

Matthew B. Toomey, Ph.D.

Assistant Professor, Department of Integrative Biology, Michigan State University, East Lansing, MI 48824

SUMMARY

I am an integrative biologist. My goal is to discover the physical, biochemical, and molecular mechanisms of trait expression and use this knowledge to understand the evolution and adaptive potential of animals. By integrating genomic, transcriptomic, chemical and molecular functional analyses, my work has revealed essential mechanisms of animal coloration and vision. I am a principal investigator supported by state and federal grants. I supervise trainees from the undergraduate to postdoctoral levels and maintain long-term international collaborations. I am a dedicated educator with classroom experience ranging from large-enrollment introductory molecular and cellular biology courses to graduate-level seminars in neuroscience and sensory biology.

FACULTY POSITIONS

- 2025–
present **Assistant Professor of Biology** — Department of Integrative Biology, Michigan State University, East Lansing, MI
- 2019–2025 **Assistant Professor of Biology** — Department of Biological Science, University of Tulsa, Tulsa, OK

POSTDOCTORAL TRAINING

- 2011–2018 **Research Fellow/Associate** — Lab of Dr. Joseph Corbo, Department of Pathology and Immunology, Washington University School of Medicine, St. Louis, MO

EDUCATION

- 2011 **Ph.D., Biology** — Arizona State University, Tempe, AZ
"Avian Retinal Carotenoid Accumulation: Ecophysiological Constraints and Behavioral Consequences"
- 2002 **B.S., Biology** — University of Vermont, Burlington, VT. Graduated *Cum Laude* with College Honors. Major: Biology; Minors: Chemistry & Physics

SUBMITTED MANUSCRIPTS

- Wade, M. J., Patton, S. A., Scheer, E. C., Koch, R. E., Zhang, Y., **Toomey, M. B.**, Hill, G. E., and Sin, S. Y. W. *In review*. Not all roads lead to red: The genetics of sexual dichromatism in the northern cardinal (*Cardinalis cardinalis*). *Genome Biology and Evolution*.
- Patton, S. A., Scheer, E. C., Koch, R. E., Zhang, Y., **Toomey, M. B.**, Hill, G. E. *Accepted*. Captivity negatively affects production of red carotenoid pigments in the northern cardinal (*Cardinalis cardinalis*).

PUBLICATIONS

Citation metrics (via Google Scholar): Total citations: 2,802 | *h*-index: 30

50. Koch, R. E., **Toomey, M. B.**, Zhang, Y. and Hill, G. E. (2025a). Mechanisms of carotenoid metabolism: understanding the links between red coloration, cellular respiration, and individual quality. *Integr. Comp. Biol.* 65(2): 496–506.
49. Koch, R. E., Truong, C. N., Reeb, H. R., Joski, B. H., Hill, G. E., Zhang, Y. and **Toomey, M. B.** (2025b). Multiple pathways to red carotenoid coloration: House finches (*Haemorrhous mexicanus*) do not use CYP2J19 to produce red plumage. *Mol. Ecol.* 34(9): e17744.
48. Liu, Y., Hurley, E. C., Ogawa, Y., Gause, M., **Toomey, M. B.**, Myers, C. A. and Corbo, J. C. (2025). Avian photoreceptor homologies and the origin of double cones. *Curr. Biol.* 35(10): 2215–2227.e6.
47. **Toomey, M. B.**, Koch, R. E., Liu, Y., von Lintig, J., Corbo, J. C., Hill, G. E. and Zhang, Y. (2025). Substrates, intermediates, and products of avian ketocarotenoid metabolism. *Biochim. Biophys. Acta Mol. Cell Biol. Lipids* 1870(6): 159654.
46. Williams, B. L., Pintor, L. M., **Toomey, M. B.** and Gray, S. M. (2025). Intraspecific variation in color and carotenoids across environmental extremes in an African cichlid. *Ecol. Evol. Physiol.* 98(2): 57–69
45. Koch, R. E., Okegbe, C., Ramanathan, C., Zhu, X., Hare, E., **Toomey, M. B.***, Hill, G. E.*, and Zhang, Y.* (2024). Captivity affects mitochondrial aerobic respiration and carotenoid metabolism in the house finch (*Haemorrhous mexicanus*). *J. Exp. Biol.* 227: jeb246980. *equal contributions
44. Khalil, S., Enbody, E. D., Frankl-Vilches, C., Welklin, J. F., Koch, R. E., **Toomey, M. B.**, Sin, S. Y. W., Edwards, S. V., Gahr, M., Schwabl, H., Webster, M. S. and Karubian, J. (2023). Testosterone coordinates gene expression across different tissues to produce carotenoid-based red ornamentation. *Mol. Biol. Evol.* 40: msad056.
43. Buchheim, M. A., Silver, A., Johnson, H.* , Portman, R. and **Toomey, M. B.** (2023). The description of *Haematococcus privus* sp. nov. (Chlorophyceae, Chlamydomonadales) from North America. *Algae* 38: 1–22. *undergraduate co-author
42. **Toomey, M. B.**, Marques, C. A., Araújo, P. M., Huang, D., Zhong, S., Liu, Y., Schreiner, G. D., Myers, C. A., Pereira, P., Afonso, S., Andrade, P., Gazda, M. A., Lopes, R. J., Viegas, I., Koch, R. E., Haynes, M. E.* , Smith, D. J.* , Ogawa, Y., Murphy, D., Kopec, R. E., Parichy, D. M., Carneiro, M. and Corbo, J. C. (2022). A mechanism for red coloration in vertebrates. *Curr. Biol.* 32(18): 4201–4214.e12. *undergraduate co-authors
41. **Toomey, M. B.**, Smith, D. J.* , Gonzales, D. M.* and McGraw, K. J. (2022). Methods for extracting and analyzing carotenoids from bird feathers. *Methods Enzymol.* 670: 459–497. *undergraduate co-authors
40. Huang, D., Lewis, V. M., Foster, T. N., **Toomey, M. B.**, Corbo, J. C. and Parichy, D. M. (2021). Development and genetics of red coloration in the zebrafish relative *Danio albolineatus*. *eLife* 10: e70253.
39. **Toomey, M. B.** and Ronald, K. L. (2021). Avian color expression and perception: is there a carotenoid link? *J. Exp. Biol.* 224(12): jeb203844.
38. Gazda, M. A., Araújo, P. M., Lopes, R. J., **Toomey, M. B.**, Andrade, P., Afonso, S., Marques, C., Nunes, L., Pereira, P., Trigo, S., Hill, G. E., Corbo, J. C. and Carneiro, M. (2020). A genetic mechanism for sexual dichromatism in birds. *Science* 368(6496): 1270–1274.
37. Gazda, M. A.* , **Toomey, M. B.***, Araújo, P. M., Lopes, R. J., Afonso, S., Myers, C. A., Serres, K., Kiser, P. D., Hill, G. E., Corbo, J. C. and Carneiro, M. (2020). Genetic basis of de novo appearance of carotenoid ornamentation in bare parts of canaries. *Mol. Biol. Evol.* 37(5): 1317–1328. *contributed equally
36. Saunders, L. M., Mishra, A. K., Aman, A. J., Lewis, V. M., **Toomey, M. B.**, Packer, J. S., Qiu, X., McFaline-Figueroa, J. L., Corbo, J. C., Trapnell, C. and Parichy, D. M. (2019). Thyroid hormone regulates distinct paths to maturation in pigment cell lineages. *eLife* 8: e45181.
35. Koch, R. E., Staley, M., Kavazis, A. N., Hasselquist, D., **Toomey, M. B.** and Hill, G. E. (2019). Testing the resource trade-off hypothesis for carotenoid-based signal honesty using genetic variants of the domestic canary. *J. Exp. Biol.* 222(6): jeb188102.
34. **Toomey, M. B.***, Marques, C. I.* , Andrade, P., Araújo, P. M., Sabatino, S., Gazda, M. A., Afonso, S., Lopes, R. J., Corbo, J. C. and Carneiro, M. (2018). A non-coding region near Follistatin controls head colour polymorphism in the Gouldian finch. *Proc. R. Soc. B* 285(1888): 20181788. *contributed equally

33. Giraudeau, M., **Toomey, M. B.**, Hutton, P. and McGraw, K. J. (2018). Expression of and choice for condition-dependent carotenoid-based color in an urbanizing context. *Behav. Ecol.* 29(6): 1307–1315.
32. Koch, R. E., Kavazis, A. N., Hasselquist, D., Hood, W. R., Zhang, Y., **Toomey, M. B.** and Hill, G. E. (2018). No evidence that carotenoid pigments boost either immune or antioxidant defenses in a songbird. *Nat. Commun.* 9: 491.
31. **Toomey, M. B.** and Corbo, J. C. (2017). Evolution, development and function of vertebrate cone oil droplets. *Front. Neural Circuits* 11: 97.
30. Morshedien, A. *, **Toomey, M. B.** *, Pollock, G. E., Frederiksen, R., Enright, J. M., McCormick, S. D., Cornwall, M. C., Fain, G. L. and Corbo, J. C. (2017). Cambrian origin of the CYP27C1-mediated vitamin A1-to-A2 switch, a key mechanism of vertebrate sensory plasticity. *R. Soc. Open Sci.* 4(9): 170362. *contributed equally
29. **Toomey, M. B.**, Lopes, R. J., Araújo, P. M., Johnson, J. D., Gazda, M. A., Afonso, S., Mota, P. G., Koch, R. E., Hill, G. E., Corbo, J. C. and Carneiro, M. (2017). High-density lipoprotein receptor SCARB1 is required for carotenoid coloration in birds. *Proc. Natl. Acad. Sci. USA* 114(20): 5219–5224.
28. Mitkus, M., Olsson, P., **Toomey, M. B.**, Corbo, J. C. and Kelber, A. (2017). Specialized photoreceptor composition in the raptor fovea. *J. Comp. Neurol.* 525(9): 2152–2163.
27. **Toomey, M. B.**, Lind, O., Frederiksen, R., Curley, R. W., Riedle, K. M., Wilby, D., Schwartz, S. J., Witt, C. C., Harrison, E. H., Roberts, N. W., Vorobyev, M., McGraw, K. J., Cornwall, M. C., Kelber, A. and Corbo, J. C. (2016). Complementary shifts in photoreceptor spectral tuning unlock the full adaptive potential of ultraviolet vision in birds. *eLife* 5: e15675.
26. Kramlinger, V. M., Nagy, L. D., Fujiwara, R., Johnson, K. M., Phan, T. T. N., Xiao, Y., Enright, J. M., **Toomey, M. B.**, Corbo, J. C. and Guengerich, F. P. (2016). Human cytochrome P450 27C1 catalyzes 3,4-desaturation of retinoids. *FEBS Lett.* 590(9): 1304–1312.
25. Lopes, R. J. *, Johnson, J. D. *, **Toomey, M. B.** *, Ferreira, M. S., Araújo, P. M., Melo-Ferreira, J., Andersson, L., Hill, G. E., Corbo, J. C. and Carneiro, M. (2016). Genetic basis for red coloration in birds. *Curr. Biol.* 26(11): 1427–1434. *contributed equally
24. **Toomey, M. B.** and McGraw, K. J. (2016). The effects of sun exposure on carotenoid accumulation and oxidative stress in the retina of the house finch (*Haemorrhous mexicanus*). *Avian Res.* 7(1): 5.
23. **Toomey, M. B.**, Collins, A. M., Frederiksen, R., Cornwall, M. C., Timlin, J. A. and Corbo, J. C. (2015). A complex carotenoid palette tunes avian color vision. *J. R. Soc. Interface* 12(111): 20150563.
22. Wilby, D., **Toomey, M. B.**, Olsson, P., Frederiksen, R., Cornwall, M. C., Oulton, R., Kelber, A., Corbo, J. C. and Roberts, N. W. (2015). Optics of cone photoreceptors in the chicken (*Gallus gallus domesticus*). *J. R. Soc. Interface* 12(111): 20150591.
21. Enright, J. M., **Toomey, M. B.**, Sato, S., Temple, S. E., Allen, J. R., Fujiwara, R., Kramlinger, V. M., Nagy, L. D., Johnson, K. M., Xiao, Y., How, M. J., Johnson, S. L., Roberts, N. W., Kefalov, V. J., Guengerich, F. P. and Corbo, J. C. (2015). Cyp27c1 red-shifts the spectral sensitivity of photoreceptors by converting vitamin A1 into A2. *Curr. Biol.* 25(23): 3048–3057.
20. Giraudeau, M., Chavez, A., **Toomey, M. B.** and McGraw, K. J. (2015). Effects of carotenoid supplementation and oxidative challenges on physiological parameters and carotenoid-based coloration in an urbanization context. *Behav. Ecol. Sociobiol.* 69(6): 957–970.
19. McGraw, K. J., Giraudeau, M., **Toomey, M. B.** and Staley, M. (2013). Ketocarotenoid circulation, but not retinal carotenoid accumulation, is linked to eye disease status in a wild songbird. *Arch. Biochem. Biophys.* 539(2): 156–162.
18. **Toomey, M. B.** and McGraw, K. J. (2012). Mate choice for a male carotenoid-based ornament is linked to female dietary carotenoid intake and accumulation. *BMC Evol. Biol.* 12: 3.
17. Behbahaninia, H., Butler, M. W., **Toomey, M. B.** and McGraw, K. J. (2012). Food color preferences against a dark, textured background vary in relation to sex and age in house finches (*Carpodacus mexicanus*). *Behaviour* 149(1): 51–65.

16. Giraudeau, M., **Toomey, M. B.** and McGraw, K. J. (2012). Can house finches (*Carpodacus mexicanus*) use non-visual cues to discriminate the carotenoid content of foods? *J. Ornithol.* 153(4): 1017–1023.
15. **Toomey, M. B.** and McGraw, K. J. (2011). The effects of dietary carotenoid supplementation and retinal carotenoid accumulation on vision-mediated foraging in the house finch. *PLoS ONE* 6(6): e21653.
14. Butler, M. W., **Toomey, M. B.**, McGraw, K. J. and Rowe, M. (2011). Ontogenetic immune challenges shape adult personality in mallard ducks. *Proc. R. Soc. B* 279(1728): 326–333.
13. Smith, C. L., **Toomey, M. B.**, Walker, B. R., Braun, E. J., Wolf, B. O., McGraw, K. J. and Sweazea, K. L. (2011). Naturally high plasma glucose levels in mourning doves (*Zenaidura macroura*) do not lead to high levels of reactive oxygen species in the vasculature. *Zoology* 114(3): 171–176.
12. Butler, M. W., **Toomey, M. B.** and McGraw, K. J. (2011). How many color metrics do we need? Evaluating how different color-scoring procedures explain carotenoid pigment content in avian bare-part and plumage ornaments. *Behav. Ecol. Sociobiol.* 65(3): 401–413.
11. **Toomey, M. B.** and McGraw, K. J. (2010). The effects of dietary carotenoid intake on carotenoid accumulation in the retina of a wild bird, the house finch (*Carpodacus mexicanus*). *Arch. Biochem. Biophys.* 504(2): 161–168.
10. **Toomey, M. B.**, Butler, M. W. and McGraw, K. J. (2010). Immune-system activation depletes retinal carotenoids in house finches. *J. Exp. Biol.* 213(10): 1709–1716.
9. **Toomey, M. B.**, Butler, M. W., Meadows, M. G., Taylor, L. A., Fokidis, H. B. and McGraw, K. J. (2010). A novel method for quantifying the glossiness of animals. *Behav. Ecol. Sociobiol.* 64(7): 1047–1055.
8. McGraw, K. J. and **Toomey, M. B.** (2010). Carotenoid accumulation in the tissues of zebra finches: predictors of integumentary pigmentation and implications for carotenoid allocation strategies. *Physiol. Biochem. Zool.* 83(1): 97–109.
7. Bascunan, A. L., Tourville, E. A., **Toomey, M. B.** and McGraw, K. J. (2009). Food color preferences of molting house finches (*Carpodacus mexicanus*) in relation to sex and plumage coloration. *Ethology* 115(11): 1066–1073.
6. Meadows, M. G., Butler, M. W., Morehouse, N. I., Taylor, L. A., **Toomey, M. B.**, McGraw, K. J. and Rutowski, R. L. (2009). Iridescence: views from many angles. *J. R. Soc. Interface* 6(Suppl 2): S107–S113.
5. **Toomey, M. B.** and McGraw, K. J. (2009). Seasonal, sexual, and quality-related variation in retinal carotenoid accumulation in the house finch (*Carpodacus mexicanus*). *Funct. Ecol.* 23(2): 321–329.
4. **Toomey, M. B.** and McGraw, K. J. (2007). Modified saponification and HPLC methods for analyzing carotenoids from Japanese quail retina: implications for use as a nonprimate model species. *Invest. Ophthalmol. Vis. Sci.* 48(9): 3976–3982.
3. McGraw, K. J., **Toomey, M. B.**, Nolan, P. M., Morehouse, N. I., Massaro, M. and Jouventin, P. (2007). A description of unique fluorescent yellow pigments in penguin feathers. *Pigment Cell Res.* 20(4): 301–304.
2. **Toomey, M. B.**, Bowman, R. and Woolfenden, G. E. (2007). The effects of social context on food handling behavior of Florida Scrub-Jays. *Ethology* 113(6): 521–527.
1. **Toomey, M. B.**, McCabe, D. and Marsden, J. E. (2002). Factors affecting the movement of adult zebra mussels (*Dreissena polymorpha*). *J. N. Am. Benthol. Soc.* 21(3): 468–475.

GRANTS AND FELLOWSHIPS

Submitted

Pending

United States National Science Foundation "Applying cell biology and biochemistry to understand honest signaling via red feathers." Co-PI with Dr. Geoff Hill (Auburn University) and Yufeng Zhang (University of Memphis)

Funded

2021– present	United States National Science Foundation — IOS 2037739 "Collaborative Research: Understanding the rules of honest signaling." \$609,980 to Toomey. Co-PI with Dr. Geoff Hill, Auburn University and Yufeng Zhang, University of Memphis
2022–2024	Interdisciplinary Project Grant , University of Tulsa, Office of Research and Sponsored Programs — "Engineering enhanced astaxanthin production in <i>Haematococcus</i> ." \$17,326. Co-PI with Dr. Mark Buchheim and Dr. Ty Johannes, University of Tulsa
2020–2023	Oklahoma Plant Science Research Grant , Oklahoma Center for the Advancement of Science — "Bioprospecting Oklahoma's Algal Diversity for High Value Products." PS20-021. \$89,657. Co-PI with Dr. Mark Buchheim, University of Tulsa
2015	Postdoctoral Research Fellowship , McDonnell Center for Cellular and Molecular Neurobiology, Washington University in St. Louis. \$30,000
2012	Postdoctoral Research Fellowship in Biology , National Science Foundation — Intersections of Biology with Math and Physical Sciences (#DBI-1202776). \$123,000
2011	Postdoctoral Training Fellowship , National Institutes of Health, National Eye Institute, Vision Sciences Training Program, Washington University in St. Louis. \$37,740
2009	Doctoral Dissertation Improvement Grant , National Science Foundation — "What you see is what you get: behavioral implications of retinal carotenoid accumulation" (#IOS-0910375). Co-PI with Dr. Kevin McGraw. \$11,370
2009	NSF Grant (#IOS-0923694) — "Condition-dependent signal reception: limitations and functions of carotenoids in avian color vision." \$356,189. Co-written with Dr. Kevin McGraw (PI)
2009	Grant in Aid of Research , Society for Integrative and Comparative Biology. \$1,000
2007	Student Research Grant , Arizona State University, Graduate and Professional Student Association. \$1,600
2007	Student Research Award , American Ornithologists Union. \$1,800
2007	Conference Development Grant , School of Life Sciences, Research and Training Initiative — with Mike Butler, Nathan Morehouse, Jonathan Douglas, Lisa Taylor, and Melissa Meadows. \$29,000
2006	Student Research Grant , Animal Behavior Society. \$1,000
2005	Grant-in-Aid-of-Research , Sigma Xi. \$2,000
2002	Undergraduate Research and Faculty Mentoring Grant , University of Vermont with Dr. J. E. Marsden. \$3,000
2000	Undergraduate Summer Research Internship , Vermont Experimental Program Stimulating Competitive Research (EPSCoR). \$5,000
1999	Undergraduate Minigrant , Hughes Endeavor for Life Science Excellence, University of Vermont. \$500

AWARDS AND HONORS

2024	Junior Faculty Research Award , Oxley College of Health and Natural Sciences, University of Tulsa
2023	Fellow, International Carotenoid Society — "Bestowed for longstanding and consistent contributions."
2016	Outstanding Poster Award, Gordon Research Conference on Carotenoids
2013	Outstanding Poster Award, Gordon Research Conference on Carotenoids
2006	Graduate Research Fellowship, National Science Foundation — Honorable Mention
2005	University Graduate Scholar Award (Recruitment Award), Arizona State University
2002	George Perkins Marsh Award in Ecology and Evolution, Department of Biology, University of Vermont
1998–2002	Vermont Scholar, University of Vermont

INVITED PRESENTATIONS

2025	Toomey, M. B. The mechanisms and meaning of ketocarotenoid-based signals in birds. Department of Integrative Biology, Michigan State University.
2024	Toomey, M. B. The mechanisms and meaning of ketocarotenoid-based signals in animals. Centre College, Danville, KY.
2023	Toomey, M. B. The mechanisms and meaning of ketocarotenoid-based signals in animals. The International Carotenoid Society, Distinguished Speakers Series.
2020	Toomey, M. B. Colorful canaries reveal the mechanisms of avian coloration. Science and Technology Seminar Series, Northeastern State University, Tahlequah, OK.
2020	Toomey, M. B. The shared chemistry of coloration and vision in birds. Department of Ecology and Evolution, University of Chicago, Chicago, IL.
2019	Toomey, M. B. The shared chemistry of coloration and vision in birds. Plenary Presentation, Sensorium 2019 Conference in Sensory Biology, University of Illinois, Urbana-Champaign.
2019	Toomey, M. B. Colorful canaries unlock the mysteries of avian coloration and vision. STEM Seminar Series, Tulsa Community College, Tulsa, OK.
2019	Toomey, M. B. Transcriptome profiling of avian cone photoreceptor subtypes reveals mechanisms of development and spectral tuning. Color Vision: Circuits and Behavior, Howard Hughes Medical Institute, Janelia Research Campus, Ashburn, VA.
2018	Toomey, M. B. Evolutionary co-option of carotenoid metabolic pathways from the visual system underlie avian color diversification. Gordon Research Conference: Carotenoids, Sunday River, ME.
2018	Toomey, M. B. A pigment's-eye view of visual ecology: understanding functional adaptation through carotenoid metabolism. Department of Biological Sciences, Florida International University, Miami, FL; Department of Biological Sciences, Loyola University, New Orleans, LA.

- 2017 **Toomey, M. B.** A pigment's-eye view of visual ecology: understanding functional adaptation through carotenoid metabolism. Department of Biology, Stanford University, Palo Alto, CA.
- 2016 **Toomey, M. B.** A pigment's-eye view of visual ecology: understanding functional adaptation through carotenoid metabolism. Department of Zoology, University of British Columbia, Vancouver, BC, Canada; Department of Biology, Indiana State University, Terre Haute, IN; Department of Biology, Maryville University, St. Louis, MO; Department of Biology, University of Cincinnati, Cincinnati, OH.
- 2016 **Toomey, M. B.** Selective carotenoid metabolism enhances avian color vision. Carotenoids Gordon-Kenan Research Seminar, Barga, Italy.
- 2015 **Toomey, M. B.** et al. Photoreceptor coevolution enhances ultraviolet vision in birds. James L. O'Leary Prize for Excellence in Neuroscience Research Competition, Washington University School of Medicine, St. Louis, MO.
- 2014 **Toomey, M. B.** et al. Carotenoid metabolism and opsin tuning have co-evolved to facilitate avian color discrimination. Departmental Seminar, Genetics, Washington University School of Medicine, St. Louis, MO.
- 2014 **Toomey, M. B.** et al. Selective apocarotenoid metabolism facilitates avian color vision. Carotenoid Interest Research Group, American Society for Nutrition, San Diego, CA.
- 2013 **Toomey, M. B.** et al. Complementary shifts in carotenoid metabolism and opsin tuning facilitate avian color vision. Symposium: Physiological and functional advances in avian coloration. American Ornithologists Meeting, Chicago, IL.
- 2013 **Toomey, M. B.** et al. Fine-tuning of avian color vision by selective apocarotenoid metabolism. Carotenoid Interest Research Group, American Society for Nutrition, Boston, MA.
- 2013 **Toomey, M. B.** et al. Fine-tuning of avian color vision by selective apocarotenoid metabolism. Carotenoids Gordon-Kenan Research Seminar, Ventura, CA.
- 2011 **Toomey, M. B.** Avian retinal carotenoid accumulation: ecophysiological constraints and behavioral consequences. Department of Biology, Purdue University, West Lafayette, IN.
- 2010 **Toomey, M. B.** Colorful birds, colorful vision: physiology and function of avian color vision. Mathematics and Cognition Seminar, School of Mathematical and Statistical Sciences, Arizona State University, Tempe, AZ.

CONTRIBUTED PRESENTATIONS

- 2024 **Toomey, M. B.,** Koch, R. E., Hill, G. E., Zhang, Y. Mechanisms of ketocarotenoid metabolism in the house finch (*Haemorrhous mexicanus*). International Conference on Carotenoids, Virtual.
- 2023 **Toomey, M. B.** The mechanisms and meaning of ketocarotenoid-based signals in animals. The International Carotenoid Society Meeting, Toyama, Japan.
- 2022 **Toomey, M. B.,** Liu, Y., Myers, C. A., Carneiro, M., and Corbo, J. C. Mechanisms of carotenoid-based spectral filtering in the avian visual system. International Conference on Carotenoids, Virtual.

- 2022 **Toomey, M. B.**, Liu, Y., Myers, C. A., Carneiro, M., and Corbo, J. C. Transcriptome profiling of avian cone photoreceptor subtypes reveals mechanisms of carotenoid pigmentation. Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ.
- 2022 Foster, T. N. and **Toomey, M. B.** Visual system plasticity in *Cyprinella lutrensis*. Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ.
- 2014 **Toomey, M. B.** Carotenoid metabolism and opsin tuning have co-evolved to facilitate avian color discrimination. 15th International Behavioral Ecology Congress, New York, NY.
- 2014 **Toomey, M. B.** Testosterone influences the accumulation of carotenoids in the retina of a wild bird. Experimental Biology, San Diego, CA.
- 2012 **Toomey, M. B.** Color and vision: the influence of dietary supplementation on retinal carotenoid accumulation and female choice for male carotenoid-based coloration. Warder Clyde Allee Session, Annual Meeting, Animal Behavior Society, Albuquerque, NM.
- 2010 **Toomey, M. B.** and McGraw, K. J. Dietary carotenoids affect color-vision based foraging in the house finch. Meeting of the American Ornithologists Union, San Diego, CA.
- 2010 **Toomey, M. B.**, Butler, M. W., and McGraw, K. J. Long-term immune system activation depletes carotenoids from retina of house finches (*Carpodacus mexicanus*). Meeting of the Society for Integrative and Comparative Biology, Seattle, WA.
- 2009 **Toomey, M. B.** and McGraw, K. J. Is there a unique role for carotenoids in production and perception of avian color signals? Meeting of the Animal Behavior Society, Pirenópolis, Goiás, Brazil.
- 2008 **Toomey, M. B.** and McGraw, K. J. Variation in and correlates of retinal carotenoid accumulation in wild house finches (*Carpodacus mexicanus*). 12th International Behavioral Ecology Congress, Ithaca, NY.
- 2007 **Toomey, M. B.** and McGraw, K. J. Carotenoid pigments in the tissues of zebra finches (*Taeniopygia guttata*): identity, distribution, and intercorrelations. Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ.

CONTRIBUTED POSTERS

- 2022 Hansen-Gonzalez, M.*, Carneiro, M., and **Toomey, M. B.** A factor required for carotenoid uptake into bird feathers. Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ. *undergraduate presenter.
- 2022 Smith, D. J.*, Corbo, J. C., Carneiro, M., and **Toomey, M. B.** A protein that facilitates carotenoid uptake into avian feathers and retinas. Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ. *undergraduate presenter.
- 2013 **Toomey, M. B.** et al. Fine-tuning of avian color vision by selective apocarotenoid metabolism. FASEB Biology and Chemistry of Vision Meeting, Steamboat Springs, CO.
- 2011 **Toomey, M. B.** and McGraw, K. J. Female mate choice for a carotenoid-based ornament is linked to carotenoid availability and assimilation in the house finch (*Carpodacus mexicanus*). Meeting of the Animal Behavior Society, Bloomington, IN.

- 2010 **Toomey, M. B.** and McGraw, K. J. The effects of dietary carotenoid supplementation on retinal carotenoid accumulation and visual foraging behavior in the house finch (*Carpodacus mexicanus*). Gordon Research Conference: Carotenoids, Ventura, CA.
- 2006 **Toomey, M. B.**, McGraw, K. J., Nolan, P. M., Morehouse, N. I., and Jouventin, P. The first description of fluorescent yellow pigments in penguin feathers. Meeting of the North American Ornithological Council, Veracruz, Mexico.
- 2006 Meadows, M. G., McGraw, K. J., **Toomey, M. B.**, and Taylor, L. A. Condition dependence of structural colors in birds: a meta-analysis. Meeting of the North American Ornithological Council, Veracruz, Mexico. (Honorable mention, student poster competition)
- 2005 **Toomey, M. B.**, Bowman, R., and Woolfenden, G. E. The effects of social context on food handling behavior of Florida Scrub-Jays. Meeting of the Animal Behavior Society, Snowbird, UT; Meeting of the American Ornithologists Union, Santa Barbara, CA.
- 2002 **Toomey, M. B.**, Marsden, J. E., and McCabe, D. J. Factors affecting the movement of adult zebra mussels (*Dreissena polymorpha*). Meeting of the North American Benthological Society, Pittsburgh, PA.

US GOVERNMENT REPORTS

Payne, K. J., Roth, M. and Toomey, M. B. Trip Report: Laysan Island, 18 February – 24 July 2003. Administrative Report, U.S. Fish and Wildlife Service, Honolulu, HI.

TEACHING

Instructor of Record

Michigan State University, East Lansing, MI

Spring 2026 *IBIO 341 Fundamental Genetics* (6 sections, 182 students)

Spring 2026 *IBIO 360 Biology of Birds* (2 sections, 49 students)

University of Tulsa, Tulsa, OK

Fall 2024 *Principles of Neuroscience* (44 students)

Fall 2024 *Graduate Workshop — Genome Biology* (14 students)

Spring 2023 *Introduction to Cell and Molecular Biology* (2 sections, 132 students)

Fall 2022 *Principles of Neuroscience* (45 students)

Fall 2022 *Graduate Seminar — Data Science for Biology* (11 students)

Spring 2022 *Introduction to Cell and Molecular Biology* (2 sections, 122 students)

Fall 2021 *Sensory Biology* (20 students)

Fall 2021 *Principles of Neuroscience* (45 students)

Spring 2021 *Introduction to Cell and Molecular Biology* (2 sections, 124 students)

Fall 2020 *Graduate Seminar in Sensory Biology* (9 students)

Fall 2020 *Principles of Neuroscience* (37 students)

Spring 2020 *Introduction to Cell and Molecular Biology* (2 sections, 178 students)

Fall 2019 *Principles of Neuroscience* (30 students)

Spring 2019 *Introduction to Cell and Molecular Biology* (co-taught, 2 sections, 143 students)

2014 Graduate Fellowship Workshop Leader, Washington University, St. Louis, MO

Graduate Teaching Assistant, Arizona State University, Tempe, AZ

2009 *Vertebrate Zoology*

2007–2008 *Human Anatomy & Physiology*

2005 *Introductory Biology*

Pedagogical Training

2015 *Teaching Students How to Read and Critically Evaluate Scientific Literature*. STEM pedagogy workshop, Washington University, St. Louis, MO

2012 *Entering Mentoring*, Washington University, St. Louis, MO

2011 *Vision, Change, and the Case Studies Approach*. Workshop, Animal Behavior Society Meeting, Bloomington, IN

2009 *Scientific Teaching*, Arizona State University, Tempe, AZ

GRADUATE COMMITTEE MEMBER

Michigan State University

Current Stella Hao (Ph.D.)

University of Tulsa

2019 Margaret Wagnon (M.S.); Vivek Khanal (Ph.D.)

2020 Alexander Hess (Ph.D.)

2021 Madison Herrboldt (Ph.D.)

2023 Rebekah Hansen (M.S.)

2024 Emily Ademic (Ph.D.)

2025 Amy West (Ph.D.)

Current Emily Bierbaum (Ph.D.); Connor Ferguson (Ph.D.); Tanner Mierow (Ph.D.); Prasad Parab (Ph.D., Chemical Engineering); Daniel Naranjo (Ph.D.); Elise Delporte (Ph.D.)

MENTORING

Postdoctoral

2021–2024 **Dr. Rebecca Koch**, Postdoctoral Research Associate. Now: Faculty, University of Wisconsin, Stevens Point

Graduate Students

- 2025 Hannah Reeb, M.S., University of Tulsa — "Evolution of a visual signal in a colonial bird."
*Co-advised with Dr. Charles Brown, University of Tulsa
- 2024 Ashley B. Silver, M.S., University of Tulsa — "Phylogenetic and biochemical diversity in *Haematococcus* algae." Co-advised with Dr. Mark Buchheim, University of Tulsa
- 2022 Tarah N. Foster, M.S., University of Tulsa — "Visual ecology and plasticity in native Oklahoma fish species"

Tulsa Undergraduate Research Challenge (2-month full-time summer program)

- 2025 A'niya Dozier, Katherine Rock, Brian Nguyen (undergraduate, University of Tulsa) — "Comparative biochemistry of cytochrome P450s in animal coloration"
- 2025 Everett Smith (TURC Junior), Holland Hall High School, Tulsa, OK — "Comparative biochemistry of cytochrome P450s in animal coloration"
- 2025 Akshaya Pradhananga (TURC Junior), Booker T. Washington High School, Tulsa, OK — "Comparative biochemistry of cytochrome P450s in animal coloration"
- 2024 Elizabeth Scheer, University of Tulsa — "Functional characterization of carotenoid metabolizing enzymes in northern cardinal"
- 2024 Nathan Reed, University of Tulsa — "Functional characterization of carotenoid metabolizing enzymes in American goldfinch"
- 2024 Brian Nguyen, University of Tulsa — "Function of ABC transporters in carotenoid-based color expression"
- 2024 Akshaya Pradhananga (TURC Junior), Booker T. Washington High School, Tulsa, OK
- 2023 Hannah Reeb, University of Tulsa — "Evolution of an animal signal in relation to group size"
- 2023 Sarah Mason (TURC Junior), Bixby High School — "Investigating the role of transthyretin in avian color expression"
- 2022 Christy Truong, University of Tulsa — "Subcellular localization of color modifying enzymes in birds"
- 2021 Desirae Gonzales, University of Tulsa — "Ecology of visual pigment composition in *Lepomis*"
- 2021 Dustin Smith, University of Tulsa — "The role of Tetratricopeptide Repeat Domain 39B in the expression of carotenoid-based coloration"

Honors Thesis

- 2009 Ana L. Bascunan & Elizabeth A. Tourville, Barrett Honors College, Arizona State University — "Food color preferences of molting house finches (*Carpodacus mexicanus*) in relation to sex and plumage coloration"

Independent Research Projects

- 2022–2023 Hannah Reeb, University of Tulsa — "The Evolution of Animal Signals in Relation to Group Size"
- 2020–2021 Meadow Hansen-Gonzalez, STEM-UP Program, University of Tulsa — "The role of ATP Binding Cassette Subfamily G Member 4 in the expression of carotenoid-based coloration"

- 2019 Maureen Haynes, University of Tulsa — "Characterizing the metabolic pathway from yellow to red carotenoids in the avian visual system"
- 2017 Malgorzata Gazda, Visiting Graduate Student, Universidade do Porto, Portugal — "The cis-regulation of β -carotene oxygenase expression and avian color variation"
- 2016 Allison Loynd, Undergraduate, Brown University — "Mechanisms of retinoid metabolism in the visual system of the sea lamprey"
- 2016 Vineeth Thirunavu, Undergraduate, Washington University — "The function of GSTA3 in avian retinal carotenoid metabolism"
- 2013 Henry Lather, Undergraduate, Washington University — "The Selective Elimination of Avian Photoreceptor Populations"
- 2011–2013 Amanda G. Elmore, Undergraduate, Purdue University — "The sensory basis of individual variation in color vision: a case study with house finches"
- 2010–2011 Hirbod Behbahaninia, Undergraduate, Arizona State University — "An experimental test of the effect of seed color contrast on food preferences of house finches"
- 2009–2010 Chelsie K. Daniel, Undergraduate, Arizona State University — "Seasonal and quality related variation in circulating antibody levels in the house finch (*Carpodacus mexicanus*)"
- 2009 Jon Miller — Arizona Science Teacher Advancement and Research Training Program — "The relationship between sex, plumage coloration, and grooming behavior in the house finch (*Carpodacus mexicanus*)"

Research Interns

- 2024 Ben Epperson, Undergraduate, University of Tulsa
- 2023 Mariah Moreland, Undergraduate, University of Tulsa
- 2022 Olivia Knight, Undergraduate, University of Tulsa
- 2022 Christy Truong, Undergraduate, University of Tulsa
- 2021–2023 Desirae Gonzales, Undergraduate, University of Tulsa
- 2021–2023 Brooke Joski, Undergraduate, University of Tulsa
- 2020–2022 Alyssa Williamson, Undergraduate, University of Tulsa
- 2019 Ethan Chandler, Undergraduate, University of Tulsa
- 2019–2022 Meadow Hansen-Gonzalez, Undergraduate, University of Tulsa (STEM-UP Program)
- 2019–2022 Dustin Smith, Undergraduate, University of Tulsa
- 2018 Sabrina Ho, Undergraduate, Washington University, St. Louis, MO
- 2017 David Corbo, High School Volunteer, Washington University in St. Louis, MO
- 2014 Sarah Shen, High School Volunteer, Washington University in St. Louis, MO
- 2013 James Allen, Graduate Rotation Student (IMSD Program), Washington University in St. Louis, MO
- 2012 Eileen Zho, Undergraduate, Vanderbilt University, Nashville, TN

2010	Paula Sicsu, Undergraduate, Universidad de Brasília, Brasília, Brazil
2010	Evan Pulsipher, Undergraduate, Arizona State University
2010	Connor Murphy, Undergraduate, Arizona State University
2009–2010	Dustin Skarupa, Undergraduate, Arizona State University
2009	Ciara Maize, Undergraduate, Arizona State University
2009	Renee Matthey, Undergraduate, Arizona State University
2008	Dane Klett, Undergraduate, Arizona State University
2008	Robert Campion, Undergraduate, Arizona State University
2007–2008	Craig Lowthrop, Undergraduate, Arizona State University

VISITING RESEARCHERS HOSTED

October 2021	Bethany Williams, Ph.D. Candidate, Ohio State University (lab of Dr. Suzanne Gray) — visited to analyze carotenoid pigmentation of <i>Pseudocrenilabrus multicolor</i> samples. Supported by a Company of Biologists Travel Fellowship.
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MANUSCRIPT PEER REVIEW

2025	<i>Evolution, Journal of Experimental Biology, Journal of Fish Biology, Molecular Ecology, PLoS ONE</i>
2024	<i>Biology Letters, Communications Biology, PNAS Nexus, Journal of Experimental Biology, Comparative Biochemistry and Physiology, Part B</i>
2023	<i>Ornithology, Developmental Cell, Frontiers in Ecology and Evolution, Communications Biology</i>
2022	<i>Behavioral Ecology and Sociobiology, Animal Behavior, Behavioral Processes, Developmental Cell, Evolution</i>
2021	<i>Current Biology, Scientific Reports, Bulletin of the British Ornithologists' Club, American Naturalist, Zoomorphology</i>
2020	<i>PLoS ONE, Vision Research, Journal of Experimental Biology, Biology Open, Electronic Journal of Biotechnology, Molecular Ecology</i>
2019	<i>PLoS ONE (2), Proceedings of the Royal Society B, Journal of Experimental Biology, Behavioral Processes, Molecular Genetics & Genomics, Journal of the Royal Society Interface</i>
2018	<i>Biochemical Genetics</i>
2017	<i>Behavioral Ecology and Sociobiology</i>
2016	<i>Biological Journal of the Linnean Society</i>
2014	<i>Journal of Experimental Biology (2), Evolutionary Biology, Ibis, PLoS ONE (3), Lipids</i>

2013	<i>Behavioral Ecology and Sociobiology, Biology Letters</i>
2012	<i>Journal of the Royal Society Interface, Journal of Comparative Physiology-A, Raptor Research, PLoS ONE (2), Brain, Behavior and Evolution</i>
2011	<i>Evolution, Behavioral Ecology and Sociobiology</i>
2010	<i>PLoS ONE, BMC Ecology, Journal of Ornithology, Behavioral Ecology and Sociobiology</i>
2009	<i>Evolution, Behavioral Ecology, Auk</i>
2008	<i>Journal of Molluscan Studies</i>
2007	<i>Biochemistry</i>
2006	<i>Proceedings of the Royal Society of London B</i>

GRANT PEER REVIEW

2024	National Science Foundation, Building Research Capacity of New Faculty in Biology (BRC-BIO), Panelist
2022	Austrian Science Fund (FWF), External reviewer
2022	National Science Foundation, Division of Environmental Biology, <i>ad hoc</i> reviewer
2022	National Science Foundation, Integrative Research in Biology (IntBIO) Program, <i>ad hoc</i> reviewer
2022	National Science Foundation, Integrative Ecological Physiology (IEP), Panelist
2020	Graduate Women in Science (GWIS), National Fellowship Competition, External reviewer
2017	Animal Behavior Society, Student Grant Program, External reviewer

SERVICE

2023–2025	Member, Nominations and Elections Committee, Oxley College of Health and Natural Sciences, University of Tulsa
2022–2025	Member, Institutional Animal Care and Use Committee, University of Tulsa
2022	Session Chair, Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ
2022	Judge, Student Poster and Presentation Competitions, Meeting of the Society for Integrative and Comparative Biology, Phoenix, AZ
2022	Faculty Search Committee Member, Department of Biological Sciences, University of Tulsa — Genetics
2019	Faculty Search Committee Member, Department of Biological Sciences, University of Tulsa — Neuroanatomy
2013–2015	Steering Committee, Carotenoid Interest Research Group, American Society for Nutrition
2006–2007	Graduate Student Research Seminar Organizer, School of Life Sciences, Arizona State University, Tempe, AZ

2006–2011 Laboratory Safety Liaison, McGraw Lab, Arizona State University, Tempe, AZ

OUTREACH

2024 Bird Walk Leader, Tulsa River Parks

2019 Public Speaking, Charleston Audubon Society, Charleston, SC

2017 Public Speaking, Webster Groves Nature Study Society, Webster Groves, MO

2017 Organizer, Rooted in STEM, Adams Elementary School, St. Louis, MO — hands-on, experiential project integrating computer programming and automation into school garden management for grades 4–6

2016 Public Speaking, Forest Park Forever, Birding Basics Class, St. Louis, MO

2015–2019 Organizer, Sun Patch Community Garden, St. Louis, MO — garden and educational resource for elementary school students and the Boys and Girls Club of St. Louis

2008 Public Speaking, McDowell Sonoran Conservancy, Scottsdale, AZ

2007 Public Speaking, Three Rivers Audubon Society, Gilbert, AZ

2006 Judge, Central Arizona Regional Science and Engineering Fair

2006 Field Trip Leader, Maricopa Audubon Society, Phoenix, AZ

2006–2011 Panelist, Ask a Biologist Program, Arizona State University, Tempe, AZ

2005–2006 Volunteer, Beginner Bird Walk, Maricopa Audubon Society, Phoenix, AZ