions*. Humanity and the Sea, Springer Science and Business Media, Dordrecht. https://doi.org/10.1007/978-94-017-8002-5_10

Thompson, PM, **Hastie, GD**, Nedwell, J, Barham, R, Brookes, KL, Cordes, LS, Bailey, H & McLean, N 2013, 'Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population', *Environmental Impact Assessment Review*, vol. 43, pp. 73-85. <https://doi.org/10.1016/j.eiar.2013.06.005>

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Pirotta, E, Milor, R, Quick, NJ, Moretti, D, Dimarzio, N, Tyack, PL, Boyd, I & **Hastie, GD** 2012, 'Vessel noise affects beaked whale behavior: Results of a dedicated acoustic response study', *PLoS One*, vol. 7, no. 8, e42535. <https://doi.org/10.1371/journal.pone.0042535>

- Sayigh, L, Quick, NJ, **Hastie, GD** & Tyack, PL 2012, 'Repeated call types in short-finned pilot whales, *Globicephala macrorhynchus*.', *Marine Mammal Science*. <https://doi.org/10.1111/j.1748-7692.2012.00577.x>
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- Fahlman, A, **Hastie, GD**, Rosen, DAS, Naito, Y & Trites, AW 2008, 'Buoyancy does not affect diving metabolism during shallow dives in Steller sea lions *Eumetopias jubatus*', *Aquatic Biology*, vol. 3, no. 2, pp. 147-154. <https://doi.org/10.3354/ab00074>
- Rosen, D, Fahlman, A, Trites, A & **Hastie, G** 2007, 'Laboratory studies in wildlife conservation: The case of the Steller sea lion', *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*, vol. 146, no. 4, pp. S84-S84. <https://doi.org/10.1016/j.cbpa.2007.01.111>
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- Fahlman, A, **Hastie, GD**, Rosen, DAS & Trites, AW 2007, 'The influence of buoyancy on diving metabolism of Steller sea lions (*Eumetopias jubatus*)', *FASEB Journal*, vol. 21, no. 5, pp. A593-A594.
- Hastie, GD**, Rosen, DAS & Trites, AW 2006, 'The influence of depth on a breath-hold diver: Predicting the diving metabolism of Steller sea lions (*Eumetopias jubatus*)', *Journal of Experimental Marine Biology and Ecology*, vol. 336, no. 2, pp. 163-170. <https://doi.org/10.1016/j.jembe.2006.05.004>
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