Curriculum Vitae

Douglas S. Fudge, Ph.D.

Professor
Schmid College of Science and Technology
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Education

NSERC Postdoctoral Fellowship (2003-2005)
University of British Columbia, Vancouver, Canada
Department of Cellular and Physiological Sciences
Project title: Intermediate filament mechanics in epithelia.
Postdoctoral supervisor: A Wayne Vogl

Ph.D. Zoology (2002)
Dept of Zoology, University of British Columbia, Vancouver, Canada
Dissertation title: The biomechanics of intermediate filament-based materials - Insights from hagfish slime threads.
Thesis supervisor: John M Gosline, FRSC

M.Sc. Zoology (1996)
Dept of Zoology, University of Guelph, Ontario, Canada
Thesis title: Anatomical and biochemical adaptation to visceral endothermy in the bluefin tuna (*Thunnus thynnus*).
Thesis supervisors: E Don Stevens and James S Ballantyne

M.A.T Science & Math Education (1992)
Cornell University, Ithaca, NY USA

B.A. Biological Sciences (1991)
Cornell University, Ithaca, NY USA

Research Focus

Research in my lab is focused on the organismal biology of hagfishes. Our work is multi-disciplinary and integrative, employing concepts and methods from biomechanics, physiology, cell biology, proteomics, materials science, and engineering. While our main focus is fundamental, discovery-based research, some of our findings have inspired practical applications, and biomimetic projects are now a major source of funding and inquiry in my lab.

Refereed Publications (2012-)

Fudge DS, Lee J, Guillen K, Donatelli C, Lowe A, Arnold L, Kahale-Lua K, Quinteros C, Ly P, Atkins L, Bressman N, McCord C (2024) Biphasic burrowing in Atlantic hagfish (*Myxine limosa*). In press at the *Journal of Experimental Biology*.

Mincarone M, Fernholm B, and Fudge DS (2024) A New Western Atlantic Species of Five-gilled Hagfish (Myxinidae: *Eptatretus*) from the Bahamas. In press at *Ichthyology and Herpetology*.

Taylor L, Chaudhary G, Jain G, Lowe A, Hupe A, Negishi A, Zeng Y, Ewoldt RH, Fudge DS (2023) Mechanisms of gill-clogging by hagfish slime. *Journal of the Royal Society Interface*. 20:20220774.

Zeng Y, Plachetzki DC, Nieders K, Campbell H, Cartee M, Pankey S, Guillen K, and Fudge DS (2023). Epidermal threads reveal the origin of hagfish slime. *Elife*, 12, e81405.

Zeng Y, Petrichko S, Nieders K, Plachetzki D, and Fudge DS (2021) Evolution of a remarkable intracellular polymer and extreme cell allometry in hagfishes. *Current Biology*, 31: 5062-8.

Bressman N and Fudge DS (2021). From reductionism to synthesis: The case of hagfish slime. *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology*, 110610.

Mincarone MM, Plachetzki D, McCord CL, Winegard TM, Fernholm B, Gonzalez CJ, Fudge DS (2021) Review of the hagfishes (Myxinidae) from the Galapagos Islands, with descriptions of four new species and their phylogenetic relationships. *Zoological Journal of the Linnean Society*, 192: 453-474.

Fudge DS and Turko AJ (2020). The best predictions in experimental biology are critical and persuasive. *Journal of Experimental Biology,* 223: jeb231894.

Cerullo A, Allam B, Baer A, Barnes WJP, Barrientos Z, Deheyn DD, Fudge DS, Gould J, Harrington MJ, Holford M, Hung C-S, Jain G, Lai T-Y, Mayer G, Medina M, Monge-Nájera J, Napolitano T, Espinosa EP, Schmidt S, Thompson EM, Braunschweig AB (2020) Comparative animal mucomics: Inspiration for functional materials from a ubiquitous and understudied biopolymer. *ACS Biomaterials Science & Engineering*, 6: 5377-5398.

Fudge DS, Ferraro SN, Siwiecki SA, Hupé A, and Jain G (2020). A new model of hagfish slime mucous vesicle stabilization and deployment. *Langmuir*, 36: 6681–6689.

McCord C, Whiteley E, Liang J, Trejo C, Caputo R, Itehua E; Hasan H, Hernandez S, Jagnandan K, Fudge DS (2020). Dose effects of three

common fish anesthetics on Pacific hagfish (*Eptatretus stoutii*). *Fish Physiology and Biochemistry,* Jan 18: 1-13.

Jain G, Starksen M, Singh K, Hoang C, Yancey P, McCord C, and Fudge DS (2019). High concentrations of trimethylamines in slime glands inhibit skein unraveling in Pacific hagfish. *Journal of Experimental Biology* 222, doi: 10.1242/jeb.213793.

Black KL, Fudge D, Jarvis, WM, & Robinson BW (2019). Functional plasticity in lamellar autotomy by larval damselflies in response to predatory larval dragonfly cues. *Evolutionary Ecology*, 33, 257-272.

Bernards Jr., MA, Schorno S, McKenzie E, Winegard, TM, Oke I, Plachetzki D & Fudge, DS (2018). Unraveling inter-species differences in hagfish slime skein deployment. *Journal of Experimental Biology*, 221, 1-11.

Chaudhary G, Fudge DS, Macias- Rodriguez; Ewoldt RH (2018) Concentration-independent mechanics and structure of hagfish slime. *Acta Biomaterialia*, https://doi.org/10.1016/ j.actbio.2018.08.022

Schorno S, Gillis TE, Fudge DS (2018) Cellular mechanisms of slime gland refilling in Pacific hagfish (*Eptatretus stoutii*). *Journal of Experimental Biology* jeb-183806.

Schorno S, Gillis TE, Fudge DS (2018) Emptying and refilling of slime glands in Atlantic (*Myxine glutinosa*) and Pacific (*Eptatretus stoutii*) hagfishes. *Journal of Experimental Biology* jeb-172254.

Boggett S, Stiles JL, Summers AP, Fudge DS (2017) Flaccid skin protects hagfishes from shark bites. *Journal of The Royal Society Interface* 14:20170765.

Soomro A, Alsop RJ, Negishi A, Kreplak L, Fudge DS, Kuczmarski ER , Goldman RD, Rheinstadter MC (2017) Giant axonal neuropathy alters the structure of keratin intermediate filaments in human hair. *J Roy Soc Interface* 14 20170123.

Freedman C and Fudge DS (2017). Hagfish Houdinis: biomechanics and behavior of squeezing through small openings. *Journal of Experimental Biology* 220: 822-7.

Turko AJ, Kültz D, Fudge DS, Croll RP, Smith FM, Stoyek MR, and Wright PA (2017) Skeletal stiffening in an amphibious fish out of water is a response to increased body weight. *Journal of Experimental Biology* 220:3621-31.

Fudge DS and Schorno S (2016) The hagfish gland thread cell: a fiber-producing cell involved in predator defense. *Cells*. 5: 25.

Icardo JM, Colvee E, Schorno S, Lauriano ER, Fudge DS, Glover CN, and Zaccone G (2016) Morphological analysis of the hagfish heart. I. The ventricle, the arterial connection and the ventral aorta. *Journal of Morphology* 277: 326-40.

Icardo JM, Colvee E, Schorno S, Laureano ER, Fudge DS, Glover CN, and Zaccone G (2016) Morphological analysis of the hagfish heart. II. The venous pole and the pericardium. *Journal of Morphology* 277: 853–865.

Weatherbee-Martin N, Xu L, Hupe A, Kreplak L, Fudge DS, Liu XQ and Rainey JK (2016) Identification of wet-spinning and post-spin stretching methods amenable to recombinant spider aciniform silk. *Biomacromolecules* 17: 2737-46.

Zaccone G, Fudge D, Winegard T, Capillo G, Kuciel M, Funakoshi K and Lauriano E (2015) Confocal imaging and phylogenetic considerations of the subcutaneous neurons in the Atlantic hagfish *Myxine glutinosa*. *Acta Zoologica* 96: 209-217.

Fudge DS, Schorno S, Ferraro S (2015) Physiology, biomechanics, and biomimetics of hagfish slime. *Annual Review of Biochemistry* 84: 947-67.

Won G-J, Fudge DS, Choh V (2015) The effects of actomyosin disruptors on the mechanical integrity of the avian crystalline lens. *Molecular Vision* 21: 98-109. (citations: 5)

Winegard TM, Herr JE, Mena C, Lee B, Dinov I, Bird D, Bernards M, Hobel S, Van Valkenburgh B, Toga A & Fudge DS (2014) Coiling and maturation of a high performance fibre in hagfish slime gland thread cells, *Nature Communications* 5: 3534.
Featured on websites io9, phys.org, EurekaAlert!, Science Daily, and Science Newsline.

Herr JE, Clifford A, Goss GG, and Fudge DS (2014) Defensive slime formation in Pacific hagfish requires Ca^{2+} and aquaporin mediated swelling of released vesicles, *Journal of Experimental Biology* 217: 2288-96.

Bernards MA, Oke I, Heyland A and Fudge DS (2014) Spontaneous unraveling of hagfish slime thread skeins is mediated by a seawater-soluble protein adhesive, *Journal of Experimental Biology* 217: 1263-68.
Featured in J Exp Biol column, Inside JEB, "Adhesive constrains hagfish thread skeins."

Pinto N, Negishi A, Yang F-C, Rheinstadter M, Gillis TE, and Fudge DS (2014) Self-assembly enhances the strength of fibres made from vimentin intermediate filament proteins, *Biomacromolecules* 15: 574-581.

Gleason JE, Fudge DS and Robinson B (2014) Eco-mechanics of lamellar autotomy in larval damselflies, *Journal of Experimental Biology* 217: 185-91.
Featured in J Exp Biol column, Inside JEB, "Damselfly larvae select quick release lamellae for survival."

Greenberg DA and Fudge DS (2012) Regulation of hard a-keratin mechanics via control of intermediate filament hydration: Matrix squeeze revisited. *Proc Roy Soc B* 280: 20122158.

Negishi A, Armstrong CL, Kreplak L, Rheinstadter MC, Lim L-T, Gillis, TE, and Fudge DS (2012) The production of fibers and films from solubilized hagfish slime thread proteins. *Biomacromolecules* 13: 3475–82. (citations: 25)
Featured on NOVA show "Making Stuff" with David Pogue (Oct 23, 2013), Discovery Channel show "Daily Planet" and on the following websites: BBC, New Scientist, Science Friday, Scientific American, Discovery News, Smithsonian, Yahoo! News, Science Daily, Tech News Daily.

Beriault DR, Haddad O, McCuaig JV, Robinson ZJ, Russell D, Lane EB, and Fudge DS (2012) The Mechanical behavior of mutant K14-R125P keratin bundles and networks in NEB-1 keratinocytes, *PLoS ONE* 7(2) e31320.

Funding (2017-)

Date	Agency	Title	Total Amt	Duration	Co-applicants
2023	DARPA	Designing novel materials inspired by hagfish predator defense	$638,788	1 yr	Randy Ewoldt Sameh Tawfick
2021	DARPA	Designing novel materials inspired by hagfish predator defense	CA$991,614	1.5 yrs	Randy Ewoldt Sameh Tawfick
2021	National Science Foundation	Covid supplement to IOS-1755397, Biogenesis and evolution of hagfish slime and slime glands	CA$45,965	1 yr	
2021	National Science Foundation	REPS supplment to IOS-1755397, Biogenesis and evolution of hagfish slime and slime glands	CA$59,515	1 yr	
2020	US Navy	Serco MVSOT Support for hagfish tests	$310,693	1 yr	

2020	National Science Foundation	RET supplement to IOS-1755397, Biogenesis and evolution of hagfish slime and slime glands	CA$28,000	1 yr	Tara Barnhart
2020	Chapman University	On-Campus Conference Award for SICB Regional Meeting	CA$6,180	1 yr	Patricia Lopes
2020	Chapman University	Bio-inspiration for the next generation of firefighting technologies	CA$15,000	1 yr	
2019	US Navy	Serco MVSOT Support for hagfish tests	CA$337,354	1 yr	
2019	Gregg Marine, Signal Hill, CA, USA	Hagfish slime biomimetics	CA$29,000	1 yr	
2019	Kimberly-Clark	Hagfish slime storage, deployment, and structure	CA$161,327	1 yr	
2018	LabArchives	Electronic Lab Notebook Developmental Grant	CA$6,200	5 yrs	
2018	National Science Foundation	Biogenesis and evolution of hagfish slime and slime glands	CA$420,079	3 yrs	D Plachetzki
2018	US Navy	ALION MVSOT Support for hagfish tests	CA$301,560	1 yr	
2017	Kimberly-Clark	Hagfish slime storage, deployment, and structure	CA$136,984	1 yr	

Recent Service (2019-)

NTT-Biology Faculty search committees (2023). Chaired two successful search committees for NTT Biology faculty in Schmid College.

Committee to create a new integrated MS program in Biology/ Schmid College (2019-2023). Chaired a committee to explore the possibility of creating a new Masters program in Biology at

Chapman University. Currently serving on a college-wide committee to develop a new program and submit for approval.

Southwest Organismal Biologists meeting, Co-Chair (2021). Patricia Lopes and I organized a regional SICB meeting in October 2021 on the Chapman University campus. The meeting included 110 attendees, with many undergraduates giving their first presentation at a science conference. We received for over $7k in funding for this conference, which allowed us to offer it for free to all attendees.

Shoals Marine Lab Alumni and Friends Association Recruitment Committee, Chair (2019-2023). I lead this committee, which consults with Shoals Lab leadership on a variety of issues. During my time as chair, I have focused on the goal of increasing the diversity of students, faculty and staff at the Shoals Lab.

Faculty Review Committee, Schmid College, Co-Chair (2019-2021). I co-chaired this committee from 2019-2021.