

# MELISSA RUSZCZYK, PH.D.

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University of Miami  
Department of Physics  
Knight Physics Building  
1320 Campo Sano Avenue  
Coral Gables, FL 33146

## EMPLOYMENT HISTORY

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### Postdoctoral Researcher

University of Miami, Miami, FL, 33146  
Department of Physics  
Advisor: Dr. Vivek N. Prakash

*September 2022-Present*

### Postdoctoral Researcher

Georgia Institute of Technology, Atlanta, GA, 30332  
School of Civil and Environmental Engineering  
Advisor: Dr. Donald R. Webster

*May 2022-August 2022*

## EDUCATION

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### Ph.D. Georgia Institute of Technology, Atlanta, GA, 30332

Ocean Science and Engineering  
Minor in Applied Mathematics

Advisors: Dr. Jeannette Yen & Dr. Donald R. Webster

*August 2017-May 2022*

### B.S. Allegheny College, Meadville, PA, 16335

Biology, Music

Advisors: Dr. Milton Ostrofsky & Dr. Lowell Hepler

*September 2013-June 2017*

## PROFESSIONAL DEVELOPMENT

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### University of Miami Teaching Academy

*Fall 2024*

A selective program where postdoctoral fellows and graduate student participants build teaching competencies, apply skills in a teaching session, and prepare components of a teaching portfolio to prepare for teaching positions in academia.

## RESEARCH INTERESTS

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Biomechanics, marine invertebrates, invertebrate morphology, bio-fluid interactions, marine ecology, life in low and intermediate Reynolds number environments

## PUBLICATIONS

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### Peer-Reviewed Manuscripts

1. **Ruszczyk, M.**, Webster, D. R., Yen, J. (2024). The response of a freshwater copepod to small-scale, dissipative eddies in turbulence. *Limnology and Oceanography*. 69, S17-S31. <https://doi.org/10.1002/lno.12402>
2. Gooshvar, S., Madhu, G., **Ruszczyk, M.**, Prakash, V. N. (2023). Non-bilaterians as model systems for tissue mechanics. *Integrative and Comparative Biology*. 63(6), 1442-1454.

<https://doi.org/10.1093/icb/icad074>

3. **Ruszczyk, M.**, Webster, D. R., Yen, J. (2022). Trends in stroke kinematics, Reynolds number, and swimming mode in shrimp-like organisms. *Integrative and Comparative Biology*, 62(3), 791-804. <https://doi.org/10.1093/icb/icac067>
4. **Ruszczyk, M.**, Webster, D. R., Yen, J. (2021). Dual phase-shifted ipsilateral metachrony in *Americamysis bahia*. *Integrative and Comparative Biology*. 61(5), 1644-1657. <https://doi.org/10.1093/icb/icab119>
5. Byron, M. L., Murphy, D. W., Katija, K., Hoover, A. P., Daniels, J., Garayev, K., Takagi, D., Kanso, E., Gemmell, B. J., **Ruszczyk, M.**, Santhanakrishnan, A. (2021). Metachronal motion across scales: Current challenges and future directions. *Integrative and Comparative Biology*, 61(5), 1674-1688. <https://doi.org/10.1093/icb/icab105>

### Manuscripts In Preparation

1. **Ruszczyk, M.**, Kiel, P. M., Chandragiri, S., Guigand, C. M., Haus, B. K., Baker, A. C., Miller, M. W., Suraneni, P., Langdon, C., Prakash, V. N. (submitted). FlumeX: A modular flume design for laboratory-based marine fluid-substrate studies. (2024). Preprint available: <https://ssrn.com/abstract=5050355>
2. **Ruszczyk, M.**, Rodriguez, S., Tuen, M., Rux, K., Chandragiri, C., Stickley, M., Haus, B. K., Baker, A. C., Miller, M. W., Suraneni, P., Langdon, C., Prakash, V. N. (in prep). Local alkalinity enhancement using artificial substrates to increase growth and survivorship in early-stage coral recruits. (2025). Preprint available: <https://doi.org/10.1101/2025.01.07.631763>
3. Shrestha, B. D., Chandragiri, S., Gibson, C. D., Couture, N. R., **Ruszczyk, M.**, Prakash, V. N. (in prep). Confinement-induced proliferation of vortices around marine invertebrate larvae. (2025). Preprint available: <https://doi.org/10.48550/arXiv.2501.11744>
4. **Ruszczyk, M.**, Madhu, G., Shrestha, B. D., Brown, O., Xia, J., McGonigle, M., Prakash, V. N. (in prep). Kinematic data of pelagic coral: Two-dimensional gamete rising and three-dimensional larvae swimming. (2025).

### TEACHING EXPERIENCE

#### Instructor on Record: University of Miami

Course	Number of Sections	Students per section	Responsibilities	Semester(s)
University Physics II: Discussion (PHY 222)	1	31	<ul style="list-style-type: none"> <li>• Prepare and present practice problems</li> <li>• Administer weekly quizzes</li> </ul>	Spring 2025
College Physics I: Discussion (PHY 101)	1	16	<ul style="list-style-type: none"> <li>• Prepare and present practice problems</li> <li>• Administer weekly quizzes</li> </ul>	Fall 2024

#### Guest Lecturer

School/Course	Number of Sections	Students per Section	Topic	Semester(s)
University of Miami –	1	17	<ul style="list-style-type: none"> <li>• Lecture: “Biomechanics of Motion”</li> </ul>	Fall 2024

Biological Physics I (PHY 325/625)			<ul style="list-style-type: none"> <li>• Gait analysis with AI activity analyzing if an AI-generated organism can exist using biomechanics principles</li> </ul>	
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**Graduate Teaching Assistant: Georgia Institute of Technology**

Course	Number of Sections	Students per Section	Responsibilities	Semester(s)
Ecology Lab (BIOL 2336)	2 (Fall 2021), 2 (Fall 2017)	16	<ul style="list-style-type: none"> <li>• Prepare 30-60min lectures on lab topic</li> <li>• Mentor students on weekly lab projects</li> <li>• Grade quizzes, lab handouts, and lab reports</li> </ul>	<i>Fall 2021, Fall 2017</i>
Experimental Design and Statistical Methods (BIOL 4401)	1	20	<ul style="list-style-type: none"> <li>• Grade homework</li> <li>• Provide office hours outside of class to review topics</li> </ul>	<i>Summer 2018</i>
Organismal Biology Lab (BIOL 1521)	2	16	<ul style="list-style-type: none"> <li>• Prepare 30-60min lectures on lab topic</li> <li>• Mentor students on weekly lab projects</li> <li>• Grade quizzes, lab handouts, and lab reports</li> </ul>	<i>Spring 2018</i>

**Undergraduate Teaching Assistant: Allegheny College**

Course	Number of Sections	Students per Section	Responsibilities	Semester(s)
Chemical Concepts II (CHEM 122)	2	24	<ul style="list-style-type: none"> <li>• Prepare and monitor lab projects for introductory chemistry class</li> </ul>	<i>Spring 2015</i>
Chemical Concepts I (CHEM 120)	2	24	<ul style="list-style-type: none"> <li>• Prepare and monitor lab projects for introductory chemistry class</li> </ul>	<i>Fall 2014</i>

**MENTORING EXPERIENCE**

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**Graduate Students**

- Thesis Committee Member
  - Reem F. A. S. H. Alreesh, M.S. Marine Biology and Ecology. Alkalinity enhancement for coral restoration: The impact of adding sodium carbonate to cementitious tiles on early post-settlement survival and growth of *Diploria labyrinthiformis* at normal and reduced pH (University of Miami: Fall 2024 – present)

**Undergraduate Students**

- Senior Thesis Committee Member

- Owen Brown: Synthesizing artificial replicates of rising coral gamete bundles (University of Miami: Fall 2023 – Spring 2024)
- Independent Research Mentor
  - Owen Brown: Concrete effects on local alkalinity (Summer 2023), Flow field analysis of coral larvae (University of Miami: Spring 2023)
  - Johnnie Xia: Coral gamete rising rates (University of Miami: Spring 2023 – Summer 2023)
  - Maria Cardelino: Kinematic analysis of phytoplankton in a Burgers vortex (Georgia Institute of Technology: Summer 2022)
  - Gianna Perretta: Kinematic analysis of phytoplankton in a Burgers vortex (Georgia Institute of Technology: Summer 2022)
  - Anikait Dhond: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Summer 2021, Spring 2022)
  - Ashley Jhun: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Summer 2021)
  - Ngoc Thuy An (Keira) Tran: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Summer 2021)
  - Juliette Goff: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Spring 2021)
  - Agam Singh: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Spring 2019), Digitization of krill biomechanics (Georgia Institute of Technology: Fall 2019 – Fall 2020)
  - Anugraha Babuji: Digitization of krill biomechanics (Georgia Institute of Technology: Summer 2020)
  - Emma Slater: Digitization of krill biomechanics (Georgia Institute of Technology: Summer 2020)
  - Enye Lee: Digitization of krill biomechanics (Georgia Institute of Technology: Fall 2019)
  - Kevin Joseph: Digitization of krill biomechanics (Georgia Institute of Technology: Fall 2019)
  - Uma Patel: Digitization of krill biomechanics (Georgia Institute of Technology: Summer 2019)
  - Tianyi Zuo: Digitization of copepod motion in a Burgers vortex (Georgia Institute of Technology: Fall 2018)

## **FUNDED RESEARCH PERFORMED**

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### **Designing optimal artificial substrate for enhanced coral growth**

L'Oréal USA for Women in Science [declined]  
 \$60,000 (November 11, 2024 – October 31, 2025)  
 PI: M. Ruszczyk

### **Identifying coral larvae's searching strategies for settlement location**

National Science Foundation: Postdoctoral Fellowship: OCE-PRF [declined]  
 \$167,800 (July 1, 2024 – June 30, 2026)  
 PI: M. Ruszczyk

## **HONORS AND AWARDS**

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<b>1<sup>st</sup> Prize Poster Presentation for Physical Sciences &amp; Engineering</b>	2024
Received for “Physicochemical dynamics of substrates for enhanced coral growth in laminar flow conditions” at the University of Miami’s Graduate Student and Postdoc Research Symposium	
<b>Excellence in Teaching: Student Choice Award</b>	2018
Received for teaching Ecology (2017) at Georgia Institute of Technology	
<b>Interdisciplinary Studies Faculty Prize</b>	2017
Received for undergraduate research thesis, “Serial Sonification of <i>Chaoborus</i> Behavior in Response to <i>Daphnia</i> Size: The Intricacies of the Predator-Prey Relationship”	
<b>Aquatic Chemical Ecology Research Experience for Undergraduates</b>	2016
Summer position in J. Yen’s laboratory at Georgia Institute of Technology funded by the National Science Foundation working on the research project, “Mate tracking behavior of <i>Hesperodiptomus shoshone</i> .”	

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## PROFESSIONAL SERVICE

### Scientific Journal Reviews

- Proceedings of the Royal Society B (1)
- Integrative and Comparative Biology (2)

### Conference Organization

- Ocean Visions 2019 (Atlanta, GA): Building Manager and Tech Supervisor
- APS DFD 2018 (Atlanta, GA): Student AV Volunteer

### Judge

- 2024 Undergraduate Research, Creativity, and Innovation Forum (University of Miami; Miami, FL)

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## SCIENTIFIC OUTREACH

<b>Connecting Science and Art: “Coral” Music</b>	2023-Present
Collaboration with undergraduate (1), masters (2), and Doctor of Musical Arts (2) candidates in the Frost School of Music at the University of Miami to compose sonifications based on coral larvae swimming trajectories.	

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## PROFESSIONAL AFFILIATIONS

The Society for Integrative and Comparative Biology, Member	2020-Present
American Physics Society, Division of Fluid Dynamics, Member	2019-Present
Association for the Sciences of Limnology and Oceanography, Member	2019-Present

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## INVITED SEMINARS

<b>University of Miami: Physics Colloquium</b>	2024
Physicochemical dynamics of substrates increase early-stage coral settlement, growth and survivorship in laminar flows	
<b>University of Miami: Music Department Forum</b>	2024

The chanting of coral reefs: Bringing awareness to the endangerment of coral reefs through the sonification of settling larvae

**University of Miami: Modern Physics Honors Seminar** 2022  
Trends in stroke kinematics, Reynolds number, and swimming mode in shrimp-like organisms

**University of Miami: Invertebrate Neuroscience Meeting** 2022  
Trends in stroke kinematics, Reynolds number, and swimming mode in shrimp-like organisms

**Georgia Institute of Technology: Ocean Science and Engineering Seminar** 2022  
Dual phase-shifted ipsilateral metachrony in *Americamysis bahia*

#### CONFERENCE PRESENTATIONS

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1. **Ruszczyk, M.**, Chandragiri, S., Alimi, W., Brown, O., Kiel, P. M., Xia, J., Haughey-Gramazio, C., Baker, A., Stickley, M., Miller, M. W., Langdon, C., Suraneni, P., Prakash, V. N. Physiochemical dynamics of substrates for enhanced coral growth in laminar flow conditions [eLightning]. In: Ocean Sciences Meeting; February 18-23, 2024; New Orleans, Louisiana.
2. **Ruszczyk, M.**, Webster, D. R., Yen, J. Copepod from alpine ponds responds different than marine copepods to dissipation-scale turbulent flow structure [poster]. In: ASLO 2023 Aquatic Sciences Meeting; June 4-9, 2023; Palma de Mallorca, Spain. Poster ID: 749.
3. **Ruszczyk, M.**, Webster, D. R., Yen, J. A freshwater copepod's response to dissipation-scale turbulent flow structure [abstract]. In: The Society for Integrative and Comparative Biology Annual Meeting 2023; January 3-7, 2023; Austin, Texas.
4. **Ruszczyk, M.**, Cardelino, M., Perretta, G., Elmi, D., Webster, D. R. Phytoplankton morphology affects susceptibility to aggregation via microscale turbulence [abstract]. In: 75<sup>th</sup> Meeting of the APS Division of Fluid Dynamics; November 20-22, 2022; Indianapolis, Indiana. Abstract ID: J05.00007.
5. **Ruszczyk, M.**, Webster, D. R., Yen, J. Metachrony across swimming modes and Reynolds number in free-swimming crustaceans [abstract]. In: Ocean Sciences Meeting; February 27-March 4, 2022; Honolulu, Hawaii.
6. **Ruszczyk, M.**, Webster, D. R., Yen, J. Trends in Reynolds number, swimming behavior, and metachronal stroke kinematics in free-swimming crustaceans [abstract]. In: The Society for Integrative and Comparative Biology Annual Meeting 2022; January 3-7, 2022; Phoenix, Arizona.
7. **Ruszczyk, M.**, Webster, D. R., Yen, J. Benefits of concurrent metachronal cycles as observed in *Americamysis bahia* [abstract]. In: 74<sup>th</sup> Meeting of the APS Division of Fluid Dynamics; November 21-23, 2021; Phoenix, Arizona.
8. **Ruszczyk, M.**, Webster, D. R., Yen, J. Metachronal stroke kinematics in *Euphausia pacifica* [abstract]. In: Southeast Regional Society for Integrative and Comparative Biology; November 6, 2021; Atlanta, Georgia.
9. **Ruszczyk, M.**, Webster, D. R., Yen, J. Dual phase-shifted ipsilateral metachrony in *Americamysis bahia* [invited speaker]. In: The Society for Integrative and Comparative Biology Annual Meeting 2021; January 3-February 28, 2021; Washington D. C.
10. **Ruszczyk, M.**, Webster, D. R., Yen, J. Metachronal swimming in Pacific krill, *Euphausia pacifica* [poster]. In: Ocean Sciences Meeting; February 16-21, 2020; San Diego, California.

Poster ID: PI44A-2527.

11. **Ruszczyk, M.**, Webster, D. R., Yen, J. Freshwater copepod behavior in turbulent eddies [[abstract](#)]. In: 72<sup>nd</sup> Meeting of the APS Division of Fluid Dynamics; November 23-26, 2019; Seattle, Washington. Abstract ID: P32.008.
12. **Ruszczyk, M.**, Webster, D. R., Yen, J. Underwater propulsion at intermediate *Re*: Multi-oar biomechanics of mysids [[abstract](#)]. In: 71<sup>st</sup> Meeting of the APS Division of Fluid Dynamics; November 18-20, 2018; Atlanta, Georgia. Abstract ID: BAPS.2018.DFD.G22.2.

## RESEARCH EXPERIENCE

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*Superscripts denote Additional Affiliations under entry*

### **Alkalinity Effects on Coral Growth in Flow** 2022-present

University of Miami, Miami, FL

Advisor: V. N. Prakash

Collaborators: DARPA X-REEFS Team ([Project Website](#)) including B. K. Haus<sup>1</sup>, A. C. Baker<sup>2</sup>, M. W. Miller<sup>3</sup>, P. Suraneni<sup>4</sup>, C. Langdon<sup>2</sup>

Additional Affiliations: <sup>1</sup>Ocean Sciences, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami; <sup>2</sup>Marine Biology and Ecology, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami; <sup>3</sup>SCORE International; <sup>4</sup>Civil and Architectural Engineering, College of Engineering, University of Miami

- Does increasing local alkalinity for settled coral larvae using different cement compounds increase coral growth under flow conditions in a laboratory setting?

### **Rising Rates of Coral Gamete Bundles** 2022-present

University of Miami, Miami, FL

Advisor: V. N. Prakash

Collaborators: M. W. Miller<sup>2</sup>, K. O'Neil<sup>5</sup>, M. McGonigle<sup>2</sup>

Additional Affiliations: <sup>2</sup>SCORE International; <sup>5</sup>The Florida Aquarium

- Estimate density of coral gamete bundles from the rising rates during spawning

### **Kinematic Analysis of Phytoplankton Trajectories in Burgers Vortex** 2022

Georgia Institute of Technology, Atlanta, GA

Advisor: D. R. Webster

- How does phytoplankton morphology affect interactions with microscale turbulence?

### **Crustacean Behavior and Morphology in Low and Intermediate Reynolds Number Environments** 2017-2022

Georgia Institute of Technology, Atlanta, GA

*Doctoral Thesis*

Advisors: D. R. Webster, J. Yen

Committee Members: E. Di Lorenzo<sup>6</sup>, M. J. Weissburg<sup>7</sup>, D. W. Murphy<sup>8</sup>

Additional Affiliations: <sup>6</sup>Earth, Environmental, and Planetary Sciences, Brown University; <sup>7</sup>Biological Sciences, Georgia Institute of Technology; <sup>8</sup>Mechanical Engineering, University of South Florida.

- How does the physics of living in a fluidic environment impact the ecology and morphology of plankton?
- Quantify and characterize swim modes and gait parameters of *Euphausia pacifica* and *Americamysis bahia*
- Quantify the freshwater *Hesperodiptomus shoshone*'s behavioral response to vortices of various orientations and intensities and compare to marine species

**Serial Sonification of *Chaoborus* Behavior in Response to *Daphnia* Size: Intricacies of the Predator-Prey Relationship** 2016-2017

Allegheny College, Meadville, PA

*Undergraduate Thesis*

Advisors: M. Ostrofsky, L. Hepler, S. Wissinger

- Can *Chaoborus* detect differences in the size of their prey, resulting in a preference before physical contact?
- Relate data across disciplines and compose a piece of music based on results

**Mate Tracking Behavior of *Hesperodiaptomus shoshone*** 2016

Georgia Institute of Technology, Atlanta, GA

*REU Position*

Advisor: J. Yen

- Where do copepods determine the sex of the copepod they track, before or upon physical contact?

**Ultraviolet Light is not the Sole Trigger of Diel Vertical Migration in *Daphnia*** 2015

Allegheny College, Meadville, PA

Advisor: M. Ostrofsky

- How does a 12:12 UV-only photoperiod affect the migration habits of *Daphnia*?

**The Impact of Environmental Stress on the Immune System of *Plethodon cinereus*** 2014

Allegheny College, Meadville, PA

Advisor: M. Venesky

- Does susceptibility to fungal pathogens increase in red-backed salamanders under increased corticosterone levels?

**Photoreactivation Efficiency in *Serratia marcescens* at Various Wavelengths** 2014

Allegheny College, Meadville, PA

Advisor: T. Humphreys

- Does photolyase in *Serratia* have an ideal wavelength at which it functions to correct mutations from ultraviolet light?

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**REFERENCES**

**Dr. Vivek N. Prakash (Postdoctoral advisor)**

[vprakash@miami.edu](mailto:vprakash@miami.edu)

Assistant Professor

Department of Physics

Secondary Faculty in Biology and Marine Biology & Ecology

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**Dr. Donald R. Webster (Postdoctoral advisor, Ph.D. advisor)**

[dwebster@ce.gatech.edu](mailto:dwebster@ce.gatech.edu)

Karen & John Huff School Chair and Professor

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