

# Eric D. Tytell

## Curriculum Vitae

Department of Biology  
Tufts University  
200 Boston Ave., Suite 4700  
Medford, MA 02155

617-627-0312  
eric.tytell@tufts.edu  
<http://ase.tufts.edu/biology/faculty/tytell/>

### Education

- Ph.D., Biology** **2005**  
*Department of Organismic and Evolutionary Biology, Harvard University*  
Supervisor: Dr. George V. Lauder.
- M.Phil., Zoology** **1999**  
*Department of Zoology, University of Cambridge*  
Supervisor: Dr. Charles P. Ellington
- B.A., Biology and Physics (Highest honors)** **1998**  
*Department of Biology, University of North Carolina at Chapel Hill*  
Supervisor: Dr. William M. Kier

### Professional Experience

- Assistant Professor** **2012 - present**  
*Department of Biology, Tufts University*
- Assistant Research Scientist** **2010 - 2012**  
*Department of Mechanical Engineering, Johns Hopkins University*
- Faculty Research Associate** **2005 – 2010**  
*Institute for Systems Research, Department of Biology, University of Maryland, College Park*  
Post-doctoral fellowship in the laboratory of Dr. Avis H. Cohen. Supported by an NIH National Research Service Award.
- Freelance Science Writer** **2004 – present**  
Authored stories published in the Los Angeles Times, Boston Globe, New Scientist (London, UK), Journal of Experimental Biology (Cambridge, UK)
- Staff Writer, Los Angeles Times, Los Angeles, CA** **2004 (summer)**  
Wrote 21 published stories as a fellow on the science desk. Sponsored by the AAAS Mass Media Fellowship.
- Director of Fluid Dynamics, Nekton Technologies, Inc., Durham, NC** **1999 – 2000**  
Supervised testing of a novel biomimetic submarine.

### Peer-reviewed publications (*h* index = 18)

1. Franklin A.M.<sup>†</sup>, Donatelli C.M.<sup>†</sup>, Tytell E.D. (2018). Meral spot total reflectance signals weapon performance in the mantis shrimp *Neogonodactylus oerstedii* (Stomatopoda). *Biol. Bull.* in press.
2. Tytell E.D., Carr J.A., Danos N., Wagenbach C.<sup>†</sup>, Sullivan C.M., Kiemel T., Cowan N.J., Ankarali M.M. (2018). Body stiffness and damping depend sensitively on the timing of muscle activation in lampreys. *Integr. Comp. Biol.* online. doi: 10.1093/icb/icy042.
3. Hoover, A. P., Cortez, R., Tytell, E. D. and Fauci, L. J. (2018). Swimming performance, resonance, and shape evolution in heaving flexible panels. *J. Fluid Mech.* **847**: 386-416. doi: 10.1017/jfm.2018.305.

4. Mekdara, P. J.<sup>†</sup>, Schwalbe, M. A. B., Coughlin, L. L.\* and Tytell, E. D. (2018). The effects of lateral line ablation and regeneration in schooling giant danios. *J. Exp. Biol.* **221**: online. doi: 10.1242/jeb.175166
5. Donatelli C. M.<sup>†</sup>, Summers A. P., Tytell E. D. (2017). Long axis twisting during locomotion of elongate fishes. *J. Exp. Biol.* 220:3632–40. doi: 10.1242/jeb.156497. (cited 1 time)
6. Massarelli N., Yau A. L.\*, Hoffman K. A., Kiemel T., Tytell E. D. (2017). Characterization of the encoding properties of intraspinal mechanosensory neurons in the lamprey. *J. Comp. Physiol. A* 203:831–41. doi: 10.1007/s00359-017-1196-2.
7. Tytell, E. D., Leftwich, M. C., Hsu, C.-Y., Griffith, B. E., Cohen, A. H., Smits, A. J., Hamlet, C. and Fauci, L. J. (2016). The role of body stiffness in undulatory swimming: Insights from robotic and computational models. *Phys. Rev. Fluids* **1**, 73202. doi: 10.1103/PhysRevFluids.1.073202. (cited 9 times)
8. Massarelli, N., Yau, A.\*, Hoffman, K., Kiemel, T. and Tytell, E. D. (2016). Understanding Locomotor Rhythm in the Lamprey Central Pattern Generator. In *Advances in the Mathematical Sciences* (ed. Letzter, G., Lauter, K., Chambers, E., Flournoy, N., Grigsby, J. E., Martin, C., Ryan, K., and Trivisa, K.), pp. 157–172. Cham: Springer International Publishing. doi: 10.1007/978-3-319-34139-2\_6.
9. Hamlet, C., Fauci, L. J. and Tytell, E. D. 2015. The effect of intrinsic muscular nonlinearities on the energetics of locomotion in a computational model of an anguilliform swimmer. *J. Theor. Biol.* **385**, 119–129. doi: 10.1016/j.jtbi.2015.08.023. (cited 9 times)
10. Maia, A., Sheltzer, A. P.\* and Tytell, E. D. 2015. Streamwise vortices destabilize swimming bluegill sunfish (*Lepomis macrochirus*). *J. Exp. Biol.* 281, 786–792. doi: 10.1242/jeb.114363. (cited 4 times)
11. Tytell, E.D., Hsu, C.-Y., and Fauci, L.J. 2014. The role of mechanical resonance in the neural control of swimming in fish. *Zoology* 117, 48–56. doi: 10.1016/j.zool.2013.10.011. (cited 16 times)
12. Miller, L.A., Goldman, D.I., Hedrick, T.L., Tytell, E.D., Wang, Z.J., Yen, J., and Alben, S. 2012. Using computational and mechanical models to study animal locomotion. *Integ. Compar. Biol.* 52, 553–575. doi: 10.1093/icb/ics115. (cited 28 times)
13. Borazjani, I., Sotiropoulos, F., Tytell, E. D., and Lauder, G. V. 2012. Hydrodynamics of the bluegill sunfish C-start escape response: three-dimensional simulations and comparison with experimental data. *J. Exp. Biol.* 215, 671–684. doi: 10.1242/jeb.063016. (cited 54 times)
14. Leftwich, M. C., Tytell, E. D., Cohen, A. H., and Smits, A. J. 2012. Wake structures behind a swimming robotic lamprey with a passively flexible tail. *J. Exp. Biol.* 215, 416–425. doi: 10.1242/jeb.061440. (cited 39 times)
15. Tytell, E.D., Holmes, P., and Cohen, A.H. 2011. Spikes alone do not behavior make: Why neuroscience needs biomechanics. *Curr.Op.Neurobio.*, 21, 816-822. doi: 10.1016/j.conb.2011.05.017. (cited 49 times)
16. Previte, J. P., Sheils, N., Hoffman, K. A., Kiemel, T. & Tytell, E. D. 2011. Entrainment ranges of forced phase oscillators. *J.Math.Biol.*, 62, 589-603. doi: 10.1007/s00285-010-0348-6. (cited 2 times)
17. Tytell, E. D. 2011. Experimental hydrodynamics. In *Encyclopedia of Fish Physiology: From Genome to Environment*, (ed. A. P. Farrell). San Diego: Elsevier. 535-546. doi: 10.1016/B978-0-1237-4553-8.00218-5.
18. Tytell, E. D., Hsu, C.-Y., Williams, T. L., Cohen, A. H. & Fauci, L. J. 2010. Interactions between body stiffness, muscle activation, and fluid environment in a neuromechanical model of lamprey swimming. *Proc.Nat.Acad.Sci.USA.*, online. doi: 10.1073/pnas.1011564107. (cited 163 times)

19. **Tytell, E. D.**, Borazjani, I., Sotiropoulos, F., Baker, T. V., Anderson, E. J. & Lauder, G. V. **2010a**. Disentangling the functional roles of morphology and motion in fish swimming. *Integr.Comp.Biol.*, 50, 1140-1154. doi: 10.1093/icb/icq057. **(cited 63 times)**
20. Oliphint, P. A., Alieva, N., Foldes, A. E., **Tytell, E. D.**, Lau, B. Y.-B., Pariseau, J. S., Cohen, A. H. & Morgan, J. R. **2010**. Regenerated synapses in lamprey spinal cord are sparse and small even after functional recovery from injury. *J.Comp.Neurol.*, 518, 2854-2872. doi: 10.1002/cne.22368. **(cited 26 times)**
21. Ayali, A., Gelman, S., **Tytell, E. D.** and Cohen, A. H. **2009**. Lateral line activity during swimming-like motion suggests a feedback link in closed-loop control of lamprey swimming. *Can.J.Zool.* 87, 671-683. doi: 10.1139/Z09-050. **(cited 11 times)**
22. **Tytell, E. D.** & Lauder, G.V. **2008**. The hydrodynamics of the escape response in the bluegill sunfish, *Lepomis macrochirus*. *J.Exp.Biol.* 211, 3359-3369. **(cited 93 times)**
23. **Tytell, E. D.** & Cohen, A. H. **2008**. Rostral versus caudal differences in mechanical entrainment of the lamprey central pattern generator for locomotion. *J. Neurophysiol.* 99, 2408-2419. **(cited 25 times)**
24. **Tytell, E. D.**, Standen, E.M., & Lauder, G.V. **2008**. Escaping Flatland: Three-dimensional kinematics and hydrodynamics of median fins in fishes. *J.Exp.Biol.* 211, 187-195. **(cited 60 times)**
25. **Tytell, E. D.** **2007**. Do trout swim better than eels? Challenges for estimating performance based on the wake of self-propelled bodies. *Exp.Fluids.* 43, 701-712. **(cited 60 times)**
26. **Tytell, E. D.** & Alexander, J.K. **2007** Bluegill *Lepomis macrochirus* synchronize pectoral fin motion and opercular pumping. *J.Fish.Biol.* 70: 1268-1279. **(cited 8 times)**
27. Gelman, S., Ayali, A., **Tytell, E. D.**, & Cohen, A.H. **2007** Larval lampreys possess a functional lateral line system. *J.Compar.Physiol.A.* 193: 271-277. **(cited 18 times)**
28. **Tytell, E. D.** **2006** Median fin function in bluegill sunfish, *Lepomis macrochirus*: Streamwise vortex structure during steady swimming. *J.Exp.Biol.* 209, 1516-1534. **(cited 75 times)**
29. Lauder, G. V. & **Tytell, E. D.** **2006** Hydrodynamics of undulatory propulsion. In *Biomechanics of Fishes* (eds. R. E. Shadwick & G. V. Lauder), pp. 425-468. San Diego: Academic Press. **(cited 189 times)**
30. **Tytell, E. D.** **2004a** Kinematics and hydrodynamics of linear acceleration in eels, *Anguilla rostrata*. *Proc.R.Soc.Lond.B* 271, 2535-2541. **(cited 51 times)**
31. **Tytell, E. D.** **2004b** The hydrodynamics of eel swimming. II. Effect of swimming speed. *J.Exp.Biol.* 207, 3265-3279. **(cited 114 times)**
32. **Tytell, E. D.** & Lauder, G. V. **2004** The hydrodynamics of eel swimming. I. Wake structure. *J.Exp.Biol.* 207, 1825-1841. **(cited 276 times)**
33. Lauder, G. V. & **Tytell, E. D.** **2004** Three Gray classics on the biomechanics of animal movement. *J.Exp.Biol.* 207, 1597-1599. **(cited 11 times)**
34. **Tytell, E. D.** & Ellington, C. P. **2003** How to perform measurements in a hovering animal's wake: Physical modelling of the vortex wake of the hawkmoth *Manduca sexta*. *Phil.Trans.R.Soc.Lond.B* 358, 1559-1566. **(cited 18 times)**
35. **Tytell, E. D.** & Lauder, G. V. **2002** The C-start escape response of *Polypterus senegalus*: Bilateral muscle activity and variation during stage 1 and 2. *J.Exp.Biol.* 205, 2591-2603. **(cited 64 times)**

#### ***In preparation***

36. Franklin, A.M., Donatelli, C.M., Culligan, C.\*, **Tytell, E.D.** (2017). Meral spot brightness signals fighting ability in the mantis shrimp *Neogonodactylus oerstedii* (Stomatopoda). *Behav. Ecol.*, submitted.

37. Schwalbe, M.A.B., Boden, A.L.\*, Wise, T.N.\*, **Tytell, E.D.** (2017). Fishes increase effective body stiffness by eccentric muscle contractions during accelerations. *J. Exp. Biol.*, submitted.
38. Wise, T.N.\*, Schwalbe, M.A.B., **Tytell, E.D.** (2017). Hydrodynamics of linear acceleration in bluegill sunfish *Lepomis macrochirus*. *J. Exp. Biol.*, submitted.
39. Hamlet, C., **Tytell, E.D.**, Hoffman, K.A., Fauci, L.J. (2017). The role of curvature feedback in lamprey swimming. *PLoS Comput. Biol.*, submitted.

†Tufts graduate student; \* Tufts undergraduate.

### ***Selected short reviews (31 total)***

- Tytell, E.D. 2013. Powered flight from passively flapping wings. *J.Exp.Biol.* 216(9), vi–vi.
- Tytell, E. D. 2010. I hear with a little help from my friends. *J.Exp.Biol.* 213(15), vi.
- Tytell, E. D. 2009. Do muscle synergies actually work? *J.Exp.Biol.* 212(15), vi.
- Tytell, E. D. 2008. Journal club. *Nature* 456, 679.
- Tytell, E. D. 2008. Insect wings flip for free. *J.Exp.Biol.* 211(3), iv.
- Tytell, E. D. 2007. Insight from deletions. *J.Exp.Biol.* 210(7), vi.
- Tytell, E. D. 2006. Optimizing walking and running. *J.Exp.Biol.* 209(7), v.
- Tytell, E.D. 2005. It's hard to hover at height. *J.Exp.Biol.* 208(7), vi.
- Tytell, E.D. 2004. The cost of bad taste. *J.Exp.Biol.* 207(15), vii–viii.
- Tytell, E. D. 2003. Fish muscle is still helical. *J.Exp.Biol.* 206, 2530.
- Tytell, E.D. 2002. Fish control their rotation. *J.Exp.Biol.* 206(3), 429.

### ***Selected popular science articles (25 total)***

- Tytell, E. D. 2007. The relentless itch. *Los Angeles Times*, 2 Apr., pp. F1, F9.
- Tytell, E. D. 2006. Gone today, hair tomorrow. *Los Angeles Times*, 17 Apr., pp. F1, F10-11.
- Tytell, E.D. 2004. The Fall Guy. *New Scientist*, 25 Dec., pp. 48-49.
- Tytell, E.D. 2004. Repairing the body one thread at a time. *Boston Globe*, 16 Nov., p. C10.
- Tytell, E. D. 2004. A Thorny Tweak for the Rose. *Los Angeles Times*, 13 Aug., pp. A1, A22.

## **Grants and Fellowships**

### **“Quantifying three-dimensional internal and external deformations in flexible organisms during locomotion”** **2017**

*Army Research Office*

Eric Tytell, principal investigator. Major equipment grant for purchasing high speed cameras and equipment for measuring internal deformations in fishes. (\$163,931)

### **“CAREER: BIOMAPS: Comparative analysis of locomotor biomechanics and control in fishes”**

**2017-2022**

*National Science Foundation*

Eric Tytell, principal investigator. Project to study how body shape and mechanical properties in fishes contribute to swimming performance and stability. (\$910,616 over 5 years)

### **“HSAP: Coupling Mechanical and Neural Properties for Effective and Adaptable Locomotion”** **2017**

*Army Research Office*

Eric Tytell, principal investigator. Summer supplement to support undergraduate or high school researchers. (\$6,000 for summer 2017).

**“Dynamic tuning of instabilities for high power movements in deformable structures”** **2016-2021**

*Army Research Office*

Eric Tytell, senior collaborator. Proposal to study mechanical instabilities in animals as a way to power high speed movements. (\$1,881,920 over 5 years).

**“CAREER: The Multi-functional Foot and its Role in Locomotor Control Across a Range of Complex Media”** **2015-2020**

*National Science Foundation*

Eric Tytell, consultant (\$4232 over 5 years). Consulting on development of 3D x-ray particle tracking methods for understanding forces in sand and other granular media.

**“Biomechanical tuning of the functional circuit of the lamprey central pattern generator for locomotion”** **summer 2015**

*Marine Biological Laboratory*

Eric Tytell, principal investigator. Fellowship to support research at the MBL over the summer.

**“Coupling mechanical and neural properties for effective and adaptable locomotion”** **2014-2017**

*Army Research Office*

Eric Tytell, principal investigator. Proposal to examine the stabilizing properties of the nervous system and muscle in swimming fishes. (\$350 366 over 3 years).

**“Neuromuscular control of rapid linear accelerations in fish”** **2014-2015**

*Army Research Office*

Eric Tytell, principal investigator. Proposal to study the mechanics and control of linear accelerations in fish. (\$48 157 over 9 months).

**“Collaborative Research: Sensory feedback loops in a swimming lamprey: Integrating fluid dynamics, body mechanics, and neurophysiology”** **2013-2016**

*National Science Foundation*

Eric Tytell, co-principal investigator. Proposal to study the role of sensory feedback in animal swimming using a computational model of a lamprey. (\$52,970 over 3 years)

**“Locomotor stability in a model swimmer: coupling fluid dynamics, neurophysiology and muscle mechanics”** **2013-2016**

*Army Research Office*

Eric Tytell, co-principal investigator. Proposal to develop computational models of swimming animals. (\$341 588 over 3 years).

**“Cyclical dynamics and control of a neuromechanical system”** **2011-2012**

*Army Research Office*

Eric Tytell, principal investigator. Examines how rhythmic neural and mechanical systems respond to perturbations (\$49 797 over 9 months).

**“Multisensory Integration in MSTd for Navigation and Control”** **2011-2014**

*Office of Naval Research*

Eric Tytell, co-investigator. Proposal to examine multisensory integration and closed-loop control of movement in primate cortex (\$751 925 over 3 years).

**“Neuromechanics and dynamics of locomotion”** **2011-2016**

*National Science Foundation, Research Coordination Networks, Biological Infrastructure*

Eric Tytell, steering committee. Proposal to develop a network for collaborations in biology and mathematics (\$489 290 over 5 years).

- “Biomechanics and the lamprey central pattern generator”** **2005 – 2008**  
*National Institutes of Health, National Research Service Award (1 F32 NS054367)*  
 Eric Tytell, PI. Post-doctoral research fellowship (\$140 000), studying the neurophysiology of lamprey swimming.
- Fellow, Harvard University Biomechanics program** **2003-2005**  
 Interdisciplinary Graduate Education and Research Training (IGERT) program
- Mass Media Science and Engineering Fellowship** **2004**  
*American Association for the Advancement of Science*  
 Summer fellowship as a science writer at the *Los Angeles Times*.
- “Fin-based propulsion for highly maneuverable underwater vehicles”** **2000**  
*Office of Naval Research (00-SC-ONR-0445)*  
 Jason Janét, PI. Eric Tytell, co-author. Grant to Nekton Technologies to develop a biomimetic submarine (\$600 000).
- Winston Churchill Foundation Scholarship** **1998 – 1999**  
 Scholarship to Churchill College, Cambridge University, Cambridge, U.K.

### Selected invited seminars (17 total)

1. **Tytell, E. D.**, Carr, J. A., Danos, N., Cowan, N. J. and Ankarali, M. M. (2018). Using noisy work loops to identify the phase-dependent stiffness and damping of muscle in lampreys. *Society for Integrative and Comparative Biology*, Symposium on Sensory Feedback and Animal Locomotion. San Francisco, CA.
2. **Tytell, E. D.** (2017). Neuromechanics of unsteady locomotion in fishes. *International Symposium on Adaptive Movement in Animals and Machines*, Sapporo, Japan.
3. **Tytell, E. D.** 2017. Neuromechanics of unsteady locomotion in fishes. Presented at the George Washington University Mechanical and Aerospace Engineering department seminar series, Washington, DC, Mar. 24, 2017.
4. **Tytell, E. D.** 2015. Neuromechanics and energetics of unsteady locomotion in fishes. Presented at the Temple University Biology department seminar series, Philadelphia, PA, Mar. 16, 2015.
5. **Tytell, E. D.** 2014. The role of mechanical resonance in the neural control of swimming in fish. Presented as part of the International Symposium on Locomotion of Animals, Robotics, and Mathematics, Hokkaido University, Sapporo, Japan, March 21, 2014.
6. **Tytell, E. D.** 2013. Forces, fluids, and feedback: Sensorimotor integration in swimming fishes. Presented as part of the Ecology and Evolutionary Biology seminar series, Brown University, Providence, MA, Apr., 2, 2013.
7. **Tytell, E. D.** 2012. A tale of two fishes: Sensory feedback in lampreys and knifefish. Presented as part of the Concord Field Station seminar series, Harvard University, Bedford, MA, Nov. 8, 2012.
8. **Tytell, E. D.** 2012. Interactions between the nervous system and “passive” mechanical systems: Insights from swimming fishes. Presented at NSF/ARO meeting on Locomotion System Science, Arlington, VA, May 29, 2012.
9. **Tytell, E.D.** 2010. Panel discussion on science writing. Presented at AAAS Mass Media Science and Engineering Fellowship meeting, Washington, DC., Aug. 16, 2010.
10. **Tytell, E.D.**, Borazjani, I., Lauder, G.V., & Sotiropoulos, F. 2010. Separating the effects of swimming mode and body shape in undulatory swimming. Part of a symposium on “Contemporary Approaches to the Study of the Evolution of Fish Body Plan and Fin Shape,” at *Soc. Integ. Compar. Bio.*, Seattle, WA., Jan. 4, 2010.

## **Awards, Honors, and Professional Appointments**

<b>Editorial Board Member, <i>Journal of Experimental Biology</i></b>	<b>2015-present</b>
<b>Editorial Board Member, <i>Scientific Reports</i> (Nature Publishing Group)</b>	<b>2015-2016</b>
<b>Carl Gans Award, <i>Society for Integrative and Comparative Biology</i></b> In recognition of distinguished contributions to the field of comparative biomechanics.	<b>2012</b>
<b>Featured paper, Inside JEB, <i>Journal of Experimental Biology</i></b>	<b>Tytell and Lauder, 2008</b>
<b>Featured paper, Inside JEB, <i>Journal of Experimental Biology</i></b>	Tytell, 2004b
<b>Graduation with highest honors, <i>University of North Carolina</i></b>	<b>1998</b>
<b>Phi Beta Kappa</b>	<b>1998</b>
<b>Coker Award, <i>Department of Biology, University of North Carolina</i></b> Best undergraduate thesis in Organismal Biology.	<b>1998</b>
<b>Summer Student Fellowship, <i>Woods Hole Oceanographic Institute</i></b> Undergraduate research fellowship in fish swimming hydrodynamics.	<b>1997</b>